CORRECTIVE ACTION PROCESS REPORT/PLAN COVER SHEET

CHAPTER 245 - STORAGE TANK AND SPILL PREVENTION ACT

Storage Tank Facility ID #: 51-33620

Consultant Name: Terraphase Engineering

Consultant Mailing Address: 100 Canal Pointe Boulevard, Suite 108, Princeton, NJ 08540

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Responsible Party Name: Philadelphia Energy Solutions Refining and Marketing LLC

Responsible Party Mailing Address:

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Responsible Party Email Address: jjeray@hilcoglobal.com

Media of Concern: [X] **Soil** [X] **Groundwater**

Contaminant(s) (*e.g. unleaded gasoline*)**:** petroleum products

(check all that apply to the enclosed submission)

- [ ] **Remedial Action Progress Report**
- [X] **Risk Assessment Report** (***e.g. vapor intrusion, ecological, or human health risk calculations***)
- [ ] **Site Characterization Report – Section 245.310(b)**
  - [ ] Residential [ ] Nonresidential
- [ ] **Site Characterization Report – Statewide Health or Background Standard**
  - [ ] Residential [ ] Nonresidential
- [X] **Site Characterization Report – Site Specific Standard**
  - [ ] Residential [X] Nonresidential
- [ ] **Remedial Action Plan – Statewide Health or Background Standard**
  - [ ] Residential [ ] Nonresidential
- [ ] **Remedial Action Plan – Site Specific Standard**
  - [ ] Residential [ ] Nonresidential
- [ ] **Remedial Action Completion Report – Statewide Health or Background Standard**
  - [ ] Residential [ ] Nonresidential
- [ ] **Remedial Action Completion Report – Site Specific Standard**
  - [ ] Residential [ ] Nonresidential
- [ ] **Post Remediation Care Report**
- [ ] **Environmental Covenant**
  - [ ] Draft [ ] Final
- [X] **Other:** Site Characterization Report Addendum

FINAL

Site Characterization Report Addendum - Tank Group 04

Former Philadelphia Energy Solutions Refinery
3144 West Passyunk Avenue
Philadelphia, Pennsylvania
Incident #57976

Prepared for

Philadelphia Energy Solutions Refining and Marketing LLC
111 S. Wacker Dr Suite 3000
Chicago, IL 60606

Prepared by

Terraphase Engineering Inc.
100 Canal Pointe Boulevard, Suite 110
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April 2023

Project Number P044.001.002

terraphase engineering

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A Revised Site-Specific Human Health Risk Assessment
B Updated Site Characterization Groundwater Results
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Acronyms and Abbreviations

25 Pa. Code	Title 25 Pennsylvania Code
Act 32	Storage Tank and Spill Prevention Act
Addendum	*Site Characterization Report Addendum for Tank Group 04*
AST	aboveground storage tank
COPC	constituents of potential concern
Evergreen	Evergreen Resources Group, LLC; includes Sunoco, Inc. n/k/a ETC Sunoco Holdings LLC, Sunoco, Inc. (R&M) n/k/a Sunoco (R&M), LLC n/k/a Energy Transfer (R&M), LLC and Evergreen collectively referred to as "Evergreen"
Facility	former Philadelphia Energy Solutions refinery facility
LNAPL	light non-aqueous phase liquid
mg/L	milligrams per liter
PADEP	Pennsylvania Department of Environmental Protection
PESRM	Philadelphia Energy Solutions Refining and Marketing LLC
RBSL	Risk-based screening level
the Risk Assessment	Site-Specific Human Health Risk Assessment
SCR	*Site Characterization Report for Tank Group 04*
the Site	Tank Group 04 location within the former Philadelphia Energy Solutions refinery facility
SSS	Site-Specific Standard
Terraphase	Terraphase Engineering Inc.
Work Plan	*Aboveground Storage Tank Closure Work Plan*

Certification

Pursuant to the requirements of the Pennsylvania Land Recycling and Environmental Remediation Standards Act (Act 2), adopted May 19, 1995, which states:

> *Interpretation of geologic and hydrogeologic data shall be prepared by a professional geologist licensed in this Commonwealth.*

I hereby attest that, as a Professional Geologist licensed in the Commonwealth of Pennsylvania, I am familiar with, and have reviewed and/or prepared the interpretation of the geology and hydrogeology presented in the attached report entitled, *Site Characterization Report – Tank Group 04, Former Philadelphia Energy Solutions Refinery, 3144 West Passyunk Avenue, Philadelphia, Pennsylvania*, dated April 2023.

Based on the available data represented in the report, I believe that the geologic and hydrogeologic interpretations made herein are reasonable and accurate.

Alexander J. Strohl, PG
Senior Staff Geologist

April 26, 2023
Date

1 Introduction

Terraphase Engineering Inc. (Terraphase) has prepared this *Site Characterization Report Addendum for Tank Group 04* (Addendum), on behalf of Philadelphia Energy Solutions Refining and Marketing LLC (PESRM). This Report serves as an addendum to the *Site Characterization Report for Tank Group 04* (SCR) submitted to the Pennsylvania Department of Environmental Protection (PADEP) on February 6, 2023. This Addendum presents additional information pertaining to the Site Assessment and Site Characterization activities at Tank Group 04 (the Site) which is located within the Former Philadelphia Energy Solutions refinery facility (the "Facility"). The Facility, which is undergoing closure activities in preparation for redevelopment, is located at 3144 West Passyunk Avenue, Philadelphia, Pennsylvania (**Figure 1**). Remediation activities are being conducted at the Facility under the Pennsylvania Land Recycling and Environmental Remediation Standards Act by both PESRM and Evergreen Resources Group, LLC (Evergreen)[1] in accordance with the 2012 Buyer-Seller Agreement and the 2020 First Amendment to that Agreement.

The Site Assessment and Site Characterization activities described in the SCR and this Addendum were performed in accordance with the applicable provisions of The Storage Tank and Spill Prevention Act (Act 32), Title 25 of the Pennsylvania Code (25 Pa. Code) Chapter 245 (Subchapter D), and Terraphase's (2021) *Aboveground Storage Tank Closure Work Plan* (Work Plan), which was approved by the PADEP on April 23, 2021. As discussed in the Work Plan, closure of the above ground storage tanks (ASTs) under Act 32 is being pursued through a group closure process, in which ASTs in the same general area (e.g., tank farm) have been demolished, removed, investigated, and evaluated at about the same time. Demolition of the tanks has been proceeding in phases from the north to the south with nine Tank Groups in all.

Tank Group 04 (**Figure 2**) is located within a larger area of the Facility referred to as the Point Breeze Refinery South Yard. Evergreen is currently engaged in characterization and remediation work at the Facility under the Pennsylvania One Cleanup Program under the oversight of the PADEP and the United States Environmental Protection Agency (eFACTS PF No. 778374 and 778376). In its associated documentation, Evergreen has identified the Tank Group 04 portions of the Point Breeze Refinery South Yard as Area of Interest 4. The specific ASTs addressed in this Report are shown on **Figure 3** and listed in **Table 1**.

The SCR submitted on February 6, 2023 was prepared in accordance with Act 32 and 25 Pa. Code Chapter 245 (Subchapter D) and provides a summary of the Site Assessment and Site Characterization activities that were performed following the identification of potential releases to the environment during the demolition and removal of the Tank Group 04 ASTs. This Addendum supplements the

[1] Evergreen Resources Management Operations, a series of Evergreen Resources Group, LLC, is managing the legacy remedial work for Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC ("Evergreen") and Sunoco (R&M), LLC. For clarity, Sunoco, Inc. n/k/a ETC Sunoco Holdings LLC, Sunoco, Inc. (R&M) f/k/a Sunoco (R&M), LLC n/k/a Energy Transfer (R&M), LLC effective 4/19/2021 and Evergreen shall be referred to collectively as "Evergreen" in this Report.

information in the SCR and demonstrates that adequate characterization has been performed to evaluate whether remedial action is warranted to attain the Site-Specific Standard (SSS).

This Addendum provides the following to supplement the information documented in the February 6, 2023 SCR:

- Summary of Second Groundwater Gauging and Sampling Event: A second round of groundwater gauging and sampling was conducted in Tank Group 04 on February 8 and 9, 2023. A summary of these field activities, including any deviations in scope from the first event is discussed herein.
- Updated Gauging and Sampling Data: Results of the second round of groundwater gauging and sampling are presented herein.
- Updated Results Evaluation: An updated interpretation of the results of the Site Characterization groundwater gauging and sampling activities are discussed. This includes an updated interpretation of unconfined aquifer groundwater flow, delineation of the identified constituents of potential concern (COPCs) in groundwater, and an evaluation of the adequacy of characterization.
- Updated Risk Assessment: Changes (if any) to the results of the Human Health Risk Assessment are summarized herein. An updated, comprehensive updated Risk Assessment is provided as **Appendix A** to this Addendum.
- Conclusions: A summary of the conclusions of the SCR are provided herein, including any changes to the conclusions as a result of the additional Site Characterization activities.

Details regarding the site setting are provided in the February 6, 2023 SCR and are not repeated herein.

2 Additional Site Characterization

This section discusses the selection of standards, the additional Site Characterization groundwater sampling performed, and updated sampling results.

2.1 Selected Standard

PESRM has selected the SSS to attain closure for Tank Group 04. As described in the SCR, and supplemented in Section 3, a Site-Specific Human Health Risk Assessment (the Risk Assessment) has been conducted to evaluate the potential significance of identified releases in Tank Group 04 and to determine whether COPC concentrations could pose unacceptable risk and/or hazard to human health, and whether such conditions would warrant management via remedial action to demonstrate attainment of the SSS. The outcome of the Risk Assessment is presented in Section 3 and is described in detail in **Appendix A**.

As part of the SCR, Risk Based Screening Levels (RBSLs) were derived in accordance with PADEP and United States Environmental Protection Agency risk assessment guidance. The RBSLs were previously presented in the SCR and groundwater RBSLs are summarized in **Table 2** for convenience.

2.2 Site Characterization Groundwater Sampling

Site Characterization groundwater activities, including monitoring well installation and the first groundwater sampling event, were previously detailed in the February 6, 2023 SCR. Details regarding the second sampling event are provided below. The second round of groundwater gauging and sampling activities have not significantly altered the Site Characterization conclusions presented in the SCR.

On February 8, 2023, Terraphase collected groundwater level and light non-aqueous phase liquid (LNAPL) thickness measurements from wells TG04-MW-01, TG04-MW-02 (dry), and TG04-MW-03, and existing monitoring wells S-216, S-415, S-365, S-121, S-122, S-219, S-381, and S-371 using an electronic oil/water interface probe. The results of the February 8, 2023 gauging event are provided in **Table 3**.

Terraphase performed additional groundwater sampling via low-flow groundwater sampling techniques. As detailed in the SCR and consistent with the initial round of groundwater sampling, groundwater samples were collected from TG04-MW-01 and TG04-MW-03 as well as existing well S-219 (replacement for well TG04-MW-02) and were analyzed for PADEP Shortlist 1-6 parameters.

2.3 Site Characterization Results

Table 4 presents the groundwater sample results from the wells sampled during both the January and February 2023 Site Characterization events and compares the concentrations to the RBSLs.

Consistent with the results of the first groundwater sampling event, a comparison of groundwater sample data from the second event to RBSLs indicates an exceedance of the Nonpotable Groundwater Use RBSL for benzene.

Figure 4 presents the updated spatial distribution of Site Characterization groundwater data relative to RBSLs. **Figure 5** shows the updated spatial distribution of benzene concentrations relative to its RBSLs in groundwater.

Appendix B provides the comprehensive groundwater analytical results from the Site Characterization and figures illustrating the groundwater analytical results in proximity to each of the tanks are provided as attachments to **Appendix A**. Laboratory reports for the first[2] and second groundwater sampling event are provided in **Appendix C**.

2.3.1 Groundwater Characterization Results

Terraphase completed the second round of gauging monitoring well locations in the vicinity of Tank Group 04, consistent with the methodologies for the first event discussed in the SCR. Terraphase gauged 11 monitoring well locations on February 8, 2023. The results of the gauging activities are presented in **Table 3**. LNAPL-corrected depth-to-water measurements and groundwater elevations are also presented in **Table 3**, and the interpreted potentiometric surface is shown in **Figure 6**.

During the second round of gauging, groundwater was encountered between approximately 10 and 24 feet below ground surface. Consistent with the SCR, the groundwater flow direction in Tank Group 04 is interpreted to be locally divided, with groundwater in the southern portion of the Tank Group flowing south/southeast, and groundwater in the central portion flowing to depressions in the northwestern portions of the Tank Group. During the second round of well gauging, measurable LNAPL was confirmed in one of the 11 monitoring wells (S-365)[3]. The measured LNAPL thickness is presented in **Table 3**. The LNAPL has been identified in this area since as early as 1995 and was characterized during a 2010 Evergreen investigation as a mixture of extremely weathered middle distillate, aviation gasoline, and heavier material. The LNAPL is not indicative of a new release from ASTs in Tank Group 04.

The results of groundwater sampling have indicated that COPCs have been adequately characterized with respect to the RBSLs. Delineation of COPCs in groundwater at concentrations above the RBSLs using groundwater sampling data is detailed below.

<u>Benzene</u>

As shown on **Table 4**, benzene was detected in groundwater in the area at concentrations greater than the Nonpotable Groundwater Use RBSL (0.30 milligrams per liter [mg/L]). The concentrations in groundwater ranged from non-detect to 0.58 mg/L during both sampling events.

As presented in the SCR, the monitoring wells are shown on **Figure 5** and provide an illustration of the spatial distribution of benzene in groundwater relative to the applicable RBSLs. Tables with the groundwater analytical results are provided in **Appendix B**. The benzene concentration reported in the February 2023 sample collected from TG04-MW-01 (0.53 and 0.51 mg/L [duplicate sample]) exceeds the

[2] A revised lab report is included for the first groundwater sampling event. The original lab report did not report the full PADEP Short List 1-6 parameters for samples collected at monitoring wells TG04-MW-01 and S-219.

[3] Measurable LNAPL was confirmed in two of the 14 monitoring wells (S-365 and S-281) during the first round of well gauging.

RBSL. As shown in **Table B1** of **Appendix B**, this is consistent with the benzene concentration (0.58 mg/L) reported in the January 2023 sample from TG04-MW-01. The benzene concentrations reported in the February 2023 samples collected from S-219 and TG04-MW-03 were non-detect and therefore, do not exceed the RBSL. Similarly, benzene was not detected above laboratory reporting limits at monitoring wells TG04-MW-03 and S-219 during January 2023 groundwater sampling event.

Benzene has been identified during prior groundwater investigations in this area of Tank Group 04. Evergreen reported benzene concentrations greater than the RBSL in nearby wells S-229 (1.9 mg/L) and S-415 (0.694 mg/L) sampled in 2005 and 2015, respectively. In addition, a historical LNAPL plume exists to the southwest of TG04-MW-01. Groundwater concentrations in the vicinity of TG04-MW-01 are consistent with Evergreen's prior characterization in the area and the concentrations identified during PESRM's Site Characterization are not indicative of a new source of groundwater contamination related to a release from Tank Group 04 ASTs.

Horizontal delineation of the benzene concentration exceeding the RBSL at TG04-MW-01 is provided by groundwater samples collected by Evergreen from wells S-225, S-216, S-416, MW-1, S-281, S-384, S-309 and S-102[4].

[4] A groundwater sample was collected most recently at monitoring well MW-1 in 2013, from monitoring well S-281 in 2015, from monitoring wells S-102, S-225, S-216, S-309, and S-416 in 2016, and from well S-384 in 2021.

3 Risk Assessment

As part of the SCR submitted on February 6, 2023, a site-specific risk assessment was performed to support a demonstration that conditions at the Site meet the tank closure performance standard as specified in the Act 32. The risk assessment report documents the methodology and results of a site-specific human health risk assessment which was conducted in accordance with 25 Pa. Code § 250.409.

This addendum includes an update to the risk assessment to incorporate the additional information pertaining to the Site Assessment and Site Characterization activities at Tank Group 04. This updated, comprehensive risk assessment is provided as **Appendix A** to this Addendum. The incorporation of the February 8, 2023 gauging and groundwater sampling results in no change to the conclusions of the risk assessment regarding the adequacy of delineation or potential significance of exposure of receptors to COPCs in groundwater.

4 Summary and Conclusions

Terraphase has prepared this Addendum, on behalf of PESRM, to detail the results of additional Site Characterization activities and to provide the further supporting information demonstrating that adequate characterization has been performed for a reliable determination of the need for remedial measures based on the selected standard.

The additional Site Characterization activities described in this Report were performed in accordance with the applicable provisions of Act 32, 25 Pa. Code Chapter 245 (Subchapter D), and Terraphase's Work Plan (2021).

The results of the investigations in Tank Group 04 identified soil and groundwater COPCs at concentrations greater than site-specific RBSLs. The results of the sampling have indicated that COPCs have been adequately characterized with respect to the RBSLs.

The potential significance of COPC concentrations were evaluated via a site-specific risk assessment. The incorporation of the additional Site Characterization activities results in no change to the conclusions of the risk assessment. Upon approval of this Site Characterization Report, PESRM will prepare and submit a Remedial Action Completion Report for Tank Group 04.

5 References

Pennsylvania Department of Environmental Protection (PADEP). 2021. Closure Requirements for Aboveground Storage Tank Systems. April 10.

———. 2021. *Land Recycling Program Technical Guidance Manual.* March 27.

———. 2022. *Site Assessment Sampling Requirements at Regulated Storage Tank System Closures.* February 7.

Terraphase Engineering Inc. (Terraphase). 2021. *Aboveground Storage Tank Closure Work Plan.* March.

———. 2022. *Site Characterization Sampling and Analysis Plan – Tank Group 04.* December.

———. 2023. *Site Characterization Report – Tank Group 04.* February.

Tables

1 Aboveground Storage Tank Details

2 Site Specific Risk Based Screening Levels (RBSLs) – Groundwater

3 Monitoring Well Gauging Summary – February 8, 2023

4 Groundwater Results Compared to Risk Based Screening Levels – Tank Group 04 (Site Characterization)

Table 1
Aboveground Storage Tank Details
Tank Group 04
Philadelphia Energy Systems Refinery and Marketing, Philadelphia, PA

Facility	State Regulation Number	Tank Number	Design Capacity (gal)	Primary Product	Proposed Analyte List[x]	Regulatory Status	Facility ID	Status Modification Date	Tank Type	Double Bottom	Diameter (ft)	Height (ft)	Remaining Liquid (gal)	GPS Survey Complete	Demo Complete	Storage Tanks Reg./Permit App Form Submitted	Release Notification	Incident No.	Int. Remedial/ Corrective Action Required
Point Breeze	011A	PB 881	8,568,000	Crude	Short List 1-5	R	51-33620	1/8/2022	EFR	Y, Removed	160	56		Y	Y	2/3/2022			
Point Breeze	012A	PB 886	13,158,600	Crude	Short List 1-5	R	51-33620	8/26/2021	IFR	Y, Removed	200	56		Y	Y	9/23/2021			
Point Breeze	040A	PB 191	634,200	Recovered Oil	Short List 1-6	R	51-33620	11/23/2021	EFR	Y, Removed	52	41			Y	12/16/2021			
Point Breeze	049A	PB 826	8,568,000	Crude	Short List 1-5	R	51-33620	4/18/2022	EFR	Y, Removed	160	57		Y	Y	4/27/2022			
Point Breeze	053A	PB 840	5,758,200	Crude	Short List 1-5	R	51-33620	3/4/2022	EFR	Y, Removed	140	50		Y	Y	3/30/2022	8/10/2022	57976	
Point Breeze	054A	PB 841	5,758,200	Crude	Short List 1-5	R	51-33620	3/14/2022	EFR	Y, Removed	140	49		Y	Y	3/30/2022			
Point Breeze	055A	PB 847	6,346,200	Crude	Short List 1-5	R	51-33620	2/3/2022	IFR	Y, Removed	150	49		Y	Y	2/3/2022			
Point Breeze	056A	PB 882	8,421,000	Crude	Short List 1-5	R	51-33620	5/20/2021	EFR	Y, Removed	160	56		Y	Y	6/18/2021			
Point Breeze	057A	PB 883	8,568,000	Crude	Short List 1-5	R	51-33620	11/24/2021	EFR	Y, Removed	160	56.5		Y	Y	12/16/2021			
Point Breeze	058A	PB 884	13,158,600	Crude	Short List 1-5	R	51-33620	11/1/2021	EFR	Y, Removed	200	56		Y	Y	12/16/2021	8/10/2022	57976	
Point Breeze	059A	PB 885	13,158,600	Crude	Short List 1-5	R	51-33620	9/23/2021	IFR	Y, Removed	200	56		Y	Y	9/27/2021			
Point Breeze	086A	PB 843	6,346,200	Crude	Short List 1-5	R	51-33620	3/16/2022	EFR	Y, Removed	150	48		Y	Y	3/30/2022			
Point Breeze	088A	PB 848	5,640,852	Light Cycle Oil	Short List 1-5	R	51-33620	1/20/2022	EFR	Y, Removed	140	50		Y	Y	2/3/2022	8/10/2022	57976	

Abbreviations:
ERF -- External Floating Roof
IRF -- Internal Floating Roof
Y -- Yes

Table 2
Site-Specific Risk Based Screening Levels (Target Risk of $1x10^{-5}$ and HQ of 0.1)
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

			Groundwater					
Chem Group	**Chemical**	**CASRN**	**Nonpotable Groundwater Use** (mg/L)	**Routine Worker Volitilization to Outdor Air** (mg/L)	**Routine Worker Vapor Intrusion** (mg/L)	**Construction Worker Direct Contact** (mg/L)	**Off-Facility Resident Vapor Intrusion** (mg/L)	**Groundwater MtSW** (mg/L)
VOC	Benzene	71-43-2	3.0E-01	5.5E+02	3.8E+00	4.0E+00	2.5E-01	1.3E+02
VOC	Cumene	98-82-8	3.7E+01	9.1E+03	6.3E+01	3.0E+01	4.0E+00	2.6E+00
VOC	1,2-Dibromoethane	106-93-4	1.7E-02	1.6E+01	1.1E-01	9.1E-01	7.9E-03	NSW
VOC	1,2-Dichloroethane	107-06-2	3.3E-01	1.7E+02	1.2E+00	4.9E+00	8.2E-02	3.1E+03
VOC	Ethyl Benzene	100-41-4	2.0E+00	2.2E+04	1.5E+02	4.0E+01	9.7E+00	1.3E+01
VOC	Methyl tert-butyl ether	1634-04-4	2.1E+01	2.9E+04	2.1E+02	1.9E+02	1.5E+01	1.1E+04
VOC	Toluene	108-88-3	2.5E+01	1.0E+05	7.0E+02	2.0E+02	4.5E+01	5.2E+01
VOC	1,2,4-Trimethylbenzene	95-63-6	8.7E+00	1.4E+03	9.7E+00	1.5E+01	6.3E-01	3.3E+01
VOC	1,3,5-Trimethylbenzene	108-67-8	8.8E+00	1.3E+03	9.1E+00	1.5E+01	5.9E-01	7.1E+01
VOC	Xylenes (total)	1330-20-7	3.7E+00	1.9E+03	1.3E+01	1.7E+01	8.6E-01	2.1E+02
SVOC	Acenaphthene	83-32-9	5.7E+01	WIT	WIT	3.9E+03	WIT	9.0E+00
SVOC	Anthracene	120-12-7	2.4E+02	WIT	WIT	1.9E+04	WIT	4.0E+01
SVOC	Benzo(a)anthracene	56-55-3	1.0E-01	NV	NV	1.4E+03	NV	1.3E-02
SVOC	Benzo(a)pyrene	50-32-8	1.0E-02	NV	NV	5.8E+00	NV	1.3E-03
SVOC	Benzo(b)fluoranthene	205-99-2	1.6E-01	NV	NV	1.4E+03	NV	1.3E-02
SVOC	Benzo(g,h,i)perylene	191-24-2	4.4E+01	NV	NV	5.8E+03	NV	1.2E-02
SVOC	Benzo(k)fluoranthene	207-08-9	9.9E-01	NV	NV	1.4E+04	NV	1.3E-01
SVOC	Chrysene	218-01-9	1.6E+01	NV	NV	1.4E+05	NV	1.3E+00
SVOC	Dibenz(a,h)anthracene	53-70-3	9.8E-03	NV	NV	1.4E+02	NV	1.3E-03
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	3.9E-05	NV	NV	5.5E-01	NV	NSW
SVOC	Ethanol	64-17-5	1.0E+04	NV	NV	8.3E+05	NV	NSW
SVOC	Fluorene	86-73-7	9.7E+01	WIT	WIT	7.8E+03	WIT	7.0E+00
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.0E-01	NV	NV	1.4E+03	NV	1.3E-02
SVOC	Naphthalene	91-20-3	3.9E-01	1.2E+02	8.8E-01	2.8E-01	6.7E-02	4.3E+01
SVOC	Phenanthrene	85-01-8	7.3E+01	WIT	WIT	5.8E+03	WIT	1.0E+00
SVOC	Pyrene	129-00-0	5.0E+01	NV	NV	5.8E+03	NV	3.0E+00
SVOC	Tetraethylene Glycol	112-60-7	2.9E+02	NV	NV	3.9E+04	NV	1.9E+05
PCB	PCBs (total)	1336-36-3	1.5E-02	NV	NV	9.7E-01	NV	6.4E-04
INORG	Antimony	7440-36-0	2.2E-02	NV	NV	1.4E+00	NV	6.4E+01
INORG	Arsenic	7440-38-2	2.1E-02	NV	NV	5.3E+01	NV	1.4E+00
INORG	Chromium III	16065-83-1	1.1E+01	NV	NV	5.3E+02	NV	7.4E+01
INORG	Chromium VI	18540-29-9	3.9E-03	NV	NV	1.7E+00	NV	1.1E+01
INORG	Cyanide (total)	57-12-5	3.0E-01	2.4E+01	2.4E-01	2.6E-01	2.5E-02	4.0E+01
INORG	Lead	7439-92-1	IE	NV	NV	IE	NV	2.5E+00
INORG	Nickel	7440-02-0	1.3E+00	NV	NV	8.6E+01	NV	5.2E+01
INORG	Vanadium	7440-62-2	1.4E-01	NV	NV	6.9E+00	NV	1.0E+02

Abbreviations:
Chem Group - chemical group
VOC - volatile organic compounds
SVOC - semi-volatile organic compounds
PCB - polychlorinated biphenyls
INORG - metals
MtGW - migration to groundwater
MtSW - migration to surface water
NV - not volatile
WIT - without inhalation toxicity data
NA - not applicable: target groundwater concentration times DAF is greater than constituent's solubility.
IE - inadequate exposure
NSW - no surface water quality criteria available

Table 3
Monitoring Well Gauging Summary
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Dataset	Location ID	TOIC (ft AMSL)	February 8, 2023					
			Depth to Product (ft below TOIC)	Depth to Water (ft below TOIC)	LNAPL Density (mg/L)	Depth to Water (Corrected) (ft below TOIC)	Groundwater Elevation (ft AMSL)	Total LNAPL Thickness (ft)
AST	TG04-MW-01	17.80	--	16.78	--	16.78	1.02	--
AST	TG04-MW-02	25.53	--	Dry	--	Dry	--	--
AST	TG04-MW-03	23.51	--	16.65	--	16.98	6.53	--
Evergreen	S-216	15.76	--	13.34	--	13.34	2.42	--
Evergreen	S-415	19.23	--	18.28	--	18.28	0.95	--
Evergreen	S-365	20.91	20.18	20.21	0.82	20.19	0.72	0.03
Evergreen	S-121	21.12	--	19.29	--	19.29	1.83	--
Evergreen	S-122	25.71	--	24.27	--	24.27	1.44	--
Evergreen	S-219	23.09	--	21.59	--	21.59	1.50	--
Evergreen	S-381	25.86	--	24.71	--	24.71	1.15	--
Evergreen	S-371	22.05	--	18.25	--	18.25	3.80	--

Notes:
Depth to water in Evergreen wells were corrected based on historical LNAPL densities associated with other Evergreen wells in the vicinity, as presented in Stantec's AOI 4 RIR.
Vertical Datum is NAVD 1988.

Table 4
Unconfined Groundwater Results Compared to Risk-Based Screening Levels
Tank Group 04 (Site Characterization)
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Dataset	Chem Group	Chemical	CASRN	Meas Basis	Analyzed	Detected	Min Detected (mg/L)	Mean Detected (mg/L)	Max Detected (mg/L)	Nonpotable Groundwater Use (mg/L)	Ratio of Max Detect to Nonpotable Groundwater Use	Construction Worker Direct Contact (mg/L)	Ratio of Max Detect to Construction Worker Direct Contact	Groundwater Migration to Surface Water (mg/L)	Ratio of Max Detect to Groundwater Migration to Surface Water
AST	VOC	Benzene	71-43-2	T	6	3	0.51	0.54	0.58	0.30	**1.9**	4.0	0.15	130	0.0045
AST	VOC	Cumene	98-82-8	T	6	3	0.058	0.066	0.075	37	0.0020	30	0.0025	2.6	0.029
AST	VOC	Ethyl Benzene	100-41-4	T	6	3	0.089	0.10	0.11	2.0	0.055	40	0.0028	13	0.0085
AST	VOC	Toluene	108-88-3	T	6	4	0.00034	0.0077	0.011	25	0.00044	200	0.000055	52	0.00021
AST	VOC	1,2,4-Trimethylbenzene	95-63-6	T	6	3	0.045	0.049	0.054	8.7	0.0062	15	0.0036	33	0.0016
AST	VOC	1,3,5-Trimethylbenzene	108-67-8	T	6	3	0.011	0.012	0.013	8.8	0.0015	15	0.00087	71	0.00018
AST	VOC	Xylenes (total)	1330-20-7	T	6	3	0.19	0.19	0.20	3.7	0.053	17	0.012	210	0.00093
AST	SVOC	Anthracene	120-12-7	T	6	3	0.00011	0.00022	0.00032	240	0.0000013	19000	0.000000017	40	0.0000080
AST	SVOC	Benzo(a)anthracene	56-55-3	T	6	4	0.000020	0.000043	0.00010	0.10	0.0010	1400	0.000000071	0.013	0.0077
AST	SVOC	Fluorene	86-73-7	T	6	3	0.00050	0.00066	0.00092	97	0.0000095	7800	0.00000012	7.0	0.00013
AST	SVOC	Naphthalene	91-20-3	T	6	3	0.00019	0.0037	0.0094	0.39	0.024	0.28	0.034	43	0.00022
AST	SVOC	Phenanthrene	85-01-8	T	6	3	0.000040	0.00011	0.00025	73	0.0000034	5800	0.000000043	1.0	0.00025
AST	SVOC	Pyrene	129-00-0	T	6	3	0.000020	0.000037	0.000060	50	0.0000012	5800	0.000000010	3.0	0.000020
Evergreen	VOC	Cumene	98-82-8	T	2	1	0.00028	0.00028	0.00028	37	0.0000076	30	0.0000093	2.6	0.00011
Evergreen	VOC	Toluene	108-88-3	T	2	1	0.00034	0.00034	0.00034	25	0.000014	200	0.0000017	52	0.0000065
Evergreen	SVOC	Benzo(a)anthracene	56-55-3	T	2	1	0.00018	0.00018	0.00018	0.10	0.0018	1400	0.00000013	0.013	0.014

Notes:
Only chemicals detected in the area are shown.
The concentrations for the Xylene isomers (m/p and o) were summed before comparing to the criteria for Xylenes (total).
Ratios of concentration to the RBSLs greater than 1 are shaded in bold.
Chem Group - chemical group; VOC - volatile organic compounds; SVOC - semi-volatile organic compounds
Meas Basis - measured basis; T = total, D = dissolved

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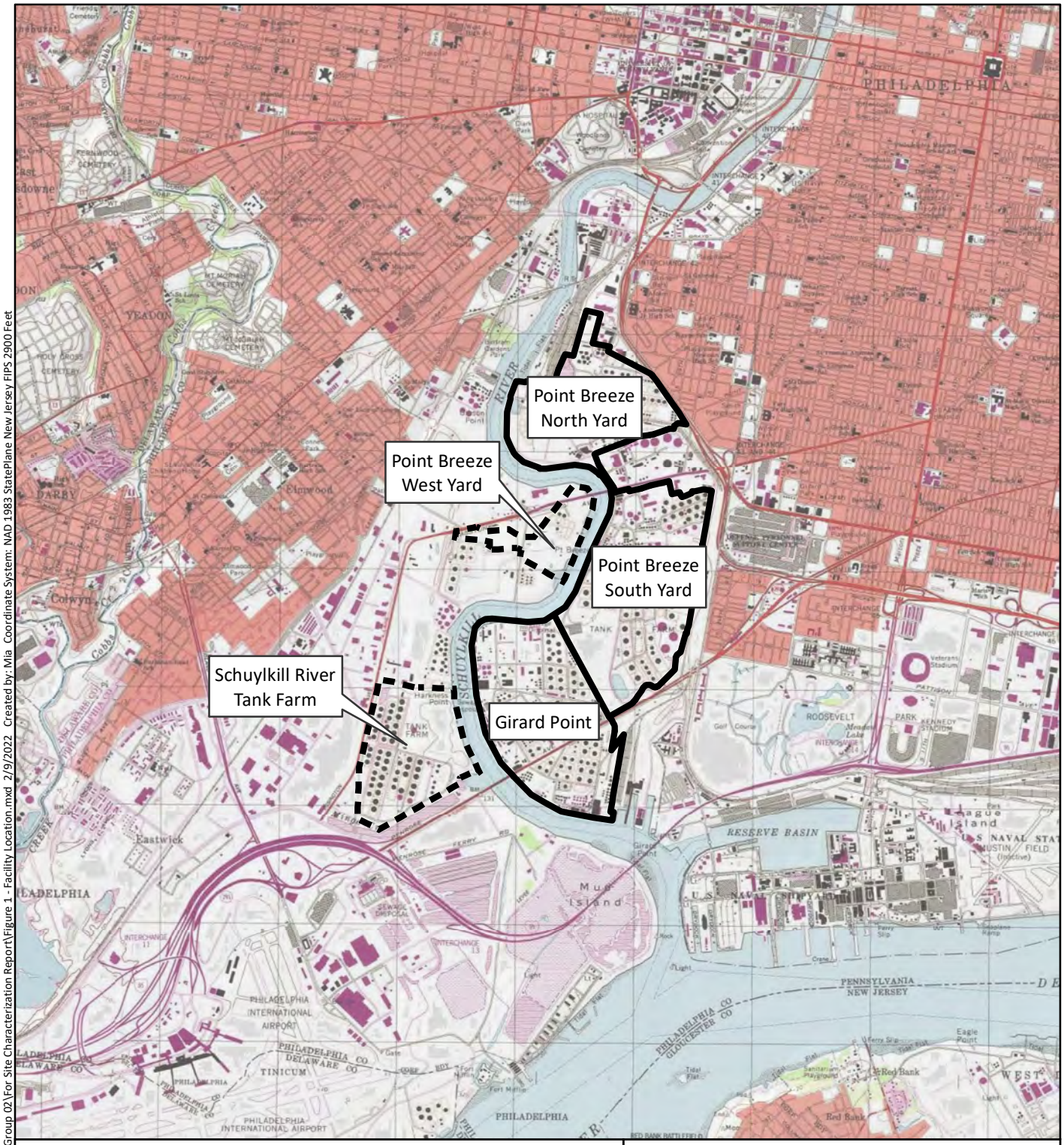
1 Facility Location
2 Site Location Map
3 Site Layout (Tank Group 04)
4 Groundwater Sample Results Compared to RBSLs (Tank Group 04)
5 Groundwater Sampling Results, Tank Group 04 (Benzene)
6 Interpreted Potentiometric Surface (February 8, 2023)



0 2,000 4,000 6,000 Feet

1 inch = 4,000 feet

N

Legend

Subject to AST Closure Plan

Not Subject to AST Closure Plan

Base Map: USGS Philadelphia 1994 7.5 Minute Quadrangle.

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

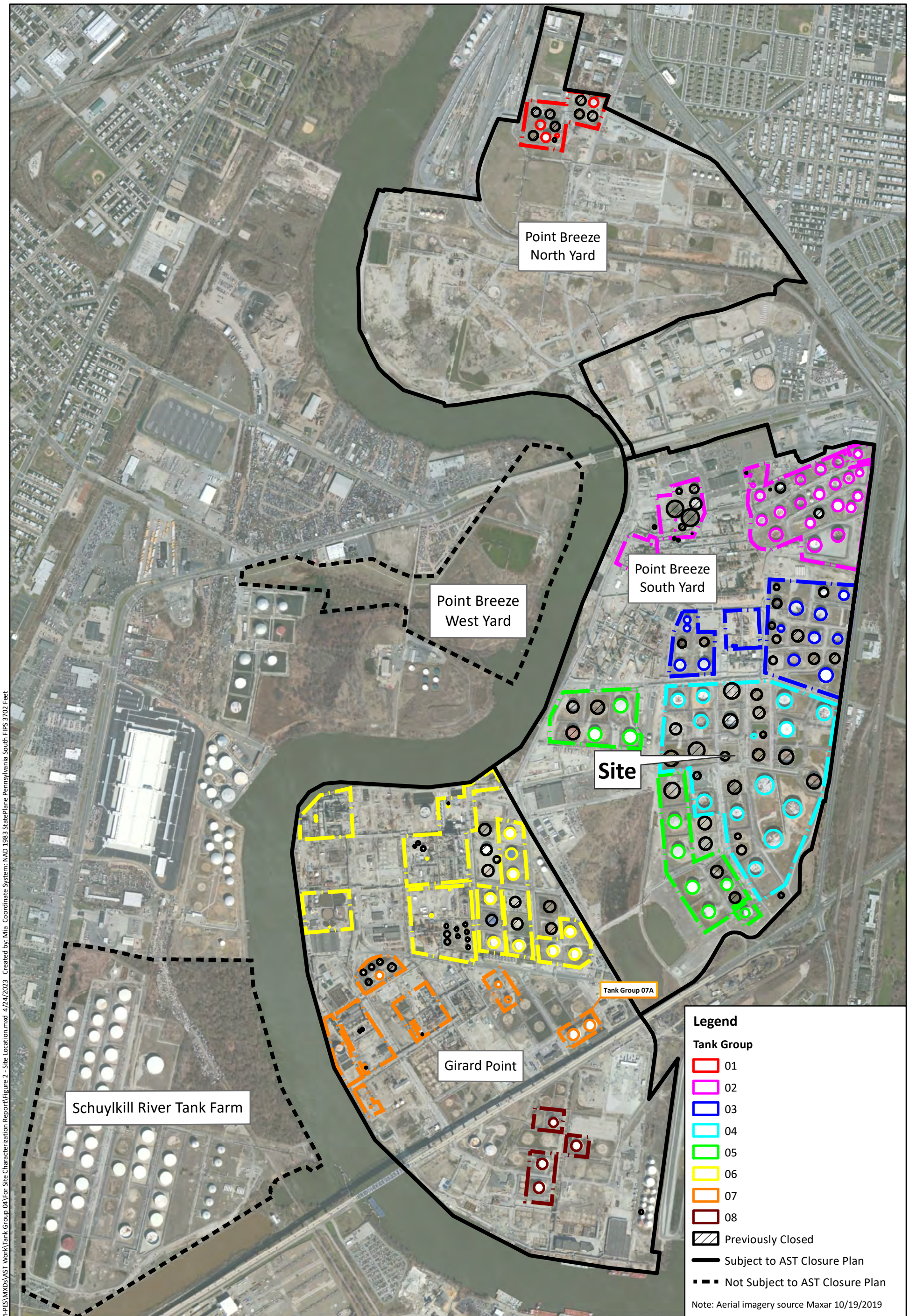
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Facility Location

Figure 1

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 02\For Site Characterization Report\Figure 1 - Facility Location.mxd 2/9/2022 Created by: Mia Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet



File: N:\GIS\Pr\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\For Site Characterization Report\Figure 2 - Site Location.mxd 4/24/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

N

0 500 1,000 1,500 Feet

1 inch = 1,000 feet

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PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Site Location

Figure 2

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\For Site Characterization Report\Figure 3 - Site Layout Map.mxd 4/24/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

N

0 100 200 300 Feet

1 inch = 200 feet

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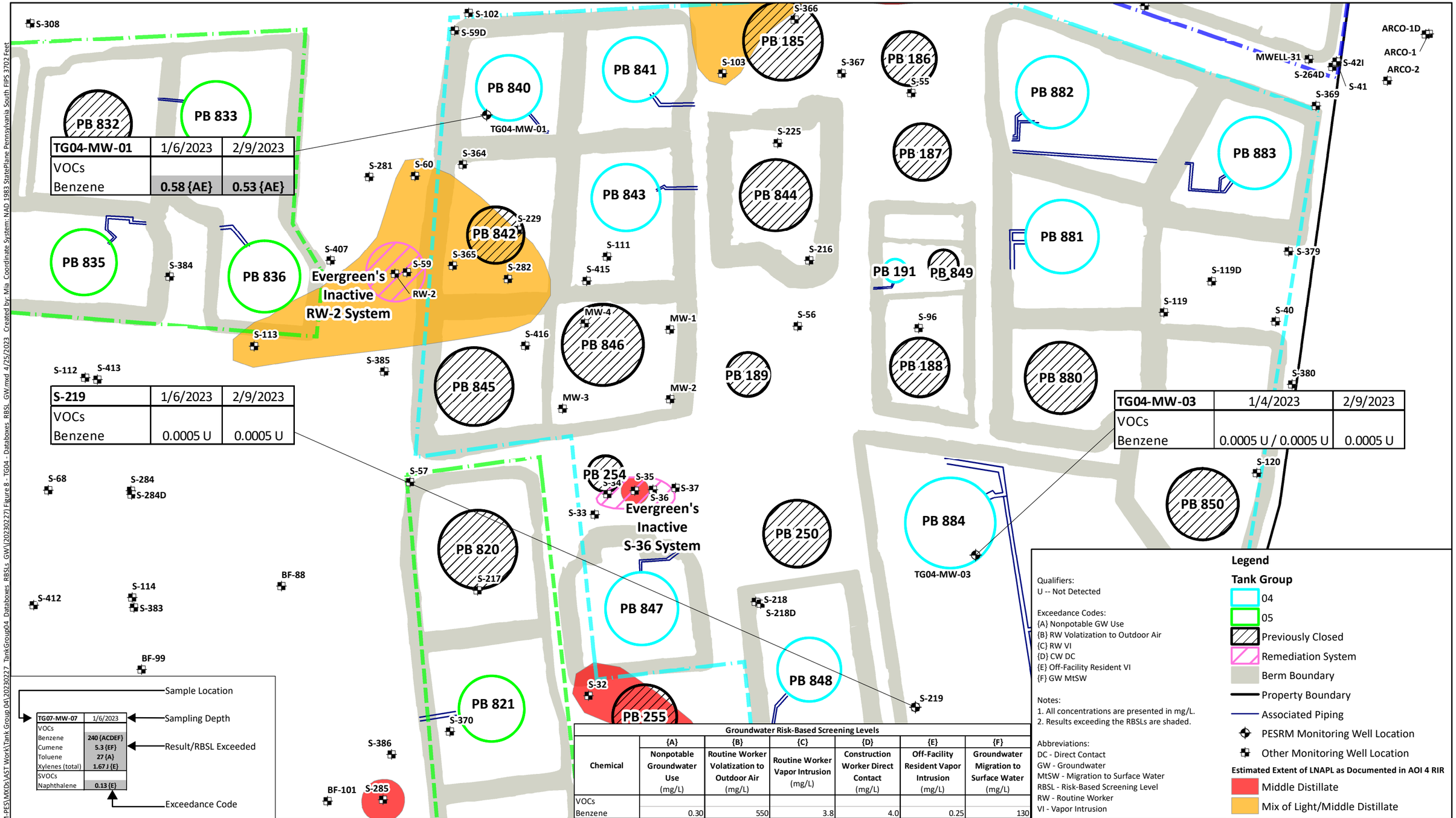
Site Layout Map
Tank Group 04

Figure 3



TG04-MW-01	1/6/2023	2/9/2023
VOCs		
Benzene	0.58 {AE}	0.53 {AE}

S-219	1/6/2023	2/9/2023
VOCs		
Benzene	0.0005 U	0.0005 U

TG04-MW-03	1/4/2023	2/9/2023
VOCs		
Benzene	0.0005 U / 0.0005 U	0.0005 U

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

Sample Location
Sampling Depth
Result/RBSL Exceeded
Exceedance Code

Groundwater Risk-Based Screening Levels

Chemical	{A} Nonpotable Groundwater Use (mg/L)	{B} Routine Worker Volatization to Outdoor Air (mg/L)	{C} Routine Worker Vapor Intrusion (mg/L)	{D} Construction Worker Direct Contact (mg/L)	{E} Off-Facility Resident Vapor Intrusion (mg/L)	{F} Groundwater Migration to Surface Water (mg/L)
VOCs						
Benzene	0.30	550	3.8	4.0	0.25	130

Qualifiers:
U -- Not Detected

Exceedance Codes:
{A} Nonpotable GW Use
{B} RW Volatization to Outdoor Air
{C} RW VI
{D} CW DC
{E} Off-Facility Resident VI
{F} GW MtSW

Notes:
1. All concentrations are presented in mg/L.
2. Results exceeding the RBSLs are shaded.

Abbreviations:
DC - Direct Contact
GW - Groundwater
MtSW - Migration to Surface Water
RBSL - Risk-Based Screening Level
RW - Routine Worker
VI - Vapor Intrusion

Legend

Tank Group
- 04
- 05
- Previously Closed
- Remediation System
- Berm Boundary
- Property Boundary
- Associated Piping
- PESRM Monitoring Well Location
- Other Monitoring Well Location

Estimated Extent of LNAPL as Documented in AOI 4 RIR
- Middle Distillate
- Mix of Light/Middle Distillate

0 100 200 300 400 Feet
1 inch = 200 feet

N

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PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Groundwater Sample Results Compared to RBSLs Tank Group 04

Figure 4

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230227_TankGroup04_Databoxes_RBSLs_GW\(20230227) Figure 8 - TG04 - Databoxes_RBSL_GW.mxd 4/25/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

PB 151
PB 152
PB 160
PB 162
PB 177
PB 174
PB 190
S-59D
S-366
PB 185
PB 186
S-103
S-367
PB 841
PB 840
PB 882
TG04-MW-01
S-225
PB 187
PB 883
S-364
PB 844
PB 843
PB 842
S-229
PB 881
S-379
S-365
S-216
Evergreen's Inactive RW-2 System
S-415
PB 191
PB 849
S-119D
S-119
MW-4
MW-1
S-96
S-40
S-416
PB 846
PB 188
PB 845
PB 189
PB 880
PB 254
S-35
S-36
Evergreen's Inactive S-36 System
S-120
PB 850
PB 884
PB 820
PB 250
S-121
TG04-MW-03
S-39D
PB 847
S-218
S-218D
PB 885
PB 848
PB 821
PB 255
S-219
Evergreen's Inactive S-30 System
PB 251
PB 886
PB 256
PB 822
S-381
PB 252
S-97
PB 826
S-123
PB 257
PB 825
PB 823
S-373
PB 260
PB 258
PB 824
PB 253
Evergreen's Inactive Penrose Avenue Remediation System

Legend

Tank Group

- 03
- 04
- 05
- Previously Closed
- Remediation System
- Berm Boundary
- Property Boundary
- Associated Piping

Estimated Extent of LNAPL as Documented in AOI 4 RIR

- Light Distillate
- Middle Distillate
- Heavy Distillate
- Mix of Light/Middle Distillate

PESRM Monitoring Well Location

- No Exceedances
- Exceeds GW RBSLs

Other Monitoring Well Location

- No Exceedances
- Exceeds GW RBSLs

Notes:
1. Sample location size symbolizes relative concentration.
2. The maximum concentrations depicted in Evergreen wells are from samples collected between 1985 and 2022.

Abbreviations:
GW -- Groundwater
RBSL -- Risk-Based Screening Level

0 50 100 200 Feet
1 inch = 100 feet

N

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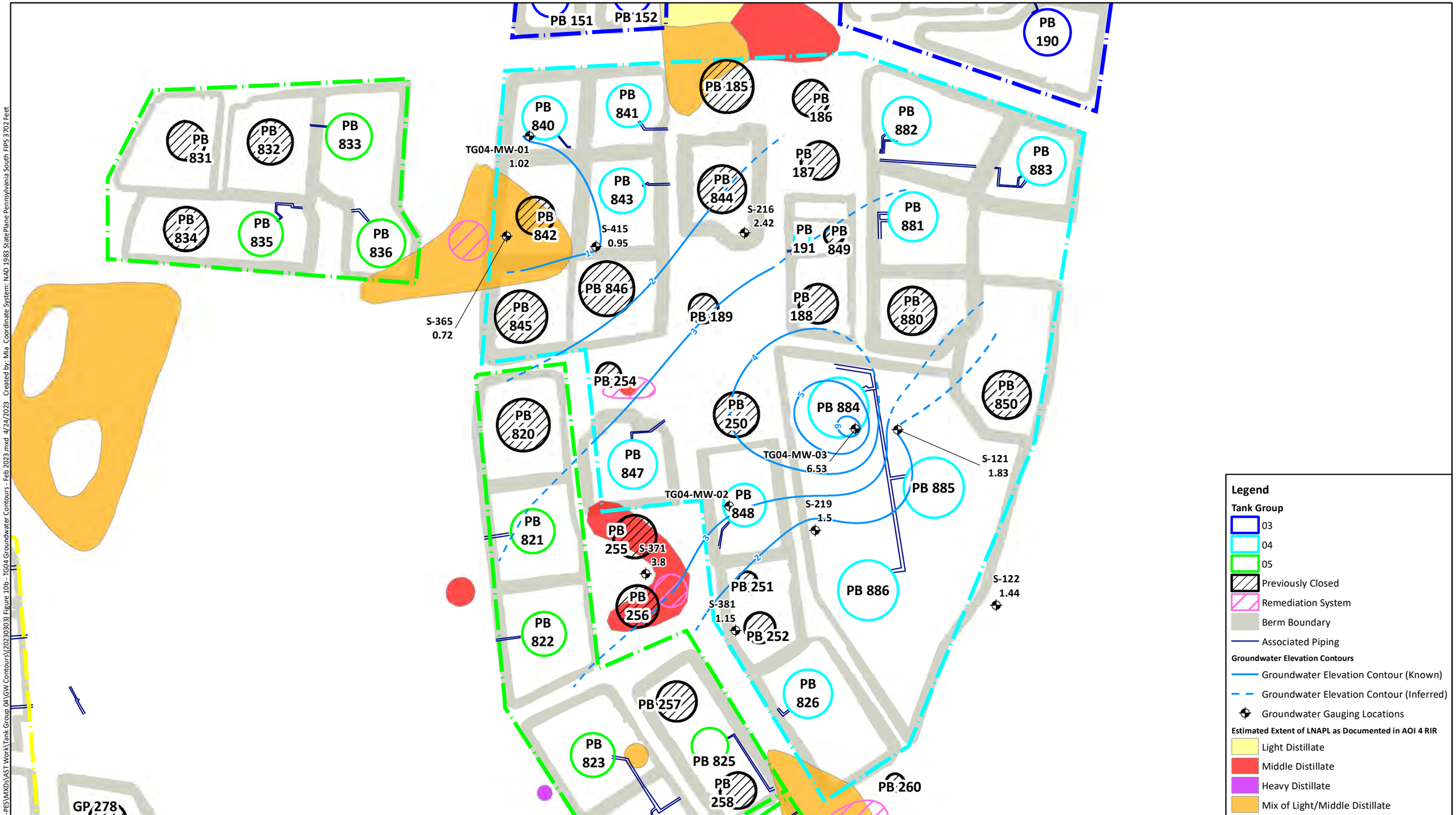
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Groundwater Sampling Results Tank Group 04 (Benzene)

Figure 5

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230123_Site Characterization - RBSLs_withEvergreen_GW_MaxResultsByChem\Figure 9 - TG04 - RBSL_GW_MaxResultsByChem_Benzene.mxd 4/5/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



Legend

Tank Group

- 03
- 04
- 05
- Previously Closed
- Remediation System
- Berm Boundary
- Associated Piping

Groundwater Elevation Contours

- Groundwater Elevation Contour (Known)
- Groundwater Elevation Contour (Inferred)
- Groundwater Gauging Locations

Estimated Extent of LNAPL as Documented in AOI 4 RIR

- Light Distillate
- Middle Distillate
- Heavy Distillate
- Mix of Light/Middle Distillate

Notes:
1. Groundwater elevation contour interval is 1.0 feet.
2. Corrected Depth to Water Levels factor an average LNAPL density of 0.82, where present.

0 300 600 Feet

1 inch = 300 feet

N

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PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Interpreted Potentiometric Surface, February 8, 2023

Figure 6

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\GW Contours\(20230303) Figure 10b - TG04 Groundwater Contours - Feb 2023.mxd 4/24/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

Appendix A

Revised Site-Specific Human Health Risk Assessment

FINAL

Revised Site-Specific Human Health Risk Assessment

Tank Group 04

Former Philadelphia Energy Solutions Refinery

3144 West Passyunk Avenue

Philadelphia, Pennsylvania

(Incident No. 57976)

Prepared for

Philadelphia Energy Solutions Refining and Marketing LLC
111 S. Wacker Dr Suite 3000
Chicago, IL 60606

Prepared by

Terraphase Engineering Inc.
100 Canal Pointe Boulevard, Suite 110
Princeton, New Jersey 08540

February 2023
Revised April 2023

Project Number P044.001.002

terraphase engineering

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B Risk-Based Screening Level Supporting Information and Calculations
C Analytical Data
D Select Figures from the AOI 4 RIR

Acronyms and Abbreviations

$\mu g/m^3$	micrograms per cubic meter
124-TMB	1,2,4-trimethylbenzene
135-TMB	1,3,5-trimethylbenzene
Act 32	Storage Tank and Spill Prevention Act
AOI 4 RIR	*Remedial Investigation Report, Area of Interest 4*
AST	above ground storage tank
AT_c	averaging time for carcinogens
bgs	below ground surface
C_{air}	constituent concentration in air
cm^2/day	square centimeters per day
COC	constituents of concern
COPC	constituent of potential concern
C_{unit}	unit constituent concentration
ED	exposure duration
EF	exposure frequency
ET	exposure time
the Facility	Former Philadelphia Energy Solutions refinery
ft	feet or foot
HI	hazard index
HQ	hazard quotient
i	route
mg/kg	kilograms
K_p	permeability coefficient
mg/cm^2	milligrams per square centimeter
mg/day	milligrams per day
mg/kg	milligrams per kilogram
PADEP	Pennsylvania Department of Environmental Protection
PM_{10}	respirable soil particulates
RBSL	risk-based screening level
Report	*Site Characterization Report*
RfC	reference concentration
RfD	reference dose
the Risk Assessment	*Site-Specific Human Health Risk Assessment*
RME	reasonable maximum exposure

SAP	*Site Characterization Sampling and Analysis Plan – Tank Group 04*
the Site	Tank Group 04
Sitewide Fate and Transport RIR	*Sitewide Fate and Transport Remedial Investigation Report*
SF	slope factor
TCRL	target cancer risk
Terraphase	Terraphase Engineering Inc.
THQ	target hazard quotient
UCL	upper confidence limit
URF	unit risk factor
USEPA	United States Environmental Protection Agency
Work Plan	*Aboveground Storage Tank Closure Work Plan*

1 Introduction

Terraphase Engineering Inc. (Terraphase), on behalf of Philadelphia Energy Solutions Refining and Marketing LLC, has prepared this *Site-Specific Human Health Risk Assessment* (the Risk Assessment) in support of the *Site Characterization Report* (Report) for Tank Group 04 (the Site), located within the Former Philadelphia Energy Solutions refinery facility (the "Facility"). This document describes the methodology and results of a site-specific human health risk assessment, performed in accordance with 25 Pa. Code § 250.409, to support a demonstration that conditions at the Site meet the tank closure requirements in accordance with the Storage Tank and Spill Prevention Act (Act 32).

The Facility, which is located at 3144 West Passyunk Avenue, Philadelphia, Pennsylvania (**Figure 1**), is undergoing tank closure activities in preparation for redevelopment. Tank Group 04 is located within an area of the Facility referred to as the Point Breeze Refinery South Yard (**Figure 2**). As discussed in Terraphase's (2021) *Aboveground Storage Tank Closure Work Plan* (Work Plan), which was approved by the Pennsylvania Department of Environmental Protection (PADEP) on April 23, 2021, closure of the above ground storage tanks (ASTs) under Act 32 is being pursued through a group closure process, in which ASTs in the same general area (e.g., tank farm) are demolished, removed, investigated, and evaluated at about the same time. There are nine tank groups in all and demolition of the tanks has been proceeding in phases at the Facility from the north to the south.

Following the demolition of the ASTs in Tank Group 04, between May 2021 and March 2022, soil and groundwater sampling was conducted in accordance with the Work Plan and the *Site Characterization Sampling and Analysis Plan – Tank Group 04* (SAP) submitted to PADEP on December 5, 2022. The sampling was performed to gather the data necessary to assess whether conditions at the Site following closure activities are protective of human health and the environment.

This Risk Assessment has been completed in accordance with the Pennsylvania Land Recycling and Environmental Remediation Standards Act and risk assessment guidance from PADEP and the United States Environmental Protection Agency (USEPA). It is organized as follows:

- Section 2 presents the site setting. Information regarding the site description, operational history and usage of the tanks, topography, geology, and hydrology of the area is summarized. A discussion of on-facility and off-facility land and groundwater use under current and reasonably expected future land and groundwater use is also provided.
- Section 3 discusses the results of the soil and groundwater sampling performed in accordance with the Work Plan and SAP. This section documents how the sampling results adequately characterize the nature and extent of constituents in the environment to select a remediation standard and perform a site-specific risk assessment.
- Section 4 discusses the preparation of data used in the risk calculations.
- Section 5 presents the human health risk assessment calculations and the resulting risk characterization.
- Section 6 provides the site-specific standards proposed to support remedial action planning in the area.

- Section 7 summarizes the results of the human health risk assessment and the site-specific standards developed to support remedial action.
- Section 8 provides the references used in the preparation of this report.

Supporting information for the Risk Assessment is provided in **Appendix A**. **Appendix B** provides a discussion regarding how risk-based screening levels were derived to support investigation decisions during the Site Characterization and to demonstrate adequate characterization to support the Risk Assessment. **Appendix C** provides the analytical results from the soil and groundwater sampling performed. Finally, **Appendix D** provides select figures from the *Remedial Investigation Report, Area of Interest 4* (AOI 4 RIR; Stantec 2017) and the *Sitewide Fate and Transport Remedial Investigation Report* (Sitewide Fate and Transport RIR; Stantec 2022).

2 Site Setting

This section presents the site setting and includes a description of the Site, operational history and usage of the tanks, topography, geology, and hydrology, and the on-facility (which includes the Site) and off-facility land and groundwater use.

2.1 Site Description

The Facility, a former 1,300-acre refinery, is currently undergoing decommissioning to support redevelopment. The Site[1] is 70.6 acres in size and is located within the Point Breeze Refinery South Yard, an area that is also referred to as AOI 4 by Evergreen as part of their One Cleanup Program effort. The Site is located south of Hartranft Street and north of Penrose Avenue, between South 26th Street and Schuylkill Avenue. The Tank Group 04 area formerly consisted of a large tank farm with large piping structures, a pump house, and plant access roadways. Except for the asphalt roadways that pass through portions of Tank Group 04, and the tank foundations themselves, the area is not covered by hardscape.

The ASTs addressed in this Report are listed in **Table 1** of the Report. Sixteen other ASTs, not subject to this closure effort, were previously located within Tank Group 04.

Figure 3 provides a layout of Tank Group 04.

2.2 Operational History/Usage of the Tanks

The Facility operated as a petroleum refinery between 1860 and 2019. The refinery ceased operations in 2019. The demolition and decommissioning of the subject ASTs began in May 2021. Prior to demolition, the primary products held within these tanks were: crude (PB 826, PB 840, PB 841, PB 843, PB 847, PB 881, PB 882, PB 883, PB 884, PB 885, and PB 886), recovered oil (PB 191), and light cycle oil (PB 848).

[1] Tank Group 04 consists of the tank farm referred to by the Facility as the No. 4 Tank Farm.

Additional details regarding the size, contents, and construction of the tanks are provided in **Table 1** of the Report.

2.3 Topography

Topography at the Site is generally flat except for containment berms constructed around the tank areas to provide containment in the event of a release. Regional topography slopes gently to the west towards the Schuylkill River, the nearest water body to the Site. The ground surface elevation at the Site is approximately 15 feet (ft) above mean sea level[2].

2.4 Regional Geology and Hydrogeology

The Facility is located within the Atlantic Coastal Plain Physiographic Province of Pennsylvania. The Atlantic Coastal Plain is a physiographic province that is defined as having a flat topography, underlain by unconsolidated sediments that thicken to the southeast. The Coastal Plain deposits are sand, gravel, silt, and clay which drape over crystalline igneous and metamorphic rocks. In general, the resulting sediments are approximately 250 ft thick along the Delaware River. These sediments unconformably overlie much older, very complexly deformed rocks of the Piedmont physiographic province. The Coastal Plain deposits in the vicinity of the Facility consist of anthropogenic fill underlain by quaternary deposits.

Much of the Facility and surrounding area is underlain by historical fill material, which was placed for the purpose of reclaiming lowlands along the banks of the tidal Delaware and Schuylkill Rivers during industrialization. Below the fill material, sediments consist of gray, muddy deposits with occasional sand, gravel, and organic-rich lenses. These sediments were deposited in floodplain, channel, and marsh environments through the Holocene. The most recent deposits are poorly consolidated and below the phreatic surface of the unconfined aquifer as a result of their relatively young geologic age and position along the Schuylkill River (tributaries and creeks). Below the Holocene deposits is a Pleistocene glacial outwash deposit, commonly referred to as the “Trenton Gravel” along the Delaware River valley. Cretaceous-age sand and clay units making up the Potomac-Raritan-Magothy aquifer system underly the Pleistocene deposits.

The sedimentary record near the Site consists of a complex series of water-bearing sand units which can comprise one or more hydrostatic units. Historical investigations conducted at the Facility have identified two saturated zones, including an unconfined shallow groundwater unit (occurring within the Holocene and Trenton Gravel deposits) and a deep groundwater unit known as the Farrington Sand, which is part of the Potomac-Raritan-Magothy aquifer system. The deeper groundwater unit is separated by a clay unit; as such, the deeper groundwater has been classified as a semi-confined aquifer. Groundwater is first encountered generally at the Facility at a depth approximately 13 to 23 ft below ground surface (bgs). **Appendix D** provides select figures from the AOI 4 RIR (Stantec 2017) and the Sitewide Fate and Transport RIR (Stantec 2022) for reference including, Figures 2-6, 2-7, and 2-8 from the AOI 4 RIR which provide a detailed cross section of the subsurface in this area.

[2] North American Vertical Datum of 1988.

2.5 Local Geology and Hydrogeology

During the Site Assessment and Site Characterization, soil at the Site was primarily investigated within the upper 5 ft, although certain Site Characterization borings were advanced to a maximum depth of 15 ft. Monitoring wells were installed to depths of up to 20 ft bgs. Anthropogenic fill up to 11 ft thick was observed in soil cores collected from most of the soil borings installed in Tank Group 04. Soil beneath the fill layer generally consists of brown to brownish red gravelly sand, clay, and silt.

Historically, unconfined aquifer groundwater has been first encountered in Tank Group 04 at a depth of approximately 12 to 25 ft bgs (Stantec 2017). During Site Characterization activities, groundwater was encountered between approximately 10 and 24 ft bgs. Perched groundwater has also been noted to be present in the anthropogenic fill layers throughout the Facility, causing mounding and irregular depressions (Stantec 2017).

Groundwater at the refinery has historically been interpreted to flow to the south toward the convergence of the Delaware and Schuylkill Rivers. However, based on Figure 5-4 of the AOI 4 RIR (Stantec 2017) and Figure 3-29 of the Sitewide Fate and Transport RIR (Stantec 2022) included in **Appendix D**, and the Site Characterization conducted by Philadelphia Energy Solutions Refining and Marketing LLC, unconfined aquifer groundwater flow within Tank Group 04 has been interpreted to be locally divided, with groundwater in the southern portion of the Tank Group flowing south, and groundwater in the central portion flowing to depressions in the northern portions of the Tank Group.

2.6 Land Use

This section describes land use under current and reasonably anticipated future conditions at and in the vicinity of the Site. This risk assessment uses “on-site” to refer to areas within the Tank Group 04 boundary. “Off-site” is used to describe areas not within the Tank Group 04 boundary but still within the Facility boundary. The terms “on-facility” and “off-facility” are used to describe areas within and outside of the Facility’s boundary, respectively.

2.6.1 Current

Currently, the on-facility area (which includes the Site) is undergoing decommissioning/demolition work, environmental investigation, and predevelopment activities. The land is zoned for Industrial Use.[3] Aside from the asphalt roadways that pass through portions of Tank Group 04, and the tank foundations themselves, the area is currently uncovered and lightly vegetated. The Site is generally flat except for containment berms constructed around the tank areas to provide containment in the event of a release.

The off-facility area is currently characterized by a mixture of residential, commercial, and industrial properties[4].

[3] https://openmaps.phila.gov/.

[4] https://openmaps.phila.gov/.

2.6.2 Future

As captured in the conceptual imagery developed by Hilco Redevelopment Partners[5], the on-facility area (which including the Site) is being redeveloped into a state-of-the-art, multimodal industrial park and life sciences campus with ancillary rail infrastructure, energy infrastructure, marine capabilities, and commercial uses. As a result, reasonably anticipated future land use on-facility (which includes the Site)is commercial/industrial. Also, following redevelopment, much of the area is expected to be covered by hardscape (e.g., building pads, drive aisles, parking lots, roadways) or other features that will generally function as barriers to direct contact exposure.

In the future, land use in off-facility areas in proximity to the Site is expected to remain a mixture of residential, commercial, and industrial properties (City of Philadelphia 2022).

2.7 Groundwater Use

Stemming from several efforts to assess the potential for current and reasonably anticipated future use of groundwater at and in the vicinity of the Facility, Evergreen has documented no confirmed drinking water supply wells within 1-mile of the Facility. These efforts have included several well searches, field verification, and a review of the City of Philadelphia's ordinances. In 2021, Evergreen supplemented these efforts by reviewing the City of Philadelphia's publicly available information concerning potable drinking water intakes, contacting PADEP's Safe Drinking Water Program, contacting the City of Philadelphia's Health Department, contacting the City of Philadelphia Water Department, contacting the City of Philadelphia Department of Parks and Recreation, conducting updated database searches (paGWIS and eMapPA), coordinating with the PADEP to obtain information from the New Jersey Department of Environmental Protection, and providing additional documentation concerning the institutional controls at the Site which prohibit groundwater use (Evergreen 2021).

Overall, with consideration for the information compiled by Evergreen regarding groundwater use, this Risk Assessment assumes the following:

- Groundwater on-facility (including on-site) is not a current or reasonably anticipated future source of potable or nonpotable water.
- Groundwater off-facility is not a current source of potable or nonpotable water.
- Groundwater off-facility is not a reasonably anticipated future source of potable water.
- Groundwater off-facility is assumed to be a reasonably anticipated future source of nonpotable water.

[5] https://www.thebellwetherdistrict.com/.

3 Site Characterization

This section discusses the results of the soil and groundwater sampling performed in accordance with the Work Plan and SAP. A review of these results and how they adequately characterize the nature and extent of constituents in soil and groundwater at the Site, in support of the site-specific risk assessment, is also provided.

3.1 Soil Investigation

As discussed in the Work Plan, when no evidence of a release to the environment was identified during Tank Group 04 AST removal, ASTs were subject to Site Assessment sampling using a grid-based approach with additional biased samples toward the locations of pipe connections or other key infrastructure. Sampling was conducted during multiple mobilizations as the tanks were being demolished and the ground became available for sampling. The first mobilization was on July 29, 2021, and the last mobilization was completed on July 15, 2022, after the removal of double bottoms.

In total, 250 soil borings were installed and 263 soil samples were collected during the Site Assessment. **Figures 4A** through **4D** show the location of each of the Site Assessment soil borings.

Based on the results of Site Assessment sampling in Tank Group 04, a Site Characterization plan was developed (Terraphase 2022). The objective of the Site Characterization was to delineate the horizontal and vertical extent of the potential releases until sufficient data were available to determine the need for interim or remedial measures. Site Characterization soil sampling was conducted between December 19, 2022, and January 4, 2023. The Site Characterization scope included the installation of an additional three soil borings and the collection of an additional four soil samples.

Each soil sample was analyzed for the constituents of potential concern (COPCs) listed in **Table 1** by Alpha Analytical, Inc. of Westborough, Massachusetts a PADEP-certified laboratories.

Further details are provided in Sections 5 and 6 of the Report.

3.2 Groundwater Investigation

In addition to soil characterization, groundwater monitoring wells were installed in the vicinity of tanks PB 840, PB 848, and PB 884, as depicted in **Figure 5**. The wells were installed to fully characterize the extent of contamination identified in the vicinity of the tanks, as required by 25 Pa. Code § 245.309(c)(10).

The locations of the monitoring wells were selected with three objectives in mind: (1) to evaluate groundwater in the vicinity of each tank with a reported release, (2) to bias monitoring well locations toward areas where higher concentrations have been detected in soil, and (3) to obtain spatial coverage across the Tank Group.

The monitoring wells were installed and developed between December 20, 2022 and January 4, 2023. Sampling was conducted 2 weeks following well development of TG04-MW-03, on January 4, 2023, and

48 hours after development of TG04-MW-01, on January 6, 2023. Monitoring well S-219[6] was also sampled on January 6, 2023. A second sampling event was conducted on February 9, 2023, and samples were collected from TG04-MW-01, TG04-MW-03, and S-219. The groundwater samples collected from the wells were analyzed for the COPCs listed in **Table 1** by Alpha Analytical, Inc. of Westborough, Massachusetts.

3.3 Adequacy of Characterization

In accordance with 25 Pa. Code § 245.309(b), the site characterization "*shall provide sufficient physical data, through field investigations, to determine the regulated substances involved, and the extent of migration of those regulated substances in surface water, groundwater, soil or sediment.*" Per the *Technical Guidance Manual* (PADEP 2021), in order to support a site-specific risk assessment "*the investigation needs to sufficiently characterize the nature and extent and composition of the regulated substances that have been released*."

Per these requirements, the soil and groundwater sampling data collected were reviewed to determine whether additional soil sampling would be warranted to complete site characterization and a site-specific risk assessment. To help support this evaluation, site-specific risk-based screening levels (RBSLs) were derived in accordance with PADEP and USEPA risk assessment guidance. The RBSLs help to segregate soil and groundwater sampling data that indicate a higher potential for health significance from those that indicate a low potential. The RBSLs and their derivation are summarized in **Appendix B**. The soil and groundwater sampling results were compared to the RBSLs and the spatial distribution of concentrations greater than these levels is presented on **Figures 4** and **5**. The identification of locations with constituent concentrations greater than these RBSLs does not necessarily mean that an unacceptable risk has been identified. It simply helps a reviewer focus on a subset of the data in order to make decisions regarding whether additional field investigation is necessary to support a risk assessment. The key consideration during this evaluation is whether constituents identified at concentrations above the RBSLs have sufficient lateral and vertical characterization to ensure that reliable and conservative estimates of the exposure concentration (usually a 95 percent upper confidence limit (UCL) on the mean) for a particular exposure area (and exposure scenario) can be developed. Based on these considerations, the soil and groundwater sample results at the Site were evaluated to determine the adequacy of the data to support the site-specific risk assessment.

3.3.1 Soil

As shown in **Table 2**, 20 of the 22 analyzed constituents were detected in soil at the Site. Benzene, cumene, ethyl benzene, 1,2,4-trimethylbenzene (124-TMB), 1,3,5-trimethylbenzene (135-TMB), xylenes (total), naphthalene, and lead were detected in soil at concentrations greater than the RBSLs. Lead was detected in soil at concentrations greater than the routine worker direct contact RBSLs. Benzene, cumene, ethyl benzene, 124-TMB, 135-TMB, xylenes (total), and naphthalene were detected in soil at

[6] Since monitoring well TG04-MW-02 was dry, Evergreen well, S-219, was sampled as a replacement well during both sampling events.

concentrations greater than the routine worker vapor intrusion RBSLs. 124-TMB, xylenes (total), naphthalene, and lead were detected in soil at concentrations greater than the construction worker direct contact RBSLs. No constituents were detected in soil at concentrations greater than the soil migration to groundwater RBSLs.

As further described in Section 7 of the Report, based on the review of the soil concentrations in comparison to the RBSLs and the spatial distribution of concentrations greater than these levels, the soil sampling performed adequately characterizes the nature and extent of regulated substances to support a site-specific risk assessment. The horizontal and vertical extent of constituents identified at concentrations above the RBSLs has been determined such that reliable and conservative estimates of the exposure concentration for the exposure area can be developed.

3.3.2 Groundwater

As shown in **Table 3**, 13 of the 22 analyzed constituents were detected in groundwater. Benzene was detected in groundwater at concentrations greater than the nonpotable groundwater use and off-facility resident vapor intrusion RBSLs. No constituents were detected in groundwater at concentrations greater than the routine worker volatilization to outdoor air, routine worker vapor intrusion, construction worker direct contact, or groundwater migration-to-surface water RBSLs.

As further described in Section 7 of the Report, based on the review of the groundwater concentrations in comparison to the RBSLs and the spatial distribution of concentrations greater than these levels, the groundwater wells provide results that adequately characterize the nature and extent of regulated substances to support a site-specific risk assessment. The horizontal extent of constituents identified at concentrations above the RBSLs has been determined such that reliable and conservative estimates of the exposure concentration for the exposure area can be developed.

4 Data Selection and Preparation

All soil and groundwater data collected during the investigation are considered in this Risk Assessment. The following procedures are used to prepare the sampling data to support quantitative risk assessment. These procedures, which account for USEPA risk assessment guidance (USEPA 1989), are as follows:

- Constituent concentrations qualified by the lab as not detected (i.e., U-qualified) are evaluated as non-detects in accordance with USEPA guidance (1989).
- Constituent concentrations qualified by the lab as estimated (i.e., J-qualified) are included and treated as detected concentrations for quantitative assessment.
- The concentrations of xylenes are the sums of the concentrations of the isomers that were detected and half the quantitation limits of the isomers that were not detected in the same sample but were detected in the same matrix at the Site. If no isomer was detected in a sample, the constituent is considered to be not detected in the sample and handled accordingly, as described in Section 5.1.2.

- Constituent concentrations in duplicate field samples are averaged to obtain a representative concentration for the sample. When a constituent was detected in only one sample of a duplicate pair, the average of the detected concentration and one-half the quantitation limit for the non-detect is used.

While PADEP's (2021) *Technical Guidance Manual* and USEPA's (1989) risk assessment guidance include an optional step for shortening the list of constituents included in quantitative assessments, this risk assessment does not eliminate any detected constituents from the cumulative risk calculations. For this Risk Assessment, any constituent detected in soil or groundwater at the Site is considered a COPC, regardless of whether its concentration exceeded the RBSL or not.

5 Human Health Risk Assessment

Terraphase has performed this risk assessment to evaluate potential human health risks that could be attributable to former releases of hazardous constituents at the Site (i.e., Tank Group 04). Potential risks are characterized using a reasonable maximum exposure (RME), or a conservative estimate of the RME under the current and reasonably anticipated future land uses at and around the Site. The methods used in the human health risk assessment are based upon PADEP and USEPA human health risk assessment guidance.

Section 5.1 describes how the exposure assessment is performed including the identification of scenarios for potential human exposure, the compilation of exposure factors for each receptor, and how exposure concentrations are calculated. Section 5.1.4.5 describes how toxicity values are compiled. Section 5.3 discusses how the risk characterization is performed and Section 5.4 summarizes the impact of currently anticipated uncertainties on the outcome of the risk characterization.

5.1 Exposure Assessment

In accordance with 25 Pa. Code § 250.602(c)(2), this section discusses the exposure assessment performed to evaluate risks associated with potential human exposures to COPCs in soil and groundwater at the Site. It discusses the exposure assumptions used to quantify potential exposure via the incidental ingestion and inhalation exposure routes. Please note that while 25 Pa. Code § 250.602(c)(2) indicates that an exposure assessment shall consider "ingestion, inhalation, and volatilization" pathways, this risk assessment also includes an evaluation of dermal contact in the exposure assessment.

The potential exposures via ingestion and dermal contact are quantified in terms of a dose as follows:

$$Dose = Concentration \times Intake$$

The dose for evaluating cancer risk is averaged over a lifetime and is called the lifetime average daily dose. For evaluating noncancer effects, the dose is averaged over the duration of potential exposure and is called the average daily dose. The concentration term in the dose equation refers to the average constituent concentration in an environmental medium to which a population is exposed over a

specified duration. The intake term refers to the intake rate of the contaminated environmental medium, which is a function of the magnitude, frequency, and duration of exposure. The methods for estimating the concentration term are discussed in Sections 5.1.2 and 5.1.3. The exposure factors used to quantify the magnitude, frequency, and duration of potential exposures are discussed in Section 5.1.4.

Inhalation exposures are quantified in terms of an exposure concentration, which is an air concentration that is time-weighted over the duration of exposure. The exposure concentration for evaluating cancer risk is an average over a lifetime. For evaluating chronic and subchronic noncancer effects, the exposure concentration is an average over the duration of exposure. The methods for estimating air concentrations are discussed in Sections 5.1.2 and 5.1.3.

The environmental setting at and around the Site, including climate, geology, hydrogeology, water supply, land and groundwater use, is discussed in the Report and Section 2, and therefore is not repeated in this section.

5.1.1 Scenarios for Potential Human Exposure

Per the requirements specified in 25 Pa. Code § 250.602 and § 250.603, this section identifies potentially exposed populations (receptors) and describes the exposure pathways for each receptor. The receptors and exposure pathways are also summarized in **Table 3**.

This risk assessment uses “on-site” to refer to areas within the Tank Group 04 boundary. “Off-site” is used to describe areas not within the Tank Group 04 boundary but still within the Facility boundary. The terms “on-facility” and “off-facility” are used to describe areas within and outside of the Facility’s boundary, respectively.

5.1.1.1 Potential On-Site Exposures

Current Conditions

The Facility (which includes the Site) is currently undergoing decommissioning/demolition work, environmental investigation, and predevelopment activities. Access to the Facility is controlled with fencing and site security. Because of this, trespassing at the Site is expected to be extremely limited under current conditions. The current on-site receptors evaluated in the human health risk assessment include construction workers who may become exposed during site redevelopment or major construction activities and trespassers. Workers who occasionally perform site investigation work on-site are not evaluated because they are required to follow health and safety procedures, including the use of appropriate personal protective equipment, to prevent unacceptable exposures. Workers involved with the redevelopment and reuse of the Site are evaluated in the risk assessment, assuming they do not follow health and safety procedures or wear personal protective equipment.

Future Conditions

Reasonably anticipated future receptors at and in the immediate vicinity of the Site could include workers who may be exposed during the performance of typical or routine commercial activities (routine workers), maintenance workers who may become exposed during maintenance activities

including minor subsurface repair/utility activities, construction workers who may become exposed during site redevelopment or major construction activities, and trespassers.

Potential exposure of routine workers is assumed to include incidental ingestion and dermal contact with COPCs in exposed surface soil. Routine workers could also be exposed to the following:

- COPCs in vapors and particulates from exposed surface soil
- COPCs in vapors from subsurface soil and shallow groundwater that migrate into outdoor air
- COPCs in vapors from subsurface soil and groundwater that migrate through building foundations into indoor air

Potential future exposure of construction workers and maintenance workers is assumed to include the following:

- Incidental ingestion and dermal contact with COPCs in exposed surface and subsurface soil and shallow groundwater
- Inhalation of COPCs in airborne particulates and vapors from exposed surface soil
- Inhalation of COPCs in vapors from subsurface soil and shallow groundwater

Potential future exposures of trespassers[7] are assumed to include the following:

- Incidental ingestion of and dermal contact with COPCs in exposed surface soil
- COPCs in vapors and particulates from exposed surface soil
- COPCs in vapors from subsurface soil and shallow groundwater that migrate into outdoor air

5.1.1.2 Potential Off-Site/Off-Facility Exposures

Potential off-site receptors under current and future conditions may include receptors who are off-facility, or receptors who are off-site (i.e., located outside of the Tank Group) but still within other portions of the Facility. Off-facility receptors include residents, routine workers, construction workers, maintenance workers and trespassers[8]. Off-site receptors include the same populations with the exception of residents who are not a reasonably anticipated receptor population on-facility.

Potential exposure of off-facility residents is assumed to include inhalation of COPCs in airborne particulates from on-site soil and/or vapors from on-site soil and groundwater. Off-facility residents could also be exposed to vapors from groundwater that migrate through building foundations into indoor air should site-related groundwater contamination migrate off-facility to areas where residential buildings exist or could exist in the future.

[7] While receptor populations could include trespassers, this risk assessment did not quantitatively evaluate the potential exposure of these receptors, but instead relies upon the quantitative risk calculations performed for on-site routine workers to serve as a surrogate for this population.

[8] Quantitative risk estimates for each of the off-facility receptors were not performed. Instead, this risk assessment relies on the quantitative risk calculations performed for off-facility residents to serve as a surrogate for these receptor populations.

The risk assessment also considers and evaluates the potential for groundwater contamination to migrate to the Schuylkill River given its proximity to the Site, which is approximately 1,250 ft to the west.

5.1.2 Exposure Concentrations

This section describes how exposure concentrations are determined for the soil and groundwater risk estimates.

5.1.2.1 Soil Exposure Concentrations

To evaluate potential exposure to soil and to streamline this risk assessment, the maximum detected concentration of each COPC in soil from any location across the Site and at any depth is conservatively used as the exposure concentration for each exposure scenario. This initial set of soil concentrations represents upper-bound estimates of the actual exposure concentrations, and as such, the cumulative cancer risk and noncancer hazard index (HI) estimates calculated using these concentrations represent upper-bound estimates.

As a supplement to these exposure area risk/HI estimates, for exposure scenarios where potentially unacceptable risks/HIs are identified and for vapor intrusion exposure, soil risk/HI estimates are calculated for each soil sampling location. This is done to facilitate the identification of areas with potentially unacceptable risks/HI and to guide risk management decision making (e.g., what areas of the Site would warrant and not warrant vapor intrusion risk management). For these location-specific calculations, the highest detected concentration of each COPC from any depth at each soil sample location is used. Additionally, where a COPC is non-detect at a location but detected within the specific exposure media at the Site, ½ the analytical limit is used. This set of soil concentrations represent upper-bound estimates of the actual exposure concentrations, and as such, the cumulative cancer risk and noncancer HI estimates calculated using these concentrations should also be considered upper-bound estimates.

5.1.2.2 Groundwater Exposure Concentrations

To evaluate potential exposure to groundwater and streamline this risk assessment, the maximum detected concentration of each COPC in groundwater from any location across the Site is conservatively used as the exposure concentration for each exposure scenario.

5.1.3 Fate and Transport Models

The following models are used in the risk assessment to estimate exposure concentrations for the exposure scenarios discussed in Section 5.1.1. These models are used by USEPA and state regulatory agencies (including PADEP) for conservative, screening level analysis. The following are brief descriptions of the models. Further details of these models are provided in **Appendix A**.

5.1.3.1 Vapor Emission from Exposed Soil

Vapor emissions from exposed soil are estimated using the Jury model (Jury et al. 1983) based on depletion over time, assuming conservatively that the soil is initially impacted from the ground surface

to the water table (a depth of approximately 19 ft bgs, the average depth to groundwater in Tank Group 04).

A discussion of the model is provided in **Appendix A**.

5.1.3.2 Vapor Emission from Groundwater

Vapor emissions from groundwater (not exposed) are calculated using the steady-state diffusion equation in one-dimension assuming a constant source concentration and a maximum concentration gradient.

A discussion of the model is provided in **Appendix A**.

5.1.3.3 Vapor Emission from Exposed Groundwater

The model for estimating vapor emissions from exposed groundwater during excavation activities is estimated using mass transfer coefficients recommended by USEPA (1995b).

A discussion of the model is provided in **Appendix A**.

5.1.3.4 Air Dispersion

Annual average air concentrations are estimated using the empirical correlations presented in USEPA's (2002) *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, assuming a square source area, and correlation coefficients for the Philadelphia, Pennsylvania meteorological area, which is the area nearest to the Site among the locations with available correlation coefficients.

For soil and groundwater exposures, the source area is assumed to be 70.6 acres, the area of Tank Group 04. For exposure scenarios where groundwater is encountered during excavations to the water table, the air concentrations are estimated in an analogous manner, but the source area is based on a 15- by 15-ft excavation area and an averaging period of 24 hours. The maximum 24-hour average air concentration was estimated from the annual average air concentration by using a conservative factor of 0.4/0.19 (or 2.1 [USEPA 2002]).

5.1.3.5 Dust Emission

For the routine worker and off-facility resident exposure scenarios that involve exposure to COPCs in outdoor soil, the emission of respirable soil particulates (PM_{10}) is calculated using the wind erosion model recommended by USEPA (1996b) with USEPA default soil parameters, and wind speed and anemometer height from the nearest weather station, which is located in Philadelphia, Pennsylvania (NOAA 2018).

During maintenance activities, the PM_{10} level is set at 50 micrograms per cubic meter ($\mu g/m^3$). This PM_{10} level is based on a time-weighted average assuming maintenance workers spend 1/3 of their exposure period excavating into the subsurface and 2/3 of their exposure period conducting maintenance activities that do not involve excavation into the subsurface. In calculating the time-weighted average,

the 24-hour average National Ambient Air Quality Standards for PM_{10} of 150 µg/m^3 is used as the PM_{10} concentration during excavations and a PM_{10} concentration of 1 µg/m^3 is used for the time during maintenance activities that do not involve excavation. The PM_{10} concentration during non-excavation maintenance activities is expected to be less than 1 µg/m^3, based on the wind erosion model recommended by USEPA (1996b) using site-specific wind speed from Philadelphia, Pennsylvania (NOAA 2018).

During construction activities, the PM_{10} level is set at 50 µg/m^3, which is the former annual average National Ambient Air Quality Standard for PM_{10} since construction workers are assumed to be performing excavations for a work year. It is assumed that the PM_{10} concentration would be at this limit every day for the entire period of construction worker exposure.

5.1.3.6 Vapor Intrusion into Future Buildings

Indoor air concentrations from the migration of vapors from soil and groundwater into a hypothetical future nonresidential building is estimated using the model described by Johnson and Ettinger (1991), which PADEP and USEPA recommend for screening level evaluations (PADEP 2021; USEPA 2004a, 2017b). Indoor air concentrations from groundwater into a hypothetical future residential building are also estimated using this model.

Indoor air concentrations from the migration of vapors from on-site soil are calculated by assuming that soil contamination extends from the bottom of the future building slab to the water table (i.e., a depth of 3 ft) for all constituents. These calculations also assume that the building cracks are filled with sand and utilize generic properties for sand recommended by USEPA (2004a). Generic residential building parameters (PADEP 2021; USEPA 2004a, 2017b) are also used.

A discussion of the model and the input parameters used in the assessment is provided in **Appendix A**.

5.1.3.7 Nonpotable Groundwater Use

Potential future off-facility exposures to COPCs in groundwater via nonpotable groundwater use are evaluated using a hypothetical scenario where groundwater is used to fill a backyard wading pool ("kiddie" pool). This scenario represents a reasonable worst case exposure scenario in which the estimated exposure is expected to be higher than those associated with other nonpotable uses (e.g., watering lawns, washing cars). The model for estimating vapor emission from a residential kiddie pool is based on models for estimating vapor emissions from open-top batch tanks (USEPA 1995a, 1995b).

A discussion of the model and the input parameters used in the assessment is provided in **Appendix A**.

5.1.3.8 Soil-to-Groundwater Pathway

Impacts to groundwater from site-related constituents are evaluated by calculating cancer risk and noncancer HI estimates by scaling off of the risk-based soil migration-to-groundwater RBSLs. These RBSLs were calculated using both an "equilibrium partitioning" (also called soil/water partitioning [USEPA 1996a]) and a "leach test" methodology, as described in **Appendix B**. For each COPC, the soil screening level corresponding to the more realistic of the two calculation methods is used as a soil

migration-to-groundwater screening level. Soil migration-to-groundwater RBSLs were calculated using the target groundwater concentrations based on groundwater RBSLs for the following scenarios:

- Routine worker exposure to COPCs in groundwater via volatilization to outdoor air and vapor intrusion
- Construction worker exposure to COPCs in groundwater via direct contact
- Off-facility resident exposure to COPCs in groundwater via vapor intrusion
- Off-facility receptor exposure to COPCs in groundwater via nonpotable groundwater use

Because the groundwater migration to surface water screening levels are not entirely human health based, estimates of cancer risk and HI are not calculated to evaluate this exposure scenario. Instead, soil concentrations that could result in exceedances of the groundwater migration to surface water RBSLs are identified.

The target groundwater concentrations are presented in **Appendix B**, **Attachment 4**.

5.1.4 Exposure Factors

In this risk assessment, standard default exposure factors[9] recommended by PADEP and USEPA for estimating RME are used where available and appropriate. Where standard default exposure factors are not available or appropriate for an exposure scenario, the evaluation was conducted using exposure factors that are based on site-specific considerations and professional judgment. The standard default exposure factors are conservative assumptions about the magnitude, frequency, and duration of exposures, which, in combination, are intended to provide estimates of exposures that are higher than actual exposures to a large portion (90 to 99 percent) of a potentially exposed population.

5.1.4.1 Routine Workers

In this risk assessment, potential exposure of routine workers to constituents in soil and groundwater is conservatively evaluated using the standard default exposure factors used by PADEP in deriving the Statewide Health Standards. Where PADEP has not recommended a standard default exposure factor, standard default exposure factors recommended by USEPA (1991, 2014) are used where available and appropriate.

<u>Soil Ingestion Rate</u>

The soil ingestion rate of 50 milligrams per day (mg/day) is PADEP's default value for evaluating RME in nonresidential settings (25 Pa. Code § 250.306(d)).

<u>Soil Dermal Contact Rate and Absorption</u>

The dermal contact rate is the product of the exposed skin surface area and the soil-to-skin adherence factor. The exposed skin surface area of 3,527 square centimeters per day (cm^2/day) and the soil-to-skin

[9] Because PADEP does not maintain default exposure factors for dermal contact with soil, this exposure assessment used standard default dermal contact exposure factors recommended by USEPA for evaluating RME (USEPA 2014).

adherence factor of 0.12 milligrams per square centimeter (mg/cm^2) are USEPA's recommended values for evaluating RME with soil by workers in commercial/industrial settings (USEPA 2014). The absorbed dose from dermal contact with soil is estimated by multiplying the dermal contact rate by USEPA-recommended absorption factors for absorption from soil (USEPA 2004c).

Exposure Time

Routine workers are assumed to be at the Site with the potential to inhale vapors and particulates from site-related sources for 8 hours/day. This exposure time is PADEP's (25 Pa. Code § 250.307(d)) and USEPA's recommended value for full-time workers (USEPA 2009).

Exposure Frequency

An exposure frequency of 180 days/year is used to evaluate outdoor nonresidential exposure to soil. It is also used to evaluate nonresidential exposure to vapors in outdoor air from shallow groundwater. This is PADEP's standard default value for evaluating nonresidential exposures, which assumes frozen ground for several days of the year consistent with 25 Pa. Code § 250.307(d).

An exposure frequency of 250 days/year is used to evaluate indoor nonresidential exposure to constituents from soil and shallow groundwater via vapor intrusion. This assumption is USEPA's standard default value for evaluating RME in commercial/industrial settings (USEPA 1991, 2014). It is based on a 5-day work week and 50 weeks/year.

Exposure Duration

The exposure duration of 25 years is the PADEP (25 Pa. Code § 250.307(d)) and USEPA (1991, 2014) standard value for estimating RME in commercial/industrial settings. It is the 95th percentile job tenure of workers in manufacturing.

This combination of exposure frequency and exposure duration is expected to be conservative for the amount of time that workers are actually exposed to soil during outdoor activities, as routine workers spend the majority of their time indoors. USEPA (1991, 2014) has recommended the use of these values for evaluating high-end routine worker exposures.

Body Weight

The body weight of 80 kilograms (kg) is PADEP's (25 Pa. Code § 250.307(d)) and USEPA's standard value for assessing exposure of adults (USEPA 2014).

Averaging Time

The averaging time for evaluating cancer risk is equal to a lifetime of 70 years, and the averaging time for evaluating noncancer risk is equal to the exposure duration (USEPA 1989).

5.1.4.2 Maintenance Workers

The exposure factors used for evaluating potential exposure of maintenance workers to soil and groundwater are as follows:

Soil Ingestion Rate

The ingestion rate of 100 mg/day is USEPA's recommended soil ingestion rate for outdoor workers engaged in high-intensity soil contact activities such as repairing underground utilities, repairing roadways or performing landscaping activities (USEPA 2002). This soil ingestion rate is proposed by USEPA to reflect increased ingestion exposures experienced by workers during landscaping or other soil disturbing activities.

Soil Dermal Contact Rate and Absorption

The dermal contact rate is the product of the exposed skin surface area and soil-to-skin adherence factor. The exposed skin surface area of 3,527 cm^2/day and the soil-to-skin adherence factor of 0.12 mg/cm^2 are USEPA's recommended values for evaluating RME in commercial/industrial settings (USEPA 2014). The exposed skin surface area is based on the weighted average of mean values for head, hands, and forearms.

Soil Exposure Frequency

The exposure frequency of 30 days/year is based on professional judgment regarding the number of days per year of maintenance activities involving soil contact. It is the number of workdays in 6 weeks of such activities, which is an estimate of the time needed to complete occasional subsurface maintenance activities. This exposure frequency is also consistent with a high-end exposure frequency expected for individuals charged with performing landscaping activities at the Site throughout a year (e.g., one day a week, every two weeks or about 26 days/year).

Inhalation Exposure Time

Maintenance workers are assumed to be at the Site with the potential to inhale vapors and particulates from site-related sources for 8 hours/day, the PADEP (25 Pa. Code § 250.307(d)) and USEPA recommended value for full-time workers (USEPA 2009).

Groundwater Ingestion

The incidental groundwater ingestion rate is the product of the hourly ingestion rate and exposure time. The ingestion rate of 0.005 liters per hour is one-tenth of USEPA's recommended value for incidental ingestion while swimming (USEPA 1989) and represents a very conservative estimate of incidental groundwater ingestion that could occur while workers are in an excavation pit. The exposure time of 2 hours per day for contact with groundwater or surface water during maintenance activities is based on professional judgment.

Groundwater Dermal Contact

The exposed skin surface area of 3,527 cm^2 is based on the USEPA-recommended exposed skin surface area for evaluating high-end contact with soil by workers in industrial settings (USEPA 2014). Workers are conservatively assumed to be covered with groundwater over this exposed skin surface area for 2 hours per event. The chemical-specific permeability coefficient (K_p) for dermal absorption from groundwater is estimated following USEPA guidance (USEPA 1992, USEPA 2004c).

Groundwater Exposure Frequency

The exposure frequency of 15 days per year assumes that the maintenance work involves excavations that encounter groundwater for 5 days per week for 3 weeks per year, based on professional judgment. These exposure frequencies are expected to be conservative for the amount of time that workers are actually exposed to soil or groundwater (as opposed to the total time for maintenance or construction, which typically includes time not associated with excavation).

Groundwater Vapor Inhalation Exposure Time

Maintenance workers are assumed to be exposed to vapors from groundwater 2 hours per day while performing maintenance activities in groundwater, based on professional judgment.

Exposure Duration

An exposure duration of 10 years is used for maintenance worker exposure to soil or groundwater. The exposure duration of 10 years is supported by the analysis of Burmaster (2000), using data from the Bureau of Labor Statistics through February 1996, which indicated that 95th and 90th percentile job tenure of workers in construction is approximately 12.48 years and 7.7 years, respectively. The duration of 10 years is longer than the length of time that workers typically work in an occupation (USEPA 2014).

Body Weight

The body weight of 80 kg is PADEP's (25 Pa. Code § 250.307(d)) and USEPA's standard value for assessing exposure of adults (USEPA 2014).

Averaging Time

The averaging time for evaluating cancer risk is equal to a lifetime of 70 years, and the averaging time for evaluating noncancer HI is equal to the exposure duration (USEPA 1989).

5.1.4.3 Construction Workers

The exposure factors used for evaluating potential exposure of construction workers to soil and groundwater are as follows:

Soil Ingestion Rate

The ingestion rate of 200 mg/day is the 90th percentile from the adult soil ingestion study published by Stanek et al. (1997). It is more appropriate than the 95th percentile (330 mg/day) from the same study, because in a study of only 10 adults, the 95th percentile is at or beyond the highest observed ingestion rate and, as such, has far more uncertainty than the 90th percentile. Using the 90th percentile is also consistent with USEPA and PADEP guidance on selecting exposure factors for estimating the RME.

Soil Dermal Contact Rate and Absorption

The dermal contact rate is the product of the exposed skin surface area and soil-to-skin adherence factor. The exposed skin surface area of 3,527 cm^2/day and the soil-to-skin adherence factor of 0.12 mg/cm^2 are USEPA's recommended values for evaluating RME in commercial/industrial settings

(USEPA 2014). The exposed skin surface area is based on the weighted average of mean values for head, hands, and forearms.

Soil Exposure Frequency

The exposure frequency of 250 days/year is based on professional judgment regarding the number of days of soil excavation or other high-intensity soil contact activities. This exposure frequency is expected to overestimate the amount of time that workers are actually exposed to soil in excavations or during other high-intensity soil contact activities (as opposed to the total time for construction, which typically includes time not associated with high-intensity soil contact activities). It is based on a 5-day work week and 50 weeks per year.

Inhalation Exposure Time

Construction workers are assumed to be at the Site with the potential to inhale vapors and particulates from site-related sources for 8 hours/day, the PADEP (25 Pa. Code § 250.307(d)) and USEPA recommended value for full-time workers (USEPA 2009).

Groundwater Ingestion

The incidental groundwater ingestion rate is the product of the hourly ingestion rate and exposure time. The ingestion rate of 0.005 liters per hour is one-tenth of USEPA's recommended value for incidental ingestion while swimming (USEPA 1989) and represents a very conservative estimate of incidental groundwater ingestion that could occur while workers are in an excavation pit. The exposure time of 2 hours per day for contact with groundwater during construction activities is based on professional judgment.

Groundwater Dermal Contact

The exposed skin surface area of 3,527 cm^2 is based on the USEPA-recommended exposed skin surface area for evaluating high-end contact with soil by workers in industrial settings (USEPA 2014). Workers are conservatively assumed to be covered with groundwater over this exposed skin surface area for 2 hours per event. K_p for dermal absorption from groundwater is estimated following USEPA guidance (USEPA 1992, USEPA 2004c).

Groundwater Exposure Frequency

The exposure frequency of 15 days per year assumes that the construction work involves excavations that encounter groundwater for 5 days per week for 3 weeks per year, based on professional judgment.

Groundwater Vapor Inhalation Exposure Time

Construction workers are assumed to be exposed to vapors from groundwater 2 hours per day while performing maintenance activities in groundwater, based on professional judgment.

Exposure Duration

The exposure duration of 1 year is based on professional judgment regarding the duration of site redevelopment activities at the Site that will involve earthmoving.

Body Weight

The body weight of 80 kg is PADEP's (25 Pa. Code § 250.307(d)) and USEPA's standard value for assessing exposure of adults (USEPA 2014).

Averaging Time

The averaging time for evaluating cancer risk is equal to a lifetime of 70 years, and the averaging time for evaluating noncancer HI is equal to the exposure duration (USEPA 1989).

5.1.4.4 Nonpotable Use

The exposure factors used for evaluating potential exposure to groundwater through a hypothetical scenario where groundwater is used to fill a backyard wading pool ("kiddie" pool) are as follows:

Exposure Frequency and Duration

The exposure frequency for the kiddie pool scenario is 96 days/year, which is based on 4 days per week for the number of months, 6 months, when the average daily temperature is above 65 degrees Fahrenheit in Philadelphia, Pennsylvania (NOAA 2018). Residents are assumed to be exposed to groundwater for 26 years (6 years as children and 20 years as adults; USEPA 2014). This combination of exposure frequency and exposure duration is expected to be conservative for the amount of time that residents would actually spend using groundwater off-facility.

Incidental Water Ingestion

The rate of 0.05 L/hour is the USEPA-recommended value for ingestion of water while swimming (USEPA 1989).

Dermal Contact Rate

The exposed skin surface areas of 6,365 cm^2 and 19,652 cm^2 are USEPA's recommended values for evaluating RME with groundwater by children and adults, respectively (USEPA 2014). Child and adult residents are assumed to wade in the pool for 2 hours per event, and one event per day, based on professional judgment. The absorbed dose for organic constituents is estimated using the nonsteady-state approach (USEPA 2004c), which is more conservative than the steady-state approach (USEPA 1989), particularly for hydrophobic constituents. The K_p for dermal absorption of organic constituents from groundwater is estimated following USEPA guidance (USEPA 2004c).

5.1.4.5 Off-Facility Residents

The exposure factors used for evaluating potential exposure of off-facility residents to on-site soil and groundwater if airborne particulates and vapor from on-site soil or airborne vapor from on-site groundwater were to migrate off-facility, are as follows:

Exposure Time

Residents are assumed to be at home with the potential to inhale vapors and particulates from site-related sources for 24 hours/day. This exposure time is PADEP's (25 Pa. Code § 250.307(d)) and USEPA's recommended value for residents (USEPA 2009).

Exposure Frequency

An exposure frequency of 250 days/year is used to evaluate outdoor residential exposure to vapors in outdoor air from site-related soil and shallow groundwater. This is PADEP's standard default value for evaluating residential exposures, which assumes frozen ground for 100 days of the year consistent with 25 Pa. Code § 250.307(d).

An exposure frequency of 350 days/year is used to evaluate indoor residential exposure to constituents from site-related shallow groundwater via vapor intrusion. This assumption is USEPA's standard default value for evaluating RME in residential settings (USEPA 1991, 2014). It is based on 7 days/week and 50 weeks/year.

Exposure Duration

The exposure duration of 26 years is USEPA's standard default value for evaluating RME in residential settings (USEPA 1991). It is the 90th percentile for time spent at one residence.

Body Weight

The body weight of 15 and 80 kg are PADEP's (25 Pa. Code § 250.307(d)) and USEPA's standard value for assessing exposure of children and adults, respectively (USEPA 2014).

Averaging Time

The averaging time for evaluating cancer risk is equal to a lifetime of 70 years, and the averaging time for evaluating noncancer risk is equal to the exposure duration (USEPA 1989).

5.2 Toxicity Assessment

In accordance with 25 Pa. Code § 250.602(c)(3), this section presents the toxicity assessment. A toxicity assessment identifies potential adverse health effects that are associated with exposure to constituents and determines the dose response relationship between exposure and the occurrence of adverse effects. The toxicity values used in this risk assessment are compiled from USEPA's hierarchy of sources (USEPA 2003), as follows:

1. Integrated Risk Information System;
2. Provisional Peer Reviewed Toxicity Values; and
3. Other Toxicity Values.

When a toxicity value is not available from the first two tiers of the hierarchy, other USEPA and non-USEPA sources (e.g., Agency for Toxic Substances and Disease Registry) of toxicity values are considered.

The toxicity values used in the risk assessment and their sources are summarized in **Appendix A**. The toxicity values used in this risk assessment are current as of January 9, 2023.

5.2.1 Cancer Toxicity Values

For constituents that USEPA assessed prior to the Guidelines for Carcinogen Risk Assessment (USEPA 2005), USEPA considers constituents belonging to the following cancer weight of evidence groups as human carcinogens:

- Group A - Known Human Carcinogen: Sufficient evidence of carcinogenicity in humans;
- Group B1 - Probable Human Carcinogen: Limited evidence of carcinogenicity in humans;
- Group B2 - Probable Human Carcinogen: Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans; and
- Group C - Possible Human Carcinogen: Limited evidence of carcinogenicity in animals and inadequate or lack of evidence in humans.

For constituents that USEPA assessed after the *Guidelines for Carcinogen Risk Assessment* (USEPA 2005), USEPA uses the following cancer weight of evidence groups:

- Carcinogenic to Humans
- Likely to be Carcinogenic to Humans
- Suggestive Evidence of Carcinogenic Potential
- Inadequate Information to Assess Carcinogenic Potential

As shown in **Appendix A**, some of the constituents in this risk assessment are not designated as Group A or as being "Carcinogenic to Humans", which means USEPA acknowledges that there is either inadequate evidence or a lack of evidence that these constituents cause cancer in humans. Therefore, evaluating these constituents as human carcinogens in the risk assessment is conservative.

Cancer slope factors (SFs) and unit risk factors (URFs) for these constituents and their sources are shown in **Appendix A**. The oral SFs and inhalation URFs represent 95 percent upper confidence bounds on the probability of getting cancer over a lifetime per unit dose. As recognized by USEPA, there is significant scientific evidence that some of the SFs and URFs may be overly conservative and may ignore the potential existence of threshold doses. Nonetheless, they are used here as assessment tools.

5.2.2 Noncancer Toxicity Values

Constituents designated by USEPA as belonging to the cancer weight-of-evidence Group D (Not Classifiable as to Human Carcinogenicity) are considered noncarcinogens. Constituents not designated as belonging to any cancer group are also treated as noncarcinogens. Chronic and subchronic reference doses (RfDs) and chronic and subchronic inhalation reference concentrations (RfCs) and their sources are shown in **Appendix A**.

The oral RfDs and inhalation RfCs represent estimates of the daily exposure to the human population, including sensitive subpopulations (e.g., children), which are likely to be without an appreciable risk of

deleterious effects during a lifetime. These RfDs and RfCs typically incorporate several safety factors to account for uncertainties in their derivation, which in combination often result in overall uncertainty factors of 1,000 or more. Furthermore, for many constituents, there is significant scientific debate about the validity of these RfDs and RfCs, and the association of these doses and concentrations to potential adverse health consequences. Nonetheless, the RfDs and RfCs are used here as conservative assessment tools.

5.2.3 Extrapolation of Toxicity Values

The USEPA sources of toxicity values listed above do not provide dermal toxicity values for any of the constituents. Therefore, oral toxicity values (i.e., oral SFs and RfDs) are used as dermal toxicity values in this risk assessment. Adjustments to the oral toxicity values, where appropriate, are made in this route-to-route extrapolation following USEPA guidance (USEPA 2004c).

The USEPA sources of toxicity values listed above do not provide inhalation toxicity values (URFs and RfCs) for all of the constituents. Route-to-route extrapolation from oral toxicity values was not performed to obtain inhalation toxicity values for these constituents, consistent with USEPA guidance on performing inhalation risk assessments (USEPA 2009).

Uncertainties introduced by using extrapolated toxicity values are discussed in Section 5.4.3.

5.3 Risk Characterization

The health significance of the potential exposures described in Section 5.1.1 is discussed in the following subsections. Section 5.3.1 describes the methods for estimating cancer risks and noncancer HIs. Section 5.3.2 discusses the risk estimates and the significance of the potential exposures for each receptor population/exposure scenario.

5.3.1 Cancer and Noncancer Risks

In accordance with 25 Pa. Code § 250.602(c)(4), this section presents the risk characterization performed to conservatively quantify the cancer risk and noncancer HI for receptors potentially exposed to COPCs in soil and groundwater at the Site.

The cancer risk associated with potential exposure to a carcinogenic constituent via ingestion and dermal contact is calculated by multiplying an estimate of the lifetime average daily dose for a particular exposure scenario by the cancer SF for the constituent as follows:

$$Risk = LADD \cdot SF$$

For the inhalation route, the cancer risk is calculated using the constituent concentration in air (C_{air}) and the URF, as follows:

$$Risk = URF \cdot C_{air} \cdot \frac{ET \cdot EF \cdot ED}{AT_c}$$

Where ET is exposure time, EF is exposure frequency, ED is exposure duration, and averaging time for carcinogens (AT_c) is the averaging time for carcinogens.

The noncancer hazard quotient (HQ) associated with potential exposure via incidental ingestion and dermal contact is calculated by dividing an estimate of the average daily dose by the RfD for the constituent as follows:

$$HQ = \frac{ADD}{RfD}$$

For the inhalation route, the HQ is calculated using C_{air} and the RfC, as follows:

$$HQ = \frac{C_{air}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT_{nc}}$$

Unit cancer risks and unit HQs are calculated for a unit constituent concentration (C_{unit}). C_{unit} is 1 milligram per kilogram (mg/kg) for soil and 1 milligram per liter for groundwater. Because risk estimates scale directly with the constituent concentration (except for cancer risk estimates at very high doses), these unit risks and unit HQs can be calculated once and used to calculate cancer and noncancer risk estimates efficiently for a large number of locations by multiplying the constituent concentrations for each location by the unit risks and unit HQs. Unit risks/HQs can also be used to derive RBSLs at a given target cancer risk level (TCRL) or target hazard quotient (THQ). The unit risks and unit HQs for all routes of exposure (incidental ingestion, dermal contact, vapor inhalation, and/or particulate inhalation) for a given receptor to constituents in a given environmental medium are conservatively summed to produce a single unit risk and unit HQ for each constituent. The cancer risk and noncancer HQ for a particular constituent *i* at a particular location are calculated as follows:

$$Risk_i = \frac{C_i \cdot UnitRisk_i}{C_{unit}}$$

$$HQ_i = \frac{C_i \cdot UnitHQ_i}{C_{unit}}$$

The media-specific cumulative cancer risk and noncancer HI from exposure to the combination of COPCs are estimated following USEPA (1989) guidance, as follows:

$$Cumulative\ Risk = \sum_i Risk_i$$

$$Hazard\ Index = \sum_i HQ_i$$

Where $Risk_i$ is the estimated cancer risk for the ith constituent and HQ_i is the HQ for the ith constituent. This approach may result in estimates of media-specific cumulative cancer risk and HI that are more conservative than necessary. For example, different COPCs may cause different and unrelated noncancer health effects, so summing the HQs for their individual effects would overestimate the significance of their combined effects. Nonetheless, this approach is used here as a conservative assessment tool.

Estimated media-specific cumulative cancer risks for each receptor population identified in **Table 3** are compared to PADEP's risk management goals established in 25 Pa. Code § 250.402(b). Specifically, cumulative cancer risks were compared to a risk of $1x10^{-4}$ while noncancer HIs are compared to an HI of 1.[10] Risk estimates equal to or below these goals represent levels which would not warrant risk management action.

In order to support site characterization decision-making, RBSLs from unit cancer risks and unit noncancer HQs are also calculated. Unit cancer risks/HQs for each route (*i*) of exposure (e.g., ingestion, dermal contact, inhalation) are used to derive RBSLs for each receptor-specific exposure scenario. RBSLs are calculated at a TCRL of $1x10^{-5}$ and a THQ of 0.1. The TCRL and THQ are used with consideration for the risk management goals established in 25 Pa. Code § 250.402(b) for attainment of the Site-Specific Standard (i.e., a cumulative excess cancer risk greater than $1x10^{-4}$ and a noncancer HI[11] greater than 1).

$$Cancer\ RBSL_i = \frac{C_{unit} \cdot TCRL}{UnitRisk_i}$$

$$Noncancer\ RBSL_i = \frac{C_{unit} \cdot THQ}{UnitHQ_i}$$

The RBSLs for each *i* are conservatively combined to give cancer and noncancer-based RBSLs as follows:

$$RBSL = \left(\sum_i RBSL_i^{-1}\right)^{-1}$$

Appendix B provides specific details on how the RBSLs for soil and groundwater were calculated using the general approach discussed above and the general assumptions provided in Sections 5.1 and 5.1.4.5.

5.3.2 Risk Characterization for Potentially Exposed Populations

The risk characterizations for routine workers, maintenance workers, construction workers, and off-facility residents are summarized in this section. The lead exposure, nonpotable groundwater use, soil migration-to-groundwater, and groundwater migration-to-surface water pathway evaluations are also presented. Further details regarding the scenarios for potential human exposure are summarized in **Table 4**.

[10] Per PADEP's request, cumulative cancer risks and noncancer HIs greater than $1.0x10^{-4}$ and 1.0 respectively, have also been identified as potentially warranting risk management. While this approach has been used in support of this project, it is Terraphase's position that USEPA's risk assessment and risk management guidance, as well as PA's regulations and guidance indicate that rounding risk estimates to one significant figure is appropriate. Presenting risk characterization results with one significant figure is standard practice, and we are not aware of any scientific basis that would justify presenting the risk characterization results with more than one significant figure. As USEPA (2004b) noted, doing so would imply a level of precision that cannot be justified.

[11] As estimated from exposure to constituents with the same target organ or target effect.

5.3.2.1 Routine Workers

Soil Contact and Soil Vapor Intrusion

As discussed in Section 5.1.1, routine workers could be exposed to soil in unpaved or uncovered areas during time spent outdoors. Routine workers could also be exposed to constituents in soil via inhalation of constituents if they were to volatilize into the outdoor air or migrate through cracks in the building foundation into indoor air. This section presents the results of risk calculations performed to characterize the risks associated with these exposures.

Potential exposure of routine workers to COPCs in soil is evaluated in this risk assessment by assuming the following two alternate hypothetical future cases:

(1) All soil at the Site is uncovered and workers are assumed to be exposed to COPCs in soil while outdoors for the entire work-day through incidental ingestion, dermal contact, and inhalation of particulates and vapors in outdoor air, or

(2) the soil is under an occupied generic commercial building to be constructed in the future, and workers are assumed to be exposed to COPCs in the soil via inhalation of vapor in indoor air (vapor intrusion) for the entire work-day.

Calculating risks for these alternate hypothetical cases is conservative and efficient because it avoids the need to prorate the portion of the day spent indoors and/or outdoors, and risk estimates for any combination of indoor and outdoor time periods would not exceed the higher of the risk estimates for the two alternative hypothetical cases.

Potential exposures for each hypothetical future case are evaluated by calculating upper-bound estimates of cumulative cancer risk and HIs to streamline the risk assessment. These estimates are calculated using the highest observed concentrations for all constituents detected in soil regardless of depth. These estimates are conservative upper-bound estimates because the site-related risks for an area would be lower if they were calculated using: (1) concentrations representative of the average concentrations to which receptors would be exposed at the area; and (2) site-specific exposure factors that account for the magnitude, frequency, and duration of exposures appropriate for the area.

The upper-bound estimates of cumulative cancer risk and HI for potential future exposure of routine workers for each alternate hypothetical case (i.e., all-day exposure to COPCs in soil during outdoor activities or all-day exposure to soil COPCs via vapor intrusion) are presented in **Table 5**.

Outdoor Direct Contact Exposure to Soil

As shown in **Table 5**, for the hypothetical case of a routine worker exposed to COPCs in soil during outdoor activities, the upper-bound cumulative cancer risk ($4x10^{-6}$) and noncancer HI (0.2) estimates are below PADEP's cumulative cancer and noncancer HI risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential routine worker exposure to COPCs in soil via direct contact while outdoors would not result in unacceptable risk.

Vapor Intrusion Exposure from Soil (into a Future Nonresidential Building)

As also shown in **Table 5**, for the hypothetical case of a routine worker exposed to COPCs in soil via vapor intrusion, the upper-bound cumulative cancer risk ($2x10^{-4}$) and noncancer HI (30) estimates are greater than PADEP's cumulative cancer and noncancer HI risk management goals of $1x10^{-4}$ and 1, respectively. As shown in **Appendix A**, **Attachment 8**, the unacceptable upper-bound cumulative cancer risk estimate is predominantly driven by benzene and naphthalene. The potentially unacceptable upper-bound HI is predominantly driven by benzene, cumene, ethyl benzene, 124-TMB, 135-TMB, xylenes (total), and naphthalene.

To support and guide risk management decisions (e.g., further sampling, further assessment, vapor mitigation, remediation, etc.), upper-bound estimates of cumulative cancer risk and HIs were also calculated on a point-by-point basis, using the highest observed concentrations for all COPCs from any depth at each location. As discussed in Section 5.1.2.1, where a COPC is non-detect at a location but detected within the specific exposure media at the Site, ½ the analytical limit at the location was used.

As shown on **Table 6** and **Figure 6**, 12 soil sample locations (i.e., PB-826-14, PB-826-15, PB-840-09, PB-847-15, PB-848-04, PB-848-06, PB-848-15, PB-881-10, PB-882-16, PB-884-09, PB-884-15 and PB-884-25) exhibited a cancer risk estimate or noncancer HI estimate greater than the risk management goal. Based upon this risk characterization, further considerations for risk management action due to routine worker vapor intrusion exposure to COPCs in soil (i.e., benzene, cumene, ethyl benzene, 124-TMB, 135-TMB, xylenes (total), and naphthalene) at these locations would be warranted.[12]

<u>Groundwater Vapor Intrusion Exposure (into a Future Nonresidential building)</u>

Routine workers could be exposed to COPCs in shallow groundwater to the extent that such COPCs volatilize and migrate through cracks in future building foundations into indoor air.

The cumulative cancer risk and noncancer HI estimates for routine worker exposure to groundwater via vapor intrusion are calculated using the highest observed concentrations for all constituents detected in groundwater.

As shown in **Table 7**, for the hypothetical case of a routine worker exposed to COPCs in groundwater via vapor intrusion, the upper-bound cumulative cancer risk ($1x10^{-6}$) and noncancer HI ($2x10^{-2}$) estimates are below PADEP's cumulative cancer and noncancer HI risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential routine worker exposure indoors to COPCs in groundwater via vapor intrusion would not result in unacceptable risk.

[12] With a generic building size of 10m x 10m (~ 33 ft x 33 ft), the soil boring spacing in Tank Group 04 doesn't allow refinement of the exposure concentration used in the soil vapor intrusion risk estimates (i.e., through the calculation of average soil concentrations under a hypothetical building footprint) as recommended by PADEP guidance. Therefore, the risk estimate for the soil vapor intrusion pathway is conservatively based on the maximum soil concentration in each boring.

Groundwater Volatilization to Outdoor Air Exposure

Routine workers could be exposed to COPCs in shallow groundwater to the extent that such COPCs volatilize and migrate into outdoor air. As shown in **Table 7**, the upper-bound cumulative cancer risk ($9x10^{-9}$) and noncancer HI ($1x10^{-4}$) estimates are below PADEP's cumulative cancer and noncancer HI risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential routine worker exposure to COPCs in groundwater via volatilization to outdoor air would not result in unacceptable risk.

5.3.2.2 Maintenance Workers

Outdoor Direct Contact Exposure to Soil

As discussed in Section 5.1.1, maintenance workers could be exposed to COPCs in soil in the future during regular maintenance activities (e.g., landscaping, underground utility repairs, etc.) following site redevelopment activities. This section presents the results of risk calculations performed to characterize the risks associated with these exposures.

Potential exposures are evaluated by calculating upper-bound estimates of cumulative cancer risk and HIs to streamline the risk assessment. These estimates are calculated using the highest observed concentrations for all constituents detected in soil regardless of depth.

The upper-bound estimates of cumulative cancer risk and HI for potential exposure of maintenance workers to soil are summarized on **Table 5**. As shown, the upper-bound estimates of cumulative cancer risk ($4x10^{-7}$) and noncancer HI (0.07) are below the risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential maintenance worker exposure to COPCs in soil would not result in unacceptable risk.

Outdoor Direct Contact Exposure to Groundwater

Maintenance workers could be directly exposed to COPCs in shallow groundwater during occasional subsurface maintenance or excavation activities that encounter groundwater. Exposure to groundwater could include incidental ingestion, dermal contact, and inhalation of vapors in outdoor air.

As shown in **Table 7**, for the hypothetical case of a maintenance worker exposed to COPCs in groundwater via direct contact, the upper-bound cumulative cancer risk is $1x10^{-6}$ and the noncancer HI is $5x10^{-2}$, below the risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential maintenance worker exposure to COPCs in groundwater via direct contact would not result in unacceptable risk.

5.3.2.3 Construction Workers

Outdoor Direct Contact Exposure to Soil

As discussed in Section 5.1.1, construction workers could be exposed to soil in the future during site redevelopment activities. This section presents the results of risk calculations performed to characterize the risks associated with these exposures.

Potential exposures are evaluated by calculating upper-bound estimates of cumulative cancer risk and HIs to streamline the risk assessment. These estimates are calculated using the highest observed concentrations for all constituents detected in soil regardless of depth.

The upper-bound estimates of cumulative cancer risk and HI for potential exposure of construction workers to soil are summarized on **Table 5**. As shown, the upper-bound estimates of cumulative cancer risk ($1x10^{-6}$) and noncancer HI (0.9) are below the risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential construction worker exposure to COPCs in soil would not result in unacceptable risk.

Outdoor Direct Contact Exposure to Groundwater

During redevelopment or site construction activities that encounter groundwater, construction workers could be directly exposed to COPCs in shallow groundwater via incidental ingestion, dermal contact, and inhalation of vapors in outdoor air.

As shown in **Table 7**, for the hypothetical case of a maintenance worker exposed to COPCs in groundwater via direct contact, the upper-bound cumulative cancer risk is $1x10^{-7}$ and the noncancer HI is $2x10^{-2}$, below the risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential construction worker exposure to COPCs in groundwater via direct contact would not result in unacceptable risk.

5.3.2.4 Off-Facility Resident

Outdoor Direct Contact Exposure to Soil

As discussed in Section 5.1.1, off-facility residents could be exposed to on-site soil if airborne particulates and vapor from on-site soil were to migrate off the Facility. Potential exposures are evaluated by calculating upper-bound estimates of cumulative cancer risk and HIs to streamline the risk assessment. These estimates are calculated using the highest observed concentrations for all constituents detected in soil regardless of depth.

As shown in **Table 5**, for the hypothetical case of off-facility residential inhalation exposure to COPCs in airborne particulates and vapor from on-site soil, the upper-bound cumulative cancer risk ($7x10^{-6}$) and noncancer HI (0.7) estimates are below PADEP's cumulative cancer and noncancer HI risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential off-facility resident exposure to COPCs in soil via direct contact while outdoors would not result in unacceptable risk.

Groundwater Vapor Intrusion Exposure (into a Future Residential Building)

Off-facility residents could be exposed to COPCs in shallow groundwater that migrate off-facility and to the extent that such COPCs volatilize and migrate through cracks in future building foundations into indoor air. The cumulative cancer risk and noncancer HI estimates for off-facility resident exposure to groundwater via vapor intrusion are calculated using the highest observed concentrations for all constituents detected in groundwater.

As shown in **Table 7**, for the hypothetical case of an off-facility resident exposed indoors to COPCs in groundwater via vapor intrusion, the upper-bound cumulative cancer risk ($2x10^{-5}$) and noncancer

HI (0.3) estimates are below PADEP's cumulative cancer and noncancer HI risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential off-facility resident exposure indoors to COPCs in groundwater via vapor intrusion would not result in unacceptable risk.

Groundwater Volatilization to Outdoor Air Exposure

Off-facility residents could be exposed to COPCs in shallow groundwater to the extent that such COPCs volatilize and migrate into outdoor air. As shown in **Table 7**, the upper-bound cumulative cancer risk ($4x10^{-8}$) and noncancer HI ($5x10^{-4}$) estimates are below PADEP's cumulative cancer and noncancer HI risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential off-facility resident exposure to COPCs in groundwater via volatilization to outdoor air would not result in unacceptable risk.

5.3.2.5 Nonpotable Groundwater Use

Potential exposures to COPCs in groundwater via nonpotable groundwater use are evaluated using a hypothetical scenario where groundwater is used to fill a backyard wading pool ("kiddie" pool), described in **Appendix A**. This scenario represents a reasonable worst case exposure scenario in which the estimated exposure is expected to be higher than those associated with other nonpotable uses (e.g., watering lawns, washing cars). Potential routes of exposure in this scenario include incidental ingestion, dermal contact, and inhalation of vapors.

The cumulative cancer risk and noncancer HI estimates for receptor exposure to groundwater via nonpotable use are calculated using the highest observed concentrations for all constituents detected in groundwater.

As shown in **Table 7**, for exposure to COPCs in groundwater via nonpotable use, the upper-bound cumulative cancer risk ($2x10^{-5}$) and noncancer HI (0.1) estimates are equal to or below the risk management goals of $1x10^{-4}$ and 1, respectively. Therefore, potential exposure of off-facility receptors to COPCs in off-facility groundwater via nonpotable groundwater use would not result in unacceptable risk.

5.3.2.6 Soil Migration-to-Groundwater Pathway

In order to evaluate the potential for subsurface soil to leach unacceptable concentrations to groundwater in the future, RBSLs were developed in accordance with the methodologies described in USEPA's (1996b) Soil Screening Guidance: User's Guide. Additional details describing the derivation of these screening levels are presented in Section 0. Upper-bound cancer risk and noncancer HI estimates were calculated by scaling off of the soil migration-to-groundwater RBSLs.

Soil migration-to-groundwater cumulative cancer risk and HI estimates were calculated for the following scenarios:

- Routine worker exposure to COPCs in groundwater via volatilization to outdoor air and vapor intrusion
- Construction worker exposure to COPCs in groundwater via direct contact
- Off-facility resident exposure to COPCs in groundwater via vapor intrusion
- Off-facility receptor exposure to COPCs in groundwater via nonpotable groundwater use

As shown in **Table 5**, the upper-bound cumulative cancer risk and HI estimate for each of these scenarios are below the risk management goals of $1x10^{-4}$ and 1, respectively. The upper-bound cumulative cancer risk and HI estimate for soil migration-to-groundwater protective of nonpotable groundwater use are $1x10^{-6}$ and 0.03, respectively. The upper-bound cumulative cancer risk and HI estimates for soil migration-to-groundwater protective of routine worker groundwater exposure via volatilization to outdoor air are not calculated due to non-detect data or lack of a screening level. The upper-bound cumulative cancer risk and HI estimates for soil migration-to-groundwater protective of routine worker groundwater exposure via vapor intrusion are $4x10^{-8}$ and 0.003, respectively. The upper-bound cumulative cancer risk and HI estimates for soil migration-to-groundwater protective of construction worker exposure to COPCs in groundwater via direct contact are $4x10^{-9}$ and 0.009, respectively. The upper-bound cumulative cancer risk and HI estimates for soil migration-to-groundwater protective of off-facility resident exposure to COPCs in groundwater via vapor intrusion are $2x10^{-6}$ and 0.1.

Therefore, potential soil migration-to-groundwater would not result in unacceptable risk.

5.3.2.7 Groundwater Migration-to-Surface Water Pathway

In order to evaluate the potential for COPCs observed in groundwater in the area to adversely impact surface water in the future as a result of groundwater migration and discharge to surface water, COPC concentrations observed in the source area wells installed by Philadelphia Energy Solutions Refining and Marketing LLC were compared to the RBSLs developed for this pathway (**Appendix B**).

As shown in **Table 3**, the concentrations for COPCs detected in groundwater do not exceed the MtSW screening level. As a result, COPCs in groundwater are at concentrations that do not pose an unacceptable risk to receptors via migration to surface water.

5.3.2.8 Exposure to Lead in Soil

Exposure of routine workers, maintenance workers, and construction workers to lead in soil during outdoor activities is evaluated using a screening level of 2,520 mg/kg. This screening level is calculated following USEPA guidance (USEPA 2003), including updates (USEPA 2009, 2017a). The derivation of the industrial soil screening level is presented in **Appendix B**. As shown on **Table 2**, the concentrations of lead in soil range from 1 mg/kg to 3,200 mg/kg and are all below the RBSL. The concentration of lead at one location (3,200 mg/kg at PB-848-07) is greater than the screening level of 2,520 mg/kg. However, as shown on **Table 2**, the average lead concentration across Tank Group 04 is 45 mg/kg[13], below the screening level of 2,520 mg/kg. Therefore, potential worker exposure to lead concentrations in soil at the Site would not result in unacceptable risk.

[13] The lead exposure concentration is an estimate of the arithmetic mean lead concentration in soil across Tank Group 04, calculated in accordance with 40 CFR Part 745 (Federal Register Volume 66, No. 4, January 5, 2001).

5.4 Uncertainty Analysis

While the Risk Assessment is conducted in accordance with PADEP and USEPA guidance, there may be some uncertainties associated with certain aspects of the risk assessment process. In general, the methods and assumptions used to complete the Risk Assessment are very conservative by design to account for such uncertainties. This section discusses potential uncertainties in the risk characterization and the potential impact (or lack thereof) such uncertainties could have on risk management decision-making.

5.4.1 Exposure Concentrations

The exposure concentrations in this risk assessment are entirely based on the highest concentrations of COPCs detected in soil and groundwater. This streamlines the risk assessment by avoiding the calculation of refinements that would not materially change the risk assessment conclusions, the need for risk management action, or require additional sampling/characterization to support the refinements. However, this approach likely overestimates the cumulative cancer risk and noncancer HI estimates because these estimates are based on maximum detected concentrations. The use of maximum detected concentrations introduces more conservatism than necessary for estimates because it assumes simultaneous worst-case exposure. The overestimation of exposure concentrations results in risk and HI estimates that are closer to, or in excess of, PADEP's risk management goals than they would be if refinements were used.

Most exposure concentrations that are based on mathematical modeling of constituent transfer from soil or groundwater to air are conservative for the same reasons discussed above, since the model estimates are predominantly based on the use of maximum detected concentrations in soil or groundwater. In addition, some model estimates are conservative because they do not account for the reduction of constituent concentration or mass in the soil or groundwater as constituents transfer from these media. Even for models that account for reduction of mass in the soil (e.g., Jury model), risk calculations for ingestion and dermal contact with soil assume soil concentrations remain constant, which is consistent with USEPA and PADEP practice but contradicts the mass conservation principle. As a result, risk estimates that are based on the sum of risk estimates from soil and soil vapor/particulates are more conservative than necessary for estimates. These include almost all of the risk estimates discussed in Section 5.3.2.

Another factor that contributes to the likely overestimation of exposure concentrations is the assumption that the COPCs are entirely site-related. The concentrations of all constituents are assumed to be site-related in this risk assessment because the field investigation did not quantify site-specific background levels (i.e., concentrations not associated with a release from the Site, for example, fill-related constituent concentrations).

Considering all these factors, the exposure concentrations used in this risk assessment are more conservative than necessary for estimates and therefore likely result in an overestimation of risk and/or hazard.

5.4.2 Exposure Factors

As discussed in Section 5.1.4, most of the exposure factors used in the risk assessment are high-end (i.e., 90th to 95th percentile) estimates of the magnitude, frequency, and duration of potential exposures. When several such high-end factors are multiplied, the resulting estimates of dose will be higher than the 90th percentile of the distribution of exposures in the potentially exposed population and could be higher than the exposure to the maximally exposed individual, particularly when such exposure factors are combined with exposure concentrations that are based on maximum detected concentrations (as discussed above). The use of upper-bound exposure factors is likely to result in an overestimate of potential risks and/or hazards.

5.4.3 Extrapolated Toxicity Values

As discussed in Section 5.1.4.5, the dermal toxicity values used in the risk assessment are oral toxicity values that were extrapolated to the dermal route without constituent-specific judgment regarding whether such extrapolation might be appropriate for a particular constituent. This is consistent with USEPA guidance (2004c) and is a conservative approach to ensure that potential risk via the dermal route is not overlooked. However, some constituents might exhibit different degrees of toxicity for the dermal route relative to the oral route. For such constituents, the extrapolation approach used in the risk evaluation could introduce uncertainty.

5.4.4 Risk Characterization

The summation of cancer risks and HQs for multiple COPCs is based upon USEPA guidance (1989) to assume dose additivity, which means that constituents in a mixture are assumed to have no synergistic or antagonistic interactions and each constituent has the same mode of action and elicits the same health effects. In general, this approach can introduce significant uncertainty with the over- or underestimation of risk and/or hazard. However, because only a few constituents contribute to the cumulative risk and HI estimates, the impact of this uncertainty on the outcome of the risk assessment is likely to be minimal.

5.5 Summary

This report documents the methodology and results of a site-specific human health risk assessment performed to support a demonstration that conditions at Tank Group 04 meet the tank closure performance standard in accordance with Act 32. The potential risks are characterized based upon the RME under the current and reasonably anticipated future land and groundwater uses at and around the Site. The scope of the human health risk assessment calculations is summarized by the scenarios for potential human exposure as shown on **Table 4**. All soil and groundwater data collected in accordance with the Work Plan and SAP were considered in this Risk Assessment.

Tables 5 through **7** present the results of the soil and groundwater risk calculations and which exposure scenarios would present an unacceptable risk and would warrant risk management action. Likewise, **Figure 6** presents the spatial distribution of potentially unacceptable risks for soil, and the general

locations where risk management action would be warranted due to unacceptable risks/HIs for specific exposure scenarios.

As presented on **Table 5**, locations with soil COPC concentrations that could result in cumulative cancer risk or HI estimates above the risk management goal for potential routine workers via vapor intrusion from soil include PB-826-14, PB-826-15, PB-840-09, PB-847-15, PB-848-04, PB-848-06, PB-848-15, PB-881-10, PB-882-16, PB-884-09, PB-884-15 and PB-884-25. These unacceptable cancer risk and HI estimates are predominately driven by benzene, cumene, ethyl benzene, 124-TMB, 135-TMB, xylenes (total), and naphthalene. However, as discussed in Section 3.1 of the Report, exposure to soil via vapor intrusion is evaluated in this Risk Assessment but risk management will be addressed following additional characterization/evaluation and eventually through pathway elimination.

Aside from soil vapor intrusion exposure, the results of the site-specific risk assessment demonstrate that COPC concentrations in soil or groundwater in the area do not pose an unacceptable risk to human health or the environment and do not warrant remedial action.

6 Site-Specific Remediation Standards

As discussed in Section 5.3, the Risk Assessment identifies potentially unacceptable risk/HI to routine workers (via vapor intrusion) from exposure to constituents of concerns (COCs) in soil via vapor intrusion in the area of Tank Group 04. The potentially unacceptable risk/HI from exposure to soil in the area is driven by the following COCs:

- Benzene
- Cumene
- Ethyl Benzene
- 124-TMB
- 135-TMB
- Xylenes (total)
- Naphthalene

No unacceptable risk/HI to routine workers, maintenance workers, construction workers, or off-facility residents from exposure to COPCs in groundwater were identified in the area of Tank Group 04.

As discussed in Section 7.3.3 of the Report, potentially unacceptable vapor intrusion exposures will be managed separately following additional characterization/evaluation and eventually through pathway elimination.

7 Summary and Conclusions

This Risk Assessment was prepared in support of the *Site Characterization Report* for Tank Group 04 to document the methodology and results of a site-specific human health risk assessment performed in accordance with 25 Pa. Code § 250.409, to support a demonstration that conditions at the Site meet the tank closure performance standard in accordance with Act 32.

As discussed in Section 3, based on the review of the soil and groundwater concentrations in comparison to the RBSLs and the spatial distribution of concentrations greater than these levels, the soil and groundwater sampling performed adequately defines the horizontal and vertical extent of COPCs to support a site-specific risk assessment.

Using soil and groundwater data collected in accordance with the Work Plan and SAP and the methodologies as described in Section 5, cumulative cancer risk and noncancer HI estimates for the exposure of current and reasonably anticipated future receptor populations to COPCs in soil and groundwater were calculated. Cumulative cancer risk and noncancer HI estimates for the exposure of routine workers to COC in soil via vapor intrusion represent the only exposure scenario resulting in cumulative cancer risk/HI greater than the risk management goals used by PADEP.

The risk assessment demonstrates that, aside from vapor intrusion exposure which is expected to be managed separately following additional characterization/evaluation and eventually through pathway elimination, COPC concentrations in the area do not pose an unacceptable risk to human health or the environment and do not warrant remedial action.

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7 Upper-Bound Cumulative Cancer Risk and Noncancer Hazard Index (HI) for Receptor Exposure to Groundwater

Table 1
Chemicals of Potential Concern
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Detected in Soil	Detected in Groundwater
VOC	Benzene	71-43-2	Y	Y
VOC	Cumene	98-82-8	Y	Y
VOC	1,2-Dibromoethane	106-93-4	N	N
VOC	1,2-Dichloroethane	107-06-2	N	N
VOC	Ethyl Benzene	100-41-4	Y	Y
VOC	Methyl tert-butyl ether	1634-04-4	Y	N
VOC	Toluene	108-88-3	Y	Y
VOC	1,2,4-Trimethylbenzene	95-63-6	Y	Y
VOC	1,3,5-Trimethylbenzene	108-67-8	Y	Y
VOC	Xylenes (total)	1330-20-7	Y	Y
SVOC	Anthracene	120-12-7	Y	Y
SVOC	Benzo(a)anthracene	56-55-3	Y	Y
SVOC	Benzo(a)pyrene	50-32-8	Y	N
SVOC	Benzo(b)fluoranthene	205-99-2	Y	N
SVOC	Benzo(g,h,i)perylene	191-24-2	Y	N
SVOC	Chrysene	218-01-9	Y	N
SVOC	Fluorene	86-73-7	Y	Y
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	Y	N
SVOC	Naphthalene	91-20-3	Y	Y
SVOC	Phenanthrene	85-01-8	Y	Y
SVOC	Pyrene	129-00-0	Y	Y
INORG	Lead	7439-92-1	Y	N

Notes:
Y - Detected.
N - Not Detected.

Table 2
Soil Results Compared to Risk-Based Screening Levels
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Chem Group	Chemical	CASRN	Analyzed	Detected	Min Detected (mg/kg)	Mean Detected (mg/kg)	Max Detected (mg/kg)	Routine Worker Direct Contact (mg/kg)	Ratio of Max Detect to Routine Worker Direct Contact	Routine Worker Vapor Intrusion (mg/kg)	Ratio of Max Detect to Routine Worker Vapor Intrusion	Construction Worker Direct Contact (mg/kg)	Ratio of Max Detect to Construction Worker Direct Contact	Soil Migration to Groundwater Screening Level (mg/kg)	Ratio of Max Detect to Soil Migration to Groundwater
VOC	Benzene	71-43-2	267	61	0.00019	0.34	7.1	63	0.11	0.46	**15**	8.7	0.82	98	0.072
VOC	Cumene	98-82-8	267	80	0.00010	0.65	15	1000	0.015	6.1	**2.5**	87	0.17	1000	0.015
VOC	Ethyl Benzene	100-41-4	267	50	0.00014	2.7	66	2300	0.029	15	**4.4**	1300	0.051	820	0.080
VOC	Methyl tert-butyl ether	1634-04-4	267	30	0.00026	0.0028	0.020	2400	0.0000083	16	0.0013	390	0.00005	5900	0.0000034
VOC	Toluene	108-88-3	263	19	0.00069	2.0	15	8000	0.0019	76	0.20	650	0.023	9800	0.0015
VOC	1,2,4-Trimethylbenzene	95-63-6	267	58	0.00034	5.1	92	180	0.51	0.92	**100**	70	**1.3**	250	0.37
VOC	1,3,5-Trimethylbenzene	108-67-8	267	59	0.00025	1.6	33	220	0.15	0.92	**36**	99	0.33	240	0.14
VOC	Xylenes (total)	1330-20-7	267	54	0.00090	8.3	200	240	0.82	1.5	**130**	51	**3.9**	340	0.58
SVOC	Anthracene	120-12-7	263	29	0.00075	0.30	3.7	46000	0.000080			46000	0.000080		
SVOC	Benzo(a)anthracene	56-55-3	263	54	0.00094	0.19	4.5	430	0.010			3200	0.0014		
SVOC	Benzo(a)pyrene	50-32-8	263	31	0.0020	0.36	7.2	43	0.17			7.7	0.94		
SVOC	Benzo(b)fluoranthene	205-99-2	263	42	0.00078	0.23	4.4	430	0.010			3200	0.0014		
SVOC	Benzo(g,h,i)perylene	191-24-2	263	36	0.0020	0.21	5.2	4600	0.0011			14000	0.00037		
SVOC	Chrysene	218-01-9	263	59	0.00066	0.22	4.4	43000	0.00010			320000	0.000014		
SVOC	Fluorene	86-73-7	263	49	0.015	0.73	14	6200	0.0023			18000	0.00078		
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	9	6	0.031	0.070	0.11	430	0.00026			3200	0.000034		
SVOC	Naphthalene	91-20-3	267	56	0.0094	1.0	9.3	41	0.23	0.54	**17**	6.0	**1.6**	27	0.34
SVOC	Phenanthrene	85-01-8	263	74	0.00093	1.1	29	4600	0.0063			14000	0.0021		
SVOC	Pyrene	129-00-0	263	71	0.0014	0.20	2.9	4600	0.00063			14000	0.00021		
INORG	Lead	7439-92-1	267	266	1.0	45	3200	2520	**1.3**			2520	**1.3**	45000	0.071

Notes:
Only constituents detected are shown.
Blank cells in the RBSL columns indicate that an RBSL was not calculated due to inadequate toxicity, low volatility, lack of published surface water criteria or, in the case of soil migration-to-groundwater, the target groundwater concentration times the DAF is greater than the constituent's solubility.
The concentrations for the Xylene isomers (m/p and o) were summed before comparing to the criteria for Xylenes (total).
Ratios of concentration to the RBSLs greater than 1 are shaded in bold.
Chem Group - chemical group; VOC - volatile organic compounds; SVOC - semi-volatile organic compounds; INORG - metals

Table 3
Unconfined Groundwater Results Compared to Risk-Based Screening Levels
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Dataset	Chem Group	Chemical	CASRN	Meas Basis	Analyzed	Detected	Min Detected (mg/L)	Mean Detected (mg/L)	Max Detected (mg/L)	Nonpotable Groundwater Use (mg/L)	Ratio of Max Detect to Nonpotable Groundwater Use	Routine Worker Volitilization to Outdor Air (mg/L)	Ratio of Max Detect to Routine Worker Volitilization to Outdor Air	Routine Worker Vapor Intrusion (mg/L)	Ratio of Max Detect to Routine Worker Vapor Intrusion	Construction Worker Direct Contact (mg/L)	Ratio of Max Detect to Construction Worker Direct Contact	Off-Facility Resident Vapor Intrusion (mg/L)	Ratio of Max Detect to Off-Facility Resident Vapor Intrusion	Groundwater Migration to Surface Water (mg/L)	Ratio of Max Detect to Groundwater Migration to Surface Water
AST	VOC	Benzene	71-43-2	T	6	3	0.51	0.54	0.58	0.30	**1.9**	550	0.0011	3.8	0.15	4.0	0.15	0.25	**2.3**	130	0.0045
AST	VOC	Cumene	98-82-8	T	6	3	0.058	0.066	0.075	37	0.0020	9100	0.0000082	63	0.0012	30	0.0025	4.0	0.019	2.6	0.029
AST	VOC	Ethyl Benzene	100-41-4	T	6	3	0.089	0.10	0.11	2.0	0.055	22000	0.0000050	150	0.00073	40	0.0028	9.7	0.011	13	0.0085
AST	VOC	Toluene	108-88-3	T	6	4	0.00034	0.0077	0.011	25	0.00044	100000	0.00000011	700	0.000016	200	0.000055	45	0.00024	52	0.00021
AST	VOC	1,2,4-Trimethylbenzene	95-63-6	T	6	3	0.045	0.049	0.054	8.7	0.0062	1400	0.000039	9.7	0.0056	15	0.0036	0.63	0.086	33	0.0016
AST	VOC	1,3,5-Trimethylbenzene	108-67-8	T	6	3	0.011	0.012	0.013	8.8	0.0015	1300	0.000010	9.1	0.0014	15	0.00087	0.59	0.022	71	0.00018
AST	VOC	Xylenes (total)	1330-20-7	T	6	3	0.19	0.19	0.20	3.7	0.053	1900	0.00010	13	0.015	17	0.012	0.86	0.23	210	0.00093
AST	SVOC	Anthracene	120-12-7	T	6	3	0.00011	0.00022	0.00032	240	0.0000013					19000	0.000000017			40	0.0000080
AST	SVOC	Benzo(a)anthracene	56-55-3	T	6	4	0.000020	0.000043	0.00010	0.10	0.0010					1400	0.000000071			0.013	0.0077
AST	SVOC	Fluorene	86-73-7	T	6	3	0.00050	0.00066	0.00092	97	0.0000095					7800	0.00000012			7.0	0.00013
AST	SVOC	Naphthalene	91-20-3	T	6	3	0.00019	0.0037	0.0094	0.39	0.024	120	0.000078	0.88	0.011	0.28	0.034	0.067	0.14	43	0.00022
AST	SVOC	Phenanthrene	85-01-8	T	6	3	0.000040	0.00011	0.00025	73	0.0000034					5800	0.000000043			1.0	0.00025
AST	SVOC	Pyrene	129-00-0	T	6	3	0.000020	0.000037	0.000060	50	0.0000012					5800	0.000000010			3.0	0.000020
Evergreen	VOC	Cumene	98-82-8	T	2	1	0.00028	0.00028	0.00028	37	0.0000076	9100	0.000000031	63	0.0000044	30	0.0000093	4.0	0.000070	2.6	0.00011
Evergreen	VOC	Toluene	108-88-3	T	2	1	0.00034	0.00034	0.00034	25	0.000014	100000	0.0000000034	700	0.00000049	200	0.0000017	45	0.0000076	52	0.0000065
Evergreen	SVOC	Benzo(a)anthracene	56-55-3	T	2	1	0.00018	0.00018	0.00018	0.10	0.0018					1400	0.00000013			0.013	0.014

Notes:
Only chemicals detected in the area are shown.
Blank cells in the RBSL columns indicate that an RBSL was not calculated due to inadequate toxicity, low volatility, lack of published surface water criteria or, in the case of soil migration-to-groundwater, the target groundwater concentration times the DAF is greater than the constituent's solubility.
The concentrations for the Xylene isomers (m/p and o) were summed before comparing to the criteria for Xylenes (total).
Ratios of concentration to the RBSLs greater than 1 are shaded in bold.
Chem Group - chemical group; VOC - volatile organic compounds; SVOC - semi-volatile organic compounds
Meas Basis - measured basis; T = total, D = dissolved

Table 4
Scenarios for Potential Human Exposure
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Receptor Population	Exposure Medium	Exposure Route	Potential Current Exposure?	Potential Future Exposure?	Comments
On-Site					
Routine Workers	surface soil	incidental ingestion of and dermal contact with surface soil	No	Yes	Currently, routine workers are not at the Site as the Facility is currently undergoing decommissioning, cleanup and redevelopment. Following redevelopment, exposure to surface soil through incidental ingestion, dermal contact, and inhalation of vapor and particulates is possible in areas without ground cover and in those areas where ground cover may be removed in the future. Following redevelopment, most of the soil at the Site will be located under building slabs, drive aisles, parking lots, new roadways, and other paved areas. Buildings in areas where potentially unacceptable vapor intrusion risks are identified will be managed via engineering controls (e.g., vapor barriers or other mitigation controls).
		inhalation of soil-derived vapors and airborne particulates (wind erosion) in outdoor air	No	Yes	
		inhalation of soil-derived vapors that migrate through building foundations into indoor air	No	Yes	
	subsurface soil	inhalation of soil-derived vapors in outdoor air	No	Yes	
		inhalation of soil-derived vapors that migrate through building foundations into indoor air	No	Yes	
	groundwater	incidental ingestion of and dermal contact with groundwater and inhalation of groundwater-derived vapors during use of groundwater for drinking water	No	No	Routine worker activities do not involve contact with groundwater. Groundwater is not currently used for potable purposes at the Site. Groundwater is not expected to be used for potable purposes in the future as the First Amendment to the Consent Order and Agreement restricts the use of groundwater at the Facility for any purpose except for sampling, treatment and/or other remedial activities, eliminating future potable or non-potable use.
		incidental ingestion of and dermal contact with groundwater and inhalation of groundwater-derived vapors during use of groundwater for purposes other than drinking water	No	No	
		inhalation of groundwater-derived vapors in outdoor air	No	Yes	Following redevelopment, exposure through inhalation of vapor is possible in areas without ground cover and in those areas where ground cover may be removed in the future. Buildings in areas where potentially unacceptable vapor intrusion risks are identified will be managed via engineering controls (e.g., vapor barriers or other mitigation controls).
		inhalation of groundwater-derived vapors that migrate through building foundations into indoor air	No	Yes	
Maintenance Workers	surface soil	incidental ingestion of and dermal contact with soil	No	Yes	Currently, maintenance workers are not at the Site as the Facility is currently undergoing decommissioning, cleanup and redevelopment. Following redevelopment, maintenance workers could be exposed (1) to surface and subsurface soil during occasional excavations, or (2) to shallow groundwater during occasional excavations that encounter the water table, that are not covered by the health and safety protocols established by the Site health and safety program.
		inhalation of soil-derived vapors and airborne particulates in work-space outdoor air	No	Yes	
	subsurface soil	incidental ingestion of and dermal contact with soil	No	Yes	
		inhalation of soil-derived vapors and airborne particulates in work-space outdoor air	No	Yes	
	groundwater	incidental ingestion of and dermal contact with exposed groundwater	No	Yes	
		inhalation of vapors from exposed groundwater in work-space outdoor air	No	Yes	
Construction (Redevelopment) Workers	surface soil	incidental ingestion of and dermal contact with soil	Yes	Yes	During redevelopment, construction workers could be exposed to (1) surface and subsurface soil during occasional excavations, or (2) shallow groundwater during occasional excavations that encounter the water table, that are not covered by the health and safety protocols established by the Site health and safety program.
		inhalation of soil-derived vapors and airborne particulates in work-space air	Yes	Yes	
	subsurface soil	incidental ingestion of and dermal contact with soil	Yes	Yes	
		inhalation of soil-derived vapors and airborne particulates in work-space air	Yes	Yes	
	groundwater	incidental ingestion of and dermal contact with exposed groundwater	Yes	Yes	
		inhalation of vapors from exposed groundwater in work-space air	Yes	Yes	
Trespassers	surface soil	incidental ingestion of and dermal contact with surface soil	Yes	Yes	Access to the Site is currently restricted by fencing and security measures. While limited, exposure to surface soil is possible in areas without ground cover, and in those areas where ground cover may be removed in the future. Following redevelopment, most of the soil at the Site will be located under building slabs, drive aisles, parking lots, new roadways, and other paved areas. Trespasser exposure to soil and groundwater will be qualitatively evaluated by using routine worker exposure estimates as a surrogate.
		inhalation of soil-derived vapors and airborne particulates (wind erosion) in outdoor air	Yes	Yes	
	subsurface soil	inhalation of soil-derived vapors in outdoor air	Yes	Yes	
	groundwater	inhalation of groundwater-derived vapors in outdoor air	Yes	Yes	

Table 4
Scenarios for Potential Human Exposure
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Receptor Population	Exposure Medium	Exposure Route	Potential Current Exposure?	Potential Future Exposure?	Comments
Off-Facility					
Residents	on-site surface soil	incidental ingestion of and dermal contact with surface soil	No	No	There is no off-facility soil contamination associated with the Site. Currently, off-facility residents could be exposed to on-site surface soil via inhalation of soil-derived vapors and windborne particulates. Following redevelopment, most of the soil at the Site will be located under building slabs, drive aisles, parking lots, new roadways, and other paved areas which will limit emission of on-site soil-derived chemicals and off-site airborne transport.
		inhalation of soil-derived vapors and airborne particulates (wind erosion) in outdoor air	Yes	Yes	
	groundwater	incidental ingestion of and dermal contact with groundwater and inhalation of groundwater-derived vapors during use of groundwater for drinking water	No	No	Groundwater is not currently used for potable purposes at or in the vicinity of the Site and it is not expected to be used for potable purposes in the future. Philadelphia's drinking water sources are the Delaware and Schuylkill Rivers. The lower (i.e., PRM) aquifer system is used as a water supply in New Jersey but off-site migration of site-related groundwater contamination is not expected to have the potential to reach the supply wells in New Jersey. A well search conducted in 2017 by Stantec, identified three potential water supply wells (two commercial supply wells and one irrigation well) within one mile of the PES Complex property line. Site-related groundwater contamination does not extent to the area of these wells.
		incidental ingestion of and dermal contact with groundwater and inhalation of groundwater-derived vapors during use of groundwater for purposes other than drinking water	No	Yes	
		inhalation of groundwater-derived vapors in outdoor air	No	Yes	Exposure through inhalation of vapor is possible in areas without ground cover and in those areas where ground cover may be removed in the future. Site-related groundwater contamination does not currently extend to areas where residential receptors currently exist.
		inhalation of groundwater-derived vapors that migrate through building foundations into indoor air	No	Yes	

Notes:
Off-facility residents will serve as a surrogate for other off-facility receptors including routine workers, construction workers, maintenance workers, and trespassers.

Table 5

Upper-Bound Cumulative Cancer Risk and Noncancer Hazard Index (HI) for Receptor Exposure to Soil

Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

	Routine Worker				Maintenance Worker		Construction Worker		Off-Facility Resident		Soil Migration to GW									
	Outdoor Activities		Vapor Intrusion		Outdoor Activities		Outdoor Activities		Outdoor Activities		Nonpotable Use		R. Worker GW Vol OA		R. Worker GW VI		Const. W GW Contact		Off-Facility Res GW VI	
Area	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**
Tank Group 04	4E-06	2E-01	**2E-04**	**3E+01**	4E-07	7E-02	1E-06	9E-01	7E-06	7E-01	1E-06	3E-02	NC	NC	4E-08	3E-03	4E-09	9E-03	2E-06	1E-01

Notes:

Cumulative cancer risk and HI estimates in excess of 1E-4 and 1, respectively, are shaded and bold.

GW - Groundwater

VI - Vapor Intrusion

OA - Outdoor Air

NC - Risk and Hazard Index (HI) estimates were not calculated for detected chemicals with inadequate toxicity or physical/chemical parameters or where chemical concentrations were non-detect.

Table 6

Location-Specific Upper-Bound Cumulative Cancer Risk and Noncancer Hazard Index (HI) for Receptor Exposure to Soil

Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

		Routine Worker	
		Vapor Intrusion	
Area	Location	Risk	HI
Tank Group 04	PB-191-01	3E-07	8E-03
Tank Group 04	PB-191-02	6E-07	1E-02
Tank Group 04	PB-191-03	7E-07	2E-02
Tank Group 04	PB-191-04	7E-07	2E-02
Tank Group 04	PB-191-05	6E-07	2E-02
Tank Group 04	PB-191-06	3E-06	9E-02
Tank Group 04	PB-191-07	1E-06	3E-02
Tank Group 04	PB-191-08	4E-07	1E-02
Tank Group 04	PB-826-01	7E-07	2E-02
Tank Group 04	PB-826-02	6E-07	2E-02
Tank Group 04	PB-826-03	6E-07	2E-02
Tank Group 04	PB-826-04	6E-07	2E-02
Tank Group 04	PB-826-05	6E-07	2E-02
Tank Group 04	PB-826-06	6E-07	2E-02
Tank Group 04	PB-826-07	6E-07	2E-02
Tank Group 04	PB-826-08	7E-07	2E-02
Tank Group 04	PB-826-09	7E-07	2E-02
Tank Group 04	PB-826-10	6E-07	2E-02
Tank Group 04	PB-826-11	6E-07	2E-02
Tank Group 04	PB-826-12	6E-07	2E-02
Tank Group 04	PB-826-13	6E-07	2E-02
Tank Group 04	PB-826-14	2E-06	**2E+00**
Tank Group 04	PB-826-15	2E-05	**5E+00**
Tank Group 04	PB-826-16	2E-07	5E-03
Tank Group 04	PB-840-01	4E-07	1E-02
Tank Group 04	PB-840-02	6E-07	2E-02
Tank Group 04	PB-840-03	6E-07	2E-02
Tank Group 04	PB-840-04	6E-07	2E-02
Tank Group 04	PB-840-05	5E-07	1E-02
Tank Group 04	PB-840-06	6E-07	2E-02
Tank Group 04	PB-840-07	1E-06	3E-02
Tank Group 04	PB-840-08	7E-07	2E-02
Tank Group 04	PB-840-09	**1E-04**	**3E+01**
Tank Group 04	PB-840-10	6E-07	2E-02
Tank Group 04	PB-840-11	8E-07	3E-02
Tank Group 04	PB-840-12	6E-07	2E-02
Tank Group 04	PB-840-13	6E-07	2E-02
Tank Group 04	PB-840-14	6E-07	2E-02
Tank Group 04	PB-840-15	6E-07	2E-02
Tank Group 04	PB-840-16	6E-07	2E-02
Tank Group 04	PB-841-01	6E-07	2E-02
Tank Group 04	PB-841-02	6E-07	2E-02
Tank Group 04	PB-841-03	6E-07	2E-02
Tank Group 04	PB-841-04	6E-07	2E-02
Tank Group 04	PB-841-05	6E-07	2E-02
Tank Group 04	PB-841-06	7E-07	2E-02
Tank Group 04	PB-841-07	7E-07	2E-02
Tank Group 04	PB-841-08	6E-07	2E-02
Tank Group 04	PB-841-09	6E-07	2E-02
Tank Group 04	PB-841-10	6E-07	2E-02
Tank Group 04	PB-841-11	6E-07	2E-02
Tank Group 04	PB-841-12	6E-07	2E-02
Tank Group 04	PB-841-13	6E-07	2E-02
Tank Group 04	PB-841-14	6E-07	2E-02
Tank Group 04	PB-843-01	6E-07	2E-02
Tank Group 04	PB-843-02	7E-07	2E-02
Tank Group 04	PB-843-03	6E-07	2E-02
Tank Group 04	PB-843-04	7E-07	2E-02
Tank Group 04	PB-843-05	8E-07	2E-02
Tank Group 04	PB-843-06	7E-07	2E-02
Tank Group 04	PB-843-07	3E-07	8E-03
Tank Group 04	PB-843-08	6E-07	2E-02
Tank Group 04	PB-843-09	7E-07	2E-02
Tank Group 04	PB-843-10	2E-06	4E-02
Tank Group 04	PB-843-11	7E-07	2E-02
Tank Group 04	PB-843-12	6E-07	2E-02

Table 6

Location-Specific Upper-Bound Cumulative Cancer Risk and Noncancer Hazard Index (HI) for Receptor Exposure to Soil

Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

		Routine Worker	
		Vapor Intrusion	
Area	Location	Risk	HI
Tank Group 04	PB-843-13	6E-07	2E-02
Tank Group 04	PB-843-14	7E-07	2E-02
Tank Group 04	PB-843-15	6E-07	2E-02
Tank Group 04	PB-843-16	6E-07	2E-02
Tank Group 04	PB-843-17	7E-07	2E-02
Tank Group 04	PB-847-01	7E-07	2E-02
Tank Group 04	PB-847-02	7E-07	2E-02
Tank Group 04	PB-847-03	6E-07	2E-02
Tank Group 04	PB-847-04	6E-07	2E-02
Tank Group 04	PB-847-05	6E-07	2E-02
Tank Group 04	PB-847-06	7E-07	2E-02
Tank Group 04	PB-847-07	7E-07	2E-02
Tank Group 04	PB-847-08	7E-07	2E-02
Tank Group 04	PB-847-09	7E-07	2E-02
Tank Group 04	PB-847-10	7E-07	2E-02
Tank Group 04	PB-847-11	7E-07	2E-02
Tank Group 04	PB-847-12	6E-07	3E-02
Tank Group 04	PB-847-13	2E-06	5E-01
Tank Group 04	PB-847-14	2E-06	1E-01
Tank Group 04	PB-847-15	5E-05	**3E+00**
Tank Group 04	PB-847-16	7E-07	2E-02
Tank Group 04	PB-847-17	8E-07	3E-02
Tank Group 04	PB-848-01	7E-07	2E-02
Tank Group 04	PB-848-02	6E-07	2E-02
Tank Group 04	PB-848-03	6E-07	2E-02
Tank Group 04	PB-848-04	4E-05	**2E+00**
Tank Group 04	PB-848-05	5E-07	1E-02
Tank Group 04	PB-848-06	1E-05	**4E+00**
Tank Group 04	PB-848-07	4E-06	5E-01
Tank Group 04	PB-848-08	7E-07	2E-02
Tank Group 04	PB-848-09	7E-07	2E-02
Tank Group 04	PB-848-10	8E-07	2E-02
Tank Group 04	PB-848-11	2E-05	3E-01
Tank Group 04	PB-848-12	3E-07	8E-03
Tank Group 04	PB-848-13	1E-06	4E-02
Tank Group 04	PB-848-14	7E-07	2E-02
Tank Group 04	PB-848-15	2E-05	**4E+00**
Tank Group 04	PB-848-16	7E-07	2E-02
Tank Group 04	PB-848-17	2E-07	5E-03
Tank Group 04	PB-848-18	9E-07	4E-02
Tank Group 04	PB-881-01	2E-06	7E-02
Tank Group 04	PB-881-02	6E-07	2E-02
Tank Group 04	PB-881-03	8E-06	2E-01
Tank Group 04	PB-881-04	3E-07	9E-03
Tank Group 04	PB-881-05	6E-07	2E-02
Tank Group 04	PB-881-06	6E-07	2E-02
Tank Group 04	PB-881-07	4E-06	3E-01
Tank Group 04	PB-881-08	7E-07	2E-02
Tank Group 04	PB-881-09	7E-07	2E-02
Tank Group 04	PB-881-10	3E-05	**2E+00**
Tank Group 04	PB-881-11	6E-07	2E-02
Tank Group 04	PB-881-12	6E-07	2E-02
Tank Group 04	PB-881-13	6E-07	2E-02
Tank Group 04	PB-881-14	6E-07	2E-02
Tank Group 04	PB-881-15	7E-07	2E-02
Tank Group 04	PB-881-16	7E-07	2E-02
Tank Group 04	PB-881-17	6E-07	2E-02
Tank Group 04	PB-881-18	6E-07	2E-02
Tank Group 04	PB-882-01	3E-08	1E-03
Tank Group 04	PB-882-02	3E-08	1E-03
Tank Group 04	PB-882-03	7E-07	2E-02
Tank Group 04	PB-882-04	7E-07	2E-02
Tank Group 04	PB-882-05	6E-07	2E-02
Tank Group 04	PB-882-06	6E-07	2E-02
Tank Group 04	PB-882-07	6E-07	2E-02
Tank Group 04	PB-882-08	1E-05	3E-01

Table 6

Location-Specific Upper-Bound Cumulative Cancer Risk and Noncancer Hazard Index (HI) for Receptor Exposure to Soil

Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

		Routine Worker	
		Vapor Intrusion	
Area	Location	Risk	HI
Tank Group 04	PB-882-09	4E-07	1E-02
Tank Group 04	PB-882-10	2E-06	1E-01
Tank Group 04	PB-882-11	7E-07	2E-02
Tank Group 04	PB-882-12	7E-07	2E-02
Tank Group 04	PB-882-13	6E-07	2E-02
Tank Group 04	PB-882-14	9E-07	3E-02
Tank Group 04	PB-882-15	7E-08	2E-03
Tank Group 04	PB-882-16	3E-05	**1E+01**
Tank Group 04	PB-882-17	7E-08	2E-03
Tank Group 04	PB-882-18	3E-08	1E-03
Tank Group 04	PB-882-19	3E-08	1E-03
Tank Group 04	PB-882-20	4E-07	1E-02
Tank Group 04	PB-883-01	7E-07	2E-02
Tank Group 04	PB-883-02	7E-07	2E-02
Tank Group 04	PB-883-03	7E-07	2E-02
Tank Group 04	PB-883-04	6E-07	2E-02
Tank Group 04	PB-883-05	7E-07	2E-02
Tank Group 04	PB-883-06	6E-07	2E-02
Tank Group 04	PB-883-07	7E-07	2E-02
Tank Group 04	PB-883-08	7E-07	2E-02
Tank Group 04	PB-883-09	6E-07	2E-02
Tank Group 04	PB-883-10	6E-07	2E-02
Tank Group 04	PB-883-11	6E-07	2E-02
Tank Group 04	PB-883-12	7E-07	2E-02
Tank Group 04	PB-883-13	7E-07	2E-02
Tank Group 04	PB-883-14	7E-07	2E-02
Tank Group 04	PB-883-15	7E-07	2E-02
Tank Group 04	PB-883-16	3E-06	9E-02
Tank Group 04	PB-883-17	3E-06	8E-02
Tank Group 04	PB-883-18	3E-06	1E-01
Tank Group 04	PB-883-19	6E-07	2E-02
Tank Group 04	PB-883-20	7E-07	2E-02
Tank Group 04	PB-883-21	2E-05	6E-01
Tank Group 04	PB-883-22	6E-07	2E-02
Tank Group 04	PB-883-23	7E-07	2E-02
Tank Group 04	PB-883-24	7E-07	2E-02
Tank Group 04	PB-884-01	7E-07	2E-02
Tank Group 04	PB-884-02	7E-07	2E-02
Tank Group 04	PB-884-03	7E-07	2E-02
Tank Group 04	PB-884-04	5E-07	2E-02
Tank Group 04	PB-884-05	6E-07	2E-02
Tank Group 04	PB-884-06	6E-07	2E-02
Tank Group 04	PB-884-07	6E-07	2E-02
Tank Group 04	PB-884-08	8E-06	8E-01
Tank Group 04	PB-884-09	6E-05	**6E+00**
Tank Group 04	PB-884-10	6E-07	2E-02
Tank Group 04	PB-884-11	5E-07	1E-02
Tank Group 04	PB-884-12	7E-07	2E-02
Tank Group 04	PB-884-13	6E-07	2E-02
Tank Group 04	PB-884-14	6E-07	2E-02
Tank Group 04	PB-884-15	5E-05	**6E+00**
Tank Group 04	PB-884-16	6E-07	2E-02
Tank Group 04	PB-884-17	6E-07	2E-02
Tank Group 04	PB-884-18	1E-06	2E-02
Tank Group 04	PB-884-19	6E-07	3E-02
Tank Group 04	PB-884-20	6E-07	2E-02
Tank Group 04	PB-884-21	6E-07	2E-02
Tank Group 04	PB-884-22	6E-07	2E-02
Tank Group 04	PB-884-23	6E-07	2E-02
Tank Group 04	PB-884-24	1E-06	7E-02
Tank Group 04	PB-884-25	**1E-04**	**6E+00**
Tank Group 04	PB-884-26	7E-07	2E-02
Tank Group 04	PB-884-27	7E-07	2E-02
Tank Group 04	PB-884-28	7E-07	2E-02
Tank Group 04	PB-884-29	7E-07	2E-02
Tank Group 04	PB-885-01	6E-07	2E-02

Table 6

Location-Specific Upper-Bound Cumulative Cancer Risk and Noncancer Hazard Index (HI) for Receptor Exposure to Soil

Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

		Routine Worker	
		Vapor Intrusion	
Area	Location	Risk	HI
Tank Group 04	PB-885-02	6E-07	2E-02
Tank Group 04	PB-885-03	6E-07	2E-02
Tank Group 04	PB-885-04	6E-07	2E-02
Tank Group 04	PB-885-05	6E-07	2E-02
Tank Group 04	PB-885-06	6E-07	2E-02
Tank Group 04	PB-885-07	6E-07	2E-02
Tank Group 04	PB-885-08	1E-06	3E-02
Tank Group 04	PB-885-09	7E-07	2E-02
Tank Group 04	PB-885-10	6E-07	2E-02
Tank Group 04	PB-885-11	7E-07	2E-02
Tank Group 04	PB-885-12	6E-07	2E-02
Tank Group 04	PB-885-13	6E-07	2E-02
Tank Group 04	PB-885-14	6E-07	2E-02
Tank Group 04	PB-885-15	6E-07	2E-02
Tank Group 04	PB-885-16	7E-07	2E-02
Tank Group 04	PB-885-17	6E-07	2E-02
Tank Group 04	PB-885-18	6E-07	2E-02
Tank Group 04	PB-885-19	6E-07	2E-02
Tank Group 04	PB-885-20	6E-07	2E-02
Tank Group 04	PB-885-21	6E-07	2E-02
Tank Group 04	PB-885-22	7E-07	2E-02
Tank Group 04	PB-885-23	1E-05	4E-01
Tank Group 04	PB-885-24	7E-07	2E-02
Tank Group 04	PB-885-25	6E-07	2E-02
Tank Group 04	PB-885-26	6E-07	2E-02
Tank Group 04	PB-886-01	6E-07	2E-02
Tank Group 04	PB-886-02	7E-07	2E-02
Tank Group 04	PB-886-03	7E-07	2E-02
Tank Group 04	PB-886-04	6E-07	2E-02
Tank Group 04	PB-886-05	6E-07	2E-02
Tank Group 04	PB-886-06	6E-07	2E-02
Tank Group 04	PB-886-07	7E-07	2E-02
Tank Group 04	PB-886-08	8E-07	4E-02
Tank Group 04	PB-886-09	6E-07	2E-02
Tank Group 04	PB-886-10	3E-07	8E-03
Tank Group 04	PB-886-11	6E-07	2E-02
Tank Group 04	PB-886-12	7E-07	2E-02
Tank Group 04	PB-886-13	7E-07	2E-02
Tank Group 04	PB-886-14	6E-07	2E-02
Tank Group 04	PB-886-15	7E-07	2E-02
Tank Group 04	PB-886-16	6E-07	2E-02
Tank Group 04	PB-886-17	6E-07	2E-02
Tank Group 04	PB-886-18	1E-06	3E-02
Tank Group 04	PB-886-19	7E-07	2E-02
Tank Group 04	PB-886-20	6E-07	2E-02
Tank Group 04	PB-886-21	6E-07	2E-02
Tank Group 04	PB-886-22	6E-07	2E-02
Tank Group 04	PB-886-23	6E-07	2E-02
Tank Group 04	PB-886-24	7E-07	2E-02
Tank Group 04	PB-886-25	6E-07	2E-02
Tank Group 04	PB-886-26	2E-07	4E-02
Tank Group 04	PB-886-27	6E-07	3E-02

Notes:

Cumulative cancer risk and HI estimates in excess of 1E-4 and 1, respectively, are shaded and bold.

Table 7

Upper-Bound Cumulative Cancer Risk and Noncancer Hazard Index (HI) for Receptor Exposure to Groundwater

Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

		Routine Worker				Maintenance Worker		Construction Worker		Off-Facility Resident				--	
		Vapor Intrusion		Outdoor Air Inhalation		Groundwater Contact		Groundwater Contact		Vapor Intrusion		Outdoor Air Inhalation		Nonpotable Use	
Dataset	**Area**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**	**Risk**	**HI**
AST	Tank Group 04	1E-06	2E-02	9E-09	1E-04	1E-06	5E-02	1E-07	2E-02	2E-05	3E-01	4E-08	5E-04	2E-05	1E-01
Evergreen	Tank Group 04	NC	5E-07	NC	3E-09	1E-11	2E-06	1E-12	1E-06	NC	8E-06	NC	1E-08	2E-08	2E-06

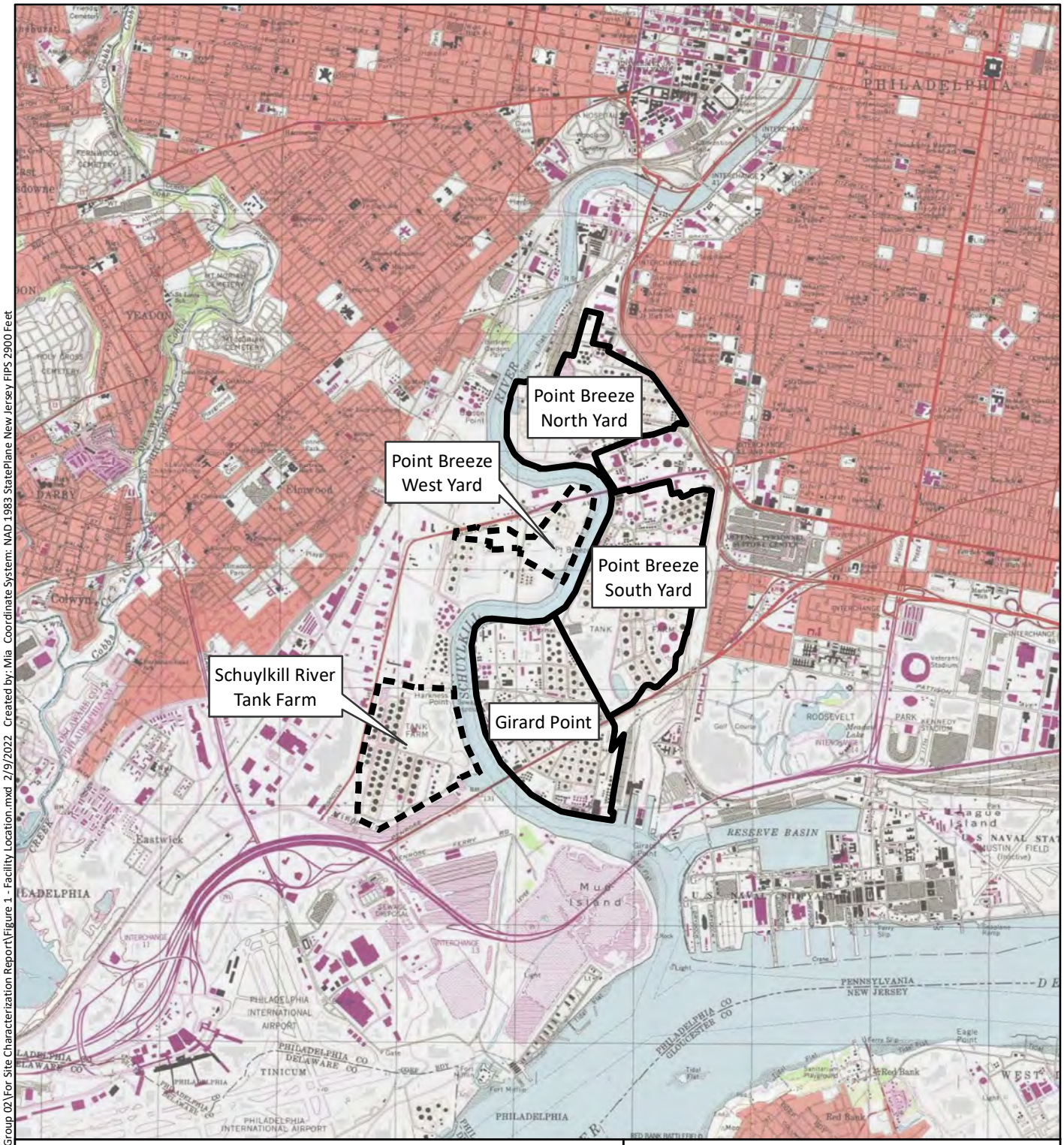
Notes:

Cumulative cancer risk and HI estimates in excess of 1E-4 and 1, respectively, are shaded and bold.

NC - Risk and HI estimates were not calculated for detected chemicals with inadequate toxicity or physical/chemical parameters or where chemical concentrations were non-detect.

Figures

1 Facility Location
2 Site Location
3 Site Layout
4 Soil Sample Results Compared to RBSLs
5 Groundwater Sample Results Compared to RBSLs
6 Risk Assessment Results (Soil)



0 2,000 4,000 6,000 Feet

1 inch = 4,000 feet

N

Legend

Subject to AST Closure Plan

Not Subject to AST Closure Plan

Base Map: USGS Philadelphia 1994 7.5 Minute Quadrangle.

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

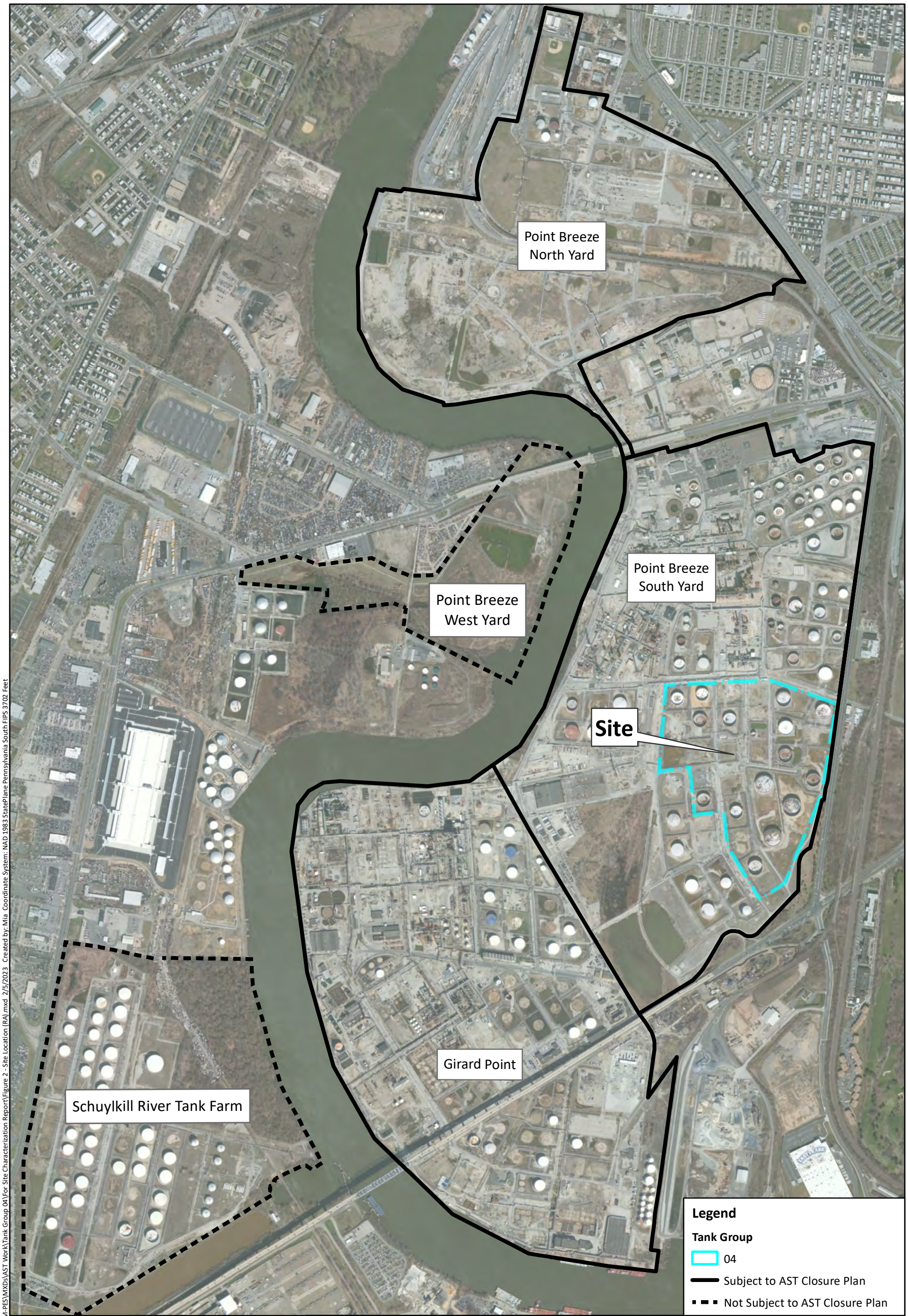
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Facility Location

Figure 1

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 02\For Site Characterization Report\Figure 1 - Facility Location.mxd 2/9/2022 Created by: Mia Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet



N

0 500 1,000 1,500 Feet

1 inch = 1,000 feet

Notes: Aerial imagery source Maxar 10/19/2019

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Site Location

Figure 2

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\For Site Characterization Report\Figure 2 - Site Location (RA).mxd 2/5/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\For Site Characterization Report\Figure 3 - Site Layout Map.mxd 4/24/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

N

0 100 200 300 Feet

1 inch = 200 feet

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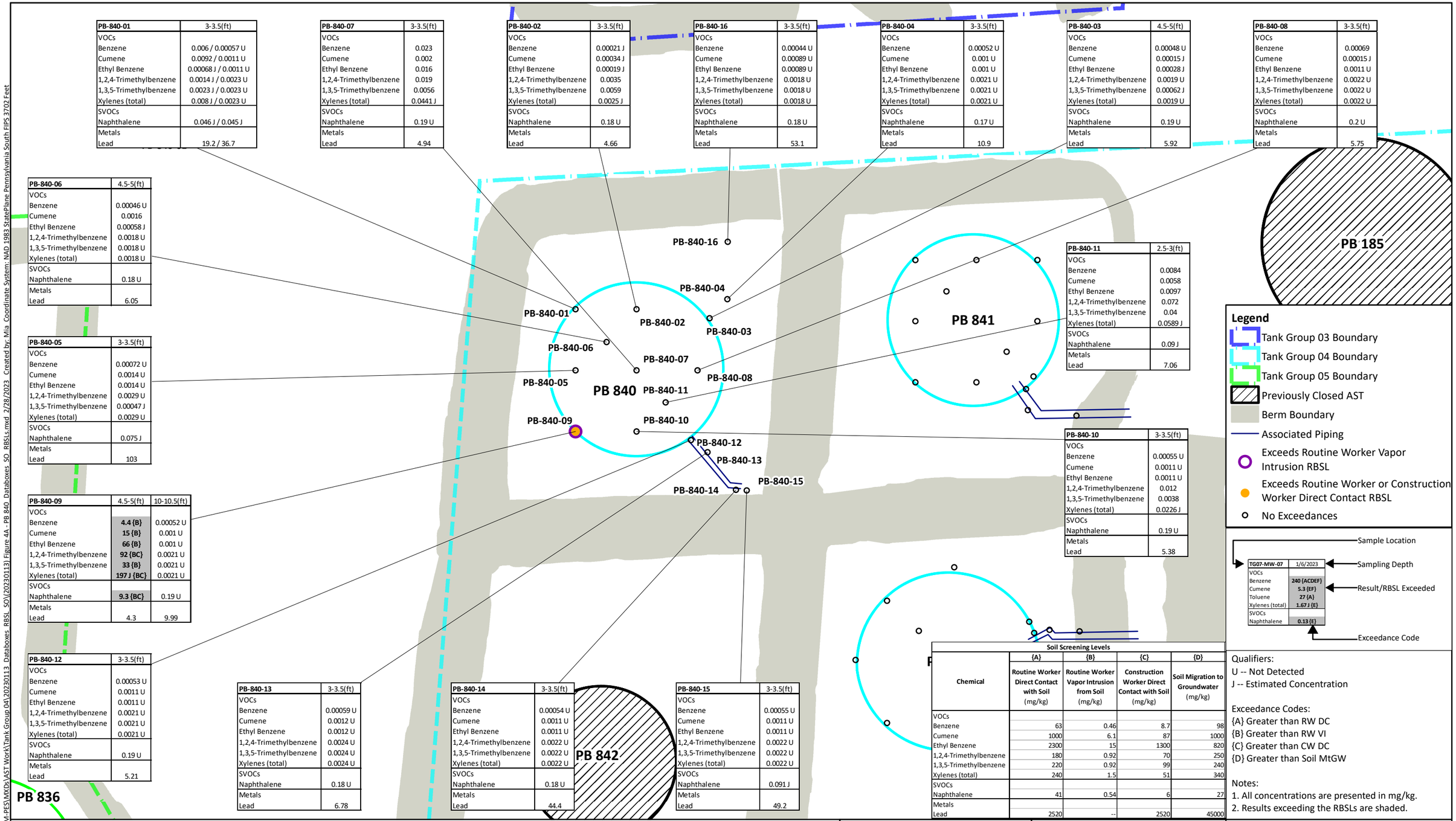
CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Site Layout Map
Tank Group 04

Figure 3



PB-840-01	3-3.5(ft)
VOCs	
Benzene	0.006 / 0.00057 U
Cumene	0.0092 / 0.0011 U
Ethyl Benzene	0.00068 J / 0.0011 U
1,2,4-Trimethylbenzene	0.0014 J / 0.0023 U
1,3,5-Trimethylbenzene	0.0023 J / 0.0023 U
Xylenes (total)	0.008 J / 0.0023 U
SVOCs	
Naphthalene	0.046 J / 0.045 J
Metals	
Lead	19.2 / 36.7

PB-840-07	3-3.5(ft)
VOCs	
Benzene	0.023
Cumene	0.002
Ethyl Benzene	0.016
1,2,4-Trimethylbenzene	0.019
1,3,5-Trimethylbenzene	0.0056
Xylenes (total)	0.0441 J
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	4.94

PB-840-02	3-3.5(ft)
VOCs	
Benzene	0.00021 J
Cumene	0.00034 J
Ethyl Benzene	0.00019 J
1,2,4-Trimethylbenzene	0.0035
1,3,5-Trimethylbenzene	0.0059
Xylenes (total)	0.0025 J
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	4.66

PB-840-16	3-3.5(ft)
VOCs	
Benzene	0.00044 U
Cumene	0.00089 U
Ethyl Benzene	0.00089 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	53.1

PB-840-04	3-3.5(ft)
VOCs	
Benzene	0.00052 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	10.9

PB-840-03	4.5-5(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00015 J
Ethyl Benzene	0.00028 J
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.00062 J
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.92

PB-840-08	3-3.5(ft)
VOCs	
Benzene	0.00069
Cumene	0.00015 J
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.75

PB-840-06	4.5-5(ft)
VOCs	
Benzene	0.00046 U
Cumene	0.0016
Ethyl Benzene	0.00058 J
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	6.05

PB-840-05	3-3.5(ft)
VOCs	
Benzene	0.00072 U
Cumene	0.0014 U
Ethyl Benzene	0.0014 U
1,2,4-Trimethylbenzene	0.0029 U
1,3,5-Trimethylbenzene	0.00047 J
Xylenes (total)	0.0029 U
SVOCs	
Naphthalene	0.075 J
Metals	
Lead	103

PB-840-09	4.5-5(ft)	10-10.5(ft)
VOCs		
Benzene	**4.4 {B}**	0.00052 U
Cumene	**15 {B}**	0.001 U
Ethyl Benzene	**66 {B}**	0.001 U
1,2,4-Trimethylbenzene	**92 {BC}**	0.0021 U
1,3,5-Trimethylbenzene	**33 {B}**	0.0021 U
Xylenes (total)	**197 J {BC}**	0.0021 U
SVOCs		
Naphthalene	**9.3 {BC}**	0.19 U
Metals		
Lead	4.3	9.99

PB-840-12	3-3.5(ft)
VOCs	
Benzene	0.00053 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.21

PB-840-13	3-3.5(ft)
VOCs	
Benzene	0.00059 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	6.78

PB-840-14	3-3.5(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	44.4

PB-840-15	3-3.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.091 J
Metals	
Lead	49.2

PB-840-11	2.5-3(ft)
VOCs	
Benzene	0.0084
Cumene	0.0058
Ethyl Benzene	0.0097
1,2,4-Trimethylbenzene	0.072
1,3,5-Trimethylbenzene	0.04
Xylenes (total)	0.0589 J
SVOCs	
Naphthalene	0.09 J
Metals	
Lead	7.06

PB-840-10	3-3.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.012
1,3,5-Trimethylbenzene	0.0038
Xylenes (total)	0.0226 J
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.38

TG07-MW-07	1/6/2023
VOCs	
Benzene	**240 {ACDEF}**
Cumene	**5.3 {EF}**
Toluene	**27 {A}**
Xylenes (total)	**1.67 J {E}**
SVOCs	
Naphthalene	**0.13 {E}**

Soil Screening Levels				
Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

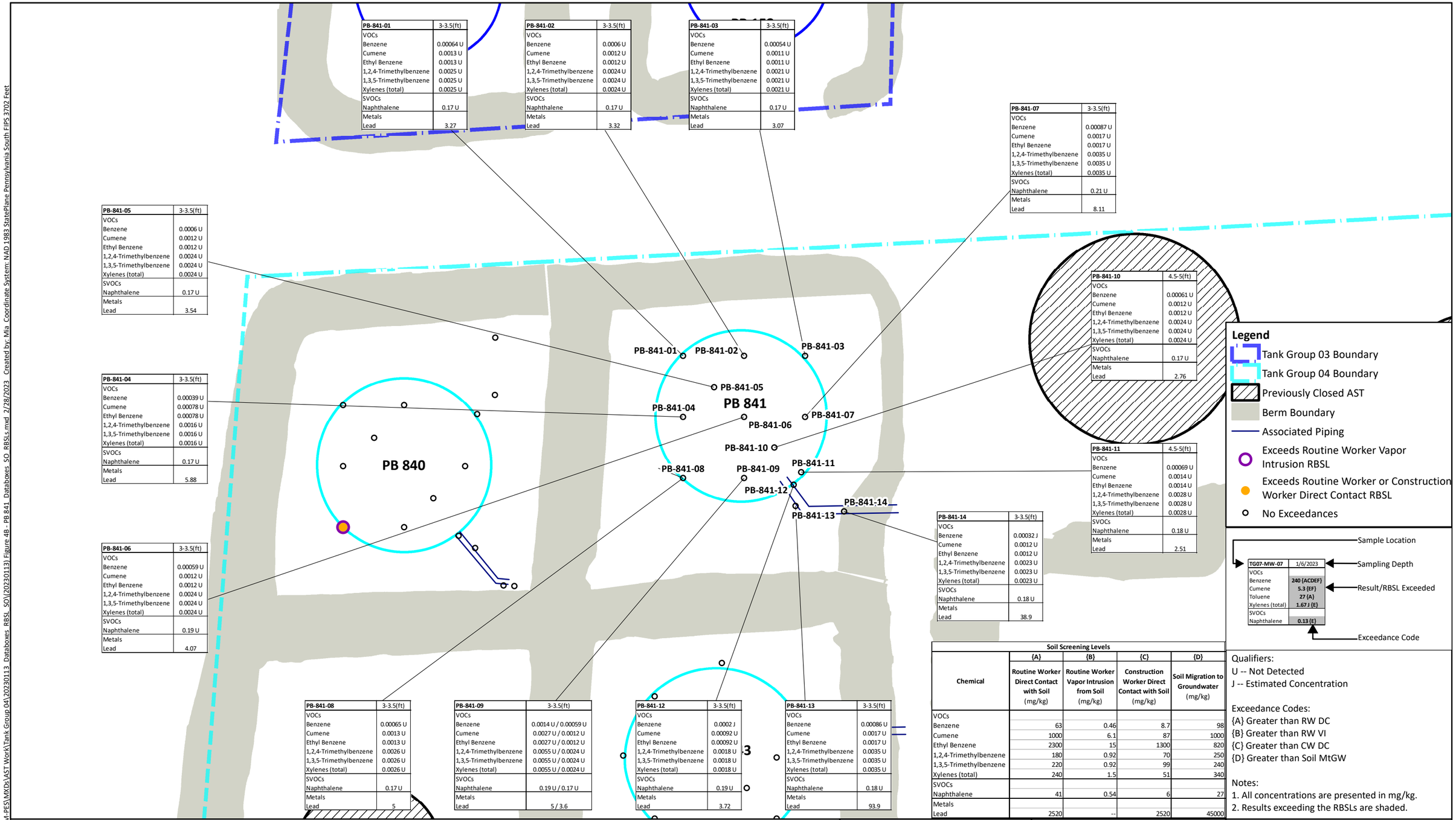
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 840)

Figure 4A

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4A - PB 840_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-841-01	3-3.5(ft)
VOCs	
Benzene	0.00064 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0025 U
1,3,5-Trimethylbenzene	0.0025 U
Xylenes (total)	0.0025 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.27

PB-841-02	3-3.5(ft)
VOCs	
Benzene	0.0006 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.32

PB-841-03	3-3.5(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.07

PB-841-07	3-3.5(ft)
VOCs	
Benzene	0.00087 U
Cumene	0.0017 U
Ethyl Benzene	0.0017 U
1,2,4-Trimethylbenzene	0.0035 U
1,3,5-Trimethylbenzene	0.0035 U
Xylenes (total)	0.0035 U
SVOCs	
Naphthalene	0.21 U
Metals	
Lead	8.11

PB-841-05	3-3.5(ft)
VOCs	
Benzene	0.0006 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.54

PB-841-10	4.5-5(ft)
VOCs	
Benzene	0.00061 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.76

PB-841-04	3-3.5(ft)
VOCs	
Benzene	0.00039 U
Cumene	0.00078 U
Ethyl Benzene	0.00078 U
1,2,4-Trimethylbenzene	0.0016 U
1,3,5-Trimethylbenzene	0.0016 U
Xylenes (total)	0.0016 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	5.88

PB-841-11	4.5-5(ft)
VOCs	
Benzene	0.00069 U
Cumene	0.0014 U
Ethyl Benzene	0.0014 U
1,2,4-Trimethylbenzene	0.0028 U
1,3,5-Trimethylbenzene	0.0028 U
Xylenes (total)	0.0028 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	2.51

PB-841-14	3-3.5(ft)
VOCs	
Benzene	0.00032 J
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	38.9

PB-841-06	3-3.5(ft)
VOCs	
Benzene	0.00059 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	4.07

PB-841-08	3-3.5(ft)
VOCs	
Benzene	0.00065 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0026 U
1,3,5-Trimethylbenzene	0.0026 U
Xylenes (total)	0.0026 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	5

PB-841-09	3-3.5(ft)
VOCs	
Benzene	0.0014 U / 0.00059 U
Cumene	0.0027 U / 0.0012 U
Ethyl Benzene	0.0027 U / 0.0012 U
1,2,4-Trimethylbenzene	0.0055 U / 0.0024 U
1,3,5-Trimethylbenzene	0.0055 U / 0.0024 U
Xylenes (total)	0.0055 U / 0.0024 U
SVOCs	
Naphthalene	0.19 U / 0.17 U
Metals	
Lead	5 / 3.6

PB-841-12	3-3.5(ft)
VOCs	
Benzene	0.0002 J
Cumene	0.00092 U
Ethyl Benzene	0.00092 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	3.72

PB-841-13	3-3.5(ft)
VOCs	
Benzene	0.00086 U
Cumene	0.0017 U
Ethyl Benzene	0.0017 U
1,2,4-Trimethylbenzene	0.0035 U
1,3,5-Trimethylbenzene	0.0035 U
Xylenes (total)	0.0035 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	93.9

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

Soil Screening Levels				
Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

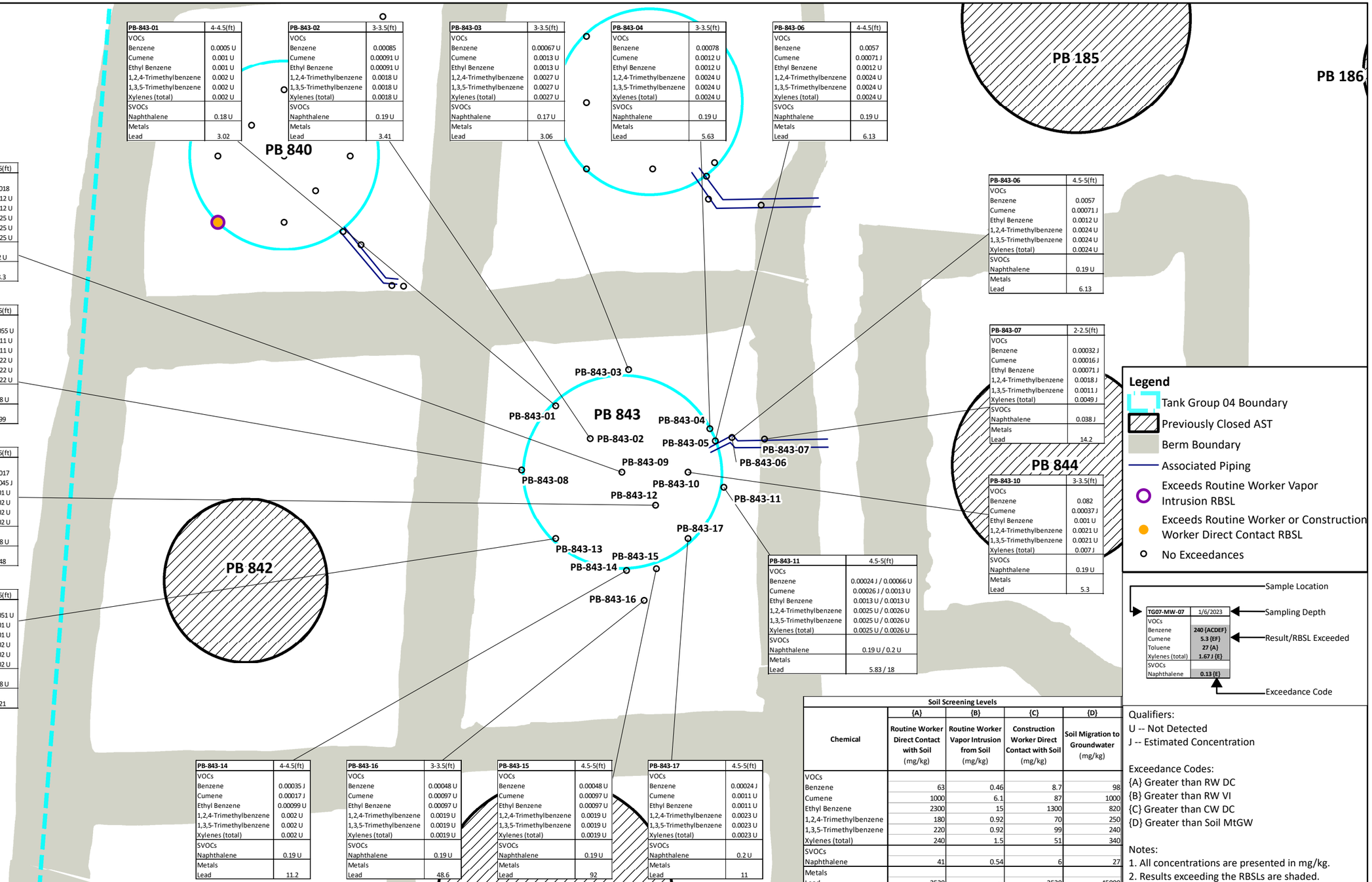
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 841)

Figure 4B

File: N:\GIS\Pr\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4B - PB 841_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-843-01	4-4.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	3.02

PB-843-02	3-3.5(ft)
VOCs	
Benzene	0.00085
Cumene	0.00091 U
Ethyl Benzene	0.00091 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	3.41

PB-843-03	3-3.5(ft)
VOCs	
Benzene	0.00067 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0027 U
1,3,5-Trimethylbenzene	0.0027 U
Xylenes (total)	0.0027 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.06

PB-843-04	3-3.5(ft)
VOCs	
Benzene	0.00078
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.63

PB-843-06	4-4.5(ft)
VOCs	
Benzene	0.0057
Cumene	0.00071 J
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	6.13

PB-843-09	4-4.5(ft)
VOCs	
Benzene	0.0018
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0025 U
1,3,5-Trimethylbenzene	0.0025 U
Xylenes (total)	0.0025 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	18.3

PB-843-08	3-3.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	3.99

PB-843-12	4-4.5(ft)
VOCs	
Benzene	0.0017
Cumene	0.00045 J
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	8.48

PB-843-13	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	3.21

PB-843-06	4.5-5(ft)
VOCs	
Benzene	0.0057
Cumene	0.00071 J
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	6.13

PB-843-07	2-2.5(ft)
VOCs	
Benzene	0.00032 J
Cumene	0.00016 J
Ethyl Benzene	0.00071 J
1,2,4-Trimethylbenzene	0.0018 J
1,3,5-Trimethylbenzene	0.0011 J
Xylenes (total)	0.0049 J
SVOCs	
Naphthalene	0.038 J
Metals	
Lead	14.2

PB-843-10	3-3.5(ft)
VOCs	
Benzene	0.082
Cumene	0.00037 J
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.007 J
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.3

PB-843-11	4.5-5(ft)
VOCs	
Benzene	0.00024 J / 0.00066 U
Cumene	0.00026 J / 0.0013 U
Ethyl Benzene	0.0013 U / 0.0013 U
1,2,4-Trimethylbenzene	0.0025 U / 0.0026 U
1,3,5-Trimethylbenzene	0.0025 U / 0.0026 U
Xylenes (total)	0.0025 U / 0.0026 U
SVOCs	
Naphthalene	0.19 U / 0.2 U
Metals	
Lead	5.83 / 18

PB-843-14	4-4.5(ft)
VOCs	
Benzene	0.00035 J
Cumene	0.00017 J
Ethyl Benzene	0.00099 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	11.2

PB-843-16	3-3.5(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00097 U
Ethyl Benzene	0.00097 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	48.6

PB-843-15	4.5-5(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00097 U
Ethyl Benzene	0.00097 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	92

PB-843-17	4.5-5(ft)
VOCs	
Benzene	0.00024 J
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	11

Legend

- Tank Group 04 Boundary
- Previously Closed AST
- Berm Boundary
- Associated Piping
- Exceeds Routine Worker Vapor Intrusion RBSL
- Exceeds Routine Worker or Construction Worker Direct Contact RBSL
- No Exceedances

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

Sample Location
Sampling Depth
Result/RBSL Exceeded
Exceedance Code

Chemical	Soil Screening Levels {A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

0 75 150 Feet
1 inch = 75 feet

N

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

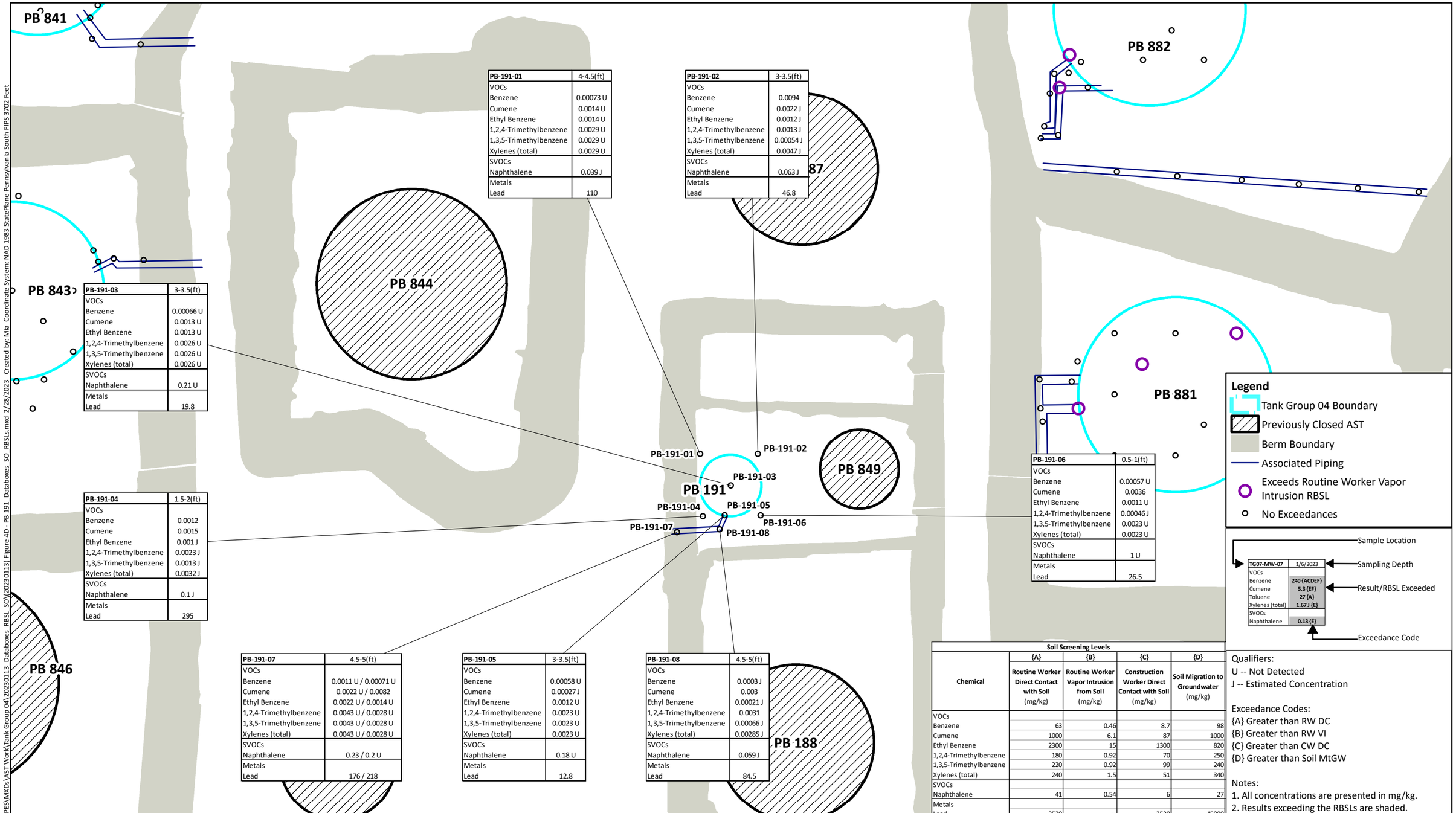
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 843)

Figure 4C

File: N:\GIS\Pr\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4C - PB 843_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-191-01	4-4.5(ft)
VOCs	
Benzene	0.00073 U
Cumene	0.0014 U
Ethyl Benzene	0.0014 U
1,2,4-Trimethylbenzene	0.0029 U
1,3,5-Trimethylbenzene	0.0029 U
Xylenes (total)	0.0029 U
SVOCs	
Naphthalene	0.039 J
Metals	
Lead	110

PB-191-02	3-3.5(ft)
VOCs	
Benzene	0.0094
Cumene	0.0022 J
Ethyl Benzene	0.0012 J
1,2,4-Trimethylbenzene	0.0013 J
1,3,5-Trimethylbenzene	0.00054 J
Xylenes (total)	0.0047 J
SVOCs	
Naphthalene	0.063 J
Metals	
Lead	46.8

PB-191-03	3-3.5(ft)
VOCs	
Benzene	0.00066 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0026 U
1,3,5-Trimethylbenzene	0.0026 U
Xylenes (total)	0.0026 U
SVOCs	
Naphthalene	0.21 U
Metals	
Lead	19.8

PB-191-04	1.5-2(ft)
VOCs	
Benzene	0.0012
Cumene	0.0015
Ethyl Benzene	0.001 J
1,2,4-Trimethylbenzene	0.0023 J
1,3,5-Trimethylbenzene	0.0013 J
Xylenes (total)	0.0032 J
SVOCs	
Naphthalene	0.1 J
Metals	
Lead	295

PB-191-06	0.5-1(ft)
VOCs	
Benzene	0.00057 U
Cumene	0.0036
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.00046 J
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	1 U
Metals	
Lead	26.5

PB-191-07	4.5-5(ft)
VOCs	
Benzene	0.0011 U / 0.00071 U
Cumene	0.0022 U / 0.0082
Ethyl Benzene	0.0022 U / 0.0014 U
1,2,4-Trimethylbenzene	0.0043 U / 0.0028 U
1,3,5-Trimethylbenzene	0.0043 U / 0.0028 U
Xylenes (total)	0.0043 U / 0.0028 U
SVOCs	
Naphthalene	0.23 / 0.2 U
Metals	
Lead	176 / 218

PB-191-05	3-3.5(ft)
VOCs	
Benzene	0.00058 U
Cumene	0.00027 J
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	12.8

PB-191-08	4.5-5(ft)
VOCs	
Benzene	0.0003 J
Cumene	0.003
Ethyl Benzene	0.00021 J
1,2,4-Trimethylbenzene	0.0031
1,3,5-Trimethylbenzene	0.00066 J
Xylenes (total)	0.00285 J
SVOCs	
Naphthalene	0.059 J
Metals	
Lead	84.5

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

Soil Screening Levels				
Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

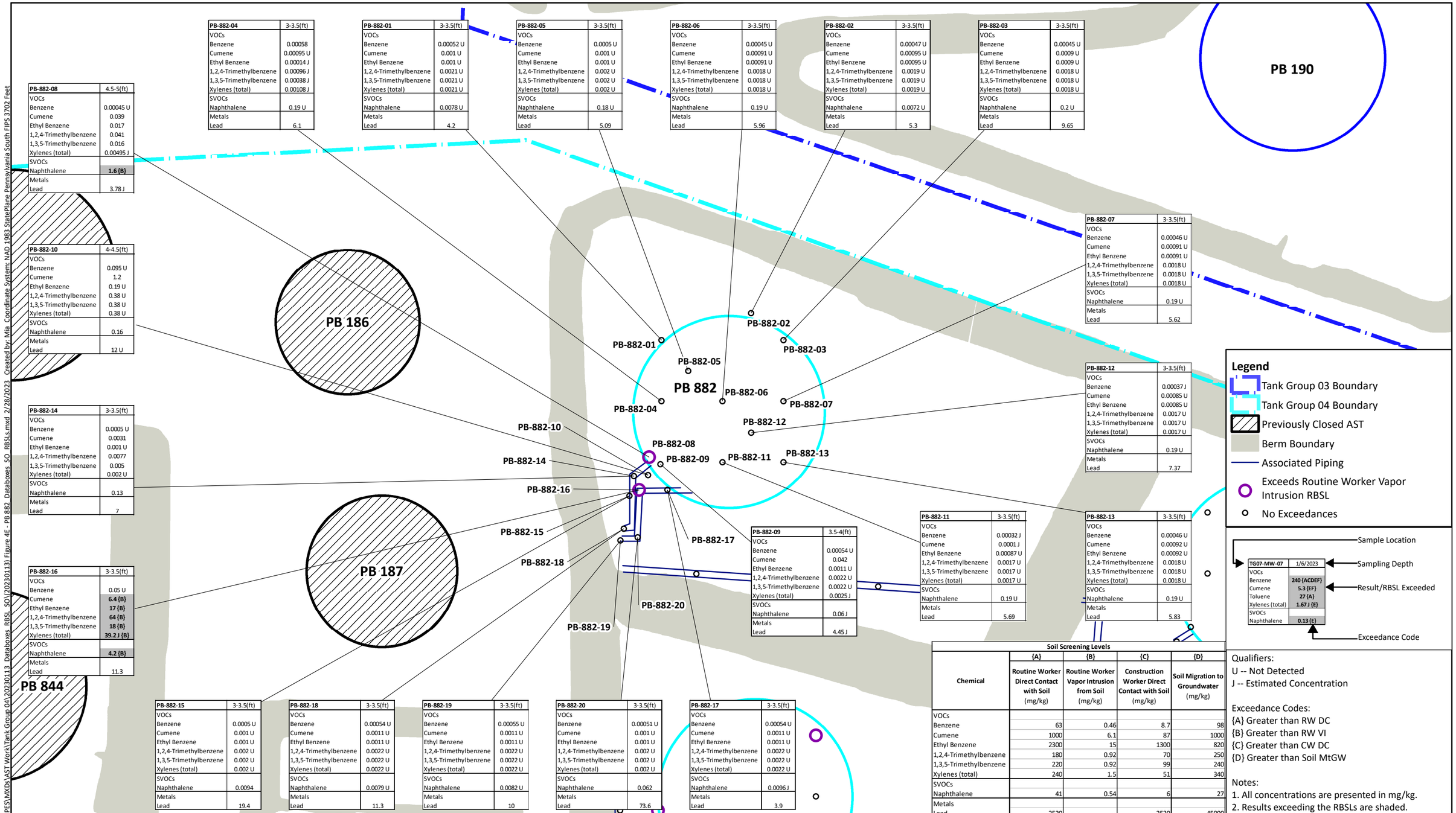
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 191)

Figure 4D

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4D - PB 191_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-882-04	3-3.5(ft)
VOCs	
Benzene	0.00058
Cumene	0.00095 U
Ethyl Benzene	0.00014 J
1,2,4-Trimethylbenzene	0.00096 J
1,3,5-Trimethylbenzene	0.00038 J
Xylenes (total)	0.00108 J
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	6.1

PB-882-01	3-3.5(ft)
VOCs	
Benzene	0.00052 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.0078 U
Metals	
Lead	4.2

PB-882-05	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	5.09

PB-882-06	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.00091 U
Ethyl Benzene	0.00091 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.96

PB-882-02	3-3.5(ft)
VOCs	
Benzene	0.00047 U
Cumene	0.00095 U
Ethyl Benzene	0.00095 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.0072 U
Metals	
Lead	5.3

PB-882-03	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.0009 U
Ethyl Benzene	0.0009 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	9.65

PB-882-08	4.5-5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.039
Ethyl Benzene	0.017
1,2,4-Trimethylbenzene	0.041
1,3,5-Trimethylbenzene	0.016
Xylenes (total)	0.00495 J
SVOCs	
Naphthalene	**1.6 {B}**
Metals	
Lead	3.78 J

PB-882-10	4-4.5(ft)
VOCs	
Benzene	0.095 U
Cumene	1.2
Ethyl Benzene	0.19 U
1,2,4-Trimethylbenzene	0.38 U
1,3,5-Trimethylbenzene	0.38 U
Xylenes (total)	0.38 U
SVOCs	
Naphthalene	0.16
Metals	
Lead	12 U

PB-882-07	3-3.5(ft)
VOCs	
Benzene	0.00046 U
Cumene	0.00091 U
Ethyl Benzene	0.00091 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.62

PB-882-12	3-3.5(ft)
VOCs	
Benzene	0.00037 J
Cumene	0.00085 U
Ethyl Benzene	0.00085 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	7.37

PB-882-14	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.0031
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0077
1,3,5-Trimethylbenzene	0.005
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.13
Metals	
Lead	7

PB-882-16	3-3.5(ft)
VOCs	
Benzene	0.05 U
Cumene	**6.4 {B}**
Ethyl Benzene	**17 {B}**
1,2,4-Trimethylbenzene	**64 {B}**
1,3,5-Trimethylbenzene	**18 {B}**
Xylenes (total)	**39.2 J {B}**
SVOCs	
Naphthalene	**4.2 {B}**
Metals	
Lead	11.3

PB-882-09	3.5-4(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.042
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0025 J
SVOCs	
Naphthalene	0.06 J
Metals	
Lead	4.45 J

PB-882-11	3-3.5(ft)
VOCs	
Benzene	0.00032 J
Cumene	0.0001 J
Ethyl Benzene	0.00087 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.69

PB-882-13	3-3.5(ft)
VOCs	
Benzene	0.00046 U
Cumene	0.00092 U
Ethyl Benzene	0.00092 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.83

PB-882-15	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.0094
Metals	
Lead	19.4

PB-882-18	3-3.5(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.0079 U
Metals	
Lead	11.3

PB-882-19	3-3.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.0082 U
Metals	
Lead	10

PB-882-20	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.062
Metals	
Lead	73.6

PB-882-17	3-3.5(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.0096 J
Metals	
Lead	3.9

Legend

- Tank Group 03 Boundary
- Tank Group 04 Boundary
- Previously Closed AST
- Berm Boundary
- Associated Piping
- Exceeds Routine Worker Vapor Intrusion RBSL
- No Exceedances

TG07-MW-07	1/6/2023
VOCs	
Benzene	**240 {ACDEF}**
Cumene	**5.3 {EF}**
Toluene	**27 {A}**
Xylenes (total)	**1.67 J {E}**
SVOCs	
Naphthalene	**0.13 {E}**

Sample Location
Sampling Depth
Result/RBSL Exceeded
Exceedance Code

Soil Screening Levels

Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

0 75 150 Feet
1 inch = 75 feet

N

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

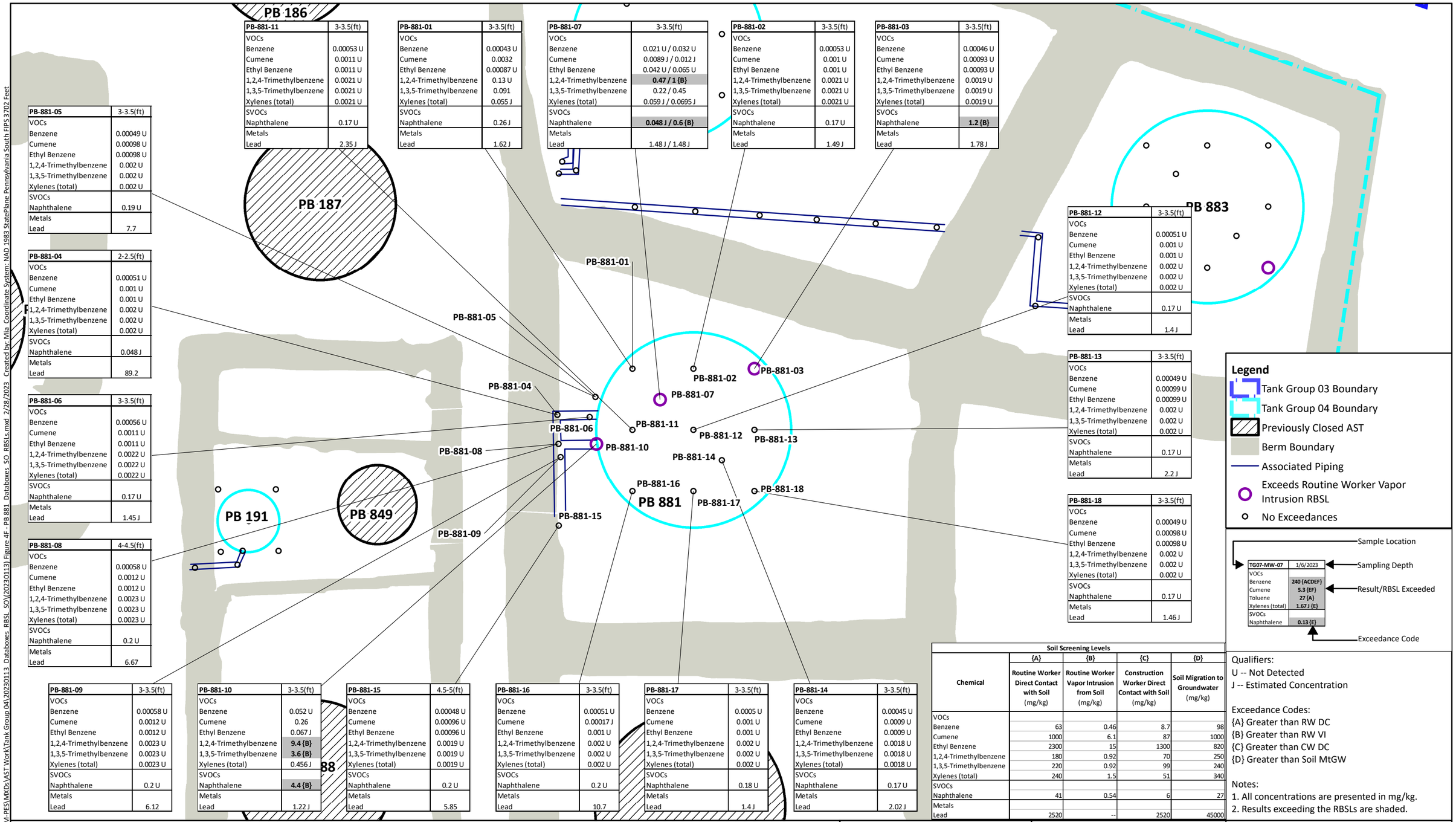
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 882)

Figure 4E

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4E - PB 882_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-881-11	3-3.5(ft)
VOCs	
Benzene	0.00053 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.35 J

PB-881-01	3-3.5(ft)
VOCs	
Benzene	0.00043 U
Cumene	0.0032
Ethyl Benzene	0.00087 U
1,2,4-Trimethylbenzene	0.13 U
1,3,5-Trimethylbenzene	0.091
Xylenes (total)	0.055 J
SVOCs	
Naphthalene	0.26 J
Metals	
Lead	1.62 J

PB-881-07	3-3.5(ft)
VOCs	
Benzene	0.021 U / 0.032 U
Cumene	0.0089 J / 0.012 J
Ethyl Benzene	0.042 U / 0.065 U
1,2,4-Trimethylbenzene	**0.47 / 1 {B}**
1,3,5-Trimethylbenzene	0.22 / 0.45
Xylenes (total)	0.059 J / 0.0695 J
SVOCs	
Naphthalene	**0.048 J / 0.6 {B}**
Metals	
Lead	1.48 J / 1.48 J

PB-881-02	3-3.5(ft)
VOCs	
Benzene	0.00053 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.49 J

PB-881-03	3-3.5(ft)
VOCs	
Benzene	0.00046 U
Cumene	0.00093 U
Ethyl Benzene	0.00093 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	**1.2 {B}**
Metals	
Lead	1.78 J

PB-881-05	3-3.5(ft)
VOCs	
Benzene	0.00049 U
Cumene	0.00098 U
Ethyl Benzene	0.00098 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	7.7

PB-881-04	2-2.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.048 J
Metals	
Lead	89.2

PB-881-06	3-3.5(ft)
VOCs	
Benzene	0.00056 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.45 J

PB-881-08	4-4.5(ft)
VOCs	
Benzene	0.00058 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	6.67

PB-881-12	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.4 J

PB-881-13	3-3.5(ft)
VOCs	
Benzene	0.00049 U
Cumene	0.00099 U
Ethyl Benzene	0.00099 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.2 J

PB-881-18	3-3.5(ft)
VOCs	
Benzene	0.00049 U
Cumene	0.00098 U
Ethyl Benzene	0.00098 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.46 J

PB-881-09	3-3.5(ft)
VOCs	
Benzene	0.00058 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	6.12

PB-881-10	3-3.5(ft)
VOCs	
Benzene	0.052 U
Cumene	0.26
Ethyl Benzene	0.067 J
1,2,4-Trimethylbenzene	**9.4 {B}**
1,3,5-Trimethylbenzene	**3.6 {B}**
Xylenes (total)	0.456 J
SVOCs	
Naphthalene	**4.4 {B}**
Metals	
Lead	1.22 J

PB-881-15	4.5-5(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00096 U
Ethyl Benzene	0.00096 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.85

PB-881-16	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.00017 J
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	10.7

PB-881-17	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	1.4 J

PB-881-14	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.0009 U
Ethyl Benzene	0.0009 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.02 J

Legend

- Tank Group 03 Boundary
- Tank Group 04 Boundary
- Previously Closed AST
- Berm Boundary
- Associated Piping
- Exceeds Routine Worker Vapor Intrusion RBSL
- No Exceedances

TG07-MW-07	1/6/2023
VOCs	
Benzene	**240 {ACDEF}**
Cumene	**5.3 {EF}**
Toluene	**27 {A}**
Xylenes (total)	**1.67 J {E}**
SVOCs	
Naphthalene	**0.13 {E}**

Sample Location
Sampling Depth
Result/RBSL Exceeded
Exceedance Code

Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

0 75 150 Feet
1 inch = 75 feet

N

SAFETY FIRST

terraphase engineering

CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

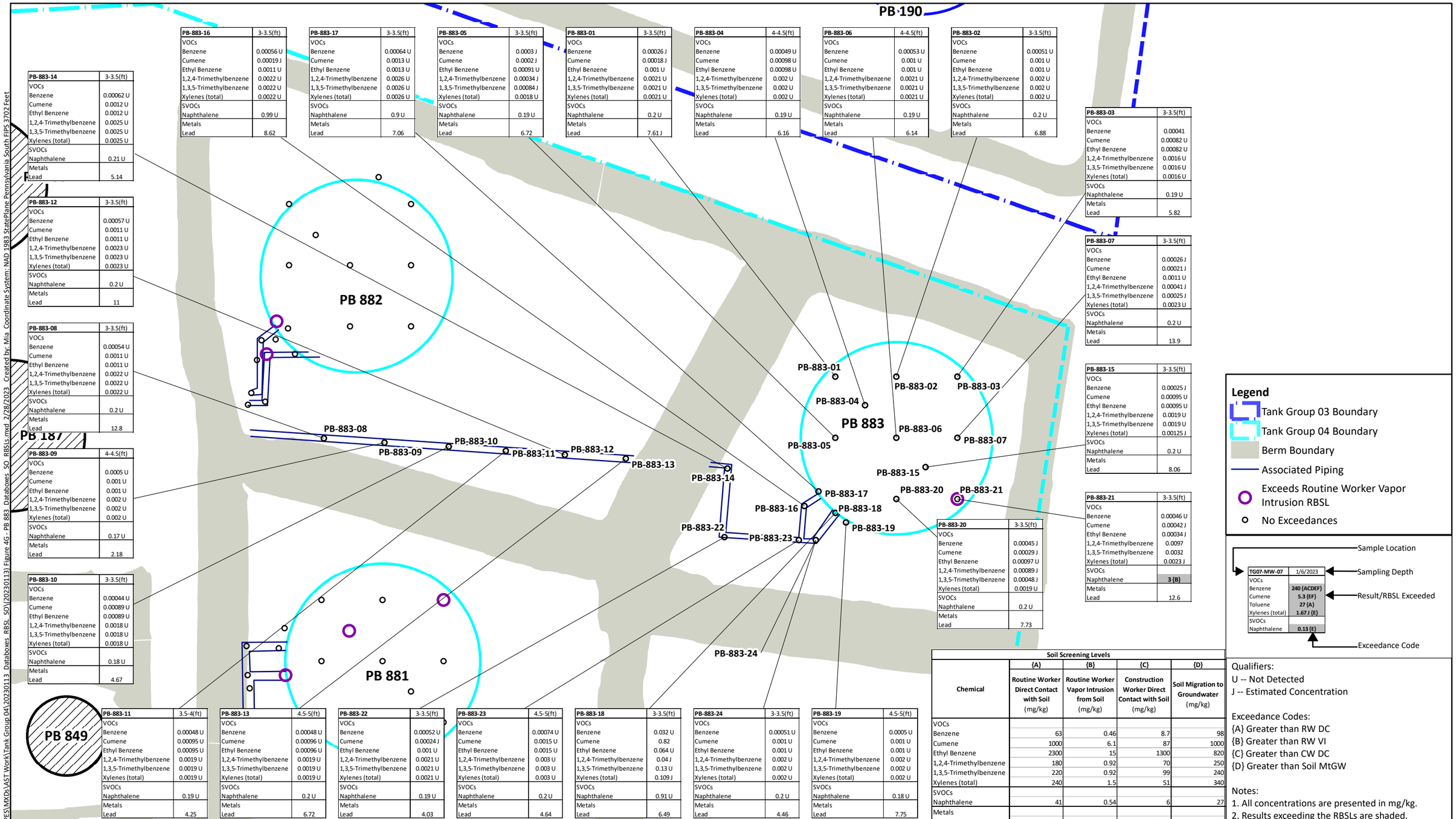
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 881)

Figure 4F

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4F - PB 881_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-883-16	3-3.5(ft)
VOCs	
Benzene	0.00056 U
Cumene	0.00019 J
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.99 U
Metals	
Lead	8.62

PB-883-17	3-3.5(ft)
VOCs	
Benzene	0.00064 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0026 U
1,3,5-Trimethylbenzene	0.0026 U
Xylenes (total)	0.0026 U
SVOCs	
Naphthalene	0.9 U
Metals	
Lead	7.06

PB-883-05	3-3.5(ft)
VOCs	
Benzene	0.0003 J
Cumene	0.0002 J
Ethyl Benzene	0.00091 U
1,2,4-Trimethylbenzene	0.00034 J
1,3,5-Trimethylbenzene	0.00084 J
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	6.72

PB-883-01	3-3.5(ft)
VOCs	
Benzene	0.00026 J
Cumene	0.00018 J
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	7.61 J

PB-883-04	4-4.5(ft)
VOCs	
Benzene	0.00049 U
Cumene	0.00098 U
Ethyl Benzene	0.00098 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	6.16

PB-883-06	4-4.5(ft)
VOCs	
Benzene	0.00053 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	6.14

PB-883-02	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	6.88

PB-883-14	3-3.5(ft)
VOCs	
Benzene	0.00062 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0025 U
1,3,5-Trimethylbenzene	0.0025 U
Xylenes (total)	0.0025 U
SVOCs	
Naphthalene	0.21 U
Metals	
Lead	5.14

PB-883-12	3-3.5(ft)
VOCs	
Benzene	0.00057 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	11

PB-883-08	3-3.5(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	12.8

PB-883-09	4-4.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.18

PB-883-10	3-3.5(ft)
VOCs	
Benzene	0.00044 U
Cumene	0.00089 U
Ethyl Benzene	0.00089 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	4.67

PB-883-03	3-3.5(ft)
VOCs	
Benzene	0.00041
Cumene	0.00082 U
Ethyl Benzene	0.00082 U
1,2,4-Trimethylbenzene	0.0016 U
1,3,5-Trimethylbenzene	0.0016 U
Xylenes (total)	0.0016 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.82

PB-883-07	3-3.5(ft)
VOCs	
Benzene	0.00026 J
Cumene	0.00021 J
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.00041 J
1,3,5-Trimethylbenzene	0.00025 J
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	13.9

PB-883-15	3-3.5(ft)
VOCs	
Benzene	0.00025 J
Cumene	0.00095 U
Ethyl Benzene	0.00095 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.00125 J
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	8.06

PB-883-21	3-3.5(ft)
VOCs	
Benzene	0.00046 U
Cumene	0.00042 J
Ethyl Benzene	0.00034 J
1,2,4-Trimethylbenzene	0.0097
1,3,5-Trimethylbenzene	0.0032
Xylenes (total)	0.0023 J
SVOCs	
Naphthalene	3 {B}
Metals	
Lead	12.6

PB-883-20	3-3.5(ft)
VOCs	
Benzene	0.00045 J
Cumene	0.00029 J
Ethyl Benzene	0.00097 U
1,2,4-Trimethylbenzene	0.00089 J
1,3,5-Trimethylbenzene	0.00048 J
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	7.73

PB-883-11	3.5-4(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00095 U
Ethyl Benzene	0.00095 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	4.25

PB-883-13	4.5-5(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00096 U
Ethyl Benzene	0.00096 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	6.72

PB-883-22	3-3.5(ft)
VOCs	
Benzene	0.00052 U
Cumene	0.00024 J
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	4.03

PB-883-23	4.5-5(ft)
VOCs	
Benzene	0.00074 U
Cumene	0.0015 U
Ethyl Benzene	0.0015 U
1,2,4-Trimethylbenzene	0.003 U
1,3,5-Trimethylbenzene	0.003 U
Xylenes (total)	0.003 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	4.64

PB-883-18	3-3.5(ft)
VOCs	
Benzene	0.032 U
Cumene	0.82
Ethyl Benzene	0.064 U
1,2,4-Trimethylbenzene	0.04 J
1,3,5-Trimethylbenzene	0.13 U
Xylenes (total)	0.109 J
SVOCs	
Naphthalene	0.91 U
Metals	
Lead	6.49

PB-883-24	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	4.46

PB-883-19	4.5-5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	7.75

Legend

- Tank Group 03 Boundary
- Tank Group 04 Boundary
- Berm Boundary
- Associated Piping
- Exceeds Routine Worker Vapor Intrusion RBSL
- No Exceedances

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

Sample Location
Sampling Depth
Result/RBSL Exceeded
Exceedance Code

Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

0 75 150 Feet
1 inch = 75 feet

N

SAFETY FIRST

terraphase engineering

CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

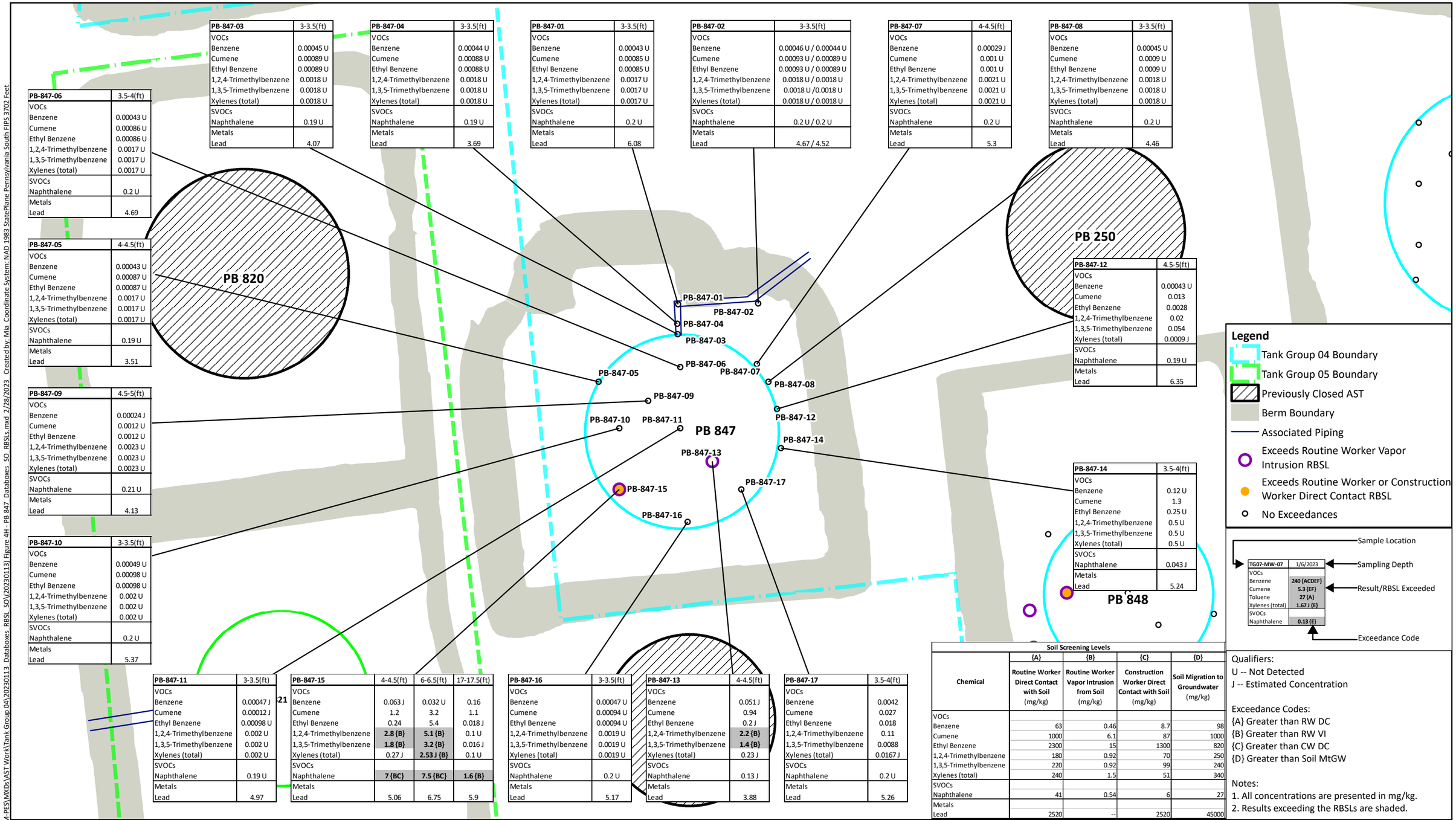
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 883)

Figure 4G

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4G - PB 883_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-847-03	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.00089 U
Ethyl Benzene	0.00089 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	4.07

PB-847-04	3-3.5(ft)
VOCs	
Benzene	0.00044 U
Cumene	0.00088 U
Ethyl Benzene	0.00088 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	3.69

PB-847-01	3-3.5(ft)
VOCs	
Benzene	0.00043 U
Cumene	0.00085 U
Ethyl Benzene	0.00085 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	6.08

PB-847-02	3-3.5(ft)
VOCs	
Benzene	0.00046 U / 0.00044 U
Cumene	0.00093 U / 0.00089 U
Ethyl Benzene	0.00093 U / 0.00089 U
1,2,4-Trimethylbenzene	0.0018 U / 0.0018 U
1,3,5-Trimethylbenzene	0.0018 U /0.0018 U
Xylenes (total)	0.0018 U / 0.0018 U
SVOCs	
Naphthalene	0.2 U / 0.2 U
Metals	
Lead	4.67 / 4.52

PB-847-07	4-4.5(ft)
VOCs	
Benzene	0.00029 J
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.3

PB-847-08	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.0009 U
Ethyl Benzene	0.0009 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	4.46

PB-847-06	3.5-4(ft)
VOCs	
Benzene	0.00043 U
Cumene	0.00086 U
Ethyl Benzene	0.00086 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	4.69

PB-847-05	4-4.5(ft)
VOCs	
Benzene	0.00043 U
Cumene	0.00087 U
Ethyl Benzene	0.00087 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	3.51

PB-847-09	4.5-5(ft)
VOCs	
Benzene	0.00024 J
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.21 U
Metals	
Lead	4.13

PB-847-10	3-3.5(ft)
VOCs	
Benzene	0.00049 U
Cumene	0.00098 U
Ethyl Benzene	0.00098 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.37

PB-847-12	4.5-5(ft)
VOCs	
Benzene	0.00043 U
Cumene	0.013
Ethyl Benzene	0.0028
1,2,4-Trimethylbenzene	0.02
1,3,5-Trimethylbenzene	0.054
Xylenes (total)	0.0009 J
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	6.35

PB-847-14	3.5-4(ft)
VOCs	
Benzene	0.12 U
Cumene	1.3
Ethyl Benzene	0.25 U
1,2,4-Trimethylbenzene	0.5 U
1,3,5-Trimethylbenzene	0.5 U
Xylenes (total)	0.5 U
SVOCs	
Naphthalene	0.043 J
Metals	
Lead	5.24

PB-847-11	3-3.5(ft)
VOCs	
Benzene	0.00047 J
Cumene	0.00012 J
Ethyl Benzene	0.00098 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	4.97

PB-847-15	4-4.5(ft)	6-6.5(ft)	17-17.5(ft)
VOCs			
Benzene	0.063 J	0.032 U	0.16
Cumene	1.2	3.2	1.1
Ethyl Benzene	0.24	5.4	0.018 J
1,2,4-Trimethylbenzene	**2.8 {B}**	**5.1 {B}**	0.1 U
1,3,5-Trimethylbenzene	**1.8 {B}**	**3.2 {B}**	0.016 J
Xylenes (total)	0.27 J	**2.53 J {B}**	0.1 U
SVOCs			
Naphthalene	**7 {BC}**	**7.5 {BC}**	**1.6 {B}**
Metals			
Lead	5.06	6.75	5.9

PB-847-16	3-3.5(ft)
VOCs	
Benzene	0.00047 U
Cumene	0.00094 U
Ethyl Benzene	0.00094 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.17

PB-847-13	4-4.5(ft)
VOCs	
Benzene	0.051 J
Cumene	0.94
Ethyl Benzene	0.2 J
1,2,4-Trimethylbenzene	**2.2 {B}**
1,3,5-Trimethylbenzene	**1.4 {B}**
Xylenes (total)	0.23 J
SVOCs	
Naphthalene	0.13 J
Metals	
Lead	3.88

PB-847-17	3.5-4(ft)
VOCs	
Benzene	0.0042
Cumene	0.027
Ethyl Benzene	0.018
1,2,4-Trimethylbenzene	0.11
1,3,5-Trimethylbenzene	0.0088
Xylenes (total)	0.0167 J
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.26

Soil Screening Levels

Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

0 75 150 Feet
1 inch = 75 feet

N

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

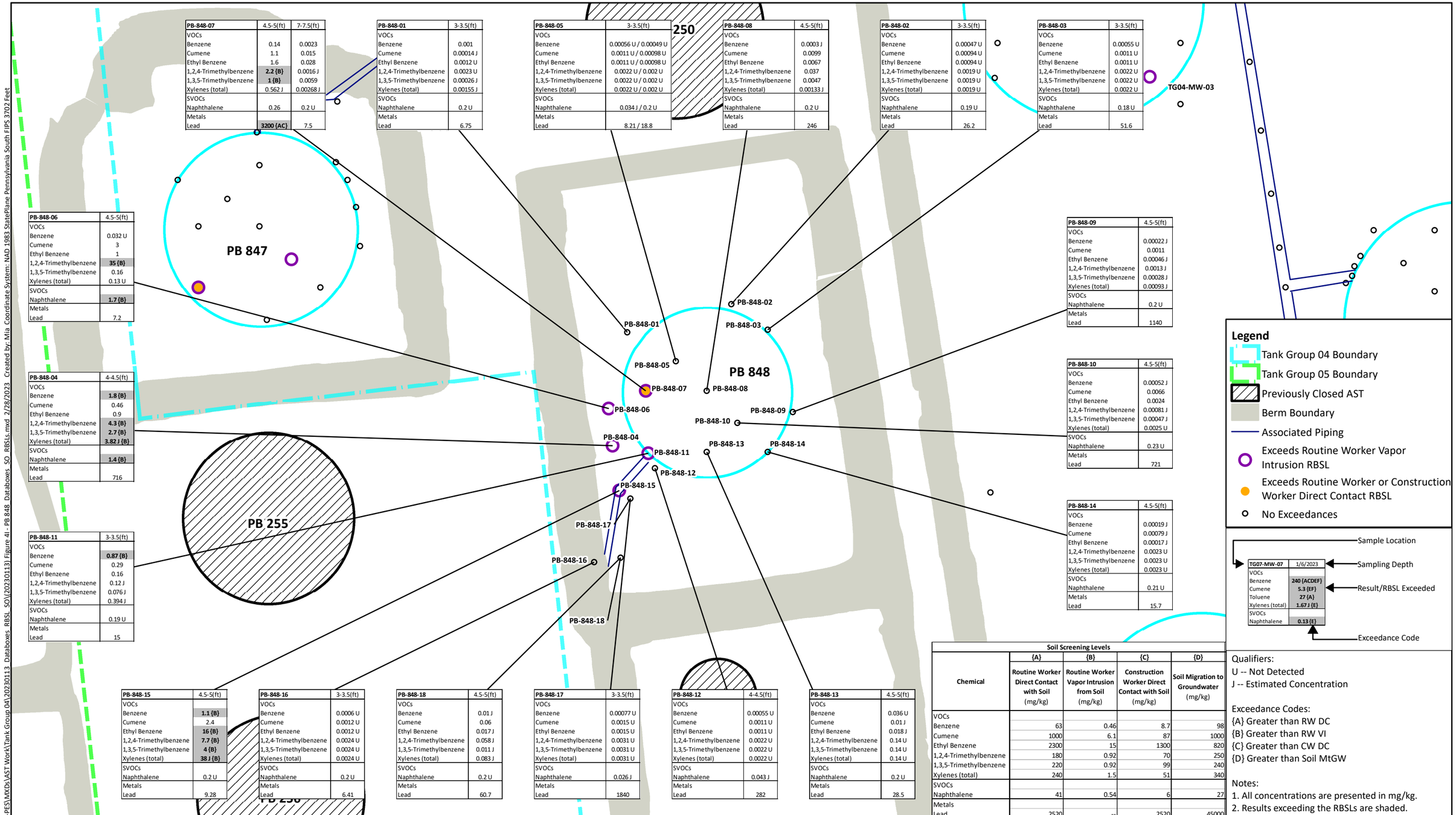
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 847)

Figure 4H

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4H - PB 847_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-848-07	4.5-5(ft)	7-7.5(ft)
VOCs		
Benzene	0.14	0.0023
Cumene	1.1	0.015
Ethyl Benzene	1.6	0.028
1,2,4-Trimethylbenzene	**2.2 {B}**	0.0016 J
1,3,5-Trimethylbenzene	**1 {B}**	0.0059
Xylenes (total)	0.562 J	0.00268 J
SVOCs		
Naphthalene	0.26	0.2 U
Metals		
Lead	**3200 {AC}**	7.5

PB-848-01	3-3.5(ft)
VOCs	
Benzene	0.001
Cumene	0.00014 J
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.00026 J
Xylenes (total)	0.00155 J
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	6.75

PB-848-05	3-3.5(ft)
VOCs	
Benzene	0.00056 U / 0.00049 U
Cumene	0.0011 U / 0.00098 U
Ethyl Benzene	0.0011 U / 0.00098 U
1,2,4-Trimethylbenzene	0.0022 U / 0.002 U
1,3,5-Trimethylbenzene	0.0022 U / 0.002 U
Xylenes (total)	0.0022 U / 0.002 U
SVOCs	
Naphthalene	0.034 J / 0.2 U
Metals	
Lead	8.21 / 18.8

PB-848-08	4.5-5(ft)
VOCs	
Benzene	0.0003 J
Cumene	0.0099
Ethyl Benzene	0.0067
1,2,4-Trimethylbenzene	0.037
1,3,5-Trimethylbenzene	0.0047
Xylenes (total)	0.00133 J
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	246

PB-848-02	3-3.5(ft)
VOCs	
Benzene	0.00047 U
Cumene	0.00094 U
Ethyl Benzene	0.00094 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	26.2

PB-848-03	3-3.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	51.6

PB-848-06	4.5-5(ft)
VOCs	
Benzene	0.032 U
Cumene	3
Ethyl Benzene	1
1,2,4-Trimethylbenzene	**35 {B}**
1,3,5-Trimethylbenzene	0.16
Xylenes (total)	0.13 U
SVOCs	
Naphthalene	**1.7 {B}**
Metals	
Lead	7.2

PB-848-04	4-4.5(ft)
VOCs	
Benzene	**1.8 {B}**
Cumene	0.46
Ethyl Benzene	0.9
1,2,4-Trimethylbenzene	**4.3 {B}**
1,3,5-Trimethylbenzene	**2.7 {B}**
Xylenes (total)	**3.82 J {B}**
SVOCs	
Naphthalene	**1.4 {B}**
Metals	
Lead	716

PB-848-11	3-3.5(ft)
VOCs	
Benzene	**0.87 {B}**
Cumene	0.29
Ethyl Benzene	0.16
1,2,4-Trimethylbenzene	0.12 J
1,3,5-Trimethylbenzene	0.076 J
Xylenes (total)	0.394 J
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	15

PB-848-09	4.5-5(ft)
VOCs	
Benzene	0.00022 J
Cumene	0.0011
Ethyl Benzene	0.00046 J
1,2,4-Trimethylbenzene	0.0013 J
1,3,5-Trimethylbenzene	0.00028 J
Xylenes (total)	0.00093 J
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	1140

PB-848-10	4.5-5(ft)
VOCs	
Benzene	0.00052 J
Cumene	0.0066
Ethyl Benzene	0.0024
1,2,4-Trimethylbenzene	0.00081 J
1,3,5-Trimethylbenzene	0.00047 J
Xylenes (total)	0.0025 U
SVOCs	
Naphthalene	0.23 U
Metals	
Lead	721

PB-848-14	4.5-5(ft)
VOCs	
Benzene	0.00019 J
Cumene	0.00079 J
Ethyl Benzene	0.00017 J
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.21 U
Metals	
Lead	15.7

PB-848-15	4.5-5(ft)
VOCs	
Benzene	**1.1 {B}**
Cumene	2.4
Ethyl Benzene	**16 {B}**
1,2,4-Trimethylbenzene	**7.7 {B}**
1,3,5-Trimethylbenzene	**4 {B}**
Xylenes (total)	**38 J {B}**
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	9.28

PB-848-16	3-3.5(ft)
VOCs	
Benzene	0.0006 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	6.41

PB-848-18	4.5-5(ft)
VOCs	
Benzene	0.01 J
Cumene	0.06
Ethyl Benzene	0.017 J
1,2,4-Trimethylbenzene	0.058 J
1,3,5-Trimethylbenzene	0.011 J
Xylenes (total)	0.083 J
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	60.7

PB-848-17	3-3.5(ft)
VOCs	
Benzene	0.00077 U
Cumene	0.0015 U
Ethyl Benzene	0.0015 U
1,2,4-Trimethylbenzene	0.0031 U
1,3,5-Trimethylbenzene	0.0031 U
Xylenes (total)	0.0031 U
SVOCs	
Naphthalene	0.026 J
Metals	
Lead	1840

PB-848-12	4-4.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.043 J
Metals	
Lead	282

PB-848-13	4.5-5(ft)
VOCs	
Benzene	0.036 U
Cumene	0.01 J
Ethyl Benzene	0.018 J
1,2,4-Trimethylbenzene	0.14 U
1,3,5-Trimethylbenzene	0.14 U
Xylenes (total)	0.14 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	28.5

Legend

- Tank Group 04 Boundary
- Tank Group 05 Boundary
- Previously Closed AST
- Berm Boundary
- Associated Piping
- Exceeds Routine Worker Vapor Intrusion RBSL
- Exceeds Routine Worker or Construction Worker Direct Contact RBSL
- No Exceedances

TG07-MW-07	1/6/2023
VOCs	
Benzene	**240 {ACDEF}**
Cumene	**5.3 {EF}**
Toluene	**27 {A}**
Xylenes (total)	**1.67 J {E}**
SVOCs	
Naphthalene	**0.13 {E}**

Sample Location
Sampling Depth
Result/RBSL Exceeded
Exceedance Code

Soil Screening Levels				
Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

0 75 150 Feet
1 inch = 75 feet

N

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

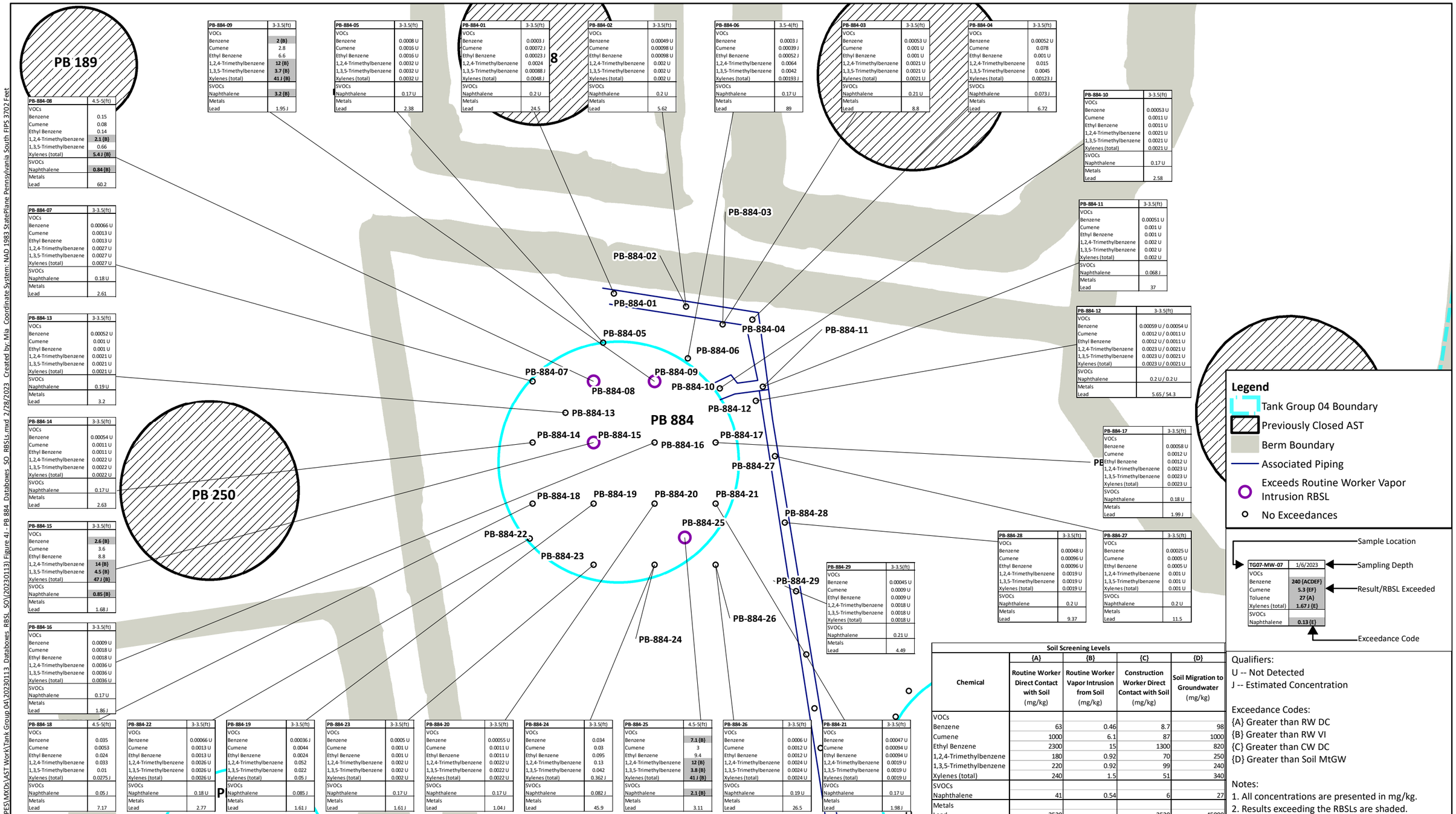
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 848)

Figure 4I

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4I - PB 848_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-884-09	3-3.5(ft)
VOCs	
Benzene	2 (B)
Cumene	2.8
Ethyl Benzene	6.6
1,2,4-Trimethylbenzene	12 (B)
1,3,5-Trimethylbenzene	3.7 (B)
Xylenes (total)	41 J (B)
SVOCs	
Naphthalene	3.2 (B)
Metals	
Lead	1.95 J

PB-884-05	3-3.5(ft)
VOCs	
Benzene	0.0008 U
Cumene	0.0016 U
Ethyl Benzene	0.0016 U
1,2,4-Trimethylbenzene	0.0032 U
1,3,5-Trimethylbenzene	0.0032 U
Xylenes (total)	0.0032 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.38

PB-884-01	3-3.5(ft)
VOCs	
Benzene	0.0003 J
Cumene	0.00072 J
Ethyl Benzene	0.00023 J
1,2,4-Trimethylbenzene	0.0024
1,3,5-Trimethylbenzene	0.00088 J
Xylenes (total)	0.0048 J
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	24.5

PB-884-02	3-3.5(ft)
VOCs	
Benzene	0.00049 U
Cumene	0.00098 U
Ethyl Benzene	0.00098 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.62

PB-884-06	3.5-4(ft)
VOCs	
Benzene	0.0003 J
Cumene	0.00039 J
Ethyl Benzene	0.00052 J
1,2,4-Trimethylbenzene	0.0064
1,3,5-Trimethylbenzene	0.0042
Xylenes (total)	0.00193 J
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	89

PB-884-03	3-3.5(ft)
VOCs	
Benzene	0.00053 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.21 U
Metals	
Lead	8.8

PB-884-04	3-3.5(ft)
VOCs	
Benzene	0.00052 U
Cumene	0.078
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.015
1,3,5-Trimethylbenzene	0.0045
Xylenes (total)	0.00123 J
SVOCs	
Naphthalene	0.073 J
Metals	
Lead	6.72

PB-884-08	4.5-5(ft)
VOCs	
Benzene	0.15
Cumene	0.08
Ethyl Benzene	0.14
1,2,4-Trimethylbenzene	2.1 (B)
1,3,5-Trimethylbenzene	0.66
Xylenes (total)	5.4 J (B)
SVOCs	
Naphthalene	0.84 (B)
Metals	
Lead	60.2

PB-884-10	3-3.5(ft)
VOCs	
Benzene	0.00053 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.58

PB-884-07	3-3.5(ft)
VOCs	
Benzene	0.00066 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0027 U
1,3,5-Trimethylbenzene	0.0027 U
Xylenes (total)	0.0027 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	2.61

PB-884-11	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.068 J
Metals	
Lead	37

PB-884-13	3-3.5(ft)
VOCs	
Benzene	0.00052 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	3.2

PB-884-12	3-3.5(ft)
VOCs	
Benzene	0.00059 U / 0.00054 U
Cumene	0.0012 U / 0.0011 U
Ethyl Benzene	0.0012 U / 0.0011 U
1,2,4-Trimethylbenzene	0.0023 U / 0.0021 U
1,3,5-Trimethylbenzene	0.0023 U / 0.0021 U
Xylenes (total)	0.0023 U / 0.0021 U
SVOCs	
Naphthalene	0.2 U / 0.2 U
Metals	
Lead	5.65 / 54.3

PB-884-14	3-3.5(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.63

PB-884-17	3-3.5(ft)
VOCs	
Benzene	0.00058 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	1.99 J

PB-884-15	3-3.5(ft)
VOCs	
Benzene	2.6 (B)
Cumene	3.6
Ethyl Benzene	8.8
1,2,4-Trimethylbenzene	14 (B)
1,3,5-Trimethylbenzene	4.5 (B)
Xylenes (total)	47 J (B)
SVOCs	
Naphthalene	0.85 (B)
Metals	
Lead	1.68 J

PB-884-28	3-3.5(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00096 U
Ethyl Benzene	0.00096 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	9.37

PB-884-27	3-3.5(ft)
VOCs	
Benzene	0.00025 U
Cumene	0.0005 U
Ethyl Benzene	0.0005 U
1,2,4-Trimethylbenzene	0.001 U
1,3,5-Trimethylbenzene	0.001 U
Xylenes (total)	0.001 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	11.5

PB-884-29	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.0009 U
Ethyl Benzene	0.0009 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.21 U
Metals	
Lead	4.49

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

PB-884-16	3-3.5(ft)
VOCs	
Benzene	0.0009 U
Cumene	0.0018 U
Ethyl Benzene	0.0018 U
1,2,4-Trimethylbenzene	0.0036 U
1,3,5-Trimethylbenzene	0.0036 U
Xylenes (total)	0.0036 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.86 J

PB-884-18	4.5-5(ft)
VOCs	
Benzene	0.035
Cumene	0.0053
Ethyl Benzene	0.024
1,2,4-Trimethylbenzene	0.033
1,3,5-Trimethylbenzene	0.01
Xylenes (total)	0.0275 J
SVOCs	
Naphthalene	0.05 J
Metals	
Lead	7.17

PB-884-22	3-3.5(ft)
VOCs	
Benzene	0.00066 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0026 U
1,3,5-Trimethylbenzene	0.0026 U
Xylenes (total)	0.0026 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	2.77

PB-884-19	3-3.5(ft)
VOCs	
Benzene	0.00036 J
Cumene	0.0044
Ethyl Benzene	0.0024
1,2,4-Trimethylbenzene	0.052
1,3,5-Trimethylbenzene	0.022
Xylenes (total)	0.05 J
SVOCs	
Naphthalene	0.085 J
Metals	
Lead	1.61 J

PB-884-23	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.61 J

PB-884-20	3-3.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.04 J

PB-884-24	3-3.5(ft)
VOCs	
Benzene	0.034
Cumene	0.03
Ethyl Benzene	0.095
1,2,4-Trimethylbenzene	0.13
1,3,5-Trimethylbenzene	0.042
Xylenes (total)	0.362 J
SVOCs	
Naphthalene	0.082 J
Metals	
Lead	45.9

PB-884-25	4.5-5(ft)
VOCs	
Benzene	7.1 (B)
Cumene	3
Ethyl Benzene	9.4
1,2,4-Trimethylbenzene	12 (B)
1,3,5-Trimethylbenzene	3.8 (B)
Xylenes (total)	41 J (B)
SVOCs	
Naphthalene	2.1 (B)
Metals	
Lead	3.11

PB-884-26	3-3.5(ft)
VOCs	
Benzene	0.0006 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	26.5

PB-884-21	3-3.5(ft)
VOCs	
Benzene	0.00047 U
Cumene	0.00094 U
Ethyl Benzene	0.00094 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.98 J

Soil Screening Levels

Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

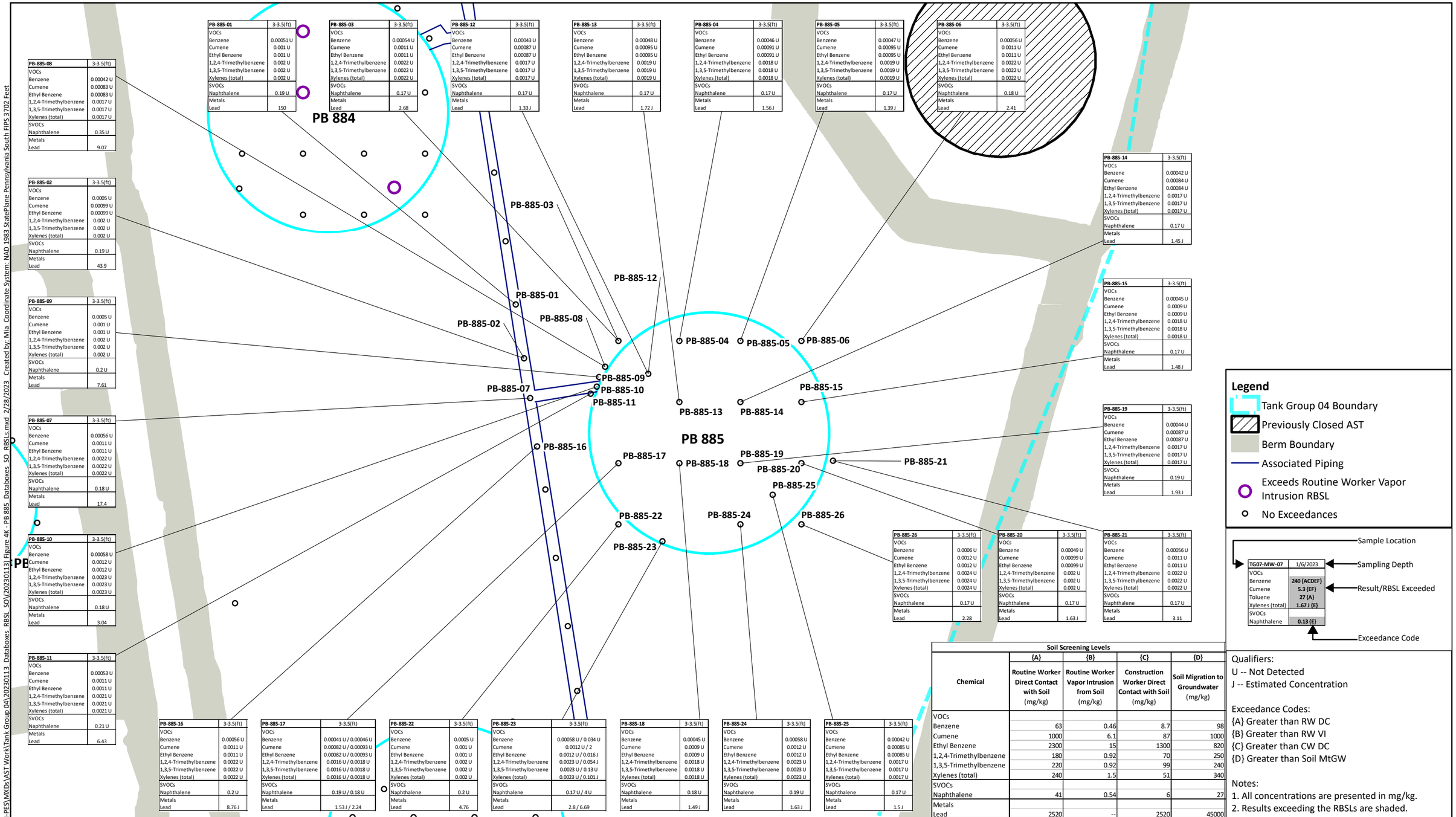
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs Tank Group 04 (AST PB 884)

Figure 4J

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4J - PB 884_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-885-01	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	150

PB-885-03	3-3.5(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.68

PB-885-12	3-3.5(ft)
VOCs	
Benzene	0.00043 U
Cumene	0.00087 U
Ethyl Benzene	0.00087 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.33 J

PB-885-13	3-3.5(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00095 U
Ethyl Benzene	0.00095 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.72 J

PB-885-04	3-3.5(ft)
VOCs	
Benzene	0.00046 U
Cumene	0.00091 U
Ethyl Benzene	0.00091 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.56 J

PB-885-05	3-3.5(ft)
VOCs	
Benzene	0.00047 U
Cumene	0.00095 U
Ethyl Benzene	0.00095 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.39 J

PB-885-06	3-3.5(ft)
VOCs	
Benzene	0.00056 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	2.41

PB-885-08	3-3.5(ft)
VOCs	
Benzene	0.00042 U
Cumene	0.00083 U
Ethyl Benzene	0.00083 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.35 U
Metals	
Lead	9.07

PB-885-02	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.00099 U
Ethyl Benzene	0.00099 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	43.9

PB-885-09	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	7.61

PB-885-07	3-3.5(ft)
VOCs	
Benzene	0.00056 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	17.4

PB-885-10	3-3.5(ft)
VOCs	
Benzene	0.00058 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	3.04

PB-885-11	3-3.5(ft)
VOCs	
Benzene	0.00053 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.21 U
Metals	
Lead	6.43

PB-885-14	3-3.5(ft)
VOCs	
Benzene	0.00042 U
Cumene	0.00084 U
Ethyl Benzene	0.00084 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.45 J

PB-885-15	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.0009 U
Ethyl Benzene	0.0009 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.48 J

PB-885-19	3-3.5(ft)
VOCs	
Benzene	0.00044 U
Cumene	0.00087 U
Ethyl Benzene	0.00087 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	1.93 J

PB-885-26	3-3.5(ft)
VOCs	
Benzene	0.0006 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.28

PB-885-20	3-3.5(ft)
VOCs	
Benzene	0.00049 U
Cumene	0.00099 U
Ethyl Benzene	0.00099 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.63 J

PB-885-21	3-3.5(ft)
VOCs	
Benzene	0.00056 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.11

PB-885-16	3-3.5(ft)
VOCs	
Benzene	0.00056 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	8.76 J

PB-885-17	3-3.5(ft)
VOCs	
Benzene	0.00041 U / 0.00046 U
Cumene	0.00082 U / 0.00093 U
Ethyl Benzene	0.00082 U / 0.00093 U
1,2,4-Trimethylbenzene	0.0016 U / 0.0018 U
1,3,5-Trimethylbenzene	0.0016 U / 0.0018 U
Xylenes (total)	0.0016 U / 0.0018 U
SVOCs	
Naphthalene	0.19 U / 0.18 U
Metals	
Lead	1.53 J / 2.24

PB-885-22	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	4.76

PB-885-23	3-3.5(ft)
VOCs	
Benzene	0.00058 U / 0.034 U
Cumene	0.0012 U / 2
Ethyl Benzene	0.0012 U / 0.016 J
1,2,4-Trimethylbenzene	0.0023 U / 0.054 J
1,3,5-Trimethylbenzene	0.0023 U / 0.13 U
Xylenes (total)	0.0023 U / 0.101 J
SVOCs	
Naphthalene	0.17 U / 4 U
Metals	
Lead	2.8 / 6.69

PB-885-18	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.0009 U
Ethyl Benzene	0.0009 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	1.49 J

PB-885-24	3-3.5(ft)
VOCs	
Benzene	0.00058 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	1.63 J

PB-885-25	3-3.5(ft)
VOCs	
Benzene	0.00042 U
Cumene	0.00085 U
Ethyl Benzene	0.00085 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	1.5 J

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

Soil Screening Levels				
Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

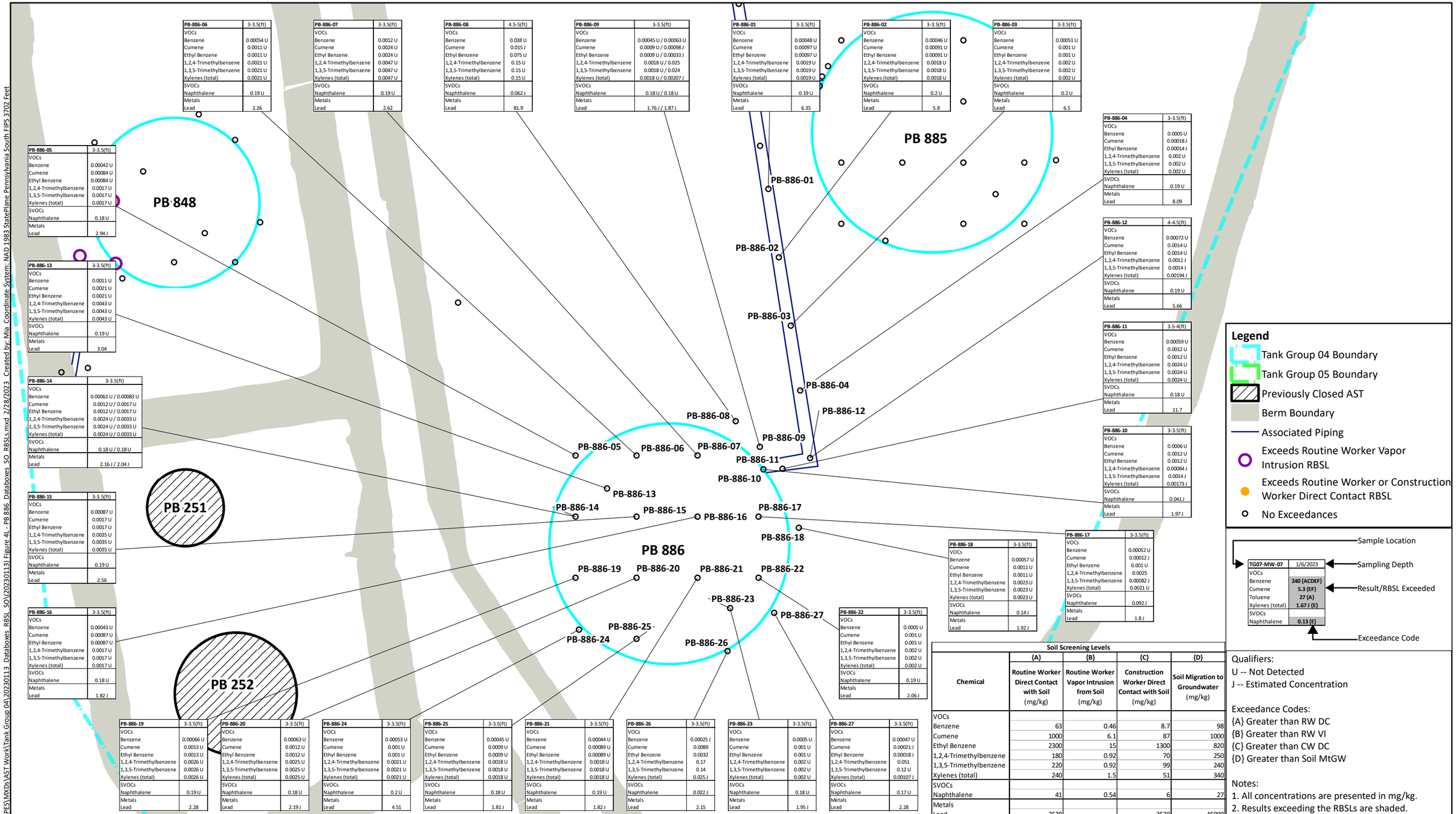
PROJECT: Aboveground Storage Tank Closure

PROJECT NUMBER: P044.001.002

Soil Sample Results Compared to RBSLs Tank Group 04 (AST PB 885)

Figure 4K

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4K - PB 885_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-886-06	3-3.5(ft)
VOCs	
Benzene	0.00054 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	2.26

PB-886-07	3-3.5(ft)
VOCs	
Benzene	0.0012 U
Cumene	0.0024 U
Ethyl Benzene	0.0024 U
1,2,4-Trimethylbenzene	0.0047 U
1,3,5-Trimethylbenzene	0.0047 U
Xylenes (total)	0.0047 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	2.62

PB-886-08	4.5-5(ft)
VOCs	
Benzene	0.038 U
Cumene	0.015 J
Ethyl Benzene	0.075 U
1,2,4-Trimethylbenzene	0.15 U
1,3,5-Trimethylbenzene	0.15 U
Xylenes (total)	0.15 U
SVOCs	
Naphthalene	0.062 J
Metals	
Lead	81.9

PB-886-09	3-3.5(ft)
VOCs	
Benzene	0.00045 U / 0.00063 U
Cumene	0.0009 U / 0.00098 J
Ethyl Benzene	0.0009 U / 0.00033 J
1,2,4-Trimethylbenzene	0.0018 U / 0.025
1,3,5-Trimethylbenzene	0.0018 U / 0.024
Xylenes (total)	0.0018 U / 0.00207 J
SVOCs	
Naphthalene	0.18 U / 0.18 U
Metals	
Lead	1.76 J / 1.87 J

PB-886-01	3-3.5(ft)
VOCs	
Benzene	0.00048 U
Cumene	0.00097 U
Ethyl Benzene	0.00097 U
1,2,4-Trimethylbenzene	0.0019 U
1,3,5-Trimethylbenzene	0.0019 U
Xylenes (total)	0.0019 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	6.35

PB-886-02	3-3.5(ft)
VOCs	
Benzene	0.00046 U
Cumene	0.00091 U
Ethyl Benzene	0.00091 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.8

PB-886-03	3-3.5(ft)
VOCs	
Benzene	0.00051 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	6.5

PB-886-04	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.00018 J
Ethyl Benzene	0.00014 J
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	8.09

PB-886-05	3-3.5(ft)
VOCs	
Benzene	0.00042 U
Cumene	0.00084 U
Ethyl Benzene	0.00084 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	2.94 J

PB-886-12	4-4.5(ft)
VOCs	
Benzene	0.00072 U
Cumene	0.0014 U
Ethyl Benzene	0.0014 U
1,2,4-Trimethylbenzene	0.0011 J
1,3,5-Trimethylbenzene	0.0014 J
Xylenes (total)	0.00194 J
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	5.66

PB-886-13	3-3.5(ft)
VOCs	
Benzene	0.0011 U
Cumene	0.0021 U
Ethyl Benzene	0.0021 U
1,2,4-Trimethylbenzene	0.0043 U
1,3,5-Trimethylbenzene	0.0043 U
Xylenes (total)	0.0043 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	3.04

PB-886-11	3.5-4(ft)
VOCs	
Benzene	0.00059 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	11.7

PB-886-14	3-3.5(ft)
VOCs	
Benzene	0.00061 U / 0.00083 U
Cumene	0.0012 U / 0.0017 U
Ethyl Benzene	0.0012 U / 0.0017 U
1,2,4-Trimethylbenzene	0.0024 U / 0.0033 U
1,3,5-Trimethylbenzene	0.0024 U / 0.0033 U
Xylenes (total)	0.0024 U / 0.0033 U
SVOCs	
Naphthalene	0.18 U / 0.18 U
Metals	
Lead	2.16 J / 2.04 J

PB-886-10	3-3.5(ft)
VOCs	
Benzene	0.0006 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.00084 J
1,3,5-Trimethylbenzene	0.0014 J
Xylenes (total)	0.00173 J
SVOCs	
Naphthalene	0.041 J
Metals	
Lead	1.97 J

PB-886-15	3-3.5(ft)
VOCs	
Benzene	0.00087 U
Cumene	0.0017 U
Ethyl Benzene	0.0017 U
1,2,4-Trimethylbenzene	0.0035 U
1,3,5-Trimethylbenzene	0.0035 U
Xylenes (total)	0.0035 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	2.56

PB-886-18	3-3.5(ft)
VOCs	
Benzene	0.00057 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0023 U
1,3,5-Trimethylbenzene	0.0023 U
Xylenes (total)	0.0023 U
SVOCs	
Naphthalene	0.14 J
Metals	
Lead	1.92 J

PB-886-17	3-3.5(ft)
VOCs	
Benzene	0.00052 U
Cumene	0.00012 J
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0025
1,3,5-Trimethylbenzene	0.00082 J
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.092 J
Metals	
Lead	1.8 J

PB-886-16	3-3.5(ft)
VOCs	
Benzene	0.00043 U
Cumene	0.00087 U
Ethyl Benzene	0.00087 U
1,2,4-Trimethylbenzene	0.0017 U
1,3,5-Trimethylbenzene	0.0017 U
Xylenes (total)	0.0017 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	1.82 J

PB-886-22	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	2.06 J

PB-886-19	3-3.5(ft)
VOCs	
Benzene	0.00066 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0026 U
1,3,5-Trimethylbenzene	0.0026 U
Xylenes (total)	0.0026 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	2.28

PB-886-20	3-3.5(ft)
VOCs	
Benzene	0.00063 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0025 U
1,3,5-Trimethylbenzene	0.0025 U
Xylenes (total)	0.0025 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	2.19 J

PB-886-24	3-3.5(ft)
VOCs	
Benzene	0.00053 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	4.51

PB-886-25	3-3.5(ft)
VOCs	
Benzene	0.00045 U
Cumene	0.0009 U
Ethyl Benzene	0.0009 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	1.81 J

PB-886-21	3-3.5(ft)
VOCs	
Benzene	0.00044 U
Cumene	0.00089 U
Ethyl Benzene	0.00089 U
1,2,4-Trimethylbenzene	0.0018 U
1,3,5-Trimethylbenzene	0.0018 U
Xylenes (total)	0.0018 U
SVOCs	
Naphthalene	0.19 U
Metals	
Lead	1.82 J

PB-886-26	3-3.5(ft)
VOCs	
Benzene	0.00025 J
Cumene	0.0089
Ethyl Benzene	0.0032
1,2,4-Trimethylbenzene	0.17
1,3,5-Trimethylbenzene	0.14
Xylenes (total)	0.025 J
SVOCs	
Naphthalene	0.022 J
Metals	
Lead	2.15

PB-886-23	3-3.5(ft)
VOCs	
Benzene	0.0005 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	1.95 J

PB-886-27	3-3.5(ft)
VOCs	
Benzene	0.00047 U
Cumene	0.00021 J
Ethyl Benzene	0.00018 J
1,2,4-Trimethylbenzene	0.051
1,3,5-Trimethylbenzene	0.12 U
Xylenes (total)	0.00107 J
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	2.28

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

Soil Screening Levels

Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

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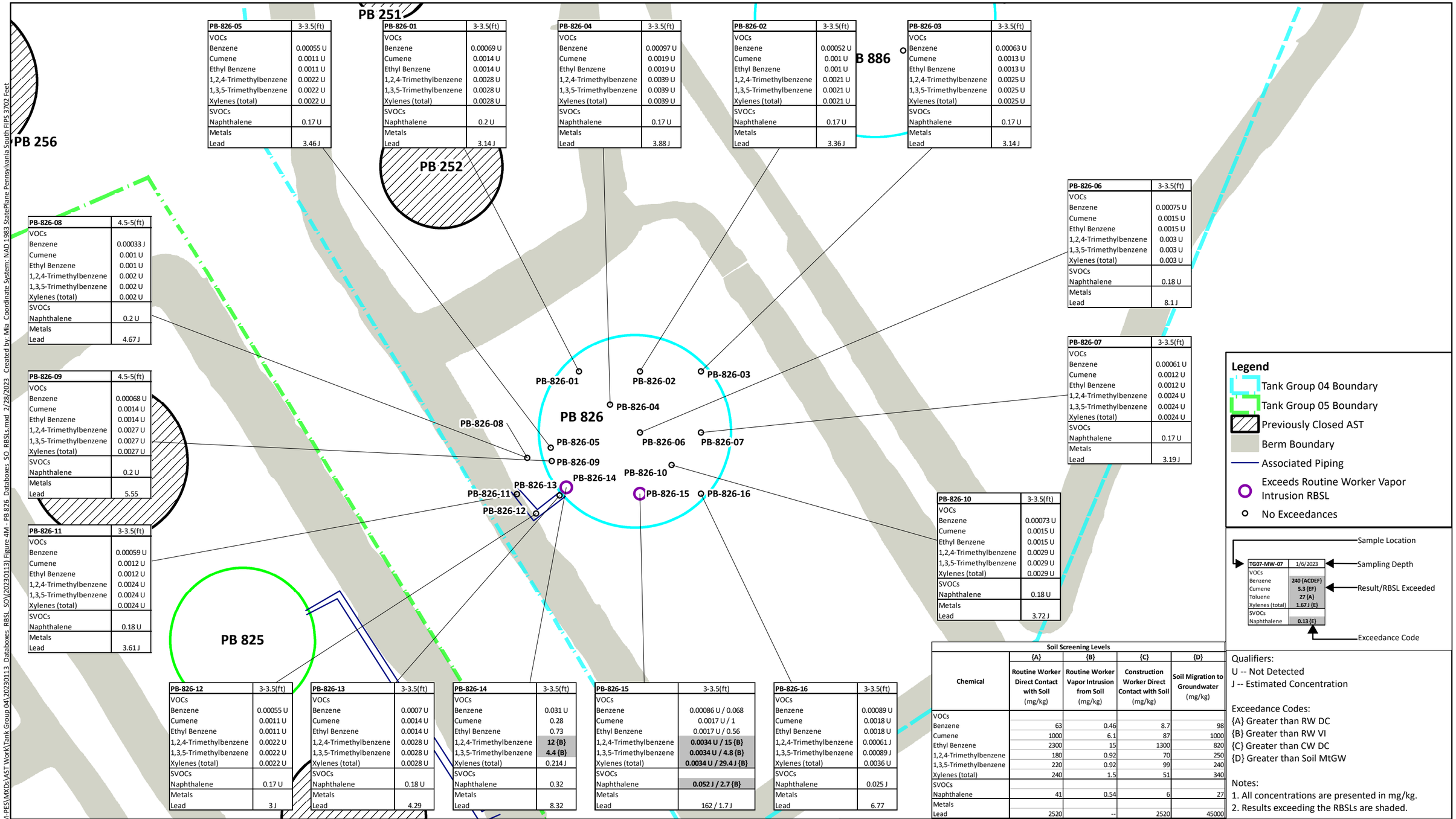
Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 886)

Figure 4L

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4L - PB 886_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



PB-826-05	3-3.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.46 J

PB-826-01	3-3.5(ft)
VOCs	
Benzene	0.00069 U
Cumene	0.0014 U
Ethyl Benzene	0.0014 U
1,2,4-Trimethylbenzene	0.0028 U
1,3,5-Trimethylbenzene	0.0028 U
Xylenes (total)	0.0028 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	3.14 J

PB-826-04	3-3.5(ft)
VOCs	
Benzene	0.00097 U
Cumene	0.0019 U
Ethyl Benzene	0.0019 U
1,2,4-Trimethylbenzene	0.0039 U
1,3,5-Trimethylbenzene	0.0039 U
Xylenes (total)	0.0039 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.88 J

PB-826-02	3-3.5(ft)
VOCs	
Benzene	0.00052 U
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.0021 U
1,3,5-Trimethylbenzene	0.0021 U
Xylenes (total)	0.0021 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.36 J

PB-826-03	3-3.5(ft)
VOCs	
Benzene	0.00063 U
Cumene	0.0013 U
Ethyl Benzene	0.0013 U
1,2,4-Trimethylbenzene	0.0025 U
1,3,5-Trimethylbenzene	0.0025 U
Xylenes (total)	0.0025 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.14 J

PB-826-06	3-3.5(ft)
VOCs	
Benzene	0.00075 U
Cumene	0.0015 U
Ethyl Benzene	0.0015 U
1,2,4-Trimethylbenzene	0.003 U
1,3,5-Trimethylbenzene	0.003 U
Xylenes (total)	0.003 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	8.1 J

PB-826-07	3-3.5(ft)
VOCs	
Benzene	0.00061 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3.19 J

PB-826-08	4.5-5(ft)
VOCs	
Benzene	0.00033 J
Cumene	0.001 U
Ethyl Benzene	0.001 U
1,2,4-Trimethylbenzene	0.002 U
1,3,5-Trimethylbenzene	0.002 U
Xylenes (total)	0.002 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	4.67 J

PB-826-09	4.5-5(ft)
VOCs	
Benzene	0.00068 U
Cumene	0.0014 U
Ethyl Benzene	0.0014 U
1,2,4-Trimethylbenzene	0.0027 U
1,3,5-Trimethylbenzene	0.0027 U
Xylenes (total)	0.0027 U
SVOCs	
Naphthalene	0.2 U
Metals	
Lead	5.55

PB-826-11	3-3.5(ft)
VOCs	
Benzene	0.00059 U
Cumene	0.0012 U
Ethyl Benzene	0.0012 U
1,2,4-Trimethylbenzene	0.0024 U
1,3,5-Trimethylbenzene	0.0024 U
Xylenes (total)	0.0024 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	3.61 J

PB-826-10	3-3.5(ft)
VOCs	
Benzene	0.00073 U
Cumene	0.0015 U
Ethyl Benzene	0.0015 U
1,2,4-Trimethylbenzene	0.0029 U
1,3,5-Trimethylbenzene	0.0029 U
Xylenes (total)	0.0029 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	3.72 J

PB-826-12	3-3.5(ft)
VOCs	
Benzene	0.00055 U
Cumene	0.0011 U
Ethyl Benzene	0.0011 U
1,2,4-Trimethylbenzene	0.0022 U
1,3,5-Trimethylbenzene	0.0022 U
Xylenes (total)	0.0022 U
SVOCs	
Naphthalene	0.17 U
Metals	
Lead	3 J

PB-826-13	3-3.5(ft)
VOCs	
Benzene	0.0007 U
Cumene	0.0014 U
Ethyl Benzene	0.0014 U
1,2,4-Trimethylbenzene	0.0028 U
1,3,5-Trimethylbenzene	0.0028 U
Xylenes (total)	0.0028 U
SVOCs	
Naphthalene	0.18 U
Metals	
Lead	4.29

PB-826-14	3-3.5(ft)
VOCs	
Benzene	0.031 U
Cumene	0.28
Ethyl Benzene	0.73
1,2,4-Trimethylbenzene	**12 {B}**
1,3,5-Trimethylbenzene	**4.4 {B}**
Xylenes (total)	0.214 J
SVOCs	
Naphthalene	0.32
Metals	
Lead	8.32

PB-826-15	3-3.5(ft)
VOCs	
Benzene	0.00086 U / 0.068
Cumene	0.0017 U / 1
Ethyl Benzene	0.0017 U / 0.56
1,2,4-Trimethylbenzene	**0.0034 U / 15 {B}**
1,3,5-Trimethylbenzene	**0.0034 U / 4.8 {B}**
Xylenes (total)	**0.0034 U / 29.4 J {B}**
SVOCs	
Naphthalene	**0.052 J / 2.7 {B}**
Metals	
Lead	162 / 1.7 J

PB-826-16	3-3.5(ft)
VOCs	
Benzene	0.00089 U
Cumene	0.0018 U
Ethyl Benzene	0.0018 U
1,2,4-Trimethylbenzene	0.00061 J
1,3,5-Trimethylbenzene	0.00089 J
Xylenes (total)	0.0036 U
SVOCs	
Naphthalene	0.025 J
Metals	
Lead	6.77

Soil Screening Levels				
Chemical	{A} Routine Worker Direct Contact with Soil (mg/kg)	{B} Routine Worker Vapor Intrusion from Soil (mg/kg)	{C} Construction Worker Direct Contact with Soil (mg/kg)	{D} Soil Migration to Groundwater (mg/kg)
VOCs				
Benzene	63	0.46	8.7	98
Cumene	1000	6.1	87	1000
Ethyl Benzene	2300	15	1300	820
1,2,4-Trimethylbenzene	180	0.92	70	250
1,3,5-Trimethylbenzene	220	0.92	99	240
Xylenes (total)	240	1.5	51	340
SVOCs				
Naphthalene	41	0.54	6	27
Metals				
Lead	2520	--	2520	45000

Qualifiers:
U -- Not Detected
J -- Estimated Concentration

Exceedance Codes:
{A} Greater than RW DC
{B} Greater than RW VI
{C} Greater than CW DC
{D} Greater than Soil MtGW

Notes:
1. All concentrations are presented in mg/kg.
2. Results exceeding the RBSLs are shaded.

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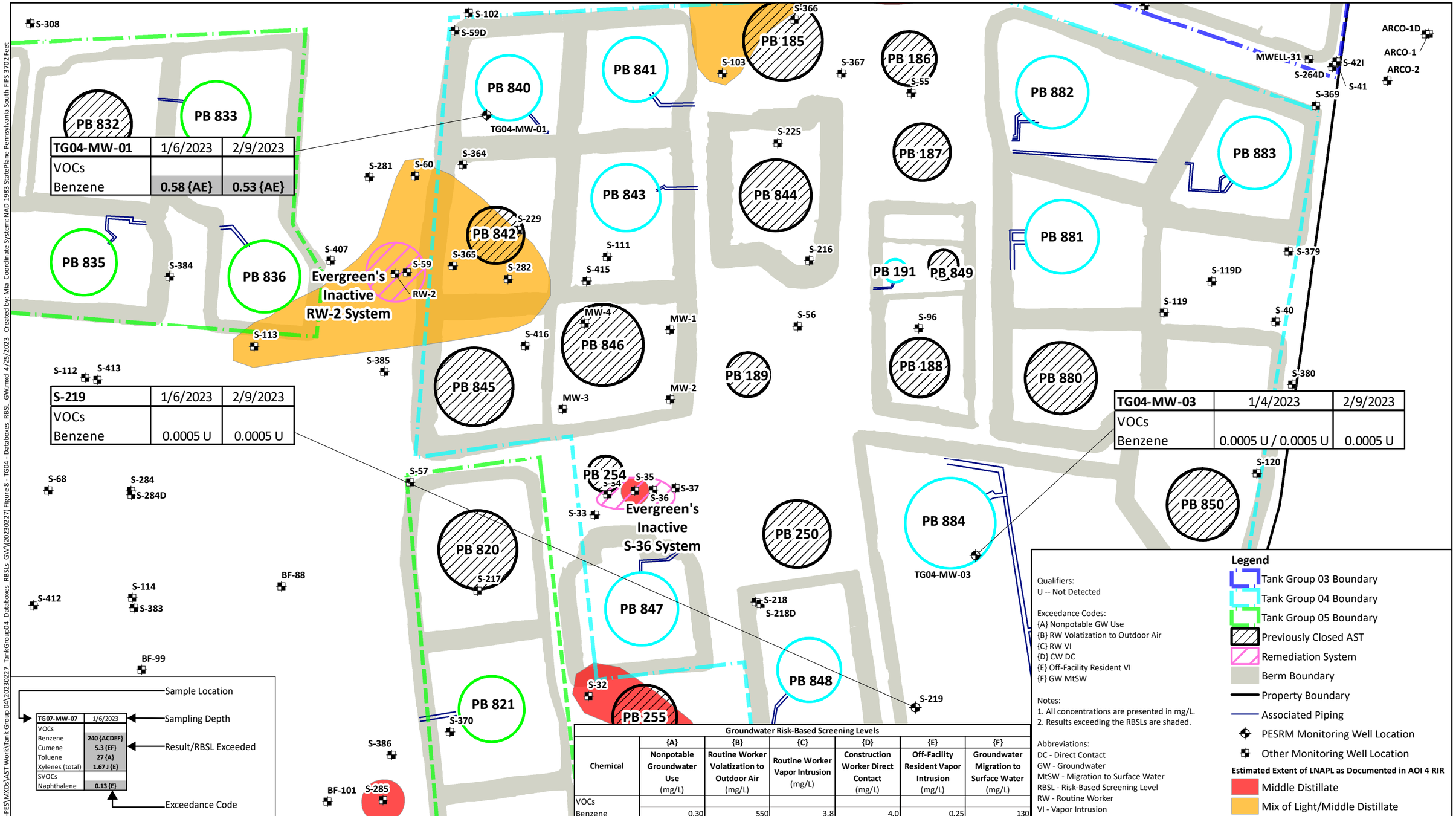
Soil Sample Results Compared to RBSLs
Tank Group 04
(AST PB 826)

Figure 4M

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230113_Databoxes_RBSL_SO\(20230113) Figure 4M - PB 826_Databoxes_SO_RBSLs.mxd 2/28/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



TG04-MW-01	1/6/2023	2/9/2023
VOCs		
Benzene	0.58 {AE}	0.53 {AE}

S-219	1/6/2023	2/9/2023
VOCs		
Benzene	0.0005 U	0.0005 U

TG04-MW-03	1/4/2023	2/9/2023
VOCs		
Benzene	0.0005 U / 0.0005 U	0.0005 U

TG07-MW-07	1/6/2023
VOCs	
Benzene	240 {ACDEF}
Cumene	5.3 {EF}
Toluene	27 {A}
Xylenes (total)	1.67 J {E}
SVOCs	
Naphthalene	0.13 {E}

Sample Location
Sampling Depth
Result/RBSL Exceeded
Exceedance Code

Groundwater Risk-Based Screening Levels

Chemical	{A} Nonpotable Groundwater Use (mg/L)	{B} Routine Worker Volatization to Outdoor Air (mg/L)	{C} Routine Worker Vapor Intrusion (mg/L)	{D} Construction Worker Direct Contact (mg/L)	{E} Off-Facility Resident Vapor Intrusion (mg/L)	{F} Groundwater Migration to Surface Water (mg/L)
VOCs						
Benzene	0.30	550	3.8	4.0	0.25	130

Qualifiers:
U -- Not Detected

Exceedance Codes:
{A} Nonpotable GW Use
{B} RW Volatization to Outdoor Air
{C} RW VI
{D} CW DC
{E} Off-Facility Resident VI
{F} GW MtSW

Notes:
1. All concentrations are presented in mg/L.
2. Results exceeding the RBSLs are shaded.

Abbreviations:
DC - Direct Contact
GW - Groundwater
MtSW - Migration to Surface Water
RBSL - Risk-Based Screening Level
RW - Routine Worker
VI - Vapor Intrusion

Legend
- Tank Group 03 Boundary
- Tank Group 04 Boundary
- Tank Group 05 Boundary
- Previously Closed AST
- Remediation System
- Berm Boundary
- Property Boundary
- Associated Piping
- PESRM Monitoring Well Location
- Other Monitoring Well Location

Estimated Extent of LNAPL as Documented in AOI 4 RIR
- Middle Distillate
- Mix of Light/Middle Distillate

0 100 200 300 400 Feet
1 inch = 200 feet

N

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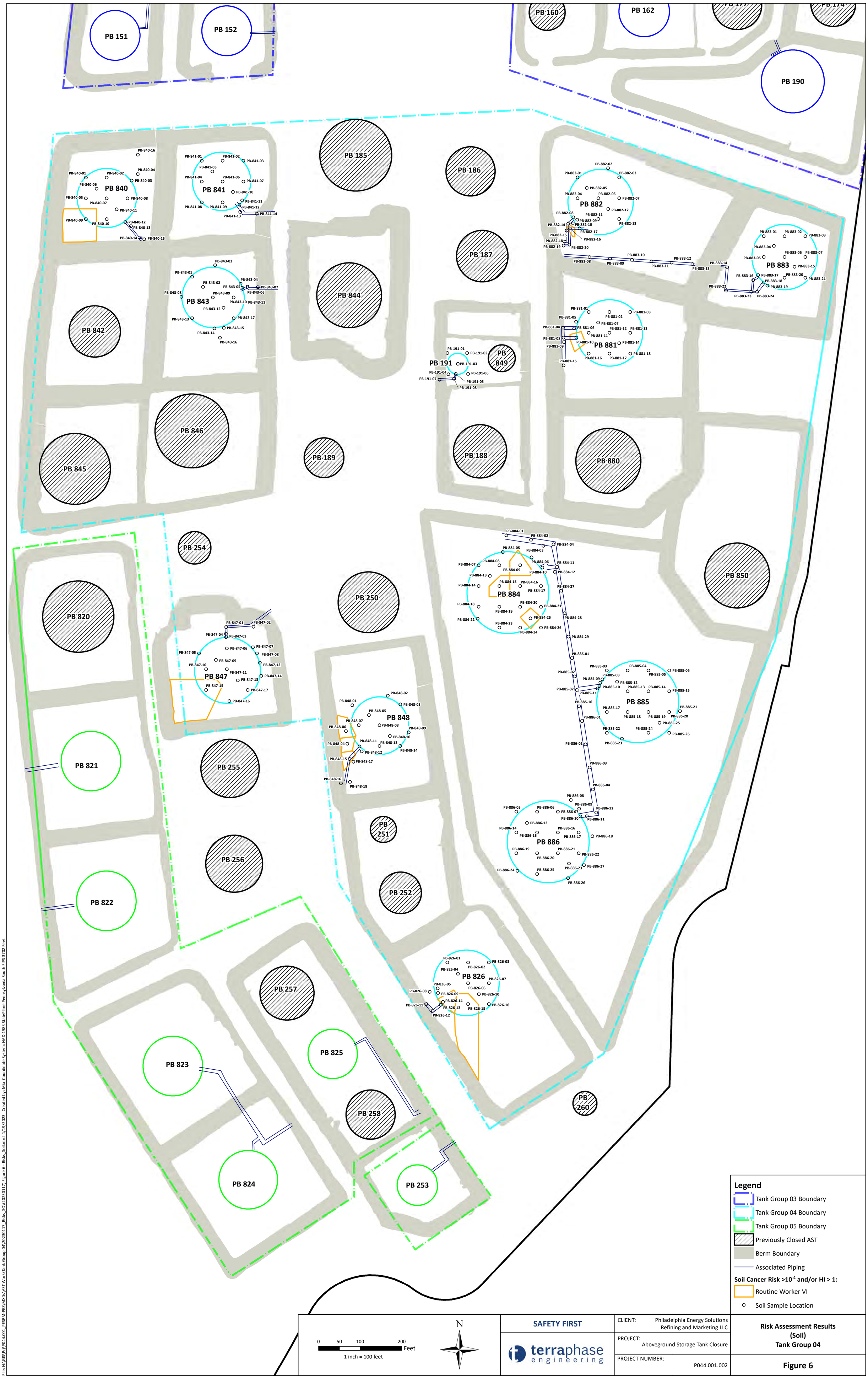
Groundwater Sample Results Compared to RBSLs Tank Group 04

Figure 5

File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230227_TankGroup04_Databoxes_RBSLs_GW\(20230227) Figure 8 - TG04 - Databoxes_RBSL_GW.mxd 4/25/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet


PB 151
PB 152
PB 160
PB 162
PB 190
PB 185
PB 186
PB 187
PB 844
PB 842
PB 846
PB 845
PB 189
PB 188
PB 880
PB 254
PB 820
PB 250
PB 850
PB 821
PB 255
PB 256
PB 251
PB 252
PB 822
PB 257
PB 823
PB 825
PB 258
PB 260
PB 824
PB 253
PB 840
PB 841
PB 843
PB 882
PB 883
PB 881
PB 191
PB 849
PB 884
PB 847
PB 848
PB 885
PB 886
PB 826
Legend
Tank Group 03 Boundary
Tank Group 04 Boundary
Tank Group 05 Boundary
Previously Closed AST
Berm Boundary
Associated Piping
Soil Cancer Risk >10-4 and/or HI > 1:
Routine Worker VI
Soil Sample Location
0 50 100 200 Feet
1 inch = 100 feet
N
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PROJECT NUMBER: P044.001.002
Risk Assessment Results (Soil) Tank Group 04
Figure 6
File: N:\GIS\Prj\P044.001_PESRM-PES\MXDs\AST Work\Tank Group 04\20230117_Risks_SQ\(20230117) Figure 6 - Risks_Soil.mxd 1/19/2023 Created by: Mia Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

Appendix A

Human Health Risk Assessment Supporting Information and Calculations

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1 Toxicity Values and Physical and Chemical Properties
2 Routine Worker Risk Calculations
3 Maintenance Work Risk Calculations
4 Construction Worker Risk Calculations
5 Off-Facility Resident Risk Calculations
6 Soil Migration to Groundwater Calculations
7 Nonpotable Groundwater Use Risk Based Screening Level Calculation
8 Single-Chemical Risk Estimates

1 Introduction

This appendix provides supplemental information supporting the human health risk assessment presented in Section 5 of the *Site-Specific Human Health Risk Assessment (*the Risk Assessment*)*. The methods used in the human health risk assessment are based on Pennsylvania Department of Environmental protection (PADEP) and the United States Environmental Protection Agency (USEPA) risk assessment guidance.

Section 5.3.1 of the Risk Assessment describes how cumulative cancer risks and noncancer hazardous Indexes (HIs) are calculated for each of the receptors potentially exposed to constituents of potential concerns (COPCs) at the Site. Several key elements of the risk assessment calculations are presented and discussed in the Risk Assessment and not repeated in this appendix. This includes the selection of COPCs (Section 3.1), the compilation of toxicity values (Section 5.2), the identification of receptors and scenarios for potential human exposure (Section 5.1.1), exposure factors used (Section 5.1.4), and the calculation of receptor specific exposure concentrations (Section 5.1.2).

This appendix provides additional details regarding how the risk calculations are performed for each receptor. This includes the fate and transport modeling needed to estimate exposure concentrations for specific receptors and specific exposure scenarios. The chemical properties used in these fate and transport modeling are provided in Attachment 1, Table 1.

The appendix is organized into sections corresponding to the following potentially exposed populations discussed in Section 5.1 of the Risk Assessment:

- Routine Workers
- Maintenance Workers
- Construction Workers
- Off-Facility Residents

2 Risk Estimation Methodology

Section 5.3.1 of the Risk Assessment describes how cancer risk and noncancer HI are calculated for receptors potentially exposed to COPCs in soil and groundwater at the Site. The exposure factors used in the risk calculations and their bases are presented in Section 5.1.4 of the Risk Assessment and are not repeated herein.

The cancer risk associated with potential exposure to a carcinogenic constituent via ingestion and dermal contact is calculated by multiplying an estimate of the lifetime average daily dose (*LADD*) for a particular exposure scenario by the cancer *SF* for the constituent as follows:

$$Risk = LADD \cdot SF$$

For the inhalation route, the cancer risk is calculated using the constituent concentration in air (C_{air}) and the *URF*, as follows:

$$Risk = URF \cdot C_{air} \cdot \frac{ET \cdot EF \cdot ED}{AT_c}$$

Where *ET* is exposure time, *EF* is exposure frequency, *ED* is exposure duration, and AT_c is the averaging time for carcinogens.

The noncancer hazard quotient (HQ) associated with potential exposure via incidental ingestion and dermal contact was calculated by dividing an estimate of the average daily dose (*ADD*) by the *RfD* for the constituent as follows:

$$HQ = \frac{ADD}{RfD}$$

For the inhalation route, the HQ was calculated using C_{air} and the *RfC*, as follows:

$$HQ = \frac{C_{air}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT_{nc}}$$

In this risk assessment, unit cancer risks and unit HQs are calculated for a unit constituent concentration (C_{unit}). C_{unit} is 1 mg/kg for soil and 1 mg/L for groundwater. Because risk estimates scale directly with the constituent concentration (except for cancer risk estimates at very high doses), these unit risks and unit HQs can be calculated once and used to calculate cancer and noncancer risk estimates efficiently for a large number of locations by multiplying the constituent concentrations for each location by the unit risks and unit HQs. The unit risks and unit HQs for all routes of exposure (incidental ingestion, dermal contact, vapor inhalation, and/or particulate inhalation) for a given receptor to constituents in a given environmental medium are conservatively summed to produce a single unit risk and unit HQ for each constituent. The cancer risk and noncancer HQ for a particular constituent *i* at a particular location are calculated as follows:

$$Risk_i = \frac{C_i \cdot UnitRisk_i}{C_{unit}}$$

$$HQ_i = \frac{C_i \cdot UnitHQ_i}{C_{unit}}$$

The media-specific cumulative cancer risk and noncancer HI from exposure to the combination of COPCs are estimated following USEPA (1989) guidance, as follows:

$$Cumulative\ Risk = \sum_i Risk_i$$

$$Hazard\ Index = \sum_i HQ_i$$

Where $Risk_i$ is the estimated cancer risk for the ith constituent and HQ_i is the HQ for the ith constituent. This approach may result in estimates of media-specific cumulative cancer risk and HI that are more

conservative than necessary. For example, different COPCs may cause different and unrelated noncancer health effects, so summing the HQs for their individual effects would overestimate the significance of their combined effects. Nonetheless, this approach is used here as a conservative assessment tool.

Estimated media-specific cumulative cancer risks for each receptor population are compared to PADEP's risk management goals established in 25 Pa. Code § 250.402(b). Specifically, cumulative cancer risks are compared to an incremental increased cancer risk goal of $1x10^{-4}$ while noncancer HIs are compared to an HI of 1. For constituents with different and unrelated noncancer health effects, summing the HQs would overestimate the significance of their combined effects. When such a summation results in an HI that exceeds 1, the HQs may be segregated by target organ and/or critical health effects (USEPA 1989). Risk estimates equal to or below these goals represent levels which would not warrant risk management action.

The following sections discuss the calculation of unit risks/HQs for each receptor exposure scenario.

2.1 Routine Workers

The risk assessment evaluates nonresidential exposures to COPCs via: (1) soil contact and inhalation during outdoor activities, (2) vapor intrusion from soil and groundwater, (3) volatilization into outdoor air from groundwater, and (4) nonpotable use of groundwater (discussed in Section 2.6).

2.1.1 Exposure to Soil During Outdoor Activities

Routine workers could be exposed to surface soil via incidental ingestion, dermal contact, and inhalation of vapors and particulates during outdoor activities. Risk estimates are calculated using unit risks and unit HQs as discussed above and in Section 5.3 of the Risk Assessment. The receptor specific calculations are discussed in this section.

<u>Lifetime Average Daily Dose</u>

The lifetime average daily doses for soil ingestion ($LADD_{ing}$) and soil dermal contact ($LADD_{derm}$) are calculated as follows, using the exposure factors for resident soil contact (Section 5.1.4 of the Risk Assessment):

$$LADD_{ing} = C_{soil} \cdot \frac{IR \cdot FC \cdot EF \cdot ED}{BW \cdot AT_c}$$

$$LADD_{derm} = C_{soil} \cdot \frac{SA \cdot AF \cdot ABS_{derm} \cdot FC \cdot EF \cdot ED}{BW \cdot AT_c}$$

where C_{soil} is the constituent concentration in soil, *IR* is the ingestion rate, *FC* is the fraction of the soil that is contaminated, *SA* is the exposed skin surface area, *AF* is the soil-to-skin adherence factor, and ABS_{derm} is the constituent-specific dermal absorption factor.

Average Daily Dose

The average daily doses for soil ingestion (ADD_{ing}) and soil dermal contact (ADD_{derm}) are calculated as follows:

$$ADD_{ing} = C_{soil} \cdot \frac{IR \cdot FC \cdot EF \cdot ED}{BW \cdot AT_{nc}}$$

$$ADD_{derm} = C_{soil} \cdot \frac{SA \cdot AF \cdot ABS_{derm} \cdot FC \cdot EF \cdot ED}{BW \cdot AT_{nc}}$$

Estimating Air Concentrations

For the inhalation route, the air concentrations of vapors and particulates from soil are calculated as follows:

$$C_{air} = J \cdot \frac{C}{Q}$$

where $J \cdot C/Q$ is an air concentration that is normalized to unit concentration in soil. The J term is the normalized average vapor (J_v) or particulate flux ($J_{10,w}$), and the C/Q term is the air concentration normalized to a unit flux (i.e., C/Q is an air dispersion factor).

The normalized average vapor flux J_v of a constituent from unsaturated soil is conservatively estimated using an unsteady-state model derived by Jury et al. (1983). This model conservatively assumes that volatile constituents are present in the soil to a finite depth equal to the approximate depth to groundwater at the Site of 19 feet (ft) below ground surface (bgs). The equation for J_v is given by:

$$J_v = \frac{C_0}{T}\left[Z_1 erfc\left(\frac{Z_1}{2\sqrt{D_E T}}\right) + 2\sqrt{\frac{D_E T}{\pi}}\left(1 - e^{-\frac{Z_1^2}{4D_E T}}\right)\right]$$

where,

$$D_E = \frac{D_G H + D_L}{\rho_b K_d + \theta_w + \theta_a H}$$

$$D_G = D_{air} \cdot \frac{\theta_a^{10/3}}{n^2}$$

$$D_L = D_{water} \cdot \frac{\theta_w^{10/3}}{n^2}$$

$C_{s,0}$ is the concentration in soil, ρ_b is the soil bulk density, T is the averaging period (equivalent to ED), H is the Henry's law constant, K_d is the equilibrium-partitioning coefficient, θ_w is the water-filled soil porosity, θ_a is the air-filled soil porosity, D_{air} is diffusion rate through air, D_{water} is the diffusion rate through water, and n is total porosity. For this risk assessment, Henry's law constants have been adjusted to reflect a specific subsurface temperature of 18°C, which is conservative (PADEP 2021).

Derivation of these equations and definition of the equation parameters can be found in the Jury et al. 1983 journal article and in USEPA guidance (1996a, 1996b), and therefore, are not repeated here. The calculation of J_v was performed using values for constituent-specific parameters and default soil parameters recommended in the USEPA guidance (2004a), using a soil type of sand, which is representative of the soil type found at the Site. The calculation of J_v is shown in Attachment 2, Table 1.

The normalized average particulate flux $J_{10,w}$ of a constituent from soil is conservatively estimated using the "unlimited reservoir" model that USEPA has adapted for screening-level analysis of particulate emissions from soil (USEPA 1996a, 1996b). This model assumes that particulate emissions are created by wind erosion. The equation for $J_{10,w}$ is given by:

$$J_{10,w} = 0.036 \cdot (1 - G) \cdot \left(\frac{u_m}{u_t}\right)^3 \cdot F(x) \frac{g}{m^2 hr} \cdot \frac{hr}{60^2 sec} \cdot \frac{10^{-3} kg}{g}$$

where G is fraction of ground/vegetative cover, u_m is the mean annual wind speed at the nearest weather station which is located in Philadelphia, Pennsylvania (NOAA 2018), u_t is the equivalent threshold wind speed at the anemometer height at which u_m was measured in Philadelphia, Pennsylvania, and $F(x)$ is a function dependent on u_m/u_t. The details of this model can be found in USEPA guidance (1996a, 1996b), and are not repeated here. The default parameter values recommended in the USEPA guidance (1996a, 1996b) are used with site-specific wind speed in calculating $J_{10,w}$. The calculation of $J_{10,w}$ is shown in Attachment 2, Table 2.

The *C/Q* term is estimated using the empirical correlation in USEPA's *Supplemental Soil Screening Guidance* (2002), using the correlation coefficients for Philadelphia, Pennsylvania, and assuming a source area of 70.6 acre. This source area size is a conservative estimate of the area potentially impacted by the release. The calculation of *C/Q* is shown in Attachment 2, Table 3.

The unit risk and unit HQ calculations are shown in Attachment 2 of this appendix, and the computation of the upper-bound site-related single-chemical cancer risk and noncancer HQ estimates, which are summed to estimate the media-specific cumulative cancer risk and noncancer HI, are shown in Attachment 8 of this appendix.

2.1.2 Vapor Intrusion

To evaluate potential future vapor intrusion exposures to soil and shallow groundwater in a hypothetical building, vapor intrusion risk estimates are developed using the following modeling approaches and input parameters discussed below.

2.1.2.1 Soil

For the vapor intrusion inhalation exposure pathway, estimates of cancer risk and noncancer HQ/HI are calculated using unit risks and unit HQs as discussed above and in Section 5.3 of the Risk Assessment.

<u>Modeling Vapor Intrusion from Soil</u>

For the indoor air exposure pathway, estimates of cancer risk and noncancer HQ are calculated as follows:

$$Risk = C_{building} \cdot URF \cdot \frac{ET \cdot EF \cdot ED}{AT_c}$$

$$HQ = \frac{C_{building}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT_{nc}}$$

where $C_{building}$ is the concentration in indoor air. For assessing routine worker exposures, chronic *RfCs* are used. The indoor air concentration is estimated using the modeling approach and input parameter values discussed below.

The indoor air concentrations are estimated using the following relationships described by Johnson and Ettinger (1991):

$$C_{building} = \alpha \cdot C_{source}$$

where α is an attenuation coefficient and C_{source} is the source vapor concentration that is given by the following equation:

$$C_{source} = C_{soil}\left(\frac{K_d}{H} + \frac{\theta_w}{\rho_b H} + \frac{\theta_a}{\rho_b}\right)^{-1}$$

The attenuation coefficient, assuming that constituents are present in the soil at constant concentrations, is given by the following equation:

$$\alpha = \frac{\left[\frac{{D_T}^{eff} A_B}{Q_{building} L_T}\right] exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right)}{exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right) + \left[\frac{{D_T}^{eff} A_B}{Q_{building} L_T}\right] + \left[\frac{{D_T}^{eff} A_B}{Q_{soil} L_T}\right]\left[exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right) - 1\right]}$$

Derivation of this equation and definition of the equation parameters can be found in Johnson and Ettinger's 1991 journal article and therefore are not repeated here.

The effective diffusion coefficient term D_T^{eff} in the equation for the attenuation coefficient α is calculated using a soil-water profile that is estimated using a soil type of sand, which is representative of the soil type found at the Site. The soil-water profile in the vadose zone is estimated using the van Genuchten soil-water retention equation with default water retention parameters appropriate for sand (USEPA 2004a). It is conservatively assumed that the building cracks are filled with sand. These parameters and the resulting soil-water profile in the vadose zone are shown in Attachment 2 of this appendix.

The remaining parameters in the equation for the attenuation coefficient α, which relate to building characteristics, are conservatively based on the default values for a slab-on-grade nonresidential building with an air exchange rate of 0.60 per hour as recommended by PADEP (2021). The values used in the calculations are shown in Attachment 2 of this appendix and their bases are discussed in PADEP (2021) and USEPA (2004a) guidance.

Mass Limit Check

Indoor air concentrations from the soil vapor intrusion are calculated with a mass balance check. The mass balance check ensures that the assumed mass of a constituent infiltrating into the building over the assumed exposure period does not exceed an upper-bound estimate of the constituent's mass in the vadose zone underlying the building. The upper-bound estimate of the constituent's mass in the vadose zone is conservatively estimated using the highest concentration of the constituent from any depth at each area and assuming this concentration represents the soil concentration from slab to the water table. The attenuation coefficient α_{ML} used in the mass balance check is given by the following equation:

$$\alpha_{ML} = \left(\frac{\rho_b K_d}{H} + \frac{\theta_w}{H} + \theta_a\right) \cdot \left(\frac{L_B \cdot W_B \cdot \Delta H}{Q_{building} \cdot ED}\right)$$

where L_B is the length of the building, W_B is the width of the building, ΔH is the contaminant thickness (conservatively assumed to be the distance between groundwater and a building foundation [$L_{T\text{-}gw}$]), and $Q_{building}$ is the air flow rate through the building. The depth to groundwater in the area of the Site is approximately 19 ft bgs. All parameters are shown in Attachment 2 of this appendix.

$Q_{building}$ is a function of the size of the building (or unit) and the amount of air exchanges that occur as a result of operating the air handling and ventilation system. It can be calculated as follows (USEPA 2004a, 2017):

$$Q_{building} = L_B \cdot W_B \cdot H_B \cdot ER$$

where H_B is the occupied height of the building and ER is the air exchange rate.

For $Q_{building}$, the length (10 m), width (10 m), and height (2.44 m) of the generic nonresidential building are assumed, consistent with PADEP's recommended default assumptions for generic slab-on-grade nonresidential buildings (PADEP 2021). A conservative estimate of *ER* (i.e., 0.60/hr) was assumed based upon PADEP's (2021) recommended default for a generic nonresidential building.

The unit risk and unit HQ calculations are shown in Attachment 2 of this appendix, and the computation of the upper-bound site-related single-chemical cancer risk and noncancer HQ estimates, which are summed to estimate the media-specific cumulative cancer risk and noncancer HI, are shown in Attachment 8 of this appendix.

2.1.2.2 Groundwater

For the vapor intrusion inhalation exposure pathway, estimates of cancer risk and noncancer HQ/HI are calculated using unit risks and unit HQs as discussed above and in Section 5.3 of the Risk Assessment.

Modeling Vapor Intrusion from Groundwater

The chemical-specific cancer risk and noncancer HQ estimates for exposure to COPCs via vapor intrusion from groundwater are calculated in a manner analogous to the approach discussed in Section 2.1.2.1, except for the calculation of source vapor concentration.

The source vapor concentration for a chemical in groundwater is calculated from the chemical's concentration in groundwater C_{gw} using Henry's law as follows:

$$C_{source} = C_{gw} \cdot H$$

In calculating the attenuation coefficient α, the depth to groundwater was assumed to be 19 ft bgs below the basement slab. The calculation of α is shown in Attachment 2 of this appendix.

The unit risk and unit HQ calculations are shown in Attachment 2 of this appendix, and the computation of the upper-bound site-related single-chemical cancer risk and noncancer HQ estimates, which are summed to estimate the media-specific cumulative cancer risk and noncancer HI, are shown in Attachment 8 of this appendix.

2.1.3 Volatilization to Outdoor Air

To evaluate potential exposure to COPCs in outdoor vapors from shallow groundwater, risk estimates are developed using the following modeling approaches and input parameters discussed below.

2.1.3.1 Groundwater

The concentration (C_{air}) of groundwater chemicals that migrate through the vadose zone to outdoor air is calculated as follows:

$$C_{air} = J \cdot C/Q$$

where J is the vapor flux, and C/Q is the normalized, annual-average, air concentration at ground level (as discussed in Section 2.1.1).

The vapor flux J is calculated by using the steady-state diffusion equation in one-dimension with a constant source concentration and the maximum concentration gradient, as follows:

$$J = D_e \cdot \frac{C_v}{L}$$

where D_e is the effective diffusion coefficient of the chemical in the vapor phase, C_v is the vapor concentration in equilibrium with the groundwater concentration, and L is the distance from the water table to the ground surface. The equilibrium vapor concentration in the above equations is related to the groundwater concentration using Henry's law as discussed in Section 2.1.2.2.

The effective diffusion coefficient for the vapor phase is calculated in a manner analogous to the approach discussed in Section 2.1.2.2. The depth to water is assumed to be 19 ft bgs, the average depth to groundwater in Tank Group 04. The parameters used to calculate the effective diffusion coefficient are shown in Attachment 2 of this appendix.

The estimated outdoor air concentrations are used in the inhalation risk equations discussed in Section 2 to calculate single-chemical inhalation cancer risk and HQ. The unit risk and unit HQ calculations, and the computation of the upper-bound single-chemical cancer risk and HQ estimates, which were summed to estimate the cumulative cancer risk and HI, are shown in Attachment 8 of this appendix.

2.2 Maintenance Worker

Risk estimates for maintenance workers are calculated for potential exposures to soil and groundwater.

2.2.1 Exposure to Soil During Maintenance Activities

This human health risk assessment evaluates maintenance worker exposures to soil via incidental ingestion, soil contact, and inhalation during outdoor activities. The calculation of the risk estimates is analogous to those for routine workers except for (1) the use of soil exposure factors for maintenance workers and (2) the calculation of airborne vapor and dust concentrations which are described in this section.

The calculation of airborne vapor concentrations is analogous to those for routine workers except for the use of a shorter averaging period (*T*). For maintenance workers, an averaging period, *T*, of 10 years is used consistent with their exposure period. The calculation of J_v is shown in Attachment 3, Table 1.

As noted in Section 5.1.3.3 of the Risk Assessment, during maintenance activities the PM_{10} level is set at 50 micrograms per cubic meter (µg/m^3). This PM_{10} level is based on a time-weighted average assuming maintenance workers spend 1/3 of their exposure period excavating into the subsurface and 2/3 of their exposure period conducting maintenance activities that do not involve excavation into the subsurface. In calculating the time-weighted average, the 24-hour average National Ambient Air Quality Standards for PM_{10} of 150 µg/m^3 is used as the PM_{10} concentration during excavations and a PM_{10} concentration of 1 µg/m^3 is used for the time during maintenance activities that do not involve excavation. The PM_{10} concentration during non-excavation maintenance activities is expected to be less than 1 µg/m^3, based on the wind erosion model recommended by USEPA (1996a) using site-specific wind speed from Philadelphia, Pennsylvania (NOAA 2018).

Attachment 3, Table 3 presents the air concentrations estimated for particulates and vapors.

The unit risk and unit HQ calculations are shown in Attachment 3. The upper-bound site-related single-chemical cancer risk and noncancer HQ estimates, which are summed to estimate the media-specific cumulative cancer risk and noncancer HI, are shown in Attachment 8.

2.2.2 Exposure to Groundwater During Maintenance Activities

As discussed in Section 5.1.1 of the Risk Assessment, maintenance workers could be exposed to groundwater via incidental ingestion, dermal contact, and inhalation of vapors during excavations that extend into the water table. The cancer risk and noncancer HQ estimates for the ingestion and dermal exposure routes are calculated in a manner analogous to the method discussed in Section 2.1.1, except the exposure factors for maintenance worker contact with groundwater are used, as presented in Section 5.1.4 of the Risk Assessment, and the *LADD* and *ADD* for the dermal route of exposure and the vapor flux are calculated as discussed below.

Lifetime Average Daily Dose

The *LADD* for groundwater ingestion ($LADD_{ing}$) and groundwater dermal contact ($LADD_{derm}$) were calculated as follows:

$$LADD_{ing} = C_{gw} \frac{IR \cdot EF \cdot ED}{BW \cdot AT_c}$$

$$LADD_{derm} = C_{gw} \frac{DA_{event} \cdot SA \cdot EV \cdot EF \cdot ED}{BW \cdot AT_c}$$

where C_{gw} is the chemical concentration in groundwater (assumed to be a unit concentration of 1 mg/L), *IR* is the groundwater ingestion rate, DA_{event} is the absorbed dose per event, *SA* is the exposed skin surface area, and *EV* is the event frequency.

The DA_{event} for organic chemicals is estimated using an unsteady-state approach (USEPA 2004b, Equations 3.2 and 3.3), which is more conservative than the steady-state approach (USEPA 1989), particularly for hydrophobic chemicals. The DA_{event} for inorganic chemicals is estimated using a steady-state approach (USEPA 2004b, Equation 3.4). The details of the calculation of DA_{event} for organic and inorganic chemicals are provided by USEPA (2004b) and not repeated here.

Average Daily Dose

The ADD for groundwater ingestion (ADD_{ing}) and groundwater dermal contact (ADD_{derm}) were calculated as follows:

$$ADD_{ing} = C_{gw} \frac{IR \cdot EF \cdot ED}{BW \cdot AT_{nc}}$$

$$ADD_{derm} = C_{gw} \frac{DA_{event} \cdot SA \cdot EV \cdot EF \cdot ED}{BW \cdot AT_{nc}}$$

Unit Cancer Risk, Unit Noncancer HQ, and RBSL for Groundwater Ingestion and Dermal Exposure Routes

For the groundwater ingestion and dermal exposure routes, the unit cancer risk and unit noncancer HQ were calculated as follows:

$$Unit\ Risk = LADD \cdot SF$$

$$Unit\ HQ = \frac{ADD}{RfD}$$

The unit risk and unit HQ calculations for each COPC for the groundwater ingestion and dermal exposure routes are presented in Attachment 3. The exposure factors used for maintenance workers are presented in Section 5.1.4. of the Risk Assessment.

Estimating Air Concentrations

For the inhalation route, the air concentrations (C_{air}) resulting from the volatilization of COPCs from groundwater in an excavation were calculated as follows:

$$C_{air} = J \cdot C/Q$$

Where $J{\cdot}C/Q$ is an air concentration that is normalized to unit concentration (i.e., 1 mg/L) in groundwater. The J term is the normalized average vapor and the C/Q term is the air concentration normalized to a unit flux (i.e., C/Q is an air dispersion factor).

The normalized vapor flux J of a chemical from groundwater was estimated using an overall mass transfer coefficient that is recommended by USEPA (1995b):

$$J = \left(\frac{1}{k_l} + \frac{1}{Hk_g}\right)^{-1} \left(\frac{m}{10^2 cm}\right)\left(\frac{10^3 L}{m^3}\right)$$

Where k_l and k_g are the liquid-phase and gas-phase mass transfer coefficients given by the following:

$$k_l = \left(\frac{MW_o}{MW}\right)^{0.5} \left(\frac{T}{298K}\right) \; k_{l,o}$$

$$k_g = \left(\frac{MW_w}{MW}\right)^{0.335} \left(\frac{T}{298K}\right)^{1.005} \; k_{g,w}$$

Where MW, MW_o, and MW_w are the molecular weights of the chemical, oxygen, and water, respectively, T is the absolute temperature of the groundwater, $k_{l,o}$ is the liquid-phase mass transfer coefficient for oxygen (0.002 centimeters per second), and $k_{g,w}$ is the gas-phase mass transfer coefficient for water vapor (0.833 centimeters per second).

For groundwater exposures during excavations to the water table, C/Q is based on a source area of a 15- by 15-ft excavation area, and an averaging period of 24 hours. The maximum 24-hour average air concentration is estimated from the annual average air concentration by using a conservative factor of 0.4/0.19 or 2.1 (USEPA 2002).

Unit Cancer Risk, Unit Noncancer HQ, and RBSL for Inhalation Route

For the inhalation route, the inhalation cancer unit risk and noncancer unit HQ are calculated using the chemical concentration in air (C_{air}), as follows:

$$Unit\ Risk_{inh} = C_{air} \cdot URF \cdot \frac{ET \cdot EF \cdot ED}{AT_c}$$

$$Unit\ HQ_{inh} = \frac{C_{air}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT_{nc}}$$

The unit risk and unit HQ calculations for each COPC for the inhalation route are presented in Attachment 3. The exposure factors used for maintenance workers are presented in Section 5.1.4. of the

Risk Assessment. The computation of the upper-bound single-chemical cancer risk and noncancer HQ estimates, which are summed to estimate the cumulative cancer risk and noncancer HI, are shown in Attachment 8 of this appendix.

2.3 Construction Worker

Risk estimates for construction workers are calculated for potential exposures to soil and groundwater.

2.3.1 Exposure to Soil During Construction Activities

This human health risk assessment evaluates construction worker exposures via incidental ingestion, soil contact, and inhalation during outdoor activities. The calculation of the risk estimates is analogous to those for routine workers except for (1) the use of soil exposure factors for construction workers and (2) the calculation of airborne vapor and dust concentrations which are described in this section.

The calculation of airborne vapor concentrations is analogous to those for residents except for the use of a shorter averaging period (T). For construction workers, an averaging period, *T*, of 1 year is used consistent with their exposure period. The calculation of J_v is shown in Attachment 4, Table 1.

As noted in Section 5.1.3.3 of the Risk Assessment, during construction activities the PM_{10} level is set at 50 µg/m^3, which is the former annual average National Ambient Air Quality Standards for PM_{10} since construction workers are assumed to be performing excavations for a work year. It is conservatively assumed that the PM_{10} concentration would be at this limit every day for the entire period of construction worker exposure.

Attachment 4, Table 3 presents the air concentrations estimated for particulates and vapors.

The unit risk and unit HQ calculations are shown in Attachment 4. The upper-bound site-related single-chemical cancer risk and noncancer HQ estimates, which are summed to estimate the media-specific cumulative cancer risk and noncancer HI, are shown in Attachment 8.

2.3.2 Exposure to Groundwater During Construction Activities

As discussed in Section 5.1.1 of the Risk Assessment, construction workers could be exposed to groundwater via incidental ingestion, dermal contact, and inhalation of vapors during excavations that extend into shallow groundwater. The computation of risk estimates for worker exposure to groundwater via incidental ingestion, dermal contact, and inhalation of vapors during construction activities is analogous to the computations discussed in Section 2.2.2 for maintenance workers, except the groundwater exposure factors for construction workers are used, as presented in Section 5.1.4. of the Risk Assessment, and subchronic noncancer toxicity values are used instead of chronic values since this exposure scenario represents a subchronic exposure.

The unit risk and unit HQ calculations are shown in Attachment 4. The upper-bound site-related single-chemical cancer risk and noncancer HQ estimates, which are summed to estimate the media-specific cumulative cancer risk and noncancer HI, are shown in Attachment 8.

2.4 Off-Facility Resident

The chemical-specific cancer risk and noncancer HQ estimates for off-facility resident exposure to COPCs via inhalation of soil vapors and particulates and vapor intrusion from groundwater are calculated in a manner analogous to the approach discussed in Section 2.1.1 and 2.1.2. The only differences are the use of exposure factors for off-facility residents, as presented in Section 5.1.4. of the Risk Assessment.

The unit risk and unit HQ calculations for each COPC are presented in Attachment 5. The upper-bound site-related single-chemical cancer risk and noncancer HQ estimates, which are summed to estimate the media-specific cumulative cancer risk and noncancer HI, are shown in Attachment 8.

2.5 Soil Migration-to-Groundwater

Cancer and noncancer risk estimates were calculated by scaling off of the soil migration-to-groundwater RBSLs. RBSLs developed to conservatively evaluate the potential for COPCs in soil to leach to groundwater at concentrations that may pose an unacceptable risk to human health or the environment are calculated using the methodologies described in the *Soil Screening Guidance: User's Guide* (USEPA 1996a).

RBSLs were calculated using both an "equilibrium partitioning" (also called soil/water partitioning [USEPA 1996a]) and a "leach test" methodology, as described below. For each COPC, the soil screening level corresponding to the more realistic of the two calculation methods is used as a soil migration-to-groundwater screening level. For COPCs that are relatively immobile in the subsurface (e.g., semivolatile organic compounds), the equilibrium partitioning method provides a more realistic, yet conservative, soil leachate concentration because it assumes that the chemical concentration in soil remains constant over time (since the chemical is immobile, its concentration in soil does not significantly decrease over time). For chemicals that are relatively mobile (e.g., volatile organic compounds), the leach test method provides a more realistic, yet conservative, soil leachate concentration because it accounts for a finite amount of chemical mass in the soil. These two approaches of estimating soil leachate concentrations are conservative since they ignore attenuation of the chemical concentration in the vadose zone and dilution at the water table.

Equilibrium Partitioning

The soil/water partition equation, which assumes an infinite source of the chemical, can be used to estimate concentrations of chemicals in soil leachate for a given soil concentration.

$$C_{soil} = C_{pw}\left(K_d + \frac{\theta_w + \theta_a H}{\rho_b}\right)$$

In this relationship, C_{soil} is the soil concentration (mg/kg), C_{pw} is the soil leachate concentration (milligrams per liter [mg/L]), K_d is the chemical specific soil-water partition coefficient (liter per kilogram), θ_w is the water-filled soil porosity (unitless), θ_a is the air-filled soil porosity (unitless), H is the chemical-specific Henry's Law constant (unitless), and ρ_b is the dry soil bulk density (kilogram per liter [kg/L]). For organic chemicals, K_d is equal to the product of the chemical-specific soil organic carbon/water partition coefficient, K_{oc} (liter per kg), and the fraction organic carbon in soil, f_{oc} (unitless).

For this analysis, the soil properties are based upon sand, the most conservative soil type identified at the Site. Specifically, θ_w is assumed to be 0.05 (liters per liter), θ_a is assumed to be 0.32 (liters per liter), and ρ_b is assumed to be 1.66 kg/L (USEPA 2004a).[1] The f_{oc} is assumed to be 0.005 (grams per gram) (USEPA 1996a). The chemical-specific K_d, and K_{oc}, and H (and their sources) used are presented in Attachment 6.

Leach Test Method

USEPA's leach test method (SW-846, Method 1312)[2] can be simulated by assuming a hypothetical worst-case leach test outcome in which the entire mass of the chemical in soil is extracted into the leaching fluid. With this assumption, the concentration of the COPC in soil can be divided by 20 (which is the ratio of the mass of leaching fluid to the mass of soil in the leaching test protocol) to estimate its leachate concentration as follows:

$$C_{soil} = C_{pw} \times \frac{mr_{fluid:solid}}{\rho_{fluid}}$$

In the relationship above, C_{soil} is the soil concentration (mg/kg), C_{pw} is the soil leachate concentration (mg/L), $mr_{fluid:solid}$ (kilogram per kilogram) is the mass ratio of the extraction fluid to soil used in the leach test (i.e., 20 kg fluid per 1 kg soil), and ρ_{fluid} (kg/L) is the density of the extraction fluid (assumed to be 1 kg/L).

Dilution Attenuation Factor and Calculation of Soil Migration to Groundwater Screening Levels

As soil leachate moves through soil and groundwater, chemical concentrations are attenuated. The reduction in concentrations can be expressed by a dilution attenuation factor (DAF) defined as a ratio of soil leachate concentration to receptor point concentration (USEPA 1996a).

Rather than independently model leachate migration to calculate a site-specific *DAF*, a generic *DAF* of 20 was conservatively used in the development of the RBSLs. This default *DAF* is recommended by USEPA (1996a) for contaminated soil sources up to 0.5 acres.

To calculate soil migration to groundwater screening levels, the equations presented above can be further refined as follows:

$$C_{soil-SPLP} = C_{pw} \times \frac{mr_{fluid:solid}}{\rho_{fluid}} \times DAF$$

$$C_{soil-Kd} = C_{pw}\left(K_d + \frac{\theta_w + \theta_a H}{\rho_b}\right) \times DAF$$

[1] Water-filled and air-filled porosity were estimated using the soil properties for sand (USEPA 2004) and the van Genuchten equation (van Genuchten 1980), assuming a depth to groundwater of 19 ft.

[2] *Method 1312: Synthetic Precipitation Leaching Procedure*, https://www.epa.gov/sites/production/files/2015-12/documents/1312.pdf.

By substituting target groundwater concentrations for C_{pw} in the leach test method and equilibrium-partitioning method equations, and assuming a *DAF*, two possible soil screening levels are calculated. The higher of the two estimated values was used as the RBSL as the higher represents the more realistic, yet conservative, soil screening level for this pathway.

Soil migration-to-groundwater RBSLs were calculated using the target groundwater concentrations based on groundwater RBSLs for the following scenarios:

- Routine worker exposure to COPCs in groundwater via volatilization to outdoor air and vapor intrusion
- Construction worker exposure to COPCs in groundwater via direct contact
- Off-facility resident exposure to COPCs in groundwater via vapor intrusion
- Receptor exposure to COPCs in groundwater via nonpotable groundwater use

The acceptable groundwater concentrations are presented in Attachment 6. The soil migration-to-groundwater screening levels are presented in Appendix B of the Risk Assessment.

2.6 Nonpotable Groundwater Use

Potential exposures to COPCs in groundwater via nonpotable groundwater use are evaluated using a hypothetical scenario where groundwater is used to fill a backyard wading pool ("kiddie" pool). This scenario represents a reasonable worst case exposure scenario in which the estimated exposure is expected to be higher than those associated with other nonpotable uses (e.g., watering lawns, washing cars). Potential routes of exposure in this scenario include incidental ingestion, dermal contact, and inhalation of vapors.

Estimates of cancer risk and noncancer HQ/HI are calculated using unit risks and unit HQs as discussed above and in Section 5.3 of the Risk Assessment and using the exposure factors as presented in Section 5.1.4. of the Risk Assessment.

<u>Water Concentration in Kiddie Pool</u>

The model for estimating vapor emission from a residential kiddie pool is based on models for estimating vapor emissions from open-top batch tanks (USEPA 1995a, 1995b). The residential kiddie pool is modeled as a 6-ft diameter tank that is 9 inches deep and is assumed to be filled with groundwater once per day. The concentration of volatile organic chemicals in the kiddie pool water decreases over time as the chemicals volatilize into the air. The average concentration over a period *t* is given by:

$$\overline{C_w} = C_{w,o}\frac{d}{K \cdot t}\left(1 - e^{-Kt/d}\right)$$

where $C_{w,o}$ is the initial concentration, *d* is the depth of water in the pool and *K* is the chemical's overall mass transfer coefficient (USEPA 1995b). *K* is calculated was follows:

$$K = \frac{k_l \cdot Hk_g}{k_l + Hk_g}$$

where H is the Henry's law constant, and k_l and k_g are the liquid-phase and gas-phase mass transfer coefficients given by the following equations (USEPA 1995a):

$$k_l = 10^{-6} + 144 \cdot 10^{-4}\left(0.01u_{10}\sqrt{6.1 + 0.63u_{10}}\right)^{2.2} {Sc_l}^{-0.5}$$

$$k_g = 4.82 \cdot 10^{-3}\ {u_{10}}^{0.78}\ {Sc_g}^{-0.67}\ {d_e}^{-0.11}$$

where Sc_l and Sc_g are liquid-phase and gas-phase Schmidt numbers, d_e is the effective diameter of the water surface (m), and u_{10} is wind speed at 10 m above the water surface, which is 4.2 m/s based on the annual average wind speed in Philadelphia, Pennsylvania (NOAA 2018).

Air Concentration from Kiddie Pool

The concentration of the chemical in air at the water surface is given by the following:

$$C_{air} = \overline{C_w} \cdot K \cdot (C/Q)$$

The *C/Q* term is estimated using the empirical correlation in USEPA's *Supplemental Soil Screening Guidance* (2002), using the correlation coefficients for Philadelphia, Pennsylvania, and assuming a source area of a 6- by 6-ft kiddie pool. This air concentration is expected to be higher than actual air concentrations to which individuals would be exposed while in the kiddie pool.

Unit Cancer Risk, Unit Noncancer HQ, and RBSL

The unit risk and unit HQ calculations are shown in Attachment 7. The upper-bound site-related single-chemical cancer risk and noncancer HQ estimates for each sampling location, which are summed to estimate the media-specific cumulative cancer risk and noncancer HI, are shown in Attachment 8.

3 References

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Attachment 1

Toxicity Values and Physical and Chemical Properties

Table 1 – Toxicity Values

Table 2 – Physical and Chemical Properties

Attachment 1
Table 1
Toxicity Values
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Cancer Classification			SF_{oral} (mg/kg/d)$^{-1}$			SF_{dermal} (mg/kg/d)$^{-1}$			URF (mg/m^3)$^{-1}$			RfD_{oral} (mg/kg/d)				RfD_{dermal} (mg/kg/d)				RfC (mg/m^3)				$SRfD_{oral}$ (mg/kg/d)				$SRfD_{dermal}$ (mg/kg/d)				SRfC (mg/m^3)			
			Group	Ref	Note	Value	Ref	Notes	Value	Ref	Notes	Value	Ref	Notes	Value	UF	Ref	Notes	Value	UF	Ref	Notes	Value	UF	Ref	Notes	Value	UF	Ref	Notes	Value	UF	Ref	Notes	Value	UF	Ref	Notes
VOC	Benzene	71-43-2	A	1		5.5E-02	1	68	5.5E-02	125	104	7.8E-03	1	60	4.0E-03	300	1		4.0E-03	300	125	104	3.0E-02	300	1		1.0E-02	100	126		1.0E-02	100	125	104	9.0E-02	100	1	110
VOC	Cumene	98-82-8	D	1											1.0E-01	1,000	1		1.0E-01	1,000	125	104	4.0E-01	1,000	1		4.0E-01	300	2		4.0E-01	300	125	104	4.0E-01	1,000	1	62
VOC	1,2-Dibromoethane	106-93-4	LC	1		2.0E+00	1		2.0E+00	125	104	6.0E-01	1		9.0E-03	3,000	1		9.0E-03	3,000	125	104	9.0E-03	300	1		9.0E-03	3,000	1	62	9.0E-03	3000	125	104	9.0E-03	300	1	62
VOC	1,2-Dichloroethane	107-06-2	B2	1		9.1E-02	1		9.1E-02	125	104	2.6E-02	1		2.0E-02	3,000	126	116	2.0E-02	3,000	125	104	7.0E-03	3,000	126		2.0E-02	3,000	126		2.0E-02	3000	125	104	7.0E-02	300	126	
VOC	Ethyl Benzene	100-41-4	D	1											1.0E-01	1,000	1		1.0E-01	1,000	125	104	1.0E+00	300	1		1.0E-01	1,000	1	62	1.0E-01	1000	125	104	9.0E+00	100	126	
VOC	Methyl tert-butyl ether	1634-04-4	C	142		1.8E-03	147		1.8E-03	125	104	2.6E-04	147		3.0E-01	300	129	111, 116	3.0E-01	300	125	104	3.0E+00	100	1		3.0E-01	300	129	111	3.0E-01	300	125	104	3.0E+00	100	1	62
VOC	Toluene	108-88-3	ID	1											8.0E-02	3,000	1		8.0E-02	3,000	125	104	5.0E+00	10	1		8.0E-01	300	1	110	8.0E-01	300	125	104	5.0E+00	10	126	
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1											1.0E-02	300	1		1.0E-02	300	125	104	6.0E-02	300	1		4.0E-02	100	1		4.0E-02	100	125	104	2.0E-01	100	1	
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1											1.0E-02	300	1		1.0E-02	300	125	104	6.0E-02	300	1		4.0E-02	100	1		4.0E-02	100	125	104	2.0E-01	100	1	
VOC	Xylenes (total)	1330-20-7	ID	1											2.0E-01	1,000	1		2.0E-01	1,000	125	104	1.0E-01	300	1		2.0E-01	1,000	1	110	2.0E-01	1000	125	104	3.0E-01	100	1	110
SVOC	Anthracene	120-12-7	ID	1											3.0E-01	3,000	1		3.0E-01	3,000	125	104			2	90	1.0E+00	1,000	126		1.0E+00	1000	125	104			2	90, 62
SVOC	Benzo(a)anthracene	56-55-3	B2	1		1.0E-01	10	5, 159	1.0E-01	125	104	6.0E-02	10	5, 159			126	90			125	104			126	90			126	90			125	104			126	90
SVOC	Benzo(a)pyrene	50-32-8	HC	1		1.0E+00	1	159	1.0E+00	125	104	6.0E-01	1	159	3.0E-04	300	1		3.0E-04	300	125	104	2.0E-06	3,000	1		3.0E-04	300	1	62	3.0E-04	300	125	104	2.0E-06	3,000	1	62
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1		1.0E-01	10	5, 159	1.0E-01	125	104	6.0E-02	10	5, 159																									
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1											3.0E-02	3,000	1	20	3.0E-02	3,000	125	104					3.0E-01	300	126	20	3.0E-01	300	125	104				
SVOC	Chrysene	218-01-9	B2	1		1.0E-03	10	5, 159	1.0E-03	125	104	6.0E-04	10	5, 159																									
SVOC	Ethanol	64-17-5													6.2E+01		910		6.2E+01		125	104	1.9E+01		910		6.2E+01		910		6.2E+01		125	104	1.9E+01		910	
SVOC	Fluorene	86-73-7	D	1											4.0E-02	3,000	1		4.0E-02	3,000	125	104					4.0E-01	300	129	111	4.0E-01	300	125	104				
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1		1.0E-01	10	5, 159	1.0E-01	125	104	6.0E-02	10	5, 159																									
SVOC	Naphthalene	91-20-3	C	1		1.2E-01	147		1.2E-01	125	104	3.4E-02	147		2.0E-02	3,000	1		2.0E-02	3,000	125	104	3.0E-03	3,000	1		2.0E-01	300	1	110	2.0E-01	300	125	104	3.0E-03	3,000	1	62
SVOC	Phenanthrene	85-01-8	D	1											3.0E-02	3,000	1	20	3.0E-02	3,000	125	104					3.0E-01	300	126	20	3.0E-01	300	125	104				
SVOC	Pyrene	129-00-0	NC	126											3.0E-02	3,000	1		3.0E-02	3,000	125	104					3.0E-01	300	126		3.0E-01	300	125	104				
SVOC	Tetraethylene Glycol	112-60-7													2.0E+00	30	126	210	2.0E+00	30	125	104			126	90, 210	2.0E+00	30	126	210	2.0E+00	30	125	104			126	90, 210
INORG	Lead	7439-92-1	B2	1																																			

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Notes:

5 Based on potency relative to Benzo(a)pyrene [CASRN 50-32-8], as described in the indicated reference.
20 Terraphase used Pyrene [CASRN 129-00-0] value from the indicated reference as a surrogate.
62 Terraphase used chronic value as a surrogate for the subchronic value.
68 IRIS provides a range of 1.5E-2 to 5.5E-2 (mg/kg/d)-1 as the oral Slope Factor for Benzene.
90 Inadequate data exist to derive a toxicity value, according to the indicated reference.
104 Dermal toxicity value is extrapolated from oral toxicity value in accordance with the referenced USEPA guidance.
110 The value is based on discussion in the indicated reference regarding the principal study USEPA used in extrapolating from subchronic to chronic.
111 Value as published is an MRL in the indicated reference.
116 Terraphase used subchronic value as a surrogate for the chronic value.
159 Because the chemical has a mutagenic mode of action according to USEPA, the SF and URF are adjusted by the following age-dependent adjustment factors (ADAFs) before use: 10 for ages 0 to 2; 3 for ages 2 to 16; and 1 for ages 16 and older (USEPA 2005).
210 Terraphase used Triethylene glycol [CASRN 112-27-6] value from the indicated reference as a surrogate.
This extract was prepared on 1/9/2023.

Attachment 1
Table 2
Physical and Chemical Properties
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	MW (g/mole)			K_{ow} (unitless)			K_{oc} (L/kg)			K_d (L/kg)			H (unitless)				D_{air} (m^2/d)			D_{water} (m^2/d)			K_p (cm/hr)			ABS_d (unitless)			FA (unitless)		
			Value	Ref	Notes	Value	Ref	Notes	Value	Ref	Notes	Value	Ref	Notes	Value	Adjust	Ref	Notes	Value	Ref	Notes	Value	Ref	Notes	Value	Ref	Notes	Value	Ref	Notes	Value	Ref	Notes
VOC	Benzene	71-43-2	7.8E+01	50.3		1.3E+02	44		5.8E+01	44	111				2.3E-01	1.7E-01	44		7.6E-01	44		8.5E-05	44		1.5E-02	44	115	0.0E+00	62		1.0E+00	62	
VOC	Cumene	98-82-8	1.2E+02	50.3		3.1E+03	69		7.1E+02	69	111				5.3E-01	3.3E-01	69		5.6E-01	69		6.1E-05	69			69	115	0.0E+00	62		1.0E+00	62	114
VOC	1,2-Dibromoethane	106-93-4	1.9E+02	50.3		4.0E+01	1		2.2E+01	1	111				2.7E-02	2.4E-02	50.3	123	3.7E-01	69		7.3E-05	69		1.6E-03	1	115	0.0E+00	62		1.0E+00	62	
VOC	1,2-Dichloroethane	107-06-2	9.9E+01	50.3		3.0E+01	44		1.7E+01	44	111				4.0E-02	2.9E-02	44		9.0E-01	44		8.6E-05	44		4.1E-03	44	115	0.0E+00	62		1.0E+00	62	
VOC	Ethyl Benzene	100-41-4	1.1E+02	50.3		1.4E+03	44		3.7E+02	44	111				3.2E-01	2.2E-01	44		6.5E-01	44		6.7E-05	44		4.8E-02	44	115	0.0E+00	62		1.0E+00	62	
VOC	Methyl tert-butyl ether	1634-04-4	8.8E+01	1		1.7E+01	39		1.1E+01	39	111				2.4E-02	1.8E-02	69		7.4E-01	69		8.7E-05	69		3.3E-03	39	115	0.0E+00	62		1.0E+00	62	114
VOC	Toluene	108-88-3	9.2E+01	50.3		5.6E+02	44		1.8E+02	44	111				2.7E-01	1.9E-01	44		7.5E-01	44		7.4E-05	44		3.2E-02	44	115	0.0E+00	62		1.0E+00	62	
VOC	1,2,4-Trimethylbenzene	95-63-6	1.2E+02	46		4.3E+03	69		9.0E+02	69	111				2.5E-01	1.6E-01	69		5.2E-01	69		6.8E-05	69			69	115	0.0E+00	62		1.0E+00	62	
VOC	1,3,5-Trimethylbenzene	108-67-8	1.2E+02	39		1.0E+04	69		1.8E+03	69	111				2.4E-01	1.5E-01	69		5.2E-01	69		7.5E-05	69			69	115	0.0E+00	62		1.0E+00	62	
VOC	Xylenes (total)	1330-20-7	1.1E+02	50.3		1.5E+03	44		3.9E+02	44	111				2.8E-01	2.5E-01	44		6.7E-01	44		7.6E-05	44		5.0E-02	44	115	0.0E+00	62		1.0E+00	62	114
SVOC	Anthracene	120-12-7	1.8E+02	50.3		3.5E+04	44		3.0E+04	44	82				2.7E-03	1.3E-03	44		2.8E-01	44		6.7E-05	44			44	115	1.3E-01	62		1.0E+00	62	117
SVOC	Benzo(a)anthracene	56-55-3	2.3E+02	50.3		5.0E+05	44		4.0E+05	44	82				1.4E-04	5.6E-05	44		4.4E-01	44		7.8E-05	44			44	115	1.3E-01	62		9.0E-01	62	117
SVOC	Benzo(a)pyrene	50-32-8	2.5E+02	50.3		1.3E+06	44		1.0E+06	44	82				4.6E-05	1.5E-05	44		3.7E-01	44		7.8E-05	44			44	115	1.3E-01	62		8.0E-01	62	117
SVOC	Benzo(b)fluoranthene	205-99-2	2.5E+02	50.1		1.6E+06	44		1.2E+06	44	82				4.6E-03	1.7E-03	44		2.0E-01	44		4.8E-05	44			44	115	1.3E-01	62		8.0E-01	62	117
SVOC	Benzo(g,h,i)perylene	191-24-2	2.8E+02	50.3		1.7E+07	69		1.3E+07	69	82				1.4E-05	1.1E-05	50.3	123	1.9E-01	69		4.5E-05	69			69	115	1.3E-01	62		7.0E-01	62	117
SVOC	Chrysene	218-01-9	2.3E+02	50.3		5.0E+05	44		4.0E+05	44	82				3.9E-03	1.5E-03	44		2.1E-01	44		5.4E-05	44			44	115	1.3E-01	62		9.0E-01	62	117
SVOC	Ethanol	64-17-5	4.6E+01	62		4.9E-01	62		6.8E-01	62	111				2.2E-04	1.7E-04	69		1.1E+00	69		1.1E-04	69		5.5E-04	62	115	0.0E+00	62		1.0E+00	62	
SVOC	Fluorene	86-73-7	1.7E+02	50.3		1.6E+04	44		1.4E+04	44	82				2.6E-03	1.4E-03	44		3.1E-01	44		6.8E-05	44			44	115	1.3E-01	62		1.0E+00	62	117
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.8E+02	50.3		4.5E+06	44		3.4E+06	44	82				6.6E-05	2.0E-05	44		1.6E-01	44		4.9E-05	44			44	115	1.3E-01	62		7.0E-01	62	117
SVOC	Naphthalene	91-20-3	1.3E+02	50.3		2.3E+03	44		2.0E+03	44	82				2.0E-02	1.2E-02	44		5.1E-01	44		6.5E-05	44			44	115	1.3E-01	62		1.0E+00	62	
SVOC	Phenanthrene	85-01-8	1.8E+02	50.3		2.9E+04	69		2.4E+04	69	82				1.7E-03	1.4E-03	50.3	123	3.2E-01	69		6.5E-05	69			69	115	1.3E-01	62		1.0E+00	62	117
SVOC	Pyrene	129-00-0	2.0E+02	50.3		1.3E+05	44		1.1E+05	44	82				4.5E-04	2.0E-04	44		2.4E-01	44		6.3E-05	44			44	115	1.3E-01	62		1.0E+00	62	117
SVOC	Tetraethylene Glycol	112-60-7	1.9E+02	69		2.8E-02	78		3.0E-02	78	82				2.0E-11	1.6E-11	69		4.4E-01	69	125	7.0E-05	69	125		78	115	1.0E-01	62		1.0E+00	62	114
INORG	Lead	7439-92-1	2.1E+02	50.3								9.0E+02	35							40	48		40	48	1.0E-04	62		0.0E+00	62				

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Notes:

48 Not Available or Not Applicable
82 Used Equation (70) from Reference 44 to calculate Koc value using Log Kow value from indicated reference.
111 Used Equation (71) from Reference 44 to calculate Koc value using Log Kow value from indicated reference.
114 A value of 1 is conservatively used because EPA guidance does not provide a default value.
115 Calculated Kp value using equation 3.8 (p.3-7) in reference 62 with log Kow from the indicated reference and the MW presented in table.
117 Derived the FA based on Exhibit A-4 in the indicated reference.
123 Value has been assigned a default reference temperature.
125 Used Triethylene glycol [CASRN 112-27-6] value from the indicated reference as a surrogate.

Attachment 2

Routine Worker Risk Calculations

Table 1 – Normalized Average Vapor Flux from Soil to Outdoor Air

Table 2 – Soil PM_{10} Emission from Wind Erosion (Unlimited Reservoir Model)

Table 3 – Dispersion Factor to Outdoor Air

Table 4 – Concentrations in Outdoor Air from Soil

Table 5a – Unit Risk Calculations for Exposure of Routine Workers to Soil

Table 5b – Unit Hazard Quotient Calculations for Exposure of Routine Workers to Soil

Figure 1 – Soil Moisture Profile for Default PADEP Nonresidential Building (Slab-On-Grade)

Table 6 – Normalized Indoor Air Concentrations in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Soil

Table 7 – Unit Risk and Hazard Quotient Calculations for Soil Vapor Intrusion into a Default PADEP Nonresidential Building (Slab-On-Grade)

Table 8 – Normalized Vapor Flux to Outdoor Air from Groundwater

Table 9 – Unit Risk and Hazard Quotient Calculations for Exposure of Routine Workers to Groundwater-derived Vapors in Outdoor Air

Table 10 – Normalized Indoor Air Concentrations in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Groundwater

Table 11 – Unit Risk and Hazard Quotient Calculations for Groundwater Vapor Intrusion into a Default PADEP Nonresidential Building (Slab-On-Grade)

Attachment 2
Table 1
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	D_{air} (m^2/d)	D_{water} (m^2/d)	D_G (m^2/d)	D_L (m^2/d)	D_E (m^2/d)	J_v (kg/m^2-s)
VOC	Benzene	71-43-2	5.82E+01		1.68E-01	7.60E-01	8.47E-05	1.23E-01	3.46E-08	3.51E-02	1.11E-05
VOC	Cumene	98-82-8	7.05E+02		3.28E-01	5.62E-01	6.13E-05	9.10E-02	2.51E-08	4.96E-03	9.32E-06
VOC	1,2-Dibromoethane	106-93-4	2.22E+01		2.37E-02	3.72E-01	7.29E-05	6.02E-02	2.98E-08	5.83E-03	9.53E-06
VOC	1,2-Dichloroethane	107-06-2	1.75E+01		2.92E-02	8.99E-01	8.55E-05	1.46E-01	3.50E-08	2.04E-02	1.07E-05
VOC	Ethyl Benzene	100-41-4	3.67E+02		2.20E-01	6.48E-01	6.74E-05	1.05E-01	2.76E-08	7.27E-03	9.80E-06
VOC	Methyl tert-butyl ether	1634-04-4	1.15E+01		1.83E-02	7.42E-01	8.73E-05	1.20E-01	3.57E-08	1.43E-02	1.05E-05
VOC	Toluene	108-88-3	1.80E+02		1.93E-01	7.52E-01	7.43E-05	1.22E-01	3.04E-08	1.46E-02	1.05E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	8.97E+02		1.61E-01	5.24E-01	6.84E-05	8.48E-02	2.80E-08	1.81E-03	7.67E-06
VOC	1,3,5-Trimethylbenzene	108-67-8	1.76E+03		1.54E-01	5.20E-01	7.49E-05	8.42E-02	3.06E-08	8.81E-04	6.17E-06
VOC	Xylenes (total)	1330-20-7	3.86E+02		2.52E-01	6.74E-01	7.56E-05	1.09E-01	3.09E-08	8.23E-03	9.94E-06
SVOC	Anthracene	120-12-7	2.97E+04		1.30E-03	2.80E-01	6.69E-05	4.53E-02	2.74E-08	2.40E-07	1.11E-07
SVOC	Benzo(a)anthracene	56-55-3	4.01E+05		5.55E-05	4.41E-01	7.78E-05	7.14E-02	3.18E-08	1.20E-09	
SVOC	Benzo(a)pyrene	50-32-8	1.01E+06		1.49E-05	3.72E-01	7.78E-05	6.02E-02	3.18E-08	1.11E-10	
SVOC	Benzo(b)fluoranthene	205-99-2	1.24E+06		1.66E-03	1.95E-01	4.80E-05	3.16E-02	1.97E-08	5.08E-09	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.28E+07		1.10E-05	1.88E-01	4.54E-05	3.04E-02	1.86E-08	3.32E-12	
SVOC	Chrysene	218-01-9	4.01E+05		1.48E-03	2.14E-01	5.37E-05	3.47E-02	2.20E-08	1.54E-08	
SVOC	Ethanol	64-17-5	6.81E-01		1.75E-04	1.06E+00	1.12E-04	1.72E-01	4.60E-08	5.09E-04	
SVOC	Fluorene	86-73-7	1.38E+04		1.39E-03	3.14E-01	6.81E-05	5.08E-02	2.79E-08	6.17E-07	1.78E-07
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	3.45E+06		2.03E-05	1.64E-01	4.89E-05	2.66E-02	2.00E-08	1.96E-11	
SVOC	Naphthalene	91-20-3	2.01E+03		1.20E-02	5.10E-01	6.48E-05	8.26E-02	2.65E-08	5.94E-05	1.75E-06
SVOC	Phenanthrene	85-01-8	2.42E+04		1.41E-03	3.24E-01	6.45E-05	5.25E-02	2.64E-08	3.67E-07	1.37E-07
SVOC	Pyrene	129-00-0	1.06E+05		2.00E-04	2.35E-01	6.26E-05	3.81E-02	2.56E-08	8.73E-09	
SVOC	Tetraethylene Glycol	112-60-7	3.00E-02		1.62E-11	4.39E-01	6.96E-05	7.11E-02	2.85E-08	5.30E-07	
INORG	Lead	7439-92-1		9.00E+02							

Attachment 2
Table 1
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Soil bulk density	kg/L	ρ_b	1.66
Soil porosity	L/L-soil	θ	0.38
Soil water content	L/L-soil	θ_w	0.05
Soil air-filled porosity	L/L-soil	θ_a	0.32
Soil organic carbon fraction	unitless	f_{oc}	0.005
Averaging period (Exposure Duration)	years	**T**	25
	days	**T**	9125
Temperature	^oC	**Temp**	18
Clean soil above source	m	Z_1	
Bottom of source depth	m	Z_2	5.79

Based on the volatilization model developed by Jury et. al. (1983) for finite sources as described in USEPA's (1996) Soil Screening Guidance: Technical Background Document.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 2

Table 2

Soil PM_{10} Emission from Wind Erosion

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Unlimited Reservoir Model

Parameter	Units	Variable	Value
Aerodynamic particle size multiplier			0.036
Ground cover fraction		**G**	0.5
Mode of aggregate size distribution	mm		0.50
Threshold friction velocity	m/s	u'_t	0.50
Correction factor			1.25
Corrected friction velocity	m/s	u^*_t	0.6252
Roughness height	m	z_0	0.005
Anemometer height	m		8.0
Friction velocity at anemometer height	m/s	u_t	11.53
Mean annual wind speed	mph	u_m	9.3
Mean annual wind speed	m/s	u_m	4.16
u_m/u_t			0.361
$x = 0.886\ u_t/u_m$			2.46
F(x)			0.064
Annual average PM_{10} flux	kg-soil/m^2-s	$J_{10,w}$	**1.5E-11**

Model described in more detail in USEPA's (1996) *Soil Screening Guidance: Technical Background Document* .

Attachment 2
Table 3
Dispersion Factor to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Parameter	Units	Value
Correlation coefficient city		Philadelphia
Correlation coefficient A		14.0111
Correlation coefficient B		19.6154
Correlation coefficient C		225.3397

Soil source area	acres	70.6
Soil C/Q averaging time		Annual Max
Conversion factor from 1-Hr Max for soil		0.19
C/Q for soil	$(kg/m^3)/(kg/m^2\text{-}s)$	**25.06**

Groundwater source area	acres	70.6000
Groundwater averaging time for C/Q		Annual Max
Conversion factor from 1-Hr Max for groundwater		0.19
C/Q for Groundwater	$(L/m^3)/(L/m^2\text{-}s)$	**25.06**

Note:
C/Q is estimated using the empirical correlation in USEPA's (2002) Supplemental Soil Screening Guidance.

Attachment 2
Table 4
Concentrations in Outdoor Air from Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

			Vapor		PM_{10}	
		C/Q (kg/m^3 per kg/m^2-s):	2.5E+01			
Chem Chem	**Chemical**	**CASRN**	C_{soil} (mg/kg)	C_{air} (mg/m^3)	C_{soil} (mg/kg)	C_{air} (mg/m^3)
VOC	Benzene	71-43-2	1.00E+00	2.78E-04	1.00E+00	3.73E-10
VOC	Cumene	98-82-8	1.00E+00	2.34E-04	1.00E+00	3.73E-10
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	2.39E-04	1.00E+00	3.73E-10
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	2.69E-04	1.00E+00	3.73E-10
VOC	Ethyl Benzene	100-41-4	1.00E+00	2.46E-04	1.00E+00	3.73E-10
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	2.62E-04	1.00E+00	3.73E-10
VOC	Toluene	108-88-3	1.00E+00	2.63E-04	1.00E+00	3.73E-10
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	1.92E-04	1.00E+00	3.73E-10
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	1.55E-04	1.00E+00	3.73E-10
VOC	Xylenes (total)	1330-20-7	1.00E+00	2.49E-04	1.00E+00	3.73E-10
SVOC	Anthracene	120-12-7	1.00E+00	2.78E-06	1.00E+00	3.73E-10
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.00E+00	3.73E-10
SVOC	Chrysene	218-01-9	1.00E+00		1.00E+00	3.73E-10
SVOC	Ethanol	64-17-5	1.00E+00		1.00E+00	3.73E-10
SVOC	Fluorene	86-73-7	1.00E+00	4.47E-06	1.00E+00	3.73E-10
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.00E+00	3.73E-10
SVOC	Naphthalene	91-20-3	1.00E+00	4.38E-05	1.00E+00	3.73E-10
SVOC	Phenanthrene	85-01-8	1.00E+00	3.44E-06	1.00E+00	3.73E-10
SVOC	Pyrene	129-00-0	1.00E+00		1.00E+00	3.73E-10
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.00E+00	3.73E-10
INORG	Lead	7439-92-1	1.00E+00		1.00E+00	3.73E-10

Attachment 2

Table 5a

Unit Risk Calculations for Exposure of Routine Worker to Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

					Soil Ingestion				Soil Dermal Contact				Soil Vapor Inhalation			Soil Particulate Inhalation			All Routes
Chem Group	Chemical	CASRN	Cancer Class	C_{soil} (mg/kg)	RBA	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	Risk	ABS_{derm}	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	Risk	C_{air} (mg/m^3)	URF (m^3/mg)	Risk	C_{air} (mg/m^3)	URF $(mg/m^3)^{-1}$	Risk	Risk
VOC	Benzene	71-43-2	A	1.00E+00		1.10E-07	5.5E-02	6.1E-09			5.5E-02		2.78E-04	7.8E-03	1.3E-07	3.73E-10	7.8E-03	1.7E-13	1.3E-07
VOC	Cumene	98-82-8	D	1.00E+00		1.10E-07							2.34E-04			3.73E-10			
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00		1.10E-07	2.0E+00	2.2E-07			2.0E+00		2.39E-04	6.0E-01	8.4E-06	3.73E-10	6.0E-01	1.3E-11	8.6E-06
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00		1.10E-07	9.1E-02	1.0E-08			9.1E-02		2.69E-04	2.6E-02	4.1E-07	3.73E-10	2.6E-02	5.7E-13	4.2E-07
VOC	Ethyl Benzene	100-41-4	D	1.00E+00		1.10E-07							2.46E-04			3.73E-10			
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00		1.10E-07	1.8E-03	2.0E-10			1.8E-03		2.62E-04	2.6E-04	4.0E-09	3.73E-10	2.6E-04	5.7E-15	4.2E-09
VOC	Toluene	108-88-3	ID	1.00E+00		1.10E-07							2.63E-04			3.73E-10			
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00		1.10E-07							1.92E-04			3.73E-10			
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00		1.10E-07							1.55E-04			3.73E-10			
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00		1.10E-07							2.49E-04			3.73E-10			
SVOC	Anthracene	120-12-7	ID	1.00E+00		1.10E-07			1.30E-01	1.21E-07			2.78E-06			3.73E-10			
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		1.10E-07	1.0E-01	1.1E-08	1.30E-01	1.21E-07	1.0E-01	1.2E-08		6.0E-02		3.73E-10	6.0E-02	1.3E-12	2.3E-08
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		1.10E-07	1.0E+00	1.1E-07	1.30E-01	1.21E-07	1.0E+00	1.2E-07		6.0E-01		3.73E-10	6.0E-01	1.3E-11	2.3E-07
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		1.10E-07	1.0E-01	1.1E-08	1.30E-01	1.21E-07	1.0E-01	1.2E-08		6.0E-02		3.73E-10	6.0E-02	1.3E-12	2.3E-08
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00		1.10E-07			1.30E-01	1.21E-07						3.73E-10			
SVOC	Chrysene	218-01-9	B2	1.00E+00		1.10E-07	1.0E-03	1.1E-10	1.30E-01	1.21E-07	1.0E-03	1.2E-10		6.0E-04		3.73E-10	6.0E-04	1.3E-14	2.3E-10
SVOC	Ethanol	64-17-5		1.00E+00		1.10E-07										3.73E-10			
SVOC	Fluorene	86-73-7	D	1.00E+00		1.10E-07			1.30E-01	1.21E-07			4.47E-06			3.73E-10			
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		1.10E-07	1.0E-01	1.1E-08	1.30E-01	1.21E-07	1.0E-01	1.2E-08		6.0E-02		3.73E-10	6.0E-02	1.3E-12	2.3E-08
SVOC	Naphthalene	91-20-3	C	1.00E+00		1.10E-07	1.2E-01	1.3E-08	1.30E-01	1.21E-07	1.2E-01	1.5E-08	4.38E-05	3.4E-02	8.7E-08	3.73E-10	3.4E-02	7.5E-13	1.2E-07
SVOC	Phenanthrene	85-01-8	D	1.00E+00		1.10E-07			1.30E-01	1.21E-07			3.44E-06			3.73E-10			
SVOC	Pyrene	129-00-0	NC	1.00E+00		1.10E-07			1.30E-01	1.21E-07						3.73E-10			
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00		1.10E-07			1.00E-01	9.32E-08						3.73E-10			
INORG	Lead	7439-92-1	B2	1.00E+00		1.10E-07										3.73E-10			

Attachment 2

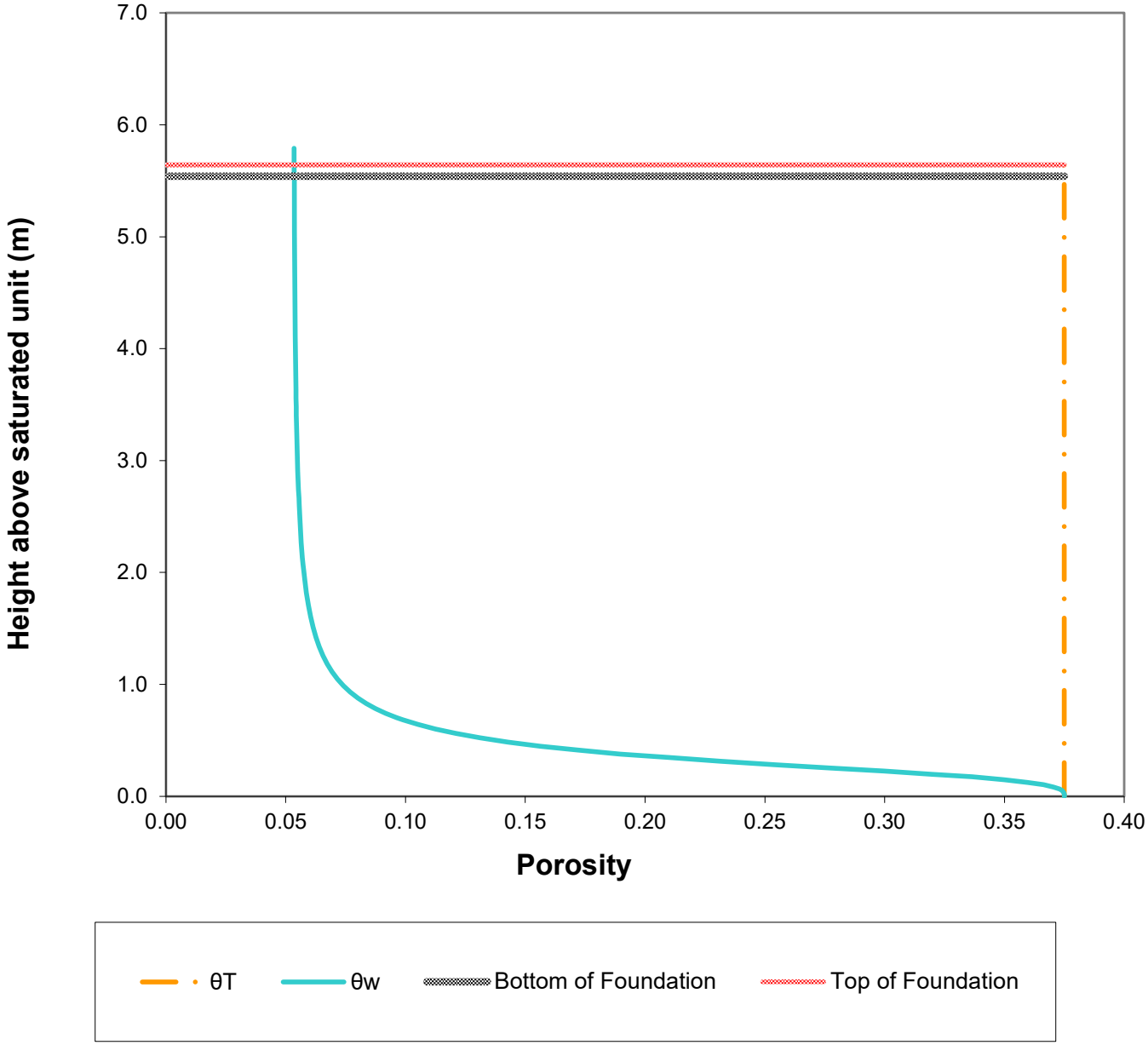
Table 5b

Unit Hazard Quotient Calculations for Exposure of Routine Worker to Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Soil Ingestion				Soil Dermal Contact				Soil Vapor Inhalation			Soil Particulate Inhalation			All Routes
Chem Group	Chemical	CASRN	C_{soil} (mg/kg)	RBA	ADD (mg/kg/d)	RfD_{oral} (mg/kg/d)	HQ	ABS_{derm}	ADD (mg/kg/d)	RfD_{derm} (mg/kg/d)	HQ	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	HQ
VOC	Benzene	71-43-2	1.00E+00		3.08E-07	4.0E-03	7.7E-05			4.0E-03		2.78E-04	3.0E-02	1.5E-03	3.73E-10	3.0E-02	2.0E-09	1.6E-03
VOC	Cumene	98-82-8	1.00E+00		3.08E-07	1.0E-01	3.1E-06			1.0E-01		2.34E-04	4.0E-01	9.6E-05	3.73E-10	4.0E-01	1.5E-10	9.9E-05
VOC	1,2-Dibromoethane	106-93-4	1.00E+00		3.08E-07	9.0E-03	3.4E-05			9.0E-03		2.39E-04	9.0E-03	4.4E-03	3.73E-10	9.0E-03	6.8E-09	4.4E-03
VOC	1,2-Dichloroethane	107-06-2	1.00E+00		3.08E-07	2.0E-02	1.5E-05			2.0E-02		2.69E-04	7.0E-03	6.3E-03	3.73E-10	7.0E-03	8.8E-09	6.3E-03
VOC	Ethyl Benzene	100-41-4	1.00E+00		3.08E-07	1.0E-01	3.1E-06			1.0E-01		2.46E-04	1.0E+00	4.0E-05	3.73E-10	1.0E+00	6.1E-11	4.3E-05
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00		3.08E-07	3.0E-01	1.0E-06			3.0E-01		2.62E-04	3.0E+00	1.4E-05	3.73E-10	3.0E+00	2.0E-11	1.5E-05
VOC	Toluene	108-88-3	1.00E+00		3.08E-07	8.0E-02	3.9E-06			8.0E-02		2.63E-04	5.0E+00	8.6E-06	3.73E-10	5.0E+00	1.2E-11	1.2E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00		3.08E-07	1.0E-02	3.1E-05			1.0E-02		1.92E-04	6.0E-02	5.3E-04	3.73E-10	6.0E-02	1.0E-09	5.6E-04
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00		3.08E-07	1.0E-02	3.1E-05			1.0E-02		1.55E-04	6.0E-02	4.2E-04	3.73E-10	6.0E-02	1.0E-09	4.5E-04
VOC	Xylenes (total)	1330-20-7	1.00E+00		3.08E-07	2.0E-01	1.5E-06			2.0E-01		2.49E-04	1.0E-01	4.1E-04	3.73E-10	1.0E-01	6.1E-10	4.1E-04
SVOC	Anthracene	120-12-7	1.00E+00		3.08E-07	3.0E-01	1.0E-06	1.30E-01	3.39E-07	3.0E-01	1.1E-06	2.78E-06			3.73E-10			2.2E-06
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		3.08E-07			1.30E-01	3.39E-07						3.73E-10			
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		3.08E-07	3.0E-04	1.0E-03	1.30E-01	3.39E-07	3.0E-04	1.1E-03		2.0E-06		3.73E-10	2.0E-06	3.1E-05	2.2E-03
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		3.08E-07			1.30E-01	3.39E-07						3.73E-10			
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		3.08E-07	3.0E-02	1.0E-05	1.30E-01	3.39E-07	3.0E-02	1.1E-05				3.73E-10			2.2E-05
SVOC	Chrysene	218-01-9	1.00E+00		3.08E-07			1.30E-01	3.39E-07						3.73E-10			
SVOC	Ethanol	64-17-5	1.00E+00		3.08E-07	6.2E+01	5.0E-09			6.2E+01			1.9E+01		3.73E-10	1.9E+01	3.2E-12	5.0E-09
SVOC	Fluorene	86-73-7	1.00E+00		3.08E-07	4.0E-02	7.7E-06	1.30E-01	3.39E-07	4.0E-02	8.5E-06	4.47E-06			3.73E-10			1.6E-05
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		3.08E-07			1.30E-01	3.39E-07						3.73E-10			
SVOC	Naphthalene	91-20-3	1.00E+00		3.08E-07	2.0E-02	1.5E-05	1.30E-01	3.39E-07	2.0E-02	1.7E-05	4.38E-05	3.0E-03	2.4E-03	3.73E-10	3.0E-03	2.0E-08	2.4E-03
SVOC	Phenanthrene	85-01-8	1.00E+00		3.08E-07	3.0E-02	1.0E-05	1.30E-01	3.39E-07	3.0E-02	1.1E-05	3.44E-06			3.73E-10			2.2E-05
SVOC	Pyrene	129-00-0	1.00E+00		3.08E-07	3.0E-02	1.0E-05	1.30E-01	3.39E-07	3.0E-02	1.1E-05				3.73E-10			2.2E-05
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		3.08E-07	2.0E+00	1.5E-07	1.00E-01	2.61E-07	2.0E+00	1.3E-07				3.73E-10			2.8E-07
INORG	Lead	7439-92-1	1.00E+00		3.08E-07										3.73E-10			

Attachment 2
Figure 1: Soil Moisture Profile for Default PADEP Nonresidential Building (Slab-On-Grade)
PESRM Philadelphia Refining Complex, Philadelphia, Pennsylvania



Attachment 2

Table 6

Normalized Indoor Air Concentration in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	D_{air} (m^2/day)	D_{water} (m^2/day)	H (unitless)	D_{crack} (m^2/day)	D_{eff}^T (m^2/day)	α_{∞}	K_{oc} (L/kg)	K_d (L/kg)	$C_{s,\ vap}$ (kg-soil/m^3)	$C_{b,\infty}$ (kg-soil/m^3)	α_{ML}	$C_{b,ML}$ (kg-soil/m^3)	$C_{b,\ norm}$ (kg-soil/m^3)
VOC	Benzene	71-43-2	7.60E-01	8.47E-05	1.68E-01	1.23E-01	1.23E-01	2.05E-03	5.82E+01	2.91E-01	4.73E+02	9.69E-01	6.06E-05	2.87E-02	2.87E-02
VOC	Cumene	98-82-8	5.62E-01	6.13E-05	3.28E-01	9.09E-02	9.09E-02	2.05E-03	7.05E+02	3.53E+00	9.05E+01	1.85E-01	3.17E-04	2.87E-02	2.87E-02
VOC	1,2-Dibromoethane	106-93-4	3.72E-01	7.29E-05	2.37E-02	6.02E-02	6.01E-02	2.05E-03	2.22E+01	1.11E-01	1.61E+02	3.29E-01	1.78E-04	2.87E-02	2.87E-02
VOC	1,2-Dichloroethane	107-06-2	8.99E-01	8.55E-05	2.92E-02	1.46E-01	1.45E-01	2.05E-03	1.75E+01	8.74E-02	2.33E+02	4.77E-01	1.23E-04	2.87E-02	2.87E-02
VOC	Ethyl Benzene	100-41-4	6.48E-01	6.74E-05	2.20E-01	1.05E-01	1.05E-01	2.05E-03	3.67E+02	1.84E+00	1.15E+02	2.36E-01	2.49E-04	2.87E-02	2.87E-02
VOC	Methyl tert-butyl ether	1634-04-4	7.42E-01	8.73E-05	1.83E-02	1.20E-01	1.20E-01	2.05E-03	1.15E+01	5.75E-02	1.97E+02	4.03E-01	1.46E-04	2.87E-02	2.87E-02
VOC	Toluene	108-88-3	7.52E-01	7.43E-05	1.93E-01	1.22E-01	1.22E-01	2.05E-03	1.80E+02	9.02E-01	1.98E+02	4.06E-01	1.45E-04	2.87E-02	2.87E-02
VOC	1,2,4-Trimethylbenzene	95-63-6	5.24E-01	6.84E-05	1.61E-01	8.48E-02	8.48E-02	2.05E-03	8.97E+02	4.49E+00	3.54E+01	7.25E-02	8.10E-04	2.87E-02	2.87E-02
VOC	1,3,5-Trimethylbenzene	108-67-8	5.20E-01	7.49E-05	1.54E-01	8.42E-02	8.42E-02	2.05E-03	1.76E+03	8.81E+00	1.74E+01	3.55E-02	1.65E-03	2.87E-02	2.87E-02
VOC	Xylenes (total)	1330-20-7	6.74E-01	7.56E-05	2.52E-01	1.09E-01	1.09E-01	2.05E-03	3.86E+02	1.93E+00	1.25E+02	2.56E-01	2.29E-04	2.87E-02	2.87E-02
SVOC	Anthracene	120-12-7	2.80E-01	6.69E-05	1.30E-03	4.54E-02	4.53E-02	2.05E-03	2.97E+04	1.49E+02	8.77E-03	1.80E-05	3.27E+00	2.87E-02	1.80E-05
SVOC	Benzo(a)anthracene	56-55-3	4.41E-01	7.78E-05	5.55E-05	7.19E-02	7.19E-02	2.05E-03	4.01E+05	2.01E+03	2.77E-05	5.67E-08	1.04E+03	2.87E-02	
SVOC	Benzo(a)pyrene	50-32-8	3.72E-01	7.78E-05	1.49E-05	6.23E-02	6.23E-02	2.05E-03	1.01E+06	5.07E+03	2.95E-06	6.03E-09	9.74E+03	2.87E-02	
SVOC	Benzo(b)fluoranthene	205-99-2	1.95E-01	4.80E-05	1.66E-03	3.16E-02	3.16E-02	2.04E-03	1.24E+06	6.22E+03	2.67E-04	5.45E-07	1.08E+02	2.87E-02	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.88E-01	4.54E-05	1.10E-05	3.21E-02	3.21E-02	2.04E-03	1.28E+07	6.40E+04	1.72E-07	3.51E-10	1.67E+05	2.87E-02	
SVOC	Chrysene	218-01-9	2.14E-01	5.37E-05	1.48E-03	3.47E-02	3.47E-02	2.05E-03	4.01E+05	2.01E+03	7.38E-04	1.51E-06	3.89E+01	2.87E-02	
SVOC	Ethanol	64-17-5	1.06E+00	1.12E-04	1.75E-04	1.72E-01	1.72E-01	2.05E-03	6.81E-01	3.40E-03	4.90E+00	1.00E-02	5.85E-03	2.87E-02	
SVOC	Fluorene	86-73-7	3.14E-01	6.81E-05	1.39E-03	5.08E-02	5.08E-02	2.05E-03	1.38E+04	6.88E+01	2.02E-02	4.12E-05	1.42E+00	2.87E-02	4.12E-05
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.64E-01	4.89E-05	2.03E-05	2.76E-02	2.76E-02	2.04E-03	3.45E+06	1.72E+04	1.18E-06	2.41E-09	2.44E+04	2.87E-02	
SVOC	Naphthalene	91-20-3	5.10E-01	6.48E-05	1.20E-02	8.25E-02	8.25E-02	2.05E-03	2.01E+03	1.00E+01	1.19E+00	2.45E-03	2.40E-02	2.87E-02	2.45E-03
SVOC	Phenanthrene	85-01-8	3.24E-01	6.45E-05	1.41E-03	5.25E-02	5.25E-02	2.05E-03	2.42E+04	1.21E+02	1.16E-02	2.37E-05	2.47E+00	2.87E-02	2.37E-05
SVOC	Pyrene	129-00-0	2.35E-01	6.26E-05	2.00E-04	3.82E-02	3.82E-02	2.05E-03	1.06E+05	5.28E+02	3.79E-04	7.76E-07	7.56E+01	2.87E-02	
SVOC	Tetraethylene Glycol	112-60-7	4.39E-01	6.96E-05	1.62E-11	1.76E+03	1.76E+03	1.68E-01	3.00E-02	1.50E-04	5.01E-07	8.40E-08	5.73E+04	2.87E-02	
INORG	Lead	7439-92-1								9.00E+02					

Attachment 2

Table 6

Normalized Indoor Air Concentration in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:	Subsurface and Building Characteristics			Crack Soil
	SCS Soil texture class			Sand
	Bulk density	kg/L	ρ_b	1.66
	Total porosity	L/L-soil	θ_T	0.375
	Water-filled porosity	L/L-soil	θ_w	0.053
	Air-filled porosity	L/L-soil	θ_a	0.322
	Organic carbon fraction	unitless	f_{oc}	NA
	Residual saturation	L/L-soil	θ_r	0.053
	Hydraulic conductivity	cm/s	K	7.4E-03
	Dynamic viscosity of water	g/cm-s	μ_w	0.01307
	Density of water	g/cm^3	ρ_w	1.0
	Gravitational acceleration	cm/s^2	g	980.7
	Intrinsic permeability	cm^2	k	9.9E-08
	Relative saturation	unitless	S_e	0.001
	van Genuchten N	unitless	N	3.18
	van Genuchten M	unitless	M	0.685
	Relative air permeability	unitless	k_{rg}	0.999
	Permeability to vapor	cm^2	k_v	9.9E-08
	Distance from building foundation to source	m	$L_{T\text{-}soil}$	0.001
	Bldg foundation thickness	m	L_{crack}	0.1
	Bldg foundation length	m		10.00
	Bldg foundation width	m		10.00
	Bldg occupied height	m		2.44
	Bldg occupied volume	m^3		244.00
	Occupied depth below ground	m		0.2
	Bldg area for vapor intrusion	m^2	A_B	106.0
	Ratio of A_{crack} to A_B		η	4E-04
	Area of cracks	m^2	A_{crack}	4.00E-02
	Air exchange rate	$hour^{-1}$	ach	0.6
	Building ventilation rate	m^3/day	Q_{bldg}	3.51E+03
	Pressure difference between outdoors-indoors	$kg/m\text{-}s^2$	ΔP	1.0
	Viscosity of air	kg/m-s	μ_a	1.8E-05
	Crack length (bldg perimeter)	m	X_{crack}	40
	Crack depth below ground	m	Z_{crack}	0.25
	Crack radius	m	r_{crack}	1E-03
	Soil gas flow rate into bldg	m^3/day	Q_{soil}	7.20E+00
	Averaging period	d	ED	9.13E+03
	Contaminant thickness	m	ΔH	5.5

Attachment 2
Table 7
Unit Risk and Hazard Quotient Calculations for Soil Vapor Intrusion into a Default PADEP Nonresidential Building (Slab-On-Grade)
Routine Worker
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Cancer			Noncancer	
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**C_{soil}** (mg/kg)	**C_{air}** (mg/m^3)	**URF** $(mg/m^3)^{-1}$	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	Benzene	71-43-2	A	1.00E+00	2.87E-02	7.8E-03	1.8E-05		3.0E-02	2.2E-01
VOC	Cumene	98-82-8	D	1.00E+00	2.87E-02				4.0E-01	1.6E-02
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	2.87E-02	6.0E-01	1.4E-03		9.0E-03	7.3E-01
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	2.87E-02	2.6E-02	6.1E-05		7.0E-03	9.4E-01
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	2.87E-02				1.0E+00	6.5E-03
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	2.87E-02	2.6E-04	6.1E-07		3.0E+00	2.2E-03
VOC	Toluene	108-88-3	ID	1.00E+00	2.87E-02				5.0E+00	1.3E-03
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	2.87E-02				6.0E-02	1.1E-01
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	2.87E-02				6.0E-02	1.1E-01
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	2.87E-02				1.0E-01	6.5E-02
SVOC	Anthracene	120-12-7	ID	1.00E+00	1.80E-05					
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		6.0E-02				
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		6.0E-01			2.0E-06	
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		6.0E-02				
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00						
SVOC	Chrysene	218-01-9	B2	1.00E+00		6.0E-04				
SVOC	Ethanol	64-17-5		1.00E+00					1.9E+01	
SVOC	Fluorene	86-73-7	D	1.00E+00	4.12E-05					
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		6.0E-02				
SVOC	Naphthalene	91-20-3	C	1.00E+00	2.45E-03	3.4E-02	6.8E-06		3.0E-03	1.9E-01
SVOC	Phenanthrene	85-01-8	D	1.00E+00	2.37E-05					
SVOC	Pyrene	129-00-0	NC	1.00E+00						
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00						
INORG	Lead	7439-92-1	B2	1.00E+00						

Attachment 2

Table 8

Normalized Vapor Flux to Outdoor Air from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	H (unitless)	D_{eff}^{T} (m^2/day)	J (L/m^2-s)	C_{air} (L/m^3)
VOC	Benzene	71-43-2	1.68E-01	3.92E-03	1.32E-06	3.31E-05
VOC	Cumene	98-82-8	3.28E-01	1.63E-03	1.07E-06	2.68E-05
VOC	1,2-Dibromoethane	106-93-4	2.37E-02	1.25E-02	5.93E-07	1.49E-05
VOC	1,2-Dichloroethane	107-06-2	2.92E-02	1.61E-02	9.41E-07	2.36E-05
VOC	Ethyl Benzene	100-41-4	2.20E-01	2.53E-03	1.11E-06	2.78E-05
VOC	Methyl tert-butyl ether	1634-04-4	1.83E-02	2.12E-02	7.79E-07	1.95E-05
VOC	Toluene	108-88-3	1.93E-01	3.14E-03	1.21E-06	3.03E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.61E-01	3.19E-03	1.03E-06	2.58E-05
VOC	1,3,5-Trimethylbenzene	108-67-8	1.54E-01	3.56E-03	1.10E-06	2.75E-05
VOC	Xylenes (total)	1330-20-7	2.52E-01	2.50E-03	1.26E-06	3.15E-05
SVOC	Anthracene	120-12-7	1.30E-03	3.20E-02	8.34E-08	2.09E-06
SVOC	Benzo(a)anthracene	56-55-3	5.55E-05	6.89E-02	7.65E-09	
SVOC	Benzo(a)pyrene	50-32-8	1.49E-05	6.47E-02	1.93E-09	
SVOC	Benzo(b)fluoranthene	205-99-2	1.66E-03	2.14E-02	7.09E-08	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.10E-05	3.41E-02	7.49E-10	
SVOC	Chrysene	218-01-9	1.48E-03	2.41E-02	7.13E-08	
SVOC	Ethanol	64-17-5	1.75E-04	1.45E-01	5.06E-08	
SVOC	Fluorene	86-73-7	1.39E-03	3.47E-02	9.63E-08	2.41E-06
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.03E-05	2.87E-02	1.16E-09	
SVOC	Naphthalene	91-20-3	1.20E-02	1.99E-02	4.78E-07	1.20E-05
SVOC	Phenanthrene	85-01-8	1.41E-03	3.51E-02	9.87E-08	2.47E-06
SVOC	Pyrene	129-00-0	2.00E-04	3.45E-02	1.38E-08	
SVOC	Tetraethylene Glycol	112-60-7	1.62E-11	2.38E+03	7.72E-11	
INORG	Lead	7439-92-1				

Parameters

Depth to groundwater	m	**DTW**	5.79
Dispersion coefficient	(L/m^3) / (L/m^2/s)	**C/Q**	25.1

Attachment 2
Table 9
Unit Risk and Hazard Quotient Calculations for Exposure of Routine Workers to Groundwater-derived Vapors in Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Cancer			Noncancer	
Chem Group	**Chemical**	**CASRN**	**Carc Class**	C_{GW} (mg/L)	C_{air} (mg/m^3)	**URF** (mg/m^3)$^{-1}$	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	Benzene	71-43-2	A	1.00E+00	3.31E-05	7.8E-03	1.5E-08		3.0E-02	1.8E-04
VOC	Cumene	98-82-8	D	1.00E+00	2.68E-05				4.0E-01	1.1E-05
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	1.49E-05	6.0E-01	5.2E-07		9.0E-03	2.7E-04
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	2.36E-05	2.6E-02	3.6E-08		7.0E-03	5.5E-04
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	2.78E-05				1.0E+00	4.6E-06
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	1.95E-05	2.6E-04	3.0E-10		3.0E+00	1.1E-06
VOC	Toluene	108-88-3	ID	1.00E+00	3.03E-05				5.0E+00	1.0E-06
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	2.58E-05				6.0E-02	7.1E-05
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	2.75E-05				6.0E-02	7.5E-05
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	3.15E-05				1.0E-01	5.2E-05
SVOC	Anthracene	120-12-7	ID	1.00E+00	2.09E-06					
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		6.0E-02				
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		6.0E-01			2.0E-06	
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		6.0E-02				
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00						
SVOC	Chrysene	218-01-9	B2	1.00E+00		6.0E-04				
SVOC	Ethanol	64-17-5		1.00E+00					1.9E+01	
SVOC	Fluorene	86-73-7	D	1.00E+00	2.41E-06					
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		6.0E-02				
SVOC	Naphthalene	91-20-3	C	1.00E+00	1.20E-05	3.4E-02	2.4E-08		3.0E-03	6.6E-04
SVOC	Phenanthrene	85-01-8	D	1.00E+00	2.47E-06					
SVOC	Pyrene	129-00-0	NC	1.00E+00						
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00						
INORG	Lead	7439-92-1	B2	1.00E+00						

Attachment 2

Table 10

Normalized Indoor Air Concentration in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	D_{air} (m^2/day)	D_{water} (m^2/day)	H (unitless)	D_{crack} (m^2/day)	D_{eff}^T (m^2/day)	α_{soil}	α_{slab}	α_{∞}	$C_{b, norm}$ (L-water/m^3)
VOC	Benzene	71-43-2	7.60E-01	8.47E-05	1.68E-01	1.23E-01	3.74E-03	9.83E-03	2.05E-03	2.01E-05	3.39E-03
VOC	Cumene	98-82-8	5.62E-01	6.13E-05	3.28E-01	9.09E-02	1.56E-03	4.12E-03	2.05E-03	8.44E-06	2.76E-03
VOC	1,2-Dibromoethane	106-93-4	3.72E-01	7.29E-05	2.37E-02	6.02E-02	1.20E-02	3.09E-02	2.05E-03	6.34E-05	1.51E-03
VOC	1,2-Dichloroethane	107-06-2	8.99E-01	8.55E-05	2.92E-02	1.46E-01	1.54E-02	3.94E-02	2.05E-03	8.08E-05	2.36E-03
VOC	Ethyl Benzene	100-41-4	6.48E-01	6.74E-05	2.20E-01	1.05E-01	2.41E-03	6.36E-03	2.05E-03	1.30E-05	2.87E-03
VOC	Methyl tert-butyl ether	1634-04-4	7.42E-01	8.73E-05	1.83E-02	1.20E-01	2.04E-02	5.14E-02	2.05E-03	1.05E-04	1.93E-03
VOC	Toluene	108-88-3	7.52E-01	7.43E-05	1.93E-01	1.22E-01	2.99E-03	7.89E-03	2.05E-03	1.62E-05	3.12E-03
VOC	1,2,4-Trimethylbenzene	95-63-6	5.24E-01	6.84E-05	1.61E-01	8.48E-02	3.05E-03	8.03E-03	2.05E-03	1.64E-05	2.65E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	5.20E-01	7.49E-05	1.54E-01	8.42E-02	3.40E-03	8.95E-03	2.05E-03	1.83E-05	2.82E-03
VOC	Xylenes (total)	1330-20-7	6.74E-01	7.56E-05	2.52E-01	1.09E-01	2.39E-03	6.30E-03	2.05E-03	1.29E-05	3.25E-03
SVOC	Anthracene	120-12-7	2.80E-01	6.69E-05	1.30E-03	4.54E-02	3.15E-02	7.73E-02	2.05E-03	1.58E-04	2.07E-04
SVOC	Benzo(a)anthracene	56-55-3	4.41E-01	7.78E-05	5.55E-05	7.19E-02	6.88E-02	1.54E-01	2.05E-03	3.17E-04	
SVOC	Benzo(a)pyrene	50-32-8	3.72E-01	7.78E-05	1.49E-05	6.23E-02	6.48E-02	1.47E-01	2.05E-03	3.01E-04	
SVOC	Benzo(b)fluoranthene	205-99-2	1.95E-01	4.80E-05	1.66E-03	3.16E-02	2.10E-02	5.29E-02	2.05E-03	1.08E-04	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.88E-01	4.54E-05	1.10E-05	3.21E-02	3.42E-02	8.33E-02	2.05E-03	1.71E-04	
SVOC	Chrysene	218-01-9	2.14E-01	5.37E-05	1.48E-03	3.47E-02	2.37E-02	5.94E-02	2.05E-03	1.22E-04	
SVOC	Ethanol	64-17-5	1.06E+00	1.12E-04	1.75E-04	1.72E-01	1.44E-01	2.76E-01	2.05E-03	5.66E-04	
SVOC	Fluorene	86-73-7	3.14E-01	6.81E-05	1.39E-03	5.08E-02	3.42E-02	8.33E-02	2.05E-03	1.71E-04	2.37E-04
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.64E-01	4.89E-05	2.03E-05	2.76E-02	2.87E-02	7.10E-02	2.05E-03	1.45E-04	
SVOC	Naphthalene	91-20-3	5.10E-01	6.48E-05	1.20E-02	8.25E-02	1.91E-02	4.84E-02	2.05E-03	9.91E-05	1.19E-03
SVOC	Phenanthrene	85-01-8	3.24E-01	6.45E-05	1.41E-03	5.25E-02	3.46E-02	8.41E-02	2.05E-03	1.72E-04	2.42E-04
SVOC	Pyrene	129-00-0	2.35E-01	6.26E-05	2.00E-04	3.82E-02	3.43E-02	8.35E-02	2.05E-03	1.71E-04	
SVOC	Tetraethylene Glycol	112-60-7	4.39E-01	6.96E-05	1.62E-11	1.76E+03	2.43E+03	9.87E-01	1.68E-01	1.66E-01	
INORG	Lead	7439-92-1									

Attachment 2

Table 10

Normalized Indoor Air Concentration in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Subsurface and Building Characteristics			**Crack Soil**
SCS Soil texture class			Sand
Bulk density	kg/L	ρ_b	1.66
Total porosity	L/L-soil	θ_T	0.375
Water-filled porosity	L/L-soil	θ_w	0.053
Air-filled porosity	L/L-soil	θ_a	0.322

Residual saturation	L/L-soil	θ_r	0.053
Hydraulic conductivity	cm/s	K	7.4E-03
Dynamic viscosity of water	g/cm-s	μ_w	0.01307
Density of water	g/cm^3	ρ_w	1.0
Gravitational acceleration	cm/s^2	g	980.7
Intrinsic permeability	cm^2	k	9.9E-08
Relative saturation	unitless	S_e	0.001
van Genuchten N	unitless	N	3.177
van Genuchten M	unitless	M	0.685
Relative air permeability	unitless	k_{rg}	0.999
Permeability to vapor	cm^2	k_v	9.91E-08
Distance from foundation to source	m	$L_{T\text{-}gw}$	5.54
Bldg foundation thickness	m	L_{crack}	0.1
Bldg foundation length	m		10.00
Bldg foundation width	m		10.00
Bldg occupied height	m		2.44
Bldg occupied volume	m^3		244.00
Occupied depth below ground	m		0.2
Bldg area for vapor intrusion	m^2	A_B	106.0
Ratio of A_{crack} to A_B		η	4E-04
Area of cracks	m^2	A_{crack}	4E-02
Air exchange rate	$hour^{-1}$	ach	0.60
Building ventilation rate	m^3/day	Q_{bldg}	3.5E+03
Pressure diff. outdoors-indoors	$kg/m\text{-}s^2$	ΔP	1.0
Viscosity of air	kg/m-s	μ_a	1.8E-05
Crack length (bldg perimeter)	m	X_{crack}	40
Crack depth below ground	m	Z_{crack}	0.25
Crack radius	m	r_{crack}	1E-03
Soil gas flow rate into bldg	m^3/day	Q_{soil}	7.20

Attachment 2

Table 11

Unit Risk and Hazard Quotient Calculations for Groundwater Vapor Intrusion into a Default PADEP Nonresidential Building (Slab-On-Grade)

Routine Worker

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

							Cancer			Noncancer	
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**C_{gw}** (mg/L)	**C_{air}** (mg/m^3)		**URF** $(mg/m^3)^{-1}$	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	Benzene	71-43-2	A	1.00E+00	3.39E-03		7.8E-03	2.2E-06		3.0E-02	2.6E-02
VOC	Cumene	98-82-8	D	1.00E+00	2.76E-03					4.0E-01	1.6E-03
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	1.51E-03		6.0E-01	7.4E-05		9.0E-03	3.8E-02
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	2.36E-03		2.6E-02	5.0E-06		7.0E-03	7.7E-02
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	2.87E-03					1.0E+00	6.5E-04
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	1.93E-03		2.6E-04	4.1E-08		3.0E+00	1.5E-04
VOC	Toluene	108-88-3	ID	1.00E+00	3.12E-03					5.0E+00	1.4E-04
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	2.65E-03					6.0E-02	1.0E-02
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	2.82E-03					6.0E-02	1.1E-02
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	3.25E-03					1.0E-01	7.4E-03
SVOC	Anthracene	120-12-7	ID	1.00E+00	2.07E-04						
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00			6.0E-02				
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00			6.0E-01			2.0E-06	
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00			6.0E-02				
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00							
SVOC	Chrysene	218-01-9	B2	1.00E+00			6.0E-04				
SVOC	Ethanol	64-17-5		1.00E+00						1.9E+01	
SVOC	Fluorene	86-73-7	D	1.00E+00	2.37E-04						
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00			6.0E-02				
SVOC	Naphthalene	91-20-3	C	1.00E+00	1.19E-03		3.4E-02	3.3E-06		3.0E-03	9.1E-02
SVOC	Phenanthrene	85-01-8	D	1.00E+00	2.42E-04						
SVOC	Pyrene	129-00-0	NC	1.00E+00							
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00							
INORG	Lead	7439-92-1	B2	1.00E+00							

Attachment 3

Maintenance Worker Risk Calculations

Table 1 – Normalized Average Vapor Flux from Soil to Outdoor Air

Table 2 – Dispersion Factor to Outdoor Air

Table 3 – Concentrations in Outdoor Air from Soil

Table 4a – Unit Risk Calculations for Exposure of Maintenance Workers to Soil

Table 4b – Unit Hazard Quotient Calculations for Exposure of Maintenance Workers to Soil

Table 5 – Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations

Table 6 – Dermal Absorbed Dose for Groundwater

Table 7a – Unit Risk Calculations for Exposure of Maintenance Workers to Groundwater in Excavations

Table 7b – Unit Hazard Quotient Calculations for Exposure of Maintenance Workers to Groundwater in Excavations

Attachment 3
Table 1
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	D_{air} (m^2/d)	D_{water} (m^2/d)	D_G (m^2/d)	D_L (m^2/d)	D_E (m^2/d)	J_v (kg/m^2-s)
VOC	Benzene	71-43-2	5.82E+01		1.68E-01	7.60E-01	8.47E-05	1.23E-01	3.46E-08	3.51E-02	2.61E-05
VOC	Cumene	98-82-8	7.05E+02		3.28E-01	5.62E-01	6.13E-05	9.10E-02	2.51E-08	4.96E-03	1.96E-05
VOC	1,2-Dibromoethane	106-93-4	2.22E+01		2.37E-02	3.72E-01	7.29E-05	6.02E-02	2.98E-08	5.83E-03	2.03E-05
VOC	1,2-Dichloroethane	107-06-2	1.75E+01		2.92E-02	8.99E-01	8.55E-05	1.46E-01	3.50E-08	2.04E-02	2.48E-05
VOC	Ethyl Benzene	100-41-4	3.67E+02		2.20E-01	6.48E-01	6.74E-05	1.05E-01	2.76E-08	7.27E-03	2.13E-05
VOC	Methyl tert-butyl ether	1634-04-4	1.15E+01		1.83E-02	7.42E-01	8.73E-05	1.20E-01	3.57E-08	1.43E-02	2.38E-05
VOC	Toluene	108-88-3	1.80E+02		1.93E-01	7.52E-01	7.43E-05	1.22E-01	3.04E-08	1.46E-02	2.38E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	8.97E+02		1.61E-01	5.24E-01	6.84E-05	8.48E-02	2.80E-08	1.81E-03	1.44E-05
VOC	1,3,5-Trimethylbenzene	108-67-8	1.76E+03		1.54E-01	5.20E-01	7.49E-05	8.42E-02	3.06E-08	8.81E-04	1.05E-05
VOC	Xylenes (total)	1330-20-7	3.86E+02		2.52E-01	6.74E-01	7.56E-05	1.09E-01	3.09E-08	8.23E-03	2.18E-05
SVOC	Anthracene	120-12-7	2.97E+04		1.30E-03	2.80E-01	6.69E-05	4.53E-02	2.74E-08	2.40E-07	1.76E-07
SVOC	Benzo(a)anthracene	56-55-3	4.01E+05		5.55E-05	4.41E-01	7.78E-05	7.14E-02	3.18E-08	1.20E-09	
SVOC	Benzo(a)pyrene	50-32-8	1.01E+06		1.49E-05	3.72E-01	7.78E-05	6.02E-02	3.18E-08	1.11E-10	
SVOC	Benzo(b)fluoranthene	205-99-2	1.24E+06		1.66E-03	1.95E-01	4.80E-05	3.16E-02	1.97E-08	5.08E-09	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.28E+07		1.10E-05	1.88E-01	4.54E-05	3.04E-02	1.86E-08	3.32E-12	
SVOC	Chrysene	218-01-9	4.01E+05		1.48E-03	2.14E-01	5.37E-05	3.47E-02	2.20E-08	1.54E-08	
SVOC	Ethanol	64-17-5	6.81E-01		1.75E-04	1.06E+00	1.12E-04	1.72E-01	4.60E-08	5.09E-04	
SVOC	Fluorene	86-73-7	1.38E+04		1.39E-03	3.14E-01	6.81E-05	5.08E-02	2.79E-08	6.17E-07	2.82E-07
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	3.45E+06		2.03E-05	1.64E-01	4.89E-05	2.66E-02	2.00E-08	1.96E-11	
SVOC	Naphthalene	91-20-3	2.01E+03		1.20E-02	5.10E-01	6.48E-05	8.26E-02	2.65E-08	5.94E-05	2.77E-06
SVOC	Phenanthrene	85-01-8	2.42E+04		1.41E-03	3.24E-01	6.45E-05	5.25E-02	2.64E-08	3.67E-07	2.17E-07
SVOC	Pyrene	129-00-0	1.06E+05		2.00E-04	2.35E-01	6.26E-05	3.81E-02	2.56E-08	8.73E-09	
SVOC	Tetraethylene Glycol	112-60-7	3.00E-02		1.62E-11	4.39E-01	6.96E-05	7.11E-02	2.85E-08	5.30E-07	
INORG	Lead	7439-92-1		9.00E+02							

Attachment 3
Table 1
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Soil bulk density	kg/L	ρ_b	1.66
Soil porosity	L/L-soil	θ	0.38
Soil water content	L/L-soil	θ_w	0.05
Soil air-filled porosity	L/L-soil	θ_a	0.32
Soil organic carbon fraction	unitless	f_{oc}	0.005
Averaging period (Exposure Duration)	years	**T**	10
	days	**T**	3650
Temperature	^oC	**Temp**	18
Clean soil above source	m	Z_1	
Bottom of source depth	m	Z_2	5.79

Based on the volatilization model developed by Jury et. al. (1983) for finite sources as described in USEPA's (1996) Soil Screening Guidance: Technical Background Document.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 3
Table 2
Dispersion Factor to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Parameter	Units	Value
Correlation coefficient city		Philadelphia
Correlation coefficient A		14.0111
Correlation coefficient B		19.6154
Correlation coefficient C		225.3397

Soil source area	acres	70.6
Soil C/Q averaging time		Annual Max
Conversion factor from 1-Hr Max for soil		0.19
C/Q for soil	$(kg/m^3)/(kg/m^2\text{-}s)$	**25.06**

Groundwater source area	acres	0.0052
Groundwater averaging time for C/Q		24-Hour Max
Conversion factor from 1-Hr Max for groundwater		0.40
C/Q for Groundwater	$(L/m^3)/(L/m^2\text{-}s)$	**9.63**

Note:
C/Q is estimated using the empirical correlation in USEPA's (2002) Supplemental Soil Screening Guidance.

Attachment 3
Table 3
Concentrations in Outdoor Air from Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

			Vapor		PM_{10}	
		C/Q (kg/m^3 per kg/m^2-s):	2.5E+01			
Chem Chem	**Chemical**	**CASRN**	C_{soil} (mg/kg)	C_{air} (mg/m^3)	C_{soil} (mg/kg)	C_{air} (mg/m^3)
VOC	Benzene	71-43-2	1.00E+00	6.55E-04	1.00E+00	5.00E-08
VOC	Cumene	98-82-8	1.00E+00	4.91E-04	1.00E+00	5.00E-08
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	5.10E-04	1.00E+00	5.00E-08
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	6.22E-04	1.00E+00	5.00E-08
VOC	Ethyl Benzene	100-41-4	1.00E+00	5.34E-04	1.00E+00	5.00E-08
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	5.95E-04	1.00E+00	5.00E-08
VOC	Toluene	108-88-3	1.00E+00	5.97E-04	1.00E+00	5.00E-08
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	3.60E-04	1.00E+00	5.00E-08
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	2.64E-04	1.00E+00	5.00E-08
VOC	Xylenes (total)	1330-20-7	1.00E+00	5.46E-04	1.00E+00	5.00E-08
SVOC	Anthracene	120-12-7	1.00E+00	4.40E-06	1.00E+00	5.00E-08
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.00E+00	5.00E-08
SVOC	Chrysene	218-01-9	1.00E+00		1.00E+00	5.00E-08
SVOC	Ethanol	64-17-5	1.00E+00		1.00E+00	5.00E-08
SVOC	Fluorene	86-73-7	1.00E+00	7.06E-06	1.00E+00	5.00E-08
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.00E+00	5.00E-08
SVOC	Naphthalene	91-20-3	1.00E+00	6.93E-05	1.00E+00	5.00E-08
SVOC	Phenanthrene	85-01-8	1.00E+00	5.44E-06	1.00E+00	5.00E-08
SVOC	Pyrene	129-00-0	1.00E+00		1.00E+00	5.00E-08
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.00E+00	5.00E-08
INORG	Lead	7439-92-1	1.00E+00		1.00E+00	5.00E-08

Attachment 3

Table 4a

Unit Risk Calculations for Exposure of Maintenance Worker to Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

					Soil Ingestion				Soil Dermal Contact				Soil Vapor Inhalation			Soil Particulate Inhalation			All Routes
Chem Group	Chemical	CASRN	Cancer Class	C_{soil} (mg/kg)	RBA	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	Risk	ABS_{derm}	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	Risk	C_{air} (mg/m^3)	URF (m^3/mg)	Risk	C_{air} (mg/m^3)	URF $(mg/m^3)^{-1}$	Risk	Risk
VOC	Benzene	71-43-2	A	1.00E+00		1.47E-08	5.5E-02	8.1E-10			5.5E-02		6.55E-04	7.8E-03	2.0E-08	5.00E-08	7.8E-03	1.5E-12	2.1E-08
VOC	Cumene	98-82-8	D	1.00E+00		1.47E-08							4.91E-04			5.00E-08			
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00		1.47E-08	2.0E+00	2.9E-08			2.0E+00		5.10E-04	6.0E-01	1.2E-06	5.00E-08	6.0E-01	1.2E-10	1.2E-06
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00		1.47E-08	9.1E-02	1.3E-09			9.1E-02		6.22E-04	2.6E-02	6.3E-08	5.00E-08	2.6E-02	5.1E-12	6.5E-08
VOC	Ethyl Benzene	100-41-4	D	1.00E+00		1.47E-08							5.34E-04			5.00E-08			
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00		1.47E-08	1.8E-03	2.6E-11			1.8E-03		5.95E-04	2.6E-04	6.1E-10	5.00E-08	2.6E-04	5.1E-14	6.3E-10
VOC	Toluene	108-88-3	ID	1.00E+00		1.47E-08							5.97E-04			5.00E-08			
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00		1.47E-08							3.60E-04			5.00E-08			
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00		1.47E-08							2.64E-04			5.00E-08			
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00		1.47E-08							5.46E-04			5.00E-08			
SVOC	Anthracene	120-12-7	ID	1.00E+00		1.47E-08			1.30E-01	8.08E-09			4.40E-06			5.00E-08			
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		1.47E-08	1.0E-01	1.5E-09	1.30E-01	8.08E-09	1.0E-01	8.1E-10		6.0E-02		5.00E-08	6.0E-02	1.2E-11	2.3E-09
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		1.47E-08	1.0E+00	1.5E-08	1.30E-01	8.08E-09	1.0E+00	8.1E-09		6.0E-01		5.00E-08	6.0E-01	1.2E-10	2.3E-08
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		1.47E-08	1.0E-01	1.5E-09	1.30E-01	8.08E-09	1.0E-01	8.1E-10		6.0E-02		5.00E-08	6.0E-02	1.2E-11	2.3E-09
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00		1.47E-08			1.30E-01	8.08E-09						5.00E-08			
SVOC	Chrysene	218-01-9	B2	1.00E+00		1.47E-08	1.0E-03	1.5E-11	1.30E-01	8.08E-09	1.0E-03	8.1E-12		6.0E-04		5.00E-08	6.0E-04	1.2E-13	2.3E-11
SVOC	Ethanol	64-17-5		1.00E+00		1.47E-08										5.00E-08			
SVOC	Fluorene	86-73-7	D	1.00E+00		1.47E-08			1.30E-01	8.08E-09			7.06E-06			5.00E-08			
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		1.47E-08	1.0E-01	1.5E-09	1.30E-01	8.08E-09	1.0E-01	8.1E-10		6.0E-02		5.00E-08	6.0E-02	1.2E-11	2.3E-09
SVOC	Naphthalene	91-20-3	C	1.00E+00		1.47E-08	1.2E-01	1.8E-09	1.30E-01	8.08E-09	1.2E-01	9.7E-10	6.93E-05	3.4E-02	9.2E-09	5.00E-08	3.4E-02	6.7E-12	1.2E-08
SVOC	Phenanthrene	85-01-8	D	1.00E+00		1.47E-08			1.30E-01	8.08E-09			5.44E-06			5.00E-08			
SVOC	Pyrene	129-00-0	NC	1.00E+00		1.47E-08			1.30E-01	8.08E-09						5.00E-08			
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00		1.47E-08			1.00E-01	6.21E-09						5.00E-08			
INORG	Lead	7439-92-1	B2	1.00E+00		1.47E-08										5.00E-08			

Notes:

The concentration of particulates in the air is assumed to be no more than the former annual National Ambient Air Quality Standards (NAAQS) for PM_{10} of 50 ug/m^3.

Attachment 3

Table 4b

Unit Hazard Quotient Calculations for Exposure of Maintenance Worker to Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Soil Ingestion				Soil Dermal Contact				Soil Vapor Inhalation			Soil Particulate Inhalation			All Routes
Chem Group	Chemical	CASRN	C_{soil} (mg/kg)	RBA	ADD (mg/kg/d)	RfD_{oral} (mg/kg/d)	HQ	ABS_{derm}	ADD (mg/kg/d)	RfD_{derm} (mg/kg/d)	HQ	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	HQ
VOC	Benzene	71-43-2	1.00E+00		1.03E-07	4.0E-03	2.6E-05			4.0E-03		6.55E-04	3.0E-02	6.0E-04	5.00E-08	3.0E-02	4.6E-08	6.2E-04
VOC	Cumene	98-82-8	1.00E+00		1.03E-07	1.0E-01	1.0E-06			1.0E-01		4.91E-04	4.0E-01	3.4E-05	5.00E-08	4.0E-01	3.4E-09	3.5E-05
VOC	1,2-Dibromoethane	106-93-4	1.00E+00		1.03E-07	9.0E-03	1.1E-05			9.0E-03		5.10E-04	9.0E-03	1.6E-03	5.00E-08	9.0E-03	1.5E-07	1.6E-03
VOC	1,2-Dichloroethane	107-06-2	1.00E+00		1.03E-07	2.0E-02	5.1E-06			2.0E-02		6.22E-04	7.0E-03	2.4E-03	5.00E-08	7.0E-03	2.0E-07	2.4E-03
VOC	Ethyl Benzene	100-41-4	1.00E+00		1.03E-07	1.0E-01	1.0E-06			1.0E-01		5.34E-04	1.0E+00	1.5E-05	5.00E-08	1.0E+00	1.4E-09	1.6E-05
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00		1.03E-07	3.0E-01	3.4E-07			3.0E-01		5.95E-04	3.0E+00	5.4E-06	5.00E-08	3.0E+00	4.6E-10	5.8E-06
VOC	Toluene	108-88-3	1.00E+00		1.03E-07	8.0E-02	1.3E-06			8.0E-02		5.97E-04	5.0E+00	3.3E-06	5.00E-08	5.0E+00	2.7E-10	4.6E-06
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00		1.03E-07	1.0E-02	1.0E-05			1.0E-02		3.60E-04	6.0E-02	1.6E-04	5.00E-08	6.0E-02	2.3E-08	1.7E-04
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00		1.03E-07	1.0E-02	1.0E-05			1.0E-02		2.64E-04	6.0E-02	1.2E-04	5.00E-08	6.0E-02	2.3E-08	1.3E-04
VOC	Xylenes (total)	1330-20-7	1.00E+00		1.03E-07	2.0E-01	5.1E-07			2.0E-01		5.46E-04	1.0E-01	1.5E-04	5.00E-08	1.0E-01	1.4E-08	1.5E-04
SVOC	Anthracene	120-12-7	1.00E+00		1.03E-07	3.0E-01	3.4E-07	1.30E-01	5.65E-08	3.0E-01	1.9E-07	4.40E-06			5.00E-08			5.3E-07
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.03E-07			1.30E-01	5.65E-08						5.00E-08			
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.03E-07	3.0E-04	3.4E-04	1.30E-01	5.65E-08	3.0E-04	1.9E-04		2.0E-06		5.00E-08	2.0E-06	6.8E-04	1.2E-03
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.03E-07			1.30E-01	5.65E-08						5.00E-08			
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.03E-07	3.0E-02	3.4E-06	1.30E-01	5.65E-08	3.0E-02	1.9E-06				5.00E-08			5.3E-06
SVOC	Chrysene	218-01-9	1.00E+00		1.03E-07			1.30E-01	5.65E-08						5.00E-08			
SVOC	Ethanol	64-17-5	1.00E+00		1.03E-07	6.2E+01	1.7E-09			6.2E+01			1.9E+01		5.00E-08	1.9E+01	7.2E-11	1.7E-09
SVOC	Fluorene	86-73-7	1.00E+00		1.03E-07	4.0E-02	2.6E-06	1.30E-01	5.65E-08	4.0E-02	1.4E-06	7.06E-06			5.00E-08			4.0E-06
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.03E-07			1.30E-01	5.65E-08						5.00E-08			
SVOC	Naphthalene	91-20-3	1.00E+00		1.03E-07	2.0E-02	5.1E-06	1.30E-01	5.65E-08	2.0E-02	2.8E-06	6.93E-05	3.0E-03	6.3E-04	5.00E-08	3.0E-03	4.6E-07	6.4E-04
SVOC	Phenanthrene	85-01-8	1.00E+00		1.03E-07	3.0E-02	3.4E-06	1.30E-01	5.65E-08	3.0E-02	1.9E-06	5.44E-06			5.00E-08			5.3E-06
SVOC	Pyrene	129-00-0	1.00E+00		1.03E-07	3.0E-02	3.4E-06	1.30E-01	5.65E-08	3.0E-02	1.9E-06				5.00E-08			5.3E-06
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.03E-07	2.0E+00	5.1E-08	1.00E-01	4.35E-08	2.0E+00	2.2E-08				5.00E-08			7.3E-08
INORG	Lead	7439-92-1	1.00E+00		1.03E-07										5.00E-08			

Notes:

The concentration of particulates in the air is assumed to be no more than the former annual National Ambient Air Quality Standards (NAAQS) for PM_{10} of 50 ug/m^3.

Attachment 3
Table 5
Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	H (unitless)	MW (g/mol)	k_G (cm/s)	k_L (cm/s)	$1/K_L$ (s/cm)	K_L (cm/s)	J_L (L/m^2-s)
VOC	Benzene	71-43-2	1.7E-01	7.8E+01	4.97E-01	1.25E-03	8.12E+02	1.23E-03	1.23E-02
VOC	Cumene	98-82-8	3.3E-01	1.2E+02	4.31E-01	1.01E-03	9.99E+02	1.00E-03	1.00E-02
VOC	1,2-Dibromoethane	106-93-4	2.4E-02	1.9E+02	3.71E-01	8.06E-04	1.35E+03	7.38E-04	7.38E-03
VOC	1,2-Dichloroethane	107-06-2	2.9E-02	9.9E+01	4.60E-01	1.11E-03	9.75E+02	1.03E-03	1.03E-02
VOC	Ethyl Benzene	100-41-4	2.2E-01	1.1E+02	4.49E-01	1.07E-03	9.43E+02	1.06E-03	1.06E-02
VOC	Methyl tert-butyl ether	1634-04-4	1.8E-02	8.8E+01	4.78E-01	1.18E-03	9.64E+02	1.04E-03	1.04E-02
VOC	Toluene	108-88-3	1.9E-01	9.2E+01	4.71E-01	1.15E-03	8.80E+02	1.14E-03	1.14E-02
VOC	1,2,4-Trimethylbenzene	95-63-6	1.6E-01	1.2E+02	4.31E-01	1.01E-03	1.01E+03	9.93E-04	9.93E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	1.5E-01	1.2E+02	4.31E-01	1.01E-03	1.01E+03	9.93E-04	9.93E-03
VOC	Xylenes (total)	1330-20-7	2.5E-01	1.1E+02	4.49E-01	1.07E-03	9.42E+02	1.06E-03	1.06E-02
SVOC	Anthracene	120-12-7	1.3E-03	1.8E+02	3.77E-01	8.28E-04	3.24E+03	3.09E-04	3.09E-03
SVOC	Benzo(a)anthracene	56-55-3	5.6E-05	2.3E+02	3.47E-01	7.31E-04	5.32E+04	1.88E-05	
SVOC	Benzo(a)pyrene	50-32-8	1.5E-05	2.5E+02	3.36E-01	6.96E-04	2.01E+05	4.98E-06	
SVOC	Benzo(b)fluoranthene	205-99-2	1.7E-03	2.5E+02	3.36E-01	6.96E-04	3.23E+03	3.09E-04	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.1E-05	2.8E+02	3.26E-01	6.65E-04	2.81E+05	3.56E-06	
SVOC	Chrysene	218-01-9	1.5E-03	2.3E+02	3.47E-01	7.31E-04	3.31E+03	3.02E-04	
SVOC	Ethanol	64-17-5	1.7E-04	4.6E+01	5.94E-01	1.63E-03	1.02E+04	9.76E-05	
SVOC	Fluorene	86-73-7	1.4E-03	1.7E+02	3.86E-01	8.57E-04	3.03E+03	3.30E-04	3.30E-03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.0E-05	2.8E+02	3.26E-01	6.65E-04	1.53E+05	6.54E-06	
SVOC	Naphthalene	91-20-3	1.2E-02	1.3E+02	4.21E-01	9.76E-04	1.22E+03	8.18E-04	8.18E-03
SVOC	Phenanthrene	85-01-8	1.4E-03	1.8E+02	3.77E-01	8.28E-04	3.09E+03	3.23E-04	3.23E-03
SVOC	Pyrene	129-00-0	2.0E-04	2.0E+02	3.62E-01	7.77E-04	1.51E+04	6.62E-05	
SVOC	Tetraethylene Glycol	112-60-7	1.6E-11	1.9E+02	3.67E-01	7.93E-04	1.68E+11	5.95E-12	
INORG	Lead	7439-92-1		2.1E+02	3.59E-01	7.68E-04			

Attachment 3
Table 5
Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Molecular Weight of Oxygen	g/mol	$\mathbf{MW_{02}}$	32
Molecular Weight of Water	g/mol	$\mathbf{MW_{H20}}$	18
Temperature	K	**Temp**	291
Liquid-phase Mass Transfer Coefficient for Oxygen	cm/s	$\mathbf{k_{L,02}}$	0.002
Gas-Phase Mass Transfer Coefficient for Water Vapor at 25 °C	cm/s	$\mathbf{K_{G,H20}}$	0.833
Dispersion coefficient	(L/m^3) / $(L/m^2/s)$	**C/Q**	9.6

Attachment 3
Table 6
Dermal Absorbed Dose for Groundwater
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	MW (g/mole)	FA (unitless)	K_p (cm/hr)	B (unitless)	t (hr)	c	b	ts (hr)	DA (L/cm^2-event)
VOC	Benzene	71-43-2	7.8E+01	1.0E+00	1.5E-02	5.0E-02	2.9E-01	3.7E-01	3.3E-01	6.9E-01	3.70E-05
VOC	Cumene	98-82-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,2-Dibromoethane	106-93-4	1.9E+02	1.0E+00	1.6E-03	8.4E-03	1.2E+00	3.4E-01	3.1E-01	2.8E+00	6.81E-06
VOC	1,2-Dichloroethane	107-06-2	9.9E+01	1.0E+00	4.1E-03	1.6E-02	3.8E-01	3.4E-01	3.1E-01	9.0E-01	1.13E-05
VOC	Ethyl Benzene	100-41-4	1.1E+02	1.0E+00	4.8E-02	1.9E-01	4.1E-01	4.7E-01	4.3E-01	9.9E-01	1.27E-04
VOC	Methyl tert-butyl ether	1634-04-4	8.8E+01	1.0E+00	3.3E-03	1.2E-02	3.3E-01	3.4E-01	3.1E-01	7.9E-01	8.84E-06
VOC	Toluene	108-88-3	9.2E+01	1.0E+00	3.2E-02	1.2E-01	3.5E-01	4.2E-01	3.8E-01	8.3E-01	8.08E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,3,5-Trimethylbenzene	108-67-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	Xylenes (total)	1330-20-7	1.1E+02	1.0E+00	5.0E-02	2.0E-01	4.1E-01	4.8E-01	4.4E-01	9.9E-01	1.32E-04
SVOC	Anthracene	120-12-7	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Benzo(a)anthracene	56-55-3	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Benzo(a)pyrene	50-32-8	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(b)fluoranthene	205-99-2	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(g,h,i)perylene	191-24-2	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Chrysene	218-01-9	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Ethanol	64-17-5	4.6E+01	1.0E+00	5.5E-04	1.4E-03	1.9E-01	3.3E-01	3.0E-01	4.6E-01	1.30E-06
SVOC	Fluorene	86-73-7	1.7E+02	1.0E+00			9.0E-01	3.3E-01	3.0E-01	2.2E+00	
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Naphthalene	91-20-3	1.3E+02	1.0E+00			5.5E-01	3.3E-01	3.0E-01	1.3E+00	
SVOC	Phenanthrene	85-01-8	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Pyrene	129-00-0	2.0E+02	1.0E+00			1.4E+00	3.3E-01	3.0E-01	3.4E+00	
SVOC	Tetraethylene Glycol	112-60-7	1.9E+02	1.0E+00			1.3E+00	3.3E-01	3.0E-01	3.1E+00	
INORG	Lead	7439-92-1	2.1E+02		1.0E-04		1.5E+00	3.3E-01	3.0E-01	3.7E+00	2.00E-07

Notes:

Event Time hours **t** 2

K_p capped at 1 cm/hr (USEPA 1992).

The dermal absorbed dose for inorganic chemicals is estimated using a steady-state approach (USEPA 2004, Equation 3.4) and for organic chemicals is estimated using a nonsteady-state approach (USEPA 2004, Equations 3.2 and 3.3).

Attachment 3

Table 7a

Unit Risk Calculations for Exposure of Maintenance Workers to Groundwater in Excavations

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

					Incidental Ingestion			Dermal Contact				Vapor Inhalation			All Routes
Chem Group	Chemical	CASRN	Cancer Class	C_{gw} (mg/l)	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	Risk	DA (L/cm^2-event)	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	Risk	C_{air} (mg/m^3)	URF $(mg/m^3)^{-1}$	Risk	Risk
VOC	Benzene	71-43-2	A	1.00E+00	7.34E-07	5.5E-02	4.0E-08	3.70E-05	9.57E-06	5.5E-02	5.3E-07	1.19E-01	7.8E-03	1.8E-06	2.4E-06
VOC	Cumene	98-82-8	D	1.00E+00	7.34E-07							9.64E-02			
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	7.34E-07	2.0E+00	1.5E-06	6.81E-06	1.76E-06	2.0E+00	3.5E-06	7.11E-02	6.0E-01	8.4E-05	8.9E-05
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	7.34E-07	9.1E-02	6.7E-08	1.13E-05	2.92E-06	9.1E-02	2.7E-07	9.88E-02	2.6E-02	5.0E-06	5.4E-06
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	7.34E-07			1.27E-04	3.28E-05			1.02E-01			
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	7.34E-07	1.8E-03	1.3E-09	8.84E-06	2.29E-06	1.8E-03	4.1E-09	9.99E-02	2.6E-04	5.1E-08	5.6E-08
VOC	Toluene	108-88-3	ID	1.00E+00	7.34E-07			8.08E-05	2.09E-05			1.09E-01			
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	7.34E-07							9.57E-02			
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	7.34E-07							9.56E-02			
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	7.34E-07			1.32E-04	3.41E-05			1.02E-01			
SVOC	Anthracene	120-12-7	ID	1.00E+00	7.34E-07							2.97E-02			
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00	7.34E-07	1.0E-01	7.3E-08			1.0E-01			6.0E-02		7.3E-08
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00	7.34E-07	1.0E+00	7.3E-07			1.0E+00			6.0E-01		7.3E-07
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00	7.34E-07	1.0E-01	7.3E-08			1.0E-01			6.0E-02		7.3E-08
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00	7.34E-07										
SVOC	Chrysene	218-01-9	B2	1.00E+00	7.34E-07	1.0E-03	7.3E-10			1.0E-03			6.0E-04		7.3E-10
SVOC	Ethanol	64-17-5		1.00E+00	7.34E-07			1.30E-06	3.36E-07						
SVOC	Fluorene	86-73-7	D	1.00E+00	7.34E-07							3.18E-02			
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00	7.34E-07	1.0E-01	7.3E-08			1.0E-01			6.0E-02		7.3E-08
SVOC	Naphthalene	91-20-3	C	1.00E+00	7.34E-07	1.2E-01	8.8E-08			1.2E-01		7.88E-02	3.4E-02	5.2E-06	5.3E-06
SVOC	Phenanthrene	85-01-8	D	1.00E+00	7.34E-07							3.11E-02			
SVOC	Pyrene	129-00-0	NC	1.00E+00	7.34E-07										
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00	7.34E-07										
INORG	Lead	7439-92-1	B2	1.00E+00	7.34E-07			2.00E-07	5.18E-08						

Attachment 3

Table 7b

Hazard Quotient Calculations for Exposure of Maintenance Workers to Groundwater in Excavations

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Incidental Ingestion			Dermal Contact				Vapor Inhalation			All Routes
Chem Group	**Chemical**	**CASRN**	**C_{gw}** (mg/L)	**ADD** (mg/kg/d)	**RfD_{oral}** (mg/kg/d)	**HQ**	**DA** (L/cm^2-event)	**ADD** (mg/kg/d)	**RfD_{derm}** (mg/kg/d)	**HQ**	**C_{air}** (mg/m^3)	**RfC** (mg/m^3)	**HQ**	**HQ**
VOC	Benzene	71-43-2	1.00E+00	5.14E-06	4.0E-03	1.3E-03	3.70E-05	6.70E-05	4.0E-03	1.7E-02	1.19E-01	3.0E-02	5.4E-02	7.2E-02
VOC	Cumene	98-82-8	1.00E+00	5.14E-06	1.0E-01	5.1E-05			1.0E-01		9.64E-02	4.0E-01	3.3E-03	3.4E-03
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	5.14E-06	9.0E-03	5.7E-04	6.81E-06	1.23E-05	9.0E-03	1.4E-03	7.11E-02	9.0E-03	1.1E-01	1.1E-01
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	5.14E-06	2.0E-02	2.6E-04	1.13E-05	2.05E-05	2.0E-02	1.0E-03	9.88E-02	7.0E-03	1.9E-01	1.9E-01
VOC	Ethyl Benzene	100-41-4	1.00E+00	5.14E-06	1.0E-01	5.1E-05	1.27E-04	2.30E-04	1.0E-01	2.3E-03	1.02E-01	1.0E+00	1.4E-03	3.7E-03
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	5.14E-06	3.0E-01	1.7E-05	8.84E-06	1.60E-05	3.0E-01	5.3E-05	9.99E-02	3.0E+00	4.6E-04	5.3E-04
VOC	Toluene	108-88-3	1.00E+00	5.14E-06	8.0E-02	6.4E-05	8.08E-05	1.46E-04	8.0E-02	1.8E-03	1.09E-01	5.0E+00	3.0E-04	2.2E-03
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	5.14E-06	1.0E-02	5.1E-04			1.0E-02		9.57E-02	6.0E-02	2.2E-02	2.2E-02
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	5.14E-06	1.0E-02	5.1E-04			1.0E-02		9.56E-02	6.0E-02	2.2E-02	2.2E-02
VOC	Xylenes (total)	1330-20-7	1.00E+00	5.14E-06	2.0E-01	2.6E-05	1.32E-04	2.39E-04	2.0E-01	1.2E-03	1.02E-01	1.0E-01	1.4E-02	1.5E-02
SVOC	Anthracene	120-12-7	1.00E+00	5.14E-06	3.0E-01	1.7E-05			3.0E-01		2.97E-02			1.7E-05
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00	5.14E-06										
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00	5.14E-06	3.0E-04	1.7E-02			3.0E-04			2.0E-06		1.7E-02
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00	5.14E-06										
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00	5.14E-06	3.0E-02	1.7E-04			3.0E-02					1.7E-04
SVOC	Chrysene	218-01-9	1.00E+00	5.14E-06										
SVOC	Ethanol	64-17-5	1.00E+00	5.14E-06	6.2E+01	8.3E-08	1.30E-06	2.35E-06	6.2E+01	3.8E-08		1.9E+01		1.2E-07
SVOC	Fluorene	86-73-7	1.00E+00	5.14E-06	4.0E-02	1.3E-04			4.0E-02		3.18E-02			1.3E-04
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00	5.14E-06										
SVOC	Naphthalene	91-20-3	1.00E+00	5.14E-06	2.0E-02	2.6E-04			2.0E-02		7.88E-02	3.0E-03	3.6E-01	3.6E-01
SVOC	Phenanthrene	85-01-8	1.00E+00	5.14E-06	3.0E-02	1.7E-04			3.0E-02		3.11E-02			1.7E-04
SVOC	Pyrene	129-00-0	1.00E+00	5.14E-06	3.0E-02	1.7E-04			3.0E-02					1.7E-04
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00	5.14E-06	2.0E+00	2.6E-06			2.0E+00					2.6E-06
INORG	Lead	7439-92-1	1.00E+00	5.14E-06			2.00E-07	3.62E-07						

Attachment 4

Construction Worker Risk Calculations

Table 1 – Normalized Average Vapor Flux from Soil to Outdoor Air

Table 2 – Dispersion Factor to Outdoor Air

Table 3 – Concentrations in Outdoor Air from Soil

Table 4a – Unit Risk Calculations for Exposure of Construction Workers to Soil

Table 4b – Unit Hazard Quotient Calculations for Exposure of Construction Workers to Soil

Table 5 – Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations

Table 6 – Dermal Absorbed Dose for Groundwater

Table 7a – Unit Risk Calculations for Exposure of Construction Workers to Groundwater in Excavations

Table 7b – Unit Hazard Quotient Calculations for Exposure of Construction Workers to Groundwater in Excavations

Attachment 4
Table 1
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	D_{air} (m^2/d)	D_{water} (m^2/d)	D_G (m^2/d)	D_L (m^2/d)	D_E (m^2/d)	J_v (kg/m^2-s)
VOC	Benzene	71-43-2	5.82E+01		1.68E-01	7.60E-01	8.47E-05	1.23E-01	3.46E-08	3.51E-02	1.79E-04
VOC	Cumene	98-82-8	7.05E+02		3.28E-01	5.62E-01	6.13E-05	9.10E-02	2.51E-08	4.96E-03	7.98E-05
VOC	1,2-Dibromoethane	106-93-4	2.22E+01		2.37E-02	3.72E-01	7.29E-05	6.02E-02	2.98E-08	5.83E-03	8.65E-05
VOC	1,2-Dichloroethane	107-06-2	1.75E+01		2.92E-02	8.99E-01	8.55E-05	1.46E-01	3.50E-08	2.04E-02	1.50E-04
VOC	Ethyl Benzene	100-41-4	3.67E+02		2.20E-01	6.48E-01	6.74E-05	1.05E-01	2.76E-08	7.27E-03	9.63E-05
VOC	Methyl tert-butyl ether	1634-04-4	1.15E+01		1.83E-02	7.42E-01	8.73E-05	1.20E-01	3.57E-08	1.43E-02	1.31E-04
VOC	Toluene	108-88-3	1.80E+02		1.93E-01	7.52E-01	7.43E-05	1.22E-01	3.04E-08	1.46E-02	1.32E-04
VOC	1,2,4-Trimethylbenzene	95-63-6	8.97E+02		1.61E-01	5.24E-01	6.84E-05	8.48E-02	2.80E-08	1.81E-03	4.83E-05
VOC	1,3,5-Trimethylbenzene	108-67-8	1.76E+03		1.54E-01	5.20E-01	7.49E-05	8.42E-02	3.06E-08	8.81E-04	3.37E-05
VOC	Xylenes (total)	1330-20-7	3.86E+02		2.52E-01	6.74E-01	7.56E-05	1.09E-01	3.09E-08	8.23E-03	1.02E-04
SVOC	Anthracene	120-12-7	2.97E+04		1.30E-03	2.80E-01	6.69E-05	4.53E-02	2.74E-08	2.40E-07	5.56E-07
SVOC	Benzo(a)anthracene	56-55-3	4.01E+05		5.55E-05	4.41E-01	7.78E-05	7.14E-02	3.18E-08	1.20E-09	
SVOC	Benzo(a)pyrene	50-32-8	1.01E+06		1.49E-05	3.72E-01	7.78E-05	6.02E-02	3.18E-08	1.11E-10	
SVOC	Benzo(b)fluoranthene	205-99-2	1.24E+06		1.66E-03	1.95E-01	4.80E-05	3.16E-02	1.97E-08	5.08E-09	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.28E+07		1.10E-05	1.88E-01	4.54E-05	3.04E-02	1.86E-08	3.32E-12	
SVOC	Chrysene	218-01-9	4.01E+05		1.48E-03	2.14E-01	5.37E-05	3.47E-02	2.20E-08	1.54E-08	
SVOC	Ethanol	64-17-5	6.81E-01		1.75E-04	1.06E+00	1.12E-04	1.72E-01	4.60E-08	5.09E-04	
SVOC	Fluorene	86-73-7	1.38E+04		1.39E-03	3.14E-01	6.81E-05	5.08E-02	2.79E-08	6.17E-07	8.91E-07
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	3.45E+06		2.03E-05	1.64E-01	4.89E-05	2.66E-02	2.00E-08	1.96E-11	
SVOC	Naphthalene	91-20-3	2.01E+03		1.20E-02	5.10E-01	6.48E-05	8.26E-02	2.65E-08	5.94E-05	8.75E-06
SVOC	Phenanthrene	85-01-8	2.42E+04		1.41E-03	3.24E-01	6.45E-05	5.25E-02	2.64E-08	3.67E-07	6.87E-07
SVOC	Pyrene	129-00-0	1.06E+05		2.00E-04	2.35E-01	6.26E-05	3.81E-02	2.56E-08	8.73E-09	
SVOC	Tetraethylene Glycol	112-60-7	3.00E-02		1.62E-11	4.39E-01	6.96E-05	7.11E-02	2.85E-08	5.30E-07	
INORG	Lead	7439-92-1		9.00E+02							

Attachment 4
Table 1
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Soil bulk density	kg/L	ρ_b	1.66
Soil porosity	L/L-soil	θ	0.38
Soil water content	L/L-soil	θ_w	0.05
Soil air-filled porosity	L/L-soil	θ_a	0.32
Soil organic carbon fraction	unitless	f_{oc}	0.005
Averaging period (Exposure Duration)	years	**T**	1
	days	**T**	365
Temperature	^oC	**Temp**	18
Clean soil above source	m	Z_1	
Bottom of source depth	m	Z_2	5.79

Based on the volatilization model developed by Jury et. al. (1983) for finite sources as described in USEPA's (1996) Soil Screening Guidance: Technical Background Document.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 4
Table 2
Dispersion Factor to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Parameter	Units	Value
Correlation coefficient city		Philadelphia
Correlation coefficient A		14.0111
Correlation coefficient B		19.6154
Correlation coefficient C		225.3397

Soil source area	acres	70.6
Soil C/Q averaging time		Annual Max
Conversion factor from 1-Hr Max for soil		0.19
C/Q for soil	$(kg/m^3)/(kg/m^2\text{-}s)$	**25.06**

Groundwater source area	acres	0.0052
Groundwater averaging time for C/Q		24-Hour Max
Conversion factor from 1-Hr Max for groundwater		0.40
C/Q for Groundwater	$(L/m^3)/(L/m^2\text{-}s)$	**9.63**

Note:
C/Q is estimated using the empirical correlation in USEPA's (2002) Supplemental Soil Screening Guidance.

Attachment 4
Table 3
Concentrations in Outdoor Air from Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

			Vapor		PM_{10}	
		C/Q (kg/m^3 per kg/m^2-s):	2.5E+01			
Chem Chem	**Chemical**	**CASRN**	C_{soil} (mg/kg)	C_{air} (mg/m^3)	C_{soil} (mg/kg)	C_{air} (mg/m^3)
VOC	Benzene	71-43-2	1.00E+00	4.49E-03	1.00E+00	5.00E-08
VOC	Cumene	98-82-8	1.00E+00	2.00E-03	1.00E+00	5.00E-08
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	2.17E-03	1.00E+00	5.00E-08
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	3.76E-03	1.00E+00	5.00E-08
VOC	Ethyl Benzene	100-41-4	1.00E+00	2.41E-03	1.00E+00	5.00E-08
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	3.27E-03	1.00E+00	5.00E-08
VOC	Toluene	108-88-3	1.00E+00	3.30E-03	1.00E+00	5.00E-08
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	1.21E-03	1.00E+00	5.00E-08
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	8.44E-04	1.00E+00	5.00E-08
VOC	Xylenes (total)	1330-20-7	1.00E+00	2.56E-03	1.00E+00	5.00E-08
SVOC	Anthracene	120-12-7	1.00E+00	1.39E-05	1.00E+00	5.00E-08
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.00E+00	5.00E-08
SVOC	Chrysene	218-01-9	1.00E+00		1.00E+00	5.00E-08
SVOC	Ethanol	64-17-5	1.00E+00		1.00E+00	5.00E-08
SVOC	Fluorene	86-73-7	1.00E+00	2.23E-05	1.00E+00	5.00E-08
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.00E+00	5.00E-08
SVOC	Naphthalene	91-20-3	1.00E+00	2.19E-04	1.00E+00	5.00E-08
SVOC	Phenanthrene	85-01-8	1.00E+00	1.72E-05	1.00E+00	5.00E-08
SVOC	Pyrene	129-00-0	1.00E+00		1.00E+00	5.00E-08
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.00E+00	5.00E-08
INORG	Lead	7439-92-1	1.00E+00		1.00E+00	5.00E-08

Attachment 4

Table 4a

Unit Risk Calculations for Exposure of Construction Worker to Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

					Soil Ingestion				Soil Dermal Contact				Soil Vapor Inhalation			Soil Particulate Inhalation			All Routes
Chem Group	Chemical	CASRN	Cancer Class	C_{soil} (mg/kg)	RBA	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	Risk	ABS_{derm}	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	Risk	C_{air} (mg/m^3)	URF (m^3/mg)	Risk	C_{air} (mg/m^3)	URF $(mg/m^3)^{-1}$	Risk	Risk
VOC	Benzene	71-43-2	A	1.00E+00		2.45E-08	5.5E-02	1.3E-09			5.5E-02		4.49E-03	7.8E-03	1.1E-07	5.00E-08	7.8E-03	1.3E-12	1.2E-07
VOC	Cumene	98-82-8	D	1.00E+00		2.45E-08							2.00E-03			5.00E-08			
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00		2.45E-08	2.0E+00	4.9E-08			2.0E+00		2.17E-03	6.0E-01	4.2E-06	5.00E-08	6.0E-01	9.8E-11	4.3E-06
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00		2.45E-08	9.1E-02	2.2E-09			9.1E-02		3.76E-03	2.6E-02	3.2E-07	5.00E-08	2.6E-02	4.2E-12	3.2E-07
VOC	Ethyl Benzene	100-41-4	D	1.00E+00		2.45E-08							2.41E-03			5.00E-08			
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00		2.45E-08	1.8E-03	4.4E-11			1.8E-03		3.27E-03	2.6E-04	2.8E-09	5.00E-08	2.6E-04	4.2E-14	2.8E-09
VOC	Toluene	108-88-3	ID	1.00E+00		2.45E-08							3.30E-03			5.00E-08			
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00		2.45E-08							1.21E-03			5.00E-08			
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00		2.45E-08							8.44E-04			5.00E-08			
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00		2.45E-08							2.56E-03			5.00E-08			
SVOC	Anthracene	120-12-7	ID	1.00E+00		2.45E-08			1.30E-01	6.73E-09			1.39E-05			5.00E-08			
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		2.45E-08	1.0E-01	2.4E-09	1.30E-01	6.73E-09	1.0E-01	6.7E-10		6.0E-02		5.00E-08	6.0E-02	9.8E-12	3.1E-09
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		2.45E-08	1.0E+00	2.4E-08	1.30E-01	6.73E-09	1.0E+00	6.7E-09		6.0E-01		5.00E-08	6.0E-01	9.8E-11	3.1E-08
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		2.45E-08	1.0E-01	2.4E-09	1.30E-01	6.73E-09	1.0E-01	6.7E-10		6.0E-02		5.00E-08	6.0E-02	9.8E-12	3.1E-09
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00		2.45E-08			1.30E-01	6.73E-09						5.00E-08			
SVOC	Chrysene	218-01-9	B2	1.00E+00		2.45E-08	1.0E-03	2.4E-11	1.30E-01	6.73E-09	1.0E-03	6.7E-12		6.0E-04		5.00E-08	6.0E-04	9.8E-14	3.1E-11
SVOC	Ethanol	64-17-5		1.00E+00		2.45E-08										5.00E-08			
SVOC	Fluorene	86-73-7	D	1.00E+00		2.45E-08			1.30E-01	6.73E-09			2.23E-05			5.00E-08			
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		2.45E-08	1.0E-01	2.4E-09	1.30E-01	6.73E-09	1.0E-01	6.7E-10		6.0E-02		5.00E-08	6.0E-02	9.8E-12	3.1E-09
SVOC	Naphthalene	91-20-3	C	1.00E+00		2.45E-08	1.2E-01	2.9E-09	1.30E-01	6.73E-09	1.2E-01	8.1E-10	2.19E-04	3.4E-02	2.4E-08	5.00E-08	3.4E-02	5.5E-12	2.8E-08
SVOC	Phenanthrene	85-01-8	D	1.00E+00		2.45E-08			1.30E-01	6.73E-09			1.72E-05			5.00E-08			
SVOC	Pyrene	129-00-0	NC	1.00E+00		2.45E-08			1.30E-01	6.73E-09						5.00E-08			
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00		2.45E-08			1.00E-01	5.18E-09						5.00E-08			
INORG	Lead	7439-92-1	B2	1.00E+00		2.45E-08										5.00E-08			

Notes:

The concentration of particulates in the air is assumed to be no more than the former annual National Ambient Air Quality Standards (NAAQS) for PM_{10} of 50 ug/m^3.

Attachment 4

Table 4b

Unit Hazard Quotient Calculations for Exposure of Construction Worker to Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Soil Ingestion				Soil Dermal Contact				Soil Vapor Inhalation			Soil Particulate Inhalation			All Routes
Chem Group	Chemical	CASRN	C_{soil} (mg/kg)	RBA	ADD (mg/kg/d)	RfD_{oral} (mg/kg/d)	HQ	ABS_{derm}	ADD (mg/kg/d)	RfD_{derm} (mg/kg/d)	HQ	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	HQ
VOC	Benzene	71-43-2	1.00E+00		1.71E-06	1.0E-02	1.7E-04			1.0E-02		4.49E-03	9.0E-02	1.1E-02	5.00E-08	9.0E-02	1.3E-07	1.2E-02
VOC	Cumene	98-82-8	1.00E+00		1.71E-06	4.0E-01	4.3E-06			4.0E-01		2.00E-03	4.0E-01	1.1E-03	5.00E-08	4.0E-01	2.9E-08	1.1E-03
VOC	1,2-Dibromoethane	106-93-4	1.00E+00		1.71E-06	9.0E-03	1.9E-04			9.0E-03		2.17E-03	9.0E-03	5.5E-02	5.00E-08	9.0E-03	1.3E-06	5.5E-02
VOC	1,2-Dichloroethane	107-06-2	1.00E+00		1.71E-06	2.0E-02	8.6E-05			2.0E-02		3.76E-03	7.0E-02	1.2E-02	5.00E-08	7.0E-02	1.6E-07	1.2E-02
VOC	Ethyl Benzene	100-41-4	1.00E+00		1.71E-06	1.0E-01	1.7E-05			1.0E-01		2.41E-03	9.0E+00	6.1E-05	5.00E-08	9.0E+00	1.3E-09	7.8E-05
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00		1.71E-06	3.0E-01	5.7E-06			3.0E-01		3.27E-03	3.0E+00	2.5E-04	5.00E-08	3.0E+00	3.8E-09	2.5E-04
VOC	Toluene	108-88-3	1.00E+00		1.71E-06	8.0E-01	2.1E-06			8.0E-01		3.30E-03	5.0E+00	1.5E-04	5.00E-08	5.0E+00	2.3E-09	1.5E-04
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00		1.71E-06	4.0E-02	4.3E-05			4.0E-02		1.21E-03	2.0E-01	1.4E-03	5.00E-08	2.0E-01	5.7E-08	1.4E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00		1.71E-06	4.0E-02	4.3E-05			4.0E-02		8.44E-04	2.0E-01	9.6E-04	5.00E-08	2.0E-01	5.7E-08	1.0E-03
VOC	Xylenes (total)	1330-20-7	1.00E+00		1.71E-06	2.0E-01	8.6E-06			2.0E-01		2.56E-03	3.0E-01	1.9E-03	5.00E-08	3.0E-01	3.8E-08	2.0E-03
SVOC	Anthracene	120-12-7	1.00E+00		1.71E-06	1.0E+00	1.7E-06	1.30E-01	4.71E-07	1.0E+00	4.7E-07	1.39E-05			5.00E-08			2.2E-06
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.71E-06			1.30E-01	4.71E-07						5.00E-08			
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.71E-06	3.0E-04	5.7E-03	1.30E-01	4.71E-07	3.0E-04	1.6E-03		2.0E-06		5.00E-08	2.0E-06	5.7E-03	1.3E-02
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.71E-06			1.30E-01	4.71E-07						5.00E-08			
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.71E-06	3.0E-01	5.7E-06	1.30E-01	4.71E-07	3.0E-01	1.6E-06				5.00E-08			7.3E-06
SVOC	Chrysene	218-01-9	1.00E+00		1.71E-06			1.30E-01	4.71E-07						5.00E-08			
SVOC	Ethanol	64-17-5	1.00E+00		1.71E-06	6.2E+01	2.8E-08			6.2E+01			1.9E+01		5.00E-08	1.9E+01	6.0E-10	2.8E-08
SVOC	Fluorene	86-73-7	1.00E+00		1.71E-06	4.0E-01	4.3E-06	1.30E-01	4.71E-07	4.0E-01	1.2E-06	2.23E-05			5.00E-08			5.5E-06
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.71E-06			1.30E-01	4.71E-07						5.00E-08			
SVOC	Naphthalene	91-20-3	1.00E+00		1.71E-06	2.0E-01	8.6E-06	1.30E-01	4.71E-07	2.0E-01	2.4E-06	2.19E-04	3.0E-03	1.7E-02	5.00E-08	3.0E-03	3.8E-06	1.7E-02
SVOC	Phenanthrene	85-01-8	1.00E+00		1.71E-06	3.0E-01	5.7E-06	1.30E-01	4.71E-07	3.0E-01	1.6E-06	1.72E-05			5.00E-08			7.3E-06
SVOC	Pyrene	129-00-0	1.00E+00		1.71E-06	3.0E-01	5.7E-06	1.30E-01	4.71E-07	3.0E-01	1.6E-06				5.00E-08			7.3E-06
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.71E-06	2.0E+00	8.6E-07	1.00E-01	3.62E-07	2.0E+00	1.8E-07				5.00E-08			1.0E-06
INORG	Lead	7439-92-1	1.00E+00		1.71E-06										5.00E-08			

Notes:

The concentration of particulates in the air is assumed to be no more than the former annual National Ambient Air Quality Standards (NAAQS) for PM_{10} of 50 ug/m^3.

Attachment 4
Table 5
Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	H (unitless)	MW (g/mol)	k_G (cm/s)	k_L (cm/s)	$1/K_L$ (s/cm)	K_L (cm/s)	J_L (L/m^2-s)
VOC	Benzene	71-43-2	1.7E-01	7.8E+01	4.97E-01	1.25E-03	8.12E+02	1.23E-03	1.23E-02
VOC	Cumene	98-82-8	3.3E-01	1.2E+02	4.31E-01	1.01E-03	9.99E+02	1.00E-03	1.00E-02
VOC	1,2-Dibromoethane	106-93-4	2.4E-02	1.9E+02	3.71E-01	8.06E-04	1.35E+03	7.38E-04	7.38E-03
VOC	1,2-Dichloroethane	107-06-2	2.9E-02	9.9E+01	4.60E-01	1.11E-03	9.75E+02	1.03E-03	1.03E-02
VOC	Ethyl Benzene	100-41-4	2.2E-01	1.1E+02	4.49E-01	1.07E-03	9.43E+02	1.06E-03	1.06E-02
VOC	Methyl tert-butyl ether	1634-04-4	1.8E-02	8.8E+01	4.78E-01	1.18E-03	9.64E+02	1.04E-03	1.04E-02
VOC	Toluene	108-88-3	1.9E-01	9.2E+01	4.71E-01	1.15E-03	8.80E+02	1.14E-03	1.14E-02
VOC	1,2,4-Trimethylbenzene	95-63-6	1.6E-01	1.2E+02	4.31E-01	1.01E-03	1.01E+03	9.93E-04	9.93E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	1.5E-01	1.2E+02	4.31E-01	1.01E-03	1.01E+03	9.93E-04	9.93E-03
VOC	Xylenes (total)	1330-20-7	2.5E-01	1.1E+02	4.49E-01	1.07E-03	9.42E+02	1.06E-03	1.06E-02
SVOC	Anthracene	120-12-7	1.3E-03	1.8E+02	3.77E-01	8.28E-04	3.24E+03	3.09E-04	3.09E-03
SVOC	Benzo(a)anthracene	56-55-3	5.6E-05	2.3E+02	3.47E-01	7.31E-04	5.32E+04	1.88E-05	
SVOC	Benzo(a)pyrene	50-32-8	1.5E-05	2.5E+02	3.36E-01	6.96E-04	2.01E+05	4.98E-06	
SVOC	Benzo(b)fluoranthene	205-99-2	1.7E-03	2.5E+02	3.36E-01	6.96E-04	3.23E+03	3.09E-04	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.1E-05	2.8E+02	3.26E-01	6.65E-04	2.81E+05	3.56E-06	
SVOC	Chrysene	218-01-9	1.5E-03	2.3E+02	3.47E-01	7.31E-04	3.31E+03	3.02E-04	
SVOC	Ethanol	64-17-5	1.7E-04	4.6E+01	5.94E-01	1.63E-03	1.02E+04	9.76E-05	
SVOC	Fluorene	86-73-7	1.4E-03	1.7E+02	3.86E-01	8.57E-04	3.03E+03	3.30E-04	3.30E-03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.0E-05	2.8E+02	3.26E-01	6.65E-04	1.53E+05	6.54E-06	
SVOC	Naphthalene	91-20-3	1.2E-02	1.3E+02	4.21E-01	9.76E-04	1.22E+03	8.18E-04	8.18E-03
SVOC	Phenanthrene	85-01-8	1.4E-03	1.8E+02	3.77E-01	8.28E-04	3.09E+03	3.23E-04	3.23E-03
SVOC	Pyrene	129-00-0	2.0E-04	2.0E+02	3.62E-01	7.77E-04	1.51E+04	6.62E-05	
SVOC	Tetraethylene Glycol	112-60-7	1.6E-11	1.9E+02	3.67E-01	7.93E-04	1.68E+11	5.95E-12	
INORG	Lead	7439-92-1		2.1E+02	3.59E-01	7.68E-04			

Attachment 4
Table 5
Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Molecular Weight of Oxygen	g/mol	$\mathbf{MW_{02}}$	32
Molecular Weight of Water	g/mol	$\mathbf{MW_{H20}}$	18
Temperature	K	**Temp**	291
Liquid-phase Mass Transfer Coefficient for Oxygen	cm/s	$\mathbf{k_{L,02}}$	0.002
Gas-Phase Mass Transfer Coefficient for Water Vapor at 25 °C	cm/s	$\mathbf{K_{G,H20}}$	0.833
Dispersion coefficient	(L/m^3) / $(L/m^2/s)$	**C/Q**	9.6

Attachment 4

Table 6

Dermal Absorbed Dose for Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	MW (g/mole)	FA (unitless)	K_p (cm/hr)	B (unitless)	t (hr)	c	b	ts (hr)	DA (L/cm^2-event)
VOC	Benzene	71-43-2	7.8E+01	1.0E+00	1.5E-02	5.0E-02	2.9E-01	3.7E-01	3.3E-01	6.9E-01	3.70E-05
VOC	Cumene	98-82-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,2-Dibromoethane	106-93-4	1.9E+02	1.0E+00	1.6E-03	8.4E-03	1.2E+00	3.4E-01	3.1E-01	2.8E+00	6.81E-06
VOC	1,2-Dichloroethane	107-06-2	9.9E+01	1.0E+00	4.1E-03	1.6E-02	3.8E-01	3.4E-01	3.1E-01	9.0E-01	1.13E-05
VOC	Ethyl Benzene	100-41-4	1.1E+02	1.0E+00	4.8E-02	1.9E-01	4.1E-01	4.7E-01	4.3E-01	9.9E-01	1.27E-04
VOC	Methyl tert-butyl ether	1634-04-4	8.8E+01	1.0E+00	3.3E-03	1.2E-02	3.3E-01	3.4E-01	3.1E-01	7.9E-01	8.84E-06
VOC	Toluene	108-88-3	9.2E+01	1.0E+00	3.2E-02	1.2E-01	3.5E-01	4.2E-01	3.8E-01	8.3E-01	8.08E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,3,5-Trimethylbenzene	108-67-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	Xylenes (total)	1330-20-7	1.1E+02	1.0E+00	5.0E-02	2.0E-01	4.1E-01	4.8E-01	4.4E-01	9.9E-01	1.32E-04
SVOC	Anthracene	120-12-7	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Benzo(a)anthracene	56-55-3	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Benzo(a)pyrene	50-32-8	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(b)fluoranthene	205-99-2	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(g,h,i)perylene	191-24-2	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Chrysene	218-01-9	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Ethanol	64-17-5	4.6E+01	1.0E+00	5.5E-04	1.4E-03	1.9E-01	3.3E-01	3.0E-01	4.6E-01	1.30E-06
SVOC	Fluorene	86-73-7	1.7E+02	1.0E+00			9.0E-01	3.3E-01	3.0E-01	2.2E+00	
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Naphthalene	91-20-3	1.3E+02	1.0E+00			5.5E-01	3.3E-01	3.0E-01	1.3E+00	
SVOC	Phenanthrene	85-01-8	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Pyrene	129-00-0	2.0E+02	1.0E+00			1.4E+00	3.3E-01	3.0E-01	3.4E+00	
SVOC	Tetraethylene Glycol	112-60-7	1.9E+02	1.0E+00			1.3E+00	3.3E-01	3.0E-01	3.1E+00	
INORG	Lead	7439-92-1	2.1E+02		1.0E-04		1.5E+00	3.3E-01	3.0E-01	3.7E+00	2.00E-07

Notes:

Event Time hours **t** 2

K_p capped at 1 cm/hr (USEPA 1992).

The dermal absorbed dose for inorganic chemicals is estimated using a steady-state approach (USEPA 2004, Equation 3.4) and for organic chemicals is estimated using a nonsteady-state approach (USEPA 2004, Equations 3.2 and 3.3).

Attachment 4

Table 7a

Unit Risk Calculations for Exposure of Construction Workers to Groundwater in Excavations

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

					Incidental Ingestion			Dermal Contact				Vapor Inhalation			All Routes
Chem Group	Chemical	CASRN	Cancer Class	C_{gw} (mg/l)	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	Risk	DA (L/cm^2-event)	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	Risk	C_{air} (mg/m^3)	URF $(mg/m^3)^{-1}$	Risk	Risk
VOC	Benzene	71-43-2	A	1.00E+00	7.34E-08	5.5E-02	4.0E-09	3.70E-05	9.57E-07	5.5E-02	5.3E-08	1.19E-01	7.8E-03	1.8E-07	2.4E-07
VOC	Cumene	98-82-8	D	1.00E+00	7.34E-08							9.64E-02			
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	7.34E-08	2.0E+00	1.5E-07	6.81E-06	1.76E-07	2.0E+00	3.5E-07	7.11E-02	6.0E-01	8.4E-06	8.9E-06
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	7.34E-08	9.1E-02	6.7E-09	1.13E-05	2.92E-07	9.1E-02	2.7E-08	9.88E-02	2.6E-02	5.0E-07	5.4E-07
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	7.34E-08			1.27E-04	3.28E-06			1.02E-01			
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	7.34E-08	1.8E-03	1.3E-10	8.84E-06	2.29E-07	1.8E-03	4.1E-10	9.99E-02	2.6E-04	5.1E-09	5.6E-09
VOC	Toluene	108-88-3	ID	1.00E+00	7.34E-08			8.08E-05	2.09E-06			1.09E-01			
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	7.34E-08							9.57E-02			
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	7.34E-08							9.56E-02			
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	7.34E-08			1.32E-04	3.41E-06			1.02E-01			
SVOC	Anthracene	120-12-7	ID	1.00E+00	7.34E-08							2.97E-02			
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00	7.34E-08	1.0E-01	7.3E-09			1.0E-01			6.0E-02		7.3E-09
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00	7.34E-08	1.0E+00	7.3E-08			1.0E+00			6.0E-01		7.3E-08
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00	7.34E-08	1.0E-01	7.3E-09			1.0E-01			6.0E-02		7.3E-09
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00	7.34E-08										
SVOC	Chrysene	218-01-9	B2	1.00E+00	7.34E-08	1.0E-03	7.3E-11			1.0E-03			6.0E-04		7.3E-11
SVOC	Ethanol	64-17-5		1.00E+00	7.34E-08			1.30E-06	3.36E-08						
SVOC	Fluorene	86-73-7	D	1.00E+00	7.34E-08							3.18E-02			
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00	7.34E-08	1.0E-01	7.3E-09			1.0E-01			6.0E-02		7.3E-09
SVOC	Naphthalene	91-20-3	C	1.00E+00	7.34E-08	1.2E-01	8.8E-09			1.2E-01		7.88E-02	3.4E-02	5.2E-07	5.3E-07
SVOC	Phenanthrene	85-01-8	D	1.00E+00	7.34E-08							3.11E-02			
SVOC	Pyrene	129-00-0	NC	1.00E+00	7.34E-08										
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00	7.34E-08										
INORG	Lead	7439-92-1	B2	1.00E+00	7.34E-08			2.00E-07	5.18E-09						

Attachment 4

Table 7b

Hazard Quotient Calculations for Exposure of Construction Workers to Groundwater in Excavations

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Incidental Ingestion			Dermal Contact				Vapor Inhalation			All Routes
Chem Group	**Chemical**	**CASRN**	**C_{gw}** (mg/L)	**ADD** (mg/kg/d)	**RfD_{oral}** (mg/kg/d)	**HQ**	**DA** (L/cm^2-event)	**ADD** (mg/kg/d)	**RfD_{derm}** (mg/kg/d)	**HQ**	**C_{air}** (mg/m^3)	**RfC** (mg/m^3)	**HQ**	**HQ**
VOC	Benzene	71-43-2	1.00E+00	5.14E-06	1.0E-02	5.1E-04	3.70E-05	6.70E-05	1.0E-02	6.7E-03	1.19E-01	9.0E-02	1.8E-02	2.5E-02
VOC	Cumene	98-82-8	1.00E+00	5.14E-06	4.0E-01	1.3E-05			4.0E-01		9.64E-02	4.0E-01	3.3E-03	3.3E-03
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	5.14E-06	9.0E-03	5.7E-04	6.81E-06	1.23E-05	9.0E-03	1.4E-03	7.11E-02	9.0E-03	1.1E-01	1.1E-01
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	5.14E-06	2.0E-02	2.6E-04	1.13E-05	2.05E-05	2.0E-02	1.0E-03	9.88E-02	7.0E-02	1.9E-02	2.1E-02
VOC	Ethyl Benzene	100-41-4	1.00E+00	5.14E-06	1.0E-01	5.1E-05	1.27E-04	2.30E-04	1.0E-01	2.3E-03	1.02E-01	9.0E+00	1.6E-04	2.5E-03
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	5.14E-06	3.0E-01	1.7E-05	8.84E-06	1.60E-05	3.0E-01	5.3E-05	9.99E-02	3.0E+00	4.6E-04	5.3E-04
VOC	Toluene	108-88-3	1.00E+00	5.14E-06	8.0E-01	6.4E-06	8.08E-05	1.46E-04	8.0E-01	1.8E-04	1.09E-01	5.0E+00	3.0E-04	4.9E-04
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	5.14E-06	4.0E-02	1.3E-04			4.0E-02		9.57E-02	2.0E-01	6.6E-03	6.7E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	5.14E-06	4.0E-02	1.3E-04			4.0E-02		9.56E-02	2.0E-01	6.5E-03	6.7E-03
VOC	Xylenes (total)	1330-20-7	1.00E+00	5.14E-06	2.0E-01	2.6E-05	1.32E-04	2.39E-04	2.0E-01	1.2E-03	1.02E-01	3.0E-01	4.7E-03	5.9E-03
SVOC	Anthracene	120-12-7	1.00E+00	5.14E-06	1.0E+00	5.1E-06			1.0E+00		2.97E-02			5.1E-06
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00	5.14E-06										
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00	5.14E-06	3.0E-04	1.7E-02			3.0E-04			2.0E-06		1.7E-02
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00	5.14E-06										
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00	5.14E-06	3.0E-01	1.7E-05			3.0E-01					1.7E-05
SVOC	Chrysene	218-01-9	1.00E+00	5.14E-06										
SVOC	Ethanol	64-17-5	1.00E+00	5.14E-06	6.2E+01	8.3E-08	1.30E-06	2.35E-06	6.2E+01	3.8E-08		1.9E+01		1.2E-07
SVOC	Fluorene	86-73-7	1.00E+00	5.14E-06	4.0E-01	1.3E-05			4.0E-01		3.18E-02			1.3E-05
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00	5.14E-06										
SVOC	Naphthalene	91-20-3	1.00E+00	5.14E-06	2.0E-01	2.6E-05			2.0E-01		7.88E-02	3.0E-03	3.6E-01	3.6E-01
SVOC	Phenanthrene	85-01-8	1.00E+00	5.14E-06	3.0E-01	1.7E-05			3.0E-01		3.11E-02			1.7E-05
SVOC	Pyrene	129-00-0	1.00E+00	5.14E-06	3.0E-01	1.7E-05			3.0E-01					1.7E-05
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00	5.14E-06	2.0E+00	2.6E-06			2.0E+00					2.6E-06
INORG	Lead	7439-92-1	1.00E+00	5.14E-06			2.00E-07	3.62E-07						

Attachment 5

Off-Facility Resident Risk Calculations

Table 1 – Normalized Average Vapor Flux from Soil to Outdoor Air

Table 2 – Soil PM_{10} Emission from Wind Erosion

Table 3 – Dispersion Factor to Outdoor Air

Table 4 – Concentrations in Outdoor Air from Soil

Table 5a – Unit Risk Calculations for Exposure of Residents to Soil

Table 5b – Unit Hazard Quotient Calculations for Exposure of Residents to Soil

Figure 1 – Soil Moisture Profile for Default PADEP Residential Building (w/ Basement)

Table 6 – Normalized Indoor Air Concentrations in a Default PADEP Residential Building (with Basement) Due to Vapor Intrusion from Groundwater

Table 7 – Unit Risk and Hazard Quotient Calculations for Groundwater Vapor Intrusion into a Default PADEP Residential Building (with Basement)

Attachment 5
Table 1
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	D_{air} (m^2/d)	D_{water} (m^2/d)	D_G (m^2/d)	D_L (m^2/d)	D_E (m^2/d)	J_v (kg/m^2-s)
VOC	Benzene	71-43-2	5.82E+01		1.68E-01	7.60E-01	8.47E-05	1.23E-01	3.46E-08	3.51E-02	1.07E-05
VOC	Cumene	98-82-8	7.05E+02		3.28E-01	5.62E-01	6.13E-05	9.10E-02	2.51E-08	4.96E-03	9.01E-06
VOC	1,2-Dibromoethane	106-93-4	2.22E+01		2.37E-02	3.72E-01	7.29E-05	6.02E-02	2.98E-08	5.83E-03	9.21E-06
VOC	1,2-Dichloroethane	107-06-2	1.75E+01		2.92E-02	8.99E-01	8.55E-05	1.46E-01	3.50E-08	2.04E-02	1.04E-05
VOC	Ethyl Benzene	100-41-4	3.67E+02		2.20E-01	6.48E-01	6.74E-05	1.05E-01	2.76E-08	7.27E-03	9.46E-06
VOC	Methyl tert-butyl ether	1634-04-4	1.15E+01		1.83E-02	7.42E-01	8.73E-05	1.20E-01	3.57E-08	1.43E-02	1.01E-05
VOC	Toluene	108-88-3	1.80E+02		1.93E-01	7.52E-01	7.43E-05	1.22E-01	3.04E-08	1.46E-02	1.01E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	8.97E+02		1.61E-01	5.24E-01	6.84E-05	8.48E-02	2.80E-08	1.81E-03	7.44E-06
VOC	1,3,5-Trimethylbenzene	108-67-8	1.76E+03		1.54E-01	5.20E-01	7.49E-05	8.42E-02	3.06E-08	8.81E-04	6.02E-06
VOC	Xylenes (total)	1330-20-7	3.86E+02		2.52E-01	6.74E-01	7.56E-05	1.09E-01	3.09E-08	8.23E-03	9.60E-06
SVOC	Anthracene	120-12-7	2.97E+04		1.30E-03	2.80E-01	6.69E-05	4.53E-02	2.74E-08	2.40E-07	1.09E-07
SVOC	Benzo(a)anthracene	56-55-3	4.01E+05		5.55E-05	4.41E-01	7.78E-05	7.14E-02	3.18E-08	1.20E-09	
SVOC	Benzo(a)pyrene	50-32-8	1.01E+06		1.49E-05	3.72E-01	7.78E-05	6.02E-02	3.18E-08	1.11E-10	
SVOC	Benzo(b)fluoranthene	205-99-2	1.24E+06		1.66E-03	1.95E-01	4.80E-05	3.16E-02	1.97E-08	5.08E-09	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.28E+07		1.10E-05	1.88E-01	4.54E-05	3.04E-02	1.86E-08	3.32E-12	
SVOC	Chrysene	218-01-9	4.01E+05		1.48E-03	2.14E-01	5.37E-05	3.47E-02	2.20E-08	1.54E-08	
SVOC	Ethanol	64-17-5	6.81E-01		1.75E-04	1.06E+00	1.12E-04	1.72E-01	4.60E-08	5.09E-04	
SVOC	Fluorene	86-73-7	1.38E+04		1.39E-03	3.14E-01	6.81E-05	5.08E-02	2.79E-08	6.17E-07	1.75E-07
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	3.45E+06		2.03E-05	1.64E-01	4.89E-05	2.66E-02	2.00E-08	1.96E-11	
SVOC	Naphthalene	91-20-3	2.01E+03		1.20E-02	5.10E-01	6.48E-05	8.26E-02	2.65E-08	5.94E-05	1.72E-06
SVOC	Phenanthrene	85-01-8	2.42E+04		1.41E-03	3.24E-01	6.45E-05	5.25E-02	2.64E-08	3.67E-07	1.35E-07
SVOC	Pyrene	129-00-0	1.06E+05		2.00E-04	2.35E-01	6.26E-05	3.81E-02	2.56E-08	8.73E-09	
SVOC	Tetraethylene Glycol	112-60-7	3.00E-02		1.62E-11	4.39E-01	6.96E-05	7.11E-02	2.85E-08	5.30E-07	
INORG	Lead	7439-92-1		9.00E+02							

Notes:

Soil bulk density	kg/L	ρ_b	1.66
Soil porosity	L/L-soil	θ	0.38
Soil water content	L/L-soil	θ_w	0.05
Soil air-filled porosity	L/L-soil	θ_a	0.32
Soil organic carbon fraction	unitless	f_{oc}	0.005
Averaging period (Exposure Duration)	years	T	26
	days	T	9490
Temperature	°C	Temp	18
Clean soil above source	m	Z_1	
Bottom of source depth	m	Z_2	5.79

Based on the volatilization model developed by Jury et. al. (1983) for finite sources as described in USEPA's (1996) Soil Screening Guidance: Technical Background Document.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 5

Table 2

Soil PM_{10} Emission from Wind Erosion

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Unlimited Reservoir Model

Parameter	Units	Variable	Value
Aerodynamic particle size multiplier			0.036
Ground cover fraction		**G**	0.5
Mode of aggregate size distribution	mm		0.50
Threshold friction velocity	m/s	u'_t	0.50
Correction factor			1.25
Corrected friction velocity	m/s	u^*_t	0.6252
Roughness height	m	z_0	0.005
Anemometer height	m		8.0
Friction velocity at anemometer height	m/s	u_t	11.53
Mean annual wind speed	mph	u_m	9.3
Mean annual wind speed	m/s	u_m	4.16
u_m/u_t			0.361
$x = 0.886\ u_t/u_m$			2.46
F(x)			0.064
Annual average PM_{10} flux	kg-soil/m^2-s	$J_{10,w}$	**1.5E-11**

Model described in more detail in USEPA's (1996) *Soil Screening Guidance: Technical Background Document* .

Attachment 5
Table 3
Dispersion Factor to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Parameter	Units	Value
Correlation coefficient city		Philadelphia
Correlation coefficient A		14.0111
Correlation coefficient B		19.6154
Correlation coefficient C		225.3397

Soil source area	acres	70.6
Soil C/Q averaging time		Annual Max
Conversion factor from 1-Hr Max for soil		0.19
C/Q for soil	$(kg/m^3)/(kg/m^2\text{-}s)$	**25.06**

Note:
C/Q is estimated using the empirical correlation in USEPA's (2002) Supplemental Soil Screening Guidance.

Attachment 5
Table 4
Concentrations in Outdoor Air from Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

			Vapor		PM_{10}	
		C/Q (kg/m^3 per kg/m^2-s):	2.5E+01			
Chem Chem	**Chemical**	**CASRN**	C_{soil} (mg/kg)	C_{air} (mg/m^3)	C_{soil} (mg/kg)	C_{air} (mg/m^3)
VOC	Benzene	71-43-2	1.00E+00	2.68E-04	1.00E+00	3.73E-10
VOC	Cumene	98-82-8	1.00E+00	2.26E-04	1.00E+00	3.73E-10
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	2.31E-04	1.00E+00	3.73E-10
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	2.60E-04	1.00E+00	3.73E-10
VOC	Ethyl Benzene	100-41-4	1.00E+00	2.37E-04	1.00E+00	3.73E-10
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	2.53E-04	1.00E+00	3.73E-10
VOC	Toluene	108-88-3	1.00E+00	2.53E-04	1.00E+00	3.73E-10
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	1.87E-04	1.00E+00	3.73E-10
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	1.51E-04	1.00E+00	3.73E-10
VOC	Xylenes (total)	1330-20-7	1.00E+00	2.40E-04	1.00E+00	3.73E-10
SVOC	Anthracene	120-12-7	1.00E+00	2.73E-06	1.00E+00	3.73E-10
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.00E+00	3.73E-10
SVOC	Chrysene	218-01-9	1.00E+00		1.00E+00	3.73E-10
SVOC	Ethanol	64-17-5	1.00E+00		1.00E+00	3.73E-10
SVOC	Fluorene	86-73-7	1.00E+00	4.38E-06	1.00E+00	3.73E-10
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.00E+00	3.73E-10
SVOC	Naphthalene	91-20-3	1.00E+00	4.30E-05	1.00E+00	3.73E-10
SVOC	Phenanthrene	85-01-8	1.00E+00	3.38E-06	1.00E+00	3.73E-10
SVOC	Pyrene	129-00-0	1.00E+00		1.00E+00	3.73E-10
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.00E+00	3.73E-10
INORG	Lead	7439-92-1	1.00E+00		1.00E+00	3.73E-10

Attachment 5
Table 5a
Unit Risk Calculations for Exposure of Off-Facility Resident to Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

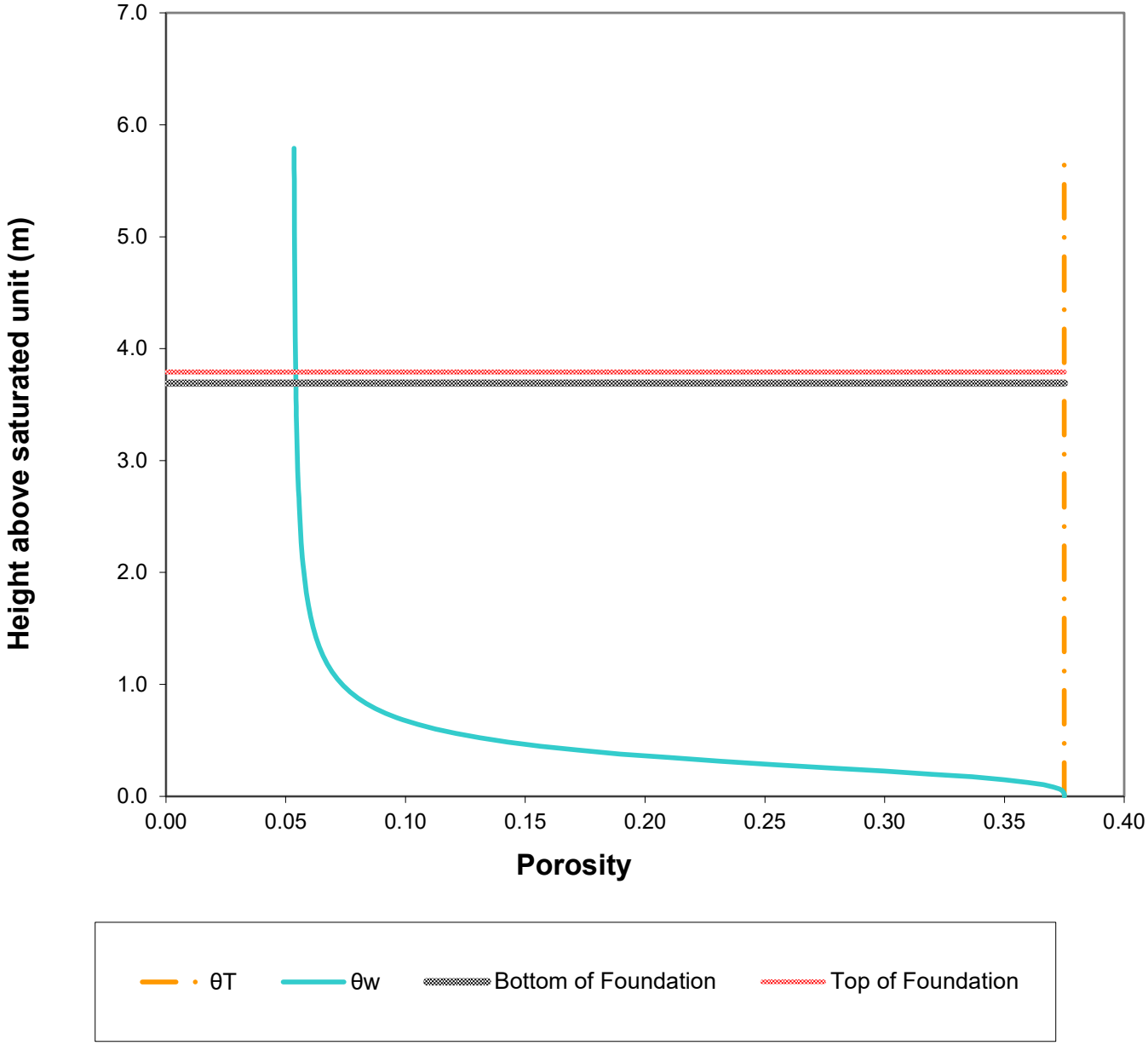
						Soil Vapor Inhalation				Soil Particulate Inhalation				All Routes
Chem Group	Chemical	CASRN	Cancer Class	ADAF	C_{soil} (mg/kg)	C_{air} (mg/m^3)	URF (m^3/mg)	f_{inh}	Risk	C_{air} (mg/m^3)	URF (mg/m^3)$^{-1}$	f_{inh}	Risk	Risk
VOC	Benzene	71-43-2	A	N	1.00E+00	2.68E-04	7.8E-03		5.3E-07	3.73E-10	7.8E-03		7.4E-13	5.3E-07
VOC	Cumene	98-82-8	D	N	1.00E+00	2.26E-04				3.73E-10				
VOC	1,2-Dibromoethane	106-93-4	LC	N	1.00E+00	2.31E-04	6.0E-01		3.5E-05	3.73E-10	6.0E-01		5.7E-11	3.5E-05
VOC	1,2-Dichloroethane	107-06-2	B2	N	1.00E+00	2.60E-04	2.6E-02		1.7E-06	3.73E-10	2.6E-02		2.5E-12	1.7E-06
VOC	Ethyl Benzene	100-41-4	D	N	1.00E+00	2.37E-04				3.73E-10				
VOC	Methyl tert-butyl ether	1634-04-4	C	N	1.00E+00	2.53E-04	2.6E-04		1.7E-08	3.73E-10	2.6E-04		2.5E-14	1.7E-08
VOC	Toluene	108-88-3	ID	N	1.00E+00	2.53E-04				3.73E-10				
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	N	1.00E+00	1.87E-04				3.73E-10				
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	N	1.00E+00	1.51E-04				3.73E-10				
VOC	Xylenes (total)	1330-20-7	ID	N	1.00E+00	2.40E-04				3.73E-10				
SVOC	Anthracene	120-12-7	ID	N	1.00E+00	2.73E-06				3.73E-10				
SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.00E+00		6.0E-02	1		3.73E-10	6.0E-02	1	1.6E-11	1.6E-11
SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.00E+00		6.0E-01	1		3.73E-10	6.0E-01	1	1.6E-10	1.6E-10
SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.00E+00		6.0E-02	1		3.73E-10	6.0E-02	1	1.6E-11	1.6E-11
SVOC	Benzo(g,h,i)perylene	191-24-2	D	N	1.00E+00					3.73E-10				
SVOC	Chrysene	218-01-9	B2	Y	1.00E+00		6.0E-04	1		3.73E-10	6.0E-04	1	1.6E-13	1.6E-13
SVOC	Ethanol	64-17-5		N	1.00E+00					3.73E-10				
SVOC	Fluorene	86-73-7	D	N	1.00E+00	4.38E-06				3.73E-10				
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	1.00E+00		6.0E-02	1		3.73E-10	6.0E-02	1	1.6E-11	1.6E-11
SVOC	Naphthalene	91-20-3	C	N	1.00E+00	4.30E-05	3.4E-02		3.7E-07	3.73E-10	3.4E-02		3.2E-12	3.7E-07
SVOC	Phenanthrene	85-01-8	D	N	1.00E+00	3.38E-06				3.73E-10				
SVOC	Pyrene	129-00-0	NC	N	1.00E+00					3.73E-10				
SVOC	Tetraethylene Glycol	112-60-7		N	1.00E+00					3.73E-10				
INORG	Lead	7439-92-1	B2	N	1.00E+00					3.73E-10				

Notes:
f_{inh} is the fraction of the inhalation toxicity value that USEPA identified as having a mutagenic mode of action.

Attachment 5
Table 5b
Unit Hazard Quotient Calculations for Exposure of Off-Facility Resident to Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Soil Vapor Inhalation			Soil Particulate Inhalation			All Routes
Chem Group	Chemical	CASRN	C_{soil} (mg/kg)	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	HQ
VOC	Benzene	71-43-2	1.00E+00	2.68E-04	3.0E-02	6.1E-03	3.73E-10	3.0E-02	8.5E-09	6.1E-03
VOC	Cumene	98-82-8	1.00E+00	2.26E-04	4.0E-01	3.9E-04	3.73E-10	4.0E-01	6.4E-10	3.9E-04
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	2.31E-04	9.0E-03	1.8E-02	3.73E-10	9.0E-03	2.8E-08	1.8E-02
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	2.60E-04	7.0E-03	2.5E-02	3.73E-10	7.0E-03	3.7E-08	2.5E-02
VOC	Ethyl Benzene	100-41-4	1.00E+00	2.37E-04	1.0E+00	1.6E-04	3.73E-10	1.0E+00	2.6E-10	1.6E-04
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	2.53E-04	3.0E+00	5.8E-05	3.73E-10	3.0E+00	8.5E-11	5.8E-05
VOC	Toluene	108-88-3	1.00E+00	2.53E-04	5.0E+00	3.5E-05	3.73E-10	5.0E+00	5.1E-11	3.5E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	1.87E-04	6.0E-02	2.1E-03	3.73E-10	6.0E-02	4.3E-09	2.1E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	1.51E-04	6.0E-02	1.7E-03	3.73E-10	6.0E-02	4.3E-09	1.7E-03
VOC	Xylenes (total)	1330-20-7	1.00E+00	2.40E-04	1.0E-01	1.6E-03	3.73E-10	1.0E-01	2.6E-09	1.6E-03
SVOC	Anthracene	120-12-7	1.00E+00	2.73E-06			3.73E-10			
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00				3.73E-10			
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		2.0E-06		3.73E-10	2.0E-06	1.3E-04	1.3E-04
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00				3.73E-10			
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00				3.73E-10			
SVOC	Chrysene	218-01-9	1.00E+00				3.73E-10			
SVOC	Ethanol	64-17-5	1.00E+00		1.9E+01		3.73E-10	1.9E+01	1.3E-11	1.3E-11
SVOC	Fluorene	86-73-7	1.00E+00	4.38E-06			3.73E-10			
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00				3.73E-10			
SVOC	Naphthalene	91-20-3	1.00E+00	4.30E-05	3.0E-03	9.8E-03	3.73E-10	3.0E-03	8.5E-08	9.8E-03
SVOC	Phenanthrene	85-01-8	1.00E+00	3.38E-06			3.73E-10			
SVOC	Pyrene	129-00-0	1.00E+00				3.73E-10			
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00				3.73E-10			
INORG	Lead	7439-92-1	1.00E+00				3.73E-10			

Attachment 5
Figure 1: Soil Moisture Profile for Default PADEP Residential Building (w/ Basement)
PESRM Philadelphia Refining Complex, Philadelphia, Pennsylvania



Attachment 5

Table 6

Normalized Indoor Air Concentration in a Default PADEP Residential Building (w/ Basement) Due to Vapor Intrusion from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	D_{air} (m^2/day)	D_{water} (m^2/day)	H (unitless)	D_{crack} (m^2/day)	D_{eff}^T (m^2/day)	α_{soil}	α_{slab}	α_{∞}	$C_{b, norm}$ (L-water/m^3)
VOC	Benzene	71-43-2	7.60E-01	8.47E-05	1.68E-01	1.23E-01	2.49E-03	1.66E-02	4.55E-03	7.55E-05	1.27E-02
VOC	Cumene	98-82-8	5.62E-01	6.13E-05	3.28E-01	9.06E-02	1.03E-03	6.94E-03	4.55E-03	3.16E-05	1.04E-02
VOC	1,2-Dibromoethane	106-93-4	3.72E-01	7.29E-05	2.37E-02	5.99E-02	8.50E-03	5.45E-02	4.55E-03	2.48E-04	5.89E-03
VOC	1,2-Dichloroethane	107-06-2	8.99E-01	8.55E-05	2.92E-02	1.45E-01	1.06E-02	6.68E-02	4.55E-03	3.04E-04	8.87E-03
VOC	Ethyl Benzene	100-41-4	6.48E-01	6.74E-05	2.20E-01	1.05E-01	1.60E-03	1.07E-02	4.55E-03	4.89E-05	1.07E-02
VOC	Methyl tert-butyl ether	1634-04-4	7.42E-01	8.73E-05	1.83E-02	1.20E-01	1.43E-02	8.81E-02	4.55E-03	4.01E-04	7.36E-03
VOC	Toluene	108-88-3	7.52E-01	7.43E-05	1.93E-01	1.21E-01	1.99E-03	1.33E-02	4.55E-03	6.05E-05	1.17E-02
VOC	1,2,4-Trimethylbenzene	95-63-6	5.24E-01	6.84E-05	1.61E-01	8.45E-02	2.03E-03	1.36E-02	4.55E-03	6.19E-05	9.96E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	5.20E-01	7.49E-05	1.54E-01	8.39E-02	2.27E-03	1.52E-02	4.55E-03	6.90E-05	1.06E-02
VOC	Xylenes (total)	1330-20-7	6.74E-01	7.56E-05	2.52E-01	1.09E-01	1.58E-03	1.06E-02	4.55E-03	4.84E-05	1.22E-02
SVOC	Anthracene	120-12-7	2.80E-01	6.69E-05	1.30E-03	4.52E-02	2.73E-02	1.56E-01	4.55E-03	7.10E-04	9.26E-04
SVOC	Benzo(a)anthracene	56-55-3	4.41E-01	7.78E-05	5.55E-05	7.17E-02	6.73E-02	3.13E-01	4.55E-03	1.43E-03	
SVOC	Benzo(a)pyrene	50-32-8	3.72E-01	7.78E-05	1.49E-05	6.21E-02	6.63E-02	3.10E-01	4.55E-03	1.41E-03	
SVOC	Benzo(b)fluoranthene	205-99-2	1.95E-01	4.80E-05	1.66E-03	3.15E-02	1.80E-02	1.08E-01	4.55E-03	4.94E-04	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.88E-01	4.54E-05	1.10E-05	3.20E-02	3.54E-02	1.94E-01	4.55E-03	8.82E-04	
SVOC	Chrysene	218-01-9	2.14E-01	5.37E-05	1.48E-03	3.46E-02	2.04E-02	1.22E-01	4.55E-03	5.54E-04	
SVOC	Ethanol	64-17-5	1.06E+00	1.12E-04	1.75E-04	1.72E-01	1.32E-01	4.73E-01	4.55E-03	2.15E-03	
SVOC	Fluorene	86-73-7	3.14E-01	6.81E-05	1.39E-03	5.06E-02	2.93E-02	1.65E-01	4.55E-03	7.54E-04	1.05E-03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.64E-01	4.89E-05	2.03E-05	2.75E-02	2.94E-02	1.66E-01	4.55E-03	7.57E-04	
SVOC	Naphthalene	91-20-3	5.10E-01	6.48E-05	1.20E-02	8.22E-02	1.37E-02	8.49E-02	4.55E-03	3.87E-04	4.66E-03
SVOC	Phenanthrene	85-01-8	3.24E-01	6.45E-05	1.41E-03	5.23E-02	2.94E-02	1.66E-01	4.55E-03	7.56E-04	1.06E-03
SVOC	Pyrene	129-00-0	2.35E-01	6.26E-05	2.00E-04	3.80E-02	3.26E-02	1.81E-01	4.55E-03	8.24E-04	
SVOC	Tetraethylene Glycol	112-60-7	4.39E-01	6.96E-05	1.62E-11	1.80E+03	2.97E+03	9.97E-01	3.14E-01	3.13E-01	
INORG	Lead	7439-92-1									

Attachment 5

Table 6

Normalized Indoor Air Concentration in a Default PADEP Residential Building (w/ Basement) Due to Vapor Intrusion from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Subsurface and Building Characteristics			**Crack Soil**
SCS Soil texture class			Sand
Bulk density	kg/L	ρ_b	1.66
Total porosity	L/L-soil	θ_T	0.375
Water-filled porosity	L/L-soil	θ_w	0.054
Air-filled porosity	L/L-soil	θ_a	0.321
Residual saturation	L/L-soil	θ_r	0.053
Hydraulic conductivity	cm/s	**K**	7.4E-03
Dynamic viscosity of water	g/cm-s	μ_w	0.01307
Density of water	g/cm^3	ρ_w	1.0
Gravitational acceleration	cm/s^2	**g**	980.7
Intrinsic permeability	cm^2	**k**	9.9E-08
Relative saturation	unitless	S_e	0.003
van Genuchten N	unitless	**N**	3.177
van Genuchten M	unitless	**M**	0.685
Relative air permeability	unitless	k_{rg}	0.998
Permeability to vapor	cm^2	k_v	9.90E-08
Distance from foundation to source	m	$L_{T\text{-}gw}$	3.69
Bldg foundation thickness	m	L_{crack}	0.1
Bldg foundation length	m		10.00
Bldg foundation width	m		10.00
Bldg occupied height	m		3.66
Bldg occupied volume	m^3		366.00
Occupied depth below ground	m		2.0
Bldg area for vapor intrusion	m^2	A_B	180.0
Ratio of A_{crack} to A_B		η	2E-04
Area of cracks	m^2	A_{crack}	4E-02
Air exchange rate	$hour^{-1}$	**ach**	0.18
Building ventilation rate	m^3/day	Q_{bldg}	1.6E+03
Pressure diff. outdoors-indoors	$kg/m\text{-}s^2$	ΔP	4.0
Viscosity of air	kg/m-s	μ_a	1.8E-05
Crack length (bldg perimeter)	m	X_{crack}	40
Crack depth below ground	m	Z_{crack}	2.10
Crack radius	m	r_{crack}	1E-03
Soil gas flow rate into bldg	m^3/day	Q_{soil}	7.20

Attachment 5
Table 7
Unit Risk and Hazard Quotient Calculations for Groundwater Vapor Intrusion into a Default PADEP Residential Building (w/ Basement)
Off-Facility Resident
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

							Cancer				Noncancer	
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**ADAF**	**C_{gw}** (mg/L)	**C_{air}** (mg/m^3)	**URF** (mg/m^3)$^{-1}$	**f_{inh}**	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	Benzene	71-43-2	A	N	1.00E+00	1.27E-02	7.8E-03		3.5E-05		3.0E-02	4.1E-01
VOC	Cumene	98-82-8	D	N	1.00E+00	1.04E-02					4.0E-01	2.5E-02
VOC	1,2-Dibromoethane	106-93-4	LC	N	1.00E+00	5.89E-03	6.0E-01		1.3E-03		9.0E-03	6.3E-01
VOC	1,2-Dichloroethane	107-06-2	B2	N	1.00E+00	8.87E-03	2.6E-02		8.2E-05		7.0E-03	1.2E+00
VOC	Ethyl Benzene	100-41-4	D	N	1.00E+00	1.07E-02					1.0E+00	1.0E-02
VOC	Methyl tert-butyl ether	1634-04-4	C	N	1.00E+00	7.36E-03	2.6E-04		6.8E-07		3.0E+00	2.4E-03
VOC	Toluene	108-88-3	ID	N	1.00E+00	1.17E-02					5.0E+00	2.2E-03
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	N	1.00E+00	9.96E-03					6.0E-02	1.6E-01
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	N	1.00E+00	1.06E-02					6.0E-02	1.7E-01
VOC	Xylenes (total)	1330-20-7	ID	N	1.00E+00	1.22E-02					1.0E-01	1.2E-01
SVOC	Anthracene	120-12-7	ID	N	1.00E+00	9.26E-04						
SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.00E+00		6.0E-02	1				
SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.00E+00		6.0E-01	1			2.0E-06	
SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.00E+00		6.0E-02	1				
SVOC	Benzo(g,h,i)perylene	191-24-2	D	N	1.00E+00							
SVOC	Chrysene	218-01-9	B2	Y	1.00E+00		6.0E-04	1				
SVOC	Ethanol	64-17-5		N	1.00E+00						1.9E+01	
SVOC	Fluorene	86-73-7	D	N	1.00E+00	1.05E-03						
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	1.00E+00		6.0E-02	1				
SVOC	Naphthalene	91-20-3	C	N	1.00E+00	4.66E-03	3.4E-02		5.6E-05		3.0E-03	1.5E+00
SVOC	Phenanthrene	85-01-8	D	N	1.00E+00	1.06E-03						
SVOC	Pyrene	129-00-0	NC	N	1.00E+00							
SVOC	Tetraethylene Glycol	112-60-7		N	1.00E+00							
INORG	Lead	7439-92-1	B2	N	1.00E+00							

Notes:
f_{inh} is the fraction of the inhalation toxicity value that USEPA identified as having a mutagenic mode of action.

Attachment 6

Soil Migration to Groundwater Calculations

Table 1 – Groundwater Protection Concentrations

Table 2 – Soil Migration to Groundwater Criteria Based on the Nonpotable GW Use RBSL [Cancer]

Table 3 – Soil Migration to Groundwater Criteria Based on the Nonpotable GW Use RBSL [Noncancer]

Table 4 – Soil Migration to Groundwater Criteria Based on the RW GW Vol to Outdoor Air RBSL [Cancer]

Table 5 – Soil Migration to Groundwater Criteria Based on the RW GW Vol to Outdoor Air RBSL [Noncancer]

Table 6 – Soil Migration to Groundwater Criteria Based on the RW GW Vapor Intrusion RBSL [Cancer]

Table 7 – Soil Migration to Groundwater Criteria Based on the RW GW Vapor Intrusion RBSL [Noncancer]

Table 8 – Soil Migration to Groundwater Criteria Based on the Construction Worker Direct Contact RBSL [Cancer]

Table 9 – Soil Migration to Groundwater Criteria Based on the Construction Worker Direct Contact RBSL [Noncancer]

Table 10 – Soil Migration to Groundwater Criteria Based on the Off-Facility Resident Vapor Intrusion RBSL [Cancer]

Table 11 – Soil Migration to Groundwater Criteria Based on the Off-Facility Resident Vapor Intrusion RBSL [Noncancer]

Table 12 – Soil Migration to Groundwater Criteria Based on the GW MtSW RBSL

Attachment 6
Table 1
Groundwater Protection Concentrations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Cancer Class	Nonpotable Groundwater Use RBSL [Cancer] (mg/L)	Nonpotable Groundwater Use RBSL [Noncancer] (mg/L)	RW GW Volitilization to Outdoor Air RBSL [Cancer] (mg/L)	RW GW Volitilization to Outdoor Air RBSL [Noncancer] (mg/L)	RW GW Vapor Intrusion RBSL [Cancer] (mg/L)	RW GW Vapor Intrusion RBSL [Noncancer] (mg/L)	Construction Worker Direct Contact RBSL [Cancer] (mg/L)	Construction Worker Direct Contact RBSL [Noncancer] (mg/L)	Off-Facility Resident Vapor Intrusion RBSL [Cancer] (mg/L)	Off-Facility Resident Vapor Intrusion RBSL [Noncancer] (mg/L)	Groundwater MtSW RBSL (mg/L)	Groundwater Protection Concentration (mg/L)	GWP Basis
VOC	Benzene	71-43-2	A	3.0E-01	6.1E-01	6.5E+02	5.5E+02	4.6E+00	3.8E+00	4.2E+01	4.0E+00	2.8E-01	2.5E-01	1.3E+02	2.5E-01	Min
VOC	Cumene	98-82-8	D		3.7E+01		9.1E+03		6.3E+01		3.0E+01		4.0E+00	2.6E+00	2.6E+00	Min
VOC	1,2-Dibromoethane	106-93-4	LC	1.7E-02	6.7E-01	1.6E+01	3.1E+02	1.1E-01	2.2E+00	1.1E+00	9.1E-01	7.9E-03	1.6E-01		7.9E-03	Min
VOC	1,2-Dichloroethane	107-06-2	B2	3.3E-01	2.2E+00	2.5E+02	1.7E+02	1.8E+00	1.2E+00	1.9E+01	4.9E+00	1.2E-01	8.2E-02	3.1E+03	8.2E-02	Min
VOC	Ethyl Benzene	100-41-4	D		2.0E+00		2.2E+04		1.5E+02		4.0E+01		9.7E+00	1.3E+01	2.0E+00	Min
VOC	Methyl tert-butyl ether	1634-04-4	C	2.1E+01	4.5E+01	2.9E+04	8.0E+04	2.1E+02	5.8E+02	1.8E+03	1.9E+02	1.5E+01	4.2E+01	1.1E+04	1.5E+01	Min
VOC	Toluene	108-88-3	ID		2.5E+01		1.0E+05		7.0E+02		2.0E+02		4.5E+01	5.2E+01	2.5E+01	Min
VOC	1,2,4-Trimethylbenzene	95-63-6	ID		8.7E+00		1.4E+03		9.7E+00		1.5E+01		6.3E-01	3.3E+01	6.3E-01	Min
VOC	1,3,5-Trimethylbenzene	108-67-8	ID		8.8E+00		1.3E+03		9.1E+00		1.5E+01		5.9E-01	7.1E+01	5.9E-01	Min
VOC	Xylenes (total)	1330-20-7	ID		3.7E+00		1.9E+03		1.3E+01		1.7E+01		8.6E-01	2.1E+02	8.6E-01	Min
SVOC	Anthracene	120-12-7	ID		2.4E+02						1.9E+04			4.0E+01	4.0E+01	Min
SVOC	Benzo(a)anthracene	56-55-3	B2	1.0E-01						1.4E+03				1.3E-02	1.3E-02	Min
SVOC	Benzo(a)pyrene	50-32-8	HC	1.0E-02	4.4E-02					1.4E+02	5.8E+00			1.3E-03	1.3E-03	Min
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.6E-01						1.4E+03				1.3E-02	1.3E-02	Min
SVOC	Benzo(g,h,i)perylene	191-24-2	D		4.4E+01						5.8E+03			1.2E-02	1.2E-02	Min
SVOC	Chrysene	218-01-9	B2	1.6E+01						1.4E+05				1.3E+00	1.3E+00	Min
SVOC	Ethanol	64-17-5			1.0E+04						8.3E+05				1.0E+04	Min
SVOC	Fluorene	86-73-7	D		9.7E+01						7.8E+03			7.0E+00	7.0E+00	Min
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.0E-01						1.4E+03				1.3E-02	1.3E-02	Min
SVOC	Naphthalene	91-20-3	C	4.2E-01	3.9E-01	3.3E+02	1.2E+02	2.4E+00	8.8E-01	1.9E+01	2.8E-01	1.8E-01	6.7E-02	4.3E+01	6.7E-02	Min
SVOC	Phenanthrene	85-01-8	D		7.3E+01						5.8E+03			1.0E+00	1.0E+00	Min
SVOC	Pyrene	129-00-0	NC		5.0E+01						5.8E+03			3.0E+00	3.0E+00	Min
SVOC	Tetraethylene Glycol	112-60-7			2.9E+02						3.9E+04			1.9E+05	2.9E+02	Min
INORG	Lead	7439-92-1	B2											2.5E+00	2.5E+00	Min

Notes:
Cancer RBSLs are calculated at a target cancer risk of 1E-05. Noncancer RBSLs are calculated at a target HQ of 0.1.

Attachment 6
Table 2
Soil Migration to Groundwater Criteria Based on the Nonpotable GW Use RBSL [Cancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	3.0E-01	TCRL	1.8E+03	5.8E+01		1.7E-01	2.1E+00	1.2E+02	1.2E+02	LT
VOC	Cumene	98-82-8			6.1E+01	7.1E+02		3.3E-01				NA
VOC	1,2-Dibromoethane	106-93-4	1.7E-02	TCRL	3.9E+03	2.2E+01		2.4E-02	5.0E-02	6.8E+00	6.8E+00	LT
VOC	1,2-Dichloroethane	107-06-2	3.3E-01	TCRL	8.5E+03	1.7E+01		2.9E-02	8.2E-01	1.3E+02	1.3E+02	LT
VOC	Ethyl Benzene	100-41-4			1.7E+02	3.7E+02		2.2E-01				NA
VOC	Methyl tert-butyl ether	1634-04-4	2.1E+01	TCRL	5.1E+04	1.1E+01		1.8E-02	3.9E+01	8.5E+03	8.5E+03	LT
VOC	Toluene	108-88-3			5.3E+02	1.8E+02		1.9E-01				NA
VOC	1,2,4-Trimethylbenzene	95-63-6			5.7E+01	9.0E+02		1.6E-01				NA
VOC	1,3,5-Trimethylbenzene	108-67-8			4.8E+01	1.8E+03		1.5E-01				NA
VOC	Xylenes (total)	1330-20-7			1.7E+02	3.9E+02		2.5E-01				NA
SVOC	Anthracene	120-12-7			4.3E-02	3.0E+04		1.3E-03				NA
SVOC	Benzo(a)anthracene	56-55-3	1.0E-01	TCRL	9.4E-03	4.0E+05		5.6E-05	4.2E+03	4.2E+01		NA
SVOC	Benzo(a)pyrene	50-32-8	1.0E-02	TCRL	1.6E-03	1.0E+06		1.5E-05	1.0E+03	4.0E+00		NA
SVOC	Benzo(b)fluoranthene	205-99-2	1.6E-01	TCRL	1.5E-03	1.2E+06		1.7E-03	1.9E+04	6.2E+01		NA
SVOC	Benzo(g,h,i)perylene	191-24-2			2.6E-04	1.3E+07		1.1E-05				NA
SVOC	Chrysene	218-01-9	1.6E+01	TCRL	1.6E-03	4.0E+05		1.5E-03	6.2E+05	6.2E+03		NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				NA
SVOC	Fluorene	86-73-7			2.0E+00	1.4E+04		1.4E-03				NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.0E-01	TCRL	2.2E-05	3.4E+06		2.0E-05	3.4E+04	4.0E+01		NA
SVOC	Naphthalene	91-20-3	4.2E-01	TCRL	3.1E+01	2.0E+03		1.2E-02	8.4E+01	1.7E+02	1.7E+02	LT
SVOC	Phenanthrene	85-01-8			1.2E+00	2.4E+04		1.4E-03				NA
SVOC	Pyrene	129-00-0			1.4E-01	1.1E+05		2.0E-04				NA
SVOC	Tetraethylene Glycol	112-60-7			1.0E+06	3.0E-02		1.6E-11				NA
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 3
Soil Migration to Groundwater Criteria Based on the Nonpotable GW Use RBSL [Noncancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	6.1E-01	THQ	1.8E+03	5.8E+01		1.7E-01	4.4E+00	2.5E+02	2.5E+02	LT
VOC	Cumene	98-82-8	3.7E+01	THQ	6.1E+01	7.1E+02		3.3E-01	2.7E+03	1.5E+04		NA
VOC	1,2-Dibromoethane	106-93-4	6.7E-01	THQ	3.9E+03	2.2E+01		2.4E-02	2.0E+00	2.7E+02	2.7E+02	LT
VOC	1,2-Dichloroethane	107-06-2	2.2E+00	THQ	8.5E+03	1.7E+01		2.9E-02	5.5E+00	8.9E+02	8.9E+02	LT
VOC	Ethyl Benzene	100-41-4	2.0E+00	THQ	1.7E+02	3.7E+02		2.2E-01	7.8E+01	8.2E+02	8.2E+02	LT
VOC	Methyl tert-butyl ether	1634-04-4	4.5E+01	THQ	5.1E+04	1.1E+01		1.8E-02	8.3E+01	1.8E+04	1.8E+04	LT
VOC	Toluene	108-88-3	2.5E+01	THQ	5.3E+02	1.8E+02		1.9E-01	4.8E+02	9.8E+03	9.8E+03	LT
VOC	1,2,4-Trimethylbenzene	95-63-6	8.7E+00	THQ	5.7E+01	9.0E+02		1.6E-01	7.9E+02	3.5E+03		NA
VOC	1,3,5-Trimethylbenzene	108-67-8	8.8E+00	THQ	4.8E+01	1.8E+03		1.5E-01	1.6E+03	3.5E+03		NA
VOC	Xylenes (total)	1330-20-7	3.7E+00	THQ	1.7E+02	3.9E+02		2.5E-01	1.5E+02	1.5E+03	1.5E+03	LT
SVOC	Anthracene	120-12-7	2.4E+02	THQ	4.3E-02	3.0E+04		1.3E-03	7.0E+05	9.4E+04		NA
SVOC	Benzo(a)anthracene	56-55-3			9.4E-03	4.0E+05		5.6E-05				NA
SVOC	Benzo(a)pyrene	50-32-8	4.4E-02	THQ	1.6E-03	1.0E+06		1.5E-05	4.5E+03	1.8E+01		NA
SVOC	Benzo(b)fluoranthene	205-99-2			1.5E-03	1.2E+06		1.7E-03				NA
SVOC	Benzo(g,h,i)perylene	191-24-2	4.4E+01	THQ	2.6E-04	1.3E+07		1.1E-05	5.6E+07	1.7E+04		NA
SVOC	Chrysene	218-01-9			1.6E-03	4.0E+05		1.5E-03				NA
SVOC	Ethanol	64-17-5	1.0E+04	THQ		6.8E-01		1.7E-04	7.5E+03	4.2E+06	4.2E+06	LT
SVOC	Fluorene	86-73-7	9.7E+01	THQ	2.0E+00	1.4E+04		1.4E-03	1.3E+05	3.9E+04		NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5			2.2E-05	3.4E+06		2.0E-05				NA
SVOC	Naphthalene	91-20-3	3.9E-01	THQ	3.1E+01	2.0E+03		1.2E-02	7.8E+01	1.5E+02	1.5E+02	LT
SVOC	Phenanthrene	85-01-8	7.3E+01	THQ	1.2E+00	2.4E+04		1.4E-03	1.8E+05	2.9E+04		NA
SVOC	Pyrene	129-00-0	5.0E+01	THQ	1.4E-01	1.1E+05		2.0E-04	5.2E+05	2.0E+04		NA
SVOC	Tetraethylene Glycol	112-60-7	2.9E+02	THQ	1.0E+06	3.0E-02		1.6E-11	1.9E+02	1.2E+05	1.2E+05	LT
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 4
Soil Migration to Groundwater Criteria Based on the RW GW Vol to Outdoor Air RBSL [Cancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	6.5E+02	TCRL	1.8E+03	5.8E+01		1.7E-01	4.7E+03	2.6E+05		NA
VOC	Cumene	98-82-8			6.1E+01	7.1E+02		3.3E-01				NA
VOC	1,2-Dibromoethane	106-93-4	1.6E+01	TCRL	3.9E+03	2.2E+01		2.4E-02	4.7E+01	6.3E+03	6.3E+03	LT
VOC	1,2-Dichloroethane	107-06-2	2.5E+02	TCRL	8.5E+03	1.7E+01		2.9E-02	6.4E+02	1.0E+05	1.0E+05	LT
VOC	Ethyl Benzene	100-41-4			1.7E+02	3.7E+02		2.2E-01				NA
VOC	Methyl tert-butyl ether	1634-04-4	2.9E+04	TCRL	5.1E+04	1.1E+01		1.8E-02	5.4E+04	1.1E+07		NA
VOC	Toluene	108-88-3			5.3E+02	1.8E+02		1.9E-01				NA
VOC	1,2,4-Trimethylbenzene	95-63-6			5.7E+01	9.0E+02		1.6E-01				NA
VOC	1,3,5-Trimethylbenzene	108-67-8			4.8E+01	1.8E+03		1.5E-01				NA
VOC	Xylenes (total)	1330-20-7			1.7E+02	3.9E+02		2.5E-01				NA
SVOC	Anthracene	120-12-7			4.3E-02	3.0E+04		1.3E-03				NA
SVOC	Benzo(a)anthracene	56-55-3			9.4E-03	4.0E+05		5.6E-05				NA
SVOC	Benzo(a)pyrene	50-32-8			1.6E-03	1.0E+06		1.5E-05				NA
SVOC	Benzo(b)fluoranthene	205-99-2			1.5E-03	1.2E+06		1.7E-03				NA
SVOC	Benzo(g,h,i)perylene	191-24-2			2.6E-04	1.3E+07		1.1E-05				NA
SVOC	Chrysene	218-01-9			1.6E-03	4.0E+05		1.5E-03				NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				NA
SVOC	Fluorene	86-73-7			2.0E+00	1.4E+04		1.4E-03				NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5			2.2E-05	3.4E+06		2.0E-05				NA
SVOC	Naphthalene	91-20-3	3.3E+02	TCRL	3.1E+01	2.0E+03		1.2E-02	6.7E+04	1.3E+05		NA
SVOC	Phenanthrene	85-01-8			1.2E+00	2.4E+04		1.4E-03				NA
SVOC	Pyrene	129-00-0			1.4E-01	1.1E+05		2.0E-04				NA
SVOC	Tetraethylene Glycol	112-60-7			1.0E+06	3.0E-02		1.6E-11				NA
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 5
Soil Migration to Groundwater Criteria Based on the RW GW Vol to Outdoor Air RBSL [Noncancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	5.5E+02	THQ	1.8E+03	5.8E+01		1.7E-01	3.9E+03	2.2E+05		NA
VOC	Cumene	98-82-8	9.1E+03	THQ	6.1E+01	7.1E+02		3.3E-01	6.6E+05	3.7E+06		NA
VOC	1,2-Dibromoethane	106-93-4	3.1E+02	THQ	3.9E+03	2.2E+01		2.4E-02	9.0E+02	1.2E+05		NA
VOC	1,2-Dichloroethane	107-06-2	1.7E+02	THQ	8.5E+03	1.7E+01		2.9E-02	4.1E+02	6.6E+04	6.6E+04	LT
VOC	Ethyl Benzene	100-41-4	2.2E+04	THQ	1.7E+02	3.7E+02		2.2E-01	8.3E+05	8.7E+06		NA
VOC	Methyl tert-butyl ether	1634-04-4	8.0E+04	THQ	5.1E+04	1.1E+01		1.8E-02	1.5E+05	3.2E+07		NA
VOC	Toluene	108-88-3	1.0E+05	THQ	5.3E+02	1.8E+02		1.9E-01	1.9E+06	4.0E+07		NA
VOC	1,2,4-Trimethylbenzene	95-63-6	1.4E+03	THQ	5.7E+01	9.0E+02		1.6E-01	1.3E+05	5.6E+05		NA
VOC	1,3,5-Trimethylbenzene	108-67-8	1.3E+03	THQ	4.8E+01	1.8E+03		1.5E-01	2.3E+05	5.2E+05		NA
VOC	Xylenes (total)	1330-20-7	1.9E+03	THQ	1.7E+02	3.9E+02		2.5E-01	7.7E+04	7.7E+05		NA
SVOC	Anthracene	120-12-7			4.3E-02	3.0E+04		1.3E-03				NA
SVOC	Benzo(a)anthracene	56-55-3			9.4E-03	4.0E+05		5.6E-05				NA
SVOC	Benzo(a)pyrene	50-32-8			1.6E-03	1.0E+06		1.5E-05				NA
SVOC	Benzo(b)fluoranthene	205-99-2			1.5E-03	1.2E+06		1.7E-03				NA
SVOC	Benzo(g,h,i)perylene	191-24-2			2.6E-04	1.3E+07		1.1E-05				NA
SVOC	Chrysene	218-01-9			1.6E-03	4.0E+05		1.5E-03				NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				NA
SVOC	Fluorene	86-73-7			2.0E+00	1.4E+04		1.4E-03				NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5			2.2E-05	3.4E+06		2.0E-05				NA
SVOC	Naphthalene	91-20-3	1.2E+02	THQ	3.1E+01	2.0E+03		1.2E-02	2.5E+04	4.9E+04		NA
SVOC	Phenanthrene	85-01-8			1.2E+00	2.4E+04		1.4E-03				NA
SVOC	Pyrene	129-00-0			1.4E-01	1.1E+05		2.0E-04				NA
SVOC	Tetraethylene Glycol	112-60-7			1.0E+06	3.0E-02		1.6E-11				NA
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 6
Soil Migration to Groundwater Criteria Based on the RW GW Vapor Intrusion RBSL [Cancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	4.6E+00	TCRL	1.8E+03	5.8E+01		1.7E-01	3.3E+01	1.8E+03	1.8E+03	LT
VOC	Cumene	98-82-8			6.1E+01	7.1E+02		3.3E-01				NA
VOC	1,2-Dibromoethane	106-93-4	1.1E-01	TCRL	3.9E+03	2.2E+01		2.4E-02	3.3E-01	4.5E+01	4.5E+01	LT
VOC	1,2-Dichloroethane	107-06-2	1.8E+00	TCRL	8.5E+03	1.7E+01		2.9E-02	4.6E+00	7.3E+02	7.3E+02	LT
VOC	Ethyl Benzene	100-41-4			1.7E+02	3.7E+02		2.2E-01				NA
VOC	Methyl tert-butyl ether	1634-04-4	2.1E+02	TCRL	5.1E+04	1.1E+01		1.8E-02	3.9E+02	8.4E+04	8.4E+04	LT
VOC	Toluene	108-88-3			5.3E+02	1.8E+02		1.9E-01				NA
VOC	1,2,4-Trimethylbenzene	95-63-6			5.7E+01	9.0E+02		1.6E-01				NA
VOC	1,3,5-Trimethylbenzene	108-67-8			4.8E+01	1.8E+03		1.5E-01				NA
VOC	Xylenes (total)	1330-20-7			1.7E+02	3.9E+02		2.5E-01				NA
SVOC	Anthracene	120-12-7			4.3E-02	3.0E+04		1.3E-03				NA
SVOC	Benzo(a)anthracene	56-55-3			9.4E-03	4.0E+05		5.6E-05				NA
SVOC	Benzo(a)pyrene	50-32-8			1.6E-03	1.0E+06		1.5E-05				NA
SVOC	Benzo(b)fluoranthene	205-99-2			1.5E-03	1.2E+06		1.7E-03				NA
SVOC	Benzo(g,h,i)perylene	191-24-2			2.6E-04	1.3E+07		1.1E-05				NA
SVOC	Chrysene	218-01-9			1.6E-03	4.0E+05		1.5E-03				NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				NA
SVOC	Fluorene	86-73-7			2.0E+00	1.4E+04		1.4E-03				NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5			2.2E-05	3.4E+06		2.0E-05				NA
SVOC	Naphthalene	91-20-3	2.4E+00	TCRL	3.1E+01	2.0E+03		1.2E-02	4.9E+02	9.7E+02		NA
SVOC	Phenanthrene	85-01-8			1.2E+00	2.4E+04		1.4E-03				NA
SVOC	Pyrene	129-00-0			1.4E-01	1.1E+05		2.0E-04				NA
SVOC	Tetraethylene Glycol	112-60-7			1.0E+06	3.0E-02		1.6E-11				NA
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 7
Soil Migration to Groundwater Criteria Based on the RW GW Vapor Intrusion RBSL [Noncancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	3.8E+00	THQ	1.8E+03	5.8E+01		1.7E-01	2.7E+01	1.5E+03	1.5E+03	LT
VOC	Cumene	98-82-8	6.3E+01	THQ	6.1E+01	7.1E+02		3.3E-01	4.6E+03	2.5E+04		NA
VOC	1,2-Dibromoethane	106-93-4	2.2E+00	THQ	3.9E+03	2.2E+01		2.4E-02	6.4E+00	8.6E+02	8.6E+02	LT
VOC	1,2-Dichloroethane	107-06-2	1.2E+00	THQ	8.5E+03	1.7E+01		2.9E-02	3.0E+00	4.8E+02	4.8E+02	LT
VOC	Ethyl Benzene	100-41-4	1.5E+02	THQ	1.7E+02	3.7E+02		2.2E-01	5.8E+03	6.1E+04		NA
VOC	Methyl tert-butyl ether	1634-04-4	5.8E+02	THQ	5.1E+04	1.1E+01		1.8E-02	1.1E+03	2.3E+05	2.3E+05	LT
VOC	Toluene	108-88-3	7.0E+02	THQ	5.3E+02	1.8E+02		1.9E-01	1.4E+04	2.8E+05		NA
VOC	1,2,4-Trimethylbenzene	95-63-6	9.7E+00	THQ	5.7E+01	9.0E+02		1.6E-01	8.9E+02	3.9E+03		NA
VOC	1,3,5-Trimethylbenzene	108-67-8	9.1E+00	THQ	4.8E+01	1.8E+03		1.5E-01	1.6E+03	3.6E+03		NA
VOC	Xylenes (total)	1330-20-7	1.3E+01	THQ	1.7E+02	3.9E+02		2.5E-01	5.4E+02	5.4E+03		NA
SVOC	Anthracene	120-12-7			4.3E-02	3.0E+04		1.3E-03				NA
SVOC	Benzo(a)anthracene	56-55-3			9.4E-03	4.0E+05		5.6E-05				NA
SVOC	Benzo(a)pyrene	50-32-8			1.6E-03	1.0E+06		1.5E-05				NA
SVOC	Benzo(b)fluoranthene	205-99-2			1.5E-03	1.2E+06		1.7E-03				NA
SVOC	Benzo(g,h,i)perylene	191-24-2			2.6E-04	1.3E+07		1.1E-05				NA
SVOC	Chrysene	218-01-9			1.6E-03	4.0E+05		1.5E-03				NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				NA
SVOC	Fluorene	86-73-7			2.0E+00	1.4E+04		1.4E-03				NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5			2.2E-05	3.4E+06		2.0E-05				NA
SVOC	Naphthalene	91-20-3	8.8E-01	THQ	3.1E+01	2.0E+03		1.2E-02	1.8E+02	3.5E+02	3.5E+02	LT
SVOC	Phenanthrene	85-01-8			1.2E+00	2.4E+04		1.4E-03				NA
SVOC	Pyrene	129-00-0			1.4E-01	1.1E+05		2.0E-04				NA
SVOC	Tetraethylene Glycol	112-60-7			1.0E+06	3.0E-02		1.6E-11				NA
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 8
Soil Migration to Groundwater Criteria Based on the Construction Worker Direct Contact RBSL [Cancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	4.2E+01	TCRL	1.8E+03	5.8E+01		1.7E-01	3.0E+02	1.7E+04	1.7E+04	LT
VOC	Cumene	98-82-8			6.1E+01	7.1E+02		3.3E-01				NA
VOC	1,2-Dibromoethane	106-93-4	1.1E+00	TCRL	3.9E+03	2.2E+01		2.4E-02	3.3E+00	4.5E+02	4.5E+02	LT
VOC	1,2-Dichloroethane	107-06-2	1.9E+01	TCRL	8.5E+03	1.7E+01		2.9E-02	4.7E+01	7.5E+03	7.5E+03	LT
VOC	Ethyl Benzene	100-41-4			1.7E+02	3.7E+02		2.2E-01				NA
VOC	Methyl tert-butyl ether	1634-04-4	1.8E+03	TCRL	5.1E+04	1.1E+01		1.8E-02	3.3E+03	7.1E+05	7.1E+05	LT
VOC	Toluene	108-88-3			5.3E+02	1.8E+02		1.9E-01				NA
VOC	1,2,4-Trimethylbenzene	95-63-6			5.7E+01	9.0E+02		1.6E-01				NA
VOC	1,3,5-Trimethylbenzene	108-67-8			4.8E+01	1.8E+03		1.5E-01				NA
VOC	Xylenes (total)	1330-20-7			1.7E+02	3.9E+02		2.5E-01				NA
SVOC	Anthracene	120-12-7			4.3E-02	3.0E+04		1.3E-03				NA
SVOC	Benzo(a)anthracene	56-55-3	1.4E+03	TCRL	9.4E-03	4.0E+05		5.6E-05	5.5E+07	5.5E+05		NA
SVOC	Benzo(a)pyrene	50-32-8	1.4E+02	TCRL	1.6E-03	1.0E+06		1.5E-05	1.4E+07	5.5E+04		NA
SVOC	Benzo(b)fluoranthene	205-99-2	1.4E+03	TCRL	1.5E-03	1.2E+06		1.7E-03	1.7E+08	5.5E+05		NA
SVOC	Benzo(g,h,i)perylene	191-24-2			2.6E-04	1.3E+07		1.1E-05				NA
SVOC	Chrysene	218-01-9	1.4E+05	TCRL	1.6E-03	4.0E+05		1.5E-03	5.5E+09	5.5E+07		NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				NA
SVOC	Fluorene	86-73-7			2.0E+00	1.4E+04		1.4E-03				NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.4E+03	TCRL	2.2E-05	3.4E+06		2.0E-05	4.7E+08	5.5E+05		NA
SVOC	Naphthalene	91-20-3	1.9E+01	TCRL	3.1E+01	2.0E+03		1.2E-02	3.8E+03	7.5E+03		NA
SVOC	Phenanthrene	85-01-8			1.2E+00	2.4E+04		1.4E-03				NA
SVOC	Pyrene	129-00-0			1.4E-01	1.1E+05		2.0E-04				NA
SVOC	Tetraethylene Glycol	112-60-7			1.0E+06	3.0E-02		1.6E-11				NA
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 9
Soil Migration to Groundwater Criteria Based on the Construction Worker Direct Contact RBSL [Noncancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	4.0E+00	THQ	1.8E+03	5.8E+01		1.7E-01	2.8E+01	1.6E+03	1.6E+03	LT
VOC	Cumene	98-82-8	3.0E+01	THQ	6.1E+01	7.1E+02		3.3E-01	2.2E+03	1.2E+04		NA
VOC	1,2-Dibromoethane	106-93-4	9.1E-01	THQ	3.9E+03	2.2E+01		2.4E-02	2.7E+00	3.6E+02	3.6E+02	LT
VOC	1,2-Dichloroethane	107-06-2	4.9E+00	THQ	8.5E+03	1.7E+01		2.9E-02	1.2E+01	1.9E+03	1.9E+03	LT
VOC	Ethyl Benzene	100-41-4	4.0E+01	THQ	1.7E+02	3.7E+02		2.2E-01	1.5E+03	1.6E+04		NA
VOC	Methyl tert-butyl ether	1634-04-4	1.9E+02	THQ	5.1E+04	1.1E+01		1.8E-02	3.5E+02	7.6E+04	7.6E+04	LT
VOC	Toluene	108-88-3	2.0E+02	THQ	5.3E+02	1.8E+02		1.9E-01	4.0E+03	8.2E+04		NA
VOC	1,2,4-Trimethylbenzene	95-63-6	1.5E+01	THQ	5.7E+01	9.0E+02		1.6E-01	1.4E+03	6.0E+03		NA
VOC	1,3,5-Trimethylbenzene	108-67-8	1.5E+01	THQ	4.8E+01	1.8E+03		1.5E-01	2.7E+03	6.0E+03		NA
VOC	Xylenes (total)	1330-20-7	1.7E+01	THQ	1.7E+02	3.9E+02		2.5E-01	6.8E+02	6.8E+03		NA
SVOC	Anthracene	120-12-7	1.9E+04	THQ	4.3E-02	3.0E+04		1.3E-03	5.8E+07	7.8E+06		NA
SVOC	Benzo(a)anthracene	56-55-3			9.4E-03	4.0E+05		5.6E-05				NA
SVOC	Benzo(a)pyrene	50-32-8	5.8E+00	THQ	1.6E-03	1.0E+06		1.5E-05	5.9E+05	2.3E+03		NA
SVOC	Benzo(b)fluoranthene	205-99-2			1.5E-03	1.2E+06		1.7E-03				NA
SVOC	Benzo(g,h,i)perylene	191-24-2	5.8E+03	THQ	2.6E-04	1.3E+07		1.1E-05	7.5E+09	2.3E+06		NA
SVOC	Chrysene	218-01-9			1.6E-03	4.0E+05		1.5E-03				NA
SVOC	Ethanol	64-17-5	8.3E+05	THQ		6.8E-01		1.7E-04	5.9E+05	3.3E+08	3.3E+08	LT
SVOC	Fluorene	86-73-7	7.8E+03	THQ	2.0E+00	1.4E+04		1.4E-03	1.1E+07	3.1E+06		NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5			2.2E-05	3.4E+06		2.0E-05				NA
SVOC	Naphthalene	91-20-3	2.8E-01	THQ	3.1E+01	2.0E+03		1.2E-02	5.6E+01	1.1E+02	1.1E+02	LT
SVOC	Phenanthrene	85-01-8	5.8E+03	THQ	1.2E+00	2.4E+04		1.4E-03	1.4E+07	2.3E+06		NA
SVOC	Pyrene	129-00-0	5.8E+03	THQ	1.4E-01	1.1E+05		2.0E-04	6.2E+07	2.3E+06		NA
SVOC	Tetraethylene Glycol	112-60-7	3.9E+04	THQ	1.0E+06	3.0E-02		1.6E-11	2.5E+04	1.6E+07	1.6E+07	LT
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 10
Soil Migration to Groundwater Criteria Based on the Off-Facility Resident Vapor Intrusion RBSL [Cancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	2.8E-01	TCRL	1.8E+03	5.8E+01		1.7E-01	2.0E+00	1.1E+02	1.1E+02	LT
VOC	Cumene	98-82-8			6.1E+01	7.1E+02		3.3E-01				NA
VOC	1,2-Dibromoethane	106-93-4	7.9E-03	TCRL	3.9E+03	2.2E+01		2.4E-02	2.3E-02	3.2E+00	3.2E+00	LT
VOC	1,2-Dichloroethane	107-06-2	1.2E-01	TCRL	8.5E+03	1.7E+01		2.9E-02	3.0E-01	4.9E+01	4.9E+01	LT
VOC	Ethyl Benzene	100-41-4			1.7E+02	3.7E+02		2.2E-01				NA
VOC	Methyl tert-butyl ether	1634-04-4	1.5E+01	TCRL	5.1E+04	1.1E+01		1.8E-02	2.7E+01	5.9E+03	5.9E+03	LT
VOC	Toluene	108-88-3			5.3E+02	1.8E+02		1.9E-01				NA
VOC	1,2,4-Trimethylbenzene	95-63-6			5.7E+01	9.0E+02		1.6E-01				NA
VOC	1,3,5-Trimethylbenzene	108-67-8			4.8E+01	1.8E+03		1.5E-01				NA
VOC	Xylenes (total)	1330-20-7			1.7E+02	3.9E+02		2.5E-01				NA
SVOC	Anthracene	120-12-7			4.3E-02	3.0E+04		1.3E-03				NA
SVOC	Benzo(a)anthracene	56-55-3			9.4E-03	4.0E+05		5.6E-05				NA
SVOC	Benzo(a)pyrene	50-32-8			1.6E-03	1.0E+06		1.5E-05				NA
SVOC	Benzo(b)fluoranthene	205-99-2			1.5E-03	1.2E+06		1.7E-03				NA
SVOC	Benzo(g,h,i)perylene	191-24-2			2.6E-04	1.3E+07		1.1E-05				NA
SVOC	Chrysene	218-01-9			1.6E-03	4.0E+05		1.5E-03				NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				NA
SVOC	Fluorene	86-73-7			2.0E+00	1.4E+04		1.4E-03				NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5			2.2E-05	3.4E+06		2.0E-05				NA
SVOC	Naphthalene	91-20-3	1.8E-01	TCRL	3.1E+01	2.0E+03		1.2E-02	3.6E+01	7.1E+01	7.1E+01	LT
SVOC	Phenanthrene	85-01-8			1.2E+00	2.4E+04		1.4E-03				NA
SVOC	Pyrene	129-00-0			1.4E-01	1.1E+05		2.0E-04				NA
SVOC	Tetraethylene Glycol	112-60-7			1.0E+06	3.0E-02		1.6E-11				NA
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 11
Soil Migration to Groundwater Criteria Based on the Off-Facility Resident Vapor Intrusion RBSL [Noncancer]
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	2.5E-01	THQ	1.8E+03	5.8E+01		1.7E-01	1.8E+00	9.8E+01	9.8E+01	LT
VOC	Cumene	98-82-8	4.0E+00	THQ	6.1E+01	7.1E+02		3.3E-01	2.9E+02	1.6E+03		NA
VOC	1,2-Dibromoethane	106-93-4	1.6E-01	THQ	3.9E+03	2.2E+01		2.4E-02	4.7E-01	6.4E+01	6.4E+01	LT
VOC	1,2-Dichloroethane	107-06-2	8.2E-02	THQ	8.5E+03	1.7E+01		2.9E-02	2.1E-01	3.3E+01	3.3E+01	LT
VOC	Ethyl Benzene	100-41-4	9.7E+00	THQ	1.7E+02	3.7E+02		2.2E-01	3.7E+02	3.9E+03		NA
VOC	Methyl tert-butyl ether	1634-04-4	4.2E+01	THQ	5.1E+04	1.1E+01		1.8E-02	7.9E+01	1.7E+04	1.7E+04	LT
VOC	Toluene	108-88-3	4.5E+01	THQ	5.3E+02	1.8E+02		1.9E-01	8.7E+02	1.8E+04		NA
VOC	1,2,4-Trimethylbenzene	95-63-6	6.3E-01	THQ	5.7E+01	9.0E+02		1.6E-01	5.7E+01	2.5E+02	2.5E+02	LT
VOC	1,3,5-Trimethylbenzene	108-67-8	5.9E-01	THQ	4.8E+01	1.8E+03		1.5E-01	1.0E+02	2.4E+02	2.4E+02	LT
VOC	Xylenes (total)	1330-20-7	8.6E-01	THQ	1.7E+02	3.9E+02		2.5E-01	3.4E+01	3.4E+02	3.4E+02	LT
SVOC	Anthracene	120-12-7			4.3E-02	3.0E+04		1.3E-03				NA
SVOC	Benzo(a)anthracene	56-55-3			9.4E-03	4.0E+05		5.6E-05				NA
SVOC	Benzo(a)pyrene	50-32-8			1.6E-03	1.0E+06		1.5E-05				NA
SVOC	Benzo(b)fluoranthene	205-99-2			1.5E-03	1.2E+06		1.7E-03				NA
SVOC	Benzo(g,h,i)perylene	191-24-2			2.6E-04	1.3E+07		1.1E-05				NA
SVOC	Chrysene	218-01-9			1.6E-03	4.0E+05		1.5E-03				NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				NA
SVOC	Fluorene	86-73-7			2.0E+00	1.4E+04		1.4E-03				NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5			2.2E-05	3.4E+06		2.0E-05				NA
SVOC	Naphthalene	91-20-3	6.7E-02	THQ	3.1E+01	2.0E+03		1.2E-02	1.4E+01	2.7E+01	2.7E+01	LT
SVOC	Phenanthrene	85-01-8			1.2E+00	2.4E+04		1.4E-03				NA
SVOC	Pyrene	129-00-0			1.4E-01	1.1E+05		2.0E-04				NA
SVOC	Tetraethylene Glycol	112-60-7			1.0E+06	3.0E-02		1.6E-11				NA
INORG	Lead	7439-92-1					9.0E+02					NA

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 6
Table 12
Soil Migration to Groundwater Criteria Based on the GW MtSW RBSL
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	1.3E+02		1.8E+03	5.8E+01		1.7E-01	9.3E+02	5.2E+04		NA
VOC	Cumene	98-82-8	2.6E+00		6.1E+01	7.1E+02		3.3E-01	1.9E+02	1.0E+03	1.0E+03	LT
VOC	1,2-Dibromoethane	106-93-4			3.9E+03	2.2E+01		2.4E-02				
VOC	1,2-Dichloroethane	107-06-2	3.1E+03		8.5E+03	1.7E+01		2.9E-02	7.8E+03	1.2E+06		NA
VOC	Ethyl Benzene	100-41-4	1.3E+01		1.7E+02	3.7E+02		2.2E-01	5.0E+02	5.2E+03		NA
VOC	Methyl tert-butyl ether	1634-04-4	1.1E+04		5.1E+04	1.1E+01		1.8E-02	2.1E+04	4.4E+06		NA
VOC	Toluene	108-88-3	5.2E+01		5.3E+02	1.8E+02		1.9E-01	1.0E+03	2.1E+04		NA
VOC	1,2,4-Trimethylbenzene	95-63-6	3.3E+01		5.7E+01	9.0E+02		1.6E-01	3.0E+03	1.3E+04		NA
VOC	1,3,5-Trimethylbenzene	108-67-8	7.1E+01		4.8E+01	1.8E+03		1.5E-01	1.3E+04	2.8E+04		NA
VOC	Xylenes (total)	1330-20-7	2.1E+02		1.7E+02	3.9E+02		2.5E-01	8.4E+03	8.4E+04		NA
SVOC	Anthracene	120-12-7	4.0E+01		4.3E-02	3.0E+04		1.3E-03	1.2E+05	1.6E+04		NA
SVOC	Benzo(a)anthracene	56-55-3	1.3E-02		9.4E-03	4.0E+05		5.6E-05	5.2E+02	5.2E+00		NA
SVOC	Benzo(a)pyrene	50-32-8	1.3E-03		1.6E-03	1.0E+06		1.5E-05	1.3E+02	5.2E-01		NA
SVOC	Benzo(b)fluoranthene	205-99-2	1.3E-02		1.5E-03	1.2E+06		1.7E-03	1.6E+03	5.2E+00		NA
SVOC	Benzo(g,h,i)perylene	191-24-2	1.2E-02		2.6E-04	1.3E+07		1.1E-05	1.5E+04	4.8E+00		NA
SVOC	Chrysene	218-01-9	1.3E+00		1.6E-03	4.0E+05		1.5E-03	5.2E+04	5.2E+02		NA
SVOC	Ethanol	64-17-5				6.8E-01		1.7E-04				
SVOC	Fluorene	86-73-7	7.0E+00		2.0E+00	1.4E+04		1.4E-03	9.6E+03	2.8E+03		NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.3E-02		2.2E-05	3.4E+06		2.0E-05	4.5E+03	5.2E+00		NA
SVOC	Naphthalene	91-20-3	4.3E+01		3.1E+01	2.0E+03		1.2E-02	8.7E+03	1.7E+04		NA
SVOC	Phenanthrene	85-01-8	1.0E+00		1.2E+00	2.4E+04		1.4E-03	2.4E+03	4.0E+02		NA
SVOC	Pyrene	129-00-0	3.0E+00		1.4E-01	1.1E+05		2.0E-04	3.2E+04	1.2E+03		NA
SVOC	Tetraethylene Glycol	112-60-7	1.9E+05		1.0E+06	3.0E-02		1.6E-11	1.2E+05	7.7E+07		NA
INORG	Lead	7439-92-1	2.5E+00				9.0E+02		4.5E+04	1.0E+03	4.5E+04	EQ

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 7

Nonpotable Groundwater Use Calculations

Table 1 – Normalized Vapor Flux to Outdoor Air from Residential Kiddie Pool

Table 2 – Nonsteady State Dermal Absorption of Chemicals from Water in Residential Kiddie Pool

Table 3 – Dispersion Factor to Outdoor Air

Table 4a – Unit Risk Calculations for Exposure of Resident to Groundwater in Kiddie Pools

Table 4b – Unit Hazard Quotient Calculations for Exposure of Resident to Groundwater in Kiddie Pools

Attachment 7

Table 1

Normalized Vapor Flux to Outdoor Air from Residential Kiddie Pool

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	H (unitless)	D_{air} (m^2/d)	D_{water} (m^2/d)	Sc_L (unitless)	Sc_G (unitless)	k_L (m/s)	k_G (m/s)	K_L (cm/s)	C_{avg}/C_0 (unitless)	J_L (L/m^2-s)
VOC	Benzene	71-43-2	1.7E-01	7.6E-01	8.5E-05	9.1E+02	1.7E+00	5.73E-06	9.43E-03	5.71E-06	4.10E-01	2.34E-03
VOC	Cumene	98-82-8	3.3E-01	5.6E-01	6.1E-05	1.3E+03	2.3E+00	5.02E-06	7.69E-03	5.01E-06	4.48E-01	2.25E-03
VOC	1,2-Dibromoethane	106-93-4	2.4E-02	3.7E-01	7.3E-05	1.1E+03	3.5E+00	5.39E-06	5.83E-03	5.18E-06	4.38E-01	2.27E-03
VOC	1,2-Dichloroethane	107-06-2	2.9E-02	9.0E-01	8.6E-05	9.0E+02	1.5E+00	5.75E-06	1.05E-02	5.64E-06	4.13E-01	2.33E-03
VOC	Ethyl Benzene	100-41-4	2.2E-01	6.5E-01	6.7E-05	1.1E+03	2.0E+00	5.22E-06	8.47E-03	5.20E-06	4.37E-01	2.28E-03
VOC	Methyl tert-butyl ether	1634-04-4	1.8E-02	7.4E-01	8.7E-05	8.8E+02	1.8E+00	5.80E-06	9.28E-03	5.61E-06	4.15E-01	2.33E-03
VOC	Toluene	108-88-3	1.9E-01	7.5E-01	7.4E-05	1.0E+03	1.7E+00	5.43E-06	9.35E-03	5.41E-06	4.26E-01	2.30E-03
VOC	1,2,4-Trimethylbenzene	95-63-6	1.6E-01	5.2E-01	6.8E-05	1.1E+03	2.5E+00	5.25E-06	7.34E-03	5.23E-06	4.36E-01	2.28E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	1.5E-01	5.2E-01	7.5E-05	1.0E+03	2.5E+00	5.45E-06	7.31E-03	5.42E-06	4.25E-01	2.30E-03
VOC	Xylenes (total)	1330-20-7	2.5E-01	6.7E-01	7.6E-05	1.0E+03	1.9E+00	5.46E-06	8.69E-03	5.45E-06	4.24E-01	2.31E-03
SVOC	Anthracene	120-12-7	1.3E-03	2.8E-01	6.7E-05	1.2E+03	4.7E+00	5.20E-06	4.83E-03	2.85E-06	6.12E-01	1.74E-03
SVOC	Benzo(a)anthracene	56-55-3	5.6E-05	4.4E-01	7.8E-05	9.9E+02	3.0E+00	5.53E-06	6.54E-03	3.41E-07	9.38E-01	
SVOC	Benzo(a)pyrene	50-32-8	1.5E-05	3.7E-01	7.8E-05	9.9E+02	3.5E+00	5.53E-06	5.83E-03	8.58E-08	9.84E-01	
SVOC	Benzo(b)fluoranthene	205-99-2	1.7E-03	2.0E-01	4.8E-05	1.6E+03	6.7E+00	4.56E-06	3.79E-03	2.64E-06	6.32E-01	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.1E-05	1.9E-01	4.5E-05	1.7E+03	6.9E+00	4.46E-06	3.69E-03	4.02E-08	9.92E-01	
SVOC	Chrysene	218-01-9	1.5E-03	2.1E-01	5.4E-05	1.4E+03	6.1E+00	4.76E-06	4.03E-03	2.65E-06	6.32E-01	
SVOC	Ethanol	64-17-5	1.7E-04	1.1E+00	1.1E-04	6.9E+02	1.2E+00	6.44E-06	1.18E-02	1.56E-06	7.55E-01	
SVOC	Fluorene	86-73-7	1.4E-03	3.1E-01	6.8E-05	1.1E+03	4.2E+00	5.24E-06	5.21E-03	3.04E-06	5.95E-01	1.81E-03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.0E-05	1.6E-01	4.9E-05	1.6E+03	7.9E+00	4.59E-06	3.38E-03	6.75E-08	9.87E-01	
SVOC	Naphthalene	91-20-3	1.2E-02	5.1E-01	6.5E-05	1.2E+03	2.6E+00	5.13E-06	7.21E-03	4.85E-06	4.58E-01	2.22E-03
SVOC	Phenanthrene	85-01-8	1.4E-03	3.2E-01	6.5E-05	1.2E+03	4.0E+00	5.13E-06	5.32E-03	3.04E-06	5.94E-01	1.81E-03
SVOC	Pyrene	129-00-0	2.0E-04	2.4E-01	6.3E-05	1.2E+03	5.5E+00	5.06E-06	4.29E-03	7.35E-07	8.73E-01	
SVOC	Tetraethylene Glycol	112-60-7	1.6E-11	4.4E-01	7.0E-05	1.1E+03	3.0E+00	5.28E-06	6.52E-03	1.06E-13	1.00E+00	
INORG	Lead	7439-92-1										

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Table 1

Normalized Vapor Flux to Outdoor Air from Residential Kiddie Pool

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:	Water density (g/cm^3)	ρ_w	1.00E+00
	Water viscosity (g/cm-s)	v_w	8.93E-03
	Air density (g/cm^3)	ρ_a	1.20E-03
	Air viscosity (g/cm-s)	v_a	1.81E-04
	Wind speed (mph)	u_{10}	9.3
	Wind speed (m/s)	u_{10}	4.2
	Friction velocity (m/s)	**u**	0.123
	Pool effective diameter (m)	d_e	2.1
	Pool water surface area (m^2)	**A**	3.3
	Pool water depth (m)	**d**	0.23
	Pool water volume (m^3)	**V**	0.76
	Fetch-to-depth ratio	**F/D**	9.0
	Averaging period (days)	**t**	1.0

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Table 2

Nonsteady State Dermal Absorption of Chemicals from Water in Residential Kiddie Pool

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	MW (g/mole)	FA (unitless)	K_p (cm/hr)	B (unitless)	t (hr)	c	b	ts (hr)	DA (L/cm^2-event)
VOC	Benzene	71-43-2	7.8E+01	1.0E+00	1.5E-02	5.0E-02	2.9E-01	3.7E-01	3.3E-01	6.9E-01	3.70E-05
VOC	Cumene	98-82-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,2-Dibromoethane	106-93-4	1.9E+02	1.0E+00	1.6E-03	8.4E-03	1.2E+00	3.4E-01	3.1E-01	2.8E+00	6.81E-06
VOC	1,2-Dichloroethane	107-06-2	9.9E+01	1.0E+00	4.1E-03	1.6E-02	3.8E-01	3.4E-01	3.1E-01	9.0E-01	1.13E-05
VOC	Ethyl Benzene	100-41-4	1.1E+02	1.0E+00	4.8E-02	1.9E-01	4.1E-01	4.7E-01	4.3E-01	9.9E-01	1.27E-04
VOC	Methyl tert-butyl ether	1634-04-4	8.8E+01	1.0E+00	3.3E-03	1.2E-02	3.3E-01	3.4E-01	3.1E-01	7.9E-01	8.84E-06
VOC	Toluene	108-88-3	9.2E+01	1.0E+00	3.2E-02	1.2E-01	3.5E-01	4.2E-01	3.8E-01	8.3E-01	8.08E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,3,5-Trimethylbenzene	108-67-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	Xylenes (total)	1330-20-7	1.1E+02	1.0E+00	5.0E-02	2.0E-01	4.1E-01	4.8E-01	4.4E-01	9.9E-01	1.32E-04
SVOC	Anthracene	120-12-7	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Benzo(a)anthracene	56-55-3	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Benzo(a)pyrene	50-32-8	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(b)fluoranthene	205-99-2	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(g,h,i)perylene	191-24-2	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Chrysene	218-01-9	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Ethanol	64-17-5	4.6E+01	1.0E+00	5.5E-04	1.4E-03	1.9E-01	3.3E-01	3.0E-01	4.6E-01	1.30E-06
SVOC	Fluorene	86-73-7	1.7E+02	1.0E+00			9.0E-01	3.3E-01	3.0E-01	2.2E+00	
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Naphthalene	91-20-3	1.3E+02	1.0E+00			5.5E-01	3.3E-01	3.0E-01	1.3E+00	
SVOC	Phenanthrene	85-01-8	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Pyrene	129-00-0	2.0E+02	1.0E+00			1.4E+00	3.3E-01	3.0E-01	3.4E+00	
SVOC	Tetraethylene Glycol	112-60-7	1.9E+02	1.0E+00			1.3E+00	3.3E-01	3.0E-01	3.1E+00	
INORG	Lead	7439-92-1	2.1E+02		1.0E-04		1.5E+00	3.3E-01	3.0E-01	3.7E+00	2.00E-07

Notes:

Event Time hours **t** 2

K_p capped at 1 cm/hr (USEPA 1992).

The dermal absorbed dose for inorganic chemicals is estimated using a steady-state approach (USEPA 2004, Equation 3.4) and for organic chemicals is estimated using a nonsteady-state approach (USEPA 2004, Equations 3.2 and 3.3).

Attachment 7
Table 3
Dispersion Factor to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Parameter	Units	Value
Correlation coefficient city		Philadelphia
Correlation coefficient A		14.0111
Correlation coefficient B		19.6154
Correlation coefficient C		225.3397

Source area	acres	0.0008
Groundwater averaging time for C/Q		1-Hour Max
C/Q	$(L/m^3)/(L/m^2\text{-}s)$	**15.83**

Note:
C/Q is estimated using the empirical correlation in USEPA's (2002) Supplemental Soil Screening Guidance.

Attachment 7
Table 4a
Unit Risk Calculations for Exposure of Residents to Groundwater in Kiddie Pools
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Incidental Ingestion				Dermal Contact					Vapor Inhalation				All Routes
Chem Group	Chemical	CASRN	Cancer Class	ADAF	C_{gw} (mg/l)	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	f_{oral}	Risk	DA (L/cm^2-event)	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	f_{oral}	Risk	C_{air} (mg/m^3)	URF $(mg/m^3)^{-1}$	f_{inh}	Risk	Risk
VOC	Benzene	71-43-2	A	N	1.00E+00	1.06E-04	5.5E-02		5.8E-06	3.70E-05	4.65E-04	5.5E-02		2.6E-05	3.70E-02	7.8E-03		2.4E-06	3.4E-05
VOC	Cumene	98-82-8	D	N	1.00E+00	1.16E-04									3.56E-02				
VOC	1,2-Dibromoethane	106-93-4	LC	N	1.00E+00	1.13E-04	2.0E+00		2.3E-04	6.81E-06	9.15E-05	2.0E+00		1.8E-04	3.60E-02	6.0E-01		1.8E-04	5.8E-04
VOC	1,2-Dichloroethane	107-06-2	B2	N	1.00E+00	1.06E-04	9.1E-02		9.7E-06	1.13E-05	1.43E-04	9.1E-02		1.3E-05	3.69E-02	2.6E-02		7.8E-06	3.1E-05
VOC	Ethyl Benzene	100-41-4	D	N	1.00E+00	1.13E-04				1.27E-04	1.70E-03				3.60E-02				
VOC	Methyl tert-butyl ether	1634-04-4	C	N	1.00E+00	1.07E-04	1.8E-03		1.9E-07	8.84E-06	1.12E-04	1.8E-03		2.0E-07	3.68E-02	2.6E-04		7.8E-08	4.7E-07
VOC	Toluene	108-88-3	ID	N	1.00E+00	1.10E-04				8.08E-05	1.05E-03				3.65E-02				
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	N	1.00E+00	1.12E-04									3.61E-02				
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	N	1.00E+00	1.10E-04									3.65E-02				
VOC	Xylenes (total)	1330-20-7	ID	N	1.00E+00	1.09E-04				1.32E-04	1.71E-03				3.65E-02				
SVOC	Anthracene	120-12-7	ID	N	1.00E+00	1.58E-04									2.76E-02				
SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.00E+00	2.42E-04	1.0E-01	1	9.5E-05			1.0E-01	1			6.0E-02	1		9.5E-05
SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.00E+00	2.54E-04	1.0E+00	1	1.0E-03			1.0E+00	1			6.0E-01	1		1.0E-03
SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.00E+00	1.63E-04	1.0E-01	1	6.4E-05			1.0E-01	1			6.0E-02	1		6.4E-05
SVOC	Benzo(g,h,i)perylene	191-24-2	D	N	1.00E+00	2.56E-04													
SVOC	Chrysene	218-01-9	B2	Y	1.00E+00	1.63E-04	1.0E-03	1	6.4E-07			1.0E-03	1			6.0E-04	1		6.4E-07
SVOC	Ethanol	64-17-5		N	1.00E+00	1.95E-04				1.30E-06	3.01E-05								
SVOC	Fluorene	86-73-7	D	N	1.00E+00	1.53E-04									2.86E-02				
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	1.00E+00	2.54E-04	1.0E-01	1	1.0E-04			1.0E-01	1			6.0E-02	1		1.0E-04
SVOC	Naphthalene	91-20-3	C	N	1.00E+00	1.18E-04	1.2E-01		1.4E-05			1.2E-01			3.52E-02	3.4E-02		9.7E-06	2.4E-05
SVOC	Phenanthrene	85-01-8	D	N	1.00E+00	1.53E-04									2.86E-02				
SVOC	Pyrene	129-00-0	NC	N	1.00E+00	2.25E-04													
SVOC	Tetraethylene Glycol	112-60-7		N	1.00E+00	2.58E-04													
INORG	Lead	7439-92-1	B2	N	1.00E+00	2.58E-04				2.00E-07	6.13E-06								

Notes:
f_{oral} and f_{inh} are the fraction of the oral and inhalation toxicity values, respectively, that USEPA identified as having a mutagenic mode of action.

Attachment 7
Table 4b
Hazard Quotient Calculations for Exposure of Residents to Groundwater in Kiddie Pools
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Incidental Ingestion			Dermal Contact				Vapor Inhalation			All Routes
Chem Group	Chemical	CASRN	C_{gw} (mg/L)	ADD (mg/kg/d)	RfD_{oral} (mg/kg/d)	HQ	DA (L/cm^2-event)	ADD (mg/kg/d)	RfD_{derm} (mg/kg/d)	HQ	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	HQ
VOC	Benzene	71-43-2	1.00E+00	2.84E-04	1.0E-02	2.8E-02	3.70E-05	1.25E-03	1.0E-02	1.3E-01	3.70E-02	9.0E-02	9.0E-03	1.6E-01
VOC	Cumene	98-82-8	1.00E+00	3.11E-04	4.0E-01	7.8E-04			4.0E-01		3.56E-02	4.0E-01	1.9E-03	2.7E-03
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	3.04E-04	9.0E-03	3.4E-02	6.81E-06	2.46E-04	9.0E-03	2.7E-02	3.60E-02	9.0E-03	8.8E-02	1.5E-01
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	2.87E-04	2.0E-02	1.4E-02	1.13E-05	3.85E-04	2.0E-02	1.9E-02	3.69E-02	7.0E-02	1.2E-02	4.5E-02
VOC	Ethyl Benzene	100-41-4	1.00E+00	3.03E-04	1.0E-01	3.0E-03	1.27E-04	4.58E-03	1.0E-01	4.6E-02	3.60E-02	9.0E+00	8.8E-05	4.9E-02
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	2.88E-04	3.0E-01	9.6E-04	8.84E-06	3.03E-04	3.0E-01	1.0E-03	3.68E-02	3.0E+00	2.7E-04	2.2E-03
VOC	Toluene	108-88-3	1.00E+00	2.95E-04	8.0E-01	3.7E-04	8.08E-05	2.84E-03	8.0E-01	3.5E-03	3.65E-02	5.0E+00	1.6E-04	4.1E-03
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	3.02E-04	4.0E-02	7.6E-03			4.0E-02		3.61E-02	2.0E-01	4.0E-03	1.2E-02
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	2.95E-04	4.0E-02	7.4E-03			4.0E-02		3.65E-02	2.0E-01	4.0E-03	1.1E-02
VOC	Xylenes (total)	1330-20-7	1.00E+00	2.94E-04	2.0E-01	1.5E-03	1.32E-04	4.61E-03	2.0E-01	2.3E-02	3.65E-02	3.0E-01	2.7E-03	2.7E-02
SVOC	Anthracene	120-12-7	1.00E+00	4.25E-04	1.0E+00	4.2E-04			1.0E+00		2.76E-02			4.2E-04
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00	6.51E-04										
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00	6.83E-04	3.0E-04	2.3E+00			3.0E-04			2.0E-06		2.3E+00
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00	4.39E-04										
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00	6.88E-04	3.0E-01	2.3E-03			3.0E-01					2.3E-03
SVOC	Chrysene	218-01-9	1.00E+00	4.38E-04										
SVOC	Ethanol	64-17-5	1.00E+00	5.24E-04	6.2E+01	8.4E-06	1.30E-06	8.10E-05	6.2E+01	1.3E-06		1.9E+01		9.8E-06
SVOC	Fluorene	86-73-7	1.00E+00	4.13E-04	4.0E-01	1.0E-03			4.0E-01		2.86E-02			1.0E-03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00	6.85E-04										
SVOC	Naphthalene	91-20-3	1.00E+00	3.18E-04	2.0E-01	1.6E-03			2.0E-01		3.52E-02	3.0E-03	2.6E-01	2.6E-01
SVOC	Phenanthrene	85-01-8	1.00E+00	4.12E-04	3.0E-01	1.4E-03			3.0E-01		2.86E-02			1.4E-03
SVOC	Pyrene	129-00-0	1.00E+00	6.06E-04	3.0E-01	2.0E-03			3.0E-01					2.0E-03
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00	6.94E-04	2.0E+00	3.5E-04			2.0E+00					3.5E-04
INORG	Lead	7439-92-1	1.00E+00	6.94E-04			2.00E-07	1.65E-05						

Attachment 8

Single-Chemical Risk Estimates

Table 1 – Upper-Bound Single-Chemical Cancer Risk and Noncancer HQ for Soil

Table 2 – Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil

Table 3 – Upper-Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Groundwater

Attachment 8
Table 1
Upper-Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Routine Worker				Maintenance Worker		Construction Worker		Off-Facility Resident		Soil Migration to GW									
						Outdoor Activities		Vapor Intrusion		Outdoor Activities		Outdoor Activities		Outdoor Activities		Nonpotable Use		R. Worker GW Vol OA		R. Worker GW VI		Const. W GW Contact		Off-Facility Res GW VI	
Area	Chem Group	Chemical	CASRN	Carc Class	Max Detect from All Depths (mg/kg)	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ
Tank Group 04	VOC	Benzene	71-43-2	A	7.10E+00	9.5E-07	1.1E-02	**1.3E-04**	**1.5E+00**	1.5E-07	4.4E-03	8.2E-07	8.2E-02	3.8E-06	4.3E-02	6.0E-07	2.9E-03	NC	NC	3.9E-08	4.6E-04	4.2E-09	4.5E-04	6.3E-07	7.2E-03
Tank Group 04	VOC	Cumene	98-82-8	D	1.50E+01	NC	1.5E-03	NC	***2.5E-01***	NC	5.2E-04	NC	1.7E-02	NC	5.8E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	VOC	Ethyl Benzene	100-41-4	D	6.60E+01	NC	2.9E-03	NC	***4.3E-01***	NC	1.0E-03	NC	5.2E-03	NC	1.1E-02	NC	8.1E-03	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	VOC	Methyl tert-butyl ether	1634-04-4	C	2.00E-02	8.4E-11	3.1E-07	1.2E-08	4.4E-05	1.3E-11	1.2E-07	5.6E-11	5.1E-06	3.3E-10	1.2E-06	2.4E-11	1.1E-07	NC	NC	2.4E-12	8.6E-09	2.8E-13	2.6E-08	3.4E-11	1.2E-07
Tank Group 04	VOC	Toluene	108-88-3	ID	1.50E+01	NC	1.9E-04	NC	2.0E-02	NC	6.8E-05	NC	2.3E-03	NC	5.2E-04	NC	1.5E-04	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	9.20E+01	NC	5.1E-02	NC	**1.0E+01**	NC	1.6E-02	NC	***1.3E-01***	NC	***2.0E-01***	NC	NC	NC	NC	NC	NC	NC	NC	NC	3.7E-02
Tank Group 04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	3.30E+01	NC	1.5E-02	NC	**3.6E+00**	NC	4.3E-03	NC	3.3E-02	NC	5.7E-02	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.4E-02
Tank Group 04	VOC	Xylenes (total)	1330-20-7	ID	1.97E+02	NC	8.1E-02	NC	**1.3E+01**	NC	3.0E-02	NC	***3.9E-01***	NC	***3.2E-01***	NC	1.3E-02	NC	NC	NC	NC	NC	NC	NC	5.7E-02
Tank Group 04	SVOC	Anthracene	120-12-7	ID	3.70E+00	NC	8.0E-06	NC	NC	NC	2.0E-06	NC	8.1E-06	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Benzo(a)anthracene	56-55-3	B2	4.50E+00	1.0E-07	NC	NC	NC	1.0E-08	NC	1.4E-08	NC	7.1E-11	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Benzo(a)pyrene	50-32-8	HC	7.20E+00	1.7E-06	1.6E-02	NC	NC	1.6E-07	8.8E-03	2.3E-07	9.3E-02	1.1E-09	9.2E-04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	4.40E+00	1.0E-07	NC	NC	NC	1.0E-08	NC	1.4E-08	NC	6.9E-11	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	5.20E+00	NC	1.1E-04	NC	NC	NC	2.8E-05	NC	3.8E-05	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Chrysene	218-01-9	B2	4.40E+00	1.0E-09	NC	NC	NC	1.0E-10	NC	1.4E-10	NC	6.9E-13	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Fluorene	86-73-7	D	1.40E+01	NC	2.3E-04	NC	NC	NC	5.6E-05	NC	7.6E-05	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E-01	2.3E-09	NC	NC	NC	2.3E-10	NC	3.1E-10	NC	1.6E-12	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Naphthalene	91-20-3	C	9.30E+00	1.1E-06	2.3E-02	***6.3E-05***	**1.7E+00**	1.1E-07	6.0E-03	2.6E-07	***1.6E-01***	3.5E-06	9.1E-02	5.6E-07	6.0E-03	NC	NC	NC	2.6E-03	NC	8.4E-03	1.3E-06	3.5E-02
Tank Group 04	SVOC	Phenanthrene	85-01-8	D	2.90E+01	NC	6.3E-04	NC	NC	NC	1.5E-04	NC	2.1E-04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	SVOC	Pyrene	129-00-0	NC	2.90E+00	NC	6.3E-05	NC	NC	NC	1.5E-05	NC	2.1E-05	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Tank Group 04	INORG	Lead	7439-92-1	B2	3.20E+03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Notes:
Only constituents detected in each area are shown.
Single-chemical cancer risk and hazard quotient (HQ) estimates in excess of PADEP's thresholds for cumulative cancer risk and HI of 1E-4 and 1, respectively, are shaded and bold
Single-chemical cancer risk and HQ estimates in excess of 1/10 PADEP's thresholds for cumulative cancer risk or HI of 1E-4 and 1, respectively, are italic and bolc
NC - Risk and HQ estimates were not calculated for detected chemicals with inadequate toxicity or physical/chemical parameters or where chemical concentrations were non-detect.
The concentrations for the Xylene isomers (m/p and o) were summed to Xylenes (total).
GW - Groundwater
VI - Vapor Intrusion
OA - Outdoor Air
Chem Group - chemical group
Carc Class - USEPA Weight-of-Evidence Cancer Classification

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-191-01	VOC	Benzene	71-43-2	A	Y		7.30E-04	3.65E-04	6.7E-09	8.0E-05
Tank Group 04	PB-191-01	VOC	Cumene	98-82-8	D	Y		1.40E-03	7.00E-04	NC	1.1E-05
Tank Group 04	PB-191-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		7.30E-04		NC	NC
Tank Group 04	PB-191-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.40E-03		NC	NC
Tank Group 04	PB-191-01	VOC	Ethyl Benzene	100-41-4	D	Y		1.40E-03	7.00E-04	NC	4.6E-06
Tank Group 04	PB-191-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.90E-03	1.45E-03	8.8E-10	3.2E-06
Tank Group 04	PB-191-01	VOC	Toluene	108-88-3	ID	Y		1.40E-03	7.00E-04	NC	9.2E-07
Tank Group 04	PB-191-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.90E-03	1.45E-03	NC	1.6E-04
Tank Group 04	PB-191-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.90E-03	1.45E-03	NC	1.6E-04
Tank Group 04	PB-191-01	VOC	Xylenes (total)	1330-20-7	ID	Y		2.90E-03	1.45E-03	NC	9.5E-05
Tank Group 04	PB-191-01	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-191-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.70E-01		1.70E-01	NC	NC
Tank Group 04	PB-191-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.50E-01		1.50E-01	NC	NC
Tank Group 04	PB-191-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.90E-01		1.90E-01	NC	NC
Tank Group 04	PB-191-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	8.80E-02		8.80E-02	NC	NC
Tank Group 04	PB-191-01	SVOC	Chrysene	218-01-9	B2	Y	1.60E-01		1.60E-01	NC	NC
Tank Group 04	PB-191-01	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-191-01	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	1.00E-01		1.00E-01	NC	NC
Tank Group 04	PB-191-01	SVOC	Naphthalene	91-20-3	C	Y	3.90E-02		3.90E-02	2.6E-07	7.3E-03
Tank Group 04	PB-191-01	SVOC	Phenanthrene	85-01-8	D	Y	1.10E-01		1.10E-01	NC	NC
Tank Group 04	PB-191-01	SVOC	Pyrene	129-00-0	NC	Y	2.20E-01		2.20E-01	NC	NC
Tank Group 04	PB-191-01	INORG	Lead	7439-92-1	B2	Y	1.10E+02		1.10E+02	NC	NC
Tank Group 04	PB-191-02	VOC	Benzene	71-43-2	A	Y	9.40E-03		9.40E-03	1.7E-07	2.1E-03
Tank Group 04	PB-191-02	VOC	Cumene	98-82-8	D	Y	2.20E-03		2.20E-03	NC	3.6E-05
Tank Group 04	PB-191-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		1.20E-03		NC	NC
Tank Group 04	PB-191-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		2.40E-03		NC	NC
Tank Group 04	PB-191-02	VOC	Ethyl Benzene	100-41-4	D	Y	1.20E-03		1.20E-03	NC	7.9E-06
Tank Group 04	PB-191-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		4.90E-03	2.45E-03	1.5E-09	5.3E-06
Tank Group 04	PB-191-02	VOC	Toluene	108-88-3	ID	Y	1.50E-03		1.50E-03	NC	2.0E-06
Tank Group 04	PB-191-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.30E-03		1.30E-03	NC	1.4E-04
Tank Group 04	PB-191-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	5.40E-04		5.40E-04	NC	5.9E-05
Tank Group 04	PB-191-02	VOC	Xylenes (total)	1330-20-7	ID	Y	4.70E-03		4.70E-03	NC	3.1E-04
Tank Group 04	PB-191-02	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-191-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	7.70E-02		7.70E-02	NC	NC
Tank Group 04	PB-191-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	7.10E-02		7.10E-02	NC	NC
Tank Group 04	PB-191-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	8.90E-02		8.90E-02	NC	NC
Tank Group 04	PB-191-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	6.20E-02		6.20E-02	NC	NC
Tank Group 04	PB-191-02	SVOC	Chrysene	218-01-9	B2	Y	8.00E-02		8.00E-02	NC	NC
Tank Group 04	PB-191-02	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-191-02	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	5.50E-02		5.50E-02	NC	NC
Tank Group 04	PB-191-02	SVOC	Naphthalene	91-20-3	C	Y	6.30E-02		6.30E-02	4.3E-07	1.2E-02
Tank Group 04	PB-191-02	SVOC	Phenanthrene	85-01-8	D	Y	9.20E-02		9.20E-02	NC	NC
Tank Group 04	PB-191-02	SVOC	Pyrene	129-00-0	NC	Y	1.00E-01		1.00E-01	NC	NC
Tank Group 04	PB-191-02	INORG	Lead	7439-92-1	B2	Y	4.68E+01		4.68E+01	NC	NC
Tank Group 04	PB-191-03	VOC	Benzene	71-43-2	A	Y		6.60E-04	3.30E-04	6.0E-09	7.2E-05
Tank Group 04	PB-191-03	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-191-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.60E-04		NC	NC
Tank Group 04	PB-191-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-191-03	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-191-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.60E-03	1.30E-03	7.9E-10	2.8E-06
Tank Group 04	PB-191-03	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-191-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-191-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-191-03	VOC	Xylenes (total)	1330-20-7	ID	Y		2.60E-03	1.30E-03	NC	8.5E-05
Tank Group 04	PB-191-03	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-191-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.10E-01		1.10E-01	NC	NC
Tank Group 04	PB-191-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.20E-01		1.20E-01	NC	NC
Tank Group 04	PB-191-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.30E-01		1.30E-01	NC	NC
Tank Group 04	PB-191-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	6.00E-02		6.00E-02	NC	NC
Tank Group 04	PB-191-03	SVOC	Chrysene	218-01-9	B2	Y	1.00E-01		1.00E-01	NC	NC
Tank Group 04	PB-191-03	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-191-03	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	7.00E-02		7.00E-02	NC	NC
Tank Group 04	PB-191-03	SVOC	Naphthalene	91-20-3	C	Y		2.10E-01	1.05E-01	7.1E-07	2.0E-02
Tank Group 04	PB-191-03	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-191-03	SVOC	Pyrene	129-00-0	NC	Y	1.60E-01		1.60E-01	NC	NC
Tank Group 04	PB-191-03	INORG	Lead	7439-92-1	B2	Y	1.98E+01		1.98E+01	NC	NC
Tank Group 04	PB-191-04	VOC	Benzene	71-43-2	A	Y	1.20E-03		1.20E-03	2.2E-08	2.6E-04
Tank Group 04	PB-191-04	VOC	Cumene	98-82-8	D	Y	1.50E-03		1.50E-03	NC	2.5E-05
Tank Group 04	PB-191-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.50E-04		NC	NC
Tank Group 04	PB-191-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-191-04	VOC	Ethyl Benzene	100-41-4	D	Y	1.00E-03		1.00E-03	NC	6.5E-06
Tank Group 04	PB-191-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.60E-03	1.30E-03	7.9E-10	2.8E-06
Tank Group 04	PB-191-04	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-191-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	2.30E-03		2.30E-03	NC	2.5E-04
Tank Group 04	PB-191-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.30E-03		1.30E-03	NC	1.4E-04
Tank Group 04	PB-191-04	VOC	Xylenes (total)	1330-20-7	ID	Y	3.20E-03		3.20E-03	NC	2.1E-04
Tank Group 04	PB-191-04	SVOC	Anthracene	120-12-7	ID	Y	4.90E-02		4.90E-02	NC	NC
Tank Group 04	PB-191-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	9.50E-02		9.50E-02	NC	NC
Tank Group 04	PB-191-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	7.60E-02		7.60E-02	NC	NC
Tank Group 04	PB-191-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	9.90E-02		9.90E-02	NC	NC
Tank Group 04	PB-191-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	5.60E-02		5.60E-02	NC	NC
Tank Group 04	PB-191-04	SVOC	Chrysene	218-01-9	B2	Y	9.50E-02		9.50E-02	NC	NC
Tank Group 04	PB-191-04	SVOC	Fluorene	86-73-7	D	Y	5.40E-02		5.40E-02	NC	NC
Tank Group 04	PB-191-04	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	5.60E-02		5.60E-02	NC	NC
Tank Group 04	PB-191-04	SVOC	Naphthalene	91-20-3	C	Y	1.00E-01		1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-191-04	SVOC	Phenanthrene	85-01-8	D	Y	1.90E-01		1.90E-01	NC	NC
Tank Group 04	PB-191-04	SVOC	Pyrene	129-00-0	NC	Y	1.40E-01		1.40E-01	NC	NC
Tank Group 04	PB-191-04	INORG	Lead	7439-92-1	B2	Y	2.95E+02		2.95E+02	NC	NC
Tank Group 04	PB-191-05	VOC	Benzene	71-43-2	A	Y		5.80E-04	2.90E-04	5.3E-09	6.3E-05
Tank Group 04	PB-191-05	VOC	Cumene	98-82-8	D	Y	2.70E-04		2.70E-04	NC	4.4E-06
Tank Group 04	PB-191-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-191-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-191-05	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-191-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-191-05	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-191-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-191-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-191-05	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-191-05	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-191-05	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-191-05	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-191-05	INORG	Lead	7439-92-1	B2	Y	1.28E+01		1.28E+01	NC	NC
Tank Group 04	PB-191-06	VOC	Benzene	71-43-2	A	Y		5.70E-04	2.85E-04	5.2E-09	6.2E-05
Tank Group 04	PB-191-06	VOC	Cumene	98-82-8	D	Y	3.60E-03		3.60E-03	NC	5.9E-05
Tank Group 04	PB-191-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.70E-04		NC	NC
Tank Group 04	PB-191-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-191-06	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-191-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-191-06	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-191-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	4.60E-04		4.60E-04	NC	5.0E-05
Tank Group 04	PB-191-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-191-06	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-191-06	SVOC	Anthracene	120-12-7	ID	Y		6.00E-01	3.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		6.00E-01	3.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		8.00E-01	4.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		6.00E-01	3.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		8.00E-01	4.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Chrysene	218-01-9	B2	Y		6.00E-01	3.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Fluorene	86-73-7	D	Y		1.00E+00	5.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y		8.00E-01	4.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Naphthalene	91-20-3	C	Y		1.00E+00	5.00E-01	3.4E-06	9.3E-02
Tank Group 04	PB-191-06	SVOC	Phenanthrene	85-01-8	D	Y		6.00E-01	3.00E-01	NC	NC
Tank Group 04	PB-191-06	SVOC	Pyrene	129-00-0	NC	Y		6.00E-01	3.00E-01	NC	NC
Tank Group 04	PB-191-06	INORG	Lead	7439-92-1	B2	Y	2.65E+01		2.65E+01	NC	NC
Tank Group 04	PB-191-07	VOC	Benzene	71-43-2	A	Y		9.05E-04	4.53E-04	8.3E-09	9.9E-05
Tank Group 04	PB-191-07	VOC	Cumene	98-82-8	D	Y	8.20E-03		8.20E-03	NC	1.3E-04
Tank Group 04	PB-191-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		9.05E-04		NC	NC
Tank Group 04	PB-191-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.80E-03		NC	NC
Tank Group 04	PB-191-07	VOC	Ethyl Benzene	100-41-4	D	Y		1.80E-03	9.00E-04	NC	5.9E-06
Tank Group 04	PB-191-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.55E-03	1.78E-03	1.1E-09	3.9E-06
Tank Group 04	PB-191-07	VOC	Toluene	108-88-3	ID	Y		1.80E-03	9.00E-04	NC	1.2E-06
Tank Group 04	PB-191-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.55E-03	1.78E-03	NC	1.9E-04
Tank Group 04	PB-191-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.55E-03	1.78E-03	NC	1.9E-04
Tank Group 04	PB-191-07	VOC	Xylenes (total)	1330-20-7	ID	Y		3.55E-03	1.78E-03	NC	1.2E-04
Tank Group 04	PB-191-07	SVOC	Anthracene	120-12-7	ID	Y	1.10E-01	1.20E-01	1.10E-01	NC	NC
Tank Group 04	PB-191-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.35E-01	1.20E-01	1.35E-01	NC	NC
Tank Group 04	PB-191-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.30E-01	1.60E-01	1.30E-01	NC	NC
Tank Group 04	PB-191-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.15E-01	1.20E-01	1.15E-01	NC	NC
Tank Group 04	PB-191-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	1.35E-01	1.60E-01	1.35E-01	NC	NC
Tank Group 04	PB-191-07	SVOC	Chrysene	218-01-9	B2	Y	1.60E-01	1.20E-01	1.60E-01	NC	NC
Tank Group 04	PB-191-07	SVOC	Fluorene	86-73-7	D	Y	5.25E-02		5.25E-02	NC	NC
Tank Group 04	PB-191-07	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	9.50E-02	1.60E-01	9.50E-02	NC	NC
Tank Group 04	PB-191-07	SVOC	Naphthalene	91-20-3	C	Y	1.65E-01	2.00E-01	1.65E-01	1.1E-06	3.1E-02
Tank Group 04	PB-191-07	SVOC	Phenanthrene	85-01-8	D	Y	4.15E-01	1.20E-01	4.15E-01	NC	NC
Tank Group 04	PB-191-07	SVOC	Pyrene	129-00-0	NC	Y	2.31E-01		2.31E-01	NC	NC
Tank Group 04	PB-191-07	INORG	Lead	7439-92-1	B2	Y	2.18E+02		2.18E+02	NC	NC
Tank Group 04	PB-191-08	VOC	Benzene	71-43-2	A	Y	3.00E-04		3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-191-08	VOC	Cumene	98-82-8	D	Y	3.00E-03		3.00E-03	NC	4.9E-05
Tank Group 04	PB-191-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.70E-04		NC	NC
Tank Group 04	PB-191-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-191-08	VOC	Ethyl Benzene	100-41-4	D	Y	2.10E-04		2.10E-04	NC	1.4E-06
Tank Group 04	PB-191-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-191-08	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-191-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	3.10E-03		3.10E-03	NC	3.4E-04
Tank Group 04	PB-191-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	6.60E-04		6.60E-04	NC	7.2E-05
Tank Group 04	PB-191-08	VOC	Xylenes (total)	1330-20-7	ID	Y	2.85E-03		2.85E-03	NC	1.9E-04
Tank Group 04	PB-191-08	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	4.70E-02		4.70E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	5.40E-02		5.40E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	4.30E-02		4.30E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Chrysene	218-01-9	B2	Y	5.20E-02		5.20E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	3.10E-02		3.10E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Naphthalene	91-20-3	C	Y	5.90E-02		5.90E-02	4.0E-07	1.1E-02
Tank Group 04	PB-191-08	SVOC	Phenanthrene	85-01-8	D	Y	8.40E-02		8.40E-02	NC	NC
Tank Group 04	PB-191-08	SVOC	Pyrene	129-00-0	NC	Y	7.00E-02		7.00E-02	NC	NC
Tank Group 04	PB-191-08	INORG	Lead	7439-92-1	B2	Y	8.45E+01		8.45E+01	NC	NC
Tank Group 04	PB-826-01	VOC	Benzene	71-43-2	A	Y		6.90E-04	3.45E-04	6.3E-09	7.5E-05
Tank Group 04	PB-826-01	VOC	Cumene	98-82-8	D	Y		1.40E-03	7.00E-04	NC	1.1E-05
Tank Group 04	PB-826-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.90E-04		NC	NC
Tank Group 04	PB-826-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.40E-03		NC	NC
Tank Group 04	PB-826-01	VOC	Ethyl Benzene	100-41-4	D	Y		1.40E-03	7.00E-04	NC	4.6E-06
Tank Group 04	PB-826-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	3.20E-04		3.20E-04	1.9E-10	7.0E-07
Tank Group 04	PB-826-01	VOC	Toluene	108-88-3	ID	Y		1.40E-03	7.00E-04	NC	9.2E-07
Tank Group 04	PB-826-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.80E-03	1.40E-03	NC	1.5E-04
Tank Group 04	PB-826-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.80E-03	1.40E-03	NC	1.5E-04
Tank Group 04	PB-826-01	VOC	Xylenes (total)	1330-20-7	ID	Y		2.80E-03	1.40E-03	NC	9.2E-05
Tank Group 04	PB-826-01	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-826-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-826-01	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-01	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-826-01	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-826-01	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-01	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-01	INORG	Lead	7439-92-1	B2	Y	3.14E+00		3.14E+00	NC	NC
Tank Group 04	PB-826-02	VOC	Benzene	71-43-2	A	Y		5.20E-04	2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-826-02	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-826-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-826-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-826-02	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-826-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.00E-03		1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-826-02	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-826-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-826-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-826-02	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-826-02	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-02	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-02	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-826-02	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-826-02	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-02	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-02	INORG	Lead	7439-92-1	B2	Y	3.36E+00		3.36E+00	NC	NC
Tank Group 04	PB-826-03	VOC	Benzene	71-43-2	A	Y		6.30E-04	3.15E-04	5.7E-09	6.9E-05
Tank Group 04	PB-826-03	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-826-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.30E-04		NC	NC
Tank Group 04	PB-826-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-826-03	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-826-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	2.00E-02		2.00E-02	1.2E-08	4.4E-05
Tank Group 04	PB-826-03	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-826-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-826-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-826-03	VOC	Xylenes (total)	1330-20-7	ID	Y		2.50E-03	1.25E-03	NC	8.2E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-826-03	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-03	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-03	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-826-03	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-826-03	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-03	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-03	INORG	Lead	7439-92-1	B2	Y	3.14E+00		3.14E+00	NC	NC
Tank Group 04	PB-826-04	VOC	Benzene	71-43-2	A	Y		9.70E-04	4.85E-04	8.8E-09	1.1E-04
Tank Group 04	PB-826-04	VOC	Cumene	98-82-8	D	Y		1.90E-03	9.50E-04	NC	1.6E-05
Tank Group 04	PB-826-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		9.70E-04		NC	NC
Tank Group 04	PB-826-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.90E-03		NC	NC
Tank Group 04	PB-826-04	VOC	Ethyl Benzene	100-41-4	D	Y		1.90E-03	9.50E-04	NC	6.2E-06
Tank Group 04	PB-826-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.20E-03		1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-826-04	VOC	Toluene	108-88-3	ID	Y		1.90E-03	9.50E-04	NC	1.2E-06
Tank Group 04	PB-826-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.90E-03	1.95E-03	NC	2.1E-04
Tank Group 04	PB-826-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.90E-03	1.95E-03	NC	2.1E-04
Tank Group 04	PB-826-04	VOC	Xylenes (total)	1330-20-7	ID	Y		3.90E-03	1.95E-03	NC	1.3E-04
Tank Group 04	PB-826-04	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-04	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-04	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-826-04	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-826-04	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-04	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-04	INORG	Lead	7439-92-1	B2	Y	3.88E+00		3.88E+00	NC	NC
Tank Group 04	PB-826-05	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-826-05	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-826-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-826-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-826-05	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-826-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-826-05	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-826-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-826-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-826-05	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-826-05	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-05	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-05	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-826-05	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-826-05	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-05	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-05	INORG	Lead	7439-92-1	B2	Y	3.46E+00		3.46E+00	NC	NC
Tank Group 04	PB-826-06	VOC	Benzene	71-43-2	A	Y		7.50E-04	3.75E-04	6.8E-09	8.2E-05
Tank Group 04	PB-826-06	VOC	Cumene	98-82-8	D	Y		1.50E-03	7.50E-04	NC	1.2E-05
Tank Group 04	PB-826-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		7.50E-04		NC	NC
Tank Group 04	PB-826-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.50E-03		NC	NC
Tank Group 04	PB-826-06	VOC	Ethyl Benzene	100-41-4	D	Y		1.50E-03	7.50E-04	NC	4.9E-06
Tank Group 04	PB-826-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.30E-02		1.30E-02	7.9E-09	2.8E-05
Tank Group 04	PB-826-06	VOC	Toluene	108-88-3	ID	Y		1.50E-03	7.50E-04	NC	9.8E-07
Tank Group 04	PB-826-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.00E-03	1.50E-03	NC	1.6E-04
Tank Group 04	PB-826-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.00E-03	1.50E-03	NC	1.6E-04
Tank Group 04	PB-826-06	VOC	Xylenes (total)	1330-20-7	ID	Y		3.00E-03	1.50E-03	NC	9.8E-05
Tank Group 04	PB-826-06	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-06	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-06	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-826-06	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-826-06	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-06	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-06	INORG	Lead	7439-92-1	B2	Y	8.10E+00		8.10E+00	NC	NC
Tank Group 04	PB-826-07	VOC	Benzene	71-43-2	A	Y		6.10E-04	3.05E-04	5.6E-09	6.7E-05
Tank Group 04	PB-826-07	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-826-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.10E-04		NC	NC
Tank Group 04	PB-826-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-826-07	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-826-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.60E-02		1.60E-02	9.7E-09	3.5E-05
Tank Group 04	PB-826-07	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-826-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-826-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-826-07	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-826-07	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-07	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-07	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-826-07	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-826-07	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-07	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-07	INORG	Lead	7439-92-1	B2	Y	3.19E+00		3.19E+00	NC	NC
Tank Group 04	PB-826-08	VOC	Benzene	71-43-2	A	Y	3.30E-04		3.30E-04	6.0E-09	7.2E-05
Tank Group 04	PB-826-08	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-826-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-826-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-826-08	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-826-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-826-08	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-826-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-826-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-826-08	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-826-08	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-826-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-826-08	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-08	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-826-08	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-826-08	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-826-08	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-08	INORG	Lead	7439-92-1	B2	Y	4.67E+00		4.67E+00	NC	NC
Tank Group 04	PB-826-09	VOC	Benzene	71-43-2	A	Y		6.80E-04	3.40E-04	6.2E-09	7.4E-05
Tank Group 04	PB-826-09	VOC	Cumene	98-82-8	D	Y		1.40E-03	7.00E-04	NC	1.1E-05
Tank Group 04	PB-826-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.80E-04		NC	NC
Tank Group 04	PB-826-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.40E-03		NC	NC
Tank Group 04	PB-826-09	VOC	Ethyl Benzene	100-41-4	D	Y		1.40E-03	7.00E-04	NC	4.6E-06
Tank Group 04	PB-826-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.70E-03	1.35E-03	8.2E-10	2.9E-06
Tank Group 04	PB-826-09	VOC	Toluene	108-88-3	ID	Y		1.40E-03	7.00E-04	NC	9.2E-07
Tank Group 04	PB-826-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.70E-03	1.35E-03	NC	1.5E-04
Tank Group 04	PB-826-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.70E-03	1.35E-03	NC	1.5E-04
Tank Group 04	PB-826-09	VOC	Xylenes (total)	1330-20-7	ID	Y		2.70E-03	1.35E-03	NC	8.8E-05
Tank Group 04	PB-826-09	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-826-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-826-09	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-09	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-826-09	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-826-09	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-09	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-09	INORG	Lead	7439-92-1	B2	Y	5.55E+00		5.55E+00	NC	NC
Tank Group 04	PB-826-10	VOC	Benzene	71-43-2	A	Y		7.30E-04	3.65E-04	6.7E-09	8.0E-05
Tank Group 04	PB-826-10	VOC	Cumene	98-82-8	D	Y		1.50E-03	7.50E-04	NC	1.2E-05
Tank Group 04	PB-826-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		7.30E-04		NC	NC
Tank Group 04	PB-826-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.50E-03		NC	NC
Tank Group 04	PB-826-10	VOC	Ethyl Benzene	100-41-4	D	Y		1.50E-03	7.50E-04	NC	4.9E-06
Tank Group 04	PB-826-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.90E-03	1.45E-03	8.8E-10	3.2E-06
Tank Group 04	PB-826-10	VOC	Toluene	108-88-3	ID	Y		1.50E-03	7.50E-04	NC	9.8E-07
Tank Group 04	PB-826-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.90E-03	1.45E-03	NC	1.6E-04
Tank Group 04	PB-826-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.90E-03	1.45E-03	NC	1.6E-04
Tank Group 04	PB-826-10	VOC	Xylenes (total)	1330-20-7	ID	Y		2.90E-03	1.45E-03	NC	9.5E-05
Tank Group 04	PB-826-10	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-10	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-10	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-826-10	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-826-10	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-10	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-10	INORG	Lead	7439-92-1	B2	Y	3.72E+00		3.72E+00	NC	NC
Tank Group 04	PB-826-11	VOC	Benzene	71-43-2	A	Y		5.90E-04	2.95E-04	5.4E-09	6.4E-05
Tank Group 04	PB-826-11	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-826-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.90E-04		NC	NC
Tank Group 04	PB-826-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-826-11	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-826-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-826-11	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-826-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-826-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-826-11	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-826-11	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-11	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-11	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-826-11	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-826-11	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-11	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-11	INORG	Lead	7439-92-1	B2	Y	3.61E+00		3.61E+00	NC	NC
Tank Group 04	PB-826-12	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-826-12	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-826-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-826-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-826-12	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-826-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-826-12	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-826-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-826-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-826-12	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-826-12	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-12	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-12	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-826-12	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-826-12	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-12	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-826-12	INORG	Lead	7439-92-1	B2	Y	3.00E+00		3.00E+00	NC	NC
Tank Group 04	PB-826-13	VOC	Benzene	71-43-2	A	Y		7.00E-04	3.50E-04	6.4E-09	7.6E-05
Tank Group 04	PB-826-13	VOC	Cumene	98-82-8	D	Y		1.40E-03	7.00E-04	NC	1.1E-05
Tank Group 04	PB-826-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		7.00E-04		NC	NC
Tank Group 04	PB-826-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.40E-03		NC	NC
Tank Group 04	PB-826-13	VOC	Ethyl Benzene	100-41-4	D	Y		1.40E-03	7.00E-04	NC	4.6E-06
Tank Group 04	PB-826-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.80E-03	1.40E-03	8.5E-10	3.1E-06
Tank Group 04	PB-826-13	VOC	Toluene	108-88-3	ID	Y		1.40E-03	7.00E-04	NC	9.2E-07
Tank Group 04	PB-826-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.80E-03	1.40E-03	NC	1.5E-04
Tank Group 04	PB-826-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.80E-03	1.40E-03	NC	1.5E-04
Tank Group 04	PB-826-13	VOC	Xylenes (total)	1330-20-7	ID	Y		2.80E-03	1.40E-03	NC	9.2E-05
Tank Group 04	PB-826-13	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-826-13	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-13	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-826-13	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-826-13	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-13	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-13	INORG	Lead	7439-92-1	B2	Y	4.29E+00		4.29E+00	NC	NC
Tank Group 04	PB-826-14	VOC	Benzene	71-43-2	A	Y		3.10E-02	1.55E-02	2.8E-07	3.4E-03
Tank Group 04	PB-826-14	VOC	Cumene	98-82-8	D	Y	2.80E-01		2.80E-01	NC	4.6E-03
Tank Group 04	PB-826-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.10E-02		NC	NC
Tank Group 04	PB-826-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.20E-02		NC	NC
Tank Group 04	PB-826-14	VOC	Ethyl Benzene	100-41-4	D	Y	7.30E-01		7.30E-01	NC	4.8E-03
Tank Group 04	PB-826-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.20E-01	6.00E-02	3.6E-08	1.3E-04
Tank Group 04	PB-826-14	VOC	Toluene	108-88-3	ID	Y		6.20E-02	3.10E-02	NC	4.1E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-826-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.20E+01		1.20E+01	NC	**1.3E+00**
Tank Group 04	PB-826-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.40E+00		4.40E+00	NC	***4.8E-01***
Tank Group 04	PB-826-14	VOC	Xylenes (total)	1330-20-7	ID	Y	2.14E-01		2.14E-01	NC	1.4E-02
Tank Group 04	PB-826-14	SVOC	Anthracene	120-12-7	ID	Y	6.10E-02		6.10E-02	NC	NC
Tank Group 04	PB-826-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.00E-02		3.00E-02	NC	NC
Tank Group 04	PB-826-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-826-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-826-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-826-14	SVOC	Chrysene	218-01-9	B2	Y	4.20E-02		4.20E-02	NC	NC
Tank Group 04	PB-826-14	SVOC	Fluorene	86-73-7	D	Y	1.80E-01		1.80E-01	NC	NC
Tank Group 04	PB-826-14	SVOC	Naphthalene	91-20-3	C	Y	3.20E-01		3.20E-01	2.2E-06	6.0E-02
Tank Group 04	PB-826-14	SVOC	Phenanthrene	85-01-8	D	Y	6.40E-01		6.40E-01	NC	NC
Tank Group 04	PB-826-14	SVOC	Pyrene	129-00-0	NC	Y	1.60E-01		1.60E-01	NC	NC
Tank Group 04	PB-826-14	INORG	Lead	7439-92-1	B2	Y	8.32E+00		8.32E+00	NC	NC
Tank Group 04	PB-826-15	VOC	Benzene	71-43-2	A	Y	6.80E-02		6.80E-02	1.2E-06	1.5E-02
Tank Group 04	PB-826-15	VOC	Cumene	98-82-8	D	Y	1.00E+00		1.00E+00	NC	1.6E-02
Tank Group 04	PB-826-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.60E-02		NC	NC
Tank Group 04	PB-826-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		7.10E-02		NC	NC
Tank Group 04	PB-826-15	VOC	Ethyl Benzene	100-41-4	D	Y	5.60E-01		5.60E-01	NC	3.7E-03
Tank Group 04	PB-826-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.40E-01	7.00E-02	4.3E-08	1.5E-04
Tank Group 04	PB-826-15	VOC	Toluene	108-88-3	ID	Y	5.10E-02		5.10E-02	NC	6.7E-05
Tank Group 04	PB-826-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.50E+01		1.50E+01	NC	**1.6E+00**
Tank Group 04	PB-826-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.80E+00		4.80E+00	NC	***5.2E-01***
Tank Group 04	PB-826-15	VOC	Xylenes (total)	1330-20-7	ID	Y	2.94E+01		2.94E+01	NC	**1.9E+00**
Tank Group 04	PB-826-15	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	4.80E-02		4.80E-02	NC	NC
Tank Group 04	PB-826-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	6.15E-02	1.40E-01	6.15E-02	NC	NC
Tank Group 04	PB-826-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	4.20E-02		4.20E-02	NC	NC
Tank Group 04	PB-826-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	3.40E-02		3.40E-02	NC	NC
Tank Group 04	PB-826-15	SVOC	Chrysene	218-01-9	B2	Y	1.50E-01		1.50E-01	NC	NC
Tank Group 04	PB-826-15	SVOC	Fluorene	86-73-7	D	Y	3.90E-01		3.90E-01	NC	NC
Tank Group 04	PB-826-15	SVOC	Naphthalene	91-20-3	C	Y	2.70E+00		2.70E+00	***1.8E-05***	***5.0E-01***
Tank Group 04	PB-826-15	SVOC	Phenanthrene	85-01-8	D	Y	9.90E-01		9.90E-01	NC	NC
Tank Group 04	PB-826-15	SVOC	Pyrene	129-00-0	NC	Y	1.33E-01		1.33E-01	NC	NC
Tank Group 04	PB-826-15	INORG	Lead	7439-92-1	B2	Y	8.19E+01		8.19E+01	NC	NC
Tank Group 04	PB-826-16	VOC	Benzene	71-43-2	A	Y		8.90E-04	4.45E-04	8.1E-09	9.7E-05
Tank Group 04	PB-826-16	VOC	Cumene	98-82-8	D	Y		1.80E-03	9.00E-04	NC	1.5E-05
Tank Group 04	PB-826-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		8.90E-04		NC	NC
Tank Group 04	PB-826-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.80E-03		NC	NC
Tank Group 04	PB-826-16	VOC	Ethyl Benzene	100-41-4	D	Y		1.80E-03	9.00E-04	NC	5.9E-06
Tank Group 04	PB-826-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.60E-03	1.80E-03	1.1E-09	3.9E-06
Tank Group 04	PB-826-16	VOC	Toluene	108-88-3	ID	Y		1.80E-03	9.00E-04	NC	1.2E-06
Tank Group 04	PB-826-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	6.10E-04		6.10E-04	NC	6.7E-05
Tank Group 04	PB-826-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	8.90E-04		8.90E-04	NC	9.7E-05
Tank Group 04	PB-826-16	VOC	Xylenes (total)	1330-20-7	ID	Y		3.60E-03	1.80E-03	NC	1.2E-04
Tank Group 04	PB-826-16	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-826-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-826-16	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-16	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-826-16	SVOC	Naphthalene	91-20-3	C	Y	2.50E-02		2.50E-02	1.7E-07	4.7E-03
Tank Group 04	PB-826-16	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-16	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-826-16	INORG	Lead	7439-92-1	B2	Y	6.77E+00		6.77E+00	NC	NC
Tank Group 04	PB-840-01	VOC	Benzene	71-43-2	A	Y	3.14E-03	5.70E-04	3.14E-03	5.7E-08	6.9E-04
Tank Group 04	PB-840-01	VOC	Cumene	98-82-8	D	Y	4.88E-03	1.10E-03	4.88E-03	NC	8.0E-05
Tank Group 04	PB-840-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.85E-04		NC	NC
Tank Group 04	PB-840-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.35E-03		NC	NC
Tank Group 04	PB-840-01	VOC	Ethyl Benzene	100-41-4	D	Y	6.15E-04	1.10E-03	6.15E-04	NC	4.0E-06
Tank Group 04	PB-840-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.75E-03	1.38E-03	8.4E-10	3.0E-06
Tank Group 04	PB-840-01	VOC	Toluene	108-88-3	ID	Y	1.58E-03	1.10E-03	1.58E-03	NC	2.1E-06
Tank Group 04	PB-840-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.28E-03	2.30E-03	1.28E-03	NC	1.4E-04
Tank Group 04	PB-840-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.73E-03	2.30E-03	1.73E-03	NC	1.9E-04
Tank Group 04	PB-840-01	VOC	Xylenes (total)	1330-20-7	ID	Y	4.58E-03	2.30E-03	4.58E-03	NC	3.0E-04
Tank Group 04	PB-840-01	SVOC	Anthracene	120-12-7	ID	Y	9.20E-02		9.20E-02	NC	NC
Tank Group 04	PB-840-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	4.40E-01		4.40E-01	NC	NC
Tank Group 04	PB-840-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	4.00E-01		4.00E-01	NC	NC
Tank Group 04	PB-840-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	5.20E-01		5.20E-01	NC	NC
Tank Group 04	PB-840-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	1.80E-01		1.80E-01	NC	NC
Tank Group 04	PB-840-01	SVOC	Chrysene	218-01-9	B2	Y	4.30E-01		4.30E-01	NC	NC
Tank Group 04	PB-840-01	SVOC	Fluorene	86-73-7	D	Y	7.60E-02		7.60E-02	NC	NC
Tank Group 04	PB-840-01	SVOC	Naphthalene	91-20-3	C	Y	4.55E-02		4.55E-02	3.1E-07	8.5E-03
Tank Group 04	PB-840-01	SVOC	Phenanthrene	85-01-8	D	Y	3.90E-01		3.90E-01	NC	NC
Tank Group 04	PB-840-01	SVOC	Pyrene	129-00-0	NC	Y	5.30E-01		5.30E-01	NC	NC
Tank Group 04	PB-840-01	INORG	Lead	7439-92-1	B2	Y	3.67E+01		3.67E+01	NC	NC
Tank Group 04	PB-840-02	VOC	Benzene	71-43-2	A	Y	2.10E-04		2.10E-04	3.8E-09	4.6E-05
Tank Group 04	PB-840-02	VOC	Cumene	98-82-8	D	Y	3.40E-04		3.40E-04	NC	5.6E-06
Tank Group 04	PB-840-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-840-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-840-02	VOC	Ethyl Benzene	100-41-4	D	Y	1.90E-04		1.90E-04	NC	1.2E-06
Tank Group 04	PB-840-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-840-02	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-840-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	3.50E-03		3.50E-03	NC	3.8E-04
Tank Group 04	PB-840-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	5.90E-03		5.90E-03	NC	6.4E-04
Tank Group 04	PB-840-02	VOC	Xylenes (total)	1330-20-7	ID	Y	2.50E-03		2.50E-03	NC	1.6E-04
Tank Group 04	PB-840-02	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-02	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-02	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-840-02	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-840-02	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-02	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-02	INORG	Lead	7439-92-1	B2	Y	4.66E+00		4.66E+00	NC	NC
Tank Group 04	PB-840-03	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-840-03	VOC	Cumene	98-82-8	D	Y	1.50E-04		1.50E-04	NC	2.5E-06
Tank Group 04	PB-840-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-840-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.50E-04		NC	NC
Tank Group 04	PB-840-03	VOC	Ethyl Benzene	100-41-4	D	Y	2.80E-04		2.80E-04	NC	1.8E-06
Tank Group 04	PB-840-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-840-03	VOC	Toluene	108-88-3	ID	Y		9.50E-04	4.75E-04	NC	6.2E-07
Tank Group 04	PB-840-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-840-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	6.20E-04		6.20E-04	NC	6.8E-05
Tank Group 04	PB-840-03	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-840-03	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-03	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-840-03	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-840-03	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-840-03	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-03	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-03	INORG	Lead	7439-92-1	B2	Y	5.92E+00		5.92E+00	NC	NC
Tank Group 04	PB-840-04	VOC	Benzene	71-43-2	A	Y		5.20E-04	2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-840-04	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-840-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-840-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-840-04	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-840-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-840-04	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-840-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-840-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-840-04	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-840-04	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-840-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-840-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-840-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-840-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-840-04	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-840-04	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-840-04	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-840-04	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-840-04	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-840-04	INORG	Lead	7439-92-1	B2	Y	1.09E+01		1.09E+01	NC	NC
Tank Group 04	PB-840-05	VOC	Benzene	71-43-2	A	Y		7.20E-04	3.60E-04	6.6E-09	7.9E-05
Tank Group 04	PB-840-05	VOC	Cumene	98-82-8	D	Y		1.40E-03	7.00E-04	NC	1.1E-05
Tank Group 04	PB-840-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		7.20E-04		NC	NC
Tank Group 04	PB-840-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.40E-03		NC	NC
Tank Group 04	PB-840-05	VOC	Ethyl Benzene	100-41-4	D	Y		1.40E-03	7.00E-04	NC	4.6E-06
Tank Group 04	PB-840-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.90E-03	1.45E-03	8.8E-10	3.2E-06
Tank Group 04	PB-840-05	VOC	Toluene	108-88-3	ID	Y		1.40E-03	7.00E-04	NC	9.2E-07
Tank Group 04	PB-840-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.90E-03	1.45E-03	NC	1.6E-04
Tank Group 04	PB-840-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.70E-04		4.70E-04	NC	5.1E-05
Tank Group 04	PB-840-05	VOC	Xylenes (total)	1330-20-7	ID	Y		2.90E-03	1.45E-03	NC	9.5E-05
Tank Group 04	PB-840-05	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.00E-02		3.00E-02	NC	NC
Tank Group 04	PB-840-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-840-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	5.30E-02		5.30E-02	NC	NC
Tank Group 04	PB-840-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	2.50E-02		2.50E-02	NC	NC
Tank Group 04	PB-840-05	SVOC	Chrysene	218-01-9	B2	Y	5.60E-02		5.60E-02	NC	NC
Tank Group 04	PB-840-05	SVOC	Fluorene	86-73-7	D	Y	2.30E-02		2.30E-02	NC	NC
Tank Group 04	PB-840-05	SVOC	Naphthalene	91-20-3	C	Y	7.50E-02		7.50E-02	5.1E-07	1.4E-02
Tank Group 04	PB-840-05	SVOC	Phenanthrene	85-01-8	D	Y	7.30E-02		7.30E-02	NC	NC
Tank Group 04	PB-840-05	SVOC	Pyrene	129-00-0	NC	Y	5.60E-02		5.60E-02	NC	NC
Tank Group 04	PB-840-05	INORG	Lead	7439-92-1	B2	Y	1.03E+02		1.03E+02	NC	NC
Tank Group 04	PB-840-06	VOC	Benzene	71-43-2	A	Y		4.60E-04	2.30E-04	4.2E-09	5.0E-05
Tank Group 04	PB-840-06	VOC	Cumene	98-82-8	D	Y	1.60E-03		1.60E-03	NC	2.6E-05
Tank Group 04	PB-840-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-840-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.30E-04		NC	NC
Tank Group 04	PB-840-06	VOC	Ethyl Benzene	100-41-4	D	Y	5.80E-04		5.80E-04	NC	3.8E-06
Tank Group 04	PB-840-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-840-06	VOC	Toluene	108-88-3	ID	Y		9.30E-04	4.65E-04	NC	6.1E-07
Tank Group 04	PB-840-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-840-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-840-06	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-840-06	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-06	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-06	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-840-06	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-840-06	SVOC	Phenanthrene	85-01-8	D	Y	4.90E-02		4.90E-02	NC	NC
Tank Group 04	PB-840-06	SVOC	Pyrene	129-00-0	NC	Y	1.80E-02		1.80E-02	NC	NC
Tank Group 04	PB-840-06	INORG	Lead	7439-92-1	B2	Y	6.05E+00		6.05E+00	NC	NC
Tank Group 04	PB-840-07	VOC	Benzene	71-43-2	A	Y	2.30E-02		2.30E-02	4.2E-07	5.0E-03
Tank Group 04	PB-840-07	VOC	Cumene	98-82-8	D	Y	2.00E-03		2.00E-03	NC	3.3E-05
Tank Group 04	PB-840-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-840-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-840-07	VOC	Ethyl Benzene	100-41-4	D	Y	1.60E-02		1.60E-02	NC	1.0E-04
Tank Group 04	PB-840-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-840-07	VOC	Toluene	108-88-3	ID	Y	7.90E-04		7.90E-04	NC	1.0E-06
Tank Group 04	PB-840-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.90E-02		1.90E-02	NC	2.1E-03
Tank Group 04	PB-840-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	5.60E-03		5.60E-03	NC	6.1E-04
Tank Group 04	PB-840-07	VOC	Xylenes (total)	1330-20-7	ID	Y	4.41E-02		4.41E-02	NC	2.9E-03
Tank Group 04	PB-840-07	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-840-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-840-07	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-07	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-840-07	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-840-07	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-07	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-07	INORG	Lead	7439-92-1	B2	Y	4.94E+00		4.94E+00	NC	NC
Tank Group 04	PB-840-08	VOC	Benzene	71-43-2	A	Y	6.90E-04		6.90E-04	1.3E-08	1.5E-04
Tank Group 04	PB-840-08	VOC	Cumene	98-82-8	D	Y	1.50E-04		1.50E-04	NC	2.5E-06
Tank Group 04	PB-840-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-840-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-840-08	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-840-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-840-08	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-840-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-840-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-840-08	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-840-08	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-840-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-840-08	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-08	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-840-08	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-840-08	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-08	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-08	INORG	Lead	7439-92-1	B2	Y	5.75E+00		5.75E+00	NC	NC
Tank Group 04	PB-840-09	VOC	Benzene	71-43-2	A	Y	4.40E+00	5.20E-04	4.40E+00	***8.0E-05***	***9.6E-01***
Tank Group 04	PB-840-09	VOC	Cumene	98-82-8	D	Y	1.50E+01	1.00E-03	1.50E+01	NC	***2.5E-01***
Tank Group 04	PB-840-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		1.50E-01		NC	NC
Tank Group 04	PB-840-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		3.00E-01		NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-840-09	VOC	Ethyl Benzene	100-41-4	D	Y	6.60E+01	1.00E-03	6.60E+01	NC	***4.3E-01***
Tank Group 04	PB-840-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		6.10E-01	3.05E-01	1.9E-07	6.7E-04
Tank Group 04	PB-840-09	VOC	Toluene	108-88-3	ID	Y	3.00E-01		3.00E-01	NC	3.9E-04
Tank Group 04	PB-840-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	9.20E+01	2.10E-03	9.20E+01	NC	**1.0E+01**
Tank Group 04	PB-840-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	3.30E+01	2.10E-03	3.30E+01	NC	**3.6E+00**
Tank Group 04	PB-840-09	VOC	Xylenes (total)	1330-20-7	ID	Y	1.97E+02	2.10E-03	1.97E+02	NC	**1.3E+01**
Tank Group 04	PB-840-09	SVOC	Anthracene	120-12-7	ID	Y	1.60E-01		1.60E-01	NC	NC
Tank Group 04	PB-840-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	9.70E-01		9.70E-01	NC	NC
Tank Group 04	PB-840-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	9.60E-02		9.60E-02	NC	NC
Tank Group 04	PB-840-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.20E-01		1.20E-01	NC	NC
Tank Group 04	PB-840-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	7.20E-02		7.20E-02	NC	NC
Tank Group 04	PB-840-09	SVOC	Chrysene	218-01-9	B2	Y	2.20E-01		2.20E-01	NC	NC
Tank Group 04	PB-840-09	SVOC	Fluorene	86-73-7	D	Y	1.90E+00		1.90E+00	NC	NC
Tank Group 04	PB-840-09	SVOC	Naphthalene	91-20-3	C	Y	9.30E+00	1.90E-01	9.30E+00	***6.3E-05***	**1.7E+00**
Tank Group 04	PB-840-09	SVOC	Phenanthrene	85-01-8	D	Y	4.80E+00		4.80E+00	NC	NC
Tank Group 04	PB-840-09	SVOC	Pyrene	129-00-0	NC	Y	4.80E-01		4.80E-01	NC	NC
Tank Group 04	PB-840-09	INORG	Lead	7439-92-1	B2	Y	9.99E+00		9.99E+00	NC	NC
Tank Group 04	PB-840-10	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-840-10	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-840-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-840-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-840-10	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-840-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-840-10	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-840-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.20E-02		1.20E-02	NC	1.3E-03
Tank Group 04	PB-840-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	3.80E-03		3.80E-03	NC	4.1E-04
Tank Group 04	PB-840-10	VOC	Xylenes (total)	1330-20-7	ID	Y	2.26E-02		2.26E-02	NC	1.5E-03
Tank Group 04	PB-840-10	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-10	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-10	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-840-10	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-840-10	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-10	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-10	INORG	Lead	7439-92-1	B2	Y	5.38E+00		5.38E+00	NC	NC
Tank Group 04	PB-840-11	VOC	Benzene	71-43-2	A	Y	8.40E-03		8.40E-03	1.5E-07	1.8E-03
Tank Group 04	PB-840-11	VOC	Cumene	98-82-8	D	Y	5.80E-03		5.80E-03	NC	9.5E-05
Tank Group 04	PB-840-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.90E-04		NC	NC
Tank Group 04	PB-840-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		7.80E-04		NC	NC
Tank Group 04	PB-840-11	VOC	Ethyl Benzene	100-41-4	D	Y	9.70E-03		9.70E-03	NC	6.4E-05
Tank Group 04	PB-840-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.60E-03	8.00E-04	4.9E-10	1.7E-06
Tank Group 04	PB-840-11	VOC	Toluene	108-88-3	ID	Y		7.80E-04	3.90E-04	NC	5.1E-07
Tank Group 04	PB-840-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	7.20E-02		7.20E-02	NC	7.9E-03
Tank Group 04	PB-840-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.00E-02		4.00E-02	NC	4.4E-03
Tank Group 04	PB-840-11	VOC	Xylenes (total)	1330-20-7	ID	Y	5.89E-02		5.89E-02	NC	3.9E-03
Tank Group 04	PB-840-11	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-840-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-840-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-840-11	SVOC	Chrysene	218-01-9	B2	Y	4.10E-02		4.10E-02	NC	NC
Tank Group 04	PB-840-11	SVOC	Fluorene	86-73-7	D	Y	7.20E-02		7.20E-02	NC	NC
Tank Group 04	PB-840-11	SVOC	Naphthalene	91-20-3	C	Y	9.00E-02		9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-840-11	SVOC	Phenanthrene	85-01-8	D	Y	1.80E-01		1.80E-01	NC	NC
Tank Group 04	PB-840-11	SVOC	Pyrene	129-00-0	NC	Y	3.10E-02		3.10E-02	NC	NC
Tank Group 04	PB-840-11	INORG	Lead	7439-92-1	B2	Y	7.06E+00		7.06E+00	NC	NC
Tank Group 04	PB-840-12	VOC	Benzene	71-43-2	A	Y		5.30E-04	2.65E-04	4.8E-09	5.8E-05
Tank Group 04	PB-840-12	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-840-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-840-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-840-12	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-840-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-840-12	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-840-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-840-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-840-12	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-840-12	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-12	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-12	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-840-12	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-840-12	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-12	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-12	INORG	Lead	7439-92-1	B2	Y	5.21E+00		5.21E+00	NC	NC
Tank Group 04	PB-840-13	VOC	Benzene	71-43-2	A	Y		5.90E-04	2.95E-04	5.4E-09	6.4E-05
Tank Group 04	PB-840-13	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-840-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.90E-04		NC	NC
Tank Group 04	PB-840-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-840-13	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-840-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-840-13	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-840-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-840-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-840-13	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-840-13	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-840-13	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-13	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-840-13	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-840-13	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-13	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-13	INORG	Lead	7439-92-1	B2	Y	6.78E+00		6.78E+00	NC	NC
Tank Group 04	PB-840-14	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-840-14	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-840-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-840-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-840-14	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-840-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-840-14	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-840-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-840-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-840-14	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-840-14	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.80E-01		1.80E-01	NC	NC
Tank Group 04	PB-840-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.80E-01		1.80E-01	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-840-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	2.20E-01		2.20E-01	NC	NC
Tank Group 04	PB-840-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	9.90E-02		9.90E-02	NC	NC
Tank Group 04	PB-840-14	SVOC	Chrysene	218-01-9	B2	Y	1.70E-01		1.70E-01	NC	NC
Tank Group 04	PB-840-14	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-840-14	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-840-14	SVOC	Phenanthrene	85-01-8	D	Y	1.70E-01		1.70E-01	NC	NC
Tank Group 04	PB-840-14	SVOC	Pyrene	129-00-0	NC	Y	2.80E-01		2.80E-01	NC	NC
Tank Group 04	PB-840-14	INORG	Lead	7439-92-1	B2	Y	4.44E+01		4.44E+01	NC	NC
Tank Group 04	PB-840-15	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-840-15	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-840-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-840-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-840-15	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-840-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-840-15	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-840-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-840-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-840-15	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-840-15	SVOC	Anthracene	120-12-7	ID	Y	1.10E-01		1.10E-01	NC	NC
Tank Group 04	PB-840-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	4.80E-01		4.80E-01	NC	NC
Tank Group 04	PB-840-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	4.60E-01		4.60E-01	NC	NC
Tank Group 04	PB-840-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	5.70E-01		5.70E-01	NC	NC
Tank Group 04	PB-840-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	2.20E-01		2.20E-01	NC	NC
Tank Group 04	PB-840-15	SVOC	Chrysene	218-01-9	B2	Y	4.40E-01		4.40E-01	NC	NC
Tank Group 04	PB-840-15	SVOC	Fluorene	86-73-7	D	Y	5.00E-02		5.00E-02	NC	NC
Tank Group 04	PB-840-15	SVOC	Naphthalene	91-20-3	C	Y	9.10E-02		9.10E-02	6.2E-07	1.7E-02
Tank Group 04	PB-840-15	SVOC	Phenanthrene	85-01-8	D	Y	4.10E-01		4.10E-01	NC	NC
Tank Group 04	PB-840-15	SVOC	Pyrene	129-00-0	NC	Y	6.80E-01		6.80E-01	NC	NC
Tank Group 04	PB-840-15	INORG	Lead	7439-92-1	B2	Y	4.92E+01		4.92E+01	NC	NC
Tank Group 04	PB-840-16	VOC	Benzene	71-43-2	A	Y		4.40E-04	2.20E-04	4.0E-09	4.8E-05
Tank Group 04	PB-840-16	VOC	Cumene	98-82-8	D	Y		8.90E-04	4.45E-04	NC	7.3E-06
Tank Group 04	PB-840-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.40E-04		NC	NC
Tank Group 04	PB-840-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.90E-04		NC	NC
Tank Group 04	PB-840-16	VOC	Ethyl Benzene	100-41-4	D	Y		8.90E-04	4.45E-04	NC	2.9E-06
Tank Group 04	PB-840-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-840-16	VOC	Toluene	108-88-3	ID	Y		8.90E-04	4.45E-04	NC	5.8E-07
Tank Group 04	PB-840-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-840-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-840-16	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-840-16	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-840-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.20E-01		1.20E-01	NC	NC
Tank Group 04	PB-840-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.40E-01		1.40E-01	NC	NC
Tank Group 04	PB-840-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.80E-01		1.80E-01	NC	NC
Tank Group 04	PB-840-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	9.80E-02		9.80E-02	NC	NC
Tank Group 04	PB-840-16	SVOC	Chrysene	218-01-9	B2	Y	1.30E-01		1.30E-01	NC	NC
Tank Group 04	PB-840-16	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-840-16	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-840-16	SVOC	Phenanthrene	85-01-8	D	Y	1.40E-01		1.40E-01	NC	NC
Tank Group 04	PB-840-16	SVOC	Pyrene	129-00-0	NC	Y	1.80E-01		1.80E-01	NC	NC
Tank Group 04	PB-840-16	INORG	Lead	7439-92-1	B2	Y	5.31E+01		5.31E+01	NC	NC
Tank Group 04	PB-841-01	VOC	Benzene	71-43-2	A	Y		6.40E-04	3.20E-04	5.8E-09	7.0E-05
Tank Group 04	PB-841-01	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-841-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.40E-04		NC	NC
Tank Group 04	PB-841-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-841-01	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-841-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.50E-03	1.25E-03	7.6E-10	2.7E-06
Tank Group 04	PB-841-01	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-841-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-841-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-841-01	VOC	Xylenes (total)	1330-20-7	ID	Y		2.50E-03	1.25E-03	NC	8.2E-05
Tank Group 04	PB-841-01	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-01	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-01	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-841-01	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-841-01	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-01	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-01	INORG	Lead	7439-92-1	B2	Y	3.27E+00		3.27E+00	NC	NC
Tank Group 04	PB-841-02	VOC	Benzene	71-43-2	A	Y		6.00E-04	3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-841-02	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-841-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.00E-04		NC	NC
Tank Group 04	PB-841-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-841-02	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-841-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-841-02	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-841-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-841-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-841-02	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-841-02	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-02	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-02	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-841-02	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-841-02	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-02	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-02	INORG	Lead	7439-92-1	B2	Y	3.32E+00		3.32E+00	NC	NC
Tank Group 04	PB-841-03	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-841-03	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-841-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-841-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-841-03	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-841-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-841-03	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-841-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-841-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-841-03	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-841-03	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-841-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-841-03	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-03	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-841-03	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-841-03	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-03	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-03	INORG	Lead	7439-92-1	B2	Y	3.07E+00		3.07E+00	NC	NC
Tank Group 04	PB-841-04	VOC	Benzene	71-43-2	A	Y		3.90E-04	1.95E-04	3.6E-09	4.3E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-841-04	VOC	Cumene	98-82-8	D	Y		7.80E-04	3.90E-04	NC	6.4E-06
Tank Group 04	PB-841-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.90E-04		NC	NC
Tank Group 04	PB-841-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		7.80E-04		NC	NC
Tank Group 04	PB-841-04	VOC	Ethyl Benzene	100-41-4	D	Y		7.80E-04	3.90E-04	NC	2.6E-06
Tank Group 04	PB-841-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.60E-03	8.00E-04	4.9E-10	1.7E-06
Tank Group 04	PB-841-04	VOC	Toluene	108-88-3	ID	Y		7.80E-04	3.90E-04	NC	5.1E-07
Tank Group 04	PB-841-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.60E-03	8.00E-04	NC	8.7E-05
Tank Group 04	PB-841-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.60E-03	8.00E-04	NC	8.7E-05
Tank Group 04	PB-841-04	VOC	Xylenes (total)	1330-20-7	ID	Y		1.60E-03	8.00E-04	NC	5.2E-05
Tank Group 04	PB-841-04	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-04	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-04	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-841-04	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-841-04	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-04	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-04	INORG	Lead	7439-92-1	B2	Y	5.88E+00		5.88E+00	NC	NC
Tank Group 04	PB-841-05	VOC	Benzene	71-43-2	A	Y		6.00E-04	3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-841-05	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-841-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.00E-04		NC	NC
Tank Group 04	PB-841-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-841-05	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-841-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-841-05	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-841-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-841-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-841-05	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-841-05	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-841-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-841-05	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-05	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-841-05	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-841-05	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-05	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-05	INORG	Lead	7439-92-1	B2	Y	3.54E+00		3.54E+00	NC	NC
Tank Group 04	PB-841-06	VOC	Benzene	71-43-2	A	Y		5.90E-04	2.95E-04	5.4E-09	6.4E-05
Tank Group 04	PB-841-06	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-841-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.90E-04		NC	NC
Tank Group 04	PB-841-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-841-06	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-841-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-841-06	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-841-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-841-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-841-06	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-841-06	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-841-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-841-06	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-06	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-841-06	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-841-06	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-06	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-06	INORG	Lead	7439-92-1	B2	Y	4.07E+00		4.07E+00	NC	NC
Tank Group 04	PB-841-07	VOC	Benzene	71-43-2	A	Y		8.70E-04	4.35E-04	7.9E-09	9.5E-05
Tank Group 04	PB-841-07	VOC	Cumene	98-82-8	D	Y		1.70E-03	8.50E-04	NC	1.4E-05
Tank Group 04	PB-841-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		8.70E-04		NC	NC
Tank Group 04	PB-841-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.70E-03		NC	NC
Tank Group 04	PB-841-07	VOC	Ethyl Benzene	100-41-4	D	Y		1.70E-03	8.50E-04	NC	5.6E-06
Tank Group 04	PB-841-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.50E-03	1.75E-03	1.1E-09	3.8E-06
Tank Group 04	PB-841-07	VOC	Toluene	108-88-3	ID	Y		1.70E-03	8.50E-04	NC	1.1E-06
Tank Group 04	PB-841-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.50E-03	1.75E-03	NC	1.9E-04
Tank Group 04	PB-841-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.50E-03	1.75E-03	NC	1.9E-04
Tank Group 04	PB-841-07	VOC	Xylenes (total)	1330-20-7	ID	Y		3.50E-03	1.75E-03	NC	1.1E-04
Tank Group 04	PB-841-07	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-841-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-841-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-841-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	3.70E-02		3.70E-02	NC	NC
Tank Group 04	PB-841-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-841-07	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-841-07	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-841-07	SVOC	Naphthalene	91-20-3	C	Y		2.10E-01	1.05E-01	7.1E-07	2.0E-02
Tank Group 04	PB-841-07	SVOC	Phenanthrene	85-01-8	D	Y	3.20E-02		3.20E-02	NC	NC
Tank Group 04	PB-841-07	SVOC	Pyrene	129-00-0	NC	Y	3.80E-02		3.80E-02	NC	NC
Tank Group 04	PB-841-07	INORG	Lead	7439-92-1	B2	Y	8.11E+00		8.11E+00	NC	NC
Tank Group 04	PB-841-08	VOC	Benzene	71-43-2	A	Y		6.50E-04	3.25E-04	5.9E-09	7.1E-05
Tank Group 04	PB-841-08	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-841-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.50E-04		NC	NC
Tank Group 04	PB-841-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-841-08	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-841-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.60E-03	1.30E-03	7.9E-10	2.8E-06
Tank Group 04	PB-841-08	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-841-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-841-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-841-08	VOC	Xylenes (total)	1330-20-7	ID	Y		2.60E-03	1.30E-03	NC	8.5E-05
Tank Group 04	PB-841-08	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-08	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-08	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-841-08	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-841-08	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-08	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-08	INORG	Lead	7439-92-1	B2	Y	5.00E+00		5.00E+00	NC	NC
Tank Group 04	PB-841-09	VOC	Benzene	71-43-2	A	Y		9.95E-04	4.98E-04	9.1E-09	1.1E-04
Tank Group 04	PB-841-09	VOC	Cumene	98-82-8	D	Y		1.95E-03	9.75E-04	NC	1.6E-05
Tank Group 04	PB-841-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		9.95E-04		NC	NC
Tank Group 04	PB-841-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.95E-03		NC	NC
Tank Group 04	PB-841-09	VOC	Ethyl Benzene	100-41-4	D	Y		1.95E-03	9.75E-04	NC	6.4E-06
Tank Group 04	PB-841-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.95E-03	1.98E-03	1.2E-09	4.3E-06
Tank Group 04	PB-841-09	VOC	Toluene	108-88-3	ID	Y		1.95E-03	9.75E-04	NC	1.3E-06
Tank Group 04	PB-841-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.95E-03	1.98E-03	NC	2.2E-04
Tank Group 04	PB-841-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.95E-03	1.98E-03	NC	2.2E-04
Tank Group 04	PB-841-09	VOC	Xylenes (total)	1330-20-7	ID	Y		3.95E-03	1.98E-03	NC	1.3E-04

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-841-09	SVOC	Anthracene	120-12-7	ID	Y	5.60E-02	1.00E-01	5.60E-02	NC	NC
Tank Group 04	PB-841-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.35E-01	1.00E-01	1.35E-01	NC	NC
Tank Group 04	PB-841-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.48E-01	1.30E-01	1.48E-01	NC	NC
Tank Group 04	PB-841-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.65E-01	1.00E-01	1.65E-01	NC	NC
Tank Group 04	PB-841-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	8.75E-02	1.30E-01	8.75E-02	NC	NC
Tank Group 04	PB-841-09	SVOC	Chrysene	218-01-9	B2	Y	1.35E-01	1.00E-01	1.35E-01	NC	NC
Tank Group 04	PB-841-09	SVOC	Fluorene	86-73-7	D	Y	5.55E-02	1.70E-01	5.55E-02	NC	NC
Tank Group 04	PB-841-09	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-841-09	SVOC	Phenanthrene	85-01-8	D	Y	1.25E-01	1.00E-01	1.25E-01	NC	NC
Tank Group 04	PB-841-09	SVOC	Pyrene	129-00-0	NC	Y	2.00E-01	1.00E-01	2.00E-01	NC	NC
Tank Group 04	PB-841-09	INORG	Lead	7439-92-1	B2	Y	4.30E+00		4.30E+00	NC	NC
Tank Group 04	PB-841-10	VOC	Benzene	71-43-2	A	Y		6.10E-04	3.05E-04	5.6E-09	6.7E-05
Tank Group 04	PB-841-10	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-841-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.10E-04		NC	NC
Tank Group 04	PB-841-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-841-10	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-841-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-841-10	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-841-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-841-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-841-10	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-841-10	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-10	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-10	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-841-10	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-841-10	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-10	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-10	INORG	Lead	7439-92-1	B2	Y	2.76E+00		2.76E+00	NC	NC
Tank Group 04	PB-841-11	VOC	Benzene	71-43-2	A	Y		6.90E-04	3.45E-04	6.3E-09	7.5E-05
Tank Group 04	PB-841-11	VOC	Cumene	98-82-8	D	Y		1.40E-03	7.00E-04	NC	1.1E-05
Tank Group 04	PB-841-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.90E-04		NC	NC
Tank Group 04	PB-841-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.40E-03		NC	NC
Tank Group 04	PB-841-11	VOC	Ethyl Benzene	100-41-4	D	Y		1.40E-03	7.00E-04	NC	4.6E-06
Tank Group 04	PB-841-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.80E-03	1.40E-03	8.5E-10	3.1E-06
Tank Group 04	PB-841-11	VOC	Toluene	108-88-3	ID	Y		1.40E-03	7.00E-04	NC	9.2E-07
Tank Group 04	PB-841-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.80E-03	1.40E-03	NC	1.5E-04
Tank Group 04	PB-841-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.80E-03	1.40E-03	NC	1.5E-04
Tank Group 04	PB-841-11	VOC	Xylenes (total)	1330-20-7	ID	Y		2.80E-03	1.40E-03	NC	9.2E-05
Tank Group 04	PB-841-11	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-841-11	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-11	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-841-11	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-841-11	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-11	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-841-11	INORG	Lead	7439-92-1	B2	Y	2.51E+00		2.51E+00	NC	NC
Tank Group 04	PB-841-12	VOC	Benzene	71-43-2	A	Y	2.00E-04		2.00E-04	3.6E-09	4.4E-05
Tank Group 04	PB-841-12	VOC	Cumene	98-82-8	D	Y		9.20E-04	4.60E-04	NC	7.5E-06
Tank Group 04	PB-841-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-841-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.20E-04		NC	NC
Tank Group 04	PB-841-12	VOC	Ethyl Benzene	100-41-4	D	Y		9.20E-04	4.60E-04	NC	3.0E-06
Tank Group 04	PB-841-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-841-12	VOC	Toluene	108-88-3	ID	Y		9.20E-04	4.60E-04	NC	6.0E-07
Tank Group 04	PB-841-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-841-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-841-12	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-841-12	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-841-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-841-12	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-12	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-841-12	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-841-12	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-12	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-12	INORG	Lead	7439-92-1	B2	Y	3.72E+00		3.72E+00	NC	NC
Tank Group 04	PB-841-13	VOC	Benzene	71-43-2	A	Y		8.60E-04	4.30E-04	7.8E-09	9.4E-05
Tank Group 04	PB-841-13	VOC	Cumene	98-82-8	D	Y		1.70E-03	8.50E-04	NC	1.4E-05
Tank Group 04	PB-841-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		8.60E-04		NC	NC
Tank Group 04	PB-841-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.70E-03		NC	NC
Tank Group 04	PB-841-13	VOC	Ethyl Benzene	100-41-4	D	Y		1.70E-03	8.50E-04	NC	5.6E-06
Tank Group 04	PB-841-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.50E-03	1.75E-03	1.1E-09	3.8E-06
Tank Group 04	PB-841-13	VOC	Toluene	108-88-3	ID	Y		1.70E-03	8.50E-04	NC	1.1E-06
Tank Group 04	PB-841-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.50E-03	1.75E-03	NC	1.9E-04
Tank Group 04	PB-841-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.50E-03	1.75E-03	NC	1.9E-04
Tank Group 04	PB-841-13	VOC	Xylenes (total)	1330-20-7	ID	Y		3.50E-03	1.75E-03	NC	1.1E-04
Tank Group 04	PB-841-13	SVOC	Anthracene	120-12-7	ID	Y	8.80E-02		8.80E-02	NC	NC
Tank Group 04	PB-841-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.40E-01		2.40E-01	NC	NC
Tank Group 04	PB-841-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	2.20E-01		2.20E-01	NC	NC
Tank Group 04	PB-841-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	2.60E-01		2.60E-01	NC	NC
Tank Group 04	PB-841-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	1.40E-01		1.40E-01	NC	NC
Tank Group 04	PB-841-13	SVOC	Chrysene	218-01-9	B2	Y	2.10E-01		2.10E-01	NC	NC
Tank Group 04	PB-841-13	SVOC	Fluorene	86-73-7	D	Y	3.60E-02		3.60E-02	NC	NC
Tank Group 04	PB-841-13	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-841-13	SVOC	Phenanthrene	85-01-8	D	Y	3.90E-01		3.90E-01	NC	NC
Tank Group 04	PB-841-13	SVOC	Pyrene	129-00-0	NC	Y	4.10E-01		4.10E-01	NC	NC
Tank Group 04	PB-841-13	INORG	Lead	7439-92-1	B2	Y	9.39E+01		9.39E+01	NC	NC
Tank Group 04	PB-841-14	VOC	Benzene	71-43-2	A	Y	3.20E-04		3.20E-04	5.8E-09	7.0E-05
Tank Group 04	PB-841-14	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-841-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-841-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-841-14	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-841-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-841-14	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-841-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-841-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-841-14	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-841-14	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-841-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.50E-02		3.50E-02	NC	NC
Tank Group 04	PB-841-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	4.40E-02		4.40E-02	NC	NC
Tank Group 04	PB-841-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	6.10E-02		6.10E-02	NC	NC
Tank Group 04	PB-841-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	3.90E-02		3.90E-02	NC	NC
Tank Group 04	PB-841-14	SVOC	Chrysene	218-01-9	B2	Y	4.40E-02		4.40E-02	NC	NC
Tank Group 04	PB-841-14	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-841-14	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-841-14	SVOC	Phenanthrene	85-01-8	D	Y	3.20E-02		3.20E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-841-14	SVOC	Pyrene	129-00-0	NC	Y	5.40E-02		5.40E-02	NC	NC
Tank Group 04	PB-841-14	INORG	Lead	7439-92-1	B2	Y	3.89E+01		3.89E+01	NC	NC
Tank Group 04	PB-843-01	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-843-01	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-843-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-843-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-843-01	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-843-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-843-01	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-843-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-843-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-843-01	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-843-01	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-843-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-843-01	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-01	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-843-01	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-843-01	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-01	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-01	INORG	Lead	7439-92-1	B2	Y	3.02E+00		3.02E+00	NC	NC
Tank Group 04	PB-843-02	VOC	Benzene	71-43-2	A	Y	8.50E-04		8.50E-04	1.6E-08	1.9E-04
Tank Group 04	PB-843-02	VOC	Cumene	98-82-8	D	Y		9.10E-04	4.55E-04	NC	7.4E-06
Tank Group 04	PB-843-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-843-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.10E-04		NC	NC
Tank Group 04	PB-843-02	VOC	Ethyl Benzene	100-41-4	D	Y		9.10E-04	4.55E-04	NC	3.0E-06
Tank Group 04	PB-843-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-843-02	VOC	Toluene	108-88-3	ID	Y		9.10E-04	4.55E-04	NC	6.0E-07
Tank Group 04	PB-843-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-843-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-843-02	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-843-02	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-02	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-02	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-02	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-843-02	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-02	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-02	INORG	Lead	7439-92-1	B2	Y	3.41E+00		3.41E+00	NC	NC
Tank Group 04	PB-843-03	VOC	Benzene	71-43-2	A	Y		6.70E-04	3.35E-04	6.1E-09	7.3E-05
Tank Group 04	PB-843-03	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-843-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.70E-04		NC	NC
Tank Group 04	PB-843-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-843-03	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-843-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.70E-03	1.35E-03	8.2E-10	2.9E-06
Tank Group 04	PB-843-03	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-843-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.70E-03	1.35E-03	NC	1.5E-04
Tank Group 04	PB-843-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.70E-03	1.35E-03	NC	1.5E-04
Tank Group 04	PB-843-03	VOC	Xylenes (total)	1330-20-7	ID	Y		2.70E-03	1.35E-03	NC	8.8E-05
Tank Group 04	PB-843-03	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-843-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-843-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-843-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-843-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-843-03	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-843-03	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-843-03	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-843-03	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-843-03	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-843-03	INORG	Lead	7439-92-1	B2	Y	3.06E+00		3.06E+00	NC	NC
Tank Group 04	PB-843-04	VOC	Benzene	71-43-2	A	Y	7.80E-04		7.80E-04	1.4E-08	1.7E-04
Tank Group 04	PB-843-04	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-843-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.10E-04		NC	NC
Tank Group 04	PB-843-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-843-04	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-843-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-843-04	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-843-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-843-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-843-04	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-843-04	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-04	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-04	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-04	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-843-04	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-04	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-04	INORG	Lead	7439-92-1	B2	Y	5.63E+00		5.63E+00	NC	NC
Tank Group 04	PB-843-05	VOC	Benzene	71-43-2	A	Y	6.70E-03		6.70E-03	1.2E-07	1.5E-03
Tank Group 04	PB-843-05	VOC	Cumene	98-82-8	D	Y	1.20E-04		1.20E-04	NC	2.0E-06
Tank Group 04	PB-843-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-843-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-843-05	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-843-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-843-05	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-843-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-843-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-843-05	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-843-05	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-05	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-05	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-05	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-843-05	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-05	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-05	INORG	Lead	7439-92-1	B2	Y	6.17E+00		6.17E+00	NC	NC
Tank Group 04	PB-843-06	VOC	Benzene	71-43-2	A	Y	5.70E-03		5.70E-03	1.0E-07	1.2E-03
Tank Group 04	PB-843-06	VOC	Cumene	98-82-8	D	Y	7.10E-04		7.10E-04	NC	1.2E-05
Tank Group 04	PB-843-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.10E-04		NC	NC
Tank Group 04	PB-843-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-843-06	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-843-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	3.70E-04		3.70E-04	2.3E-10	8.1E-07
Tank Group 04	PB-843-06	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-843-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-843-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-843-06	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-843-06	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-06	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-06	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-06	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-843-06	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-06	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-06	INORG	Lead	7439-92-1	B2	Y	6.13E+00		6.13E+00	NC	NC
Tank Group 04	PB-843-07	VOC	Benzene	71-43-2	A	Y	3.20E-04		3.20E-04	5.8E-09	7.0E-05
Tank Group 04	PB-843-07	VOC	Cumene	98-82-8	D	Y	1.60E-04		1.60E-04	NC	2.6E-06
Tank Group 04	PB-843-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-843-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.60E-04		NC	NC
Tank Group 04	PB-843-07	VOC	Ethyl Benzene	100-41-4	D	Y	7.10E-04		7.10E-04	NC	4.6E-06
Tank Group 04	PB-843-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	4.70E-04		4.70E-04	2.9E-10	1.0E-06
Tank Group 04	PB-843-07	VOC	Toluene	108-88-3	ID	Y	2.00E-03		2.00E-03	NC	2.6E-06
Tank Group 04	PB-843-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.80E-03		1.80E-03	NC	2.0E-04
Tank Group 04	PB-843-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.10E-03		1.10E-03	NC	1.2E-04
Tank Group 04	PB-843-07	VOC	Xylenes (total)	1330-20-7	ID	Y	4.90E-03		4.90E-03	NC	3.2E-04
Tank Group 04	PB-843-07	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.70E-02		3.70E-02	NC	NC
Tank Group 04	PB-843-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	3.30E-02		3.30E-02	NC	NC
Tank Group 04	PB-843-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-07	SVOC	Chrysene	218-01-9	B2	Y	1.00E-01		1.00E-01	NC	NC
Tank Group 04	PB-843-07	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-07	SVOC	Naphthalene	91-20-3	C	Y	3.80E-02		3.80E-02	2.6E-07	7.1E-03
Tank Group 04	PB-843-07	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-07	SVOC	Pyrene	129-00-0	NC	Y	1.40E-01		1.40E-01	NC	NC
Tank Group 04	PB-843-07	INORG	Lead	7439-92-1	B2	Y	1.42E+01		1.42E+01	NC	NC
Tank Group 04	PB-843-08	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-843-08	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-843-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-843-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-843-08	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-843-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-843-08	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-843-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-843-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-843-08	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-843-08	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-843-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-843-08	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-08	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-843-08	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-843-08	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-08	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-08	INORG	Lead	7439-92-1	B2	Y	3.99E+00		3.99E+00	NC	NC
Tank Group 04	PB-843-09	VOC	Benzene	71-43-2	A	Y	1.80E-03		1.80E-03	3.3E-08	3.9E-04
Tank Group 04	PB-843-09	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-843-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.30E-04		NC	NC
Tank Group 04	PB-843-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-843-09	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-843-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.50E-03	1.25E-03	7.6E-10	2.7E-06
Tank Group 04	PB-843-09	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-843-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-843-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-843-09	VOC	Xylenes (total)	1330-20-7	ID	Y		2.50E-03	1.25E-03	NC	8.2E-05
Tank Group 04	PB-843-09	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-09	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-09	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-843-09	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-843-09	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-09	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-09	INORG	Lead	7439-92-1	B2	Y	1.83E+01		1.83E+01	NC	NC
Tank Group 04	PB-843-10	VOC	Benzene	71-43-2	A	Y	8.20E-02		8.20E-02	1.5E-06	1.8E-02
Tank Group 04	PB-843-10	VOC	Cumene	98-82-8	D	Y	3.70E-04		3.70E-04	NC	6.1E-06
Tank Group 04	PB-843-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-843-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-843-10	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-843-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.20E-03		1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-843-10	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-843-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-843-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-843-10	VOC	Xylenes (total)	1330-20-7	ID	Y	7.00E-03		7.00E-03	NC	4.6E-04
Tank Group 04	PB-843-10	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-10	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-10	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-10	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-843-10	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-10	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-10	INORG	Lead	7439-92-1	B2	Y	5.30E+00		5.30E+00	NC	NC
Tank Group 04	PB-843-11	VOC	Benzene	71-43-2	A	Y	2.85E-04	6.60E-04	2.85E-04	5.2E-09	6.2E-05
Tank Group 04	PB-843-11	VOC	Cumene	98-82-8	D	Y	4.55E-04	1.30E-03	4.55E-04	NC	7.4E-06
Tank Group 04	PB-843-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.60E-04		NC	NC
Tank Group 04	PB-843-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-843-11	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-843-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	8.75E-04	2.60E-03	8.75E-04	5.3E-10	1.9E-06
Tank Group 04	PB-843-11	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-843-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-843-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-843-11	VOC	Xylenes (total)	1330-20-7	ID	Y		2.60E-03	1.30E-03	NC	8.5E-05
Tank Group 04	PB-843-11	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.85E-02		3.85E-02	NC	NC
Tank Group 04	PB-843-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-11	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-843-11	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-843-11	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-843-11	SVOC	Phenanthrene	85-01-8	D	Y	4.05E-02		4.05E-02	NC	NC
Tank Group 04	PB-843-11	SVOC	Pyrene	129-00-0	NC	Y	4.05E-02		4.05E-02	NC	NC
Tank Group 04	PB-843-11	INORG	Lead	7439-92-1	B2	Y	1.80E+01		1.80E+01	NC	NC
Tank Group 04	PB-843-12	VOC	Benzene	71-43-2	A	Y	1.70E-03		1.70E-03	3.1E-08	3.7E-04
Tank Group 04	PB-843-12	VOC	Cumene	98-82-8	D	Y	4.50E-04		4.50E-04	NC	7.4E-06
Tank Group 04	PB-843-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-843-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-843-12	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-843-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	9.00E-04		9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-843-12	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-843-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-843-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-843-12	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-843-12	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-12	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-12	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-843-12	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-843-12	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-12	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-12	INORG	Lead	7439-92-1	B2	Y	8.48E+00		8.48E+00	NC	NC
Tank Group 04	PB-843-13	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-843-13	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-843-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-843-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-843-13	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-843-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-843-13	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-843-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-843-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-843-13	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-843-13	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-843-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-843-13	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-13	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-843-13	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-843-13	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-13	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-843-13	INORG	Lead	7439-92-1	B2	Y	3.21E+00		3.21E+00	NC	NC
Tank Group 04	PB-843-14	VOC	Benzene	71-43-2	A	Y	3.50E-04		3.50E-04	6.4E-09	7.6E-05
Tank Group 04	PB-843-14	VOC	Cumene	98-82-8	D	Y	1.70E-04		1.70E-04	NC	2.8E-06
Tank Group 04	PB-843-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-843-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.90E-04		NC	NC
Tank Group 04	PB-843-14	VOC	Ethyl Benzene	100-41-4	D	Y		9.90E-04	4.95E-04	NC	3.2E-06
Tank Group 04	PB-843-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	6.00E-04		6.00E-04	3.6E-10	1.3E-06
Tank Group 04	PB-843-14	VOC	Toluene	108-88-3	ID	Y		9.90E-04	4.95E-04	NC	6.5E-07
Tank Group 04	PB-843-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-843-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-843-14	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-843-14	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-843-14	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-14	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-14	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-843-14	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-14	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-14	INORG	Lead	7439-92-1	B2	Y	1.12E+01		1.12E+01	NC	NC
Tank Group 04	PB-843-15	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-843-15	VOC	Cumene	98-82-8	D	Y		9.70E-04	4.85E-04	NC	7.9E-06
Tank Group 04	PB-843-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-843-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.70E-04		NC	NC
Tank Group 04	PB-843-15	VOC	Ethyl Benzene	100-41-4	D	Y		9.70E-04	4.85E-04	NC	3.2E-06
Tank Group 04	PB-843-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-843-15	VOC	Toluene	108-88-3	ID	Y		9.70E-04	4.85E-04	NC	6.4E-07
Tank Group 04	PB-843-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-843-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-843-15	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-843-15	SVOC	Anthracene	120-12-7	ID	Y	5.00E-02		5.00E-02	NC	NC
Tank Group 04	PB-843-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.40E-01		2.40E-01	NC	NC
Tank Group 04	PB-843-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	2.30E-01		2.30E-01	NC	NC
Tank Group 04	PB-843-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	2.70E-01		2.70E-01	NC	NC
Tank Group 04	PB-843-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	1.20E-01		1.20E-01	NC	NC
Tank Group 04	PB-843-15	SVOC	Chrysene	218-01-9	B2	Y	2.40E-01		2.40E-01	NC	NC
Tank Group 04	PB-843-15	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-15	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-843-15	SVOC	Phenanthrene	85-01-8	D	Y	1.90E-01		1.90E-01	NC	NC
Tank Group 04	PB-843-15	SVOC	Pyrene	129-00-0	NC	Y	3.90E-01		3.90E-01	NC	NC
Tank Group 04	PB-843-15	INORG	Lead	7439-92-1	B2	Y	9.20E+01		9.20E+01	NC	NC
Tank Group 04	PB-843-16	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-843-16	VOC	Cumene	98-82-8	D	Y		9.70E-04	4.85E-04	NC	7.9E-06
Tank Group 04	PB-843-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-843-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.70E-04		NC	NC
Tank Group 04	PB-843-16	VOC	Ethyl Benzene	100-41-4	D	Y		9.70E-04	4.85E-04	NC	3.2E-06
Tank Group 04	PB-843-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-843-16	VOC	Toluene	108-88-3	ID	Y		9.70E-04	4.85E-04	NC	6.4E-07
Tank Group 04	PB-843-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-843-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-843-16	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-843-16	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-16	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-16	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-843-16	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-843-16	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-16	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-16	INORG	Lead	7439-92-1	B2	Y	4.86E+01		4.86E+01	NC	NC
Tank Group 04	PB-843-17	VOC	Benzene	71-43-2	A	Y	2.40E-04		2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-843-17	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-843-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.70E-04		NC	NC
Tank Group 04	PB-843-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-843-17	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-843-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	5.50E-04		5.50E-04	3.3E-10	1.2E-06
Tank Group 04	PB-843-17	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-843-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-843-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-843-17	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-843-17	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-843-17	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-17	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-843-17	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-843-17	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-17	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-843-17	INORG	Lead	7439-92-1	B2	Y	1.10E+01		1.10E+01	NC	NC
Tank Group 04	PB-847-01	VOC	Benzene	71-43-2	A	Y		4.30E-04	2.15E-04	3.9E-09	4.7E-05
Tank Group 04	PB-847-01	VOC	Cumene	98-82-8	D	Y		8.50E-04	4.25E-04	NC	7.0E-06
Tank Group 04	PB-847-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-847-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.50E-04		NC	NC
Tank Group 04	PB-847-01	VOC	Ethyl Benzene	100-41-4	D	Y		8.50E-04	4.25E-04	NC	2.8E-06
Tank Group 04	PB-847-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-847-01	VOC	Toluene	108-88-3	ID	Y		8.50E-04	4.25E-04	NC	5.6E-07
Tank Group 04	PB-847-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-847-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-847-01	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-847-01	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-01	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-01	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-01	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-847-01	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-01	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-01	INORG	Lead	7439-92-1	B2	Y	6.08E+00		6.08E+00	NC	NC
Tank Group 04	PB-847-02	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-847-02	VOC	Cumene	98-82-8	D	Y		9.10E-04	4.55E-04	NC	7.4E-06
Tank Group 04	PB-847-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-847-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.10E-04		NC	NC
Tank Group 04	PB-847-02	VOC	Ethyl Benzene	100-41-4	D	Y		9.10E-04	4.55E-04	NC	3.0E-06
Tank Group 04	PB-847-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-847-02	VOC	Toluene	108-88-3	ID	Y		9.10E-04	4.55E-04	NC	6.0E-07
Tank Group 04	PB-847-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-847-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-847-02	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-847-02	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-02	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-02	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-02	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-847-02	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-02	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-02	INORG	Lead	7439-92-1	B2	Y	4.60E+00		4.60E+00	NC	NC
Tank Group 04	PB-847-03	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-847-03	VOC	Cumene	98-82-8	D	Y		8.90E-04	4.45E-04	NC	7.3E-06
Tank Group 04	PB-847-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-847-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.90E-04		NC	NC
Tank Group 04	PB-847-03	VOC	Ethyl Benzene	100-41-4	D	Y		8.90E-04	4.45E-04	NC	2.9E-06
Tank Group 04	PB-847-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-847-03	VOC	Toluene	108-88-3	ID	Y		8.90E-04	4.45E-04	NC	5.8E-07
Tank Group 04	PB-847-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-847-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-847-03	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-847-03	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-03	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-03	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-847-03	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-847-03	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-03	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-03	INORG	Lead	7439-92-1	B2	Y	4.07E+00		4.07E+00	NC	NC
Tank Group 04	PB-847-04	VOC	Benzene	71-43-2	A	Y		4.40E-04	2.20E-04	4.0E-09	4.8E-05
Tank Group 04	PB-847-04	VOC	Cumene	98-82-8	D	Y		8.80E-04	4.40E-04	NC	7.2E-06
Tank Group 04	PB-847-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.40E-04		NC	NC
Tank Group 04	PB-847-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.80E-04		NC	NC
Tank Group 04	PB-847-04	VOC	Ethyl Benzene	100-41-4	D	Y		8.80E-04	4.40E-04	NC	2.9E-06
Tank Group 04	PB-847-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-847-04	VOC	Toluene	108-88-3	ID	Y		8.80E-04	4.40E-04	NC	5.8E-07
Tank Group 04	PB-847-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-847-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-847-04	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-847-04	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-04	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-04	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-847-04	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-847-04	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-04	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-04	INORG	Lead	7439-92-1	B2	Y	3.69E+00		3.69E+00	NC	NC
Tank Group 04	PB-847-05	VOC	Benzene	71-43-2	A	Y		4.30E-04	2.15E-04	3.9E-09	4.7E-05
Tank Group 04	PB-847-05	VOC	Cumene	98-82-8	D	Y		8.70E-04	4.35E-04	NC	7.1E-06
Tank Group 04	PB-847-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-847-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.70E-04		NC	NC
Tank Group 04	PB-847-05	VOC	Ethyl Benzene	100-41-4	D	Y		8.70E-04	4.35E-04	NC	2.8E-06
Tank Group 04	PB-847-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-847-05	VOC	Toluene	108-88-3	ID	Y		8.70E-04	4.35E-04	NC	5.7E-07
Tank Group 04	PB-847-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-847-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-847-05	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-847-05	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-847-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-05	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-05	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-847-05	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-847-05	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-05	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-847-05	INORG	Lead	7439-92-1	B2	Y	3.51E+00		3.51E+00	NC	NC
Tank Group 04	PB-847-06	VOC	Benzene	71-43-2	A	Y		4.30E-04	2.15E-04	3.9E-09	4.7E-05
Tank Group 04	PB-847-06	VOC	Cumene	98-82-8	D	Y		8.60E-04	4.30E-04	NC	7.0E-06
Tank Group 04	PB-847-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-847-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.60E-04		NC	NC
Tank Group 04	PB-847-06	VOC	Ethyl Benzene	100-41-4	D	Y		8.60E-04	4.30E-04	NC	2.8E-06
Tank Group 04	PB-847-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-847-06	VOC	Toluene	108-88-3	ID	Y		8.60E-04	4.30E-04	NC	5.6E-07
Tank Group 04	PB-847-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-847-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-847-06	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-847-06	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-06	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-06	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-06	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-847-06	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-06	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-06	INORG	Lead	7439-92-1	B2	Y	4.69E+00		4.69E+00	NC	NC
Tank Group 04	PB-847-07	VOC	Benzene	71-43-2	A	Y	2.90E-04		2.90E-04	5.3E-09	6.3E-05
Tank Group 04	PB-847-07	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-847-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-847-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-847-07	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-847-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-847-07	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-847-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-847-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-847-07	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-847-07	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-07	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-07	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-07	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-847-07	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-07	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-07	INORG	Lead	7439-92-1	B2	Y	5.30E+00		5.30E+00	NC	NC
Tank Group 04	PB-847-08	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-847-08	VOC	Cumene	98-82-8	D	Y		9.00E-04	4.50E-04	NC	7.4E-06
Tank Group 04	PB-847-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-847-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.00E-04		NC	NC
Tank Group 04	PB-847-08	VOC	Ethyl Benzene	100-41-4	D	Y		9.00E-04	4.50E-04	NC	2.9E-06
Tank Group 04	PB-847-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-847-08	VOC	Toluene	108-88-3	ID	Y		9.00E-04	4.50E-04	NC	5.9E-07
Tank Group 04	PB-847-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-847-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-847-08	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-847-08	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-08	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-08	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-08	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-847-08	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-08	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-08	INORG	Lead	7439-92-1	B2	Y	4.46E+00		4.46E+00	NC	NC
Tank Group 04	PB-847-09	VOC	Benzene	71-43-2	A	Y	2.40E-04		2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-847-09	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-847-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-847-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-847-09	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-847-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-847-09	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-847-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-847-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-847-09	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-847-09	SVOC	Anthracene	120-12-7	ID	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-847-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-847-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-847-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-847-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-847-09	SVOC	Chrysene	218-01-9	B2	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-847-09	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-847-09	SVOC	Naphthalene	91-20-3	C	Y		2.10E-01	1.05E-01	7.1E-07	2.0E-02
Tank Group 04	PB-847-09	SVOC	Phenanthrene	85-01-8	D	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-847-09	SVOC	Pyrene	129-00-0	NC	Y		1.30E-01	6.50E-02	NC	NC
Tank Group 04	PB-847-09	INORG	Lead	7439-92-1	B2	Y	4.13E+00		4.13E+00	NC	NC
Tank Group 04	PB-847-10	VOC	Benzene	71-43-2	A	Y		4.90E-04	2.45E-04	4.5E-09	5.3E-05
Tank Group 04	PB-847-10	VOC	Cumene	98-82-8	D	Y		9.80E-04	4.90E-04	NC	8.0E-06
Tank Group 04	PB-847-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-847-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.80E-04		NC	NC
Tank Group 04	PB-847-10	VOC	Ethyl Benzene	100-41-4	D	Y		9.80E-04	4.90E-04	NC	3.2E-06
Tank Group 04	PB-847-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-847-10	VOC	Toluene	108-88-3	ID	Y		9.80E-04	4.90E-04	NC	6.4E-07
Tank Group 04	PB-847-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-847-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-847-10	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-847-10	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-10	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-10	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-10	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-847-10	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-10	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-10	INORG	Lead	7439-92-1	B2	Y	5.37E+00		5.37E+00	NC	NC
Tank Group 04	PB-847-11	VOC	Benzene	71-43-2	A	Y	4.70E-04		4.70E-04	8.6E-09	1.0E-04

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-847-11	VOC	Cumene	98-82-8	D	Y	1.20E-04		1.20E-04	NC	2.0E-06
Tank Group 04	PB-847-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-847-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.80E-04		NC	NC
Tank Group 04	PB-847-11	VOC	Ethyl Benzene	100-41-4	D	Y		9.80E-04	4.90E-04	NC	3.2E-06
Tank Group 04	PB-847-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	3.50E-03		3.50E-03	2.1E-09	7.6E-06
Tank Group 04	PB-847-11	VOC	Toluene	108-88-3	ID	Y		9.80E-04	4.90E-04	NC	6.4E-07
Tank Group 04	PB-847-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-847-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-847-11	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-847-11	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-11	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-11	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-847-11	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-847-11	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-11	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-11	INORG	Lead	7439-92-1	B2	Y	4.97E+00		4.97E+00	NC	NC
Tank Group 04	PB-847-12	VOC	Benzene	71-43-2	A	Y		4.30E-04	2.15E-04	3.9E-09	4.7E-05
Tank Group 04	PB-847-12	VOC	Cumene	98-82-8	D	Y	1.30E-02		1.30E-02	NC	2.1E-04
Tank Group 04	PB-847-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-847-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.70E-04		NC	NC
Tank Group 04	PB-847-12	VOC	Ethyl Benzene	100-41-4	D	Y	2.80E-03		2.80E-03	NC	1.8E-05
Tank Group 04	PB-847-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-847-12	VOC	Toluene	108-88-3	ID	Y		8.70E-04	4.35E-04	NC	5.7E-07
Tank Group 04	PB-847-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	2.00E-02		2.00E-02	NC	2.2E-03
Tank Group 04	PB-847-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	5.40E-02		5.40E-02	NC	5.9E-03
Tank Group 04	PB-847-12	VOC	Xylenes (total)	1330-20-7	ID	Y	9.00E-04		9.00E-04	NC	5.9E-05
Tank Group 04	PB-847-12	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-12	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-12	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-847-12	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-847-12	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-12	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-12	INORG	Lead	7439-92-1	B2	Y	6.35E+00		6.35E+00	NC	NC
Tank Group 04	PB-847-13	VOC	Benzene	71-43-2	A	Y	5.10E-02		5.10E-02	9.3E-07	1.1E-02
Tank Group 04	PB-847-13	VOC	Cumene	98-82-8	D	Y	9.40E-01		9.40E-01	NC	1.5E-02
Tank Group 04	PB-847-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		1.10E-01		NC	NC
Tank Group 04	PB-847-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		2.10E-01		NC	NC
Tank Group 04	PB-847-13	VOC	Ethyl Benzene	100-41-4	D	Y	2.00E-01		2.00E-01	NC	1.3E-03
Tank Group 04	PB-847-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		4.30E-01	2.15E-01	1.3E-07	4.7E-04
Tank Group 04	PB-847-13	VOC	Toluene	108-88-3	ID	Y		2.10E-01	1.05E-01	NC	1.4E-04
Tank Group 04	PB-847-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	2.20E+00		2.20E+00	NC	***2.4E-01***
Tank Group 04	PB-847-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.40E+00		1.40E+00	NC	***1.5E-01***
Tank Group 04	PB-847-13	VOC	Xylenes (total)	1330-20-7	ID	Y	2.30E-01		2.30E-01	NC	1.5E-02
Tank Group 04	PB-847-13	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-847-13	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-13	SVOC	Fluorene	86-73-7	D	Y	1.20E-01		1.20E-01	NC	NC
Tank Group 04	PB-847-13	SVOC	Naphthalene	91-20-3	C	Y	1.30E-01		1.30E-01	8.8E-07	2.4E-02
Tank Group 04	PB-847-13	SVOC	Phenanthrene	85-01-8	D	Y	2.90E-01		2.90E-01	NC	NC
Tank Group 04	PB-847-13	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-13	INORG	Lead	7439-92-1	B2	Y	3.88E+00		3.88E+00	NC	NC
Tank Group 04	PB-847-14	VOC	Benzene	71-43-2	A	Y		1.20E-01	6.00E-02	1.1E-06	1.3E-02
Tank Group 04	PB-847-14	VOC	Cumene	98-82-8	D	Y	1.30E+00		1.30E+00	NC	2.1E-02
Tank Group 04	PB-847-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		1.20E-01		NC	NC
Tank Group 04	PB-847-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		2.50E-01		NC	NC
Tank Group 04	PB-847-14	VOC	Ethyl Benzene	100-41-4	D	Y		2.50E-01	1.25E-01	NC	8.2E-04
Tank Group 04	PB-847-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		5.00E-01	2.50E-01	1.5E-07	5.5E-04
Tank Group 04	PB-847-14	VOC	Toluene	108-88-3	ID	Y		2.50E-01	1.25E-01	NC	1.6E-04
Tank Group 04	PB-847-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		5.00E-01	2.50E-01	NC	2.7E-02
Tank Group 04	PB-847-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		5.00E-01	2.50E-01	NC	2.7E-02
Tank Group 04	PB-847-14	VOC	Xylenes (total)	1330-20-7	ID	Y		5.00E-01	2.50E-01	NC	1.6E-02
Tank Group 04	PB-847-14	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-14	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-14	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-14	SVOC	Naphthalene	91-20-3	C	Y	4.30E-02		4.30E-02	2.9E-07	8.0E-03
Tank Group 04	PB-847-14	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-14	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-14	INORG	Lead	7439-92-1	B2	Y	5.24E+00		5.24E+00	NC	NC
Tank Group 04	PB-847-15	VOC	Benzene	71-43-2	A	Y	1.60E-01	3.20E-02	1.60E-01	2.9E-06	3.5E-02
Tank Group 04	PB-847-15	VOC	Cumene	98-82-8	D	Y	3.20E+00		3.20E+00	NC	5.2E-02
Tank Group 04	PB-847-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		1.20E-01		NC	NC
Tank Group 04	PB-847-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		2.30E-01		NC	NC
Tank Group 04	PB-847-15	VOC	Ethyl Benzene	100-41-4	D	Y	5.40E+00		5.40E+00	NC	3.5E-02
Tank Group 04	PB-847-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		4.60E-01	2.30E-01	1.4E-07	5.0E-04
Tank Group 04	PB-847-15	VOC	Toluene	108-88-3	ID	Y		2.30E-01	1.15E-01	NC	1.5E-04
Tank Group 04	PB-847-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	5.10E+00	1.00E-01	5.10E+00	NC	***5.6E-01***
Tank Group 04	PB-847-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	3.20E+00		3.20E+00	NC	***3.5E-01***
Tank Group 04	PB-847-15	VOC	Xylenes (total)	1330-20-7	ID	Y	2.53E+00	1.00E-01	2.53E+00	NC	***1.7E-01***
Tank Group 04	PB-847-15	SVOC	Anthracene	120-12-7	ID	Y	1.70E+00		1.70E+00	NC	NC
Tank Group 04	PB-847-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E+00	5.50E-01	NC	NC
Tank Group 04	PB-847-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E+00	7.50E-01	NC	NC
Tank Group 04	PB-847-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E+00	5.50E-01	NC	NC
Tank Group 04	PB-847-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E+00	7.50E-01	NC	NC
Tank Group 04	PB-847-15	SVOC	Chrysene	218-01-9	B2	Y		1.10E+00	5.50E-01	NC	NC
Tank Group 04	PB-847-15	SVOC	Fluorene	86-73-7	D	Y	5.30E+00		5.30E+00	NC	NC
Tank Group 04	PB-847-15	SVOC	Naphthalene	91-20-3	C	Y	7.50E+00		7.50E+00	***5.1E-05***	**1.4E+00**
Tank Group 04	PB-847-15	SVOC	Phenanthrene	85-01-8	D	Y	1.20E+01		1.20E+01	NC	NC
Tank Group 04	PB-847-15	SVOC	Pyrene	129-00-0	NC	Y	5.00E-01		5.00E-01	NC	NC
Tank Group 04	PB-847-15	INORG	Lead	7439-92-1	B2	Y	6.75E+00		6.75E+00	NC	NC
Tank Group 04	PB-847-16	VOC	Benzene	71-43-2	A	Y		4.70E-04	2.35E-04	4.3E-09	5.1E-05
Tank Group 04	PB-847-16	VOC	Cumene	98-82-8	D	Y		9.40E-04	4.70E-04	NC	7.7E-06
Tank Group 04	PB-847-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.70E-04		NC	NC
Tank Group 04	PB-847-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.40E-04		NC	NC
Tank Group 04	PB-847-16	VOC	Ethyl Benzene	100-41-4	D	Y		9.40E-04	4.70E-04	NC	3.1E-06
Tank Group 04	PB-847-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-847-16	VOC	Toluene	108-88-3	ID	Y		9.40E-04	4.70E-04	NC	6.2E-07
Tank Group 04	PB-847-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-847-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-847-16	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-847-16	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-16	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-16	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-16	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-847-16	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-16	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-16	INORG	Lead	7439-92-1	B2	Y	5.17E+00		5.17E+00	NC	NC
Tank Group 04	PB-847-17	VOC	Benzene	71-43-2	A	Y	4.20E-03		4.20E-03	7.7E-08	9.2E-04
Tank Group 04	PB-847-17	VOC	Cumene	98-82-8	D	Y	2.70E-02		2.70E-02	NC	4.4E-04
Tank Group 04	PB-847-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-847-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-847-17	VOC	Ethyl Benzene	100-41-4	D	Y	1.80E-02		1.80E-02	NC	1.2E-04
Tank Group 04	PB-847-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-847-17	VOC	Toluene	108-88-3	ID	Y	7.30E-04		7.30E-04	NC	9.6E-07
Tank Group 04	PB-847-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.10E-01		1.10E-01	NC	1.2E-02
Tank Group 04	PB-847-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	8.80E-03		8.80E-03	NC	9.6E-04
Tank Group 04	PB-847-17	VOC	Xylenes (total)	1330-20-7	ID	Y	1.67E-02		1.67E-02	NC	1.1E-03
Tank Group 04	PB-847-17	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-847-17	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-17	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-847-17	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-847-17	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-17	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-847-17	INORG	Lead	7439-92-1	B2	Y	5.26E+00		5.26E+00	NC	NC
Tank Group 04	PB-848-01	VOC	Benzene	71-43-2	A	Y	1.00E-03		1.00E-03	1.8E-08	2.2E-04
Tank Group 04	PB-848-01	VOC	Cumene	98-82-8	D	Y	1.40E-04		1.40E-04	NC	2.3E-06
Tank Group 04	PB-848-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-848-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-848-01	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-848-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-848-01	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-848-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-848-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	2.60E-04		2.60E-04	NC	2.8E-05
Tank Group 04	PB-848-01	VOC	Xylenes (total)	1330-20-7	ID	Y	1.55E-03		1.55E-03	NC	1.0E-04
Tank Group 04	PB-848-01	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-01	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-01	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-848-01	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-848-01	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-01	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-01	INORG	Lead	7439-92-1	B2	Y	6.75E+00		6.75E+00	NC	NC
Tank Group 04	PB-848-02	VOC	Benzene	71-43-2	A	Y		4.70E-04	2.35E-04	4.3E-09	5.1E-05
Tank Group 04	PB-848-02	VOC	Cumene	98-82-8	D	Y		9.40E-04	4.70E-04	NC	7.7E-06
Tank Group 04	PB-848-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.70E-04		NC	NC
Tank Group 04	PB-848-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.40E-04		NC	NC
Tank Group 04	PB-848-02	VOC	Ethyl Benzene	100-41-4	D	Y		9.40E-04	4.70E-04	NC	3.1E-06
Tank Group 04	PB-848-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-848-02	VOC	Toluene	108-88-3	ID	Y		9.40E-04	4.70E-04	NC	6.2E-07
Tank Group 04	PB-848-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-848-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-848-02	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-848-02	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-848-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-848-02	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-02	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-848-02	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-848-02	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-02	SVOC	Pyrene	129-00-0	NC	Y	2.90E-02		2.90E-02	NC	NC
Tank Group 04	PB-848-02	INORG	Lead	7439-92-1	B2	Y	2.62E+01		2.62E+01	NC	NC
Tank Group 04	PB-848-03	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-848-03	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-848-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-848-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-848-03	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-848-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-848-03	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-848-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-848-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-848-03	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-848-03	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-848-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-848-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-848-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-848-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-848-03	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-848-03	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-848-03	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-848-03	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-848-03	SVOC	Pyrene	129-00-0	NC	Y	2.40E-02		2.40E-02	NC	NC
Tank Group 04	PB-848-03	INORG	Lead	7439-92-1	B2	Y	5.16E+01		5.16E+01	NC	NC
Tank Group 04	PB-848-04	VOC	Benzene	71-43-2	A	Y	1.80E+00		1.80E+00	***3.3E-05***	***3.9E-01***
Tank Group 04	PB-848-04	VOC	Cumene	98-82-8	D	Y	4.60E-01		4.60E-01	NC	7.5E-03
Tank Group 04	PB-848-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		1.30E-01		NC	NC
Tank Group 04	PB-848-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		2.50E-01		NC	NC
Tank Group 04	PB-848-04	VOC	Ethyl Benzene	100-41-4	D	Y	9.00E-01		9.00E-01	NC	5.9E-03
Tank Group 04	PB-848-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		5.10E-01	2.55E-01	1.6E-07	5.6E-04
Tank Group 04	PB-848-04	VOC	Toluene	108-88-3	ID	Y		2.50E-01	1.25E-01	NC	1.6E-04
Tank Group 04	PB-848-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	4.30E+00		4.30E+00	NC	***4.7E-01***
Tank Group 04	PB-848-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	2.70E+00		2.70E+00	NC	***2.9E-01***
Tank Group 04	PB-848-04	VOC	Xylenes (total)	1330-20-7	ID	Y	3.82E+00		3.82E+00	NC	***2.5E-01***
Tank Group 04	PB-848-04	SVOC	Anthracene	120-12-7	ID	Y	2.90E-01		2.90E-01	NC	NC
Tank Group 04	PB-848-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-04	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-04	SVOC	Fluorene	86-73-7	D	Y	2.30E+00		2.30E+00	NC	NC
Tank Group 04	PB-848-04	SVOC	Naphthalene	91-20-3	C	Y	1.40E+00		1.40E+00	9.5E-06	***2.6E-01***
Tank Group 04	PB-848-04	SVOC	Phenanthrene	85-01-8	D	Y	1.90E+00		1.90E+00	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-848-04	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-04	INORG	Lead	7439-92-1	B2	Y	7.16E+02		7.16E+02	NC	NC
Tank Group 04	PB-848-05	VOC	Benzene	71-43-2	A	Y		5.25E-04	2.63E-04	4.8E-09	5.7E-05
Tank Group 04	PB-848-05	VOC	Cumene	98-82-8	D	Y		1.04E-03	5.20E-04	NC	8.5E-06
Tank Group 04	PB-848-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.25E-04		NC	NC
Tank Group 04	PB-848-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.04E-03		NC	NC
Tank Group 04	PB-848-05	VOC	Ethyl Benzene	100-41-4	D	Y		1.04E-03	5.20E-04	NC	3.4E-06
Tank Group 04	PB-848-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	6.55E-04		6.55E-04	4.0E-10	1.4E-06
Tank Group 04	PB-848-05	VOC	Toluene	108-88-3	ID	Y		1.04E-03	5.20E-04	NC	6.8E-07
Tank Group 04	PB-848-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-848-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-848-05	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-848-05	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	5.75E-02		5.75E-02	NC	NC
Tank Group 04	PB-848-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	6.40E-02		6.40E-02	NC	NC
Tank Group 04	PB-848-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	5.65E-02		5.65E-02	NC	NC
Tank Group 04	PB-848-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	5.30E-02		5.30E-02	NC	NC
Tank Group 04	PB-848-05	SVOC	Chrysene	218-01-9	B2	Y	5.40E-02		5.40E-02	NC	NC
Tank Group 04	PB-848-05	SVOC	Fluorene	86-73-7	D	Y	8.45E-02	2.00E-01	8.45E-02	NC	NC
Tank Group 04	PB-848-05	SVOC	Naphthalene	91-20-3	C	Y	6.70E-02	2.00E-01	6.70E-02	4.5E-07	1.2E-02
Tank Group 04	PB-848-05	SVOC	Phenanthrene	85-01-8	D	Y	9.10E-02		9.10E-02	NC	NC
Tank Group 04	PB-848-05	SVOC	Pyrene	129-00-0	NC	Y	8.00E-02		8.00E-02	NC	NC
Tank Group 04	PB-848-05	INORG	Lead	7439-92-1	B2	Y	1.88E+01		1.88E+01	NC	NC
Tank Group 04	PB-848-06	VOC	Benzene	71-43-2	A	Y		3.20E-02	1.60E-02	2.9E-07	3.5E-03
Tank Group 04	PB-848-06	VOC	Cumene	98-82-8	D	Y	3.00E+00		3.00E+00	NC	4.9E-02
Tank Group 04	PB-848-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.20E-02		NC	NC
Tank Group 04	PB-848-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.40E-02		NC	NC
Tank Group 04	PB-848-06	VOC	Ethyl Benzene	100-41-4	D	Y	1.00E+00		1.00E+00	NC	6.5E-03
Tank Group 04	PB-848-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.30E-01	6.50E-02	4.0E-08	1.4E-04
Tank Group 04	PB-848-06	VOC	Toluene	108-88-3	ID	Y		6.40E-02	3.20E-02	NC	4.2E-05
Tank Group 04	PB-848-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	3.50E+01		3.50E+01	NC	**3.8E+00**
Tank Group 04	PB-848-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.60E-01		1.60E-01	NC	1.7E-02
Tank Group 04	PB-848-06	VOC	Xylenes (total)	1330-20-7	ID	Y		1.30E-01	6.50E-02	NC	4.3E-03
Tank Group 04	PB-848-06	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-06	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-06	SVOC	Fluorene	86-73-7	D	Y	1.40E-01		1.40E-01	NC	NC
Tank Group 04	PB-848-06	SVOC	Naphthalene	91-20-3	C	Y	1.70E+00		1.70E+00	***1.2E-05***	***3.2E-01***
Tank Group 04	PB-848-06	SVOC	Phenanthrene	85-01-8	D	Y	1.50E-01		1.50E-01	NC	NC
Tank Group 04	PB-848-06	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-06	INORG	Lead	7439-92-1	B2	Y	7.20E+00		7.20E+00	NC	NC
Tank Group 04	PB-848-07	VOC	Benzene	71-43-2	A	Y	1.40E-01		1.40E-01	2.6E-06	3.1E-02
Tank Group 04	PB-848-07	VOC	Cumene	98-82-8	D	Y	1.10E+00		1.10E+00	NC	1.8E-02
Tank Group 04	PB-848-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.40E-02		NC	NC
Tank Group 04	PB-848-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.70E-02		NC	NC
Tank Group 04	PB-848-07	VOC	Ethyl Benzene	100-41-4	D	Y	1.60E+00		1.60E+00	NC	1.0E-02
Tank Group 04	PB-848-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	2.60E-04	1.30E-01	2.60E-04	1.6E-10	5.7E-07
Tank Group 04	PB-848-07	VOC	Toluene	108-88-3	ID	Y	8.70E-02		8.70E-02	NC	1.1E-04
Tank Group 04	PB-848-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	2.20E+00		2.20E+00	NC	***2.4E-01***
Tank Group 04	PB-848-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.00E+00		1.00E+00	NC	***1.1E-01***
Tank Group 04	PB-848-07	VOC	Xylenes (total)	1330-20-7	ID	Y	5.62E-01		5.62E-01	NC	3.7E-02
Tank Group 04	PB-848-07	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.50E-02		2.50E-02	NC	NC
Tank Group 04	PB-848-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	6.50E-02		6.50E-02	NC	NC
Tank Group 04	PB-848-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	4.90E-02		4.90E-02	NC	NC
Tank Group 04	PB-848-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	6.40E-02		6.40E-02	NC	NC
Tank Group 04	PB-848-07	SVOC	Chrysene	218-01-9	B2	Y	2.80E-02		2.80E-02	NC	NC
Tank Group 04	PB-848-07	SVOC	Fluorene	86-73-7	D	Y	8.90E-02		8.90E-02	NC	NC
Tank Group 04	PB-848-07	SVOC	Naphthalene	91-20-3	C	Y	2.60E-01	2.00E-01	2.60E-01	1.8E-06	4.8E-02
Tank Group 04	PB-848-07	SVOC	Phenanthrene	85-01-8	D	Y	5.90E-02		5.90E-02	NC	NC
Tank Group 04	PB-848-07	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-07	INORG	Lead	7439-92-1	B2	Y	3.20E+03		3.20E+03	NC	NC
Tank Group 04	PB-848-08	VOC	Benzene	71-43-2	A	Y	3.00E-04		3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-848-08	VOC	Cumene	98-82-8	D	Y	9.90E-03		9.90E-03	NC	1.6E-04
Tank Group 04	PB-848-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-848-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.20E-04		NC	NC
Tank Group 04	PB-848-08	VOC	Ethyl Benzene	100-41-4	D	Y	6.70E-03		6.70E-03	NC	4.4E-05
Tank Group 04	PB-848-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-848-08	VOC	Toluene	108-88-3	ID	Y		9.20E-04	4.60E-04	NC	6.0E-07
Tank Group 04	PB-848-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	3.70E-02		3.70E-02	NC	4.0E-03
Tank Group 04	PB-848-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.70E-03		4.70E-03	NC	5.1E-04
Tank Group 04	PB-848-08	VOC	Xylenes (total)	1330-20-7	ID	Y	1.33E-03		1.33E-03	NC	8.7E-05
Tank Group 04	PB-848-08	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-08	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-08	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-848-08	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-848-08	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-08	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-08	INORG	Lead	7439-92-1	B2	Y	2.46E+02		2.46E+02	NC	NC
Tank Group 04	PB-848-09	VOC	Benzene	71-43-2	A	Y	2.20E-04		2.20E-04	4.0E-09	4.8E-05
Tank Group 04	PB-848-09	VOC	Cumene	98-82-8	D	Y	1.10E-03		1.10E-03	NC	1.8E-05
Tank Group 04	PB-848-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-848-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.80E-04		NC	NC
Tank Group 04	PB-848-09	VOC	Ethyl Benzene	100-41-4	D	Y	4.60E-04		4.60E-04	NC	3.0E-06
Tank Group 04	PB-848-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-848-09	VOC	Toluene	108-88-3	ID	Y		9.80E-04	4.90E-04	NC	6.4E-07
Tank Group 04	PB-848-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.30E-03		1.30E-03	NC	1.4E-04
Tank Group 04	PB-848-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	2.80E-04		2.80E-04	NC	3.1E-05
Tank Group 04	PB-848-09	VOC	Xylenes (total)	1330-20-7	ID	Y	9.30E-04		9.30E-04	NC	6.1E-05
Tank Group 04	PB-848-09	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-09	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-09	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-848-09	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-848-09	SVOC	Phenanthrene	85-01-8	D	Y	3.40E-02		3.40E-02	NC	NC
Tank Group 04	PB-848-09	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-09	INORG	Lead	7439-92-1	B2	Y	1.14E+03		1.14E+03	NC	NC
Tank Group 04	PB-848-10	VOC	Benzene	71-43-2	A	Y	5.20E-04		5.20E-04	9.5E-09	1.1E-04
Tank Group 04	PB-848-10	VOC	Cumene	98-82-8	D	Y	6.60E-03		6.60E-03	NC	1.1E-04
Tank Group 04	PB-848-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.30E-04		NC	NC
Tank Group 04	PB-848-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-848-10	VOC	Ethyl Benzene	100-41-4	D	Y	2.40E-03		2.40E-03	NC	1.6E-05
Tank Group 04	PB-848-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.50E-03	1.25E-03	7.6E-10	2.7E-06
Tank Group 04	PB-848-10	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-848-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	8.10E-04		8.10E-04	NC	8.8E-05
Tank Group 04	PB-848-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.70E-04		4.70E-04	NC	5.1E-05
Tank Group 04	PB-848-10	VOC	Xylenes (total)	1330-20-7	ID	Y		2.50E-03	1.25E-03	NC	8.2E-05
Tank Group 04	PB-848-10	SVOC	Anthracene	120-12-7	ID	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-848-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-848-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-848-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-848-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-848-10	SVOC	Chrysene	218-01-9	B2	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-848-10	SVOC	Fluorene	86-73-7	D	Y		2.30E-01	1.15E-01	NC	NC
Tank Group 04	PB-848-10	SVOC	Naphthalene	91-20-3	C	Y		2.30E-01	1.15E-01	7.8E-07	2.1E-02
Tank Group 04	PB-848-10	SVOC	Phenanthrene	85-01-8	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-848-10	SVOC	Pyrene	129-00-0	NC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-848-10	INORG	Lead	7439-92-1	B2	Y	7.21E+02		7.21E+02	NC	NC
Tank Group 04	PB-848-11	VOC	Benzene	71-43-2	A	Y	8.70E-01		8.70E-01	***1.6E-05***	***1.9E-01***
Tank Group 04	PB-848-11	VOC	Cumene	98-82-8	D	Y	2.90E-01		2.90E-01	NC	4.7E-03
Tank Group 04	PB-848-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.40E-02		NC	NC
Tank Group 04	PB-848-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.80E-02		NC	NC
Tank Group 04	PB-848-11	VOC	Ethyl Benzene	100-41-4	D	Y	1.60E-01		1.60E-01	NC	1.0E-03
Tank Group 04	PB-848-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.40E-01	7.00E-02	4.3E-08	1.5E-04
Tank Group 04	PB-848-11	VOC	Toluene	108-88-3	ID	Y	1.20E-01		1.20E-01	NC	1.6E-04
Tank Group 04	PB-848-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.20E-01		1.20E-01	NC	1.3E-02
Tank Group 04	PB-848-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	7.60E-02		7.60E-02	NC	8.3E-03
Tank Group 04	PB-848-11	VOC	Xylenes (total)	1330-20-7	ID	Y	3.94E-01		3.94E-01	NC	2.6E-02
Tank Group 04	PB-848-11	SVOC	Anthracene	120-12-7	ID	Y	8.10E-02		8.10E-02	NC	NC
Tank Group 04	PB-848-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.90E-02		2.90E-02	NC	NC
Tank Group 04	PB-848-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-848-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	3.70E-02		3.70E-02	NC	NC
Tank Group 04	PB-848-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	3.90E-02		3.90E-02	NC	NC
Tank Group 04	PB-848-11	SVOC	Chrysene	218-01-9	B2	Y	3.40E-02		3.40E-02	NC	NC
Tank Group 04	PB-848-11	SVOC	Fluorene	86-73-7	D	Y	2.50E-01		2.50E-01	NC	NC
Tank Group 04	PB-848-11	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-848-11	SVOC	Phenanthrene	85-01-8	D	Y	3.50E-01		3.50E-01	NC	NC
Tank Group 04	PB-848-11	SVOC	Pyrene	129-00-0	NC	Y	5.80E-02		5.80E-02	NC	NC
Tank Group 04	PB-848-11	INORG	Lead	7439-92-1	B2	Y	1.50E+01		1.50E+01	NC	NC
Tank Group 04	PB-848-12	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-848-12	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-848-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-848-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-848-12	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-848-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-848-12	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-848-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-848-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-848-12	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-848-12	SVOC	Anthracene	120-12-7	ID	Y	1.90E-01		1.90E-01	NC	NC
Tank Group 04	PB-848-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.30E-01		3.30E-01	NC	NC
Tank Group 04	PB-848-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	3.00E-01		3.00E-01	NC	NC
Tank Group 04	PB-848-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	3.60E-01		3.60E-01	NC	NC
Tank Group 04	PB-848-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	1.10E-01		1.10E-01	NC	NC
Tank Group 04	PB-848-12	SVOC	Chrysene	218-01-9	B2	Y	3.00E-01		3.00E-01	NC	NC
Tank Group 04	PB-848-12	SVOC	Fluorene	86-73-7	D	Y	1.30E-01		1.30E-01	NC	NC
Tank Group 04	PB-848-12	SVOC	Naphthalene	91-20-3	C	Y	4.30E-02		4.30E-02	2.9E-07	8.0E-03
Tank Group 04	PB-848-12	SVOC	Phenanthrene	85-01-8	D	Y	6.80E-01		6.80E-01	NC	NC
Tank Group 04	PB-848-12	SVOC	Pyrene	129-00-0	NC	Y	5.10E-01		5.10E-01	NC	NC
Tank Group 04	PB-848-12	INORG	Lead	7439-92-1	B2	Y	2.82E+02		2.82E+02	NC	NC
Tank Group 04	PB-848-13	VOC	Benzene	71-43-2	A	Y		3.60E-02	1.80E-02	3.3E-07	3.9E-03
Tank Group 04	PB-848-13	VOC	Cumene	98-82-8	D	Y	1.00E-02		1.00E-02	NC	1.6E-04
Tank Group 04	PB-848-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.60E-02		NC	NC
Tank Group 04	PB-848-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		7.20E-02		NC	NC
Tank Group 04	PB-848-13	VOC	Ethyl Benzene	100-41-4	D	Y	1.80E-02		1.80E-02	NC	1.2E-04
Tank Group 04	PB-848-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.40E-01	7.00E-02	4.3E-08	1.5E-04
Tank Group 04	PB-848-13	VOC	Toluene	108-88-3	ID	Y	3.90E-02		3.90E-02	NC	5.1E-05
Tank Group 04	PB-848-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.40E-01	7.00E-02	NC	7.6E-03
Tank Group 04	PB-848-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.40E-01	7.00E-02	NC	7.6E-03
Tank Group 04	PB-848-13	VOC	Xylenes (total)	1330-20-7	ID	Y		1.40E-01	7.00E-02	NC	4.6E-03
Tank Group 04	PB-848-13	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-13	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-13	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-848-13	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-848-13	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-13	SVOC	Pyrene	129-00-0	NC	Y	2.20E-02		2.20E-02	NC	NC
Tank Group 04	PB-848-13	INORG	Lead	7439-92-1	B2	Y	2.85E+01		2.85E+01	NC	NC
Tank Group 04	PB-848-14	VOC	Benzene	71-43-2	A	Y	1.90E-04		1.90E-04	3.5E-09	4.1E-05
Tank Group 04	PB-848-14	VOC	Cumene	98-82-8	D	Y	7.90E-04		7.90E-04	NC	1.3E-05
Tank Group 04	PB-848-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-848-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-848-14	VOC	Ethyl Benzene	100-41-4	D	Y	1.70E-04		1.70E-04	NC	1.1E-06
Tank Group 04	PB-848-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-848-14	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-848-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-848-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-848-14	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-848-14	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-14	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-14	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-848-14	SVOC	Naphthalene	91-20-3	C	Y		2.10E-01	1.05E-01	7.1E-07	2.0E-02
Tank Group 04	PB-848-14	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-14	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-14	INORG	Lead	7439-92-1	B2	Y	1.57E+01		1.57E+01	NC	NC
Tank Group 04	PB-848-15	VOC	Benzene	71-43-2	A	Y	1.10E+00		1.10E+00	***2.0E-05***	***2.4E-01***
Tank Group 04	PB-848-15	VOC	Cumene	98-82-8	D	Y	2.40E+00		2.40E+00	NC	3.9E-02
Tank Group 04	PB-848-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		2.80E-02		NC	NC
Tank Group 04	PB-848-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		5.50E-02		NC	NC
Tank Group 04	PB-848-15	VOC	Ethyl Benzene	100-41-4	D	Y	1.60E+01		1.60E+01	NC	1.0E-01
Tank Group 04	PB-848-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.10E-01	5.50E-02	3.3E-08	1.2E-04
Tank Group 04	PB-848-15	VOC	Toluene	108-88-3	ID	Y	7.80E-02		7.80E-02	NC	1.0E-04
Tank Group 04	PB-848-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	7.70E+00		7.70E+00	NC	***8.4E-01***
Tank Group 04	PB-848-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.00E+00		4.00E+00	NC	***4.4E-01***
Tank Group 04	PB-848-15	VOC	Xylenes (total)	1330-20-7	ID	Y	3.80E+01		3.80E+01	NC	**2.5E+00**
Tank Group 04	PB-848-15	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-15	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-848-15	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-848-15	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-848-15	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-15	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-15	INORG	Lead	7439-92-1	B2	Y	9.28E+00		9.28E+00	NC	NC
Tank Group 04	PB-848-16	VOC	Benzene	71-43-2	A	Y		6.00E-04	3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-848-16	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-848-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.00E-04		NC	NC
Tank Group 04	PB-848-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-848-16	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-848-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-848-16	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-848-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-848-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-848-16	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-848-16	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-16	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-16	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-848-16	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-848-16	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-16	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-16	INORG	Lead	7439-92-1	B2	Y	6.41E+00		6.41E+00	NC	NC
Tank Group 04	PB-848-17	VOC	Benzene	71-43-2	A	Y		7.70E-04	3.85E-04	7.0E-09	8.4E-05
Tank Group 04	PB-848-17	VOC	Cumene	98-82-8	D	Y		1.50E-03	7.50E-04	NC	1.2E-05
Tank Group 04	PB-848-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		7.70E-04		NC	NC
Tank Group 04	PB-848-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.50E-03		NC	NC
Tank Group 04	PB-848-17	VOC	Ethyl Benzene	100-41-4	D	Y		1.50E-03	7.50E-04	NC	4.9E-06
Tank Group 04	PB-848-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.10E-03	1.55E-03	9.4E-10	3.4E-06
Tank Group 04	PB-848-17	VOC	Toluene	108-88-3	ID	Y		1.50E-03	7.50E-04	NC	9.8E-07
Tank Group 04	PB-848-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.10E-03	1.55E-03	NC	1.7E-04
Tank Group 04	PB-848-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.10E-03	1.55E-03	NC	1.7E-04
Tank Group 04	PB-848-17	VOC	Xylenes (total)	1330-20-7	ID	Y		3.10E-03	1.55E-03	NC	1.0E-04
Tank Group 04	PB-848-17	SVOC	Anthracene	120-12-7	ID	Y	9.00E-02		9.00E-02	NC	NC
Tank Group 04	PB-848-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	4.50E+00		4.50E+00	NC	NC
Tank Group 04	PB-848-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	7.20E+00		7.20E+00	NC	NC
Tank Group 04	PB-848-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	4.40E+00		4.40E+00	NC	NC
Tank Group 04	PB-848-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	5.20E+00		5.20E+00	NC	NC
Tank Group 04	PB-848-17	SVOC	Chrysene	218-01-9	B2	Y	4.40E+00		4.40E+00	NC	NC
Tank Group 04	PB-848-17	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-848-17	SVOC	Naphthalene	91-20-3	C	Y	2.60E-02		2.60E-02	1.8E-07	4.8E-03
Tank Group 04	PB-848-17	SVOC	Phenanthrene	85-01-8	D	Y	3.40E-01		3.40E-01	NC	NC
Tank Group 04	PB-848-17	SVOC	Pyrene	129-00-0	NC	Y	7.90E-01		7.90E-01	NC	NC
Tank Group 04	PB-848-17	INORG	Lead	7439-92-1	B2	Y	1.84E+03		1.84E+03	NC	NC
Tank Group 04	PB-848-18	VOC	Benzene	71-43-2	A	Y	1.00E-02		1.00E-02	1.8E-07	2.2E-03
Tank Group 04	PB-848-18	VOC	Cumene	98-82-8	D	Y	6.00E-02		6.00E-02	NC	9.8E-04
Tank Group 04	PB-848-18	VOC	1,2-Dibromoethane	106-93-4	LC	N		2.70E-02		NC	NC
Tank Group 04	PB-848-18	VOC	1,2-Dichloroethane	107-06-2	B2	N		5.40E-02		NC	NC
Tank Group 04	PB-848-18	VOC	Ethyl Benzene	100-41-4	D	Y	1.70E-02		1.70E-02	NC	1.1E-04
Tank Group 04	PB-848-18	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.10E-01	5.50E-02	3.3E-08	1.2E-04
Tank Group 04	PB-848-18	VOC	Toluene	108-88-3	ID	Y		5.40E-02	2.70E-02	NC	3.5E-05
Tank Group 04	PB-848-18	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	5.80E-02		5.80E-02	NC	6.3E-03
Tank Group 04	PB-848-18	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.10E-02		1.10E-02	NC	1.2E-03
Tank Group 04	PB-848-18	VOC	Xylenes (total)	1330-20-7	ID	Y	8.30E-02		8.30E-02	NC	5.4E-03
Tank Group 04	PB-848-18	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-18	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-18	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-18	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-18	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-848-18	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-18	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-848-18	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-848-18	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-18	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-848-18	INORG	Lead	7439-92-1	B2	Y	6.07E+01		6.07E+01	NC	NC
Tank Group 04	PB-881-01	VOC	Benzene	71-43-2	A	Y		4.30E-04	2.15E-04	3.9E-09	4.7E-05
Tank Group 04	PB-881-01	VOC	Cumene	98-82-8	D	Y	3.20E-03		3.20E-03	NC	5.2E-05
Tank Group 04	PB-881-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-881-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.70E-04		NC	NC
Tank Group 04	PB-881-01	VOC	Ethyl Benzene	100-41-4	D	Y		8.70E-04	4.35E-04	NC	2.8E-06
Tank Group 04	PB-881-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-881-01	VOC	Toluene	108-88-3	ID	Y		8.70E-04	4.35E-04	NC	5.7E-07
Tank Group 04	PB-881-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.30E-01	6.50E-02	NC	7.1E-03
Tank Group 04	PB-881-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	9.10E-02		9.10E-02	NC	9.9E-03
Tank Group 04	PB-881-01	VOC	Xylenes (total)	1330-20-7	ID	Y	5.50E-02		5.50E-02	NC	3.6E-03
Tank Group 04	PB-881-01	SVOC	Anthracene	120-12-7	ID	Y		5.20E-01	2.60E-01	NC	NC
Tank Group 04	PB-881-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		5.20E-01	2.60E-01	NC	NC
Tank Group 04	PB-881-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		7.00E-01	3.50E-01	NC	NC
Tank Group 04	PB-881-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		5.20E-01	2.60E-01	NC	NC
Tank Group 04	PB-881-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		7.00E-01	3.50E-01	NC	NC
Tank Group 04	PB-881-01	SVOC	Chrysene	218-01-9	B2	Y	2.20E-01		2.20E-01	NC	NC
Tank Group 04	PB-881-01	SVOC	Fluorene	86-73-7	D	Y	1.90E-01		1.90E-01	NC	NC
Tank Group 04	PB-881-01	SVOC	Naphthalene	91-20-3	C	Y	2.60E-01		2.60E-01	1.8E-06	4.8E-02
Tank Group 04	PB-881-01	SVOC	Phenanthrene	85-01-8	D	Y	1.60E-01		1.60E-01	NC	NC
Tank Group 04	PB-881-01	SVOC	Pyrene	129-00-0	NC	Y	1.50E-01		1.50E-01	NC	NC
Tank Group 04	PB-881-01	INORG	Lead	7439-92-1	B2	Y	1.62E+00		1.62E+00	NC	NC
Tank Group 04	PB-881-02	VOC	Benzene	71-43-2	A	Y		5.30E-04	2.65E-04	4.8E-09	5.8E-05
Tank Group 04	PB-881-02	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-881-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-881-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-881-02	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-881-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-881-02	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-881-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-881-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-881-02	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-881-02	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-02	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-02	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-881-02	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-881-02	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-02	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-02	INORG	Lead	7439-92-1	B2	Y	1.49E+00		1.49E+00	NC	NC
Tank Group 04	PB-881-03	VOC	Benzene	71-43-2	A	Y		4.60E-04	2.30E-04	4.2E-09	5.0E-05
Tank Group 04	PB-881-03	VOC	Cumene	98-82-8	D	Y		9.30E-04	4.65E-04	NC	7.6E-06
Tank Group 04	PB-881-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-881-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.30E-04		NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-881-03	VOC	Ethyl Benzene	100-41-4	D	Y		9.30E-04	4.65E-04	NC	3.0E-06
Tank Group 04	PB-881-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-881-03	VOC	Toluene	108-88-3	ID	Y		9.30E-04	4.65E-04	NC	6.1E-07
Tank Group 04	PB-881-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-881-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-881-03	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-881-03	SVOC	Anthracene	120-12-7	ID	Y	9.70E-02		9.70E-02	NC	NC
Tank Group 04	PB-881-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	4.00E-02		4.00E-02	NC	NC
Tank Group 04	PB-881-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-03	SVOC	Chrysene	218-01-9	B2	Y	2.00E-01		2.00E-01	NC	NC
Tank Group 04	PB-881-03	SVOC	Fluorene	86-73-7	D	Y	5.10E-01		5.10E-01	NC	NC
Tank Group 04	PB-881-03	SVOC	Naphthalene	91-20-3	C	Y	1.20E+00		1.20E+00	8.1E-06	***2.2E-01***
Tank Group 04	PB-881-03	SVOC	Phenanthrene	85-01-8	D	Y	1.00E+00		1.00E+00	NC	NC
Tank Group 04	PB-881-03	SVOC	Pyrene	129-00-0	NC	Y	1.50E-01		1.50E-01	NC	NC
Tank Group 04	PB-881-03	INORG	Lead	7439-92-1	B2	Y	1.78E+00		1.78E+00	NC	NC
Tank Group 04	PB-881-04	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-881-04	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-881-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-881-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-881-04	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-881-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-881-04	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-881-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-04	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-881-04	SVOC	Anthracene	120-12-7	ID	Y	4.70E-02		4.70E-02	NC	NC
Tank Group 04	PB-881-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.30E-01		2.30E-01	NC	NC
Tank Group 04	PB-881-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	2.50E-01		2.50E-01	NC	NC
Tank Group 04	PB-881-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	2.90E-01		2.90E-01	NC	NC
Tank Group 04	PB-881-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	1.40E-01		1.40E-01	NC	NC
Tank Group 04	PB-881-04	SVOC	Chrysene	218-01-9	B2	Y	2.20E-01		2.20E-01	NC	NC
Tank Group 04	PB-881-04	SVOC	Fluorene	86-73-7	D	Y	1.80E-02		1.80E-02	NC	NC
Tank Group 04	PB-881-04	SVOC	Naphthalene	91-20-3	C	Y	4.80E-02		4.80E-02	3.3E-07	8.9E-03
Tank Group 04	PB-881-04	SVOC	Phenanthrene	85-01-8	D	Y	2.10E-01		2.10E-01	NC	NC
Tank Group 04	PB-881-04	SVOC	Pyrene	129-00-0	NC	Y	2.80E-01		2.80E-01	NC	NC
Tank Group 04	PB-881-04	INORG	Lead	7439-92-1	B2	Y	8.92E+01		8.92E+01	NC	NC
Tank Group 04	PB-881-05	VOC	Benzene	71-43-2	A	Y		4.90E-04	2.45E-04	4.5E-09	5.3E-05
Tank Group 04	PB-881-05	VOC	Cumene	98-82-8	D	Y		9.80E-04	4.90E-04	NC	8.0E-06
Tank Group 04	PB-881-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-881-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.80E-04		NC	NC
Tank Group 04	PB-881-05	VOC	Ethyl Benzene	100-41-4	D	Y		9.80E-04	4.90E-04	NC	3.2E-06
Tank Group 04	PB-881-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.20E-03		1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-881-05	VOC	Toluene	108-88-3	ID	Y		9.80E-04	4.90E-04	NC	6.4E-07
Tank Group 04	PB-881-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-05	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-881-05	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-881-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-881-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-881-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-881-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-881-05	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-881-05	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-881-05	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-881-05	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-881-05	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-881-05	INORG	Lead	7439-92-1	B2	Y	7.70E+00		7.70E+00	NC	NC
Tank Group 04	PB-881-06	VOC	Benzene	71-43-2	A	Y		5.60E-04	2.80E-04	5.1E-09	6.1E-05
Tank Group 04	PB-881-06	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-881-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-881-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-881-06	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-881-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-881-06	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-881-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-881-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-881-06	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-881-06	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-06	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-06	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-881-06	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-881-06	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-06	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-06	INORG	Lead	7439-92-1	B2	Y	1.45E+00		1.45E+00	NC	NC
Tank Group 04	PB-881-07	VOC	Benzene	71-43-2	A	Y		3.20E-02	1.60E-02	2.9E-07	3.5E-03
Tank Group 04	PB-881-07	VOC	Cumene	98-82-8	D	Y	1.20E-02		1.20E-02	NC	2.0E-04
Tank Group 04	PB-881-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.20E-02		NC	NC
Tank Group 04	PB-881-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.50E-02		NC	NC
Tank Group 04	PB-881-07	VOC	Ethyl Benzene	100-41-4	D	Y		6.50E-02	3.25E-02	NC	2.1E-04
Tank Group 04	PB-881-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.30E-01	6.50E-02	4.0E-08	1.4E-04
Tank Group 04	PB-881-07	VOC	Toluene	108-88-3	ID	Y		6.50E-02	3.25E-02	NC	4.3E-05
Tank Group 04	PB-881-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.00E+00		1.00E+00	NC	***1.1E-01***
Tank Group 04	PB-881-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.50E-01		4.50E-01	NC	4.9E-02
Tank Group 04	PB-881-07	VOC	Xylenes (total)	1330-20-7	ID	Y	6.95E-02		6.95E-02	NC	4.6E-03
Tank Group 04	PB-881-07	SVOC	Anthracene	120-12-7	ID	Y	6.30E-02		6.30E-02	NC	NC
Tank Group 04	PB-881-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.10E-02		3.10E-02	NC	NC
Tank Group 04	PB-881-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-881-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-07	SVOC	Chrysene	218-01-9	B2	Y	1.50E-01		1.50E-01	NC	NC
Tank Group 04	PB-881-07	SVOC	Fluorene	86-73-7	D	Y	4.10E-01		4.10E-01	NC	NC
Tank Group 04	PB-881-07	SVOC	Naphthalene	91-20-3	C	Y	6.00E-01		6.00E-01	4.1E-06	***1.1E-01***
Tank Group 04	PB-881-07	SVOC	Phenanthrene	85-01-8	D	Y	8.80E-01		8.80E-01	NC	NC
Tank Group 04	PB-881-07	SVOC	Pyrene	129-00-0	NC	Y	1.00E-01		1.00E-01	NC	NC
Tank Group 04	PB-881-07	INORG	Lead	7439-92-1	B2	Y	1.48E+00		1.48E+00	NC	NC
Tank Group 04	PB-881-08	VOC	Benzene	71-43-2	A	Y		5.80E-04	2.90E-04	5.3E-09	6.3E-05
Tank Group 04	PB-881-08	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-881-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-881-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-881-08	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-881-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-881-08	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-881-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-881-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-881-08	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-881-08	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-881-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-881-08	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-08	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-881-08	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-881-08	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-08	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-08	INORG	Lead	7439-92-1	B2	Y	6.67E+00		6.67E+00	NC	NC
Tank Group 04	PB-881-09	VOC	Benzene	71-43-2	A	Y		5.80E-04	2.90E-04	5.3E-09	6.3E-05
Tank Group 04	PB-881-09	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-881-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-881-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-881-09	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-881-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-881-09	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-881-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-881-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-881-09	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-881-09	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-881-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-881-09	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-09	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-881-09	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-881-09	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-09	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-09	INORG	Lead	7439-92-1	B2	Y	6.12E+00		6.12E+00	NC	NC
Tank Group 04	PB-881-10	VOC	Benzene	71-43-2	A	Y		5.20E-02	2.60E-02	4.7E-07	5.7E-03
Tank Group 04	PB-881-10	VOC	Cumene	98-82-8	D	Y	2.60E-01		2.60E-01	NC	4.3E-03
Tank Group 04	PB-881-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-02		NC	NC
Tank Group 04	PB-881-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-01		NC	NC
Tank Group 04	PB-881-10	VOC	Ethyl Benzene	100-41-4	D	Y	6.70E-02		6.70E-02	NC	4.4E-04
Tank Group 04	PB-881-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-01	1.05E-01	6.4E-08	2.3E-04
Tank Group 04	PB-881-10	VOC	Toluene	108-88-3	ID	Y		1.00E-01	5.00E-02	NC	6.5E-05
Tank Group 04	PB-881-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	9.40E+00		9.40E+00	NC	***1.0E+00***
Tank Group 04	PB-881-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	3.60E+00		3.60E+00	NC	***3.9E-01***
Tank Group 04	PB-881-10	VOC	Xylenes (total)	1330-20-7	ID	Y	4.56E-01		4.56E-01	NC	3.0E-02
Tank Group 04	PB-881-10	SVOC	Anthracene	120-12-7	ID	Y		5.10E-01	2.55E-01	NC	NC
Tank Group 04	PB-881-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.70E-01		1.70E-01	NC	NC
Tank Group 04	PB-881-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		6.90E-01	3.45E-01	NC	NC
Tank Group 04	PB-881-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		5.10E-01	2.55E-01	NC	NC
Tank Group 04	PB-881-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		6.90E-01	3.45E-01	NC	NC
Tank Group 04	PB-881-10	SVOC	Chrysene	218-01-9	B2	Y	3.40E-01		3.40E-01	NC	NC
Tank Group 04	PB-881-10	SVOC	Fluorene	86-73-7	D	Y	1.10E+00		1.10E+00	NC	NC
Tank Group 04	PB-881-10	SVOC	Naphthalene	91-20-3	C	Y	4.40E+00		4.40E+00	***3.0E-05***	***8.2E-01***
Tank Group 04	PB-881-10	SVOC	Phenanthrene	85-01-8	D	Y	1.90E+00		1.90E+00	NC	NC
Tank Group 04	PB-881-10	SVOC	Pyrene	129-00-0	NC	Y	2.30E-01		2.30E-01	NC	NC
Tank Group 04	PB-881-10	INORG	Lead	7439-92-1	B2	Y	1.22E+00		1.22E+00	NC	NC
Tank Group 04	PB-881-11	VOC	Benzene	71-43-2	A	Y		5.30E-04	2.65E-04	4.8E-09	5.8E-05
Tank Group 04	PB-881-11	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-881-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-881-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-881-11	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-881-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-881-11	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-881-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-881-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-881-11	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-881-11	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-11	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-11	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-881-11	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-881-11	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-11	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-11	INORG	Lead	7439-92-1	B2	Y	2.35E+00		2.35E+00	NC	NC
Tank Group 04	PB-881-12	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-881-12	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-881-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-881-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-881-12	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-881-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-881-12	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-881-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-12	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-881-12	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-12	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-12	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-881-12	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-881-12	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-12	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-12	INORG	Lead	7439-92-1	B2	Y	1.40E+00		1.40E+00	NC	NC
Tank Group 04	PB-881-13	VOC	Benzene	71-43-2	A	Y		4.90E-04	2.45E-04	4.5E-09	5.3E-05
Tank Group 04	PB-881-13	VOC	Cumene	98-82-8	D	Y		9.90E-04	4.95E-04	NC	8.1E-06
Tank Group 04	PB-881-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-881-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.90E-04		NC	NC
Tank Group 04	PB-881-13	VOC	Ethyl Benzene	100-41-4	D	Y		9.90E-04	4.95E-04	NC	3.2E-06
Tank Group 04	PB-881-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-881-13	VOC	Toluene	108-88-3	ID	Y		9.90E-04	4.95E-04	NC	6.5E-07
Tank Group 04	PB-881-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-13	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-881-13	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-13	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-13	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-881-13	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-881-13	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-13	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-13	INORG	Lead	7439-92-1	B2	Y	2.20E+00		2.20E+00	NC	NC
Tank Group 04	PB-881-14	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

										Routine Worker	
										Vapor Intrusion	
Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Risk	HQ
Tank Group 04	PB-881-14	VOC	Cumene	98-82-8	D	Y		9.00E-04	4.50E-04	NC	7.4E-06
Tank Group 04	PB-881-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-881-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.00E-04		NC	NC
Tank Group 04	PB-881-14	VOC	Ethyl Benzene	100-41-4	D	Y		9.00E-04	4.50E-04	NC	2.9E-06
Tank Group 04	PB-881-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-881-14	VOC	Toluene	108-88-3	ID	Y		9.00E-04	4.50E-04	NC	5.9E-07
Tank Group 04	PB-881-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-881-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-881-14	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-881-14	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-14	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-14	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-881-14	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-881-14	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-14	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-14	INORG	Lead	7439-92-1	B2	Y	2.02E+00		2.02E+00	NC	NC
Tank Group 04	PB-881-15	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-881-15	VOC	Cumene	98-82-8	D	Y		9.60E-04	4.80E-04	NC	7.9E-06
Tank Group 04	PB-881-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-881-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.60E-04		NC	NC
Tank Group 04	PB-881-15	VOC	Ethyl Benzene	100-41-4	D	Y		9.60E-04	4.80E-04	NC	3.1E-06
Tank Group 04	PB-881-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	5.40E-04		5.40E-04	3.3E-10	1.2E-06
Tank Group 04	PB-881-15	VOC	Toluene	108-88-3	ID	Y		9.60E-04	4.80E-04	NC	6.3E-07
Tank Group 04	PB-881-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-881-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-881-15	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-881-15	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-881-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-881-15	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-15	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-881-15	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-881-15	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-15	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-15	INORG	Lead	7439-92-1	B2	Y	5.85E+00		5.85E+00	NC	NC
Tank Group 04	PB-881-16	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-881-16	VOC	Cumene	98-82-8	D	Y	1.70E-04		1.70E-04	NC	2.8E-06
Tank Group 04	PB-881-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-881-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-881-16	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-881-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-881-16	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-881-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-16	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-881-16	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-881-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-881-16	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-16	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-881-16	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-881-16	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-16	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-881-16	INORG	Lead	7439-92-1	B2	Y	1.07E+01		1.07E+01	NC	NC
Tank Group 04	PB-881-17	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-881-17	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-881-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-881-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-881-17	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-881-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-881-17	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-881-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-17	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-881-17	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-17	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-17	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-881-17	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-881-17	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-17	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-17	INORG	Lead	7439-92-1	B2	Y	1.40E+00		1.40E+00	NC	NC
Tank Group 04	PB-881-18	VOC	Benzene	71-43-2	A	Y		4.90E-04	2.45E-04	4.5E-09	5.3E-05
Tank Group 04	PB-881-18	VOC	Cumene	98-82-8	D	Y		9.80E-04	4.90E-04	NC	8.0E-06
Tank Group 04	PB-881-18	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-881-18	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.80E-04		NC	NC
Tank Group 04	PB-881-18	VOC	Ethyl Benzene	100-41-4	D	Y		9.80E-04	4.90E-04	NC	3.2E-06
Tank Group 04	PB-881-18	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-881-18	VOC	Toluene	108-88-3	ID	Y		9.80E-04	4.90E-04	NC	6.4E-07
Tank Group 04	PB-881-18	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-18	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-881-18	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-881-18	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-18	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-18	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-18	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-18	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-881-18	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-18	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-881-18	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-881-18	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-18	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-881-18	INORG	Lead	7439-92-1	B2	Y	1.46E+00		1.46E+00	NC	NC
Tank Group 04	PB-882-01	VOC	Benzene	71-43-2	A	Y		5.20E-04	2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-882-01	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-882-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-882-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-882-01	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-882-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-882-01	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-882-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-882-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-882-01	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-882-01	SVOC	Anthracene	120-12-7	ID	Y		7.80E-03	3.90E-03	NC	NC
Tank Group 04	PB-882-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.40E-03		1.40E-03	NC	NC
Tank Group 04	PB-882-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		7.80E-03	3.90E-03	NC	NC
Tank Group 04	PB-882-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	7.80E-04		7.80E-04	NC	NC
Tank Group 04	PB-882-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		7.80E-03	3.90E-03	NC	NC
Tank Group 04	PB-882-01	SVOC	Chrysene	218-01-9	B2	Y	6.60E-04		6.60E-04	NC	NC
Tank Group 04	PB-882-01	SVOC	Fluorene	86-73-7	D	Y		7.80E-03	3.90E-03	NC	NC
Tank Group 04	PB-882-01	SVOC	Naphthalene	91-20-3	C	Y		7.80E-03	3.90E-03	2.6E-08	7.3E-04
Tank Group 04	PB-882-01	SVOC	Phenanthrene	85-01-8	D	Y	9.30E-04		9.30E-04	NC	NC
Tank Group 04	PB-882-01	SVOC	Pyrene	129-00-0	NC	Y	1.40E-03		1.40E-03	NC	NC
Tank Group 04	PB-882-01	INORG	Lead	7439-92-1	B2	Y	4.20E+00		4.20E+00	NC	NC
Tank Group 04	PB-882-02	VOC	Benzene	71-43-2	A	Y		4.70E-04	2.35E-04	4.3E-09	5.1E-05
Tank Group 04	PB-882-02	VOC	Cumene	98-82-8	D	Y		9.50E-04	4.75E-04	NC	7.8E-06
Tank Group 04	PB-882-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.70E-04		NC	NC
Tank Group 04	PB-882-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.50E-04		NC	NC
Tank Group 04	PB-882-02	VOC	Ethyl Benzene	100-41-4	D	Y		9.50E-04	4.75E-04	NC	3.1E-06
Tank Group 04	PB-882-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-882-02	VOC	Toluene	108-88-3	ID	Y		9.50E-04	4.75E-04	NC	6.2E-07
Tank Group 04	PB-882-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-882-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-882-02	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-882-02	SVOC	Anthracene	120-12-7	ID	Y		7.20E-03	3.60E-03	NC	NC
Tank Group 04	PB-882-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	9.40E-04		9.40E-04	NC	NC
Tank Group 04	PB-882-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		7.20E-03	3.60E-03	NC	NC
Tank Group 04	PB-882-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		7.20E-03	3.60E-03	NC	NC
Tank Group 04	PB-882-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		7.20E-03	3.60E-03	NC	NC
Tank Group 04	PB-882-02	SVOC	Chrysene	218-01-9	B2	Y		7.20E-03	3.60E-03	NC	NC
Tank Group 04	PB-882-02	SVOC	Fluorene	86-73-7	D	Y		7.20E-03	3.60E-03	NC	NC
Tank Group 04	PB-882-02	SVOC	Naphthalene	91-20-3	C	Y		7.20E-03	3.60E-03	2.4E-08	6.7E-04
Tank Group 04	PB-882-02	SVOC	Phenanthrene	85-01-8	D	Y		7.20E-03	3.60E-03	NC	NC
Tank Group 04	PB-882-02	SVOC	Pyrene	129-00-0	NC	Y		7.20E-03	3.60E-03	NC	NC
Tank Group 04	PB-882-02	INORG	Lead	7439-92-1	B2	Y	5.30E+00		5.30E+00	NC	NC
Tank Group 04	PB-882-03	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-882-03	VOC	Cumene	98-82-8	D	Y		9.00E-04	4.50E-04	NC	7.4E-06
Tank Group 04	PB-882-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-882-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.00E-04		NC	NC
Tank Group 04	PB-882-03	VOC	Ethyl Benzene	100-41-4	D	Y		9.00E-04	4.50E-04	NC	2.9E-06
Tank Group 04	PB-882-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-882-03	VOC	Toluene	108-88-3	ID	Y		9.00E-04	4.50E-04	NC	5.9E-07
Tank Group 04	PB-882-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-882-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-882-03	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-882-03	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-882-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-882-03	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-03	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-882-03	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-882-03	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-03	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-03	INORG	Lead	7439-92-1	B2	Y	9.65E+00		9.65E+00	NC	NC
Tank Group 04	PB-882-04	VOC	Benzene	71-43-2	A	Y	5.80E-04		5.80E-04	1.1E-08	1.3E-04
Tank Group 04	PB-882-04	VOC	Cumene	98-82-8	D	Y		9.50E-04	4.75E-04	NC	7.8E-06
Tank Group 04	PB-882-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-882-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.50E-04		NC	NC
Tank Group 04	PB-882-04	VOC	Ethyl Benzene	100-41-4	D	Y	1.40E-04		1.40E-04	NC	9.2E-07
Tank Group 04	PB-882-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-882-04	VOC	Toluene	108-88-3	ID	Y		9.50E-04	4.75E-04	NC	6.2E-07
Tank Group 04	PB-882-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	9.60E-04		9.60E-04	NC	1.0E-04
Tank Group 04	PB-882-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	3.80E-04		3.80E-04	NC	4.1E-05
Tank Group 04	PB-882-04	VOC	Xylenes (total)	1330-20-7	ID	Y	1.08E-03		1.08E-03	NC	7.0E-05
Tank Group 04	PB-882-04	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-04	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-04	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-882-04	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-882-04	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-04	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-04	INORG	Lead	7439-92-1	B2	Y	6.10E+00		6.10E+00	NC	NC
Tank Group 04	PB-882-05	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-882-05	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-882-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-882-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-882-05	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-882-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-882-05	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-882-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-882-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-882-05	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-882-05	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-05	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-05	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-882-05	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-882-05	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-05	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-05	INORG	Lead	7439-92-1	B2	Y	5.09E+00		5.09E+00	NC	NC
Tank Group 04	PB-882-06	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-882-06	VOC	Cumene	98-82-8	D	Y		9.10E-04	4.55E-04	NC	7.4E-06
Tank Group 04	PB-882-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-882-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.10E-04		NC	NC
Tank Group 04	PB-882-06	VOC	Ethyl Benzene	100-41-4	D	Y		9.10E-04	4.55E-04	NC	3.0E-06
Tank Group 04	PB-882-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-882-06	VOC	Toluene	108-88-3	ID	Y		9.10E-04	4.55E-04	NC	6.0E-07
Tank Group 04	PB-882-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-882-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-882-06	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-882-06	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-06	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-06	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-882-06	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-882-06	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-882-06	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-06	INORG	Lead	7439-92-1	B2	Y	5.96E+00		5.96E+00	NC	NC
Tank Group 04	PB-882-07	VOC	Benzene	71-43-2	A	Y		4.60E-04	2.30E-04	4.2E-09	5.0E-05
Tank Group 04	PB-882-07	VOC	Cumene	98-82-8	D	Y		9.10E-04	4.55E-04	NC	7.4E-06
Tank Group 04	PB-882-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-882-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.10E-04		NC	NC
Tank Group 04	PB-882-07	VOC	Ethyl Benzene	100-41-4	D	Y		9.10E-04	4.55E-04	NC	3.0E-06
Tank Group 04	PB-882-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-882-07	VOC	Toluene	108-88-3	ID	Y		9.10E-04	4.55E-04	NC	6.0E-07
Tank Group 04	PB-882-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-882-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-882-07	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-882-07	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-07	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-07	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-882-07	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-882-07	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-07	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-07	INORG	Lead	7439-92-1	B2	Y	5.62E+00		5.62E+00	NC	NC
Tank Group 04	PB-882-08	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-882-08	VOC	Cumene	98-82-8	D	Y	3.90E-02		3.90E-02	NC	6.4E-04
Tank Group 04	PB-882-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-882-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.90E-04		NC	NC
Tank Group 04	PB-882-08	VOC	Ethyl Benzene	100-41-4	D	Y	1.70E-02		1.70E-02	NC	1.1E-04
Tank Group 04	PB-882-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-882-08	VOC	Toluene	108-88-3	ID	Y		8.90E-04	4.45E-04	NC	5.8E-07
Tank Group 04	PB-882-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	4.10E-02		4.10E-02	NC	4.5E-03
Tank Group 04	PB-882-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.60E-02		1.60E-02	NC	1.7E-03
Tank Group 04	PB-882-08	VOC	Xylenes (total)	1330-20-7	ID	Y	4.95E-03		4.95E-03	NC	3.2E-04
Tank Group 04	PB-882-08	SVOC	Anthracene	120-12-7	ID	Y	4.10E-02		4.10E-02	NC	NC
Tank Group 04	PB-882-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-08	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-08	SVOC	Fluorene	86-73-7	D	Y	4.00E-01		4.00E-01	NC	NC
Tank Group 04	PB-882-08	SVOC	Naphthalene	91-20-3	C	Y	1.60E+00		1.60E+00	***1.1E-05***	***3.0E-01***
Tank Group 04	PB-882-08	SVOC	Phenanthrene	85-01-8	D	Y	7.80E-01		7.80E-01	NC	NC
Tank Group 04	PB-882-08	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-08	INORG	Lead	7439-92-1	B2	Y	3.78E+00		3.78E+00	NC	NC
Tank Group 04	PB-882-09	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-882-09	VOC	Cumene	98-82-8	D	Y	4.20E-02		4.20E-02	NC	6.9E-04
Tank Group 04	PB-882-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-882-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-882-09	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-882-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-882-09	VOC	Toluene	108-88-3	ID	Y	7.90E-04		7.90E-04	NC	1.0E-06
Tank Group 04	PB-882-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-882-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-882-09	VOC	Xylenes (total)	1330-20-7	ID	Y	2.50E-03		2.50E-03	NC	1.6E-04
Tank Group 04	PB-882-09	SVOC	Anthracene	120-12-7	ID	Y	7.60E-02		7.60E-02	NC	NC
Tank Group 04	PB-882-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.40E-02		2.40E-02	NC	NC
Tank Group 04	PB-882-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-882-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-882-09	SVOC	Chrysene	218-01-9	B2	Y	9.40E-02		9.40E-02	NC	NC
Tank Group 04	PB-882-09	SVOC	Fluorene	86-73-7	D	Y	9.90E-01		9.90E-01	NC	NC
Tank Group 04	PB-882-09	SVOC	Naphthalene	91-20-3	C	Y	6.00E-02		6.00E-02	4.1E-07	1.1E-02
Tank Group 04	PB-882-09	SVOC	Phenanthrene	85-01-8	D	Y	1.70E+00		1.70E+00	NC	NC
Tank Group 04	PB-882-09	SVOC	Pyrene	129-00-0	NC	Y	6.20E-02		6.20E-02	NC	NC
Tank Group 04	PB-882-09	INORG	Lead	7439-92-1	B2	Y	4.45E+00		4.45E+00	NC	NC
Tank Group 04	PB-882-10	VOC	Benzene	71-43-2	A	Y		9.50E-02	4.75E-02	8.7E-07	1.0E-02
Tank Group 04	PB-882-10	VOC	Cumene	98-82-8	D	Y	1.20E+00		1.20E+00	NC	2.0E-02
Tank Group 04	PB-882-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		9.50E-02		NC	NC
Tank Group 04	PB-882-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.90E-01		NC	NC
Tank Group 04	PB-882-10	VOC	Ethyl Benzene	100-41-4	D	Y		1.90E-01	9.50E-02	NC	6.2E-04
Tank Group 04	PB-882-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.80E-01	1.90E-01	1.2E-07	4.1E-04
Tank Group 04	PB-882-10	VOC	Toluene	108-88-3	ID	Y		1.90E-01	9.50E-02	NC	1.2E-04
Tank Group 04	PB-882-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.80E-01	1.90E-01	NC	2.1E-02
Tank Group 04	PB-882-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.80E-01	1.90E-01	NC	2.1E-02
Tank Group 04	PB-882-10	VOC	Xylenes (total)	1330-20-7	ID	Y		3.80E-01	1.90E-01	NC	1.2E-02
Tank Group 04	PB-882-10	SVOC	Anthracene	120-12-7	ID	Y	6.80E-02		6.80E-02	NC	NC
Tank Group 04	PB-882-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.20E-02		2.20E-02	NC	NC
Tank Group 04	PB-882-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.40E-02		1.40E-02	NC	NC
Tank Group 04	PB-882-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	2.80E-02		2.80E-02	NC	NC
Tank Group 04	PB-882-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	1.80E-02		1.80E-02	NC	NC
Tank Group 04	PB-882-10	SVOC	Chrysene	218-01-9	B2	Y	2.70E-01		2.70E-01	NC	NC
Tank Group 04	PB-882-10	SVOC	Fluorene	86-73-7	D	Y	5.70E-01		5.70E-01	NC	NC
Tank Group 04	PB-882-10	SVOC	Naphthalene	91-20-3	C	Y	1.60E-01		1.60E-01	1.1E-06	3.0E-02
Tank Group 04	PB-882-10	SVOC	Phenanthrene	85-01-8	D	Y	1.40E+00		1.40E+00	NC	NC
Tank Group 04	PB-882-10	SVOC	Pyrene	129-00-0	NC	Y	8.30E-02		8.30E-02	NC	NC
Tank Group 04	PB-882-10	INORG	Lead	7439-92-1	B2	Y		1.20E+01	6.00E+00	NC	NC
Tank Group 04	PB-882-11	VOC	Benzene	71-43-2	A	Y	3.20E-04		3.20E-04	5.8E-09	7.0E-05
Tank Group 04	PB-882-11	VOC	Cumene	98-82-8	D	Y	1.00E-04		1.00E-04	NC	1.6E-06
Tank Group 04	PB-882-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-882-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.70E-04		NC	NC
Tank Group 04	PB-882-11	VOC	Ethyl Benzene	100-41-4	D	Y		8.70E-04	4.35E-04	NC	2.8E-06
Tank Group 04	PB-882-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.60E-03		1.60E-03	9.7E-10	3.5E-06
Tank Group 04	PB-882-11	VOC	Toluene	108-88-3	ID	Y		8.70E-04	4.35E-04	NC	5.7E-07
Tank Group 04	PB-882-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-882-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-882-11	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-882-11	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-11	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-11	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-882-11	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-882-11	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-11	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-11	INORG	Lead	7439-92-1	B2	Y	5.69E+00		5.69E+00	NC	NC
Tank Group 04	PB-882-12	VOC	Benzene	71-43-2	A	Y	3.70E-04		3.70E-04	6.8E-09	8.1E-05
Tank Group 04	PB-882-12	VOC	Cumene	98-82-8	D	Y		8.50E-04	4.25E-04	NC	7.0E-06
Tank Group 04	PB-882-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-882-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.50E-04		NC	NC
Tank Group 04	PB-882-12	VOC	Ethyl Benzene	100-41-4	D	Y		8.50E-04	4.25E-04	NC	2.8E-06
Tank Group 04	PB-882-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-882-12	VOC	Toluene	108-88-3	ID	Y		8.50E-04	4.25E-04	NC	5.6E-07

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-882-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-882-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-882-12	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-882-12	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-12	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-12	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-882-12	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-882-12	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-12	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-882-12	INORG	Lead	7439-92-1	B2	Y	7.37E+00		7.37E+00	NC	NC
Tank Group 04	PB-882-13	VOC	Benzene	71-43-2	A	Y		4.60E-04	2.30E-04	4.2E-09	5.0E-05
Tank Group 04	PB-882-13	VOC	Cumene	98-82-8	D	Y		9.20E-04	4.60E-04	NC	7.5E-06
Tank Group 04	PB-882-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-882-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.20E-04		NC	NC
Tank Group 04	PB-882-13	VOC	Ethyl Benzene	100-41-4	D	Y		9.20E-04	4.60E-04	NC	3.0E-06
Tank Group 04	PB-882-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-882-13	VOC	Toluene	108-88-3	ID	Y		9.20E-04	4.60E-04	NC	6.0E-07
Tank Group 04	PB-882-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-882-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-882-13	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-882-13	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-882-13	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-13	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-882-13	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-882-13	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-13	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-882-13	INORG	Lead	7439-92-1	B2	Y	5.83E+00		5.83E+00	NC	NC
Tank Group 04	PB-882-14	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-882-14	VOC	Cumene	98-82-8	D	Y	3.10E-03		3.10E-03	NC	5.1E-05
Tank Group 04	PB-882-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-882-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-882-14	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-882-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-882-14	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-882-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	7.70E-03		7.70E-03	NC	8.4E-04
Tank Group 04	PB-882-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	5.00E-03		5.00E-03	NC	5.5E-04
Tank Group 04	PB-882-14	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-882-14	SVOC	Anthracene	120-12-7	ID	Y		1.60E-02	8.00E-03	NC	NC
Tank Group 04	PB-882-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.50E-02		3.50E-02	NC	NC
Tank Group 04	PB-882-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.80E-02		1.80E-02	NC	NC
Tank Group 04	PB-882-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	2.00E-02		2.00E-02	NC	NC
Tank Group 04	PB-882-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	9.70E-03		9.70E-03	NC	NC
Tank Group 04	PB-882-14	SVOC	Chrysene	218-01-9	B2	Y	1.60E-01		1.60E-01	NC	NC
Tank Group 04	PB-882-14	SVOC	Fluorene	86-73-7	D	Y	2.90E-01		2.90E-01	NC	NC
Tank Group 04	PB-882-14	SVOC	Naphthalene	91-20-3	C	Y	1.30E-01		1.30E-01	8.8E-07	2.4E-02
Tank Group 04	PB-882-14	SVOC	Phenanthrene	85-01-8	D	Y	8.40E-01		8.40E-01	NC	NC
Tank Group 04	PB-882-14	SVOC	Pyrene	129-00-0	NC	Y	5.00E-02		5.00E-02	NC	NC
Tank Group 04	PB-882-14	INORG	Lead	7439-92-1	B2	Y	7.00E+00		7.00E+00	NC	NC
Tank Group 04	PB-882-15	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-882-15	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-882-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-882-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-882-15	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-882-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-882-15	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-882-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-882-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-882-15	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-882-15	SVOC	Anthracene	120-12-7	ID	Y	2.40E-02		2.40E-02	NC	NC
Tank Group 04	PB-882-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.00E-02		3.00E-02	NC	NC
Tank Group 04	PB-882-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.90E-02		1.90E-02	NC	NC
Tank Group 04	PB-882-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	2.40E-02		2.40E-02	NC	NC
Tank Group 04	PB-882-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	7.60E-03		7.60E-03	NC	NC
Tank Group 04	PB-882-15	SVOC	Chrysene	218-01-9	B2	Y	2.30E-02		2.30E-02	NC	NC
Tank Group 04	PB-882-15	SVOC	Fluorene	86-73-7	D	Y	1.50E-02		1.50E-02	NC	NC
Tank Group 04	PB-882-15	SVOC	Naphthalene	91-20-3	C	Y	9.40E-03		9.40E-03	6.4E-08	1.7E-03
Tank Group 04	PB-882-15	SVOC	Phenanthrene	85-01-8	D	Y	7.90E-02		7.90E-02	NC	NC
Tank Group 04	PB-882-15	SVOC	Pyrene	129-00-0	NC	Y	4.70E-02		4.70E-02	NC	NC
Tank Group 04	PB-882-15	INORG	Lead	7439-92-1	B2	Y	1.94E+01		1.94E+01	NC	NC
Tank Group 04	PB-882-16	VOC	Benzene	71-43-2	A	Y		5.00E-02	2.50E-02	4.6E-07	5.5E-03
Tank Group 04	PB-882-16	VOC	Cumene	98-82-8	D	Y	6.40E+00		6.40E+00	NC	1.0E-01
Tank Group 04	PB-882-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-02		NC	NC
Tank Group 04	PB-882-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-01		NC	NC
Tank Group 04	PB-882-16	VOC	Ethyl Benzene	100-41-4	D	Y	1.70E+01		1.70E+01	NC	***1.1E-01***
Tank Group 04	PB-882-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-01	1.00E-01	6.1E-08	2.2E-04
Tank Group 04	PB-882-16	VOC	Toluene	108-88-3	ID	Y		1.00E-01	5.00E-02	NC	6.5E-05
Tank Group 04	PB-882-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	6.40E+01		6.40E+01	NC	**7.0E+00**
Tank Group 04	PB-882-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.80E+01		1.80E+01	NC	**2.0E+00**
Tank Group 04	PB-882-16	VOC	Xylenes (total)	1330-20-7	ID	Y	3.92E+01		3.92E+01	NC	**2.6E+00**
Tank Group 04	PB-882-16	SVOC	Anthracene	120-12-7	ID	Y		7.70E-02	3.85E-02	NC	NC
Tank Group 04	PB-882-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	7.00E-02		7.00E-02	NC	NC
Tank Group 04	PB-882-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	3.60E-02		3.60E-02	NC	NC
Tank Group 04	PB-882-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	4.70E-02		4.70E-02	NC	NC
Tank Group 04	PB-882-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	3.50E-02		3.50E-02	NC	NC
Tank Group 04	PB-882-16	SVOC	Chrysene	218-01-9	B2	Y	4.40E-01		4.40E-01	NC	NC
Tank Group 04	PB-882-16	SVOC	Fluorene	86-73-7	D	Y	7.80E-01		7.80E-01	NC	NC
Tank Group 04	PB-882-16	SVOC	Naphthalene	91-20-3	C	Y	4.20E+00		4.20E+00	***2.8E-05***	***7.8E-01***
Tank Group 04	PB-882-16	SVOC	Phenanthrene	85-01-8	D	Y	2.30E+00		2.30E+00	NC	NC
Tank Group 04	PB-882-16	SVOC	Pyrene	129-00-0	NC	Y	1.60E-01		1.60E-01	NC	NC
Tank Group 04	PB-882-16	INORG	Lead	7439-92-1	B2	Y	1.13E+01		1.13E+01	NC	NC
Tank Group 04	PB-882-17	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-882-17	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-882-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-882-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-882-17	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-882-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-882-17	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-882-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-882-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-882-17	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-882-17	SVOC	Anthracene	120-12-7	ID	Y		1.40E-02	7.00E-03	NC	NC
Tank Group 04	PB-882-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	6.90E-03		6.90E-03	NC	NC
Tank Group 04	PB-882-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	2.00E-03		2.00E-03	NC	NC
Tank Group 04	PB-882-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	4.80E-03		4.80E-03	NC	NC
Tank Group 04	PB-882-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	2.00E-03		2.00E-03	NC	NC
Tank Group 04	PB-882-17	SVOC	Chrysene	218-01-9	B2	Y	2.80E-02		2.80E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-882-17	SVOC	Fluorene	86-73-7	D	Y	8.80E-02		8.80E-02	NC	NC
Tank Group 04	PB-882-17	SVOC	Naphthalene	91-20-3	C	Y	9.60E-03		9.60E-03	6.5E-08	1.8E-03
Tank Group 04	PB-882-17	SVOC	Phenanthrene	85-01-8	D	Y	1.10E-01		1.10E-01	NC	NC
Tank Group 04	PB-882-17	SVOC	Pyrene	129-00-0	NC	Y	8.90E-03		8.90E-03	NC	NC
Tank Group 04	PB-882-17	INORG	Lead	7439-92-1	B2	Y	3.90E+00		3.90E+00	NC	NC
Tank Group 04	PB-882-18	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-882-18	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-882-18	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-882-18	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-882-18	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-882-18	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-882-18	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-882-18	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-882-18	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-882-18	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-882-18	SVOC	Anthracene	120-12-7	ID	Y	7.50E-04		7.50E-04	NC	NC
Tank Group 04	PB-882-18	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		7.90E-03	3.95E-03	NC	NC
Tank Group 04	PB-882-18	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		7.90E-03	3.95E-03	NC	NC
Tank Group 04	PB-882-18	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		7.90E-03	3.95E-03	NC	NC
Tank Group 04	PB-882-18	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		7.90E-03	3.95E-03	NC	NC
Tank Group 04	PB-882-18	SVOC	Chrysene	218-01-9	B2	Y		7.90E-03	3.95E-03	NC	NC
Tank Group 04	PB-882-18	SVOC	Fluorene	86-73-7	D	Y		7.90E-03	3.95E-03	NC	NC
Tank Group 04	PB-882-18	SVOC	Naphthalene	91-20-3	C	Y		7.90E-03	3.95E-03	2.7E-08	7.4E-04
Tank Group 04	PB-882-18	SVOC	Phenanthrene	85-01-8	D	Y	4.10E-03		4.10E-03	NC	NC
Tank Group 04	PB-882-18	SVOC	Pyrene	129-00-0	NC	Y	2.00E-03		2.00E-03	NC	NC
Tank Group 04	PB-882-18	INORG	Lead	7439-92-1	B2	Y	1.13E+01		1.13E+01	NC	NC
Tank Group 04	PB-882-19	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-882-19	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-882-19	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-882-19	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-882-19	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-882-19	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-882-19	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-882-19	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-882-19	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-882-19	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-882-19	SVOC	Anthracene	120-12-7	ID	Y		8.20E-03	4.10E-03	NC	NC
Tank Group 04	PB-882-19	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		8.20E-03	4.10E-03	NC	NC
Tank Group 04	PB-882-19	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		8.20E-03	4.10E-03	NC	NC
Tank Group 04	PB-882-19	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		8.20E-03	4.10E-03	NC	NC
Tank Group 04	PB-882-19	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		8.20E-03	4.10E-03	NC	NC
Tank Group 04	PB-882-19	SVOC	Chrysene	218-01-9	B2	Y		8.20E-03	4.10E-03	NC	NC
Tank Group 04	PB-882-19	SVOC	Fluorene	86-73-7	D	Y		8.20E-03	4.10E-03	NC	NC
Tank Group 04	PB-882-19	SVOC	Naphthalene	91-20-3	C	Y		8.20E-03	4.10E-03	2.8E-08	7.6E-04
Tank Group 04	PB-882-19	SVOC	Phenanthrene	85-01-8	D	Y	1.40E-03		1.40E-03	NC	NC
Tank Group 04	PB-882-19	SVOC	Pyrene	129-00-0	NC	Y		8.20E-03	4.10E-03	NC	NC
Tank Group 04	PB-882-19	INORG	Lead	7439-92-1	B2	Y	1.00E+01		1.00E+01	NC	NC
Tank Group 04	PB-882-20	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-882-20	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-882-20	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-882-20	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-882-20	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-882-20	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-882-20	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-882-20	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-882-20	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-882-20	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-882-20	SVOC	Anthracene	120-12-7	ID	Y		1.60E-02	8.00E-03	NC	NC
Tank Group 04	PB-882-20	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	7.60E-02		7.60E-02	NC	NC
Tank Group 04	PB-882-20	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	4.00E-02		4.00E-02	NC	NC
Tank Group 04	PB-882-20	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	7.40E-02		7.40E-02	NC	NC
Tank Group 04	PB-882-20	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	3.80E-02		3.80E-02	NC	NC
Tank Group 04	PB-882-20	SVOC	Chrysene	218-01-9	B2	Y	4.20E-01		4.20E-01	NC	NC
Tank Group 04	PB-882-20	SVOC	Fluorene	86-73-7	D	Y	4.60E-01		4.60E-01	NC	NC
Tank Group 04	PB-882-20	SVOC	Naphthalene	91-20-3	C	Y	6.20E-02		6.20E-02	4.2E-07	1.2E-02
Tank Group 04	PB-882-20	SVOC	Phenanthrene	85-01-8	D	Y	1.20E+00		1.20E+00	NC	NC
Tank Group 04	PB-882-20	SVOC	Pyrene	129-00-0	NC	Y	1.40E-01		1.40E-01	NC	NC
Tank Group 04	PB-882-20	INORG	Lead	7439-92-1	B2	Y	7.36E+01		7.36E+01	NC	NC
Tank Group 04	PB-883-01	VOC	Benzene	71-43-2	A	Y	2.60E-04		2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-883-01	VOC	Cumene	98-82-8	D	Y	1.80E-04		1.80E-04	NC	2.9E-06
Tank Group 04	PB-883-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-883-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-883-01	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-883-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	3.20E-04		3.20E-04	1.9E-10	7.0E-07
Tank Group 04	PB-883-01	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-883-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-883-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-883-01	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-883-01	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-01	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-01	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-01	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-01	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-01	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-01	INORG	Lead	7439-92-1	B2	Y	7.61E+00		7.61E+00	NC	NC
Tank Group 04	PB-883-02	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-883-02	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-883-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-883-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-883-02	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-883-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.80E-03		1.80E-03	1.1E-09	3.9E-06
Tank Group 04	PB-883-02	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-883-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-02	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-883-02	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-02	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-02	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-02	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-02	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-02	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-02	INORG	Lead	7439-92-1	B2	Y	6.88E+00		6.88E+00	NC	NC
Tank Group 04	PB-883-03	VOC	Benzene	71-43-2	A	Y	4.10E-04		4.10E-04	7.5E-09	9.0E-05
Tank Group 04	PB-883-03	VOC	Cumene	98-82-8	D	Y		8.20E-04	4.10E-04	NC	6.7E-06
Tank Group 04	PB-883-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.10E-04		NC	NC
Tank Group 04	PB-883-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.20E-04		NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-883-03	VOC	Ethyl Benzene	100-41-4	D	Y		8.20E-04	4.10E-04	NC	2.7E-06
Tank Group 04	PB-883-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	2.00E-03		2.00E-03	1.2E-09	4.4E-06
Tank Group 04	PB-883-03	VOC	Toluene	108-88-3	ID	Y		8.20E-04	4.10E-04	NC	5.4E-07
Tank Group 04	PB-883-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.60E-03	8.00E-04	NC	8.7E-05
Tank Group 04	PB-883-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.60E-03	8.00E-04	NC	8.7E-05
Tank Group 04	PB-883-03	VOC	Xylenes (total)	1330-20-7	ID	Y		1.60E-03	8.00E-04	NC	5.2E-05
Tank Group 04	PB-883-03	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-03	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-03	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-883-03	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-883-03	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-03	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-03	INORG	Lead	7439-92-1	B2	Y	5.82E+00		5.82E+00	NC	NC
Tank Group 04	PB-883-04	VOC	Benzene	71-43-2	A	Y		4.90E-04	2.45E-04	4.5E-09	5.3E-05
Tank Group 04	PB-883-04	VOC	Cumene	98-82-8	D	Y		9.80E-04	4.90E-04	NC	8.0E-06
Tank Group 04	PB-883-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-883-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.80E-04		NC	NC
Tank Group 04	PB-883-04	VOC	Ethyl Benzene	100-41-4	D	Y		9.80E-04	4.90E-04	NC	3.2E-06
Tank Group 04	PB-883-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-883-04	VOC	Toluene	108-88-3	ID	Y		9.80E-04	4.90E-04	NC	6.4E-07
Tank Group 04	PB-883-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-04	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-883-04	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-04	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-04	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-883-04	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-883-04	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-04	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-04	INORG	Lead	7439-92-1	B2	Y	6.16E+00		6.16E+00	NC	NC
Tank Group 04	PB-883-05	VOC	Benzene	71-43-2	A	Y	3.00E-04		3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-883-05	VOC	Cumene	98-82-8	D	Y	2.00E-04		2.00E-04	NC	3.3E-06
Tank Group 04	PB-883-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-883-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.10E-04		NC	NC
Tank Group 04	PB-883-05	VOC	Ethyl Benzene	100-41-4	D	Y		9.10E-04	4.55E-04	NC	3.0E-06
Tank Group 04	PB-883-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	4.20E-03		4.20E-03	2.6E-09	9.2E-06
Tank Group 04	PB-883-05	VOC	Toluene	108-88-3	ID	Y		9.10E-04	4.55E-04	NC	6.0E-07
Tank Group 04	PB-883-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	3.40E-04		3.40E-04	NC	3.7E-05
Tank Group 04	PB-883-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	8.40E-04		8.40E-04	NC	9.2E-05
Tank Group 04	PB-883-05	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-883-05	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-05	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-05	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-883-05	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-883-05	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-05	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-05	INORG	Lead	7439-92-1	B2	Y	6.72E+00		6.72E+00	NC	NC
Tank Group 04	PB-883-06	VOC	Benzene	71-43-2	A	Y		5.30E-04	2.65E-04	4.8E-09	5.8E-05
Tank Group 04	PB-883-06	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-883-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-883-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-883-06	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-883-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	4.80E-04		4.80E-04	2.9E-10	1.0E-06
Tank Group 04	PB-883-06	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-883-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-883-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-883-06	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-883-06	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-06	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-06	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-883-06	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-883-06	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-06	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-06	INORG	Lead	7439-92-1	B2	Y	6.14E+00		6.14E+00	NC	NC
Tank Group 04	PB-883-07	VOC	Benzene	71-43-2	A	Y	2.60E-04		2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-883-07	VOC	Cumene	98-82-8	D	Y	2.10E-04		2.10E-04	NC	3.4E-06
Tank Group 04	PB-883-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-883-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-883-07	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-883-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.60E-03		1.60E-03	9.7E-10	3.5E-06
Tank Group 04	PB-883-07	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-883-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	4.10E-04		4.10E-04	NC	4.5E-05
Tank Group 04	PB-883-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	2.50E-04		2.50E-04	NC	2.7E-05
Tank Group 04	PB-883-07	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-883-07	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-07	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-07	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-07	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-07	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-07	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-07	INORG	Lead	7439-92-1	B2	Y	1.39E+01		1.39E+01	NC	NC
Tank Group 04	PB-883-08	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-883-08	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-883-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-883-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-883-08	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-883-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-883-08	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-883-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-883-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-883-08	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-883-08	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-883-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-08	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-08	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-08	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-08	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-08	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-08	INORG	Lead	7439-92-1	B2	Y	1.28E+01		1.28E+01	NC	NC
Tank Group 04	PB-883-09	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-883-09	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-883-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-883-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-883-09	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-883-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-883-09	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-883-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-09	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-883-09	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-883-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-883-09	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-09	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-883-09	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-883-09	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-09	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-09	INORG	Lead	7439-92-1	B2	Y	2.18E+00		2.18E+00	NC	NC
Tank Group 04	PB-883-10	VOC	Benzene	71-43-2	A	Y		4.40E-04	2.20E-04	4.0E-09	4.8E-05
Tank Group 04	PB-883-10	VOC	Cumene	98-82-8	D	Y		8.90E-04	4.45E-04	NC	7.3E-06
Tank Group 04	PB-883-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.40E-04		NC	NC
Tank Group 04	PB-883-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.90E-04		NC	NC
Tank Group 04	PB-883-10	VOC	Ethyl Benzene	100-41-4	D	Y		8.90E-04	4.45E-04	NC	2.9E-06
Tank Group 04	PB-883-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-883-10	VOC	Toluene	108-88-3	ID	Y		8.90E-04	4.45E-04	NC	5.8E-07
Tank Group 04	PB-883-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-883-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-883-10	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-883-10	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-10	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-10	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-883-10	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-883-10	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-10	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-10	INORG	Lead	7439-92-1	B2	Y	4.67E+00		4.67E+00	NC	NC
Tank Group 04	PB-883-11	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-883-11	VOC	Cumene	98-82-8	D	Y		9.50E-04	4.75E-04	NC	7.8E-06
Tank Group 04	PB-883-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-883-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.50E-04		NC	NC
Tank Group 04	PB-883-11	VOC	Ethyl Benzene	100-41-4	D	Y		9.50E-04	4.75E-04	NC	3.1E-06
Tank Group 04	PB-883-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-883-11	VOC	Toluene	108-88-3	ID	Y		9.50E-04	4.75E-04	NC	6.2E-07
Tank Group 04	PB-883-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-883-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-883-11	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-883-11	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-11	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-11	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-883-11	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-883-11	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-11	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-11	INORG	Lead	7439-92-1	B2	Y	4.25E+00		4.25E+00	NC	NC
Tank Group 04	PB-883-12	VOC	Benzene	71-43-2	A	Y		5.70E-04	2.85E-04	5.2E-09	6.2E-05
Tank Group 04	PB-883-12	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-883-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.70E-04		NC	NC
Tank Group 04	PB-883-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-883-12	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-883-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-883-12	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-883-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-883-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-883-12	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-883-12	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-12	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-12	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-12	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-12	SVOC	Phenanthrene	85-01-8	D	Y	2.80E-02		2.80E-02	NC	NC
Tank Group 04	PB-883-12	SVOC	Pyrene	129-00-0	NC	Y	2.10E-02		2.10E-02	NC	NC
Tank Group 04	PB-883-12	INORG	Lead	7439-92-1	B2	Y	1.10E+01		1.10E+01	NC	NC
Tank Group 04	PB-883-13	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-883-13	VOC	Cumene	98-82-8	D	Y		9.60E-04	4.80E-04	NC	7.9E-06
Tank Group 04	PB-883-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-883-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.60E-04		NC	NC
Tank Group 04	PB-883-13	VOC	Ethyl Benzene	100-41-4	D	Y		9.60E-04	4.80E-04	NC	3.1E-06
Tank Group 04	PB-883-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-883-13	VOC	Toluene	108-88-3	ID	Y		9.60E-04	4.80E-04	NC	6.3E-07
Tank Group 04	PB-883-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-883-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-883-13	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-883-13	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-13	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-13	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-13	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-13	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-13	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-13	INORG	Lead	7439-92-1	B2	Y	6.72E+00		6.72E+00	NC	NC
Tank Group 04	PB-883-14	VOC	Benzene	71-43-2	A	Y		6.20E-04	3.10E-04	5.7E-09	6.8E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-883-14	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-883-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.20E-04		NC	NC
Tank Group 04	PB-883-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-883-14	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-883-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.50E-03	1.25E-03	7.6E-10	2.7E-06
Tank Group 04	PB-883-14	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-883-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-883-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-883-14	VOC	Xylenes (total)	1330-20-7	ID	Y		2.50E-03	1.25E-03	NC	8.2E-05
Tank Group 04	PB-883-14	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-14	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-14	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-883-14	SVOC	Naphthalene	91-20-3	C	Y		2.10E-01	1.05E-01	7.1E-07	2.0E-02
Tank Group 04	PB-883-14	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-14	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-14	INORG	Lead	7439-92-1	B2	Y	5.14E+00		5.14E+00	NC	NC
Tank Group 04	PB-883-15	VOC	Benzene	71-43-2	A	Y	2.50E-04		2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-883-15	VOC	Cumene	98-82-8	D	Y		9.50E-04	4.75E-04	NC	7.8E-06
Tank Group 04	PB-883-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-883-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.50E-04		NC	NC
Tank Group 04	PB-883-15	VOC	Ethyl Benzene	100-41-4	D	Y		9.50E-04	4.75E-04	NC	3.1E-06
Tank Group 04	PB-883-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	1.80E-03		1.80E-03	1.1E-09	3.9E-06
Tank Group 04	PB-883-15	VOC	Toluene	108-88-3	ID	Y		9.50E-04	4.75E-04	NC	6.2E-07
Tank Group 04	PB-883-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-883-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-883-15	VOC	Xylenes (total)	1330-20-7	ID	Y	1.25E-03		1.25E-03	NC	8.2E-05
Tank Group 04	PB-883-15	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-15	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-15	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-15	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-15	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-15	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-15	INORG	Lead	7439-92-1	B2	Y	8.06E+00		8.06E+00	NC	NC
Tank Group 04	PB-883-16	VOC	Benzene	71-43-2	A	Y		5.60E-04	2.80E-04	5.1E-09	6.1E-05
Tank Group 04	PB-883-16	VOC	Cumene	98-82-8	D	Y	1.90E-04		1.90E-04	NC	3.1E-06
Tank Group 04	PB-883-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-883-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-883-16	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-883-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-883-16	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-883-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-883-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-883-16	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-883-16	SVOC	Anthracene	120-12-7	ID	Y		5.90E-01	2.95E-01	NC	NC
Tank Group 04	PB-883-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		5.90E-01	2.95E-01	NC	NC
Tank Group 04	PB-883-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		7.90E-01	3.95E-01	NC	NC
Tank Group 04	PB-883-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		5.90E-01	2.95E-01	NC	NC
Tank Group 04	PB-883-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		7.90E-01	3.95E-01	NC	NC
Tank Group 04	PB-883-16	SVOC	Chrysene	218-01-9	B2	Y	4.30E-01		4.30E-01	NC	NC
Tank Group 04	PB-883-16	SVOC	Fluorene	86-73-7	D	Y		9.90E-01	4.95E-01	NC	NC
Tank Group 04	PB-883-16	SVOC	Naphthalene	91-20-3	C	Y		9.90E-01	4.95E-01	3.4E-06	9.2E-02
Tank Group 04	PB-883-16	SVOC	Phenanthrene	85-01-8	D	Y		5.90E-01	2.95E-01	NC	NC
Tank Group 04	PB-883-16	SVOC	Pyrene	129-00-0	NC	Y	3.60E-01		3.60E-01	NC	NC
Tank Group 04	PB-883-16	INORG	Lead	7439-92-1	B2	Y	8.62E+00		8.62E+00	NC	NC
Tank Group 04	PB-883-17	VOC	Benzene	71-43-2	A	Y		6.40E-04	3.20E-04	5.8E-09	7.0E-05
Tank Group 04	PB-883-17	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-883-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.40E-04		NC	NC
Tank Group 04	PB-883-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-883-17	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-883-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.60E-03	1.30E-03	7.9E-10	2.8E-06
Tank Group 04	PB-883-17	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-883-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-883-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-883-17	VOC	Xylenes (total)	1330-20-7	ID	Y		2.60E-03	1.30E-03	NC	8.5E-05
Tank Group 04	PB-883-17	SVOC	Anthracene	120-12-7	ID	Y		5.40E-01	2.70E-01	NC	NC
Tank Group 04	PB-883-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.30E-01		1.30E-01	NC	NC
Tank Group 04	PB-883-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		7.20E-01	3.60E-01	NC	NC
Tank Group 04	PB-883-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		5.40E-01	2.70E-01	NC	NC
Tank Group 04	PB-883-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		7.20E-01	3.60E-01	NC	NC
Tank Group 04	PB-883-17	SVOC	Chrysene	218-01-9	B2	Y	3.60E-01		3.60E-01	NC	NC
Tank Group 04	PB-883-17	SVOC	Fluorene	86-73-7	D	Y	2.90E-01		2.90E-01	NC	NC
Tank Group 04	PB-883-17	SVOC	Naphthalene	91-20-3	C	Y		9.00E-01	4.50E-01	3.1E-06	8.4E-02
Tank Group 04	PB-883-17	SVOC	Phenanthrene	85-01-8	D	Y	4.30E-01		4.30E-01	NC	NC
Tank Group 04	PB-883-17	SVOC	Pyrene	129-00-0	NC	Y	2.00E-01		2.00E-01	NC	NC
Tank Group 04	PB-883-17	INORG	Lead	7439-92-1	B2	Y	7.06E+00		7.06E+00	NC	NC
Tank Group 04	PB-883-18	VOC	Benzene	71-43-2	A	Y		3.20E-02	1.60E-02	2.9E-07	3.5E-03
Tank Group 04	PB-883-18	VOC	Cumene	98-82-8	D	Y	8.20E-01		8.20E-01	NC	1.3E-02
Tank Group 04	PB-883-18	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.20E-02		NC	NC
Tank Group 04	PB-883-18	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.40E-02		NC	NC
Tank Group 04	PB-883-18	VOC	Ethyl Benzene	100-41-4	D	Y		6.40E-02	3.20E-02	NC	2.1E-04
Tank Group 04	PB-883-18	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.30E-01	6.50E-02	4.0E-08	1.4E-04
Tank Group 04	PB-883-18	VOC	Toluene	108-88-3	ID	Y		6.40E-02	3.20E-02	NC	4.2E-05
Tank Group 04	PB-883-18	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	4.00E-02		4.00E-02	NC	4.4E-03
Tank Group 04	PB-883-18	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.30E-01	6.50E-02	NC	7.1E-03
Tank Group 04	PB-883-18	VOC	Xylenes (total)	1330-20-7	ID	Y	1.09E-01		1.09E-01	NC	7.1E-03
Tank Group 04	PB-883-18	SVOC	Anthracene	120-12-7	ID	Y		5.40E-01	2.70E-01	NC	NC
Tank Group 04	PB-883-18	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		5.40E-01	2.70E-01	NC	NC
Tank Group 04	PB-883-18	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		7.20E-01	3.60E-01	NC	NC
Tank Group 04	PB-883-18	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		5.40E-01	2.70E-01	NC	NC
Tank Group 04	PB-883-18	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		7.20E-01	3.60E-01	NC	NC
Tank Group 04	PB-883-18	SVOC	Chrysene	218-01-9	B2	Y	3.70E-01		3.70E-01	NC	NC
Tank Group 04	PB-883-18	SVOC	Fluorene	86-73-7	D	Y	2.50E-01		2.50E-01	NC	NC
Tank Group 04	PB-883-18	SVOC	Naphthalene	91-20-3	C	Y		9.10E-01	4.55E-01	3.1E-06	8.5E-02
Tank Group 04	PB-883-18	SVOC	Phenanthrene	85-01-8	D	Y	5.20E-01		5.20E-01	NC	NC
Tank Group 04	PB-883-18	SVOC	Pyrene	129-00-0	NC	Y	1.90E-01		1.90E-01	NC	NC
Tank Group 04	PB-883-18	INORG	Lead	7439-92-1	B2	Y	6.49E+00		6.49E+00	NC	NC
Tank Group 04	PB-883-19	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-883-19	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-883-19	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-883-19	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-883-19	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-883-19	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-883-19	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-883-19	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-19	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-19	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-883-19	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-19	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-19	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-883-19	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-19	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-883-19	SVOC	Chrysene	218-01-9	B2	Y	2.70E-02		2.70E-02	NC	NC
Tank Group 04	PB-883-19	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-883-19	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-883-19	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-19	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-883-19	INORG	Lead	7439-92-1	B2	Y	7.75E+00		7.75E+00	NC	NC
Tank Group 04	PB-883-20	VOC	Benzene	71-43-2	A	Y	4.50E-04		4.50E-04	8.2E-09	9.8E-05
Tank Group 04	PB-883-20	VOC	Cumene	98-82-8	D	Y	2.90E-04		2.90E-04	NC	4.7E-06
Tank Group 04	PB-883-20	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-883-20	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.70E-04		NC	NC
Tank Group 04	PB-883-20	VOC	Ethyl Benzene	100-41-4	D	Y		9.70E-04	4.85E-04	NC	3.2E-06
Tank Group 04	PB-883-20	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	5.10E-03		5.10E-03	3.1E-09	1.1E-05
Tank Group 04	PB-883-20	VOC	Toluene	108-88-3	ID	Y		9.70E-04	4.85E-04	NC	6.4E-07
Tank Group 04	PB-883-20	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	8.90E-04		8.90E-04	NC	9.7E-05
Tank Group 04	PB-883-20	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.80E-04		4.80E-04	NC	5.2E-05
Tank Group 04	PB-883-20	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-883-20	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-20	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-20	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-20	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-20	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-20	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-20	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-20	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-20	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-20	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-20	INORG	Lead	7439-92-1	B2	Y	7.73E+00		7.73E+00	NC	NC
Tank Group 04	PB-883-21	VOC	Benzene	71-43-2	A	Y		4.60E-04	2.30E-04	4.2E-09	5.0E-05
Tank Group 04	PB-883-21	VOC	Cumene	98-82-8	D	Y	4.20E-04		4.20E-04	NC	6.9E-06
Tank Group 04	PB-883-21	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-883-21	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.10E-04		NC	NC
Tank Group 04	PB-883-21	VOC	Ethyl Benzene	100-41-4	D	Y	3.40E-04		3.40E-04	NC	2.2E-06
Tank Group 04	PB-883-21	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-883-21	VOC	Toluene	108-88-3	ID	Y		9.10E-04	4.55E-04	NC	6.0E-07
Tank Group 04	PB-883-21	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	9.70E-03		9.70E-03	NC	1.1E-03
Tank Group 04	PB-883-21	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	3.20E-03		3.20E-03	NC	3.5E-04
Tank Group 04	PB-883-21	VOC	Xylenes (total)	1330-20-7	ID	Y	2.30E-03		2.30E-03	NC	1.5E-04
Tank Group 04	PB-883-21	SVOC	Anthracene	120-12-7	ID	Y	7.40E-01		7.40E-01	NC	NC
Tank Group 04	PB-883-21	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-21	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-21	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-21	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-21	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-883-21	SVOC	Fluorene	86-73-7	D	Y	1.20E+00		1.20E+00	NC	NC
Tank Group 04	PB-883-21	SVOC	Naphthalene	91-20-3	C	Y	3.00E+00		3.00E+00	***2.0E-05***	***5.6E-01***
Tank Group 04	PB-883-21	SVOC	Phenanthrene	85-01-8	D	Y	3.70E+00		3.70E+00	NC	NC
Tank Group 04	PB-883-21	SVOC	Pyrene	129-00-0	NC	Y	2.30E-01		2.30E-01	NC	NC
Tank Group 04	PB-883-21	INORG	Lead	7439-92-1	B2	Y	1.26E+01		1.26E+01	NC	NC
Tank Group 04	PB-883-22	VOC	Benzene	71-43-2	A	Y		5.20E-04	2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-883-22	VOC	Cumene	98-82-8	D	Y	2.40E-04		2.40E-04	NC	3.9E-06
Tank Group 04	PB-883-22	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-883-22	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-883-22	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-883-22	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-883-22	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-883-22	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-883-22	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-883-22	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-883-22	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-22	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-22	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-22	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-22	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-883-22	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-22	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-883-22	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-883-22	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-22	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-22	INORG	Lead	7439-92-1	B2	Y	4.03E+00		4.03E+00	NC	NC
Tank Group 04	PB-883-23	VOC	Benzene	71-43-2	A	Y		7.40E-04	3.70E-04	6.8E-09	8.1E-05
Tank Group 04	PB-883-23	VOC	Cumene	98-82-8	D	Y		1.50E-03	7.50E-04	NC	1.2E-05
Tank Group 04	PB-883-23	VOC	1,2-Dibromoethane	106-93-4	LC	N		7.40E-04		NC	NC
Tank Group 04	PB-883-23	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.50E-03		NC	NC
Tank Group 04	PB-883-23	VOC	Ethyl Benzene	100-41-4	D	Y		1.50E-03	7.50E-04	NC	4.9E-06
Tank Group 04	PB-883-23	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.00E-03	1.50E-03	9.1E-10	3.3E-06
Tank Group 04	PB-883-23	VOC	Toluene	108-88-3	ID	Y		1.50E-03	7.50E-04	NC	9.8E-07
Tank Group 04	PB-883-23	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.00E-03	1.50E-03	NC	1.6E-04
Tank Group 04	PB-883-23	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.00E-03	1.50E-03	NC	1.6E-04
Tank Group 04	PB-883-23	VOC	Xylenes (total)	1330-20-7	ID	Y		3.00E-03	1.50E-03	NC	9.8E-05
Tank Group 04	PB-883-23	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-23	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-23	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-23	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-23	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-23	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-23	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-23	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-23	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-23	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-23	INORG	Lead	7439-92-1	B2	Y	4.64E+00		4.64E+00	NC	NC
Tank Group 04	PB-883-24	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-883-24	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-883-24	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-883-24	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-883-24	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-883-24	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-883-24	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-883-24	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-24	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-883-24	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-883-24	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-24	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-24	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-24	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-24	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-883-24	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-24	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-883-24	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-883-24	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-883-24	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-883-24	INORG	Lead	7439-92-1	B2	Y	4.46E+00		4.46E+00	NC	NC
Tank Group 04	PB-884-01	VOC	Benzene	71-43-2	A	Y	3.00E-04		3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-884-01	VOC	Cumene	98-82-8	D	Y	7.20E-04		7.20E-04	NC	1.2E-05
Tank Group 04	PB-884-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-884-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.20E-04		NC	NC
Tank Group 04	PB-884-01	VOC	Ethyl Benzene	100-41-4	D	Y	2.30E-04		2.30E-04	NC	1.5E-06
Tank Group 04	PB-884-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-884-01	VOC	Toluene	108-88-3	ID	Y	1.00E-03		1.00E-03	NC	1.3E-06
Tank Group 04	PB-884-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	2.40E-03		2.40E-03	NC	2.6E-04
Tank Group 04	PB-884-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	8.80E-04		8.80E-04	NC	9.6E-05
Tank Group 04	PB-884-01	VOC	Xylenes (total)	1330-20-7	ID	Y	4.80E-03		4.80E-03	NC	3.1E-04
Tank Group 04	PB-884-01	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	5.30E-02		5.30E-02	NC	NC
Tank Group 04	PB-884-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	5.50E-02		5.50E-02	NC	NC
Tank Group 04	PB-884-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	7.70E-02		7.70E-02	NC	NC
Tank Group 04	PB-884-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	3.20E-02		3.20E-02	NC	NC
Tank Group 04	PB-884-01	SVOC	Chrysene	218-01-9	B2	Y	4.80E-02		4.80E-02	NC	NC
Tank Group 04	PB-884-01	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-884-01	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-884-01	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-01	SVOC	Pyrene	129-00-0	NC	Y	3.10E-02		3.10E-02	NC	NC
Tank Group 04	PB-884-01	INORG	Lead	7439-92-1	B2	Y	2.45E+01		2.45E+01	NC	NC
Tank Group 04	PB-884-02	VOC	Benzene	71-43-2	A	Y		4.90E-04	2.45E-04	4.5E-09	5.3E-05
Tank Group 04	PB-884-02	VOC	Cumene	98-82-8	D	Y		9.80E-04	4.90E-04	NC	8.0E-06
Tank Group 04	PB-884-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-884-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.80E-04		NC	NC
Tank Group 04	PB-884-02	VOC	Ethyl Benzene	100-41-4	D	Y		9.80E-04	4.90E-04	NC	3.2E-06
Tank Group 04	PB-884-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-884-02	VOC	Toluene	108-88-3	ID	Y		9.80E-04	4.90E-04	NC	6.4E-07
Tank Group 04	PB-884-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-884-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-884-02	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-884-02	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-02	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-02	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-884-02	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-884-02	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-02	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-02	INORG	Lead	7439-92-1	B2	Y	5.62E+00		5.62E+00	NC	NC
Tank Group 04	PB-884-03	VOC	Benzene	71-43-2	A	Y		5.30E-04	2.65E-04	4.8E-09	5.8E-05
Tank Group 04	PB-884-03	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-884-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-884-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-884-03	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-884-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-884-03	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-884-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-884-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-884-03	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-884-03	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	5.30E-02		5.30E-02	NC	NC
Tank Group 04	PB-884-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	5.10E-02		5.10E-02	NC	NC
Tank Group 04	PB-884-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-03	SVOC	Chrysene	218-01-9	B2	Y	4.80E-02		4.80E-02	NC	NC
Tank Group 04	PB-884-03	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-884-03	SVOC	Naphthalene	91-20-3	C	Y		2.10E-01	1.05E-01	7.1E-07	2.0E-02
Tank Group 04	PB-884-03	SVOC	Phenanthrene	85-01-8	D	Y	3.30E-02		3.30E-02	NC	NC
Tank Group 04	PB-884-03	SVOC	Pyrene	129-00-0	NC	Y	5.50E-02		5.50E-02	NC	NC
Tank Group 04	PB-884-03	INORG	Lead	7439-92-1	B2	Y	8.80E+00		8.80E+00	NC	NC
Tank Group 04	PB-884-04	VOC	Benzene	71-43-2	A	Y		5.20E-04	2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-884-04	VOC	Cumene	98-82-8	D	Y	7.80E-02		7.80E-02	NC	1.3E-03
Tank Group 04	PB-884-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-884-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-884-04	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-884-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	3.00E-04		3.00E-04	1.8E-10	6.5E-07
Tank Group 04	PB-884-04	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-884-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.50E-02		1.50E-02	NC	1.6E-03
Tank Group 04	PB-884-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.50E-03		4.50E-03	NC	4.9E-04
Tank Group 04	PB-884-04	VOC	Xylenes (total)	1330-20-7	ID	Y	1.23E-03		1.23E-03	NC	8.1E-05
Tank Group 04	PB-884-04	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-04	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-04	SVOC	Fluorene	86-73-7	D	Y	3.50E-01		3.50E-01	NC	NC
Tank Group 04	PB-884-04	SVOC	Naphthalene	91-20-3	C	Y	7.30E-02		7.30E-02	5.0E-07	1.4E-02
Tank Group 04	PB-884-04	SVOC	Phenanthrene	85-01-8	D	Y	3.20E-01		3.20E-01	NC	NC
Tank Group 04	PB-884-04	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-04	INORG	Lead	7439-92-1	B2	Y	6.72E+00		6.72E+00	NC	NC
Tank Group 04	PB-884-05	VOC	Benzene	71-43-2	A	Y		8.00E-04	4.00E-04	7.3E-09	8.7E-05
Tank Group 04	PB-884-05	VOC	Cumene	98-82-8	D	Y		1.60E-03	8.00E-04	NC	1.3E-05
Tank Group 04	PB-884-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		8.00E-04		NC	NC
Tank Group 04	PB-884-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.60E-03		NC	NC
Tank Group 04	PB-884-05	VOC	Ethyl Benzene	100-41-4	D	Y		1.60E-03	8.00E-04	NC	5.2E-06
Tank Group 04	PB-884-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.20E-03	1.60E-03	9.7E-10	3.5E-06
Tank Group 04	PB-884-05	VOC	Toluene	108-88-3	ID	Y		1.60E-03	8.00E-04	NC	1.0E-06
Tank Group 04	PB-884-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.20E-03	1.60E-03	NC	1.7E-04
Tank Group 04	PB-884-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.20E-03	1.60E-03	NC	1.7E-04
Tank Group 04	PB-884-05	VOC	Xylenes (total)	1330-20-7	ID	Y		3.20E-03	1.60E-03	NC	1.0E-04
Tank Group 04	PB-884-05	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-05	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-05	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-05	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-05	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-05	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-05	INORG	Lead	7439-92-1	B2	Y	2.38E+00		2.38E+00	NC	NC
Tank Group 04	PB-884-06	VOC	Benzene	71-43-2	A	Y	3.00E-04		3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-884-06	VOC	Cumene	98-82-8	D	Y	3.90E-04		3.90E-04	NC	6.4E-06
Tank Group 04	PB-884-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-884-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.00E-04		NC	NC
Tank Group 04	PB-884-06	VOC	Ethyl Benzene	100-41-4	D	Y	5.20E-04		5.20E-04	NC	3.4E-06
Tank Group 04	PB-884-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-884-06	VOC	Toluene	108-88-3	ID	Y	6.90E-04		6.90E-04	NC	9.0E-07

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

										Routine Worker	
										Vapor Intrusion	
Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Risk	HQ
Tank Group 04	PB-884-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	6.40E-03		6.40E-03	NC	7.0E-04
Tank Group 04	PB-884-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.20E-03		4.20E-03	NC	4.6E-04
Tank Group 04	PB-884-06	VOC	Xylenes (total)	1330-20-7	ID	Y	1.93E-03		1.93E-03	NC	1.3E-04
Tank Group 04	PB-884-06	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.80E-02		2.80E-02	NC	NC
Tank Group 04	PB-884-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-06	SVOC	Chrysene	218-01-9	B2	Y	2.70E-02		2.70E-02	NC	NC
Tank Group 04	PB-884-06	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-06	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-06	SVOC	Phenanthrene	85-01-8	D	Y	6.50E-02		6.50E-02	NC	NC
Tank Group 04	PB-884-06	SVOC	Pyrene	129-00-0	NC	Y	3.90E-02		3.90E-02	NC	NC
Tank Group 04	PB-884-06	INORG	Lead	7439-92-1	B2	Y	8.90E+01		8.90E+01	NC	NC
Tank Group 04	PB-884-07	VOC	Benzene	71-43-2	A	Y		6.60E-04	3.30E-04	6.0E-09	7.2E-05
Tank Group 04	PB-884-07	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-884-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.60E-04		NC	NC
Tank Group 04	PB-884-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-884-07	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-884-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.70E-03	1.35E-03	8.2E-10	2.9E-06
Tank Group 04	PB-884-07	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-884-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.70E-03	1.35E-03	NC	1.5E-04
Tank Group 04	PB-884-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.70E-03	1.35E-03	NC	1.5E-04
Tank Group 04	PB-884-07	VOC	Xylenes (total)	1330-20-7	ID	Y		2.70E-03	1.35E-03	NC	8.8E-05
Tank Group 04	PB-884-07	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.00E-02		3.00E-02	NC	NC
Tank Group 04	PB-884-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-07	SVOC	Chrysene	218-01-9	B2	Y	2.10E-02		2.10E-02	NC	NC
Tank Group 04	PB-884-07	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-884-07	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-884-07	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-07	SVOC	Pyrene	129-00-0	NC	Y	4.30E-02		4.30E-02	NC	NC
Tank Group 04	PB-884-07	INORG	Lead	7439-92-1	B2	Y	2.61E+00		2.61E+00	NC	NC
Tank Group 04	PB-884-08	VOC	Benzene	71-43-2	A	Y	1.50E-01		1.50E-01	2.7E-06	3.3E-02
Tank Group 04	PB-884-08	VOC	Cumene	98-82-8	D	Y	8.00E-02		8.00E-02	NC	1.3E-03
Tank Group 04	PB-884-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.30E-02		NC	NC
Tank Group 04	PB-884-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.50E-02		NC	NC
Tank Group 04	PB-884-08	VOC	Ethyl Benzene	100-41-4	D	Y	1.40E-01		1.40E-01	NC	9.2E-04
Tank Group 04	PB-884-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.30E-01	6.50E-02	4.0E-08	1.4E-04
Tank Group 04	PB-884-08	VOC	Toluene	108-88-3	ID	Y	8.20E-02		8.20E-02	NC	1.1E-04
Tank Group 04	PB-884-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	2.10E+00		2.10E+00	NC	***2.3E-01***
Tank Group 04	PB-884-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	6.60E-01		6.60E-01	NC	7.2E-02
Tank Group 04	PB-884-08	VOC	Xylenes (total)	1330-20-7	ID	Y	5.40E+00		5.40E+00	NC	***3.5E-01***
Tank Group 04	PB-884-08	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	5.80E-02		5.80E-02	NC	NC
Tank Group 04	PB-884-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	5.50E-02		5.50E-02	NC	NC
Tank Group 04	PB-884-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	8.00E-02		8.00E-02	NC	NC
Tank Group 04	PB-884-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	4.10E-02		4.10E-02	NC	NC
Tank Group 04	PB-884-08	SVOC	Chrysene	218-01-9	B2	Y	1.10E-01		1.10E-01	NC	NC
Tank Group 04	PB-884-08	SVOC	Fluorene	86-73-7	D	Y	2.50E-01		2.50E-01	NC	NC
Tank Group 04	PB-884-08	SVOC	Naphthalene	91-20-3	C	Y	8.40E-01		8.40E-01	5.7E-06	***1.6E-01***
Tank Group 04	PB-884-08	SVOC	Phenanthrene	85-01-8	D	Y	4.50E-01		4.50E-01	NC	NC
Tank Group 04	PB-884-08	SVOC	Pyrene	129-00-0	NC	Y	1.30E-01		1.30E-01	NC	NC
Tank Group 04	PB-884-08	INORG	Lead	7439-92-1	B2	Y	6.02E+01		6.02E+01	NC	NC
Tank Group 04	PB-884-09	VOC	Benzene	71-43-2	A	Y	2.00E+00		2.00E+00	***3.6E-05***	***4.4E-01***
Tank Group 04	PB-884-09	VOC	Cumene	98-82-8	D	Y	2.80E+00		2.80E+00	NC	4.6E-02
Tank Group 04	PB-884-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.40E-02		NC	NC
Tank Group 04	PB-884-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.80E-02		NC	NC
Tank Group 04	PB-884-09	VOC	Ethyl Benzene	100-41-4	D	Y	6.60E+00		6.60E+00	NC	4.3E-02
Tank Group 04	PB-884-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.40E-01	7.00E-02	4.3E-08	1.5E-04
Tank Group 04	PB-884-09	VOC	Toluene	108-88-3	ID	Y	1.30E+01		1.30E+01	NC	1.7E-02
Tank Group 04	PB-884-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.20E+01		1.20E+01	NC	**1.3E+00**
Tank Group 04	PB-884-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	3.70E+00		3.70E+00	NC	***4.0E-01***
Tank Group 04	PB-884-09	VOC	Xylenes (total)	1330-20-7	ID	Y	4.10E+01		4.10E+01	NC	**2.7E+00**
Tank Group 04	PB-884-09	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.20E-02		2.20E-02	NC	NC
Tank Group 04	PB-884-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-09	SVOC	Chrysene	218-01-9	B2	Y	9.20E-02		9.20E-02	NC	NC
Tank Group 04	PB-884-09	SVOC	Fluorene	86-73-7	D	Y	2.50E-01		2.50E-01	NC	NC
Tank Group 04	PB-884-09	SVOC	Naphthalene	91-20-3	C	Y	3.20E+00		3.20E+00	***2.2E-05***	***6.0E-01***
Tank Group 04	PB-884-09	SVOC	Phenanthrene	85-01-8	D	Y	7.00E-01		7.00E-01	NC	NC
Tank Group 04	PB-884-09	SVOC	Pyrene	129-00-0	NC	Y	5.60E-02		5.60E-02	NC	NC
Tank Group 04	PB-884-09	INORG	Lead	7439-92-1	B2	Y	1.95E+00		1.95E+00	NC	NC
Tank Group 04	PB-884-10	VOC	Benzene	71-43-2	A	Y		5.30E-04	2.65E-04	4.8E-09	5.8E-05
Tank Group 04	PB-884-10	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-884-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-884-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-884-10	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-884-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-884-10	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-884-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-884-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-884-10	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-884-10	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-10	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-10	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-10	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-10	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-10	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-10	INORG	Lead	7439-92-1	B2	Y	2.58E+00		2.58E+00	NC	NC
Tank Group 04	PB-884-11	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-884-11	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-884-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-884-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-884-11	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-884-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-884-11	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-884-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-884-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-884-11	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-884-11	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	8.90E-02		8.90E-02	NC	NC
Tank Group 04	PB-884-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	7.40E-02		7.40E-02	NC	NC
Tank Group 04	PB-884-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	9.50E-02		9.50E-02	NC	NC
Tank Group 04	PB-884-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	3.80E-02		3.80E-02	NC	NC
Tank Group 04	PB-884-11	SVOC	Chrysene	218-01-9	B2	Y	8.70E-02		8.70E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

										Routine Worker	
										Vapor Intrusion	
Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Risk	HQ
Tank Group 04	PB-884-11	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-884-11	SVOC	Naphthalene	91-20-3	C	Y	6.80E-02		6.80E-02	4.6E-07	1.3E-02
Tank Group 04	PB-884-11	SVOC	Phenanthrene	85-01-8	D	Y	6.50E-02		6.50E-02	NC	NC
Tank Group 04	PB-884-11	SVOC	Pyrene	129-00-0	NC	Y	9.10E-02		9.10E-02	NC	NC
Tank Group 04	PB-884-11	INORG	Lead	7439-92-1	B2	Y	3.70E+01		3.70E+01	NC	NC
Tank Group 04	PB-884-12	VOC	Benzene	71-43-2	A	Y		5.65E-04	2.83E-04	5.2E-09	6.2E-05
Tank Group 04	PB-884-12	VOC	Cumene	98-82-8	D	Y		1.15E-03	5.75E-04	NC	9.4E-06
Tank Group 04	PB-884-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.65E-04		NC	NC
Tank Group 04	PB-884-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.15E-03		NC	NC
Tank Group 04	PB-884-12	VOC	Ethyl Benzene	100-41-4	D	Y		1.15E-03	5.75E-04	NC	3.8E-06
Tank Group 04	PB-884-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-884-12	VOC	Toluene	108-88-3	ID	Y		1.15E-03	5.75E-04	NC	7.5E-07
Tank Group 04	PB-884-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-884-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-884-12	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-884-12	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-12	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-12	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-884-12	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-884-12	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-12	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-12	INORG	Lead	7439-92-1	B2	Y	5.43E+01		5.43E+01	NC	NC
Tank Group 04	PB-884-13	VOC	Benzene	71-43-2	A	Y		5.20E-04	2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-884-13	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-884-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-884-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-884-13	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-884-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-884-13	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-884-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-884-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-884-13	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-884-13	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-884-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-884-13	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-13	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-884-13	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-884-13	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-13	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-13	INORG	Lead	7439-92-1	B2	Y	3.20E+00		3.20E+00	NC	NC
Tank Group 04	PB-884-14	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-884-14	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-884-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-884-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-884-14	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-884-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-884-14	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-884-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-884-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-884-14	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-884-14	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-14	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-14	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-14	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-14	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-14	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-14	INORG	Lead	7439-92-1	B2	Y	2.63E+00		2.63E+00	NC	NC
Tank Group 04	PB-884-15	VOC	Benzene	71-43-2	A	Y	2.60E+00		2.60E+00	***4.7E-05***	***5.7E-01***
Tank Group 04	PB-884-15	VOC	Cumene	98-82-8	D	Y	3.60E+00		3.60E+00	NC	5.9E-02
Tank Group 04	PB-884-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		2.90E-02		NC	NC
Tank Group 04	PB-884-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		5.90E-02		NC	NC
Tank Group 04	PB-884-15	VOC	Ethyl Benzene	100-41-4	D	Y	8.80E+00		8.80E+00	NC	5.8E-02
Tank Group 04	PB-884-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.20E-01	6.00E-02	3.6E-08	1.3E-04
Tank Group 04	PB-884-15	VOC	Toluene	108-88-3	ID	Y	9.00E+00		9.00E+00	NC	1.2E-02
Tank Group 04	PB-884-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.40E+01		1.40E+01	NC	**1.5E+00**
Tank Group 04	PB-884-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.50E+00		4.50E+00	NC	***4.9E-01***
Tank Group 04	PB-884-15	VOC	Xylenes (total)	1330-20-7	ID	Y	4.70E+01		4.70E+01	NC	**3.1E+00**
Tank Group 04	PB-884-15	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-15	SVOC	Chrysene	218-01-9	B2	Y	5.90E-02		5.90E-02	NC	NC
Tank Group 04	PB-884-15	SVOC	Fluorene	86-73-7	D	Y	1.30E-01		1.30E-01	NC	NC
Tank Group 04	PB-884-15	SVOC	Naphthalene	91-20-3	C	Y	8.50E-01		8.50E-01	5.8E-06	***1.6E-01***
Tank Group 04	PB-884-15	SVOC	Phenanthrene	85-01-8	D	Y	4.50E-01		4.50E-01	NC	NC
Tank Group 04	PB-884-15	SVOC	Pyrene	129-00-0	NC	Y	3.60E-02		3.60E-02	NC	NC
Tank Group 04	PB-884-15	INORG	Lead	7439-92-1	B2	Y	1.68E+00		1.68E+00	NC	NC
Tank Group 04	PB-884-16	VOC	Benzene	71-43-2	A	Y		9.00E-04	4.50E-04	8.2E-09	9.8E-05
Tank Group 04	PB-884-16	VOC	Cumene	98-82-8	D	Y		1.80E-03	9.00E-04	NC	1.5E-05
Tank Group 04	PB-884-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		9.00E-04		NC	NC
Tank Group 04	PB-884-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.80E-03		NC	NC
Tank Group 04	PB-884-16	VOC	Ethyl Benzene	100-41-4	D	Y		1.80E-03	9.00E-04	NC	5.9E-06
Tank Group 04	PB-884-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.60E-03	1.80E-03	1.1E-09	3.9E-06
Tank Group 04	PB-884-16	VOC	Toluene	108-88-3	ID	Y		1.80E-03	9.00E-04	NC	1.2E-06
Tank Group 04	PB-884-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.60E-03	1.80E-03	NC	2.0E-04
Tank Group 04	PB-884-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.60E-03	1.80E-03	NC	2.0E-04
Tank Group 04	PB-884-16	VOC	Xylenes (total)	1330-20-7	ID	Y		3.60E-03	1.80E-03	NC	1.2E-04
Tank Group 04	PB-884-16	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-16	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-16	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-16	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-16	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-16	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-16	INORG	Lead	7439-92-1	B2	Y	1.86E+00		1.86E+00	NC	NC
Tank Group 04	PB-884-17	VOC	Benzene	71-43-2	A	Y		5.80E-04	2.90E-04	5.3E-09	6.3E-05
Tank Group 04	PB-884-17	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-884-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-884-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-884-17	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-884-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-884-17	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-884-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-884-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-884-17	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-884-17	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-17	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-17	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-884-17	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-884-17	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-17	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-17	INORG	Lead	7439-92-1	B2	Y	1.99E+00		1.99E+00	NC	NC
Tank Group 04	PB-884-18	VOC	Benzene	71-43-2	A	Y	3.50E-02		3.50E-02	6.4E-07	7.6E-03
Tank Group 04	PB-884-18	VOC	Cumene	98-82-8	D	Y	5.30E-03		5.30E-03	NC	8.7E-05
Tank Group 04	PB-884-18	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-884-18	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-884-18	VOC	Ethyl Benzene	100-41-4	D	Y	2.40E-02		2.40E-02	NC	1.6E-04
Tank Group 04	PB-884-18	VOC	Methyl tert-butyl ether	1634-04-4	C	Y	5.40E-04		5.40E-04	3.3E-10	1.2E-06
Tank Group 04	PB-884-18	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-884-18	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	3.30E-02		3.30E-02	NC	3.6E-03
Tank Group 04	PB-884-18	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.00E-02		1.00E-02	NC	1.1E-03
Tank Group 04	PB-884-18	VOC	Xylenes (total)	1330-20-7	ID	Y	2.75E-02		2.75E-02	NC	1.8E-03
Tank Group 04	PB-884-18	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-18	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-18	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-18	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-18	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-18	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-18	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-884-18	SVOC	Naphthalene	91-20-3	C	Y	5.00E-02		5.00E-02	3.4E-07	9.3E-03
Tank Group 04	PB-884-18	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-18	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-18	INORG	Lead	7439-92-1	B2	Y	7.17E+00		7.17E+00	NC	NC
Tank Group 04	PB-884-19	VOC	Benzene	71-43-2	A	Y	3.60E-04		3.60E-04	6.6E-09	7.9E-05
Tank Group 04	PB-884-19	VOC	Cumene	98-82-8	D	Y	4.40E-03		4.40E-03	NC	7.2E-05
Tank Group 04	PB-884-19	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.70E-04		NC	NC
Tank Group 04	PB-884-19	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-884-19	VOC	Ethyl Benzene	100-41-4	D	Y	2.40E-03		2.40E-03	NC	1.6E-05
Tank Group 04	PB-884-19	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-884-19	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-884-19	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	5.20E-02		5.20E-02	NC	5.7E-03
Tank Group 04	PB-884-19	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	2.20E-02		2.20E-02	NC	2.4E-03
Tank Group 04	PB-884-19	VOC	Xylenes (total)	1330-20-7	ID	Y	5.00E-02		5.00E-02	NC	3.3E-03
Tank Group 04	PB-884-19	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-19	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-19	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-19	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-19	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-19	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-19	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-19	SVOC	Naphthalene	91-20-3	C	Y	8.50E-02		8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-19	SVOC	Phenanthrene	85-01-8	D	Y	4.00E-02		4.00E-02	NC	NC
Tank Group 04	PB-884-19	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-19	INORG	Lead	7439-92-1	B2	Y	1.61E+00		1.61E+00	NC	NC
Tank Group 04	PB-884-20	VOC	Benzene	71-43-2	A	Y		5.50E-04	2.75E-04	5.0E-09	6.0E-05
Tank Group 04	PB-884-20	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-884-20	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.50E-04		NC	NC
Tank Group 04	PB-884-20	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-884-20	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-884-20	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-884-20	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-884-20	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-884-20	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-884-20	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-884-20	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-20	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-20	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-20	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-20	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-20	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-20	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-20	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-20	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-20	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-20	INORG	Lead	7439-92-1	B2	Y	1.04E+00		1.04E+00	NC	NC
Tank Group 04	PB-884-21	VOC	Benzene	71-43-2	A	Y		4.70E-04	2.35E-04	4.3E-09	5.1E-05
Tank Group 04	PB-884-21	VOC	Cumene	98-82-8	D	Y		9.40E-04	4.70E-04	NC	7.7E-06
Tank Group 04	PB-884-21	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.70E-04		NC	NC
Tank Group 04	PB-884-21	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.40E-04		NC	NC
Tank Group 04	PB-884-21	VOC	Ethyl Benzene	100-41-4	D	Y		9.40E-04	4.70E-04	NC	3.1E-06
Tank Group 04	PB-884-21	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-884-21	VOC	Toluene	108-88-3	ID	Y		9.40E-04	4.70E-04	NC	6.2E-07
Tank Group 04	PB-884-21	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-884-21	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-884-21	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-884-21	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-21	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-21	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-21	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-21	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-21	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-21	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-21	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-21	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-21	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-21	INORG	Lead	7439-92-1	B2	Y	1.98E+00		1.98E+00	NC	NC
Tank Group 04	PB-884-22	VOC	Benzene	71-43-2	A	Y		6.60E-04	3.30E-04	6.0E-09	7.2E-05
Tank Group 04	PB-884-22	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-884-22	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.60E-04		NC	NC
Tank Group 04	PB-884-22	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-884-22	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-884-22	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.60E-03	1.30E-03	7.9E-10	2.8E-06
Tank Group 04	PB-884-22	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-884-22	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-884-22	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-884-22	VOC	Xylenes (total)	1330-20-7	ID	Y		2.60E-03	1.30E-03	NC	8.5E-05
Tank Group 04	PB-884-22	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-22	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-22	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

										Routine Worker	
										Vapor Intrusion	
Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Risk	HQ
Tank Group 04	PB-884-22	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-22	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-22	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-22	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-884-22	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-884-22	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-22	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-22	INORG	Lead	7439-92-1	B2	Y	2.77E+00		2.77E+00	NC	NC
Tank Group 04	PB-884-23	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-884-23	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-884-23	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-884-23	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-884-23	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-884-23	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-884-23	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-884-23	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-884-23	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-884-23	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-884-23	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-23	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-23	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-23	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-23	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-23	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-23	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-884-23	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-884-23	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-23	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-884-23	INORG	Lead	7439-92-1	B2	Y	1.61E+00		1.61E+00	NC	NC
Tank Group 04	PB-884-24	VOC	Benzene	71-43-2	A	Y	3.40E-02		3.40E-02	6.2E-07	7.4E-03
Tank Group 04	PB-884-24	VOC	Cumene	98-82-8	D	Y	3.00E-02		3.00E-02	NC	4.9E-04
Tank Group 04	PB-884-24	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.30E-04		NC	NC
Tank Group 04	PB-884-24	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-884-24	VOC	Ethyl Benzene	100-41-4	D	Y	9.50E-02		9.50E-02	NC	6.2E-04
Tank Group 04	PB-884-24	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.50E-03	1.25E-03	7.6E-10	2.7E-06
Tank Group 04	PB-884-24	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-884-24	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.30E-01		1.30E-01	NC	1.4E-02
Tank Group 04	PB-884-24	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	4.20E-02		4.20E-02	NC	4.6E-03
Tank Group 04	PB-884-24	VOC	Xylenes (total)	1330-20-7	ID	Y	3.62E-01		3.62E-01	NC	2.4E-02
Tank Group 04	PB-884-24	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-24	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	4.80E-02		4.80E-02	NC	NC
Tank Group 04	PB-884-24	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-24	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	4.60E-02		4.60E-02	NC	NC
Tank Group 04	PB-884-24	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-24	SVOC	Chrysene	218-01-9	B2	Y	4.00E-02		4.00E-02	NC	NC
Tank Group 04	PB-884-24	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-884-24	SVOC	Naphthalene	91-20-3	C	Y	8.20E-02		8.20E-02	5.6E-07	1.5E-02
Tank Group 04	PB-884-24	SVOC	Phenanthrene	85-01-8	D	Y	4.20E-02		4.20E-02	NC	NC
Tank Group 04	PB-884-24	SVOC	Pyrene	129-00-0	NC	Y	5.10E-02		5.10E-02	NC	NC
Tank Group 04	PB-884-24	INORG	Lead	7439-92-1	B2	Y	4.59E+01		4.59E+01	NC	NC
Tank Group 04	PB-884-25	VOC	Benzene	71-43-2	A	Y	7.10E+00		7.10E+00	**1.3E-04**	**1.5E+00**
Tank Group 04	PB-884-25	VOC	Cumene	98-82-8	D	Y	3.00E+00		3.00E+00	NC	4.9E-02
Tank Group 04	PB-884-25	VOC	1,2-Dibromoethane	106-93-4	LC	N		2.70E-02		NC	NC
Tank Group 04	PB-884-25	VOC	1,2-Dichloroethane	107-06-2	B2	N		5.40E-02		NC	NC
Tank Group 04	PB-884-25	VOC	Ethyl Benzene	100-41-4	D	Y	9.40E+00		9.40E+00	NC	6.2E-02
Tank Group 04	PB-884-25	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.10E-01	5.50E-02	3.3E-08	1.2E-04
Tank Group 04	PB-884-25	VOC	Toluene	108-88-3	ID	Y	1.50E+01		1.50E+01	NC	2.0E-02
Tank Group 04	PB-884-25	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.20E+01		1.20E+01	NC	**1.3E+00**
Tank Group 04	PB-884-25	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	3.80E+00		3.80E+00	NC	***4.1E-01***
Tank Group 04	PB-884-25	VOC	Xylenes (total)	1330-20-7	ID	Y	4.10E+01		4.10E+01	NC	**2.7E+00**
Tank Group 04	PB-884-25	SVOC	Anthracene	120-12-7	ID	Y	3.50E-02		3.50E-02	NC	NC
Tank Group 04	PB-884-25	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.20E-02		2.20E-02	NC	NC
Tank Group 04	PB-884-25	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-25	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-884-25	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-884-25	SVOC	Chrysene	218-01-9	B2	Y	8.40E-02		8.40E-02	NC	NC
Tank Group 04	PB-884-25	SVOC	Fluorene	86-73-7	D	Y	3.10E-01		3.10E-01	NC	NC
Tank Group 04	PB-884-25	SVOC	Naphthalene	91-20-3	C	Y	2.10E+00		2.10E+00	***1.4E-05***	***3.9E-01***
Tank Group 04	PB-884-25	SVOC	Phenanthrene	85-01-8	D	Y	5.30E-01		5.30E-01	NC	NC
Tank Group 04	PB-884-25	SVOC	Pyrene	129-00-0	NC	Y	4.80E-02		4.80E-02	NC	NC
Tank Group 04	PB-884-25	INORG	Lead	7439-92-1	B2	Y	3.11E+00		3.11E+00	NC	NC
Tank Group 04	PB-884-26	VOC	Benzene	71-43-2	A	Y		6.00E-04	3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-884-26	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-884-26	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.00E-04		NC	NC
Tank Group 04	PB-884-26	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-884-26	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-884-26	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-884-26	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-884-26	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-884-26	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-884-26	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-884-26	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-26	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-26	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-26	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-26	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-26	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-26	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-884-26	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-884-26	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-26	SVOC	Pyrene	129-00-0	NC	Y	2.50E-02		2.50E-02	NC	NC
Tank Group 04	PB-884-26	INORG	Lead	7439-92-1	B2	Y	2.65E+01		2.65E+01	NC	NC
Tank Group 04	PB-884-27	VOC	Benzene	71-43-2	A	Y		2.50E-04	1.25E-04	2.3E-09	2.7E-05
Tank Group 04	PB-884-27	VOC	Cumene	98-82-8	D	Y		5.00E-04	2.50E-04	NC	4.1E-06
Tank Group 04	PB-884-27	VOC	1,2-Dibromoethane	106-93-4	LC	N		2.50E-04		NC	NC
Tank Group 04	PB-884-27	VOC	1,2-Dichloroethane	107-06-2	B2	N		5.00E-04		NC	NC
Tank Group 04	PB-884-27	VOC	Ethyl Benzene	100-41-4	D	Y		5.00E-04	2.50E-04	NC	1.6E-06
Tank Group 04	PB-884-27	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.00E-03	5.00E-04	3.0E-10	1.1E-06
Tank Group 04	PB-884-27	VOC	Toluene	108-88-3	ID	Y		5.00E-04	2.50E-04	NC	3.3E-07
Tank Group 04	PB-884-27	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.00E-03	5.00E-04	NC	5.5E-05
Tank Group 04	PB-884-27	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.00E-03	5.00E-04	NC	5.5E-05
Tank Group 04	PB-884-27	VOC	Xylenes (total)	1330-20-7	ID	Y		1.00E-03	5.00E-04	NC	3.3E-05
Tank Group 04	PB-884-27	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-27	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-27	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-27	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-27	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-27	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-27	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-884-27	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-884-27	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-27	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-27	INORG	Lead	7439-92-1	B2	Y	1.15E+01		1.15E+01	NC	NC
Tank Group 04	PB-884-28	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

										Routine Worker	
										Vapor Intrusion	
Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Risk	HQ
Tank Group 04	PB-884-28	VOC	Cumene	98-82-8	D	Y		9.60E-04	4.80E-04	NC	7.9E-06
Tank Group 04	PB-884-28	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-884-28	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.60E-04		NC	NC
Tank Group 04	PB-884-28	VOC	Ethyl Benzene	100-41-4	D	Y		9.60E-04	4.80E-04	NC	3.1E-06
Tank Group 04	PB-884-28	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-884-28	VOC	Toluene	108-88-3	ID	Y		9.60E-04	4.80E-04	NC	6.3E-07
Tank Group 04	PB-884-28	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-884-28	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-884-28	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-884-28	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-28	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	4.20E-02		4.20E-02	NC	NC
Tank Group 04	PB-884-28	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-28	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	3.90E-02		3.90E-02	NC	NC
Tank Group 04	PB-884-28	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-28	SVOC	Chrysene	218-01-9	B2	Y	3.80E-02		3.80E-02	NC	NC
Tank Group 04	PB-884-28	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-884-28	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-884-28	SVOC	Phenanthrene	85-01-8	D	Y	4.50E-02		4.50E-02	NC	NC
Tank Group 04	PB-884-28	SVOC	Pyrene	129-00-0	NC	Y	6.00E-02		6.00E-02	NC	NC
Tank Group 04	PB-884-28	INORG	Lead	7439-92-1	B2	Y	9.37E+00		9.37E+00	NC	NC
Tank Group 04	PB-884-29	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-884-29	VOC	Cumene	98-82-8	D	Y		9.00E-04	4.50E-04	NC	7.4E-06
Tank Group 04	PB-884-29	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-884-29	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.00E-04		NC	NC
Tank Group 04	PB-884-29	VOC	Ethyl Benzene	100-41-4	D	Y		9.00E-04	4.50E-04	NC	2.9E-06
Tank Group 04	PB-884-29	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-884-29	VOC	Toluene	108-88-3	ID	Y		9.00E-04	4.50E-04	NC	5.9E-07
Tank Group 04	PB-884-29	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-884-29	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-884-29	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-884-29	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-29	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-29	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-29	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-29	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-884-29	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-29	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-884-29	SVOC	Naphthalene	91-20-3	C	Y		2.10E-01	1.05E-01	7.1E-07	2.0E-02
Tank Group 04	PB-884-29	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-29	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-884-29	INORG	Lead	7439-92-1	B2	Y	4.49E+00		4.49E+00	NC	NC
Tank Group 04	PB-885-01	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-885-01	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-885-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-885-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-885-01	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-885-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-885-01	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-885-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-01	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-885-01	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-01	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-01	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-885-01	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-885-01	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-01	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-01	INORG	Lead	7439-92-1	B2	Y	1.50E+02		1.50E+02	NC	NC
Tank Group 04	PB-885-02	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-885-02	VOC	Cumene	98-82-8	D	Y		9.90E-04	4.95E-04	NC	8.1E-06
Tank Group 04	PB-885-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-885-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.90E-04		NC	NC
Tank Group 04	PB-885-02	VOC	Ethyl Benzene	100-41-4	D	Y		9.90E-04	4.95E-04	NC	3.2E-06
Tank Group 04	PB-885-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-885-02	VOC	Toluene	108-88-3	ID	Y		9.90E-04	4.95E-04	NC	6.5E-07
Tank Group 04	PB-885-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-02	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-885-02	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	3.10E-02		3.10E-02	NC	NC
Tank Group 04	PB-885-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y	5.40E-02		5.40E-02	NC	NC
Tank Group 04	PB-885-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	7.50E-02		7.50E-02	NC	NC
Tank Group 04	PB-885-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	4.80E-02		4.80E-02	NC	NC
Tank Group 04	PB-885-02	SVOC	Chrysene	218-01-9	B2	Y	3.60E-02		3.60E-02	NC	NC
Tank Group 04	PB-885-02	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-885-02	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-885-02	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-02	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-02	INORG	Lead	7439-92-1	B2	Y	4.39E+01		4.39E+01	NC	NC
Tank Group 04	PB-885-03	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-885-03	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-885-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-885-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-885-03	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-885-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-885-03	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-885-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-03	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-885-03	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-03	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-03	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-03	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-03	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-03	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-03	INORG	Lead	7439-92-1	B2	Y	2.68E+00		2.68E+00	NC	NC
Tank Group 04	PB-885-04	VOC	Benzene	71-43-2	A	Y		4.60E-04	2.30E-04	4.2E-09	5.0E-05
Tank Group 04	PB-885-04	VOC	Cumene	98-82-8	D	Y		9.10E-04	4.55E-04	NC	7.4E-06
Tank Group 04	PB-885-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-885-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.10E-04		NC	NC
Tank Group 04	PB-885-04	VOC	Ethyl Benzene	100-41-4	D	Y		9.10E-04	4.55E-04	NC	3.0E-06
Tank Group 04	PB-885-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-885-04	VOC	Toluene	108-88-3	ID	Y		9.10E-04	4.55E-04	NC	6.0E-07
Tank Group 04	PB-885-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-885-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-885-04	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-885-04	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-04	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-04	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-04	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-04	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-04	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-04	INORG	Lead	7439-92-1	B2	Y	1.56E+00		1.56E+00	NC	NC
Tank Group 04	PB-885-05	VOC	Benzene	71-43-2	A	Y		4.70E-04	2.35E-04	4.3E-09	5.1E-05
Tank Group 04	PB-885-05	VOC	Cumene	98-82-8	D	Y		9.50E-04	4.75E-04	NC	7.8E-06
Tank Group 04	PB-885-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.70E-04		NC	NC
Tank Group 04	PB-885-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.50E-04		NC	NC
Tank Group 04	PB-885-05	VOC	Ethyl Benzene	100-41-4	D	Y		9.50E-04	4.75E-04	NC	3.1E-06
Tank Group 04	PB-885-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-885-05	VOC	Toluene	108-88-3	ID	Y		9.50E-04	4.75E-04	NC	6.2E-07
Tank Group 04	PB-885-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-885-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-885-05	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-885-05	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-05	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-05	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-05	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-05	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-05	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-05	INORG	Lead	7439-92-1	B2	Y	1.39E+00		1.39E+00	NC	NC
Tank Group 04	PB-885-06	VOC	Benzene	71-43-2	A	Y		5.60E-04	2.80E-04	5.1E-09	6.1E-05
Tank Group 04	PB-885-06	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-885-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-885-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-885-06	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-885-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-885-06	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-885-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-06	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-885-06	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-06	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-06	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-885-06	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-885-06	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-06	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-06	INORG	Lead	7439-92-1	B2	Y	2.41E+00		2.41E+00	NC	NC
Tank Group 04	PB-885-07	VOC	Benzene	71-43-2	A	Y		5.60E-04	2.80E-04	5.1E-09	6.1E-05
Tank Group 04	PB-885-07	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-885-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-885-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-885-07	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-885-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-885-07	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-885-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-07	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-885-07	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-07	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-07	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-885-07	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-885-07	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-07	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-07	INORG	Lead	7439-92-1	B2	Y	1.74E+01		1.74E+01	NC	NC
Tank Group 04	PB-885-08	VOC	Benzene	71-43-2	A	Y		4.20E-04	2.10E-04	3.8E-09	4.6E-05
Tank Group 04	PB-885-08	VOC	Cumene	98-82-8	D	Y		8.30E-04	4.15E-04	NC	6.8E-06
Tank Group 04	PB-885-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.20E-04		NC	NC
Tank Group 04	PB-885-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.30E-04		NC	NC
Tank Group 04	PB-885-08	VOC	Ethyl Benzene	100-41-4	D	Y		8.30E-04	4.15E-04	NC	2.7E-06
Tank Group 04	PB-885-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-885-08	VOC	Toluene	108-88-3	ID	Y		8.30E-04	4.15E-04	NC	5.4E-07
Tank Group 04	PB-885-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-08	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-885-08	SVOC	Anthracene	120-12-7	ID	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-885-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-885-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		2.80E-01	1.40E-01	NC	NC
Tank Group 04	PB-885-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-885-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		2.80E-01	1.40E-01	NC	NC
Tank Group 04	PB-885-08	SVOC	Chrysene	218-01-9	B2	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-885-08	SVOC	Fluorene	86-73-7	D	Y		3.50E-01	1.75E-01	NC	NC
Tank Group 04	PB-885-08	SVOC	Naphthalene	91-20-3	C	Y		3.50E-01	1.75E-01	1.2E-06	3.3E-02
Tank Group 04	PB-885-08	SVOC	Phenanthrene	85-01-8	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-885-08	SVOC	Pyrene	129-00-0	NC	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-885-08	INORG	Lead	7439-92-1	B2	Y	9.07E+00		9.07E+00	NC	NC
Tank Group 04	PB-885-09	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-885-09	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-885-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-885-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-885-09	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-885-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-885-09	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-885-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-09	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-885-09	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-885-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-885-09	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-09	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-885-09	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-885-09	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-885-09	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-09	INORG	Lead	7439-92-1	B2	Y	7.61E+00		7.61E+00	NC	NC
Tank Group 04	PB-885-10	VOC	Benzene	71-43-2	A	Y		5.80E-04	2.90E-04	5.3E-09	6.3E-05
Tank Group 04	PB-885-10	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-885-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-885-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-885-10	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-885-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-885-10	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-885-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-885-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-885-10	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-885-10	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-10	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-10	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-885-10	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-885-10	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-10	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-10	INORG	Lead	7439-92-1	B2	Y	3.04E+00		3.04E+00	NC	NC
Tank Group 04	PB-885-11	VOC	Benzene	71-43-2	A	Y		5.30E-04	2.65E-04	4.8E-09	5.8E-05
Tank Group 04	PB-885-11	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-885-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-885-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-885-11	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-885-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-885-11	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-885-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-885-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-885-11	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-885-11	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-11	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-11	SVOC	Fluorene	86-73-7	D	Y		2.10E-01	1.05E-01	NC	NC
Tank Group 04	PB-885-11	SVOC	Naphthalene	91-20-3	C	Y		2.10E-01	1.05E-01	7.1E-07	2.0E-02
Tank Group 04	PB-885-11	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-11	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-11	INORG	Lead	7439-92-1	B2	Y	6.43E+00		6.43E+00	NC	NC
Tank Group 04	PB-885-12	VOC	Benzene	71-43-2	A	Y		4.30E-04	2.15E-04	3.9E-09	4.7E-05
Tank Group 04	PB-885-12	VOC	Cumene	98-82-8	D	Y		8.70E-04	4.35E-04	NC	7.1E-06
Tank Group 04	PB-885-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-885-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.70E-04		NC	NC
Tank Group 04	PB-885-12	VOC	Ethyl Benzene	100-41-4	D	Y		8.70E-04	4.35E-04	NC	2.8E-06
Tank Group 04	PB-885-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-885-12	VOC	Toluene	108-88-3	ID	Y		8.70E-04	4.35E-04	NC	5.7E-07
Tank Group 04	PB-885-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-12	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-885-12	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-12	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-12	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-12	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-12	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-12	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-12	INORG	Lead	7439-92-1	B2	Y	1.33E+00		1.33E+00	NC	NC
Tank Group 04	PB-885-13	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-885-13	VOC	Cumene	98-82-8	D	Y		9.50E-04	4.75E-04	NC	7.8E-06
Tank Group 04	PB-885-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-885-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.50E-04		NC	NC
Tank Group 04	PB-885-13	VOC	Ethyl Benzene	100-41-4	D	Y		9.50E-04	4.75E-04	NC	3.1E-06
Tank Group 04	PB-885-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-885-13	VOC	Toluene	108-88-3	ID	Y		9.50E-04	4.75E-04	NC	6.2E-07
Tank Group 04	PB-885-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-885-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-885-13	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-885-13	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-13	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-13	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-13	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-13	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-13	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-13	INORG	Lead	7439-92-1	B2	Y	1.72E+00		1.72E+00	NC	NC
Tank Group 04	PB-885-14	VOC	Benzene	71-43-2	A	Y		4.20E-04	2.10E-04	3.8E-09	4.6E-05
Tank Group 04	PB-885-14	VOC	Cumene	98-82-8	D	Y		8.40E-04	4.20E-04	NC	6.9E-06
Tank Group 04	PB-885-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.20E-04		NC	NC
Tank Group 04	PB-885-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.40E-04		NC	NC
Tank Group 04	PB-885-14	VOC	Ethyl Benzene	100-41-4	D	Y		8.40E-04	4.20E-04	NC	2.8E-06
Tank Group 04	PB-885-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-885-14	VOC	Toluene	108-88-3	ID	Y		8.40E-04	4.20E-04	NC	5.5E-07
Tank Group 04	PB-885-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-14	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-885-14	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-14	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-14	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-14	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-14	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-14	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-14	INORG	Lead	7439-92-1	B2	Y	1.45E+00		1.45E+00	NC	NC
Tank Group 04	PB-885-15	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-885-15	VOC	Cumene	98-82-8	D	Y		9.00E-04	4.50E-04	NC	7.4E-06
Tank Group 04	PB-885-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-885-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.00E-04		NC	NC
Tank Group 04	PB-885-15	VOC	Ethyl Benzene	100-41-4	D	Y		9.00E-04	4.50E-04	NC	2.9E-06
Tank Group 04	PB-885-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-885-15	VOC	Toluene	108-88-3	ID	Y		9.00E-04	4.50E-04	NC	5.9E-07

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-885-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-885-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-885-15	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-885-15	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-15	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-15	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-15	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-15	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-15	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-15	INORG	Lead	7439-92-1	B2	Y	1.48E+00		1.48E+00	NC	NC
Tank Group 04	PB-885-16	VOC	Benzene	71-43-2	A	Y		5.60E-04	2.80E-04	5.1E-09	6.1E-05
Tank Group 04	PB-885-16	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-885-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-885-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-885-16	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-885-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-885-16	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-885-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-16	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-885-16	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-885-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-885-16	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-16	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-885-16	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-885-16	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-16	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-16	INORG	Lead	7439-92-1	B2	Y	8.76E+00		8.76E+00	NC	NC
Tank Group 04	PB-885-17	VOC	Benzene	71-43-2	A	Y		4.60E-04	2.30E-04	4.2E-09	5.0E-05
Tank Group 04	PB-885-17	VOC	Cumene	98-82-8	D	Y		9.30E-04	4.65E-04	NC	7.6E-06
Tank Group 04	PB-885-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-885-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.30E-04		NC	NC
Tank Group 04	PB-885-17	VOC	Ethyl Benzene	100-41-4	D	Y		9.30E-04	4.65E-04	NC	3.0E-06
Tank Group 04	PB-885-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-885-17	VOC	Toluene	108-88-3	ID	Y		9.30E-04	4.65E-04	NC	6.1E-07
Tank Group 04	PB-885-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-885-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-885-17	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-885-17	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-17	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-17	SVOC	Fluorene	86-73-7	D	Y		1.85E-01	9.25E-02	NC	NC
Tank Group 04	PB-885-17	SVOC	Naphthalene	91-20-3	C	Y		1.85E-01	9.25E-02	6.3E-07	1.7E-02
Tank Group 04	PB-885-17	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-17	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-17	INORG	Lead	7439-92-1	B2	Y	2.24E+00		2.24E+00	NC	NC
Tank Group 04	PB-885-18	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-885-18	VOC	Cumene	98-82-8	D	Y		9.00E-04	4.50E-04	NC	7.4E-06
Tank Group 04	PB-885-18	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-885-18	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.00E-04		NC	NC
Tank Group 04	PB-885-18	VOC	Ethyl Benzene	100-41-4	D	Y		9.00E-04	4.50E-04	NC	2.9E-06
Tank Group 04	PB-885-18	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-885-18	VOC	Toluene	108-88-3	ID	Y		9.00E-04	4.50E-04	NC	5.9E-07
Tank Group 04	PB-885-18	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-885-18	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-885-18	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-885-18	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-18	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-18	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-18	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-18	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-18	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-18	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-885-18	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-885-18	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-18	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-18	INORG	Lead	7439-92-1	B2	Y	1.49E+00		1.49E+00	NC	NC
Tank Group 04	PB-885-19	VOC	Benzene	71-43-2	A	Y		4.40E-04	2.20E-04	4.0E-09	4.8E-05
Tank Group 04	PB-885-19	VOC	Cumene	98-82-8	D	Y		8.70E-04	4.35E-04	NC	7.1E-06
Tank Group 04	PB-885-19	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.40E-04		NC	NC
Tank Group 04	PB-885-19	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.70E-04		NC	NC
Tank Group 04	PB-885-19	VOC	Ethyl Benzene	100-41-4	D	Y		8.70E-04	4.35E-04	NC	2.8E-06
Tank Group 04	PB-885-19	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-885-19	VOC	Toluene	108-88-3	ID	Y		8.70E-04	4.35E-04	NC	5.7E-07
Tank Group 04	PB-885-19	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-19	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-19	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-885-19	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-19	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-19	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-19	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-19	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-19	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-19	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-885-19	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-885-19	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-19	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-19	INORG	Lead	7439-92-1	B2	Y	1.93E+00		1.93E+00	NC	NC
Tank Group 04	PB-885-20	VOC	Benzene	71-43-2	A	Y		4.90E-04	2.45E-04	4.5E-09	5.3E-05
Tank Group 04	PB-885-20	VOC	Cumene	98-82-8	D	Y		9.90E-04	4.95E-04	NC	8.1E-06
Tank Group 04	PB-885-20	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.90E-04		NC	NC
Tank Group 04	PB-885-20	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.90E-04		NC	NC
Tank Group 04	PB-885-20	VOC	Ethyl Benzene	100-41-4	D	Y		9.90E-04	4.95E-04	NC	3.2E-06
Tank Group 04	PB-885-20	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-885-20	VOC	Toluene	108-88-3	ID	Y		9.90E-04	4.95E-04	NC	6.5E-07
Tank Group 04	PB-885-20	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-20	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-20	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-885-20	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-20	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-20	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-20	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-20	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-20	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

										Routine Worker	
										Vapor Intrusion	
Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Risk	HQ
Tank Group 04	PB-885-20	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-20	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-20	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-20	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-20	INORG	Lead	7439-92-1	B2	Y	1.63E+00		1.63E+00	NC	NC
Tank Group 04	PB-885-21	VOC	Benzene	71-43-2	A	Y		5.60E-04	2.80E-04	5.1E-09	6.1E-05
Tank Group 04	PB-885-21	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-885-21	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.60E-04		NC	NC
Tank Group 04	PB-885-21	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-885-21	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-885-21	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.20E-03	1.10E-03	6.7E-10	2.4E-06
Tank Group 04	PB-885-21	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-885-21	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-21	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.20E-03	1.10E-03	NC	1.2E-04
Tank Group 04	PB-885-21	VOC	Xylenes (total)	1330-20-7	ID	Y		2.20E-03	1.10E-03	NC	7.2E-05
Tank Group 04	PB-885-21	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-21	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-21	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-21	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-21	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-21	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-21	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-21	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-21	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-21	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-21	INORG	Lead	7439-92-1	B2	Y	3.11E+00		3.11E+00	NC	NC
Tank Group 04	PB-885-22	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-885-22	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-885-22	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-885-22	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-885-22	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-885-22	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-885-22	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-885-22	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-22	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-885-22	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-885-22	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-22	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-22	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-885-22	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-22	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-885-22	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-22	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-885-22	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-885-22	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-22	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-885-22	INORG	Lead	7439-92-1	B2	Y	4.76E+00		4.76E+00	NC	NC
Tank Group 04	PB-885-23	VOC	Benzene	71-43-2	A	Y		3.40E-02	1.70E-02	3.1E-07	3.7E-03
Tank Group 04	PB-885-23	VOC	Cumene	98-82-8	D	Y	2.00E+00		2.00E+00	NC	3.3E-02
Tank Group 04	PB-885-23	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.40E-02		NC	NC
Tank Group 04	PB-885-23	VOC	1,2-Dichloroethane	107-06-2	B2	N		6.70E-02		NC	NC
Tank Group 04	PB-885-23	VOC	Ethyl Benzene	100-41-4	D	Y	1.60E-02		1.60E-02	NC	1.0E-04
Tank Group 04	PB-885-23	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.30E-01	6.50E-02	4.0E-08	1.4E-04
Tank Group 04	PB-885-23	VOC	Toluene	108-88-3	ID	Y		6.70E-02	3.35E-02	NC	4.4E-05
Tank Group 04	PB-885-23	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	5.40E-02		5.40E-02	NC	5.9E-03
Tank Group 04	PB-885-23	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.30E-01	6.50E-02	NC	7.1E-03
Tank Group 04	PB-885-23	VOC	Xylenes (total)	1330-20-7	ID	Y	1.01E-01		1.01E-01	NC	6.6E-03
Tank Group 04	PB-885-23	SVOC	Anthracene	120-12-7	ID	Y	3.70E+00		3.70E+00	NC	NC
Tank Group 04	PB-885-23	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		2.40E+00	1.20E+00	NC	NC
Tank Group 04	PB-885-23	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		3.20E+00	1.60E+00	NC	NC
Tank Group 04	PB-885-23	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		2.40E+00	1.20E+00	NC	NC
Tank Group 04	PB-885-23	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		3.20E+00	1.60E+00	NC	NC
Tank Group 04	PB-885-23	SVOC	Chrysene	218-01-9	B2	Y		2.40E+00	1.20E+00	NC	NC
Tank Group 04	PB-885-23	SVOC	Fluorene	86-73-7	D	Y	1.40E+01		1.40E+01	NC	NC
Tank Group 04	PB-885-23	SVOC	Naphthalene	91-20-3	C	Y		4.00E+00	2.00E+00	***1.4E-05***	***3.7E-01***
Tank Group 04	PB-885-23	SVOC	Phenanthrene	85-01-8	D	Y	2.90E+01		2.90E+01	NC	NC
Tank Group 04	PB-885-23	SVOC	Pyrene	129-00-0	NC	Y	2.90E+00		2.90E+00	NC	NC
Tank Group 04	PB-885-23	INORG	Lead	7439-92-1	B2	Y	6.69E+00		6.69E+00	NC	NC
Tank Group 04	PB-885-24	VOC	Benzene	71-43-2	A	Y		5.80E-04	2.90E-04	5.3E-09	6.3E-05
Tank Group 04	PB-885-24	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-885-24	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.80E-04		NC	NC
Tank Group 04	PB-885-24	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-885-24	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-885-24	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-885-24	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-885-24	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-885-24	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-885-24	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-885-24	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-24	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-24	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-24	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-24	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-885-24	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-24	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-885-24	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-885-24	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-24	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-885-24	INORG	Lead	7439-92-1	B2	Y	1.63E+00		1.63E+00	NC	NC
Tank Group 04	PB-885-25	VOC	Benzene	71-43-2	A	Y		4.20E-04	2.10E-04	3.8E-09	4.6E-05
Tank Group 04	PB-885-25	VOC	Cumene	98-82-8	D	Y		8.50E-04	4.25E-04	NC	7.0E-06
Tank Group 04	PB-885-25	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.20E-04		NC	NC
Tank Group 04	PB-885-25	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.50E-04		NC	NC
Tank Group 04	PB-885-25	VOC	Ethyl Benzene	100-41-4	D	Y		8.50E-04	4.25E-04	NC	2.8E-06
Tank Group 04	PB-885-25	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-885-25	VOC	Toluene	108-88-3	ID	Y		8.50E-04	4.25E-04	NC	5.6E-07
Tank Group 04	PB-885-25	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-25	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-885-25	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-885-25	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-25	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-25	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-25	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-25	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-25	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-25	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-25	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-25	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-25	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-25	INORG	Lead	7439-92-1	B2	Y	1.50E+00		1.50E+00	NC	NC
Tank Group 04	PB-885-26	VOC	Benzene	71-43-2	A	Y		6.00E-04	3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-885-26	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-885-26	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.00E-04		NC	NC
Tank Group 04	PB-885-26	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-885-26	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-885-26	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-885-26	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-885-26	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-885-26	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-885-26	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-885-26	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-26	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-26	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-26	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-26	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-885-26	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-26	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-885-26	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-885-26	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-26	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-885-26	INORG	Lead	7439-92-1	B2	Y	2.28E+00		2.28E+00	NC	NC
Tank Group 04	PB-886-01	VOC	Benzene	71-43-2	A	Y		4.80E-04	2.40E-04	4.4E-09	5.2E-05
Tank Group 04	PB-886-01	VOC	Cumene	98-82-8	D	Y		9.70E-04	4.85E-04	NC	7.9E-06
Tank Group 04	PB-886-01	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.80E-04		NC	NC
Tank Group 04	PB-886-01	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.70E-04		NC	NC
Tank Group 04	PB-886-01	VOC	Ethyl Benzene	100-41-4	D	Y		9.70E-04	4.85E-04	NC	3.2E-06
Tank Group 04	PB-886-01	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-886-01	VOC	Toluene	108-88-3	ID	Y		9.70E-04	4.85E-04	NC	6.4E-07
Tank Group 04	PB-886-01	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-886-01	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.90E-03	9.50E-04	NC	1.0E-04
Tank Group 04	PB-886-01	VOC	Xylenes (total)	1330-20-7	ID	Y		1.90E-03	9.50E-04	NC	6.2E-05
Tank Group 04	PB-886-01	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-01	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-01	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-01	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-01	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-01	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-01	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-01	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-01	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-01	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-01	INORG	Lead	7439-92-1	B2	Y	6.35E+00		6.35E+00	NC	NC
Tank Group 04	PB-886-02	VOC	Benzene	71-43-2	A	Y		4.60E-04	2.30E-04	4.2E-09	5.0E-05
Tank Group 04	PB-886-02	VOC	Cumene	98-82-8	D	Y		9.10E-04	4.55E-04	NC	7.4E-06
Tank Group 04	PB-886-02	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.60E-04		NC	NC
Tank Group 04	PB-886-02	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.10E-04		NC	NC
Tank Group 04	PB-886-02	VOC	Ethyl Benzene	100-41-4	D	Y		9.10E-04	4.55E-04	NC	3.0E-06
Tank Group 04	PB-886-02	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-886-02	VOC	Toluene	108-88-3	ID	Y		9.10E-04	4.55E-04	NC	6.0E-07
Tank Group 04	PB-886-02	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-886-02	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-886-02	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-886-02	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-02	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-02	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-886-02	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-02	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-886-02	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-02	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-886-02	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-886-02	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-02	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-02	INORG	Lead	7439-92-1	B2	Y	5.80E+00		5.80E+00	NC	NC
Tank Group 04	PB-886-03	VOC	Benzene	71-43-2	A	Y		5.10E-04	2.55E-04	4.7E-09	5.6E-05
Tank Group 04	PB-886-03	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-886-03	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.10E-04		NC	NC
Tank Group 04	PB-886-03	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-886-03	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-886-03	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-886-03	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-886-03	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-886-03	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-886-03	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-886-03	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-03	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-03	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-886-03	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-03	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-886-03	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-03	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-886-03	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-886-03	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-03	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-03	INORG	Lead	7439-92-1	B2	Y	6.50E+00		6.50E+00	NC	NC
Tank Group 04	PB-886-04	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-886-04	VOC	Cumene	98-82-8	D	Y	1.80E-04		1.80E-04	NC	2.9E-06
Tank Group 04	PB-886-04	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-886-04	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-886-04	VOC	Ethyl Benzene	100-41-4	D	Y	1.40E-04		1.40E-04	NC	9.2E-07
Tank Group 04	PB-886-04	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-886-04	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-886-04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-886-04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-886-04	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-886-04	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-04	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-04	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-886-04	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-04	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-886-04	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-04	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-04	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-04	SVOC	Phenanthrene	85-01-8	D	Y	4.30E-02		4.30E-02	NC	NC
Tank Group 04	PB-886-04	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-04	INORG	Lead	7439-92-1	B2	Y	8.09E+00		8.09E+00	NC	NC
Tank Group 04	PB-886-05	VOC	Benzene	71-43-2	A	Y		4.20E-04	2.10E-04	3.8E-09	4.6E-05
Tank Group 04	PB-886-05	VOC	Cumene	98-82-8	D	Y		8.40E-04	4.20E-04	NC	6.9E-06
Tank Group 04	PB-886-05	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.20E-04		NC	NC
Tank Group 04	PB-886-05	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.40E-04		NC	NC
Tank Group 04	PB-886-05	VOC	Ethyl Benzene	100-41-4	D	Y		8.40E-04	4.20E-04	NC	2.8E-06
Tank Group 04	PB-886-05	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-886-05	VOC	Toluene	108-88-3	ID	Y		8.40E-04	4.20E-04	NC	5.5E-07
Tank Group 04	PB-886-05	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-886-05	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-886-05	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05
Tank Group 04	PB-886-05	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-05	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-05	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

										Routine Worker	
										Vapor Intrusion	
Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Risk	HQ
Tank Group 04	PB-886-05	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-05	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-05	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-05	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-886-05	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-886-05	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-05	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-05	INORG	Lead	7439-92-1	B2	Y	2.94E+00		2.94E+00	NC	NC
Tank Group 04	PB-886-06	VOC	Benzene	71-43-2	A	Y		5.40E-04	2.70E-04	4.9E-09	5.9E-05
Tank Group 04	PB-886-06	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-886-06	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.40E-04		NC	NC
Tank Group 04	PB-886-06	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-886-06	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-886-06	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-886-06	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-886-06	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-886-06	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-886-06	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-886-06	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-06	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-06	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-06	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-06	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-06	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-06	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-06	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-06	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-06	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-06	INORG	Lead	7439-92-1	B2	Y	2.26E+00		2.26E+00	NC	NC
Tank Group 04	PB-886-07	VOC	Benzene	71-43-2	A	Y		1.20E-03	6.00E-04	1.1E-08	1.3E-04
Tank Group 04	PB-886-07	VOC	Cumene	98-82-8	D	Y		2.40E-03	1.20E-03	NC	2.0E-05
Tank Group 04	PB-886-07	VOC	1,2-Dibromoethane	106-93-4	LC	N		1.20E-03		NC	NC
Tank Group 04	PB-886-07	VOC	1,2-Dichloroethane	107-06-2	B2	N		2.40E-03		NC	NC
Tank Group 04	PB-886-07	VOC	Ethyl Benzene	100-41-4	D	Y		2.40E-03	1.20E-03	NC	7.9E-06
Tank Group 04	PB-886-07	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		4.70E-03	2.35E-03	1.4E-09	5.1E-06
Tank Group 04	PB-886-07	VOC	Toluene	108-88-3	ID	Y		2.40E-03	1.20E-03	NC	1.6E-06
Tank Group 04	PB-886-07	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		4.70E-03	2.35E-03	NC	2.6E-04
Tank Group 04	PB-886-07	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		4.70E-03	2.35E-03	NC	2.6E-04
Tank Group 04	PB-886-07	VOC	Xylenes (total)	1330-20-7	ID	Y		4.70E-03	2.35E-03	NC	1.5E-04
Tank Group 04	PB-886-07	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-07	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-07	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-07	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-07	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-07	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-07	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-07	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-07	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-07	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-07	INORG	Lead	7439-92-1	B2	Y	2.62E+00		2.62E+00	NC	NC
Tank Group 04	PB-886-08	VOC	Benzene	71-43-2	A	Y		3.80E-02	1.90E-02	3.5E-07	4.1E-03
Tank Group 04	PB-886-08	VOC	Cumene	98-82-8	D	Y	1.50E-02		1.50E-02	NC	2.5E-04
Tank Group 04	PB-886-08	VOC	1,2-Dibromoethane	106-93-4	LC	N		3.80E-02		NC	NC
Tank Group 04	PB-886-08	VOC	1,2-Dichloroethane	107-06-2	B2	N		7.50E-02		NC	NC
Tank Group 04	PB-886-08	VOC	Ethyl Benzene	100-41-4	D	Y		7.50E-02	3.75E-02	NC	2.5E-04
Tank Group 04	PB-886-08	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.50E-01	7.50E-02	4.6E-08	1.6E-04
Tank Group 04	PB-886-08	VOC	Toluene	108-88-3	ID	Y		7.50E-02	3.75E-02	NC	4.9E-05
Tank Group 04	PB-886-08	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.50E-01	7.50E-02	NC	8.2E-03
Tank Group 04	PB-886-08	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.50E-01	7.50E-02	NC	8.2E-03
Tank Group 04	PB-886-08	VOC	Xylenes (total)	1330-20-7	ID	Y		1.50E-01	7.50E-02	NC	4.9E-03
Tank Group 04	PB-886-08	SVOC	Anthracene	120-12-7	ID	Y	3.20E-01		3.20E-01	NC	NC
Tank Group 04	PB-886-08	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-08	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-08	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-08	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-08	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-08	SVOC	Fluorene	86-73-7	D	Y	8.80E-01		8.80E-01	NC	NC
Tank Group 04	PB-886-08	SVOC	Naphthalene	91-20-3	C	Y	6.20E-02		6.20E-02	4.2E-07	1.2E-02
Tank Group 04	PB-886-08	SVOC	Phenanthrene	85-01-8	D	Y	1.70E+00		1.70E+00	NC	NC
Tank Group 04	PB-886-08	SVOC	Pyrene	129-00-0	NC	Y	1.00E-01		1.00E-01	NC	NC
Tank Group 04	PB-886-08	INORG	Lead	7439-92-1	B2	Y	8.19E+01		8.19E+01	NC	NC
Tank Group 04	PB-886-09	VOC	Benzene	71-43-2	A	Y		6.30E-04	3.15E-04	5.7E-09	6.9E-05
Tank Group 04	PB-886-09	VOC	Cumene	98-82-8	D	Y	9.80E-04		9.80E-04	NC	1.6E-05
Tank Group 04	PB-886-09	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.30E-04		NC	NC
Tank Group 04	PB-886-09	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-886-09	VOC	Ethyl Benzene	100-41-4	D	Y	3.90E-04		3.90E-04	NC	2.6E-06
Tank Group 04	PB-886-09	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.50E-03	1.25E-03	7.6E-10	2.7E-06
Tank Group 04	PB-886-09	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-886-09	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	2.50E-02		2.50E-02	NC	2.7E-03
Tank Group 04	PB-886-09	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	2.40E-02		2.40E-02	NC	2.6E-03
Tank Group 04	PB-886-09	VOC	Xylenes (total)	1330-20-7	ID	Y	2.07E-03		2.07E-03	NC	1.4E-04
Tank Group 04	PB-886-09	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-09	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-09	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-09	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-09	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-09	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-09	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-886-09	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-886-09	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-09	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-09	INORG	Lead	7439-92-1	B2	Y	1.87E+00		1.87E+00	NC	NC
Tank Group 04	PB-886-10	VOC	Benzene	71-43-2	A	Y		6.00E-04	3.00E-04	5.5E-09	6.5E-05
Tank Group 04	PB-886-10	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-886-10	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.00E-04		NC	NC
Tank Group 04	PB-886-10	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-886-10	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-886-10	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-886-10	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-886-10	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	8.40E-04		8.40E-04	NC	9.2E-05
Tank Group 04	PB-886-10	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.40E-03		1.40E-03	NC	1.5E-04
Tank Group 04	PB-886-10	VOC	Xylenes (total)	1330-20-7	ID	Y	1.73E-03		1.73E-03	NC	1.1E-04
Tank Group 04	PB-886-10	SVOC	Anthracene	120-12-7	ID	Y	1.60E-01		1.60E-01	NC	NC
Tank Group 04	PB-886-10	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-10	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-10	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-10	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-10	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-10	SVOC	Fluorene	86-73-7	D	Y	3.50E-01		3.50E-01	NC	NC
Tank Group 04	PB-886-10	SVOC	Naphthalene	91-20-3	C	Y	4.10E-02		4.10E-02	2.8E-07	7.6E-03
Tank Group 04	PB-886-10	SVOC	Phenanthrene	85-01-8	D	Y	7.80E-01		7.80E-01	NC	NC
Tank Group 04	PB-886-10	SVOC	Pyrene	129-00-0	NC	Y	4.90E-02		4.90E-02	NC	NC
Tank Group 04	PB-886-10	INORG	Lead	7439-92-1	B2	Y	1.97E+00		1.97E+00	NC	NC
Tank Group 04	PB-886-11	VOC	Benzene	71-43-2	A	Y		5.90E-04	2.95E-04	5.4E-09	6.4E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

										Routine Worker	
										Vapor Intrusion	
Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Risk	HQ
Tank Group 04	PB-886-11	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-886-11	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.90E-04		NC	NC
Tank Group 04	PB-886-11	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-886-11	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-886-11	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.40E-03	1.20E-03	7.3E-10	2.6E-06
Tank Group 04	PB-886-11	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-886-11	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-886-11	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.40E-03	1.20E-03	NC	1.3E-04
Tank Group 04	PB-886-11	VOC	Xylenes (total)	1330-20-7	ID	Y		2.40E-03	1.20E-03	NC	7.9E-05
Tank Group 04	PB-886-11	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-11	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-11	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-11	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-11	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-11	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-11	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-886-11	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-886-11	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-11	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-11	INORG	Lead	7439-92-1	B2	Y	1.17E+01		1.17E+01	NC	NC
Tank Group 04	PB-886-12	VOC	Benzene	71-43-2	A	Y		7.20E-04	3.60E-04	6.6E-09	7.9E-05
Tank Group 04	PB-886-12	VOC	Cumene	98-82-8	D	Y		1.40E-03	7.00E-04	NC	1.1E-05
Tank Group 04	PB-886-12	VOC	1,2-Dibromoethane	106-93-4	LC	N		7.20E-04		NC	NC
Tank Group 04	PB-886-12	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.40E-03		NC	NC
Tank Group 04	PB-886-12	VOC	Ethyl Benzene	100-41-4	D	Y		1.40E-03	7.00E-04	NC	4.6E-06
Tank Group 04	PB-886-12	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.90E-03	1.45E-03	8.8E-10	3.2E-06
Tank Group 04	PB-886-12	VOC	Toluene	108-88-3	ID	Y		1.40E-03	7.00E-04	NC	9.2E-07
Tank Group 04	PB-886-12	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.10E-03		1.10E-03	NC	1.2E-04
Tank Group 04	PB-886-12	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.40E-03		1.40E-03	NC	1.5E-04
Tank Group 04	PB-886-12	VOC	Xylenes (total)	1330-20-7	ID	Y	1.94E-03		1.94E-03	NC	1.3E-04
Tank Group 04	PB-886-12	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-12	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-12	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-12	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-12	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-12	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-12	SVOC	Fluorene	86-73-7	D	Y	4.40E-02		4.40E-02	NC	NC
Tank Group 04	PB-886-12	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-12	SVOC	Phenanthrene	85-01-8	D	Y	1.20E-01		1.20E-01	NC	NC
Tank Group 04	PB-886-12	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-12	INORG	Lead	7439-92-1	B2	Y	5.66E+00		5.66E+00	NC	NC
Tank Group 04	PB-886-13	VOC	Benzene	71-43-2	A	Y		1.10E-03	5.50E-04	1.0E-08	1.2E-04
Tank Group 04	PB-886-13	VOC	Cumene	98-82-8	D	Y		2.10E-03	1.05E-03	NC	1.7E-05
Tank Group 04	PB-886-13	VOC	1,2-Dibromoethane	106-93-4	LC	N		1.10E-03		NC	NC
Tank Group 04	PB-886-13	VOC	1,2-Dichloroethane	107-06-2	B2	N		2.10E-03		NC	NC
Tank Group 04	PB-886-13	VOC	Ethyl Benzene	100-41-4	D	Y		2.10E-03	1.05E-03	NC	6.9E-06
Tank Group 04	PB-886-13	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		4.30E-03	2.15E-03	1.3E-09	4.7E-06
Tank Group 04	PB-886-13	VOC	Toluene	108-88-3	ID	Y		2.10E-03	1.05E-03	NC	1.4E-06
Tank Group 04	PB-886-13	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		4.30E-03	2.15E-03	NC	2.3E-04
Tank Group 04	PB-886-13	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		4.30E-03	2.15E-03	NC	2.3E-04
Tank Group 04	PB-886-13	VOC	Xylenes (total)	1330-20-7	ID	Y		4.30E-03	2.15E-03	NC	1.4E-04
Tank Group 04	PB-886-13	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-13	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-13	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-13	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-13	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-13	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-13	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-13	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-13	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-13	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-13	INORG	Lead	7439-92-1	B2	Y	3.04E+00		3.04E+00	NC	NC
Tank Group 04	PB-886-14	VOC	Benzene	71-43-2	A	Y		8.30E-04	4.15E-04	7.6E-09	9.1E-05
Tank Group 04	PB-886-14	VOC	Cumene	98-82-8	D	Y		1.70E-03	8.50E-04	NC	1.4E-05
Tank Group 04	PB-886-14	VOC	1,2-Dibromoethane	106-93-4	LC	N		8.30E-04		NC	NC
Tank Group 04	PB-886-14	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.70E-03		NC	NC
Tank Group 04	PB-886-14	VOC	Ethyl Benzene	100-41-4	D	Y		1.70E-03	8.50E-04	NC	5.6E-06
Tank Group 04	PB-886-14	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.30E-03	1.65E-03	1.0E-09	3.6E-06
Tank Group 04	PB-886-14	VOC	Toluene	108-88-3	ID	Y		1.70E-03	8.50E-04	NC	1.1E-06
Tank Group 04	PB-886-14	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.30E-03	1.65E-03	NC	1.8E-04
Tank Group 04	PB-886-14	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.30E-03	1.65E-03	NC	1.8E-04
Tank Group 04	PB-886-14	VOC	Xylenes (total)	1330-20-7	ID	Y		3.30E-03	1.65E-03	NC	1.1E-04
Tank Group 04	PB-886-14	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-14	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-14	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-14	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-14	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-14	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-14	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-886-14	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-886-14	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-14	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-14	INORG	Lead	7439-92-1	B2	Y	2.10E+00		2.10E+00	NC	NC
Tank Group 04	PB-886-15	VOC	Benzene	71-43-2	A	Y		8.70E-04	4.35E-04	7.9E-09	9.5E-05
Tank Group 04	PB-886-15	VOC	Cumene	98-82-8	D	Y		1.70E-03	8.50E-04	NC	1.4E-05
Tank Group 04	PB-886-15	VOC	1,2-Dibromoethane	106-93-4	LC	N		8.70E-04		NC	NC
Tank Group 04	PB-886-15	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.70E-03		NC	NC
Tank Group 04	PB-886-15	VOC	Ethyl Benzene	100-41-4	D	Y		1.70E-03	8.50E-04	NC	5.6E-06
Tank Group 04	PB-886-15	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		3.50E-03	1.75E-03	1.1E-09	3.8E-06
Tank Group 04	PB-886-15	VOC	Toluene	108-88-3	ID	Y		1.70E-03	8.50E-04	NC	1.1E-06
Tank Group 04	PB-886-15	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		3.50E-03	1.75E-03	NC	1.9E-04
Tank Group 04	PB-886-15	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		3.50E-03	1.75E-03	NC	1.9E-04
Tank Group 04	PB-886-15	VOC	Xylenes (total)	1330-20-7	ID	Y		3.50E-03	1.75E-03	NC	1.1E-04
Tank Group 04	PB-886-15	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-15	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-15	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-15	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-15	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-15	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-15	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-15	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-15	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-15	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-15	INORG	Lead	7439-92-1	B2	Y	2.56E+00		2.56E+00	NC	NC
Tank Group 04	PB-886-16	VOC	Benzene	71-43-2	A	Y		4.30E-04	2.15E-04	3.9E-09	4.7E-05
Tank Group 04	PB-886-16	VOC	Cumene	98-82-8	D	Y		8.70E-04	4.35E-04	NC	7.1E-06
Tank Group 04	PB-886-16	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.30E-04		NC	NC
Tank Group 04	PB-886-16	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.70E-04		NC	NC
Tank Group 04	PB-886-16	VOC	Ethyl Benzene	100-41-4	D	Y		8.70E-04	4.35E-04	NC	2.8E-06
Tank Group 04	PB-886-16	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.70E-03	8.50E-04	5.2E-10	1.9E-06
Tank Group 04	PB-886-16	VOC	Toluene	108-88-3	ID	Y		8.70E-04	4.35E-04	NC	5.7E-07
Tank Group 04	PB-886-16	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-886-16	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.70E-03	8.50E-04	NC	9.3E-05
Tank Group 04	PB-886-16	VOC	Xylenes (total)	1330-20-7	ID	Y		1.70E-03	8.50E-04	NC	5.6E-05

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-886-16	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-16	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-16	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-16	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-16	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-16	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-16	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-886-16	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-886-16	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-16	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-16	INORG	Lead	7439-92-1	B2	Y	1.82E+00		1.82E+00	NC	NC
Tank Group 04	PB-886-17	VOC	Benzene	71-43-2	A	Y		5.20E-04	2.60E-04	4.7E-09	5.7E-05
Tank Group 04	PB-886-17	VOC	Cumene	98-82-8	D	Y	1.20E-04		1.20E-04	NC	2.0E-06
Tank Group 04	PB-886-17	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.20E-04		NC	NC
Tank Group 04	PB-886-17	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-886-17	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-886-17	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-886-17	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-886-17	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	2.50E-03		2.50E-03	NC	2.7E-04
Tank Group 04	PB-886-17	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	8.20E-04		8.20E-04	NC	9.0E-05
Tank Group 04	PB-886-17	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-886-17	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-17	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-17	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-17	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-17	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-17	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-17	SVOC	Fluorene	86-73-7	D	Y	4.60E-02		4.60E-02	NC	NC
Tank Group 04	PB-886-17	SVOC	Naphthalene	91-20-3	C	Y	9.20E-02		9.20E-02	6.2E-07	1.7E-02
Tank Group 04	PB-886-17	SVOC	Phenanthrene	85-01-8	D	Y	1.30E-01		1.30E-01	NC	NC
Tank Group 04	PB-886-17	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-17	INORG	Lead	7439-92-1	B2	Y	1.80E+00		1.80E+00	NC	NC
Tank Group 04	PB-886-18	VOC	Benzene	71-43-2	A	Y		5.70E-04	2.85E-04	5.2E-09	6.2E-05
Tank Group 04	PB-886-18	VOC	Cumene	98-82-8	D	Y		1.10E-03	5.50E-04	NC	9.0E-06
Tank Group 04	PB-886-18	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.70E-04		NC	NC
Tank Group 04	PB-886-18	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-886-18	VOC	Ethyl Benzene	100-41-4	D	Y		1.10E-03	5.50E-04	NC	3.6E-06
Tank Group 04	PB-886-18	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-886-18	VOC	Toluene	108-88-3	ID	Y		1.10E-03	5.50E-04	NC	7.2E-07
Tank Group 04	PB-886-18	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-886-18	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.30E-03	1.15E-03	NC	1.3E-04
Tank Group 04	PB-886-18	VOC	Xylenes (total)	1330-20-7	ID	Y		2.30E-03	1.15E-03	NC	7.5E-05
Tank Group 04	PB-886-18	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-18	SVOC	Benzo(a)anthracene	56-55-3	B2	Y	2.20E-02		2.20E-02	NC	NC
Tank Group 04	PB-886-18	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-18	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	3.60E-02		3.60E-02	NC	NC
Tank Group 04	PB-886-18	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y	2.70E-02		2.70E-02	NC	NC
Tank Group 04	PB-886-18	SVOC	Chrysene	218-01-9	B2	Y	9.30E-02		9.30E-02	NC	NC
Tank Group 04	PB-886-18	SVOC	Fluorene	86-73-7	D	Y	3.00E-02		3.00E-02	NC	NC
Tank Group 04	PB-886-18	SVOC	Naphthalene	91-20-3	C	Y	1.40E-01		1.40E-01	9.5E-07	2.6E-02
Tank Group 04	PB-886-18	SVOC	Phenanthrene	85-01-8	D	Y	1.20E-01		1.20E-01	NC	NC
Tank Group 04	PB-886-18	SVOC	Pyrene	129-00-0	NC	Y	1.10E-01		1.10E-01	NC	NC
Tank Group 04	PB-886-18	INORG	Lead	7439-92-1	B2	Y	1.92E+00		1.92E+00	NC	NC
Tank Group 04	PB-886-19	VOC	Benzene	71-43-2	A	Y		6.60E-04	3.30E-04	6.0E-09	7.2E-05
Tank Group 04	PB-886-19	VOC	Cumene	98-82-8	D	Y		1.30E-03	6.50E-04	NC	1.1E-05
Tank Group 04	PB-886-19	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.60E-04		NC	NC
Tank Group 04	PB-886-19	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.30E-03		NC	NC
Tank Group 04	PB-886-19	VOC	Ethyl Benzene	100-41-4	D	Y		1.30E-03	6.50E-04	NC	4.3E-06
Tank Group 04	PB-886-19	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.60E-03	1.30E-03	7.9E-10	2.8E-06
Tank Group 04	PB-886-19	VOC	Toluene	108-88-3	ID	Y		1.30E-03	6.50E-04	NC	8.5E-07
Tank Group 04	PB-886-19	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-886-19	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.60E-03	1.30E-03	NC	1.4E-04
Tank Group 04	PB-886-19	VOC	Xylenes (total)	1330-20-7	ID	Y		2.60E-03	1.30E-03	NC	8.5E-05
Tank Group 04	PB-886-19	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-19	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-19	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-19	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-19	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-19	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-19	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-19	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-19	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-19	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-19	INORG	Lead	7439-92-1	B2	Y	2.28E+00		2.28E+00	NC	NC
Tank Group 04	PB-886-20	VOC	Benzene	71-43-2	A	Y		6.30E-04	3.15E-04	5.7E-09	6.9E-05
Tank Group 04	PB-886-20	VOC	Cumene	98-82-8	D	Y		1.20E-03	6.00E-04	NC	9.8E-06
Tank Group 04	PB-886-20	VOC	1,2-Dibromoethane	106-93-4	LC	N		6.30E-04		NC	NC
Tank Group 04	PB-886-20	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.20E-03		NC	NC
Tank Group 04	PB-886-20	VOC	Ethyl Benzene	100-41-4	D	Y		1.20E-03	6.00E-04	NC	3.9E-06
Tank Group 04	PB-886-20	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.50E-03	1.25E-03	7.6E-10	2.7E-06
Tank Group 04	PB-886-20	VOC	Toluene	108-88-3	ID	Y		1.20E-03	6.00E-04	NC	7.9E-07
Tank Group 04	PB-886-20	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-886-20	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.50E-03	1.25E-03	NC	1.4E-04
Tank Group 04	PB-886-20	VOC	Xylenes (total)	1330-20-7	ID	Y		2.50E-03	1.25E-03	NC	8.2E-05
Tank Group 04	PB-886-20	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-20	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-20	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-20	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-20	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-20	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-20	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-886-20	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-886-20	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-20	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-20	INORG	Lead	7439-92-1	B2	Y	2.19E+00		2.19E+00	NC	NC
Tank Group 04	PB-886-21	VOC	Benzene	71-43-2	A	Y		4.40E-04	2.20E-04	4.0E-09	4.8E-05
Tank Group 04	PB-886-21	VOC	Cumene	98-82-8	D	Y		8.90E-04	4.45E-04	NC	7.3E-06
Tank Group 04	PB-886-21	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.40E-04		NC	NC
Tank Group 04	PB-886-21	VOC	1,2-Dichloroethane	107-06-2	B2	N		8.90E-04		NC	NC
Tank Group 04	PB-886-21	VOC	Ethyl Benzene	100-41-4	D	Y		8.90E-04	4.45E-04	NC	2.9E-06
Tank Group 04	PB-886-21	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-886-21	VOC	Toluene	108-88-3	ID	Y		8.90E-04	4.45E-04	NC	5.8E-07
Tank Group 04	PB-886-21	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-886-21	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-886-21	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-886-21	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-21	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-21	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-21	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-21	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-21	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-21	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-21	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-21	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-886-21	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-21	INORG	Lead	7439-92-1	B2	Y	1.82E+00		1.82E+00	NC	NC
Tank Group 04	PB-886-22	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-886-22	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-886-22	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-886-22	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-886-22	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-886-22	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-886-22	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-886-22	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-886-22	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-886-22	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-886-22	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-22	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-22	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-22	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-22	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-22	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-22	SVOC	Fluorene	86-73-7	D	Y		1.90E-01	9.50E-02	NC	NC
Tank Group 04	PB-886-22	SVOC	Naphthalene	91-20-3	C	Y		1.90E-01	9.50E-02	6.4E-07	1.8E-02
Tank Group 04	PB-886-22	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-22	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-22	INORG	Lead	7439-92-1	B2	Y	2.06E+00		2.06E+00	NC	NC
Tank Group 04	PB-886-23	VOC	Benzene	71-43-2	A	Y		5.00E-04	2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-886-23	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-886-23	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.00E-04		NC	NC
Tank Group 04	PB-886-23	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-886-23	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-886-23	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.00E-03	1.00E-03	6.1E-10	2.2E-06
Tank Group 04	PB-886-23	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-886-23	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-886-23	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.00E-03	1.00E-03	NC	1.1E-04
Tank Group 04	PB-886-23	VOC	Xylenes (total)	1330-20-7	ID	Y		2.00E-03	1.00E-03	NC	6.5E-05
Tank Group 04	PB-886-23	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-23	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-23	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-23	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-23	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-23	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-23	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-886-23	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-886-23	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-23	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-23	INORG	Lead	7439-92-1	B2	Y	1.95E+00		1.95E+00	NC	NC
Tank Group 04	PB-886-24	VOC	Benzene	71-43-2	A	Y		5.30E-04	2.65E-04	4.8E-09	5.8E-05
Tank Group 04	PB-886-24	VOC	Cumene	98-82-8	D	Y		1.00E-03	5.00E-04	NC	8.2E-06
Tank Group 04	PB-886-24	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.30E-04		NC	NC
Tank Group 04	PB-886-24	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.00E-03		NC	NC
Tank Group 04	PB-886-24	VOC	Ethyl Benzene	100-41-4	D	Y		1.00E-03	5.00E-04	NC	3.3E-06
Tank Group 04	PB-886-24	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.10E-03	1.05E-03	6.4E-10	2.3E-06
Tank Group 04	PB-886-24	VOC	Toluene	108-88-3	ID	Y		1.00E-03	5.00E-04	NC	6.5E-07
Tank Group 04	PB-886-24	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-886-24	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		2.10E-03	1.05E-03	NC	1.1E-04
Tank Group 04	PB-886-24	VOC	Xylenes (total)	1330-20-7	ID	Y		2.10E-03	1.05E-03	NC	6.9E-05
Tank Group 04	PB-886-24	SVOC	Anthracene	120-12-7	ID	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-24	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-24	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-886-24	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-24	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.60E-01	8.00E-02	NC	NC
Tank Group 04	PB-886-24	SVOC	Chrysene	218-01-9	B2	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-24	SVOC	Fluorene	86-73-7	D	Y		2.00E-01	1.00E-01	NC	NC
Tank Group 04	PB-886-24	SVOC	Naphthalene	91-20-3	C	Y		2.00E-01	1.00E-01	6.8E-07	1.9E-02
Tank Group 04	PB-886-24	SVOC	Phenanthrene	85-01-8	D	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-24	SVOC	Pyrene	129-00-0	NC	Y		1.20E-01	6.00E-02	NC	NC
Tank Group 04	PB-886-24	INORG	Lead	7439-92-1	B2	Y	4.51E+00		4.51E+00	NC	NC
Tank Group 04	PB-886-25	VOC	Benzene	71-43-2	A	Y		4.50E-04	2.25E-04	4.1E-09	4.9E-05
Tank Group 04	PB-886-25	VOC	Cumene	98-82-8	D	Y		9.00E-04	4.50E-04	NC	7.4E-06
Tank Group 04	PB-886-25	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.50E-04		NC	NC
Tank Group 04	PB-886-25	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.00E-04		NC	NC
Tank Group 04	PB-886-25	VOC	Ethyl Benzene	100-41-4	D	Y		9.00E-04	4.50E-04	NC	2.9E-06
Tank Group 04	PB-886-25	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.80E-03	9.00E-04	5.5E-10	2.0E-06
Tank Group 04	PB-886-25	VOC	Toluene	108-88-3	ID	Y		9.00E-04	4.50E-04	NC	5.9E-07
Tank Group 04	PB-886-25	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-886-25	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.80E-03	9.00E-04	NC	9.8E-05
Tank Group 04	PB-886-25	VOC	Xylenes (total)	1330-20-7	ID	Y		1.80E-03	9.00E-04	NC	5.9E-05
Tank Group 04	PB-886-25	SVOC	Anthracene	120-12-7	ID	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-25	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-25	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-25	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-25	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.50E-01	7.50E-02	NC	NC
Tank Group 04	PB-886-25	SVOC	Chrysene	218-01-9	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-25	SVOC	Fluorene	86-73-7	D	Y		1.80E-01	9.00E-02	NC	NC
Tank Group 04	PB-886-25	SVOC	Naphthalene	91-20-3	C	Y		1.80E-01	9.00E-02	6.1E-07	1.7E-02
Tank Group 04	PB-886-25	SVOC	Phenanthrene	85-01-8	D	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-25	SVOC	Pyrene	129-00-0	NC	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-25	INORG	Lead	7439-92-1	B2	Y	1.81E+00		1.81E+00	NC	NC
Tank Group 04	PB-886-26	VOC	Benzene	71-43-2	A	Y	2.50E-04		2.50E-04	4.6E-09	5.5E-05
Tank Group 04	PB-886-26	VOC	Cumene	98-82-8	D	Y	8.90E-03		8.90E-03	NC	1.5E-04
Tank Group 04	PB-886-26	VOC	1,2-Dibromoethane	106-93-4	LC	N		5.70E-04		NC	NC
Tank Group 04	PB-886-26	VOC	1,2-Dichloroethane	107-06-2	B2	N		1.10E-03		NC	NC
Tank Group 04	PB-886-26	VOC	Ethyl Benzene	100-41-4	D	Y	3.20E-03		3.20E-03	NC	2.1E-05
Tank Group 04	PB-886-26	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		2.30E-03	1.15E-03	7.0E-10	2.5E-06
Tank Group 04	PB-886-26	VOC	Toluene	108-88-3	ID	Y	1.20E-03		1.20E-03	NC	1.6E-06
Tank Group 04	PB-886-26	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	1.70E-01		1.70E-01	NC	1.9E-02
Tank Group 04	PB-886-26	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y	1.40E-01		1.40E-01	NC	1.5E-02
Tank Group 04	PB-886-26	VOC	Xylenes (total)	1330-20-7	ID	Y	2.50E-02		2.50E-02	NC	1.6E-03
Tank Group 04	PB-886-26	SVOC	Anthracene	120-12-7	ID	Y	3.40E-02		3.40E-02	NC	NC
Tank Group 04	PB-886-26	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-26	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-26	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.10E-01	5.50E-02	NC	NC
Tank Group 04	PB-886-26	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-26	SVOC	Chrysene	218-01-9	B2	Y	3.10E-02		3.10E-02	NC	NC
Tank Group 04	PB-886-26	SVOC	Fluorene	86-73-7	D	Y	5.40E-02		5.40E-02	NC	NC
Tank Group 04	PB-886-26	SVOC	Naphthalene	91-20-3	C	Y	2.20E-02		2.20E-02	1.5E-07	4.1E-03
Tank Group 04	PB-886-26	SVOC	Phenanthrene	85-01-8	D	Y	1.20E-01		1.20E-01	NC	NC
Tank Group 04	PB-886-26	SVOC	Pyrene	129-00-0	NC	Y	4.50E-02		4.50E-02	NC	NC
Tank Group 04	PB-886-26	INORG	Lead	7439-92-1	B2	Y	2.15E+00		2.15E+00	NC	NC
Tank Group 04	PB-886-27	VOC	Benzene	71-43-2	A	Y		4.70E-04	2.35E-04	4.3E-09	5.1E-05
Tank Group 04	PB-886-27	VOC	Cumene	98-82-8	D	Y	2.10E-04		2.10E-04	NC	3.4E-06
Tank Group 04	PB-886-27	VOC	1,2-Dibromoethane	106-93-4	LC	N		4.70E-04		NC	NC
Tank Group 04	PB-886-27	VOC	1,2-Dichloroethane	107-06-2	B2	N		9.50E-04		NC	NC
Tank Group 04	PB-886-27	VOC	Ethyl Benzene	100-41-4	D	Y	1.80E-04		1.80E-04	NC	1.2E-06
Tank Group 04	PB-886-27	VOC	Methyl tert-butyl ether	1634-04-4	C	Y		1.90E-03	9.50E-04	5.8E-10	2.1E-06
Tank Group 04	PB-886-27	VOC	Toluene	108-88-3	ID	Y		9.50E-04	4.75E-04	NC	6.2E-07

Attachment 8
Table 2
Location-Specific Upper Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Soil
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Area	Location	Chem Group	Chemical	CASRN	Carc Class	Detected in Soil	Max Detect from All Depths (mg/kg)	Max Limit from All Depths (mg/kg)	Exposure Concentration (mg/kg)	Routine Worker Vapor Intrusion Risk	Routine Worker Vapor Intrusion HQ
Tank Group 04	PB-886-27	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	Y	5.10E-02		5.10E-02	NC	5.6E-03
Tank Group 04	PB-886-27	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	Y		1.20E-01	6.00E-02	NC	6.5E-03
Tank Group 04	PB-886-27	VOC	Xylenes (total)	1330-20-7	ID	Y	1.07E-03		1.07E-03	NC	7.0E-05
Tank Group 04	PB-886-27	SVOC	Anthracene	120-12-7	ID	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-27	SVOC	Benzo(a)anthracene	56-55-3	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-27	SVOC	Benzo(a)pyrene	50-32-8	HC	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-27	SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-27	SVOC	Benzo(g,h,i)perylene	191-24-2	D	Y		1.40E-01	7.00E-02	NC	NC
Tank Group 04	PB-886-27	SVOC	Chrysene	218-01-9	B2	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-27	SVOC	Fluorene	86-73-7	D	Y		1.70E-01	8.50E-02	NC	NC
Tank Group 04	PB-886-27	SVOC	Naphthalene	91-20-3	C	Y		1.70E-01	8.50E-02	5.8E-07	1.6E-02
Tank Group 04	PB-886-27	SVOC	Phenanthrene	85-01-8	D	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-27	SVOC	Pyrene	129-00-0	NC	Y		1.00E-01	5.00E-02	NC	NC
Tank Group 04	PB-886-27	INORG	Lead	7439-92-1	B2	Y	2.28E+00		2.28E+00	NC	NC

Notes:
Only constituents detected in each area are shown.
Single-chemical cancer risk and hazard quotient (HQ) estimates in excess of PADEP's thresholds for cumulative cancer risk and HI of 1E-4 and 1, respectively, are shaded and bold.
Single-chemical cancer risk and HQ estimates in excess of 1/10 PADEP's thresholds for cumulative cancer risk or HI of 1E-4 and 1, respectively, are italic and bold
Where a chemical is non-detect at a location but detected within the media at the Site, half of the analytical limit is used as the exposure concentration
NC - Risk and HQ estimates were not calculated for detected chemicals with inadequate toxicity or physical/chemical parameters or where chemical concentrations were non-detect.
The concentrations for the Xylene isomers (m/p and o) were summed to Xylenes (total).
Chem Group - chemical group
Carc Class - USEPA Weight-of-Evidence Cancer Classification

Attachment 8
Table 3
Upper-Bound Single-Chemical Cancer Risk and Noncancer Hazard Quotient (HQ) for Receptor Exposure to Groundwater
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

							Routine Worker				Maintenance Worker		Construction Worker		Off-Facility Resident				--	
							Vapor Intrusion		Outdoor Air Inhalation		Groundwater Contact		Groundwater Contact		Vapor Intrusion		Outdoor Air Inhalation		Nonpotable Use	
Dataset	Area	Chem Group	Chemical	CASRN	Carc Class	Max Detected (mg/L)	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ
AST	Tank Group 04	VOC	Benzene	71-43-2	A	5.80E-01	1.3E-06	1.5E-02	8.8E-09	1.1E-04	1.4E-06	4.2E-02	1.4E-07	1.5E-02	***2.0E-05***	***2.4E-01***	3.8E-08	4.4E-04	***2.0E-05***	9.4E-02
AST	Tank Group 04	VOC	Cumene	98-82-8	D	7.50E-02	NC	1.2E-04	NC	8.3E-07	NC	2.5E-04	NC	2.5E-04	NC	1.9E-03	NC	3.4E-06	NC	2.0E-04
AST	Tank Group 04	VOC	Ethyl Benzene	100-41-4	D	1.10E-01	NC	7.2E-05	NC	5.0E-07	NC	4.1E-04	NC	2.8E-04	NC	1.1E-03	NC	2.1E-06	NC	5.4E-03
AST	Tank Group 04	VOC	Toluene	108-88-3	ID	1.10E-02	NC	1.6E-06	NC	1.1E-08	NC	2.4E-05	NC	5.4E-06	NC	2.5E-05	NC	4.6E-08	NC	4.5E-05
AST	Tank Group 04	VOC	1,2,4-Trimethylbenzene	95-63-6	ID	5.40E-02	NC	5.4E-04	NC	3.8E-06	NC	1.2E-03	NC	3.6E-04	NC	8.6E-03	NC	1.6E-05	NC	6.2E-04
AST	Tank Group 04	VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.30E-02	NC	1.4E-04	NC	9.8E-07	NC	2.9E-04	NC	8.7E-05	NC	2.2E-03	NC	4.1E-06	NC	1.5E-04
AST	Tank Group 04	VOC	Xylenes (total)	1330-20-7	ID	1.91E-01	NC	1.4E-03	NC	9.9E-06	NC	2.9E-03	NC	1.1E-03	NC	2.2E-02	NC	4.1E-05	NC	5.2E-03
AST	Tank Group 04	SVOC	Anthracene	120-12-7	ID	3.20E-04	NC	NC	NC	NC	NC	5.5E-09	NC	1.6E-09	NC	NC	NC	NC	NC	1.4E-07
AST	Tank Group 04	SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E-04	NC	NC	NC	NC	7.3E-12	NC	7.3E-13	NC	NC	NC	NC	NC	9.5E-09	NC
AST	Tank Group 04	SVOC	Fluorene	86-73-7	D	9.20E-04	NC	NC	NC	NC	NC	1.2E-07	NC	1.2E-08	NC	NC	NC	NC	NC	9.5E-07
AST	Tank Group 04	SVOC	Naphthalene	91-20-3	C	9.40E-03	3.1E-08	8.5E-04	2.2E-10	6.2E-06	5.0E-08	3.4E-03	5.0E-09	3.4E-03	5.3E-07	1.4E-02	9.7E-10	2.6E-05	2.2E-07	2.4E-03
AST	Tank Group 04	SVOC	Phenanthrene	85-01-8	D	2.50E-04	NC	NC	NC	NC	NC	4.3E-08	NC	4.3E-09	NC	NC	NC	NC	NC	3.4E-07
AST	Tank Group 04	SVOC	Pyrene	129-00-0	NC	6.00E-05	NC	NC	NC	NC	NC	1.0E-08	NC	1.0E-09	NC	NC	NC	NC	NC	1.2E-07
Evergreen	Tank Group 04	VOC	Cumene	98-82-8	D	2.80E-04	NC	4.4E-07	NC	3.1E-09	NC	9.4E-07	NC	9.3E-07	NC	7.0E-06	NC	1.3E-08	NC	7.6E-07
Evergreen	Tank Group 04	VOC	Toluene	108-88-3	ID	3.40E-04	NC	4.8E-08	NC	3.4E-10	NC	7.5E-07	NC	1.7E-07	NC	7.6E-07	NC	1.4E-09	NC	1.4E-06
Evergreen	Tank Group 04	SVOC	Benzo(a)anthracene	56-55-3	B2	1.80E-04	NC	NC	NC	NC	1.3E-11	NC	1.3E-12	NC	NC	NC	NC	NC	1.7E-08	NC

Notes:
Only constituents detected in each area are shown.
Single-chemical cancer risk and hazard quotient (HQ) estimates in excess of PADEP's thresholds for cumulative cancer risk and HI of 1E-4 and 1, respectively, are shaded and bold.
Single-chemical cancer risk and HQ estimates in excess of 1/10 PADEP's thresholds for cumulative cancer risk or HI of 1E-4 and 1, respectively, are italic and bold.
NC - Risk and HQ estimates were not calculated for detected chemicals with inadequate toxicity or physical/chemical parameters or where chemical concentrations were non-detect.
The concentrations for the Xylene isomers (m/p and o) were summed to Xylenes (total).
Chem Group - chemical group
Carc Class - USEPA Weight-of-Evidence Cancer Classification

Appendix B

Risk-Based Screening Level Supporting Information and Calculations

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Attachments

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2 Routine Worker Risk Based Screening Level Calculations
3 Construction Worker Risk Based Screening Level Calculations
4 Soil Migration to Groundwater Screening Level Calculations
5 Off-Facility Resident Risk Based Screening Level Calculations
6 Nonpotable Groundwater Use Risk Based Screening Level Calculations

1 Introduction

Terraphase Engineering, Inc. (Terraphase), on behalf of Philadelphia Energy Solutions Refining and Marketing LLC (PESRM), has prepared this appendix to document the calculation of site-specific risk-based screening levels (RBSLs) for soil and groundwater. The RBSLs have been developed to support investigation decision-making at the Facility and determine the adequacy of data collected to support site-specific risk assessments which will be performed to close out areas of the Facility which are subject to various investigation/remedial action as part of redevelopment. This includes efforts to complete Site Assessment and Characterization for aboveground storage tanks under Act 32, efforts to investigate and obtain liability protection for several areas with suspected releases to the environment in accordance with Act 2, and efforts to investigate and attain closure of hazardous waste units in accordance with the Code of Federal Regulations Title 40, Part 264 Subpart G (as incorporated by reference in 25 Pa. Code § 264a).

The RBSLs are developed with consideration for current and reasonably expected future land and groundwater use at and in the immediate vicinity of the Facility and use methods and assumptions consistent with Pennsylvania Department of Environmental Protection (PADEP) and United States Environmental Protection Agency (USEPA) risk assessment guidance.

RBSLs are developed for the following exposure scenarios:

Soil Exposure

- Routine worker exposure to constituents of potential concern (COPC) in soil via direct contact[1] and vapor intrusion
- Construction worker exposure to COPC in soil via direct contact
- Migration of COPC in soil to groundwater[2]

Groundwater Exposure

- Routine worker exposure to COPC in groundwater via volatilization to outdoor air and vapor intrusion
- Construction worker exposure to COPC in groundwater via direct contact
- Off-facility resident exposure to COPC in groundwater via vapor intrusion
- Receptor exposure to COPC in groundwater via nonpotable groundwater use
- Migration of COPC in groundwater to surface water

[1] Includes incidental ingestion and dermal contact with COPCs in soil and inhalation of COPCs in soil-derived vapor and particulates.

[2] Uses groundwater RBSLs as target groundwater concentrations.

RBSLs are calculated for each of the COPC that have been (or will be) included in the soil and groundwater sampling performed by PESRM. A list of these COPC is provided in Attachment 1, Table 1.

The general assumptions used in the calculation of the human health-based RBSLs are summarized in Attachment 1, Table 2. The exposure factors for each receptor and exposure scenario are presented in Attachment 1, Table 3. Human health-based RBSLs are calculated at a target cancer risk level of $1x10^{-5}$ and a target noncancer hazard quotient of 0.1 and are presented in Attachment 1, Table 4. The target cancer risk level and target noncancer hazard quotient are used with consideration for the risk management goals established in 25 Pa. Code § 250.402(b) for attainment of the Site-Specific Standard (i.e., a cumulative excess cancer risk greater than $1x10^{-4}$ and a noncancer hazard index greater than 1[3]).

For efficiency, the RBSLs are developed in a manner that allows them to be used site-wide to complete Site Characterization at each area (e.g., Tank Group).

2 Risk-Based Screening Levels for Soil

This section details how RBSLs for soil are calculated accounting for routine worker (Section 2.1) and construction worker (Section 2.2) exposure scenarios. RBSLs which consider potential soil migration-to-groundwater assuming site-specific target groundwater concentrations are detailed in Section 2.3. The calculation of an RBSL for lead is summarized in Section 2.4.

The resulting RBSLs are presented in Attachment 1, Table 4.

2.1 Routine Workers

The RBSLs were calculated to evaluate commercial/industrial worker exposures to COPC in soil via: (1) direct contact and inhalation during outdoor activities and (2) vapor intrusion.

2.1.1 Exposure to Soil During Outdoor Activities

RBSLs for routine worker exposure to COPC in soil via incidental ingestion, dermal contact, and inhalation of particulates and vapors were estimated from unit risks and unit HQs as described below.

<u>Lifetime Average Daily Dose</u>

The lifetime average daily doses for soil ingestion ($LADD_{ing}$) and soil dermal contact ($LADD_{derm}$) are calculated as follows:

$$LADD_{ing} = C_{soil} \cdot \frac{IR \cdot FC \cdot EF \cdot ED}{BW \cdot AT_c}$$

$$LADD_{derm} = C_{soil} \cdot \frac{SA \cdot AF \cdot ABS_{derm} \cdot FC \cdot EF \cdot ED}{BW \cdot AT_c}$$

[3] As estimated from exposure to COPC with the same target organ or target effect.

where C_{soil} is the chemical concentration in soil, *IR* is the ingestion rate, *FC* is the fraction of the soil that is contaminated, *SA* is the exposed skin surface area, *AF* is the soil-to-skin adherence factor, and ABS_{derm} is the chemical-specific dermal absorption factor.

Average Daily Dose

The average daily doses for soil ingestion (ADD_{ing}) and soil dermal contact (ADD_{derm}) are calculated as follows:

$$ADD_{ing} = C_{soil} \cdot \frac{IR \cdot FC \cdot EF \cdot ED}{BW \cdot AT_{nc}}$$

$$ADD_{derm} = C_{soil} \cdot \frac{SA \cdot AF \cdot ABS_{derm} \cdot FC \cdot EF \cdot ED}{BW \cdot AT_{nc}}$$

Unit Cancer Risk, Unit Noncancer HQ, and RBSL for Soil Ingestion and Dermal Exposure Routes

For the soil ingestion and dermal exposure routes, the unit cancer risk and unit noncancer HQ are calculated as follows:

$$Unit\ Risk = LADD \cdot SF$$

$$Unit\ HQ = \frac{ADD}{RfD}$$

The resulting RBSLs for each route (*i*) were calculated as follows:

$$Cancer\ RBSL_i = \frac{C_{unit} \cdot TCRL}{UnitRisk_i}$$

$$Noncancer\ RBSL_i = \frac{C_{unit} \cdot THQ}{UnitHQ_i}$$

The RBSLs for each route (*i*) are conservatively combined to give cancer and noncancer-based RBSLs that are based upon the combined receptor-specific exposure:

$$RBSL = \left(\sum_i RBSL_i^{-1}\right)^{-1}$$

The unit risk, unit HQ, and resulting RBSL calculations for each COPC for the soil ingestion and dermal exposure routes are presented in Attachment 2. The exposure factors used for routine workers are presented in Attachment 1, Table 3. The RBSLs for routine worker exposure to soil are provided in Attachment 1, Table 4.

Estimating Air Concentrations

For the inhalation route, the air concentrations (C_{air}) of vapors and particulates from soil are calculated as follows:

$$C_{air} = J \cdot \frac{C}{Q}$$

where *J·C/Q* is an air concentration that is normalized to unit concentration (i.e., 1 milligram per kilogram [mg/kg]) in soil. The *J* term is the normalized average vapor (J_v) or particulate flux ($J_{10,w}$), and the *C/Q* term is the air concentration normalized to a unit flux (i.e., *C/Q* is an air dispersion factor).

The normalized average vapor flux J_v of a chemical from unsaturated soil is conservatively estimated using an unsteady-state model derived by Jury et al. (1983). This model conservatively assumes that volatile chemicals are present in the soil to a finite depth equal to the approximate depth to groundwater at the Facility of 19 feet (ft) below ground surface (bgs)[4]. The equation for J_v is given by:

$$J_v = \frac{C_0}{T}\left[Z_1 erfc\left(\frac{Z_1}{2\sqrt{D_E T}}\right) + 2\sqrt{\frac{D_E T}{\pi}}\left(1 - e^{-\frac{Z_1^2}{4D_E T}}\right)\right]$$

where,

$$D_E = \frac{D_G H + D_L}{\rho_b K_d + \theta_w + \theta_a H}$$

$$D_G = D_{air} \cdot \frac{\theta_a^{10/3}}{n^2}$$

$$D_L = D_{water} \cdot \frac{\theta_w^{10/3}}{n^2}$$

$C_{s,0}$ is the concentration in soil, ρ_b is the soil bulk density, *T* is the averaging period (equivalent to *ED*), *H* is the Henry's law constant, K_d is the equilibrium-partitioning coefficient, θ_w is the water-filled soil porosity, θ_a is the air-filled soil porosity, D_{air} is diffusion rate through air, D_{water} is the diffusion rate through water, and *n* is total porosity. For this risk assessment, Henry's law constants have been adjusted to reflect a specific subsurface temperature of 18°C (PADEP 2021).

Derivation of these equations and definition of the equation parameters can be found in the Jury et al. 1983 journal article and in USEPA guidance (1996a, 1996b), and therefore, are not repeated here. The calculation of J_v was performed using values for chemical-specific parameters and default soil parameters recommended in the USEPA guidance (2004a) using a soil type of sand, which is

[4] Depth to groundwater varies across the Facility. 19 ft bgs is the average depth to groundwater in Tanks Groups 02, 03, 04, and 05. The average depth to groundwater in Tank Group 01 is 10 ft bgs. The average depth to groundwater in Tank Groups 06, 07, and 08 is 3 ft bgs. Using a depth to groundwater of 19 ft bgs results in the most conservative RBSLs for this exposure route in comparison to using groundwater depths observed at other areas of the Facility.

representative of the soil type found at the Facility. The calculation of J_v is shown in Attachment 2, Table 1.

The normalized average particulate flux $J_{10,w}$ of a chemical from soil is conservatively estimated using the "unlimited reservoir" model that USEPA has adapted for screening-level analysis of particulate emissions from soil (USEPA 1996a, 1996b). This model assumes that particulate emissions are created by wind erosion. The equation for $J_{10,w}$ is given by:

$$J_{10,w} = 0.036 \cdot (1 - G) \cdot \left(\frac{u_m}{u_t}\right)^3 \cdot F(x) \frac{g}{m^2 hr} \cdot \frac{hr}{60^2 sec} \cdot \frac{10^{-3} kg}{g}$$

where G is fraction of ground/vegetative cover, u_m is the mean annual wind speed at the nearest weather station which is located in Philadelphia, Pennsylvania (NOAA 2018), u_t is the equivalent threshold wind speed at the anemometer height at which u_m was measured in Philadelphia, Pennsylvania, and $F(x)$ is a function dependent on u_m/u_t. The details of this model can be found in USEPA guidance (1996a, 1996b), and are not repeated here. The default parameter values recommended in the USEPA guidance (1996a, 1996b) are used with site-specific wind speed in calculating $J_{10,w}$. The calculation of $J_{10,w}$ is shown in Attachment 2, Table 2.

The *C/Q* term is estimated using the empirical correlation in USEPA's *Supplemental Soil Screening Guidance* (2002), using the correlation coefficients for Philadelphia, Pennsylvania, and assuming a source area of 70.6 acres. This source area size is a conservative estimate using the largest area evaluated currently being characterized by PESRM. The calculation of C/Q is shown in Attachment 2, Table 4.

<u>Unit Cancer Risk, Unit Noncancer HQ, and RBSL for Inhalation Route</u>

For the inhalation route, the inhalation cancer unit risk and noncancer unit HQ are calculated using the chemical concentration in air (C_{air}), as follows:

$$Unit\ Risk_{inh} = C_{air} \cdot URF \cdot \frac{ET \cdot EF \cdot ED}{AT_c}$$

$$Unit\ HQ_{inh} = \frac{C_{air}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT_{nc}}$$

The resulting RBSLs for the inhalation route were calculated as follows:

$$Cancer\ RBSL_{inh} = \frac{C_{unit} \cdot TCRL}{UnitRisk_{inh}}$$

$$Noncancer\ RBSL_{inh} = \frac{C_{unit} \cdot THQ}{UnitHQ_{inh}}$$

The RBSLs for each route (i) were conservatively combined to give cancer and noncancer-based RBSLs that are based upon the combined receptor-specific exposure:

$$RBSL = \left(\sum_i RBSL_i^{-1}\right)^{-1}$$

The unit risk, unit HQ, and resulting RBSL calculations for each COPC for the inhalation route are presented in Attachment 2. The exposure factors used for routine workers are presented in Attachment 1, Table 3. The RBSLs for routine worker exposure to soil are provided in Attachment 1, Table 4.

2.1.2 Vapor Intrusion

RBSLs for routine worker exposure to COPC in soil via vapor intrusion were estimated from unit risks and unit HQs in accordance with the general methodology described in Section 2.1.1.

<u>Modeling Vapor Intrusion from Soil</u>

For the indoor air exposure pathway, the unit cancer risk and unit noncancer HQ are calculated as follows:

$$Unit\ Risk = C_{building} \cdot URF \cdot \frac{ET \cdot EF \cdot ED}{AT_c}$$

$$Unit\ HQ = \frac{C_{building}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT_{nc}}$$

where $C_{building}$ is the concentration in indoor air. For assessing routine worker exposures, chronic *RfCs* are used. The indoor air concentration is estimated using the modeling approach and input parameter values discussed below.

The indoor air concentrations are estimated using the following relationships described by Johnson and Ettinger (1991):

$$C_{building} = \alpha \cdot C_{source}$$

where α is an attenuation coefficient and C_{source} is the source vapor concentration that is given by the following equation:

$$C_{source} = C_{soil}\left(\frac{K_d}{H} + \frac{\theta_w}{\rho_b H} + \frac{\theta_a}{\rho_b}\right)^{-1}$$

The attenuation coefficient, assuming that chemicals are present in the soil at constant concentrations, is given by the following equation:

$$\alpha = \frac{\left[\frac{{D_T}^{eff} A_B}{Q_{building} L_T}\right] exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right)}{exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right) + \left[\frac{{D_T}^{eff} A_B}{Q_{building} L_T}\right] + \left[\frac{{D_T}^{eff} A_B}{Q_{soil} L_T}\right]\left[exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right) - 1\right]}$$

Derivation of this equation and definition of the equation parameters can be found in Johnson and Ettinger's 1991 journal article and therefore are not repeated here.

The effective diffusion coefficient term D_T^{eff} in the equation for the attenuation coefficient α is calculated using a soil-water profile that is estimated using a soil type of sand, which is a conservative assumption for the range of soil types found at the Facility. The soil-water profile in the vadose zone is estimated using the van Genuchten soil-water retention equation with default water retention parameters appropriate for sand (USEPA 2004a). It is conservatively assumed that the building cracks are filled with sand. These parameters and the resulting soil-water profile in the vadose zone are shown in Attachment 2 of this appendix.

The remaining parameters in the equation for the attenuation coefficient α, which relate to building characteristics, are conservatively based on the default values for a slab-on-grade nonresidential building with an air exchange rate (*ER*) of 0.60 per hour as recommended by PADEP (2021). The values used in the calculations are shown in Attachment 2 of this appendix and their bases are discussed in PADEP (2021) and USEPA (2004a) guidance.

Indoor air concentrations from the soil vapor intrusion are calculated with a mass balance check. The mass balance check ensures that the assumed mass of a chemical infiltrating into the building over the assumed exposure period does not exceed an upper-bound estimate of the chemical's mass in the vadose zone underlying the building. The upper-bound estimate of the constituent's mass in the vadose zone is conservatively estimated using the highest concentration of the constituent from any depth at each area and assuming this concentration represents the soil concentration from slab to the water table. The attenuation coefficient α_{ML} used in the mass balance check is given by the following equation:

$$\alpha_{ML} = \left(\frac{\rho_b K_d}{H} + \frac{\theta_w}{H} + \theta_a\right) \cdot \left(\frac{L_B \cdot W_B \cdot \Delta H}{Q_{building} \cdot ED}\right)$$

where L_B is the length of the building, W_B is the width of the building, ΔH is the contaminant thickness (conservatively assumed to be the distance between groundwater and a building foundation ($L_{T\text{-}gw}$)), and $Q_{building}$ is the air flow rate through the building. The depth to groundwater is conservatively assumed to be 19 ft bgs[5]. All parameters are shown in Attachment 2 of this appendix.

$Q_{building}$ is a function of the size of the building (or unit) and the amount of air exchanges that occur as a result of operating the air handling and ventilation system. It can be calculated as follows (USEPA 2004a, 2017b):

$$Q_{building} = L_B \cdot W_B \cdot H_B \cdot ER$$

where H_B is the occupied height of the building and ER is the air exchange rate.

[5] Depth to groundwater varies across the Facility. 19 ft bgs is the average depth to groundwater in Tanks Groups 02, 03, 04, and 05. The average depth to groundwater in Tank Group 01 is 10 ft bgs. The average depth to groundwater in Tank Groups 06, 07, and 08 is 3 ft bgs. Using a depth to groundwater of 19 ft bgs results in the most conservative RBSLs for this exposure route in comparison to using groundwater depths observed at other areas of the Facility.

For $Q_{building}$, the length (10 m), width (10 m), and height (2.44 m) of the generic nonresidential building were assumed, consistent with PADEP's recommended default assumptions for generic slab-on-grade nonresidential buildings (PADEP 2021). A conservative estimate of *ER* (i.e., 0.60/hr) was assumed based upon PADEP's (2021) recommended default for a generic nonresidential building.

The unit risk, unit HQ, and resulting RBSL calculations for each COPC for the inhalation route are presented in Attachment 2 of this appendix. The RBSLs for routine worker exposure to soil are provided in Attachment 1, Table 4.

2.2 Construction Workers

RBSLs for construction worker exposure to COPC in soil via incidental ingestion, dermal contact, and inhalation of particulates and vapors were estimated from unit risks and unit HQs in a manner analogous to the calculation described in Section 2.1.1 for routine workers. The only differences are the use of exposure factors for construction workers and that airborne dust concentrations are estimated as discussed below.

During construction activities the PM_{10} level is set at 50 micrograms per cubic meter, which is the former annual average National Ambient Air Quality Standard for PM_{10} since construction workers are assumed to be performing excavations for a work year. It is conservatively assumed that the PM_{10} concentration would be at this limit every day for the entire period of construction worker exposure.

The unit risk, unit HQ, and resulting RBSL calculations for each COPC are presented in Attachment 3. The exposure factors used for construction workers are presented in Attachment 1, Table 3. The RBSLs for construction worker exposure to soil are provided in Attachment 1, Table 4.

2.3 Soil Migration-to-Groundwater

RBSLs developed to conservatively evaluate the potential for COPC in soil to leach to groundwater at concentrations that may pose an unacceptable risk to human health or the environment are calculated using the methodologies described in the *Soil Screening Guidance: User's Guide* (USEPA 1996a).

RBSLs were calculated using both an "equilibrium partitioning" (also called soil/water partitioning [USEPA 1996a]) and a "leach test" methodology, as described below. For each COPC, the soil screening level corresponding to the more realistic of the two calculation methods is used as a soil migration-to-groundwater screening level. For COPC that are relatively immobile in the subsurface (e.g., semivolatile organic compounds), the equilibrium partitioning method provides a more realistic, yet conservative, soil leachate concentration because it assumes that the chemical concentration in soil remains constant over time (since the chemical is immobile, its concentration in soil does not significantly decrease over time). For chemicals that are relatively mobile (e.g., volatile organic compounds), the leach test method provides a more realistic, yet conservative, soil leachate concentration because it accounts for a finite amount of chemical mass in the soil. These two approaches of estimating soil leachate concentrations are conservative since they ignore attenuation of the chemical concentration in the vadose zone and dilution at the water table.

Equilibrium Partitioning

The soil/water partition equation, which assumes an infinite source of the chemical, can be used to estimate concentrations of chemicals in soil leachate for a given soil concentration.

$$C_{soil} = C_{pw}\left(K_d + \frac{\theta_w + \theta_a H}{\rho_b}\right)$$

In this relationship, C_{soil} is the soil concentration (mg/kg), C_{pw} is the soil leachate concentration (milligrams per liter [mg/L]), K_d is the chemical specific soil-water partition coefficient (liter per kilogram), θ_w is the water-filled soil porosity (unitless), θ_a is the air-filled soil porosity (unitless), H is the chemical-specific Henry's Law constant (unitless), and ρ_b is the dry soil bulk density (kilogram per liter [kg/L]). For organic chemicals, K_d is equal to the product of the chemical-specific soil organic carbon/water partition coefficient, K_{oc} (liter per kg), and the fraction organic carbon in soil, f_{oc} (unitless). For this analysis, the soil properties are based upon sand, the most conservative soil type identified at the Site. Specifically, θ_w is assumed to be 0.05 (liters per liter), θ_a is assumed to be 0.32 (liters per liter), and ρ_b is assumed to be 1.66 kg/L (USEPA 2004a).[6] The f_{oc} is assumed to be 0.005 (grams per gram) (USEPA 1996a). The chemical-specific K_d, and K_{oc}, and H (and their sources) used are presented in Attachment 4.

Leach Test Method

USEPA's leach test method (SW-846, Method 1312)[7] can be simulated by assuming a hypothetical worst-case leach test outcome in which the entire mass of the chemical in soil is extracted into the leaching fluid. With this assumption, the concentration of the COPC in soil can be divided by 20 (which is the ratio of the mass of leaching fluid to the mass of soil in the leaching test protocol) to estimate its leachate concentration as follows:

$$C_{soil} = C_{pw} \times \frac{mr_{fluid:solid}}{\rho_{fluid}}$$

In the relationship above, C_{soil} is the soil concentration (mg/kg), C_{pw} is the soil leachate concentration (mg/L), $mr_{fluid:solid}$ (kilogram per kilogram) is the mass ratio of the extraction fluid to soil used in the leach test (i.e., 20 kg fluid per 1 kg soil), and ρ_{fluid} (kg/L) is the density of the extraction fluid (assumed to be 1 kg/L).

Dilution Attenuation Factor and Calculation of Soil Migration to Groundwater Screening Levels

As soil leachate moves through soil and groundwater, chemical concentrations are attenuated. The reduction in concentrations can be expressed by a dilution attenuation factor (*DAF*) defined as a ratio of soil leachate concentration to receptor point concentration (USEPA 1996a).

[6] Water-filled and air-filled porosity were estimated using the soil properties for sand (USEPA 2004) and the van Genuchten equation (van Genuchten 1980), assuming a depth to groundwater of 19 ft.

[7] *Method 1312: Synthetic Precipitation Leaching Procedure*, https://www.epa.gov/sites/production/files/2015-12/documents/1312.pdf.

Rather than independently model leachate migration to calculate a site-specific *DAF*, a generic *DAF* of 20 was conservatively used in the development of the RBSLs. This default *DAF* is recommended by USEPA (1996a) for contaminated soil sources up to 0.5 acres.

To calculate soil migration to groundwater screening levels, the equations presented above can be further refined as follows:

$$C_{soil-SPLP} = C_{pw} \times \frac{mr_{fluid:solid}}{\rho_{fluid}} \times DAF$$

$$C_{soil-Kd} = C_{pw}\left(K_d + \frac{\theta_w + \theta_a H}{\rho_b}\right) \times DAF$$

By substituting target groundwater concentrations for C_{pw} in the leach test method and equilibrium-partitioning method equations, and assuming a *DAF*, two possible soil screening levels are calculated. The higher of the two estimated values was used as the RBSL as the higher represents the more realistic, yet conservative, soil screening level for this pathway.

The target groundwater concentration for these screening levels is based on the minimum of the following groundwater RBSLs:

- Routine worker exposure to COPC in groundwater via volatilization to outdoor air and vapor intrusion
- Construction worker exposure to COPC in groundwater via direct contact
- Off-facility resident exposure to COPC in groundwater via vapor intrusion
- Receptor exposure to COPC in groundwater via nonpotable groundwater use
- Migration of COPC in groundwater to surface water

The acceptable groundwater concentrations are presented in Attachment 4. The soil migration-to-groundwater screening levels are presented in Attachment 1, Table 4.

2.4 Lead

Exposure of routine workers to lead in soil during outdoor activities is evaluated using a screening level of 2,520 mg/kg. This screening level is calculated following USEPA guidance (USEPA 2003), including updates (USEPA 2009, 2017a). The screening level is intended to protect female workers of child-bearing age who contact soil.

The derivation of the industrial soil screening level is presented in Attachment 2, Table 12.

3 Risk-Based Screening Levels for Groundwater

This section details how RBSLs for groundwater are calculated for the routine worker (Section 3.1), construction worker (Section 3.2), and off-facility residential (Section 3.3) exposure scenarios. RBSLs which consider potential off-facility nonpotable groundwater use and surface water exposure are detailed in Sections 3.4 and 3.5, respectively.

The resulting RBSLs are presented in Attachment 1, Table 4.

3.1 Routine Workers

The RBSLs are calculated to evaluate commercial/industrial worker exposures to COPC via: (1) volatilization to outdoor air from groundwater and (2) vapor intrusion from groundwater.

3.1.1 Exposure to Groundwater Via Volatilization to Outdoor Air

RBSLs for routine worker exposure to COPC in groundwater via volatilization to outdoor air were estimated from unit risks and unit HQs in accordance with the general methodology discussed in Section 2.1.1, except for the calculation of the vapor flux *J*.

Vapor emissions from groundwater (not exposed) are calculated using the steady-state diffusion equation in one-dimension assuming a constant source concentration and a maximum concentration gradient, as follows:

$$J = D_e \cdot \frac{C_v}{L}$$

where D_e is the effective diffusion coefficient of the chemical in the vapor phase, C_v is the vapor concentration in equilibrium with the groundwater concentration, and L is the distance from the water table to the ground surface. The equilibrium "source" vapor concentration in the above equations is related to the chemicals' groundwater concentration (C_{gw}) using Henry's law (H):

$$C_{source} = C_{gw} \cdot H$$

D_e for the vapor phase is calculated using a soil-water profile that is estimated using a soil type of sand, the most conservative soil type identified at the Facility. The soil-water profile in the vadose zone, shown in Attachment 2, is estimated using the van Genuchten soil-water retention equation with default water retention parameters appropriate for sand (USEPA 2004a). The depth to groundwater is assumed to be 3 ft bgs[8].

[8] Depth to groundwater varies across the Facility. 19 ft bgs is the average depth to groundwater in Tanks Groups 02, 03, 04, and 05. The average depth to groundwater in Tank Group 01 is 10 ft bgs. The average depth to groundwater in Tank Groups 06, 07, and 08 is 3 ft bgs. Using a depth to groundwater of 3 ft bgs results in the most conservative RBSLs for this exposure route in comparison to using groundwater depths observed at other areas of the Facility.

The calculation of D_e is shown in Attachment 2.

The unit risk, unit HQ, and resulting RBSL calculations for each COPC for the inhalation route are presented in Attachment 2. The exposure factors used for routine workers are presented in Attachment 1, Table 3. The RBSLs for routine worker exposure to groundwater are provided in Attachment 1, Table 4.

3.1.2 Vapor Intrusion

RBSLs for routine worker exposure to COPC via vapor intrusion from groundwater are estimated from unit risks and unit HQs in accordance with the general methodology described in Section 2.1.2, except for the calculation of source vapor concentration.

The source vapor concentration for a chemical in groundwater is calculated from the chemical's concentration in groundwater C_{gw} using Henry's law as follows:

$$C_{source} = C_{gw} \cdot H$$

In calculating the attenuation coefficient α, the depth to groundwater was conservatively assumed to be 3 ft bgs below the basement slab. The calculation of α is shown in Attachment 2 of this appendix.

The unit risk, unit HQ, and resulting RBSL calculations for each COPC for the inhalation route are presented in Attachment 2. The exposure factors used for routine workers are presented in Attachment 1, Table 3. The RBSLs for routine worker exposure to groundwater are provided in Attachment 1, Table 4.

3.2 Construction Workers

RBSLs for construction worker exposure to COPC in groundwater via incidental ingestion, dermal contact, and inhalation of vapors during excavations that extend into the water table are estimated from unit risks and unit HQs in accordance with the general methodology described in Section 2.1.1.

<u>Lifetime Average Daily Dose</u>

The LADD for groundwater ingestion ($LADD_{ing}$) and groundwater dermal contact ($LADD_{derm}$) were calculated as follows:

$$LADD_{ing} = C_{gw} \frac{IR \cdot EF \cdot ED}{BW \cdot AT_c}$$

$$LADD_{derm} = C_{gw} \frac{DA_{event} \cdot SA \cdot EV \cdot EF \cdot ED}{BW \cdot AT_c}$$

where C_{gw} is the chemical concentration in groundwater (assumed to be a unit concentration of 1 mg/L), *IR* is the groundwater ingestion rate, DA_{event} is the absorbed dose per event, *SA* is the exposed skin surface area, and *EV* is the event frequency.

The DA_{event} for organic chemicals is estimated using an unsteady-state approach (USEPA 2004b, Equations 3.2 and 3.3), which is more conservative than the steady-state approach (USEPA 1989), particularly for hydrophobic chemicals. The DA_{event} for inorganic chemicals is estimated using a steady-state approach (USEPA 2004b, Equation 3.4). The details of the calculation of DA_{event} for organic and inorganic chemicals are provided by USEPA (2004b) and not repeated here.

Average Daily Dose

Average daily dose (ADD) for groundwater ingestion (ADD_{ing}) and groundwater dermal contact (ADD_{derm}) were calculated as follows:

$$ADD_{ing} = C_{gw} \frac{IR \cdot EF \cdot ED}{BW \cdot AT_{nc}}$$

$$ADD_{derm} = C_{gw} \frac{DA_{event} \cdot SA \cdot EV \cdot EF \cdot ED}{BW \cdot AT_{nc}}$$

Unit Cancer Risk, Unit Noncancer HQ, and RBSL for Groundwater Ingestion and Dermal Exposure Routes

For the groundwater ingestion and dermal exposure routes, the unit cancer risk and unit noncancer HQ were calculated as follows:

$$Unit\ Risk = LADD \cdot SF$$

$$Unit\ HQ = \frac{ADD}{RfD}$$

The unit risk, unit HQ, and resulting RBSL calculations for each COPC for the groundwater ingestion and dermal exposure routes are presented in Attachment 3. The exposure factors used for construction workers are presented in Attachment 1, Table 3. The RBSLs for construction worker exposure to groundwater are provided in Attachment 1, Table 4.

Estimating Air Concentrations

For the inhalation route, the air concentrations (C_{air}) resulting from the volatilization of COCs from groundwater in an excavation were calculated as follows:

$$C_{air} = J \cdot C/Q$$

Where $J \cdot C/Q$ is an air concentration that is normalized to unit concentration (i.e., 1 mg/L) in groundwater. The J term is the normalized average vapor and the C/Q term is the air concentration normalized to a unit flux (i.e., C/Q is an air dispersion factor).

The normalized vapor flux J of a chemical from groundwater was estimated using an overall mass transfer coefficient that is recommended by USEPA (1995b):

$$J = \left(\frac{1}{k_l} + \frac{1}{Hk_g}\right)^{-1} \left(\frac{m}{10^2 cm}\right)\left(\frac{10^3 L}{m^3}\right)$$

Where k_l and k_g are the liquid-phase and gas-phase mass transfer coefficients given by the following:

$$k_l = \left(\frac{MW_o}{MW}\right)^{0.5} \left(\frac{T}{298K}\right) \; k_{l,o}$$

$$k_g = \left(\frac{MW_w}{MW}\right)^{0.335} \left(\frac{T}{298K}\right)^{1.005} \; k_{g,w}$$

Where MW, MW_o, and MW_w are the molecular weights of the chemical, oxygen, and water, respectively, T is the absolute temperature of the groundwater, $k_{l,o}$ is the liquid-phase mass transfer coefficient for oxygen (0.002 centimeters per second), and $k_{g,w}$ is the gas-phase mass transfer coefficient for water vapor (0.833 centimeters per second).

For groundwater exposures during excavations to the water table, *C/Q* is based on a source area of a 15- by 15-foot excavation area, and an averaging period of 24 hours. The maximum 24-hour average air concentration is estimated from the annual average air concentration by using a conservative factor of 0.4/0.19 or 2.1 (USEPA 2002).

<u>Unit Cancer Risk, Unit Noncancer HQ, and RBSL for Inhalation Route</u>

For the inhalation route, the inhalation cancer unit risk and noncancer unit HQ are calculated using the chemical concentration in air (C_{air}), as follows:

$$Unit\ Risk_{inh} = C_{air} \cdot URF \cdot \frac{ET \cdot EF \cdot ED}{AT_c}$$

$$Unit\ HQ_{inh} = \frac{C_{air}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT_{nc}}$$

The unit risk, unit HQ, and resulting RBSLs calculations for each COPC for the inhalation route are presented in Attachment 3. The exposure factors used for construction workers are presented in Attachment 1, Table 3. The RBSLs for construction worker exposure to groundwater are provided in Attachment 1, Table 4.

3.3 Off-Facility Resident

RBSLs for off-facility resident exposure to COPC via vapor intrusion from groundwater were estimated from unit risks and unit HQs in accordance with the general methodology described in Section 2.1.2 for routine workers. The only differences are the use of exposure factors for off-facility residents and that a depth to groundwater of 19 ft bgs was used, consistent with the average depth to groundwater identified in areas currently being investigated by PESRM that are in closest proximity to off-facility residential areas.[9]

[9] Tank Groups 02, 03, 04, and 05.

The unit risk, unit HQ, and resulting RBSL calculations for each COPC are presented in Attachment 5. The exposure factors used for routine workers are presented in Attachment 1, Table 3. The RBSLs for off-facility resident exposure to groundwater are provided in Attachment 1, Table 4.

3.4 Nonpotable Groundwater Use

Potential exposures to COPC in groundwater via nonpotable groundwater use are evaluated using a hypothetical scenario where groundwater is used to fill a backyard wading pool ("kiddie" pool). This scenario represents a reasonable worst case exposure scenario in which the estimated exposure is expected to be higher than those associated with other nonpotable uses (e.g., watering lawns, washing cars). Potential routes of exposure in this scenario include incidental ingestion, dermal contact, and inhalation of vapors. RBSLs were estimated from unit risks and unit HQs in accordance with the general methodology described in Section 2.1.1 and the following exposure factors:

<u>Exposure Factors</u>

For this evaluation, standard default exposure factors recommended by PADEP and USEPA for estimating RME are used where available and appropriate. Where standard default exposure factors are not available or appropriate for an exposure scenario, the evaluation is conducted using similarly conservative exposure factors that are based on site-specific considerations and professional judgment.

Exposure Frequency and Duration

The exposure frequency for the kiddie pool scenario is 96 days/year, which is based on 4 days per week for the number of months, 6 months, when the average daily temperature is above 65 degrees Fahrenheit in Philadelphia, Pennsylvania (NOAA 2018). Residents are assumed to be exposed to groundwater for 26 years (6 years as children and 20 years as adults; USEPA 2014). This combination of exposure frequency and exposure duration is expected to be conservative for the amount of time that residents would actually spend using groundwater off-facility.

Incidental Water Ingestion

The rate of 0.05 L/hour is the USEPA-recommended value for ingestion of water while swimming (USEPA 1989).

Dermal Contact Rate

The exposed skin surface areas of 6,365 cm^2 and 19,652 cm^2 are USEPA's recommended values for evaluating RME with groundwater by children and adults, respectively (USEPA 2014). Child and adult residents are assumed to wade in the pool for 2 hours per event, and one event per day, based on professional judgment. The absorbed dose for organic chemicals is estimated using the nonsteady-state approach (USEPA 2004b), which is more conservative than the steady-state approach (USEPA 1989), particularly for hydrophobic chemicals. The permeability coefficient (K_p) for dermal absorption of organic chemicals from groundwater is estimated following USEPA guidance (USEPA 2004b).

Water Concentration in Kiddie Pool

The model for estimating vapor emission from a residential kiddie pool is based on models for estimating vapor emissions from open-top batch tanks (USEPA 1995a, 1995b). The residential kiddie pool is modeled as a 6-ft diameter tank that is 9 inches deep and is assumed to be filled with groundwater once per day. The concentration of volatile organic chemicals in the kiddie pool water decreases over time as the chemicals volatilize into the air. The average concentration over a period *t* is given by:

$$\overline{C_w} = C_{w,o} \frac{d}{K \cdot t} \left(1 - e^{-Kt/d}\right)$$

where $C_{w,o}$ is the initial concentration, *d* is the depth of water in the pool and *K* is the chemical's overall mass transfer coefficient (USEPA 1995b). *K* is calculated was follows:

$$K = \frac{k_l \cdot Hk_g}{k_l + Hk_g}$$

where *H* is the Henry's law constant, and k_l and k_g are the liquid-phase and gas-phase mass transfer coefficients given by the following equations (USEPA 1995a):

$$k_l = 10^{-6} + 144 \cdot 10^{-4} \left(0.01 u_{10} \sqrt{6.1 + 0.63 u_{10}}\right)^{2.2} {Sc_l}^{-0.5}$$

$$k_g = 4.82 \cdot 10^{-3}\, {u_{10}}^{0.78}\, {Sc_g}^{-0.67}\, {d_e}^{-0.11}$$

where Sc_l and Sc_g are liquid-phase and gas-phase Schmidt numbers, d_e is the effective diameter of the water surface (m), and u_{10} is wind speed at 10 m above the water surface, which is 4.2 m/s based on the annual average wind speed in Philadelphia, Pennsylvania (NOAA 2018).

Air Concentration from Kiddie Pool

The concentration of the chemical in air at the water surface is given by the following:

$$C_{air} = \overline{C_w} \cdot K \cdot (C/Q)$$

The *C/Q* term is estimated using the empirical correlation in USEPA's *Supplemental Soil Screening Guidance* (2002), using the correlation coefficients for Philadelphia, Pennsylvania, and assuming a source area of a 6 by 6 foot kiddie pool. This air concentration is expected to be higher than actual air concentrations to which individuals would be exposed while in the kiddie pool.

Unit Cancer Risk, Unit Noncancer HQ, and RBSL

The unit risk, unit HQ, and resulting RBSL calculations for each COPC for the groundwater ingestion, dermal, and inhalation of vapor exposure routes are presented in Attachment 6. The RBSLs for off-facility nonpotable groundwater use are provided in Attachment 1, Table 4.

3.5 Groundwater Migration-to-Surface Water

This section explains how groundwater screening levels are derived to support the evaluation of groundwater-to-surface water exposure scenarios.

The groundwater (MtSW) screening levels are based upon Pennsylvania surface water quality criteria consistent with the designated water use of the Schuylkill River[10] and the National Recommended Water Quality Criteria for human health consumption of organisms only[11]. The minimum of these criteria was conservatively selected. Where criteria were not available for a specific chemical, the criteria were selected from the USEPA Region 3 Biological Technical Assistance Group Freshwater Screening Benchmarks[12] or the USEPA Region 4 Ecological Screening Values[13].

Per the analysis conducted by Baird (2002), a conservative estimate of the groundwater-surface water mixing ratio of 0.0013 (or a dilution factor ~ 1000) was used to conservatively derive groundwater concentrations that would be protective of surface water exposures in the Schuylkill River.

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Attachment 1

Risk Based Screening Levels

Table 1 – Chemicals of Potential Concern (COPC)

Table 2 – General Assumptions

Table 3 – High End Exposure Factors

Table 4 – Site-Specific Risk Based Screening Levels (Target Risk of $1x10^{-5}$ and HQ of 0.1)

Attachment 1
Table 1:
Constituents of Potential Concern (COPC)
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Chem Group	Chemical	CASRN
VOC	Benzene	71-43-2
VOC	Cumene	98-82-8
VOC	1,2-Dibromoethane	106-93-4
VOC	1,2-Dichloroethane	107-06-2
VOC	Ethyl Benzene	100-41-4
VOC	Methyl tert-butyl ether	1634-04-4
VOC	Toluene	108-88-3
VOC	1,2,4-Trimethylbenzene	95-63-6
VOC	1,3,5-Trimethylbenzene	108-67-8
VOC	Xylenes (total)	1330-20-7
SVOC	Acenaphthene	83-32-9
SVOC	Anthracene	120-12-7
SVOC	Benzo(a)anthracene	56-55-3
SVOC	Benzo(a)pyrene	50-32-8
SVOC	Benzo(b)fluoranthene	205-99-2
SVOC	Benzo(g,h,i)perylene	191-24-2
SVOC	Benzo(k)fluoranthene	207-08-9
SVOC	Chrysene	218-01-9
SVOC	Dibenz(a,h)anthracene	53-70-3
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6
SVOC	Ethanol	64-17-5
SVOC	Fluorene	86-73-7
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5
SVOC	Naphthalene	91-20-3
SVOC	Phenanthrene	85-01-8
SVOC	Pyrene	129-00-0
SVOC	Tetraethylene Glycol	112-60-7
PCB	PCBs (total)	1336-36-3
INORG	Antimony	7440-36-0
INORG	Arsenic	7440-38-2
INORG	Chromium III	16065-83-1
INORG	Chromium VI	18540-29-9
INORG	Cyanide (total)	57-12-5
INORG	Lead	7439-92-1
INORG	Nickel	7440-02-0
INORG	Vanadium	7440-62-2

Abbreviations:
Chem Group - chemical group
VOC - volatile organic compounds
SVOC - semi-volatile organic compounds
PCB - polychlorinated biphenyls
INORG - metals

Attachment 1
Table 2:
General Assumptions
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Parameter	Value	Units	Basis
Exposure Factors	Various	-	High-end exposure factors compiled for each receptor/exposure scenario. Based upon standard default exposure factors used by PADEP [25 Pa Code 250.602(c)(2)] and USEPA (1991, 2011, 2014) for estimating reasonable maximum exposures.
Toxicity Values	Various	-	Compiled in accordance with USEPA (2003)
Target Cancer Risk Level	$1x10^{-5}$	-	Project-Specific
Target Noncancer Hazard Quotient	0.1	-	Project-Specific
Dispersion Model Correlation Area	Philadelphia	-	Per USEPA (2002)
Emission Area for Soil and Noncontact GW Exposures	70.6	acres	Total area of the largest Tank Group (i.e., Tank Group 04)
Mean Annual Wind Speed	9.3	mph	NOAA (2018), For Philadelphia
Depth to Groundwater			
Tank Group 01	10	ft bgs	Temporal and spatial average depth to groundwater
Tank Group 02, 03, 04, and 05	19	ft bgs	
Tank Group 06, 07, 08	3	ft bgs	
Soil Type	Sand	-	Based upon the extensive presence of fill material across the Site
Fraction Organic Carbon	0.005	unitless	Per PADEP (2021)
Building Parameter Assumptions			
Commercial/Industrial			PADEP (2021) Default
Bldg foundation thickness	0.1	m	
Bldg foundation length	10	m	
Bldg foundation width	10	m	
Bldg occupied height	2.44	m	
Occupied depth below ground	0.15	m	
Air exchange rate	0.6	hr^{-1}	
Crack radius	1E-03	m	
Distance from contaminated soil to foundation	0.001	m	
Soil gas entry flow rate (Q_{soil})	5	L/min	
Off-Facility Residential			
Bldg foundation thickness	0.1	m	
Bldg foundation length	10	m	
Bldg foundation width	10	m	
Bldg occupied height	3.66	m	
Occupied depth below ground	2	m	
Air exchange rate	0.18	hr^{-1}	
Crack radius	1E-03	m	
Distance from contaminated soil to foundation	0.001	m	
Soil gas entry flow rate (Q_{soil})	5	L/min	

Attachment 1
Table 3:
High-End Exposure Factors
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

			Resident Age 0-2	Resident Age 2-6	Resident Age 6-16	Resident Age 16-26	Routine Worker	Maintenance Worker	Construction Worker
Soil Ingestion									
Ingestion Rate (mg/d)	IR		100	100	50	50	50	100	200
Conversion Factor (kg/mg)	CF		1E-06	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
Fraction Contacted (unitless)	FC		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Exposure Frequency (d/yr)	EF		250	250	250	250	180	30	250
Exposure Duration (yr)	ED		2	4	10	10	25	10	1
Body Weight (kg-bw)	BW		15	15	80	80	80	80	80
Averaging Time, carc (d)	AT_c		25,550	25,550	25,550	25,550	25,550	25,550	25,550
Averaging Time, noncarc (d)	AT_{nc}		9,490	9,490	9,490	9,490	9,125	3,650	365
Soil Dermal Contact									
Adherence Factor (mg/cm^2)	AD		0.2	0.2	0.07	0.07	0.12	0.12	0.12
Skin Surface Area (cm^2/d)	SA		2,373	2,373	6,032	6,032	3,527	3,527	3,527
Conversion Factor (kg/mg)	CF		1E-06	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
Fraction Contacted (unitless)	FC		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Exposure Frequency (d/yr)	EF		250	250	250	250	180	30	250
Exposure Duration (yr)	ED		2	4	10	10	25	10	1
Body Weight (kg-bw)	BW		15	15	80	80	80	80	80
Averaging Time, carc (d)	AT_c		25,550	25,550	25,550	25,550	25,550	25,550	25,550
Averaging Time, noncarc (d)	AT_{nc}		9,490	9,490	9,490	9,490	9,125	3,650	365
Outdoor Air Inhalation of Soil Vapor and/or Particulates									
Exposure Time (h/d)	ET		24	24	24	24	8	8	8
Exposure Frequency (d/yr)	EF		250	250	250	250	180	30	250
Exposure Duration (yr)	ED		2	4	10	10	25	10	1
Averaging Time, carc (h)	AT_c		613,200	613,200	613,200	613,200	613,200	613,200	613,200
Averaging Time, noncarc (h)	AT_{nc}		227,760	227,760	227,760	227,760	219,000	87,600	8,760
Incidental Groundwater Ingestion									
Ingestion Rate (L/hr)	DR							0.005	0.005
Exposure Time (h/d)	ET							2	2
Exposure Frequency (d/yr)	EF							15	15
Exposure Duration (yr)	ED							10	1
Body Weight (kg-bw)	BW							80	80
Averaging Time, canc (d)	AT_c							25,550	25,550
Averaging Time, noncanc (d)	AT_{nc}							3,650	365
Groundwater Dermal Contact									
Event Time (hr)	t							2	2
Skin Surface Area (cm^2)	SA							3,527	3,527
Events per Day (event/d)	EV							1	1
Exposure Frequency (d/yr)	EF							15	15
Exposure Duration (yr)	ED							10	1
Body Weight (kg)	BW							80	80
Averaging Time, cancer (days)	AT_c							25,550	25,550
Averaging Time, noncancer (days)	AT_{nc}							3,650	365
Outdoor Groundwater Vapor Inhalation									
Exposure Time (h/d)	ET		24	24	24	24	8	8	8
Exposure Frequency (d/yr)	EF		250	250	250	250	180	15	15
Exposure Duration (yr)	ED		2	4	10	10	25	10	1
Averaging Time, carc (h)	AT_c		613,200	613,200	613,200	613,200	613,200	613,200	613,200
Averaging Time, noncarc (h)	AT_{nc}		227,760	227,760	227,760	227,760	219,000	87,600	8,760
Indoor Soil and/or Groundwater Vapor Inhalation									
Exposure Time (h/d)	ET		24	24	24	24	8		
Exposure Frequency (d/yr)	EF		350	350	350	350	250		
Exposure Duration (yr)	ED		2	4	10	10	25		
Averaging Time, carc (h)	AT_c		613,200	613,200	613,200	613,200	613,200		
Averaging Time, noncarc (h)	AT_{nc}		227,760	227,760	227,760	227,760	219,000		

Attachment 1
Table 4:
Site-Specific Risk Based Screening Levels (Target Risk of $1x10^{-5}$ and HQ of 0.1)
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

			Soil				Groundwater					
Chem Group	**Chemical**	**CASRN**	**Routine Worker Direct Contact** (mg/kg)	**Routine Worker Vapor Intrusion** (mg/kg)	**Construction Worker Direct Contact** (mg/kg)	**Soil MtGW** (mg/kg)	**Nonpotable Groundwater Use** (mg/L)	**Routine Worker Volitilization to Outdor Air** (mg/L)	**Routine Worker Vapor Intrusion** (mg/L)	**Construction Worker Direct Contact** (mg/L)	**Off-Facility Resident Vapor Intrusion** (mg/L)	**Groundwater MtSW** (mg/L)
VOC	Benzene	71-43-2	6.3E+01	4.6E-01	8.7E+00	9.8E+01	3.0E-01	5.5E+02	3.8E+00	4.0E+00	2.5E-01	1.3E+02
VOC	Cumene	98-82-8	1.0E+03	6.1E+00	8.7E+01	1.0E+03	3.7E+01	9.1E+03	6.3E+01	3.0E+01	4.0E+00	2.6E+00
VOC	1,2-Dibromoethane	106-93-4	1.2E+00	7.1E-03	1.8E+00	3.2E+00	1.7E-02	1.6E+01	1.1E-01	9.1E-01	7.9E-03	NSW
VOC	1,2-Dichloroethane	107-06-2	1.6E+01	1.1E-01	8.1E+00	3.3E+01	3.3E-01	1.7E+02	1.2E+00	4.9E+00	8.2E-02	3.1E+03
VOC	Ethyl Benzene	100-41-4	2.3E+03	1.5E+01	1.3E+03	8.2E+02	2.0E+00	2.2E+04	1.5E+02	4.0E+01	9.7E+00	1.3E+01
VOC	Methyl tert-butyl ether	1634-04-4	2.4E+03	1.6E+01	3.9E+02	5.9E+03	2.1E+01	2.9E+04	2.1E+02	1.9E+02	1.5E+01	1.1E+04
VOC	Toluene	108-88-3	8.0E+03	7.6E+01	6.5E+02	9.8E+03	2.5E+01	1.0E+05	7.0E+02	2.0E+02	4.5E+01	5.2E+01
VOC	1,2,4-Trimethylbenzene	95-63-6	1.8E+02	9.2E-01	7.0E+01	2.5E+02	8.7E+00	1.4E+03	9.7E+00	1.5E+01	6.3E-01	3.3E+01
VOC	1,3,5-Trimethylbenzene	108-67-8	2.2E+02	9.2E-01	9.9E+01	2.4E+02	8.8E+00	1.3E+03	9.1E+00	1.5E+01	5.9E-01	7.1E+01
VOC	Xylenes (total)	1330-20-7	2.4E+02	1.5E+00	5.1E+01	3.4E+02	3.7E+00	1.9E+03	1.3E+01	1.7E+01	8.6E-01	2.1E+02
SVOC	Acenaphthene	83-32-9	9.3E+03	WIT	9.2E+03	NA	5.7E+01	WIT	WIT	3.9E+03	WIT	9.0E+00
SVOC	Anthracene	120-12-7	4.6E+04	WIT	4.6E+04	NA	2.4E+02	WIT	WIT	1.9E+04	WIT	4.0E+01
SVOC	Benzo(a)anthracene	56-55-3	4.3E+02	NV	3.2E+03	NA	1.0E-01	NV	NV	1.4E+03	NV	1.3E-02
SVOC	Benzo(a)pyrene	50-32-8	4.3E+01	NV	7.7E+00	NA	1.0E-02	NV	NV	5.8E+00	NV	1.3E-03
SVOC	Benzo(b)fluoranthene	205-99-2	4.3E+02	NV	3.2E+03	NA	1.6E-01	NV	NV	1.4E+03	NV	1.3E-02
SVOC	Benzo(g,h,i)perylene	191-24-2	4.6E+03	NV	1.4E+04	NA	4.4E+01	NV	NV	5.8E+03	NV	1.2E-02
SVOC	Benzo(k)fluoranthene	207-08-9	4.3E+03	NV	3.2E+04	NA	9.9E-01	NV	NV	1.4E+04	NV	1.3E-01
SVOC	Chrysene	218-01-9	4.3E+04	NV	3.2E+05	NA	1.6E+01	NV	NV	1.4E+05	NV	1.3E+00
SVOC	Dibenz(a,h)anthracene	53-70-3	4.3E+01	NV	3.2E+02	NA	9.8E-03	NV	NV	1.4E+02	NV	1.3E-03
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	2.0E-01	NV	1.3E+00	2.0E+00	3.9E-05	NV	NV	5.5E-01	NV	NSW
SVOC	Ethanol	64-17-5	1.0E+06	NV	1.0E+06	1.0E+06	1.0E+04	NV	NV	8.3E+05	NV	NSW
SVOC	Fluorene	86-73-7	6.2E+03	WIT	1.8E+04	NA	9.7E+01	WIT	WIT	7.8E+03	WIT	7.0E+00
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	4.3E+02	NV	3.2E+03	NA	1.0E-01	NV	NV	1.4E+03	NV	1.3E-02
SVOC	Naphthalene	91-20-3	4.1E+01	5.4E-01	6.0E+00	2.7E+01	3.9E-01	1.2E+02	8.8E-01	2.8E-01	6.7E-02	4.3E+01
SVOC	Phenanthrene	85-01-8	4.6E+03	WIT	1.4E+04	NA	7.3E+01	WIT	WIT	5.8E+03	WIT	1.0E+00
SVOC	Pyrene	129-00-0	4.6E+03	NV	1.4E+04	NA	5.0E+01	NV	NV	5.8E+03	NV	3.0E+00
SVOC	Tetraethylene Glycol	112-60-7	3.5E+05	NV	9.6E+04	1.2E+05	2.9E+02	NV	NV	3.9E+04	NV	1.9E+05
PCB	PCBs (total)	1336-36-3	3.0E+00	NV	2.3E+00	NA	1.5E-02	NV	NV	9.7E-01	NV	6.4E-04
INORG	Antimony	7440-36-0	1.3E+02	NV	2.3E+01	2.0E+01	2.2E-02	NV	NV	1.4E+00	NV	6.4E+01
INORG	Arsenic	7440-38-2	7.1E+01	NV	1.0E+02	1.2E+01	2.1E-02	NV	NV	5.3E+01	NV	1.4E+00
INORG	Chromium III	16065-83-1	4.6E+05	NV	2.9E+04	1.0E+06	1.1E+01	NV	NV	5.3E+02	NV	7.4E+01
INORG	Chromium VI	18540-29-9	1.8E+02	NV	2.8E+02	1.5E+00	3.9E-03	NV	NV	1.7E+00	NV	1.1E+01
INORG	Cyanide (total)	57-12-5	1.5E+01	8.6E-01	8.8E+00	9.9E+00	3.0E-01	2.4E+01	2.4E-01	2.6E-01	2.5E-02	4.0E+01
INORG	Lead	7439-92-1	2.5E+03	NV	2.5E+03	4.5E+04	IE	NV	NV	IE	NV	2.5E+00
INORG	Nickel	7440-02-0	6.2E+03	NV	7.0E+02	1.7E+03	1.3E+00	NV	NV	8.6E+01	NV	5.2E+01
INORG	Vanadium	7440-62-2	1.6E+03	NV	3.5E+02	2.8E+03	1.4E-01	NV	NV	6.9E+00	NV	1.0E+02

Abbreviations:
Chem Group - chemical group
VOC - volatile organic compounds
SVOC - semi-volatile organic compounds
PCB - polychlorinated biphenyls
INORG - metals
MtGW - migration to groundwater
MtSW - migration to surface water
NV - not volatile
WIT - without inhalation toxicity data
NA - not applicable: target groundwater concentration times DAF is greater than constituent's solubility.
IE - inadequate exposure
NSW - no surface water quality criteria available

Attachment 2

Routine Worker Risk Based Screening Level Calculations

Table 1 – Normalized Average Vapor Flux from Soil to Outdoor Air

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Table 8 – Normalized Vapor Flux to Outdoor Air from Groundwater

Table 9 – Unit Risk, Unit HQ, and RBSLs for Exposure of Routine Workers to Groundwater-derived Vapors in Outdoor Air

Table 10 – Normalized Indoor Air Concentrations in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Groundwater

Table 11 – Unit Risk, Unit HQ, and RBSLs for Groundwater Vapor Intrusion into a Default PADEP Nonresidential Building (Slab-On-Grade)

Table 12 – Blood Lead Model for Adult Exposure to Lead in Soil

Attachment 2
Table 1:
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	D_{air} (m^2/d)	D_{water} (m^2/d)	D_G (m^2/d)	D_L (m^2/d)	D_E (m^2/d)	J_v (kg/m^2-s)
VOC	Benzene	71-43-2	5.82E+01		1.68E-01	7.60E-01	8.47E-05	1.23E-01	3.46E-08	3.51E-02	1.11E-05
VOC	Cumene	98-82-8	7.05E+02		3.28E-01	5.62E-01	6.13E-05	9.10E-02	2.51E-08	4.96E-03	9.32E-06
VOC	1,2-Dibromoethane	106-93-4	2.22E+01		2.37E-02	3.72E-01	7.29E-05	6.02E-02	2.98E-08	5.83E-03	9.53E-06
VOC	1,2-Dichloroethane	107-06-2	1.75E+01		2.92E-02	8.99E-01	8.55E-05	1.46E-01	3.50E-08	2.04E-02	1.07E-05
VOC	Ethyl Benzene	100-41-4	3.67E+02		2.20E-01	6.48E-01	6.74E-05	1.05E-01	2.76E-08	7.27E-03	9.80E-06
VOC	Methyl tert-butyl ether	1634-04-4	1.15E+01		1.83E-02	7.42E-01	8.73E-05	1.20E-01	3.57E-08	1.43E-02	1.05E-05
VOC	Toluene	108-88-3	1.80E+02		1.93E-01	7.52E-01	7.43E-05	1.22E-01	3.04E-08	1.46E-02	1.05E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	8.97E+02		1.61E-01	5.24E-01	6.84E-05	8.48E-02	2.80E-08	1.81E-03	7.67E-06
VOC	1,3,5-Trimethylbenzene	108-67-8	1.76E+03		1.54E-01	5.20E-01	7.49E-05	8.42E-02	3.06E-08	8.81E-04	6.17E-06
VOC	Xylenes (total)	1330-20-7	3.86E+02		2.52E-01	6.74E-01	7.56E-05	1.09E-01	3.09E-08	8.23E-03	9.94E-06
SVOC	Acenaphthene	83-32-9	7.14E+03		3.40E-03	3.64E-01	6.64E-05	5.89E-02	2.72E-08	3.38E-06	4.17E-07
SVOC	Anthracene	120-12-7	2.97E+04		1.30E-03	2.80E-01	6.69E-05	4.53E-02	2.74E-08	2.40E-07	1.11E-07
SVOC	Benzo(a)anthracene	56-55-3	4.01E+05		5.55E-05	4.41E-01	7.78E-05	7.14E-02	3.18E-08	1.20E-09	
SVOC	Benzo(a)pyrene	50-32-8	1.01E+06		1.49E-05	3.72E-01	7.78E-05	6.02E-02	3.18E-08	1.11E-10	
SVOC	Benzo(b)fluoranthene	205-99-2	1.24E+06		1.66E-03	1.95E-01	4.80E-05	3.16E-02	1.97E-08	5.08E-09	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.28E+07		1.10E-05	1.88E-01	4.54E-05	3.04E-02	1.86E-08	3.32E-12	
SVOC	Benzo(k)fluoranthene	207-08-9	1.24E+06		1.16E-05	1.95E-01	4.80E-05	3.16E-02	1.97E-08	3.73E-11	
SVOC	Chrysene	218-01-9	4.01E+05		1.48E-03	2.14E-01	5.37E-05	3.47E-02	2.20E-08	1.54E-08	
SVOC	Dibenz(a,h)anthracene	53-70-3	3.77E+06		9.57E-08	1.75E-01	4.48E-05	2.83E-02	1.83E-08	6.71E-13	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	5.03E+05		1.03E-06	6.91E-01	6.91E-05	1.12E-01	2.83E-08	3.45E-11	
SVOC	Ethanol	64-17-5	6.81E-01		1.96E-04	1.06E+00	1.12E-04	1.72E-01	4.60E-08	5.71E-04	
SVOC	Fluorene	86-73-7	1.38E+04		1.39E-03	3.14E-01	6.81E-05	5.08E-02	2.79E-08	6.17E-07	1.78E-07
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	3.45E+06		2.03E-05	1.64E-01	4.89E-05	2.66E-02	2.00E-08	1.96E-11	
SVOC	Naphthalene	91-20-3	2.01E+03		1.20E-02	5.10E-01	6.48E-05	8.26E-02	2.65E-08	5.94E-05	1.75E-06
SVOC	Phenanthrene	85-01-8	2.42E+04		1.41E-03	3.24E-01	6.45E-05	5.25E-02	2.64E-08	3.67E-07	1.37E-07
SVOC	Pyrene	129-00-0	1.06E+05		2.00E-04	2.35E-01	6.26E-05	3.81E-02	2.56E-08	8.73E-09	
SVOC	Tetraethylene Glycol	112-60-7	3.00E-02		1.62E-11	4.39E-01	6.96E-05	7.11E-02	2.85E-08	5.30E-07	
PCB	PCBs (total)	1336-36-3	2.45E+06		6.64E-02	1.75E-01	4.32E-05	2.83E-02	1.77E-08	9.22E-08	
INORG	Antimony	7440-36-0		4.50E+01							
INORG	Arsenic	7440-38-2		2.90E+01							
INORG	Chromium III	16065-83-1		1.80E+06							
INORG	Chromium VI	18540-29-9		1.90E+01							
INORG	Cyanide (total)	57-12-5		9.90E+00	1.97E-03	1.35E+00	1.53E-04	2.18E-01	6.26E-08	2.61E-05	1.16E-06
INORG	Lead	7439-92-1		9.00E+02							
INORG	Nickel	7440-02-0		6.50E+01							
INORG	Vanadium	7440-62-2		1.00E+03							

Attachment 2
Table 1:
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Soil bulk density	kg/L	ρ_b	1.66
Soil porosity	L/L-soil	θ	0.38
Soil water content	L/L-soil	θ_w	0.05
Soil air-filled porosity	L/L-soil	θ_a	0.32
Soil organic carbon fraction	unitless	f_{oc}	0.005
Averaging period (Exposure Duration)	years	**T**	25
	days	**T**	9125
Temperature	^oC	**Temp**	18
Clean soil above source	m	Z_1	
Bottom of source depth	m	Z_2	5.79

Based on the volatilization model developed by Jury et. al. (1983) for finite sources as described in USEPA's (1996) Soil Screening Guidance: Technical Background Document.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 2

Table 2:

Soil PM_{10} Emission from Wind Erosion

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Unlimited Reservoir Model

Parameter	Units	Variable	Value
Aerodynamic particle size multiplier			0.036
Ground cover fraction		**G**	0.5
Mode of aggregate size distribution	mm		0.50
Threshold friction velocity	m/s	u'_t	0.50
Correction factor			1.25
Corrected friction velocity	m/s	u^*_t	0.6252
Roughness height	m	z_0	0.005
Anemometer height	m		8.0
Friction velocity at anemometer height	m/s	u_t	11.53
Mean annual wind speed	mph	u_m	9.3
Mean annual wind speed	m/s	u_m	4.16
u_m/u_t			0.361
$x = 0.886\ u_t/u_m$			2.46
F(x)			0.064
Annual average PM_{10} flux	kg-soil/m^2-s	$J_{10,w}$	**1.5E-11**

Model described in more detail in USEPA's (1996) *Soil Screening Guidance: Technical Background Document* .

Attachment 2
Table 3:
Dispersion Factor to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Parameter	Units	Value
Correlation coefficient city		Philadelphia
Correlation coefficient A		14.0111
Correlation coefficient B		19.6154
Correlation coefficient C		225.3397

Soil source area	acres	70.6
Soil C/Q averaging time		Annual Max
Conversion factor from 1-Hr Max for soil		0.19
C/Q for soil	$(kg/m^3)/(kg/m^2\text{-}s)$	**25.06**

Groundwater source area	acres	70.6000
Groundwater averaging time for C/Q		Annual Max
Conversion factor from 1-Hr Max for groundwater		0.19
C/Q for Groundwater	$(L/m^3)/(L/m^2\text{-}s)$	**25.06**

Note:
C/Q is estimated using the empirical correlation in USEPA's (2002) Supplemental Soil Screening Guidance.

Attachment 2
Table 4:
Concentrations in Outdoor Air from Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

			Vapor		PM_{10}	
		C/Q (kg/m^3 per kg/m^2-s):	2.5E+01			
Chem Chem	**Chemical**	**CASRN**	C_{soil} (mg/kg)	C_{air} (mg/m^3)	C_{soil} (mg/kg)	C_{air} (mg/m^3)
VOC	Benzene	71-43-2	1.00E+00	2.78E-04	1.00E+00	3.73E-10
VOC	Cumene	98-82-8	1.00E+00	2.34E-04	1.00E+00	3.73E-10
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	2.39E-04	1.00E+00	3.73E-10
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	2.69E-04	1.00E+00	3.73E-10
VOC	Ethyl Benzene	100-41-4	1.00E+00	2.46E-04	1.00E+00	3.73E-10
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	2.62E-04	1.00E+00	3.73E-10
VOC	Toluene	108-88-3	1.00E+00	2.63E-04	1.00E+00	3.73E-10
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	1.92E-04	1.00E+00	3.73E-10
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	1.55E-04	1.00E+00	3.73E-10
VOC	Xylenes (total)	1330-20-7	1.00E+00	2.49E-04	1.00E+00	3.73E-10
SVOC	Acenaphthene	83-32-9	1.00E+00	1.04E-05	1.00E+00	3.73E-10
SVOC	Anthracene	120-12-7	1.00E+00	2.78E-06	1.00E+00	3.73E-10
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.00E+00	3.73E-10
SVOC	Benzo(k)fluoranthene	207-08-9	1.00E+00		1.00E+00	3.73E-10
SVOC	Chrysene	218-01-9	1.00E+00		1.00E+00	3.73E-10
SVOC	Dibenz(a,h)anthracene	53-70-3	1.00E+00		1.00E+00	3.73E-10
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.00E+00		1.00E+00	3.73E-10
SVOC	Ethanol	64-17-5	1.00E+00		1.00E+00	3.73E-10
SVOC	Fluorene	86-73-7	1.00E+00	4.47E-06	1.00E+00	3.73E-10
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.00E+00	3.73E-10
SVOC	Naphthalene	91-20-3	1.00E+00	4.38E-05	1.00E+00	3.73E-10
SVOC	Phenanthrene	85-01-8	1.00E+00	3.44E-06	1.00E+00	3.73E-10
SVOC	Pyrene	129-00-0	1.00E+00		1.00E+00	3.73E-10
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.00E+00	3.73E-10
PCB	PCBs (total)	1336-36-3	1.00E+00		1.00E+00	3.73E-10
INORG	Antimony	7440-36-0	1.00E+00		1.00E+00	3.73E-10
INORG	Arsenic	7440-38-2	1.00E+00		1.00E+00	3.73E-10
INORG	Chromium III	16065-83-1	1.00E+00		1.00E+00	3.73E-10
INORG	Chromium VI	18540-29-9	1.00E+00		1.00E+00	3.73E-10
INORG	Cyanide (total)	57-12-5	1.00E+00	2.90E-05	1.00E+00	3.73E-10
INORG	Lead	7439-92-1	1.00E+00		1.00E+00	3.73E-10
INORG	Nickel	7440-02-0	1.00E+00		1.00E+00	3.73E-10
INORG	Vanadium	7440-62-2	1.00E+00		1.00E+00	3.73E-10

Attachment 2
Table 5a:
Unit Risk and Cancer-Based RBSLs for Exposure of Routine Worker to Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

					Soil Ingestion					Soil Dermal Contact					Soil Vapor Inhalation				Soil Particulate Inhalation				All Routes	
Chem Group	Chemical	CASRN	Cancer Class	C_{soil} (mg/kg)	RBA	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	Risk	RBSL (mg/kg)	ABS_{derm}	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	Risk	RBSL (mg/kg)	C_{air} (mg/m^3)	URF (m^3/mg)	Risk	RBSL (mg/kg)	C_{air} (mg/m^3)	URF $(m^3/mg)^{-1}$	Risk	RBSL (mg/kg)	Risk	RBSL (mg/kg)
VOC	Benzene	71-43-2	A	1.00E+00		1.10E-07	5.5E-02	6.1E-09	1.7E+03			5.5E-02			2.78E-04	7.8E-03	1.3E-07	7.9E+01	3.73E-10	7.8E-03	1.7E-13	5.8E+07	1.3E-07	7.5E+01
VOC	Cumene	98-82-8	D	1.00E+00		1.10E-07									2.34E-04				3.73E-10					
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00		1.10E-07	2.0E+00	2.2E-07	4.5E+01			2.0E+00			2.39E-04	6.0E-01	8.4E-06	1.2E+00	3.73E-10	6.0E-01	1.3E-11	7.6E+05	8.6E-06	1.2E+00
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00		1.10E-07	9.1E-02	1.0E-08	1.0E+03			9.1E-02			2.69E-04	2.6E-02	4.1E-07	2.4E+01	3.73E-10	2.6E-02	5.7E-13	1.8E+07	4.2E-07	2.4E+01
VOC	Ethyl Benzene	100-41-4	D	1.00E+00		1.10E-07									2.46E-04				3.73E-10					
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00		1.10E-07	1.8E-03	2.0E-10	5.0E+04			1.8E-03			2.62E-04	2.6E-04	4.0E-09	2.5E+03	3.73E-10	2.6E-04	5.7E-15	1.8E+09	4.2E-09	2.4E+03
VOC	Toluene	108-88-3	ID	1.00E+00		1.10E-07									2.63E-04				3.73E-10					
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00		1.10E-07									1.92E-04				3.73E-10					
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00		1.10E-07									1.55E-04				3.73E-10					
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00		1.10E-07									2.49E-04				3.73E-10					
SVOC	Acenaphthene	83-32-9	ID	1.00E+00		1.10E-07				1.30E-01	1.21E-07				1.04E-05				3.73E-10					
SVOC	Anthracene	120-12-7	ID	1.00E+00		1.10E-07				1.30E-01	1.21E-07				2.78E-06				3.73E-10					
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		1.10E-07	1.0E-01	1.1E-08	9.1E+02	1.30E-01	1.21E-07	1.0E-01	1.2E-08	8.3E+02		6.0E-02			3.73E-10	6.0E-02	1.3E-12	7.6E+06	2.3E-08	4.3E+02
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		1.10E-07	1.0E+00	1.1E-07	9.1E+01	1.30E-01	1.21E-07	1.0E+00	1.2E-07	8.3E+01		6.0E-01			3.73E-10	6.0E-01	1.3E-11	7.6E+05	2.3E-07	4.3E+01
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		1.10E-07	1.0E-01	1.1E-08	9.1E+02	1.30E-01	1.21E-07	1.0E-01	1.2E-08	8.3E+02		6.0E-02			3.73E-10	6.0E-02	1.3E-12	7.6E+06	2.3E-08	4.3E+02
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00		1.10E-07				1.30E-01	1.21E-07								3.73E-10					
SVOC	Benzo(k)fluoranthene	207-08-9	B2	1.00E+00		1.10E-07	1.0E-02	1.1E-09	9.1E+03	1.30E-01	1.21E-07	1.0E-02	1.2E-09	8.3E+03		6.0E-03			3.73E-10	6.0E-03	1.3E-13	7.6E+07	2.3E-09	4.3E+03
SVOC	Chrysene	218-01-9	B2	1.00E+00		1.10E-07	1.0E-03	1.1E-10	9.1E+04	1.30E-01	1.21E-07	1.0E-03	1.2E-10	8.3E+04		6.0E-04			3.73E-10	6.0E-04	1.3E-14	7.6E+08	2.3E-10	4.3E+04
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	1.00E+00		1.10E-07	1.0E+00	1.1E-07	9.1E+01	1.30E-01	1.21E-07	1.0E+00	1.2E-07	8.3E+01		6.0E-01			3.73E-10	6.0E-01	1.3E-11	7.6E+05	2.3E-07	4.3E+01
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	1.00E+00		1.10E-07	2.5E+02	2.8E-05	3.6E-01	1.00E-01	9.32E-08	2.5E+02	2.3E-05	4.3E-01		7.1E+01			3.73E-10	7.1E+01	1.6E-09	6.4E+03	5.1E-05	2.0E-01
SVOC	Ethanol	64-17-5		1.00E+00		1.10E-07													3.73E-10					
SVOC	Fluorene	86-73-7	D	1.00E+00		1.10E-07				1.30E-01	1.21E-07				4.47E-06				3.73E-10					
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		1.10E-07	1.0E-01	1.1E-08	9.1E+02	1.30E-01	1.21E-07	1.0E-01	1.2E-08	8.3E+02		6.0E-02			3.73E-10	6.0E-02	1.3E-12	7.6E+06	2.3E-08	4.3E+02
SVOC	Naphthalene	91-20-3	C	1.00E+00		1.10E-07	1.2E-01	1.3E-08	7.6E+02	1.30E-01	1.21E-07	1.2E-01	1.5E-08	6.9E+02	4.38E-05	3.4E-02	8.7E-08	1.1E+02	3.73E-10	3.4E-02	7.5E-13	1.3E+07	1.2E-07	8.7E+01
SVOC	Phenanthrene	85-01-8	D	1.00E+00		1.10E-07				1.30E-01	1.21E-07				3.44E-06				3.73E-10					
SVOC	Pyrene	129-00-0	NC	1.00E+00		1.10E-07				1.30E-01	1.21E-07								3.73E-10					
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00		1.10E-07				1.00E-01	9.32E-08								3.73E-10					
PCB	PCBs (total)	1336-36-3	B2	1.00E+00		1.10E-07	2.0E+00	2.2E-07	4.5E+01	1.40E-01	1.30E-07	2.0E+00	2.6E-07	3.8E+01		5.7E-01			3.73E-10	5.7E-01	1.3E-11	8.0E+05	4.8E-07	2.1E+01
INORG	Antimony	7440-36-0	ID	1.00E+00		1.10E-07													3.73E-10					
INORG	Arsenic	7440-38-2	A	1.00E+00	0.6	1.10E-07	1.5E+00	9.9E-08	1.0E+02	3.00E-02	2.80E-08	1.5E+00	4.2E-08	2.4E+02		4.3E+00			3.73E-10	4.3E+00	9.4E-11	1.1E+05	1.4E-07	7.1E+01
INORG	Chromium III	16065-83-1	D	1.00E+00		1.10E-07													3.73E-10					
INORG	Chromium VI	18540-29-9	A	1.00E+00		1.10E-07	5.0E-01	5.5E-08	1.8E+02			2.0E+01				1.2E+01			3.73E-10	1.2E+01	2.6E-10	3.8E+04	5.5E-08	1.8E+02
INORG	Cyanide (total)	57-12-5		1.00E+00		1.10E-07									2.90E-05				3.73E-10					
INORG	Lead	7439-92-1	B2	1.00E+00		1.10E-07													3.73E-10					
INORG	Nickel	7440-02-0	A	1.00E+00		1.10E-07										2.4E-01			3.73E-10	2.4E-01	5.3E-12	1.9E+06	5.3E-12	1.9E+06
INORG	Vanadium	7440-62-2	ID	1.00E+00		1.10E-07													3.73E-10					

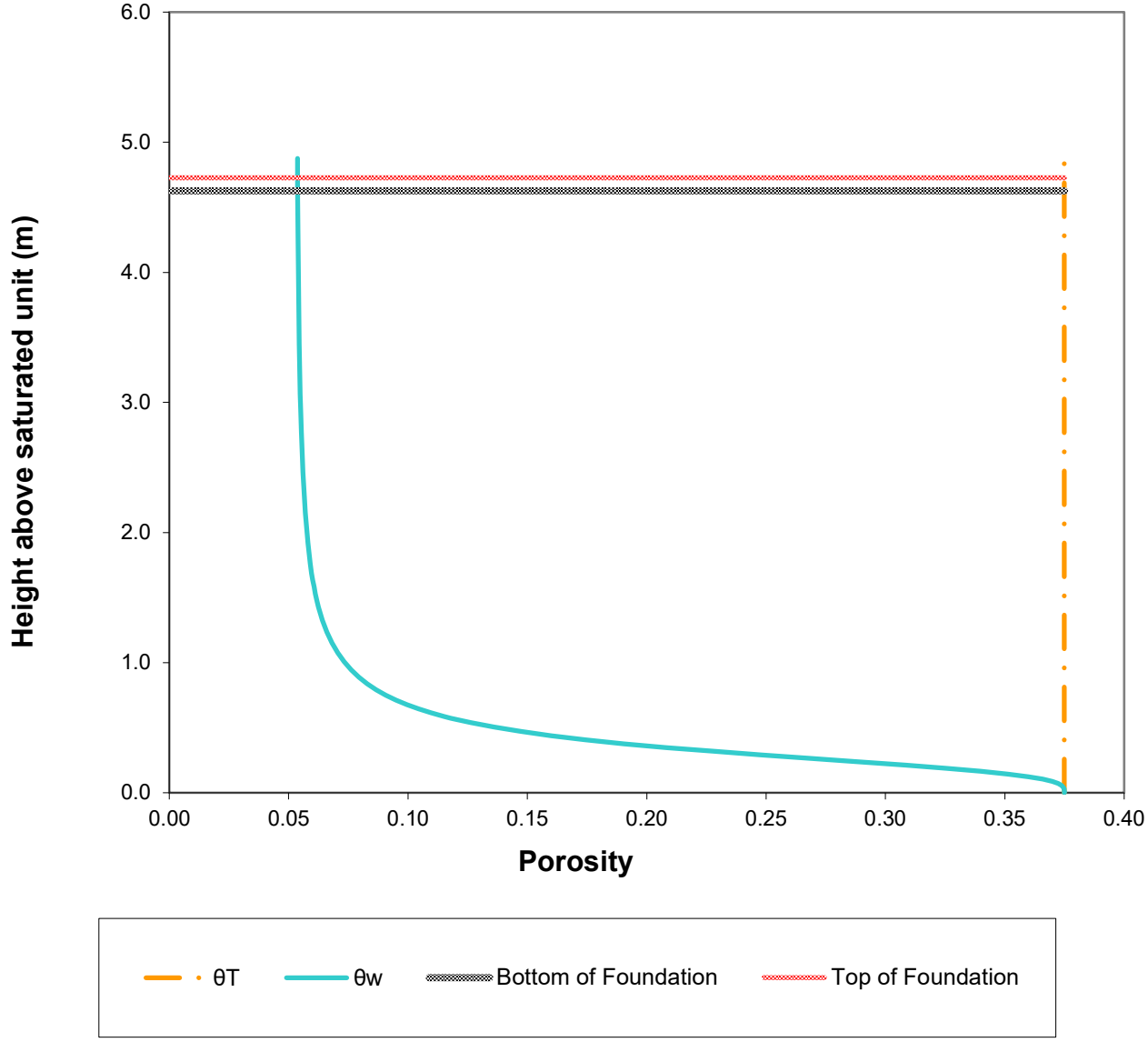
Notes:
Cancer RBSLs are calculated at a target cancer risk of 1E-05.

Attachment 2
Table 5b:
Unit HQ and Noncancer-Based RBSLs for Exposure of Routine Worker to Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Soil Ingestion					Soil Dermal Contact					Soil Vapor Inhalation				Soil Particulate Inhalation				All Routes	
Chem Group	Chemical	CASRN	C_{soil} (mg/kg)	RBA	ADD (mg/kg/d)	RfD_{oral} (mg/kg/d)	HQ	RBSL (mg/kg)	ABS_{derm}	ADD (mg/kg/d)	RfD_{derm} (mg/kg/d)	HQ	RBSL (mg/kg)	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	RBSL (mg/kg)	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	RBSL (mg/kg)	HQ	RBSL (mg/kg)
VOC	Benzene	71-43-2	1.00E+00		3.08E-07	4.0E-03	7.7E-05	1.3E+03			4.0E-03			2.78E-04	3.0E-02	1.5E-03	6.6E+01	3.73E-10	3.0E-02	2.0E-09	4.9E+07	1.6E-03	6.3E+01
VOC	Cumene	98-82-8	1.00E+00		3.08E-07	1.0E-01	3.1E-06	3.2E+04			1.0E-01			2.34E-04	4.0E-01	9.6E-05	1.0E+03	3.73E-10	4.0E-01	1.5E-10	6.5E+08	9.9E-05	1.0E+03
VOC	1,2-Dibromoethane	106-93-4	1.00E+00		3.08E-07	9.0E-03	3.4E-05	2.9E+03			9.0E-03			2.39E-04	9.0E-03	4.4E-03	2.3E+01	3.73E-10	9.0E-03	6.8E-09	1.5E+07	4.4E-03	2.3E+01
VOC	1,2-Dichloroethane	107-06-2	1.00E+00		3.08E-07	6.0E-03	5.1E-05	1.9E+03			6.0E-03			2.69E-04	7.0E-03	6.3E-03	1.6E+01	3.73E-10	7.0E-03	8.8E-09	1.1E+07	6.4E-03	1.6E+01
VOC	Ethyl Benzene	100-41-4	1.00E+00		3.08E-07	1.0E-01	3.1E-06	3.2E+04			1.0E-01			2.46E-04	1.0E+00	4.0E-05	2.5E+03	3.73E-10	1.0E+00	6.1E-11	1.6E+09	4.3E-05	2.3E+03
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00		3.08E-07	3.0E-01	1.0E-06	9.7E+04			3.0E-01			2.62E-04	3.0E+00	1.4E-05	7.0E+03	3.73E-10	3.0E+00	2.0E-11	4.9E+09	1.5E-05	6.5E+03
VOC	Toluene	108-88-3	1.00E+00		3.08E-07	8.0E-02	3.9E-06	2.6E+04			8.0E-02			2.63E-04	5.0E+00	8.6E-06	1.2E+04	3.73E-10	5.0E+00	1.2E-11	8.1E+09	1.2E-05	8.0E+03
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00		3.08E-07	1.0E-02	3.1E-05	3.2E+03			1.0E-02			1.92E-04	6.0E-02	5.3E-04	1.9E+02	3.73E-10	6.0E-02	1.0E-09	9.8E+07	5.6E-04	1.8E+02
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00		3.08E-07	1.0E-02	3.1E-05	3.2E+03			1.0E-02			1.55E-04	6.0E-02	4.2E-04	2.4E+02	3.73E-10	6.0E-02	1.0E-09	9.8E+07	4.5E-04	2.2E+02
VOC	Xylenes (total)	1330-20-7	1.00E+00		3.08E-07	2.0E-01	1.5E-06	6.5E+04			2.0E-01			2.49E-04	1.0E-01	4.1E-04	2.4E+02	3.73E-10	1.0E-01	6.1E-10	1.6E+08	4.1E-04	2.4E+02
SVOC	Acenaphthene	83-32-9	1.00E+00		3.08E-07	6.0E-02	5.1E-06	1.9E+04	1.30E-01	3.39E-07	6.0E-02	5.7E-06	1.8E+04	1.04E-05				3.73E-10				1.1E-05	9.3E+03
SVOC	Anthracene	120-12-7	1.00E+00		3.08E-07	3.0E-01	1.0E-06	9.7E+04	1.30E-01	3.39E-07	3.0E-01	1.1E-06	8.8E+04	2.78E-06				3.73E-10				2.2E-06	4.6E+04
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		3.08E-07				1.30E-01	3.39E-07								3.73E-10					
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		3.08E-07	3.0E-04	1.0E-03	9.7E+01	1.30E-01	3.39E-07	3.0E-04	1.1E-03	8.8E+01		2.0E-06			3.73E-10	2.0E-06	3.1E-05	3.3E+03	2.2E-03	4.6E+01
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		3.08E-07				1.30E-01	3.39E-07								3.73E-10					
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		3.08E-07	3.0E-02	1.0E-05	9.7E+03	1.30E-01	3.39E-07	3.0E-02	1.1E-05	8.8E+03					3.73E-10				2.2E-05	4.6E+03
SVOC	Benzo(k)fluoranthene	207-08-9	1.00E+00		3.08E-07				1.30E-01	3.39E-07								3.73E-10					
SVOC	Chrysene	218-01-9	1.00E+00		3.08E-07				1.30E-01	3.39E-07								3.73E-10					
SVOC	Dibenz(a,h)anthracene	53-70-3	1.00E+00		3.08E-07				1.30E-01	3.39E-07								3.73E-10					
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.00E+00		3.08E-07				1.00E-01	2.61E-07								3.73E-10					
SVOC	Ethanol	64-17-5	1.00E+00		3.08E-07	6.2E+01	5.0E-09	2.0E+07			6.2E+01				1.9E+01			3.73E-10	1.9E+01	3.2E-12	3.1E+10	5.0E-09	2.0E+07
SVOC	Fluorene	86-73-7	1.00E+00		3.08E-07	4.0E-02	7.7E-06	1.3E+04	1.30E-01	3.39E-07	4.0E-02	8.5E-06	1.2E+04	4.47E-06				3.73E-10				1.6E-05	6.2E+03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		3.08E-07				1.30E-01	3.39E-07								3.73E-10					
SVOC	Naphthalene	91-20-3	1.00E+00		3.08E-07	2.0E-02	1.5E-05	6.5E+03	1.30E-01	3.39E-07	2.0E-02	1.7E-05	5.9E+03	4.38E-05	3.0E-03	2.4E-03	4.2E+01	3.73E-10	3.0E-03	2.0E-08	4.9E+06	2.4E-03	4.1E+01
SVOC	Phenanthrene	85-01-8	1.00E+00		3.08E-07	3.0E-02	1.0E-05	9.7E+03	1.30E-01	3.39E-07	3.0E-02	1.1E-05	8.8E+03	3.44E-06				3.73E-10				2.2E-05	4.6E+03
SVOC	Pyrene	129-00-0	1.00E+00		3.08E-07	3.0E-02	1.0E-05	9.7E+03	1.30E-01	3.39E-07	3.0E-02	1.1E-05	8.8E+03					3.73E-10				2.2E-05	4.6E+03
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		3.08E-07	2.0E+00	1.5E-07	6.5E+05	1.00E-01	2.61E-07	2.0E+00	1.3E-07	7.7E+05					3.73E-10				2.8E-07	3.5E+05
PCB	PCBs (total)	1336-36-3	1.00E+00		3.08E-07				1.40E-01	3.65E-07								3.73E-10					
INORG	Antimony	7440-36-0	1.00E+00		3.08E-07	4.0E-04	7.7E-04	1.3E+02			6.0E-05							3.73E-10				7.7E-04	1.3E+02
INORG	Arsenic	7440-38-2	1.00E+00	0.6	3.08E-07	3.0E-04	6.2E-04	1.6E+02	3.00E-02	7.83E-08	3.0E-04	2.6E-04	3.8E+02		1.5E-05			3.73E-10	1.5E-05	4.1E-06	2.4E+04	8.8E-04	1.1E+02
INORG	Chromium III	16065-83-1	1.00E+00		3.08E-07	1.5E+00	2.1E-07	4.9E+05			2.0E-02				5.0E-03			3.73E-10	5.0E-03	1.2E-08	8.1E+06	2.2E-07	4.6E+05
INORG	Chromium VI	18540-29-9	1.00E+00		3.08E-07	3.0E-03	1.0E-04	9.7E+02			7.5E-05				1.0E-04			3.73E-10	1.0E-04	6.1E-07	1.6E+05	1.0E-04	9.7E+02
INORG	Cyanide (total)	57-12-5	1.00E+00		3.08E-07	6.0E-04	5.1E-04	1.9E+02			6.0E-04			2.90E-05	8.0E-04	6.0E-03	1.7E+01	3.73E-10	8.0E-04	7.7E-08	1.3E+06	6.5E-03	1.5E+01
INORG	Lead	7439-92-1	1.00E+00		3.08E-07													3.73E-10					
INORG	Nickel	7440-02-0	1.00E+00		3.08E-07	2.0E-02	1.5E-05	6.5E+03			8.0E-04				9.0E-05			3.73E-10	9.0E-05	6.8E-07	1.5E+05	1.6E-05	6.2E+03
INORG	Vanadium	7440-62-2	1.00E+00		3.08E-07	5.0E-03	6.2E-05	1.6E+03			1.3E-04				1.0E-04			3.73E-10	1.0E-04	6.1E-07	1.6E+05	6.2E-05	1.6E+03

Notes:
Noncancer RBSLs are calculated at a target HQ of 0.1.

Attachment 2
Figure 1:Soil Moisture Profile for Default PADEP Nonresidential Building (Slab-On-Grade)
PESRM Philadelphia Refining Complex, Philadelphia, Pennsylvania



Attachment 2

Table 6:

Normalized Indoor Air Concentration in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	D_{air} (m^2/day)	D_{water} (m^2/day)	H (unitless)	D_{crack} (m^2/day)	D_{eff}^T (m^2/day)	α_{∞}	K_{oc} (L/kg)	K_d (L/kg)	$C_{s,\ vap}$ (kg-soil/m^3)	$C_{b,\infty}$ (kg-soil/m^3)	α_{ML}	$C_{b,ML}$ (kg-soil/m^3)	$C_{b,\ norm}$ (kg-soil/m^3)
VOC	Benzene	71-43-2	7.60E-01	8.47E-05	1.68E-01	1.23E-01	1.23E-01	2.05E-03	5.82E+01	2.91E-01	4.73E+02	9.69E-01	6.06E-05	2.87E-02	2.87E-02
VOC	Cumene	98-82-8	5.62E-01	6.13E-05	3.28E-01	9.09E-02	9.09E-02	2.05E-03	7.05E+02	3.53E+00	9.05E+01	1.85E-01	3.17E-04	2.87E-02	2.87E-02
VOC	1,2-Dibromoethane	106-93-4	3.72E-01	7.29E-05	2.37E-02	6.02E-02	6.01E-02	2.05E-03	2.22E+01	1.11E-01	1.61E+02	3.29E-01	1.78E-04	2.87E-02	2.87E-02
VOC	1,2-Dichloroethane	107-06-2	8.99E-01	8.55E-05	2.92E-02	1.46E-01	1.45E-01	2.05E-03	1.75E+01	8.74E-02	2.33E+02	4.77E-01	1.23E-04	2.87E-02	2.87E-02
VOC	Ethyl Benzene	100-41-4	6.48E-01	6.74E-05	2.20E-01	1.05E-01	1.05E-01	2.05E-03	3.67E+02	1.84E+00	1.15E+02	2.36E-01	2.49E-04	2.87E-02	2.87E-02
VOC	Methyl tert-butyl ether	1634-04-4	7.42E-01	8.73E-05	1.83E-02	1.20E-01	1.20E-01	2.05E-03	1.15E+01	5.75E-02	1.97E+02	4.03E-01	1.46E-04	2.87E-02	2.87E-02
VOC	Toluene	108-88-3	7.52E-01	7.43E-05	1.93E-01	1.22E-01	1.22E-01	2.05E-03	1.80E+02	9.02E-01	1.98E+02	4.06E-01	1.45E-04	2.87E-02	2.87E-02
VOC	1,2,4-Trimethylbenzene	95-63-6	5.24E-01	6.84E-05	1.61E-01	8.48E-02	8.48E-02	2.05E-03	8.97E+02	4.49E+00	3.54E+01	7.25E-02	8.10E-04	2.87E-02	2.87E-02
VOC	1,3,5-Trimethylbenzene	108-67-8	5.20E-01	7.49E-05	1.54E-01	8.42E-02	8.42E-02	2.05E-03	1.76E+03	8.81E+00	1.74E+01	3.55E-02	1.65E-03	2.87E-02	2.87E-02
VOC	Xylenes (total)	1330-20-7	6.74E-01	7.56E-05	2.52E-01	1.09E-01	1.09E-01	2.05E-03	3.86E+02	1.93E+00	1.25E+02	2.56E-01	2.29E-04	2.87E-02	2.87E-02
SVOC	Acenaphthene	83-32-9	3.64E-01	6.64E-05	3.40E-03	5.89E-02	5.89E-02	2.05E-03	7.14E+03	3.57E+01	9.51E-02	1.95E-04	3.02E-01	2.87E-02	1.95E-04
SVOC	Anthracene	120-12-7	2.80E-01	6.69E-05	1.30E-03	4.54E-02	4.53E-02	2.05E-03	2.97E+04	1.49E+02	8.77E-03	1.80E-05	3.27E+00	2.87E-02	1.80E-05
SVOC	Benzo(a)anthracene	56-55-3	4.41E-01	7.78E-05	5.55E-05	7.19E-02	7.19E-02	2.05E-03	4.01E+05	2.01E+03	2.77E-05	5.67E-08	1.04E+03	2.87E-02	
SVOC	Benzo(a)pyrene	50-32-8	3.72E-01	7.78E-05	1.49E-05	6.23E-02	6.23E-02	2.05E-03	1.01E+06	5.07E+03	2.95E-06	6.03E-09	9.74E+03	2.87E-02	
SVOC	Benzo(b)fluoranthene	205-99-2	1.95E-01	4.80E-05	1.66E-03	3.16E-02	3.16E-02	2.04E-03	1.24E+06	6.22E+03	2.67E-04	5.45E-07	1.08E+02	2.87E-02	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.88E-01	4.54E-05	1.10E-05	3.21E-02	3.21E-02	2.04E-03	1.28E+07	6.40E+04	1.72E-07	3.51E-10	1.67E+05	2.87E-02	
SVOC	Benzo(k)fluoranthene	207-08-9	1.95E-01	4.80E-05	1.16E-05	3.33E-02	3.33E-02	2.05E-03	1.24E+06	6.22E+03	1.86E-06	3.80E-09	1.54E+04	2.87E-02	
SVOC	Chrysene	218-01-9	2.14E-01	5.37E-05	1.48E-03	3.47E-02	3.47E-02	2.05E-03	4.01E+05	2.01E+03	7.38E-04	1.51E-06	3.89E+01	2.87E-02	
SVOC	Dibenz(a,h)anthracene	53-70-3	1.75E-01	4.48E-05	9.57E-08	2.20E-01	2.20E-01	2.05E-03	3.77E+06	1.89E+04	5.08E-09	1.04E-11	5.65E+06	2.87E-02	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	6.91E-01	6.91E-05	1.03E-06	1.39E-01	1.39E-01	2.05E-03	5.03E+05	2.52E+03	4.11E-07	8.41E-10	6.99E+04	2.87E-02	
SVOC	Ethanol	64-17-5	1.06E+00	1.12E-04	1.96E-04	1.72E-01	1.72E-01	2.05E-03	6.81E-01	3.40E-03	5.50E+00	1.13E-02	5.22E-03	2.87E-02	
SVOC	Fluorene	86-73-7	3.14E-01	6.81E-05	1.39E-03	5.08E-02	5.08E-02	2.05E-03	1.38E+04	6.88E+01	2.02E-02	4.12E-05	1.42E+00	2.87E-02	4.12E-05
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.64E-01	4.89E-05	2.03E-05	2.76E-02	2.76E-02	2.04E-03	3.45E+06	1.72E+04	1.18E-06	2.41E-09	2.44E+04	2.87E-02	
SVOC	Naphthalene	91-20-3	5.10E-01	6.48E-05	1.20E-02	8.25E-02	8.25E-02	2.05E-03	2.01E+03	1.00E+01	1.19E+00	2.45E-03	2.40E-02	2.87E-02	2.45E-03
SVOC	Phenanthrene	85-01-8	3.24E-01	6.45E-05	1.41E-03	5.25E-02	5.25E-02	2.05E-03	2.42E+04	1.21E+02	1.16E-02	2.37E-05	2.47E+00	2.87E-02	2.37E-05
SVOC	Pyrene	129-00-0	2.35E-01	6.26E-05	2.00E-04	3.82E-02	3.82E-02	2.05E-03	1.06E+05	5.28E+02	3.79E-04	7.76E-07	7.56E+01	2.87E-02	
SVOC	Tetraethylene Glycol	112-60-7	4.39E-01	6.96E-05	1.62E-11	1.76E+03	1.76E+03	1.68E-01	3.00E-02	1.50E-04	5.01E-07	8.40E-08	5.73E+04	2.87E-02	
PCB	PCBs (total)	1336-36-3	1.75E-01	4.32E-05	6.64E-02	2.83E-02	2.83E-02	2.04E-03	2.45E+06	1.23E+04	5.42E-03	1.11E-05	5.30E+00	2.87E-02	
INORG	Antimony	7440-36-0								4.50E+01					
INORG	Arsenic	7440-38-2								2.90E+01					
INORG	Chromium III	16065-83-1								1.80E+06					
INORG	Chromium VI	18540-29-9								1.90E+01					
INORG	Cyanide (total)	57-12-5	1.35E+00	1.53E-04	1.97E-03	2.18E-01	2.18E-01	2.05E-03		9.90E+00	1.99E-01	4.07E-04	1.44E-01	2.87E-02	4.07E-04
INORG	Lead	7439-92-1								9.00E+02					
INORG	Nickel	7440-02-0								6.50E+01					
INORG	Vanadium	7440-62-2								1.00E+03					

Attachment 2

Table 6:

Normalized Indoor Air Concentration in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Soil

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:	Subsurface and Building Characteristics			Crack Soil
	SCS Soil texture class			Sand
	Bulk density	kg/L	ρ_b	1.66
	Total porosity	L/L-soil	θ_T	0.375
	Water-filled porosity	L/L-soil	θ_w	0.053
	Air-filled porosity	L/L-soil	θ_a	0.322
	Organic carbon fraction	unitless	f_{oc}	NA
	Residual saturation	L/L-soil	θ_r	0.053
	Hydraulic conductivity	cm/s	K	7.4E-03
	Dynamic viscosity of water	g/cm-s	μ_w	0.01307
	Density of water	g/cm^3	ρ_w	1.0
	Gravitational acceleration	cm/s^2	g	980.7
	Intrinsic permeability	cm^2	k	9.9E-08
	Relative saturation	unitless	S_e	0.001
	van Genuchten N	unitless	N	3.18
	van Genuchten M	unitless	M	0.685
	Relative air permeability	unitless	k_{rg}	0.999
	Permeability to vapor	cm^2	k_v	9.9E-08
	Distance from building foundation to source	m	$L_{T\text{-}soil}$	0.001
	Bldg foundation thickness	m	L_{crack}	0.1
	Bldg foundation length	m		10.00
	Bldg foundation width	m		10.00
	Bldg occupied height	m		2.44
	Bldg occupied volume	m^3		244.00
	Occupied depth below ground	m		0.2
	Bldg area for vapor intrusion	m^2	A_B	106.0
	Ratio of A_{crack} to A_B		η	4E-04
	Area of cracks	m^2	A_{crack}	4.00E-02
	Air exchange rate	$hour^{-1}$	ach	0.6
	Building ventilation rate	m^3/day	Q_{bldg}	3.51E+03
	Pressure difference between outdoors-indoors	$kg/m\text{-}s^2$	ΔP	1.0
	Viscosity of air	kg/m-s	μ_a	1.8E-05
	Crack length (bldg perimeter)	m	X_{crack}	40
	Crack depth below ground	m	Z_{crack}	0.25
	Crack radius	m	r_{crack}	1E-03
	Soil gas flow rate into bldg	m^3/day	Q_{soil}	7.20E+00
	Averaging period	d	ED	9.13E+03
	Contaminant thickness	m	ΔH	5.5

Attachment 2

Table 7:

Unit Risk, Unit HQ, and RBSLs for Soil Vapor Intrusion into a Default PADEP Nonresidential Building (Slab-On-Grade)

Routine Worker

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Cancer				Noncancer		
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**C_{soil}** (mg/kg)	**C_{air}** (mg/m^3)	**URF** $(mg/m^3)^{-1}$	**Risk**	**RBSL** (mg/kg)		**RfC** (mg/m^3)	**HQ**	**RBSL** (mg/kg)
VOC	Benzene	71-43-2	A	1.00E+00	2.87E-02	7.8E-03	1.8E-05	5.5E-01		3.0E-02	2.2E-01	4.6E-01
VOC	Cumene	98-82-8	D	1.00E+00	2.87E-02					4.0E-01	1.6E-02	6.1E+00
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	2.87E-02	6.0E-01	1.4E-03	7.1E-03		9.0E-03	7.3E-01	1.4E-01
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	2.87E-02	2.6E-02	6.1E-05	1.6E-01		7.0E-03	9.4E-01	1.1E-01
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	2.87E-02					1.0E+00	6.5E-03	1.5E+01
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	2.87E-02	2.6E-04	6.1E-07	1.6E+01		3.0E+00	2.2E-03	4.6E+01
VOC	Toluene	108-88-3	ID	1.00E+00	2.87E-02					5.0E+00	1.3E-03	7.6E+01
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	2.87E-02					6.0E-02	1.1E-01	9.2E-01
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	2.87E-02					6.0E-02	1.1E-01	9.2E-01
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	2.87E-02					1.0E-01	6.5E-02	1.5E+00
SVOC	Acenaphthene	83-32-9	ID	1.00E+00	1.95E-04							
SVOC	Anthracene	120-12-7	ID	1.00E+00	1.80E-05							
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		6.0E-02						
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		6.0E-01				2.0E-06		
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		6.0E-02						
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00								
SVOC	Benzo(k)fluoranthene	207-08-9	B2	1.00E+00		6.0E-03						
SVOC	Chrysene	218-01-9	B2	1.00E+00		6.0E-04						
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	1.00E+00		6.0E-01						
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	1.00E+00		7.1E+01						
SVOC	Ethanol	64-17-5		1.00E+00						1.9E+01		
SVOC	Fluorene	86-73-7	D	1.00E+00	4.12E-05							
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		6.0E-02						
SVOC	Naphthalene	91-20-3	C	1.00E+00	2.45E-03	3.4E-02	6.8E-06	1.5E+00		3.0E-03	1.9E-01	5.4E-01
SVOC	Phenanthrene	85-01-8	D	1.00E+00	2.37E-05							
SVOC	Pyrene	129-00-0	NC	1.00E+00								
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00								
PCB	PCBs (total)	1336-36-3	B2	1.00E+00		5.7E-01						
INORG	Antimony	7440-36-0	ID	1.00E+00								
INORG	Arsenic	7440-38-2	A	1.00E+00		4.3E+00				1.5E-05		
INORG	Chromium III	16065-83-1	D	1.00E+00						5.0E-03		
INORG	Chromium VI	18540-29-9	A	1.00E+00		1.2E+01				1.0E-04		
INORG	Cyanide (total)	57-12-5		1.00E+00	4.07E-04					8.0E-04	1.2E-01	8.6E-01
INORG	Lead	7439-92-1	B2	1.00E+00								
INORG	Nickel	7440-02-0	A	1.00E+00		2.4E-01				9.0E-05		
INORG	Vanadium	7440-62-2	ID	1.00E+00						1.0E-04		

Note:

Cancer RBSLs are calculated at a target cancer risk of 1E-05.

Noncancer RBSLs are calculated at a target HQ of 0.1.

Attachment 2

Table 8:

Normalized Vapor Flux to Outdoor Air from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	H (unitless)	D_{eff}^{T} (m^2/day)	J (L/m^2-s)	C_{air} (L/m^3)
VOC	Benzene	71-43-2	1.68E-01	6.25E-04	1.33E-06	3.34E-05
VOC	Cumene	98-82-8	3.28E-01	2.57E-04	1.06E-06	2.67E-05
VOC	1,2-Dibromoethane	106-93-4	2.37E-02	2.38E-03	7.16E-07	1.79E-05
VOC	1,2-Dichloroethane	107-06-2	2.92E-02	2.78E-03	1.03E-06	2.57E-05
VOC	Ethyl Benzene	100-41-4	2.20E-01	4.00E-04	1.11E-06	2.79E-05
VOC	Methyl tert-butyl ether	1634-04-4	1.83E-02	3.92E-03	9.10E-07	2.28E-05
VOC	Toluene	108-88-3	1.93E-01	4.97E-04	1.21E-06	3.04E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.61E-01	5.12E-04	1.04E-06	2.62E-05
VOC	1,3,5-Trimethylbenzene	108-67-8	1.54E-01	5.74E-04	1.12E-06	2.80E-05
VOC	Xylenes (total)	1330-20-7	2.52E-01	3.95E-04	1.26E-06	3.15E-05
SVOC	Acenaphthene	83-32-9	3.40E-03	8.55E-03	3.68E-07	9.22E-06
SVOC	Anthracene	120-12-7	1.30E-03	1.31E-02	2.15E-07	5.40E-06
SVOC	Benzo(a)anthracene	56-55-3	5.55E-05	6.47E-02	4.55E-08	
SVOC	Benzo(a)pyrene	50-32-8	1.49E-05	9.62E-02	1.82E-08	
SVOC	Benzo(b)fluoranthene	205-99-2	1.66E-03	8.18E-03	1.72E-07	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.10E-05	5.98E-02	8.33E-09	
SVOC	Benzo(k)fluoranthene	207-08-9	1.16E-05	6.13E-02	8.96E-09	
SVOC	Chrysene	218-01-9	1.48E-03	9.60E-03	1.80E-07	
SVOC	Dibenz(a,h)anthracene	53-70-3	9.57E-08	2.65E+00	3.21E-09	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.03E-06	5.36E-01	7.01E-09	
SVOC	Ethanol	64-17-5	1.96E-04	8.08E-02	2.01E-07	
SVOC	Fluorene	86-73-7	1.39E-03	1.35E-02	2.37E-07	5.94E-06
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.03E-05	4.34E-02	1.11E-08	
SVOC	Naphthalene	91-20-3	1.20E-02	3.93E-03	5.99E-07	1.50E-05
SVOC	Phenanthrene	85-01-8	1.41E-03	1.33E-02	2.36E-07	5.91E-06
SVOC	Pyrene	129-00-0	2.00E-04	2.53E-02	6.41E-08	
SVOC	Tetraethylene Glycol	112-60-7	1.62E-11	2.39E+04	4.90E-09	
PCB	PCBs (total)	1336-36-3	6.64E-02	6.01E-04	5.05E-07	
INORG	Antimony	7440-36-0				
INORG	Arsenic	7440-38-2				
INORG	Chromium III	16065-83-1				
INORG	Chromium VI	18540-29-9				
INORG	Cyanide (total)	57-12-5	1.97E-03	3.30E-02	8.25E-07	2.07E-05
INORG	Lead	7439-92-1				
INORG	Nickel	7440-02-0				
INORG	Vanadium	7440-62-2				

Parameters

Depth to groundwater	m	**DTW**	0.91
Dispersion coefficient	(L/m^3) / (L/m^2/s)	**C/Q**	25.1

Attachment 2
Table 9:
Unit Risk, Unit HQ, and RBSLs for Exposure of Routine Workers to Groundwater-derived Vapors in Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Cancer				Noncancer		
Chem Group	**Chemical**	**CASRN**	**Carc Class**	C_{GW} (mg/L)	C_{air} (mg/m^3)	**URF** (mg/m^3)$^{-1}$	**Risk**	**RBSL** (mg/L)		**RfC** (mg/m^3)	**HQ**	**RBSL** (mg/L)
VOC	Benzene	71-43-2	A	1.00E+00	3.34E-05	7.8E-03	1.5E-08	6.5E+02		3.0E-02	1.8E-04	5.5E+02
VOC	Cumene	98-82-8	D	1.00E+00	2.67E-05					4.0E-01	1.1E-05	9.1E+03
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	1.79E-05	6.0E-01	6.3E-07	1.6E+01		9.0E-03	3.3E-04	3.1E+02
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	2.57E-05	2.6E-02	3.9E-08	2.5E+02		7.0E-03	6.0E-04	1.7E+02
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	2.79E-05					1.0E+00	4.6E-06	2.2E+04
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	2.28E-05	2.6E-04	3.5E-10	2.9E+04		3.0E+00	1.2E-06	8.0E+04
VOC	Toluene	108-88-3	ID	1.00E+00	3.04E-05					5.0E+00	1.0E-06	1.0E+05
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	2.62E-05					6.0E-02	7.2E-05	1.4E+03
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	2.80E-05					6.0E-02	7.7E-05	1.3E+03
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	3.15E-05					1.0E-01	5.2E-05	1.9E+03
SVOC	Acenaphthene	83-32-9	ID	1.00E+00	9.22E-06							
SVOC	Anthracene	120-12-7	ID	1.00E+00	5.40E-06							
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		6.0E-02						
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		6.0E-01				2.0E-06		
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		6.0E-02						
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00								
SVOC	Benzo(k)fluoranthene	207-08-9	B2	1.00E+00		6.0E-03						
SVOC	Chrysene	218-01-9	B2	1.00E+00		6.0E-04						
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	1.00E+00		6.0E-01						
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	1.00E+00		7.1E+01						
SVOC	Ethanol	64-17-5		1.00E+00						1.9E+01		
SVOC	Fluorene	86-73-7	D	1.00E+00	5.94E-06							
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		6.0E-02						
SVOC	Naphthalene	91-20-3	C	1.00E+00	1.50E-05	3.4E-02	3.0E-08	3.3E+02		3.0E-03	8.2E-04	1.2E+02
SVOC	Phenanthrene	85-01-8	D	1.00E+00	5.91E-06							
SVOC	Pyrene	129-00-0	NC	1.00E+00								
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00								
PCB	PCBs (total)	1336-36-3	B2	1.00E+00		5.7E-01						
INORG	Antimony	7440-36-0	ID	1.00E+00								
INORG	Arsenic	7440-38-2	A	1.00E+00		4.3E+00				1.5E-05		
INORG	Chromium III	16065-83-1	D	1.00E+00						5.0E-03		
INORG	Chromium VI	18540-29-9	A	1.00E+00		1.2E+01				1.0E-04		
INORG	Cyanide (total)	57-12-5		1.00E+00	2.07E-05					8.0E-04	4.2E-03	2.4E+01
INORG	Lead	7439-92-1	B2	1.00E+00								
INORG	Nickel	7440-02-0	A	1.00E+00		2.4E-01				9.0E-05		
INORG	Vanadium	7440-62-2	ID	1.00E+00						1.0E-04		

Attachment 2

Table 10:

Normalized Indoor Air Concentration in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	D_{air} (m^2/day)	D_{water} (m^2/day)	H (unitless)	D_{crack} (m^2/day)	D_{eff}^T (m^2/day)	α_{soil}	α_{slab}	α_{∞}	$C_{b, norm}$ (L-water/m^3)
VOC	Benzene	71-43-2	7.60E-01	8.47E-05	1.68E-01	8.24E-02	4.54E-04	9.96E-03	2.05E-03	2.04E-05	3.44E-03
VOC	Cumene	98-82-8	5.62E-01	6.13E-05	3.28E-01	6.09E-02	1.86E-04	4.11E-03	2.05E-03	8.43E-06	2.76E-03
VOC	1,2-Dibromoethane	106-93-4	3.72E-01	7.29E-05	2.37E-02	4.03E-02	1.76E-03	3.75E-02	2.05E-03	7.68E-05	1.82E-03
VOC	1,2-Dichloroethane	107-06-2	8.99E-01	8.55E-05	2.92E-02	9.74E-02	2.03E-03	4.31E-02	2.05E-03	8.84E-05	2.58E-03
VOC	Ethyl Benzene	100-41-4	6.48E-01	6.74E-05	2.20E-01	7.02E-02	2.91E-04	6.40E-03	2.05E-03	1.31E-05	2.88E-03
VOC	Methyl tert-butyl ether	1634-04-4	7.42E-01	8.73E-05	1.83E-02	8.04E-02	2.88E-03	6.00E-02	2.05E-03	1.23E-04	2.25E-03
VOC	Toluene	108-88-3	7.52E-01	7.43E-05	1.93E-01	8.15E-02	3.61E-04	7.94E-03	2.05E-03	1.63E-05	3.14E-03
VOC	1,2,4-Trimethylbenzene	95-63-6	5.24E-01	6.84E-05	1.61E-01	5.67E-02	3.72E-04	8.18E-03	2.05E-03	1.68E-05	2.70E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	5.20E-01	7.49E-05	1.54E-01	5.64E-02	4.17E-04	9.16E-03	2.05E-03	1.88E-05	2.89E-03
VOC	Xylenes (total)	1330-20-7	6.74E-01	7.56E-05	2.52E-01	7.30E-02	2.87E-04	6.32E-03	2.05E-03	1.30E-05	3.26E-03
SVOC	Acenaphthene	83-32-9	3.64E-01	6.64E-05	3.40E-03	3.95E-02	6.59E-03	1.27E-01	2.05E-03	2.61E-04	8.87E-04
SVOC	Anthracene	120-12-7	2.80E-01	6.69E-05	1.30E-03	3.05E-02	1.07E-02	1.92E-01	2.05E-03	3.93E-04	5.12E-04
SVOC	Benzo(a)anthracene	56-55-3	4.41E-01	7.78E-05	5.55E-05	5.10E-02	7.14E-02	6.13E-01	2.05E-03	1.26E-03	
SVOC	Benzo(a)pyrene	50-32-8	3.72E-01	7.78E-05	1.49E-05	5.23E-02	1.40E-01	7.56E-01	2.05E-03	1.55E-03	
SVOC	Benzo(b)fluoranthene	205-99-2	1.95E-01	4.80E-05	1.66E-03	2.12E-02	6.62E-03	1.28E-01	2.05E-03	2.62E-04	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.88E-01	4.54E-05	1.10E-05	2.99E-02	9.63E-02	6.81E-01	2.05E-03	1.40E-03	
SVOC	Benzo(k)fluoranthene	207-08-9	1.95E-01	4.80E-05	1.16E-05	3.08E-02	9.78E-02	6.84E-01	2.05E-03	1.40E-03	
SVOC	Chrysene	218-01-9	2.14E-01	5.37E-05	1.48E-03	2.33E-02	7.83E-03	1.48E-01	2.05E-03	3.03E-04	
SVOC	Dibenz(a,h)anthracene	53-70-3	1.75E-01	4.48E-05	9.57E-08	1.10E+00	7.36E+00	9.94E-01	2.05E-03	2.04E-03	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	6.91E-01	6.91E-05	1.03E-06	2.30E-01	1.18E+00	9.63E-01	2.05E-03	1.97E-03	
SVOC	Ethanol	64-17-5	1.06E+00	1.12E-04	1.96E-04	1.16E-01	7.21E-02	6.15E-01	2.05E-03	1.26E-03	
SVOC	Fluorene	86-73-7	3.14E-01	6.81E-05	1.39E-03	3.41E-02	1.10E-02	1.95E-01	2.05E-03	4.00E-04	5.56E-04
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.64E-01	4.89E-05	2.03E-05	2.34E-02	6.38E-02	5.86E-01	2.05E-03	1.20E-03	
SVOC	Naphthalene	91-20-3	5.10E-01	6.48E-05	1.20E-02	5.53E-02	2.91E-03	6.05E-02	2.05E-03	1.24E-04	1.49E-03
SVOC	Phenanthrene	85-01-8	3.24E-01	6.45E-05	1.41E-03	3.52E-02	1.07E-02	1.92E-01	2.05E-03	3.93E-04	5.52E-04
SVOC	Pyrene	129-00-0	2.35E-01	6.26E-05	2.00E-04	2.62E-02	2.48E-02	3.55E-01	2.05E-03	7.27E-04	
SVOC	Tetraethylene Glycol	112-60-7	4.39E-01	6.96E-05	1.62E-11	9.95E+03	6.72E+04	1.00E+00	5.32E-01	5.32E-01	
PCB	PCBs (total)	1336-36-3	1.75E-01	4.32E-05	6.64E-02	1.89E-02	4.40E-04	9.65E-03	2.05E-03	1.98E-05	
INORG	Antimony	7440-36-0									
INORG	Arsenic	7440-38-2									
INORG	Chromium III	16065-83-1									
INORG	Chromium VI	18540-29-9									
INORG	Cyanide (total)	57-12-5	1.35E+00	1.53E-04	1.97E-03	1.46E-01	2.55E-02	3.61E-01	2.05E-03	7.40E-04	1.46E-03
INORG	Lead	7439-92-1									
INORG	Nickel	7440-02-0									
INORG	Vanadium	7440-62-2									

Attachment 2

Table 10:

Normalized Indoor Air Concentration in a Default PADEP Nonresidential Building (Slab-On-Grade) Due to Vapor Intrusion from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Subsurface and Building Characteristics			**Crack Soil**
SCS Soil texture class			Sand
Bulk density	kg/L	ρ_b	1.66
Total porosity	L/L-soil	θ_T	0.375
Water-filled porosity	L/L-soil	θ_w	0.090
Air-filled porosity	L/L-soil	θ_a	0.285

Residual saturation	L/L-soil	θ_r	0.053
Hydraulic conductivity	cm/s	K	7.4E-03
Dynamic viscosity of water	g/cm-s	μ_w	0.01307
Density of water	g/cm^3	ρ_w	1.0
Gravitational acceleration	cm/s^2	g	980.7
Intrinsic permeability	cm^2	k	9.9E-08
Relative saturation	unitless	S_e	0.115
van Genuchten N	unitless	N	3.177
van Genuchten M	unitless	M	0.685
Relative air permeability	unitless	k_{rg}	0.887
Permeability to vapor	cm^2	k_v	8.79E-08
Distance from foundation to source	m	$L_{T\text{-}gw}$	0.66
Bldg foundation thickness	m	L_{crack}	0.1
Bldg foundation length	m		10.00
Bldg foundation width	m		10.00
Bldg occupied height	m		2.44
Bldg occupied volume	m^3		244.00
Occupied depth below ground	m		0.2
Bldg area for vapor intrusion	m^2	A_B	106.0
Ratio of A_{crack} to A_B		η	4E-04
Area of cracks	m^2	A_{crack}	4E-02
Air exchange rate	$hour^{-1}$	ach	0.60
Building ventilation rate	m^3/day	Q_{bldg}	3.5E+03
Pressure diff. outdoors-indoors	$kg/m\text{-}s^2$	ΔP	1.0
Viscosity of air	kg/m-s	μ_a	1.8E-05
Crack length (bldg perimeter)	m	X_{crack}	40
Crack depth below ground	m	Z_{crack}	0.25
Crack radius	m	r_{crack}	1E-03
Soil gas flow rate into bldg	m^3/day	Q_{soil}	7.20

Attachment 2
Table 11:
Unit Risk, Unit HQ, and RBSLs for Groundwater Vapor Intrusion into a Default PADEP Nonresidential Building (Slab-On-Grade)
Routine Worker
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Cancer			Noncancer		
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**C_{gw}** (mg/L)	**C_{air}** (mg/m^3)	**URF** (mg/m^3)$^{-1}$	**Risk**	**RBSL** (mg/L)	**RfC** (mg/m^3)	**HQ**	**RBSL** (mg/L)
VOC	Benzene	71-43-2	A	1.00E+00	3.44E-03	7.8E-03	2.2E-06	4.6E+00	3.0E-02	2.6E-02	3.8E+00
VOC	Cumene	98-82-8	D	1.00E+00	2.76E-03				4.0E-01	1.6E-03	6.3E+01
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	1.82E-03	6.0E-01	8.9E-05	1.1E-01	9.0E-03	4.6E-02	2.2E+00
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	2.58E-03	2.6E-02	5.5E-06	1.8E+00	7.0E-03	8.4E-02	1.2E+00
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	2.88E-03				1.0E+00	6.6E-04	1.5E+02
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	2.25E-03	2.6E-04	4.8E-08	2.1E+02	3.0E+00	1.7E-04	5.8E+02
VOC	Toluene	108-88-3	ID	1.00E+00	3.14E-03				5.0E+00	1.4E-04	7.0E+02
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	2.70E-03				6.0E-02	1.0E-02	9.7E+00
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	2.89E-03				6.0E-02	1.1E-02	9.1E+00
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	3.26E-03				1.0E-01	7.4E-03	1.3E+01
SVOC	Acenaphthene	83-32-9	ID	1.00E+00	8.87E-04						
SVOC	Anthracene	120-12-7	ID	1.00E+00	5.12E-04						
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		6.0E-02					
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		6.0E-01			2.0E-06		
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		6.0E-02					
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00							
SVOC	Benzo(k)fluoranthene	207-08-9	B2	1.00E+00		6.0E-03					
SVOC	Chrysene	218-01-9	B2	1.00E+00		6.0E-04					
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	1.00E+00		6.0E-01					
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	1.00E+00		7.1E+01					
SVOC	Ethanol	64-17-5		1.00E+00					1.9E+01		
SVOC	Fluorene	86-73-7	D	1.00E+00	5.56E-04						
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		6.0E-02					
SVOC	Naphthalene	91-20-3	C	1.00E+00	1.49E-03	3.4E-02	4.1E-06	2.4E+00	3.0E-03	1.1E-01	8.8E-01
SVOC	Phenanthrene	85-01-8	D	1.00E+00	5.52E-04						
SVOC	Pyrene	129-00-0	NC	1.00E+00							
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00							
PCB	PCBs (total)	1336-36-3	B2	1.00E+00		5.7E-01					
INORG	Antimony	7440-36-0	ID	1.00E+00							
INORG	Arsenic	7440-38-2	A	1.00E+00		4.3E+00			1.5E-05		
INORG	Chromium III	16065-83-1	D	1.00E+00					5.0E-03		
INORG	Chromium VI	18540-29-9	A	1.00E+00		1.2E+01			1.0E-04		
INORG	Cyanide (total)	57-12-5		1.00E+00	1.46E-03				8.0E-04	4.2E-01	2.4E-01
INORG	Lead	7439-92-1	B2	1.00E+00							

Attachment 2

Table 11:

Unit Risk, Unit HQ, and RBSLs for Groundwater Vapor Intrusion into a Default PADEP Nonresidential Building (Slab-On-Grade)

Routine Worker

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Cancer			Noncancer		
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**C_{gw}** (mg/L)	**C_{air}** (mg/m^3)	**URF** (mg/m^3)$^{-1}$	**Risk**	**RBSL** (mg/L)	**RfC** (mg/m^3)	**HQ**	**RBSL** (mg/L)
INORG	Nickel	7440-02-0	A	1.00E+00		2.4E-01			9.0E-05		
INORG	Vanadium	7440-62-2	ID	1.00E+00					1.0E-04		

Notes:

Cancer RBSLs are calculated at a target cancer risk of 1E-05.

Noncancer RBSLs are calculated at a target HQ of 0.1.

Attachment 2
Table 12:
Blood Lead Model for Adult Exposure to Lead in Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania
Soil Ingestion

Soil Pb concentration		mg-Pb/kg-soil	2,518
Gastrointestinal absorption	**AF**	unitless	0.12
Ingestion rate	**IR**	mg-soil/day	50
Conversion factor		kg/mg	1E-06
Exposure frequency	**EF**	days/year	219
Averaging time	**AT**	days	365

Baseline blood lead	$\mathbf{PbB_{baseline}}$	ug-Pb/dL	0.6
Biokinetic slope factor	**BSF**	ug-Pb/dL per ug-Pb/day	0.4
Geometric std deviation	**GSD**		1.8

Blood lead goal	$\mathbf{PbB_{goal}}$	ug-Pb/dL	10

Soil Pb to meet PbB_{goal} at specific percentiles	**z**	**Percentile**	**Soil Pb** (mg/kg)
	0.000	**50**	**7,299**
	0.674	75	4,774
	1.036	85	3,779
	1.282	90	3,216
	1.645	**95**	**2,518**
	2.054	98	1,891
	2.326	99	1,549

Notes:
The model is adapted from the methodology provided in *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks associated with Adult Exposure to Lead in Soil* (USEPA 2003), including *Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters* (USEPA 2017).
The shaded value represents the screening level.

Attachment 3

Construction Worker Risk Based Screening Level Calculations

Table 1 – Normalized Average Vapor Flux from Soil to Outdoor Air

Table 2 – Dispersion Factor to Outdoor Air

Table 3 – Concentrations in Outdoor Air from Soil

Table 4a – Unit Risk and Cancer-Based RBSLs for Exposure of Construction Workers to Soil

Table 4b – Unit HQ and Noncancer-Based RBSLs for Exposure of Construction Workers to Soil

Table 5 – Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations

Table 6 – Dermal Absorbed Dose for Groundwater

Table 7a – Unit Risk and Cancer-Based RBSLs for Exposure of Construction Workers to Groundwater in Excavations

Table 7b – Unit HQ and Noncancer-Based RBSLs for Exposure of Construction Workers to Groundwater in Excavations

Attachment 3
Table 1:
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	D_{air} (m^2/d)	D_{water} (m^2/d)	D_G (m^2/d)	D_L (m^2/d)	D_E (m^2/d)	J_v (kg/m^2-s)
VOC	Benzene	71-43-2	5.82E+01		1.68E-01	7.60E-01	8.47E-05	1.23E-01	3.46E-08	3.51E-02	1.79E-04
VOC	Cumene	98-82-8	7.05E+02		3.28E-01	5.62E-01	6.13E-05	9.10E-02	2.51E-08	4.96E-03	7.98E-05
VOC	1,2-Dibromoethane	106-93-4	2.22E+01		2.37E-02	3.72E-01	7.29E-05	6.02E-02	2.98E-08	5.83E-03	8.65E-05
VOC	1,2-Dichloroethane	107-06-2	1.75E+01		2.92E-02	8.99E-01	8.55E-05	1.46E-01	3.50E-08	2.04E-02	1.50E-04
VOC	Ethyl Benzene	100-41-4	3.67E+02		2.20E-01	6.48E-01	6.74E-05	1.05E-01	2.76E-08	7.27E-03	9.63E-05
VOC	Methyl tert-butyl ether	1634-04-4	1.15E+01		1.83E-02	7.42E-01	8.73E-05	1.20E-01	3.57E-08	1.43E-02	1.31E-04
VOC	Toluene	108-88-3	1.80E+02		1.93E-01	7.52E-01	7.43E-05	1.22E-01	3.04E-08	1.46E-02	1.32E-04
VOC	1,2,4-Trimethylbenzene	95-63-6	8.97E+02		1.61E-01	5.24E-01	6.84E-05	8.48E-02	2.80E-08	1.81E-03	4.83E-05
VOC	1,3,5-Trimethylbenzene	108-67-8	1.76E+03		1.54E-01	5.20E-01	7.49E-05	8.42E-02	3.06E-08	8.81E-04	3.37E-05
VOC	Xylenes (total)	1330-20-7	3.86E+02		2.52E-01	6.74E-01	7.56E-05	1.09E-01	3.09E-08	8.23E-03	1.02E-04
SVOC	Acenaphthene	83-32-9	7.14E+03		3.40E-03	3.64E-01	6.64E-05	5.89E-02	2.72E-08	3.38E-06	2.09E-06
SVOC	Anthracene	120-12-7	2.97E+04		1.30E-03	2.80E-01	6.69E-05	4.53E-02	2.74E-08	2.40E-07	5.56E-07
SVOC	Benzo(a)anthracene	56-55-3	4.01E+05		5.55E-05	4.41E-01	7.78E-05	7.14E-02	3.18E-08	1.20E-09	
SVOC	Benzo(a)pyrene	50-32-8	1.01E+06		1.49E-05	3.72E-01	7.78E-05	6.02E-02	3.18E-08	1.11E-10	
SVOC	Benzo(b)fluoranthene	205-99-2	1.24E+06		1.66E-03	1.95E-01	4.80E-05	3.16E-02	1.97E-08	5.08E-09	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.28E+07		1.10E-05	1.88E-01	4.54E-05	3.04E-02	1.86E-08	3.32E-12	
SVOC	Benzo(k)fluoranthene	207-08-9	1.24E+06		1.16E-05	1.95E-01	4.80E-05	3.16E-02	1.97E-08	3.73E-11	
SVOC	Chrysene	218-01-9	4.01E+05		1.48E-03	2.14E-01	5.37E-05	3.47E-02	2.20E-08	1.54E-08	
SVOC	Dibenz(a,h)anthracene	53-70-3	3.77E+06		9.57E-08	1.75E-01	4.48E-05	2.83E-02	1.83E-08	6.71E-13	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	5.03E+05		1.03E-06	6.91E-01	6.91E-05	1.12E-01	2.83E-08	3.45E-11	
SVOC	Ethanol	64-17-5	6.81E-01		1.96E-04	1.06E+00	1.12E-04	1.72E-01	4.60E-08	5.71E-04	
SVOC	Fluorene	86-73-7	1.38E+04		1.39E-03	3.14E-01	6.81E-05	5.08E-02	2.79E-08	6.17E-07	8.91E-07
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	3.45E+06		2.03E-05	1.64E-01	4.89E-05	2.66E-02	2.00E-08	1.96E-11	
SVOC	Naphthalene	91-20-3	2.01E+03		1.20E-02	5.10E-01	6.48E-05	8.26E-02	2.65E-08	5.94E-05	8.75E-06
SVOC	Phenanthrene	85-01-8	2.42E+04		1.41E-03	3.24E-01	6.45E-05	5.25E-02	2.64E-08	3.67E-07	6.87E-07
SVOC	Pyrene	129-00-0	1.06E+05		2.00E-04	2.35E-01	6.26E-05	3.81E-02	2.56E-08	8.73E-09	
SVOC	Tetraethylene Glycol	112-60-7	3.00E-02		1.62E-11	4.39E-01	6.96E-05	7.11E-02	2.85E-08	5.30E-07	
PCB	PCBs (total)	1336-36-3	2.45E+06		6.64E-02	1.75E-01	4.32E-05	2.83E-02	1.77E-08	9.22E-08	
INORG	Antimony	7440-36-0		4.50E+01							
INORG	Arsenic	7440-38-2		2.90E+01							
INORG	Chromium III	16065-83-1		1.80E+06							
INORG	Chromium VI	18540-29-9		1.90E+01							
INORG	Cyanide (total)	57-12-5		9.90E+00	1.97E-03	1.35E+00	1.53E-04	2.18E-01	6.26E-08	2.61E-05	5.80E-06
INORG	Lead	7439-92-1		9.00E+02							
INORG	Nickel	7440-02-0		6.50E+01							
INORG	Vanadium	7440-62-2		1.00E+03							

Attachment 3
Table 1:
Normalized Average Vapor Flux from Soil to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Soil bulk density	kg/L	ρ_b	1.66
Soil porosity	L/L-soil	θ	0.38
Soil water content	L/L-soil	θ_w	0.05
Soil air-filled porosity	L/L-soil	θ_a	0.32
Soil organic carbon fraction	unitless	f_{oc}	0.005
Averaging period (Exposure Duration)	years	**T**	1
	days	**T**	365
Temperature	^oC	**Temp**	18
Clean soil above source	m	Z_1	
Bottom of source depth	m	Z_2	5.79

Based on the volatilization model developed by Jury et. al. (1983) for finite sources as described in USEPA's (1996) Soil Screening Guidance: Technical Background Document.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 3
Table 2:
Dispersion Factor to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Parameter	Units	Value
Correlation coefficient city		Philadelphia
Correlation coefficient A		14.0111
Correlation coefficient B		19.6154
Correlation coefficient C		225.3397

Soil source area	acres	70.6
Soil C/Q averaging time		Annual Max
Conversion factor from 1-Hr Max for soil		0.19
C/Q for soil	$(kg/m^3)/(kg/m^2\text{-}s)$	**25.06**

Groundwater source area	acres	0.0052
Groundwater averaging time for C/Q		24-Hour Max
Conversion factor from 1-Hr Max for groundwater		0.40
C/Q for Groundwater	$(L/m^3)/(L/m^2\text{-}s)$	**9.63**

Note:
C/Q is estimated using the empirical correlation in USEPA's (2002) Supplemental Soil Screening Guidance.

Attachment 3
Table 3:
Concentrations in Outdoor Air from Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

			Vapor		PM_{10}	
		C/Q (kg/m^3 per kg/m^2-s):	2.5E+01			
Chem Chem	**Chemical**	**CASRN**	C_{soil} (mg/kg)	C_{air} (mg/m^3)	C_{soil} (mg/kg)	C_{air} (mg/m^3)
VOC	Benzene	71-43-2	1.00E+00	4.49E-03	1.00E+00	5.00E-08
VOC	Cumene	98-82-8	1.00E+00	2.00E-03	1.00E+00	5.00E-08
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	2.17E-03	1.00E+00	5.00E-08
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	3.76E-03	1.00E+00	5.00E-08
VOC	Ethyl Benzene	100-41-4	1.00E+00	2.41E-03	1.00E+00	5.00E-08
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	3.27E-03	1.00E+00	5.00E-08
VOC	Toluene	108-88-3	1.00E+00	3.30E-03	1.00E+00	5.00E-08
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	1.21E-03	1.00E+00	5.00E-08
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	8.44E-04	1.00E+00	5.00E-08
VOC	Xylenes (total)	1330-20-7	1.00E+00	2.56E-03	1.00E+00	5.00E-08
SVOC	Acenaphthene	83-32-9	1.00E+00	5.22E-05	1.00E+00	5.00E-08
SVOC	Anthracene	120-12-7	1.00E+00	1.39E-05	1.00E+00	5.00E-08
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.00E+00	5.00E-08
SVOC	Benzo(k)fluoranthene	207-08-9	1.00E+00		1.00E+00	5.00E-08
SVOC	Chrysene	218-01-9	1.00E+00		1.00E+00	5.00E-08
SVOC	Dibenz(a,h)anthracene	53-70-3	1.00E+00		1.00E+00	5.00E-08
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.00E+00		1.00E+00	5.00E-08
SVOC	Ethanol	64-17-5	1.00E+00		1.00E+00	5.00E-08
SVOC	Fluorene	86-73-7	1.00E+00	2.23E-05	1.00E+00	5.00E-08
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.00E+00	5.00E-08
SVOC	Naphthalene	91-20-3	1.00E+00	2.19E-04	1.00E+00	5.00E-08
SVOC	Phenanthrene	85-01-8	1.00E+00	1.72E-05	1.00E+00	5.00E-08
SVOC	Pyrene	129-00-0	1.00E+00		1.00E+00	5.00E-08
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.00E+00	5.00E-08
PCB	PCBs (total)	1336-36-3	1.00E+00		1.00E+00	5.00E-08
INORG	Antimony	7440-36-0	1.00E+00		1.00E+00	5.00E-08
INORG	Arsenic	7440-38-2	1.00E+00		1.00E+00	5.00E-08
INORG	Chromium III	16065-83-1	1.00E+00		1.00E+00	5.00E-08
INORG	Chromium VI	18540-29-9	1.00E+00		1.00E+00	5.00E-08
INORG	Cyanide (total)	57-12-5	1.00E+00	1.45E-04	1.00E+00	5.00E-08
INORG	Lead	7439-92-1	1.00E+00		1.00E+00	5.00E-08
INORG	Nickel	7440-02-0	1.00E+00		1.00E+00	5.00E-08
INORG	Vanadium	7440-62-2	1.00E+00		1.00E+00	5.00E-08

Attachment 3
Table 4a:
Unit Risk and Cancer-Based RBSLs for Exposure of Construction Worker to Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

					Soil Ingestion					Soil Dermal Contact					Soil Vapor Inhalation				Soil Particulate Inhalation				All Routes	
Chem Group	Chemical	CASRN	Cancer Class	C_{soil} (mg/kg)	RBA	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	Risk	RBSL (mg/kg)	ABS_{derm}	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	Risk	RBSL (mg/kg)	C_{air} (mg/m^3)	URF (m^3/mg)	Risk	RBSL (mg/kg)	C_{air} (mg/m^3)	URF $(m^3/m^3)^{-1}$	Risk	RBSL (mg/kg)	Risk	RBSL (mg/kg)
VOC	Benzene	71-43-2	A	1.00E+00		2.45E-08	5.5E-02	1.3E-09	7.4E+03			5.5E-02			4.49E-03	7.8E-03	1.1E-07	8.8E+01	5.00E-08	7.8E-03	1.3E-12	7.9E+06	1.2E-07	8.7E+01
VOC	Cumene	98-82-8	D	1.00E+00		2.45E-08									2.00E-03				5.00E-08					
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00		2.45E-08	2.0E+00	4.9E-08	2.0E+02			2.0E+00			2.17E-03	6.0E-01	4.2E-06	2.4E+00	5.00E-08	6.0E-01	9.8E-11	1.0E+05	4.3E-06	2.3E+00
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00		2.45E-08	9.1E-02	2.2E-09	4.5E+03			9.1E-02			3.76E-03	2.6E-02	3.2E-07	3.1E+01	5.00E-08	2.6E-02	4.2E-12	2.4E+06	3.2E-07	3.1E+01
VOC	Ethyl Benzene	100-41-4	D	1.00E+00		2.45E-08									2.41E-03				5.00E-08					
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00		2.45E-08	1.8E-03	4.4E-11	2.3E+05			1.8E-03			3.27E-03	2.6E-04	2.8E-09	3.6E+03	5.00E-08	2.6E-04	4.2E-14	2.4E+08	2.8E-09	3.5E+03
VOC	Toluene	108-88-3	ID	1.00E+00		2.45E-08									3.30E-03				5.00E-08					
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00		2.45E-08									1.21E-03				5.00E-08					
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00		2.45E-08									8.44E-04				5.00E-08					
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00		2.45E-08									2.56E-03				5.00E-08					
SVOC	Acenaphthene	83-32-9	ID	1.00E+00		2.45E-08				1.30E-01	6.73E-09				5.22E-05				5.00E-08					
SVOC	Anthracene	120-12-7	ID	1.00E+00		2.45E-08				1.30E-01	6.73E-09				1.39E-05				5.00E-08					
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		2.45E-08	1.0E-01	2.4E-09	4.1E+03	1.30E-01	6.73E-09	1.0E-01	6.7E-10	1.5E+04		6.0E-02			5.00E-08	6.0E-02	9.8E-12	1.0E+06	3.1E-09	3.2E+03
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		2.45E-08	1.0E+00	2.4E-08	4.1E+02	1.30E-01	6.73E-09	1.0E+00	6.7E-09	1.5E+03		6.0E-01			5.00E-08	6.0E-01	9.8E-11	1.0E+05	3.1E-08	3.2E+02
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		2.45E-08	1.0E-01	2.4E-09	4.1E+03	1.30E-01	6.73E-09	1.0E-01	6.7E-10	1.5E+04		6.0E-02			5.00E-08	6.0E-02	9.8E-12	1.0E+06	3.1E-09	3.2E+03
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00		2.45E-08				1.30E-01	6.73E-09								5.00E-08					
SVOC	Benzo(k)fluoranthene	207-08-9	B2	1.00E+00		2.45E-08	1.0E-02	2.4E-10	4.1E+04	1.30E-01	6.73E-09	1.0E-02	6.7E-11	1.5E+05		6.0E-03			5.00E-08	6.0E-03	9.8E-13	1.0E+07	3.1E-10	3.2E+04
SVOC	Chrysene	218-01-9	B2	1.00E+00		2.45E-08	1.0E-03	2.4E-11	4.1E+05	1.30E-01	6.73E-09	1.0E-03	6.7E-12	1.5E+06		6.0E-04			5.00E-08	6.0E-04	9.8E-14	1.0E+08	3.1E-11	3.2E+05
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	1.00E+00		2.45E-08	1.0E+00	2.4E-08	4.1E+02	1.30E-01	6.73E-09	1.0E+00	6.7E-09	1.5E+03		6.0E-01			5.00E-08	6.0E-01	9.8E-11	1.0E+05	3.1E-08	3.2E+02
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	1.00E+00		2.45E-08	2.5E+02	6.1E-06	1.6E+00	1.00E-01	5.18E-09	2.5E+02	1.3E-06	7.7E+00		7.1E+01			5.00E-08	7.1E+01	1.2E-08	8.6E+02	7.4E-06	1.3E+00
SVOC	Ethanol	64-17-5		1.00E+00		2.45E-08													5.00E-08					
SVOC	Fluorene	86-73-7	D	1.00E+00		2.45E-08				1.30E-01	6.73E-09				2.23E-05				5.00E-08					
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		2.45E-08	1.0E-01	2.4E-09	4.1E+03	1.30E-01	6.73E-09	1.0E-01	6.7E-10	1.5E+04		6.0E-02			5.00E-08	6.0E-02	9.8E-12	1.0E+06	3.1E-09	3.2E+03
SVOC	Naphthalene	91-20-3	C	1.00E+00		2.45E-08	1.2E-01	2.9E-09	3.4E+03	1.30E-01	6.73E-09	1.2E-01	8.1E-10	1.2E+04	2.19E-04	3.4E-02	2.4E-08	4.1E+02	5.00E-08	3.4E-02	5.5E-12	1.8E+06	2.8E-08	3.6E+02
SVOC	Phenanthrene	85-01-8	D	1.00E+00		2.45E-08				1.30E-01	6.73E-09				1.72E-05				5.00E-08					
SVOC	Pyrene	129-00-0	NC	1.00E+00		2.45E-08				1.30E-01	6.73E-09								5.00E-08					
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00		2.45E-08				1.00E-01	5.18E-09								5.00E-08					
PCB	PCBs (total)	1336-36-3	B2	1.00E+00		2.45E-08	2.0E+00	4.9E-08	2.0E+02	1.40E-01	7.25E-09	2.0E+00	1.4E-08	6.9E+02		5.7E-01			5.00E-08	5.7E-01	9.3E-11	1.1E+05	6.4E-08	1.6E+02
INORG	Antimony	7440-36-0	ID	1.00E+00		2.45E-08													5.00E-08					
INORG	Arsenic	7440-38-2	A	1.00E+00	0.6	2.45E-08	1.5E+00	2.2E-08	4.5E+02	3.00E-02	1.55E-09	1.5E+00	2.3E-09	4.3E+03		4.3E+00			5.00E-08	4.3E+00	7.0E-10	1.4E+04	2.5E-08	4.0E+02
INORG	Chromium III	16065-83-1	D	1.00E+00		2.45E-08													5.00E-08					
INORG	Chromium VI	18540-29-9	A	1.00E+00		2.45E-08	5.0E-01	1.2E-08	8.2E+02			2.0E+01				1.2E+01			5.00E-08	1.2E+01	2.0E-09	5.1E+03	1.4E-08	7.0E+02
INORG	Cyanide (total)	57-12-5		1.00E+00		2.45E-08									1.45E-04				5.00E-08					
INORG	Lead	7439-92-1	B2	1.00E+00		2.45E-08													5.00E-08					
INORG	Nickel	7440-02-0	A	1.00E+00		2.45E-08										2.4E-01			5.00E-08	2.4E-01	3.9E-11	2.6E+05	3.9E-11	2.6E+05
INORG	Vanadium	7440-62-2	ID	1.00E+00		2.45E-08													5.00E-08					

Notes:
The concentration of particulates in the air is assumed to be no more than the former annual National Ambient Air Quality Standards (NAAQS) for PM_{10} of 50 ug/m^3.
Cancer RBSLs are calculated at a target cancer risk of 1E-05.

Attachment 3
Table 4b:
Unit HQ and Noncancer-Based RBSLs for Exposure of Construction Worker to Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Soil Ingestion					Soil Dermal Contact					Soil Vapor Inhalation				Soil Particulate Inhalation				All Routes	
Chem Group	Chemical	CASRN	C_{soil} (mg/kg)	RBA	ADD (mg/kg/d)	RfD_{oral} (mg/kg/d)	HQ	RBSL (mg/kg)	ABS_{derm}	ADD (mg/kg/d)	RfD_{derm} (mg/kg/d)	HQ	RBSL (mg/kg)	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	RBSL (mg/kg)	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	RBSL (mg/kg)	HQ	RBSL (mg/kg)
VOC	Benzene	71-43-2	1.00E+00		1.71E-06	1.0E-02	1.7E-04	5.8E+02			1.0E-02			4.49E-03	9.0E-02	1.1E-02	8.8E+00	5.00E-08	9.0E-02	1.3E-07	7.9E+05	1.2E-02	8.7E+00
VOC	Cumene	98-82-8	1.00E+00		1.71E-06	4.0E-01	4.3E-06	2.3E+04			4.0E-01			2.00E-03	4.0E-01	1.1E-03	8.8E+01	5.00E-08	4.0E-01	2.9E-08	3.5E+06	1.1E-03	8.7E+01
VOC	1,2-Dibromoethane	106-93-4	1.00E+00		1.71E-06	9.0E-03	1.9E-04	5.3E+02			9.0E-03			2.17E-03	9.0E-03	5.5E-02	1.8E+00	5.00E-08	9.0E-03	1.3E-06	7.9E+04	5.5E-02	1.8E+00
VOC	1,2-Dichloroethane	107-06-2	1.00E+00		1.71E-06	2.0E-02	8.6E-05	1.2E+03			2.0E-02			3.76E-03	7.0E-02	1.2E-02	8.1E+00	5.00E-08	7.0E-02	1.6E-07	6.1E+05	1.2E-02	8.1E+00
VOC	Ethyl Benzene	100-41-4	1.00E+00		1.71E-06	1.0E-01	1.7E-05	5.8E+03			1.0E-01			2.41E-03	9.0E+00	6.1E-05	1.6E+03	5.00E-08	9.0E+00	1.3E-09	7.9E+07	7.8E-05	1.3E+03
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00		1.71E-06	3.0E-01	5.7E-06	1.8E+04			3.0E-01			3.27E-03	3.0E+00	2.5E-04	4.0E+02	5.00E-08	3.0E+00	3.8E-09	2.6E+07	2.5E-04	3.9E+02
VOC	Toluene	108-88-3	1.00E+00		1.71E-06	8.0E-01	2.1E-06	4.7E+04			8.0E-01			3.30E-03	5.0E+00	1.5E-04	6.6E+02	5.00E-08	5.0E+00	2.3E-09	4.4E+07	1.5E-04	6.5E+02
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00		1.71E-06	4.0E-02	4.3E-05	2.3E+03			4.0E-02			1.21E-03	2.0E-01	1.4E-03	7.2E+01	5.00E-08	2.0E-01	5.7E-08	1.8E+06	1.4E-03	7.0E+01
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00		1.71E-06	4.0E-02	4.3E-05	2.3E+03			4.0E-02			8.44E-04	2.0E-01	9.6E-04	1.0E+02	5.00E-08	2.0E-01	5.7E-08	1.8E+06	1.0E-03	9.9E+01
VOC	Xylenes (total)	1330-20-7	1.00E+00		1.71E-06	2.0E-01	8.6E-06	1.2E+04			2.0E-01			2.56E-03	3.0E-01	1.9E-03	5.1E+01	5.00E-08	3.0E-01	3.8E-08	2.6E+06	2.0E-03	5.1E+01
SVOC	Acenaphthene	83-32-9	1.00E+00		1.71E-06	2.0E-01	8.6E-06	1.2E+04	1.30E-01	4.71E-07	2.0E-01	2.4E-06	4.2E+04	5.22E-05				5.00E-08				1.1E-05	9.2E+03
SVOC	Anthracene	120-12-7	1.00E+00		1.71E-06	1.0E+00	1.7E-06	5.8E+04	1.30E-01	4.71E-07	1.0E+00	4.7E-07	2.1E+05	1.39E-05				5.00E-08				2.2E-06	4.6E+04
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00		1.71E-06				1.30E-01	4.71E-07								5.00E-08					
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00		1.71E-06	3.0E-04	5.7E-03	1.8E+01	1.30E-01	4.71E-07	3.0E-04	1.6E-03	6.4E+01		2.0E-06			5.00E-08	2.0E-06	5.7E-03	1.8E+01	1.3E-02	7.7E+00
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00		1.71E-06				1.30E-01	4.71E-07								5.00E-08					
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00		1.71E-06	3.0E-01	5.7E-06	1.8E+04	1.30E-01	4.71E-07	3.0E-01	1.6E-06	6.4E+04					5.00E-08				7.3E-06	1.4E+04
SVOC	Benzo(k)fluoranthene	207-08-9	1.00E+00		1.71E-06				1.30E-01	4.71E-07								5.00E-08					
SVOC	Chrysene	218-01-9	1.00E+00		1.71E-06				1.30E-01	4.71E-07								5.00E-08					
SVOC	Dibenz(a,h)anthracene	53-70-3	1.00E+00		1.71E-06				1.30E-01	4.71E-07								5.00E-08					
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.00E+00		1.71E-06				1.00E-01	3.62E-07								5.00E-08					
SVOC	Ethanol	64-17-5	1.00E+00		1.71E-06	6.2E+01	2.8E-08	3.6E+06			6.2E+01				1.9E+01			5.00E-08	1.9E+01	6.0E-10	1.7E+08	2.8E-08	3.5E+06
SVOC	Fluorene	86-73-7	1.00E+00		1.71E-06	4.0E-01	4.3E-06	2.3E+04	1.30E-01	4.71E-07	4.0E-01	1.2E-06	8.5E+04	2.23E-05				5.00E-08				5.5E-06	1.8E+04
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00		1.71E-06				1.30E-01	4.71E-07								5.00E-08					
SVOC	Naphthalene	91-20-3	1.00E+00		1.71E-06	2.0E-01	8.6E-06	1.2E+04	1.30E-01	4.71E-07	2.0E-01	2.4E-06	4.2E+04	2.19E-04	3.0E-03	1.7E-02	6.0E+00	5.00E-08	3.0E-03	3.8E-06	2.6E+04	1.7E-02	6.0E+00
SVOC	Phenanthrene	85-01-8	1.00E+00		1.71E-06	3.0E-01	5.7E-06	1.8E+04	1.30E-01	4.71E-07	3.0E-01	1.6E-06	6.4E+04	1.72E-05				5.00E-08				7.3E-06	1.4E+04
SVOC	Pyrene	129-00-0	1.00E+00		1.71E-06	3.0E-01	5.7E-06	1.8E+04	1.30E-01	4.71E-07	3.0E-01	1.6E-06	6.4E+04					5.00E-08				7.3E-06	1.4E+04
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00		1.71E-06	2.0E+00	8.6E-07	1.2E+05	1.00E-01	3.62E-07	2.0E+00	1.8E-07	5.5E+05					5.00E-08				1.0E-06	9.6E+04
PCB	PCBs (total)	1336-36-3	1.00E+00		1.71E-06	5.0E-05	3.4E-02	2.9E+00	1.40E-01	5.07E-07	5.0E-05	1.0E-02	9.9E+00					5.00E-08				4.4E-02	2.3E+00
INORG	Antimony	7440-36-0	1.00E+00		1.71E-06	4.0E-04	4.3E-03	2.3E+01			6.0E-05							5.00E-08				4.3E-03	2.3E+01
INORG	Arsenic	7440-38-2	1.00E+00	0.6	1.71E-06	5.0E-03	2.1E-04	4.9E+02	3.00E-02	1.09E-07	5.0E-03	2.2E-05	4.6E+03		1.5E-05			5.00E-08	1.5E-05	7.6E-04	1.3E+02	9.9E-04	1.0E+02
INORG	Chromium III	16065-83-1	1.00E+00		1.71E-06	1.5E+00	1.1E-06	8.8E+04			2.0E-02				5.0E-03			5.00E-08	5.0E-03	2.3E-06	4.4E+04	3.4E-06	2.9E+04
INORG	Chromium VI	18540-29-9	1.00E+00		1.71E-06	5.0E-03	3.4E-04	2.9E+02			1.3E-04				1.0E-03			5.00E-08	1.0E-03	1.1E-05	8.8E+03	3.5E-04	2.8E+02
INORG	Cyanide (total)	57-12-5	1.00E+00		1.71E-06	6.0E-03	2.9E-04	3.5E+02			6.0E-03			1.45E-04	3.0E-03	1.1E-02	9.0E+00	5.00E-08	3.0E-03	3.8E-06	2.6E+04	1.1E-02	8.8E+00
INORG	Lead	7439-92-1	1.00E+00		1.71E-06													5.00E-08					
INORG	Nickel	7440-02-0	1.00E+00		1.71E-06	2.0E-02	8.6E-05	1.2E+03			8.0E-04				2.0E-04			5.00E-08	2.0E-04	5.7E-05	1.8E+03	1.4E-04	7.0E+02
INORG	Vanadium	7440-62-2	1.00E+00		1.71E-06	1.0E-02	1.7E-04	5.8E+02			2.6E-04				1.0E-04			5.00E-08	1.0E-04	1.1E-04	8.8E+02	2.9E-04	3.5E+02

Notes:
The concentration of particulates in the air is assumed to be no more than the former annual National Ambient Air Quality Standards (NAAQS) for PM_{10} of 50 ug/m^3.
Noncancer RBSLs are calculated at a target HQ of 0.1.

Attachment 3
Table 5:
Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	H (unitless)	MW (g/mol)	k_G (cm/s)	k_L (cm/s)	$1/K_L$ (s/cm)	K_L (cm/s)	J_L (L/m^2-s)
VOC	Benzene	71-43-2	1.7E-01	7.8E+01	4.97E-01	1.25E-03	8.12E+02	1.23E-03	1.23E-02
VOC	Cumene	98-82-8	3.3E-01	1.2E+02	4.31E-01	1.01E-03	9.99E+02	1.00E-03	1.00E-02
VOC	1,2-Dibromoethane	106-93-4	2.4E-02	1.9E+02	3.71E-01	8.06E-04	1.35E+03	7.38E-04	7.38E-03
VOC	1,2-Dichloroethane	107-06-2	2.9E-02	9.9E+01	4.60E-01	1.11E-03	9.75E+02	1.03E-03	1.03E-02
VOC	Ethyl Benzene	100-41-4	2.2E-01	1.1E+02	4.49E-01	1.07E-03	9.43E+02	1.06E-03	1.06E-02
VOC	Methyl tert-butyl ether	1634-04-4	1.8E-02	8.8E+01	4.78E-01	1.18E-03	9.64E+02	1.04E-03	1.04E-02
VOC	Toluene	108-88-3	1.9E-01	9.2E+01	4.71E-01	1.15E-03	8.80E+02	1.14E-03	1.14E-02
VOC	1,2,4-Trimethylbenzene	95-63-6	1.6E-01	1.2E+02	4.31E-01	1.01E-03	1.01E+03	9.93E-04	9.93E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	1.5E-01	1.2E+02	4.31E-01	1.01E-03	1.01E+03	9.93E-04	9.93E-03
VOC	Xylenes (total)	1330-20-7	2.5E-01	1.1E+02	4.49E-01	1.07E-03	9.42E+02	1.06E-03	1.06E-02
SVOC	Acenaphthene	83-32-9	3.4E-03	1.5E+02	3.96E-01	8.90E-04	1.87E+03	5.36E-04	5.36E-03
SVOC	Anthracene	120-12-7	1.3E-03	1.8E+02	3.77E-01	8.28E-04	3.24E+03	3.09E-04	3.09E-03
SVOC	Benzo(a)anthracene	56-55-3	5.6E-05	2.3E+02	3.47E-01	7.31E-04	5.32E+04	1.88E-05	
SVOC	Benzo(a)pyrene	50-32-8	1.5E-05	2.5E+02	3.36E-01	6.96E-04	2.01E+05	4.98E-06	
SVOC	Benzo(b)fluoranthene	205-99-2	1.7E-03	2.5E+02	3.36E-01	6.96E-04	3.23E+03	3.09E-04	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.1E-05	2.8E+02	3.26E-01	6.65E-04	2.81E+05	3.56E-06	
SVOC	Benzo(k)fluoranthene	207-08-9	1.2E-05	2.5E+02	3.36E-01	6.96E-04	2.59E+05	3.86E-06	
SVOC	Chrysene	218-01-9	1.5E-03	2.3E+02	3.47E-01	7.31E-04	3.31E+03	3.02E-04	
SVOC	Dibenz(a,h)anthracene	53-70-3	9.6E-08	2.8E+02	3.25E-01	6.62E-04	3.22E+07	3.11E-08	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.0E-06	2.6E+02	3.34E-01	6.90E-04	2.90E+06	3.45E-07	
SVOC	Ethanol	64-17-5	2.0E-04	4.6E+01	5.94E-01	1.63E-03	9.21E+03	1.09E-04	
SVOC	Fluorene	86-73-7	1.4E-03	1.7E+02	3.86E-01	8.57E-04	3.03E+03	3.30E-04	3.30E-03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.0E-05	2.8E+02	3.26E-01	6.65E-04	1.53E+05	6.54E-06	
SVOC	Naphthalene	91-20-3	1.2E-02	1.3E+02	4.21E-01	9.76E-04	1.22E+03	8.18E-04	8.18E-03
SVOC	Phenanthrene	85-01-8	1.4E-03	1.8E+02	3.77E-01	8.28E-04	3.09E+03	3.23E-04	3.23E-03
SVOC	Pyrene	129-00-0	2.0E-04	2.0E+02	3.62E-01	7.77E-04	1.51E+04	6.62E-05	
SVOC	Tetraethylene Glycol	112-60-7	1.6E-11	1.9E+02	3.67E-01	7.93E-04	1.68E+11	5.95E-12	
PCB	PCBs (total)	1336-36-3	6.6E-02	3.3E+02	3.08E-01	6.10E-04	1.69E+03	5.92E-04	
INORG	Antimony	7440-36-0		1.2E+02	4.29E-01	1.00E-03			
INORG	Arsenic	7440-38-2		7.5E+01	5.04E-01	1.28E-03			
INORG	Chromium III	16065-83-1		5.2E+01	5.70E-01	1.53E-03			
INORG	Chromium VI	18540-29-9		5.2E+01	5.70E-01	1.53E-03			
INORG	Cyanide (total)	57-12-5	2.0E-03	2.6E+01	7.19E-01	2.17E-03	1.17E+03	8.57E-04	8.57E-03
INORG	Lead	7439-92-1		2.1E+02	3.59E-01	7.68E-04			
INORG	Nickel	7440-02-0		5.9E+01	5.47E-01	1.44E-03			
INORG	Vanadium	7440-62-2		5.1E+01	5.74E-01	1.55E-03			

Attachment 3
Table 5:
Normalized Vapor Flux to Outdoor Air from Exposed Groundwater in Excavations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Molecular Weight of Oxygen	g/mol	$\mathbf{MW_{02}}$	32
Molecular Weight of Water	g/mol	$\mathbf{MW_{H20}}$	18
Temperature	K	**Temp**	291
Liquid-phase Mass Transfer Coefficient for Oxygen	cm/s	$\mathbf{k_{L,02}}$	0.002
Gas-Phase Mass Transfer Coefficient for Water Vapor at 25 °C	cm/s	$\mathbf{K_{G,H20}}$	0.833
Dispersion coefficient	(L/m^3) / $(L/m^2/s)$	**C/Q**	9.6

Attachment 3
Table 6:
Dermal Absorbed Dose for Groundwater
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	MW (g/mole)	FA (unitless)	K_p (cm/hr)	B (unitless)	t (hr)	c	b	ts (hr)	DA (L/cm^2-event)
VOC	Benzene	71-43-2	7.8E+01	1.0E+00	1.5E-02	5.0E-02	2.9E-01	3.7E-01	3.3E-01	6.9E-01	3.70E-05
VOC	Cumene	98-82-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,2-Dibromoethane	106-93-4	1.9E+02	1.0E+00	1.6E-03	8.4E-03	1.2E+00	3.4E-01	3.1E-01	2.8E+00	6.81E-06
VOC	1,2-Dichloroethane	107-06-2	9.9E+01	1.0E+00	4.1E-03	1.6E-02	3.8E-01	3.4E-01	3.1E-01	9.0E-01	1.13E-05
VOC	Ethyl Benzene	100-41-4	1.1E+02	1.0E+00	4.8E-02	1.9E-01	4.1E-01	4.7E-01	4.3E-01	9.9E-01	1.27E-04
VOC	Methyl tert-butyl ether	1634-04-4	8.8E+01	1.0E+00	3.3E-03	1.2E-02	3.3E-01	3.4E-01	3.1E-01	7.9E-01	8.84E-06
VOC	Toluene	108-88-3	9.2E+01	1.0E+00	3.2E-02	1.2E-01	3.5E-01	4.2E-01	3.8E-01	8.3E-01	8.08E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,3,5-Trimethylbenzene	108-67-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	Xylenes (total)	1330-20-7	1.1E+02	1.0E+00	5.0E-02	2.0E-01	4.1E-01	4.8E-01	4.4E-01	9.9E-01	1.32E-04
SVOC	Acenaphthene	83-32-9	1.5E+02	1.0E+00			7.7E-01	3.3E-01	3.0E-01	1.8E+00	
SVOC	Anthracene	120-12-7	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Benzo(a)anthracene	56-55-3	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Benzo(a)pyrene	50-32-8	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(b)fluoranthene	205-99-2	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(g,h,i)perylene	191-24-2	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Benzo(k)fluoranthene	207-08-9	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Chrysene	218-01-9	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Dibenz(a,h)anthracene	53-70-3	2.8E+02	7.0E-01			3.8E+00	3.3E-01	3.0E-01	9.1E+00	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	2.6E+02	1.0E+00			2.9E+00	3.3E-01	3.0E-01	6.9E+00	
SVOC	Ethanol	64-17-5	4.6E+01	1.0E+00	5.5E-04	1.4E-03	1.9E-01	3.3E-01	3.0E-01	4.6E-01	1.30E-06
SVOC	Fluorene	86-73-7	1.7E+02	1.0E+00			9.0E-01	3.3E-01	3.0E-01	2.2E+00	
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Naphthalene	91-20-3	1.3E+02	1.0E+00			5.5E-01	3.3E-01	3.0E-01	1.3E+00	
SVOC	Phenanthrene	85-01-8	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Pyrene	129-00-0	2.0E+02	1.0E+00			1.4E+00	3.3E-01	3.0E-01	3.4E+00	
SVOC	Tetraethylene Glycol	112-60-7	1.9E+02	1.0E+00			1.3E+00	3.3E-01	3.0E-01	3.1E+00	
PCB	PCBs (total)	1336-36-3	3.3E+02	7.0E-01			7.2E+00	3.3E-01	3.0E-01	1.7E+01	
INORG	Antimony	7440-36-0	1.2E+02		1.0E-03		5.1E-01	3.3E-01	3.0E-01	1.2E+00	2.00E-06
INORG	Arsenic	7440-38-2	7.5E+01		1.0E-03		2.8E-01	3.3E-01	3.0E-01	6.6E-01	2.00E-06
INORG	Chromium III	16065-83-1	5.2E+01		1.0E-03		2.1E-01	3.3E-01	3.0E-01	4.9E-01	2.00E-06
INORG	Chromium VI	18540-29-9	5.2E+01		2.0E-03		2.1E-01	3.3E-01	3.0E-01	4.9E-01	4.00E-06
INORG	Cyanide (total)	57-12-5	2.6E+01		1.0E-03		1.5E-01	3.3E-01	3.0E-01	3.5E-01	2.00E-06
INORG	Lead	7439-92-1	2.1E+02		1.0E-04		1.5E+00	3.3E-01	3.0E-01	3.7E+00	2.00E-07
INORG	Nickel	7440-02-0	5.9E+01		2.0E-04		2.2E-01	3.3E-01	3.0E-01	5.4E-01	4.00E-07
INORG	Vanadium	7440-62-2	5.1E+01		1.0E-03		2.0E-01	3.3E-01	3.0E-01	4.9E-01	2.00E-06

Notes:

Event Time hours **t** 2

K_p capped at 1 cm/hr (USEPA 1992).

The dermal absorbed dose for inorganic chemicals is estimated using a steady-state approach (USEPA 2004, Equation 3.4) and for organic chemicals is estimated using a nonsteady-state approach (USEPA 2004, Equations 3.2 and 3.3).

Attachment 3

Table 7a:

Unit Risk and Cancer-Based RBSLs for Exposure of Construction Workers to Groundwater in Excavations

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

					Incidental Ingestion				Dermal Contact					Vapor Inhalation				All Routes	
Chem Group	Chemical	CASRN	Cancer Class	C_{gw} (mg/l)	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	Risk	RBSL (mg/L)	DA (L/cm^2-event)	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	Risk	RBSL (mg/L)	C_{air} (mg/m^3)	URF $(mg/m^3)^{-1}$	Risk	RBSL (mg/L)	Risk	RBSL (mg/L)
VOC	Benzene	71-43-2	A	1.00E+00	7.34E-08	5.5E-02	4.0E-09	2.5E+03	3.70E-05	9.57E-07	5.5E-02	5.3E-08	1.9E+02	1.19E-01	7.8E-03	1.8E-07	5.5E+01	2.4E-07	4.2E+01
VOC	Cumene	98-82-8	D	1.00E+00	7.34E-08									9.64E-02					
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	7.34E-08	2.0E+00	1.5E-07	6.8E+01	6.81E-06	1.76E-07	2.0E+00	3.5E-07	2.8E+01	7.11E-02	6.0E-01	8.4E-06	1.2E+00	8.9E-06	1.1E+00
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	7.34E-08	9.1E-02	6.7E-09	1.5E+03	1.13E-05	2.92E-07	9.1E-02	2.7E-08	3.8E+02	9.88E-02	2.6E-02	5.0E-07	2.0E+01	5.4E-07	1.9E+01
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	7.34E-08				1.27E-04	3.28E-06				1.02E-01					
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	7.34E-08	1.8E-03	1.3E-10	7.6E+04	8.84E-06	2.29E-07	1.8E-03	4.1E-10	2.4E+04	9.99E-02	2.6E-04	5.1E-09	2.0E+03	5.6E-09	1.8E+03
VOC	Toluene	108-88-3	ID	1.00E+00	7.34E-08				8.08E-05	2.09E-06				1.09E-01					
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	7.34E-08									9.57E-02					
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	7.34E-08									9.56E-02					
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	7.34E-08				1.32E-04	3.41E-06				1.02E-01					
SVOC	Acenaphthene	83-32-9	ID	1.00E+00	7.34E-08									5.16E-02					
SVOC	Anthracene	120-12-7	ID	1.00E+00	7.34E-08									2.97E-02					
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00	7.34E-08	1.0E-01	7.3E-09	1.4E+03			1.0E-01				6.0E-02			7.3E-09	1.4E+03
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00	7.34E-08	1.0E+00	7.3E-08	1.4E+02			1.0E+00				6.0E-01			7.3E-08	1.4E+02
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00	7.34E-08	1.0E-01	7.3E-09	1.4E+03			1.0E-01				6.0E-02			7.3E-09	1.4E+03
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00	7.34E-08														
SVOC	Benzo(k)fluoranthene	207-08-9	B2	1.00E+00	7.34E-08	1.0E-02	7.3E-10	1.4E+04			1.0E-02				6.0E-03			7.3E-10	1.4E+04
SVOC	Chrysene	218-01-9	B2	1.00E+00	7.34E-08	1.0E-03	7.3E-11	1.4E+05			1.0E-03				6.0E-04			7.3E-11	1.4E+05
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	1.00E+00	7.34E-08	1.0E+00	7.3E-08	1.4E+02			1.0E+00				6.0E-01			7.3E-08	1.4E+02
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	1.00E+00	7.34E-08	2.5E+02	1.8E-05	5.5E-01			2.5E+02				7.1E+01			1.8E-05	5.5E-01
SVOC	Ethanol	64-17-5		1.00E+00	7.34E-08				1.30E-06	3.36E-08									
SVOC	Fluorene	86-73-7	D	1.00E+00	7.34E-08									3.18E-02					
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00	7.34E-08	1.0E-01	7.3E-09	1.4E+03			1.0E-01				6.0E-02			7.3E-09	1.4E+03
SVOC	Naphthalene	91-20-3	C	1.00E+00	7.34E-08	1.2E-01	8.8E-09	1.1E+03			1.2E-01			7.88E-02	3.4E-02	5.2E-07	1.9E+01	5.3E-07	1.9E+01
SVOC	Phenanthrene	85-01-8	D	1.00E+00	7.34E-08									3.11E-02					
SVOC	Pyrene	129-00-0	NC	1.00E+00	7.34E-08														
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00	7.34E-08														
PCB	PCBs (total)	1336-36-3	B2	1.00E+00	7.34E-08	2.0E+00	1.5E-07	6.8E+01			2.0E+00				5.7E-01			1.5E-07	6.8E+01
INORG	Antimony	7440-36-0	ID	1.00E+00	7.34E-08				2.00E-06	5.18E-08									
INORG	Arsenic	7440-38-2	A	1.00E+00	7.34E-08	1.5E+00	1.1E-07	9.1E+01	2.00E-06	5.18E-08	1.5E+00	7.8E-08	1.3E+02		4.3E+00			1.9E-07	5.3E+01
INORG	Chromium III	16065-83-1	D	1.00E+00	7.34E-08				2.00E-06	5.18E-08									
INORG	Chromium VI	18540-29-9	A	1.00E+00	7.34E-08	5.0E-01	3.7E-08	2.7E+02	4.00E-06	1.04E-07	2.0E+01	2.1E-06	4.8E+00		1.2E+01			2.1E-06	4.7E+00
INORG	Cyanide (total)	57-12-5		1.00E+00	7.34E-08				2.00E-06	5.18E-08				8.26E-02					
INORG	Lead	7439-92-1	B2	1.00E+00	7.34E-08				2.00E-07	5.18E-09									
INORG	Nickel	7440-02-0	A	1.00E+00	7.34E-08				4.00E-07	1.04E-08					2.4E-01				
INORG	Vanadium	7440-62-2	ID	1.00E+00	7.34E-08				2.00E-06	5.18E-08									

Notes:

Cancer RBSLs are calculated at a target cancer risk of 1E-05.

Attachment 3
Table 7b:
Unit HQ and Noncancer-Based RBSLs for Exposure of Construction Workers to Groundwater in Excavations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Incidental Ingestion				Dermal Contact					Vapor Inhalation				All Routes	
Chem Group	**Chemical**	**CASRN**	**C_{gw}** (mg/L)	**ADD** (mg/kg/d)	**RfD_{oral}** (mg/kg/d)	**HQ**	**RBSL** (mg/L)	**DA** (L/cm^2-event)	**ADD** (mg/kg/d)	**RfD_{derm}** (mg/kg/d)	**HQ**	**RBSL** (mg/L)	**C_{air}** (mg/m^3)	**RfC** (mg/m^3)	**HQ**	**RBSL** (mg/L)	**HQ**	**RBSL** (mg/L)
VOC	Benzene	71-43-2	1.00E+00	5.14E-06	1.0E-02	5.1E-04	1.9E+02	3.70E-05	6.70E-05	1.0E-02	6.7E-03	1.5E+01	1.19E-01	9.0E-02	1.8E-02	5.5E+00	2.5E-02	4.0E+00
VOC	Cumene	98-82-8	1.00E+00	5.14E-06	4.0E-01	1.3E-05	7.8E+03			4.0E-01			9.64E-02	4.0E-01	3.3E-03	3.0E+01	3.3E-03	3.0E+01
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	5.14E-06	9.0E-03	5.7E-04	1.8E+02	6.81E-06	1.23E-05	9.0E-03	1.4E-03	7.3E+01	7.11E-02	9.0E-03	1.1E-01	9.2E-01	1.1E-01	9.1E-01
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	5.14E-06	2.0E-02	2.6E-04	3.9E+02	1.13E-05	2.05E-05	2.0E-02	1.0E-03	9.8E+01	9.88E-02	7.0E-02	1.9E-02	5.2E+00	2.1E-02	4.9E+00
VOC	Ethyl Benzene	100-41-4	1.00E+00	5.14E-06	1.0E-01	5.1E-05	1.9E+03	1.27E-04	2.30E-04	1.0E-01	2.3E-03	4.4E+01	1.02E-01	9.0E+00	1.6E-04	6.4E+02	2.5E-03	4.0E+01
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	5.14E-06	3.0E-01	1.7E-05	5.8E+03	8.84E-06	1.60E-05	3.0E-01	5.3E-05	1.9E+03	9.99E-02	3.0E+00	4.6E-04	2.2E+02	5.3E-04	1.9E+02
VOC	Toluene	108-88-3	1.00E+00	5.14E-06	8.0E-01	6.4E-06	1.6E+04	8.08E-05	1.46E-04	8.0E-01	1.8E-04	5.5E+02	1.09E-01	5.0E+00	3.0E-04	3.3E+02	4.9E-04	2.0E+02
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	5.14E-06	4.0E-02	1.3E-04	7.8E+02			4.0E-02			9.57E-02	2.0E-01	6.6E-03	1.5E+01	6.7E-03	1.5E+01
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	5.14E-06	4.0E-02	1.3E-04	7.8E+02			4.0E-02			9.56E-02	2.0E-01	6.5E-03	1.5E+01	6.7E-03	1.5E+01
VOC	Xylenes (total)	1330-20-7	1.00E+00	5.14E-06	2.0E-01	2.6E-05	3.9E+03	1.32E-04	2.39E-04	2.0E-01	1.2E-03	8.4E+01	1.02E-01	3.0E-01	4.7E-03	2.1E+01	5.9E-03	1.7E+01
SVOC	Acenaphthene	83-32-9	1.00E+00	5.14E-06	2.0E-01	2.6E-05	3.9E+03			2.0E-01			5.16E-02				2.6E-05	3.9E+03
SVOC	Anthracene	120-12-7	1.00E+00	5.14E-06	1.0E+00	5.1E-06	1.9E+04			1.0E+00			2.97E-02				5.1E-06	1.9E+04
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00	5.14E-06														
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00	5.14E-06	3.0E-04	1.7E-02	5.8E+00			3.0E-04				2.0E-06			1.7E-02	5.8E+00
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00	5.14E-06														
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00	5.14E-06	3.0E-01	1.7E-05	5.8E+03			3.0E-01							1.7E-05	5.8E+03
SVOC	Benzo(k)fluoranthene	207-08-9	1.00E+00	5.14E-06														
SVOC	Chrysene	218-01-9	1.00E+00	5.14E-06														
SVOC	Dibenz(a,h)anthracene	53-70-3	1.00E+00	5.14E-06														
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.00E+00	5.14E-06														
SVOC	Ethanol	64-17-5	1.00E+00	5.14E-06	6.2E+01	8.3E-08	1.2E+06	1.30E-06	2.35E-06	6.2E+01	3.8E-08	2.6E+06		1.9E+01			1.2E-07	8.3E+05
SVOC	Fluorene	86-73-7	1.00E+00	5.14E-06	4.0E-01	1.3E-05	7.8E+03			4.0E-01			3.18E-02				1.3E-05	7.8E+03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00	5.14E-06														
SVOC	Naphthalene	91-20-3	1.00E+00	5.14E-06	2.0E-01	2.6E-05	3.9E+03			2.0E-01			7.88E-02	3.0E-03	3.6E-01	2.8E-01	3.6E-01	2.8E-01
SVOC	Phenanthrene	85-01-8	1.00E+00	5.14E-06	3.0E-01	1.7E-05	5.8E+03			3.0E-01			3.11E-02				1.7E-05	5.8E+03
SVOC	Pyrene	129-00-0	1.00E+00	5.14E-06	3.0E-01	1.7E-05	5.8E+03			3.0E-01							1.7E-05	5.8E+03
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00	5.14E-06	2.0E+00	2.6E-06	3.9E+04			2.0E+00							2.6E-06	3.9E+04
PCB	PCBs (total)	1336-36-3	1.00E+00	5.14E-06	5.0E-05	1.0E-01	9.7E-01			5.0E-05							1.0E-01	9.7E-01
INORG	Antimony	7440-36-0	1.00E+00	5.14E-06	4.0E-04	1.3E-02	7.8E+00	2.00E-06	3.62E-06	6.0E-05	6.0E-02	1.7E+00					7.3E-02	1.4E+00
INORG	Arsenic	7440-38-2	1.00E+00	5.14E-06	5.0E-03	1.0E-03	9.7E+01	2.00E-06	3.62E-06	5.0E-03	7.2E-04	1.4E+02		1.5E-05			1.8E-03	5.7E+01
INORG	Chromium III	16065-83-1	1.00E+00	5.14E-06	1.5E+00	3.4E-06	2.9E+04	2.00E-06	3.62E-06	2.0E-02	1.9E-04	5.4E+02		5.0E-03			1.9E-04	5.3E+02
INORG	Chromium VI	18540-29-9	1.00E+00	5.14E-06	5.0E-03	1.0E-03	9.7E+01	4.00E-06	7.25E-06	1.3E-04	5.8E-02	1.7E+00		1.0E-03			5.9E-02	1.7E+00
INORG	Cyanide (total)	57-12-5	1.00E+00	5.14E-06	6.0E-03	8.6E-04	1.2E+02	2.00E-06	3.62E-06	6.0E-03	6.0E-04	1.7E+02	8.26E-02	3.0E-03	3.8E-01	2.7E-01	3.8E-01	2.6E-01
INORG	Lead	7439-92-1	1.00E+00	5.14E-06				2.00E-07	3.62E-07									
INORG	Nickel	7440-02-0	1.00E+00	5.14E-06	2.0E-02	2.6E-04	3.9E+02	4.00E-07	7.25E-07	8.0E-04	9.1E-04	1.1E+02		2.0E-04			1.2E-03	8.6E+01
INORG	Vanadium	7440-62-2	1.00E+00	5.14E-06	1.0E-02	5.1E-04	1.9E+02	2.00E-06	3.62E-06	2.6E-04	1.4E-02	7.2E+00		1.0E-04			1.4E-02	6.9E+00

Notes:
Noncancer RBSLs are calculated at a target HQ of 0.1.

Attachment 4

Soil Migration to Groundwater Screening Level Calculations

Table 1 – Groundwater Protection Concentrations

Table 2 – Soil Migration to Groundwater Criteria

Attachment 4
Table 1
Groundwater Protection Concentrations
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Cancer Class	Groundwater Protection Concentration (mg/L)	GWP Basis
VOC	Benzene	71-43-2	A	2.5E-01	Min
VOC	Cumene	98-82-8	D	2.6E+00	Min
VOC	1,2-Dibromoethane	106-93-4	LC	7.9E-03	Min
VOC	1,2-Dichloroethane	107-06-2	B2	8.2E-02	Min
VOC	Ethyl Benzene	100-41-4	D	2.0E+00	Min
VOC	Methyl tert-butyl ether	1634-04-4	C	1.5E+01	Min
VOC	Toluene	108-88-3	ID	2.5E+01	Min
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	6.3E-01	Min
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	5.9E-01	Min
VOC	Xylenes (total)	1330-20-7	ID	8.6E-01	Min
SVOC	Acenaphthene	83-32-9	ID	9.0E+00	Min
SVOC	Anthracene	120-12-7	ID	4.0E+01	Min
SVOC	Benzo(a)anthracene	56-55-3	B2	1.3E-02	Min
SVOC	Benzo(a)pyrene	50-32-8	HC	1.3E-03	Min
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.3E-02	Min
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.2E-02	Min
SVOC	Benzo(k)fluoranthene	207-08-9	B2	1.3E-01	Min
SVOC	Chrysene	218-01-9	B2	1.3E+00	Min
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	1.3E-03	Min
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	3.9E-05	Min
SVOC	Ethanol	64-17-5		1.0E+04	Min
SVOC	Fluorene	86-73-7	D	7.0E+00	Min
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.3E-02	Min
SVOC	Naphthalene	91-20-3	C	6.7E-02	Min
SVOC	Phenanthrene	85-01-8	D	1.0E+00	Min
SVOC	Pyrene	129-00-0	NC	3.0E+00	Min
SVOC	Tetraethylene Glycol	112-60-7		2.9E+02	Min
PCB	PCBs (total)	1336-36-3	B2	6.4E-04	Min
INORG	Antimony	7440-36-0	ID	2.2E-02	Min
INORG	Arsenic	7440-38-2	A	2.1E-02	Min
INORG	Chromium III	16065-83-1	D	1.1E+01	Min
INORG	Chromium VI	18540-29-9	A	3.9E-03	Min
INORG	Cyanide (total)	57-12-5		2.5E-02	Min
INORG	Lead	7439-92-1	B2	2.5E+00	Min
INORG	Nickel	7440-02-0	A	1.3E+00	Min
INORG	Vanadium	7440-62-2	ID	1.4E-01	Min

Notes:
The target groundwater protection concentration is based on the minimum of the groundwater RBSLs.

Attachment 4
Table 2
Soil Migration to Groundwater Criteria
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	Target Concentration in Groundwater (mg/L)		Solubility (mg/L)	K_{oc} (L/kg)	K_d (L/kg)	H (unitless)	$C_{soil\text{-}MtGW\text{-}Eq}$ (mg/kg)	$C_{soil\text{-}MtGW\text{-}Lt}$ (mg/kg)	Soil MtGW Screening Level (mg/kg)	
VOC	Benzene	71-43-2	2.5E-01	Min	1.8E+03	5.8E+01		1.7E-01	1.8E+00	9.8E+01	9.8E+01	LT
VOC	Cumene	98-82-8	2.6E+00	Min	6.1E+01	7.1E+02		3.3E-01	1.9E+02	1.0E+03	1.0E+03	LT
VOC	1,2-Dibromoethane	106-93-4	7.9E-03	Min	3.9E+03	2.2E+01		2.4E-02	2.3E-02	3.2E+00	3.2E+00	LT
VOC	1,2-Dichloroethane	107-06-2	8.2E-02	Min	8.5E+03	1.7E+01		2.9E-02	2.1E-01	3.3E+01	3.3E+01	LT
VOC	Ethyl Benzene	100-41-4	2.0E+00	Min	1.7E+02	3.7E+02		2.2E-01	7.8E+01	8.2E+02	8.2E+02	LT
VOC	Methyl tert-butyl ether	1634-04-4	1.5E+01	Min	5.1E+04	1.1E+01		1.8E-02	2.7E+01	5.9E+03	5.9E+03	LT
VOC	Toluene	108-88-3	2.5E+01	Min	5.3E+02	1.8E+02		1.9E-01	4.8E+02	9.8E+03	9.8E+03	LT
VOC	1,2,4-Trimethylbenzene	95-63-6	6.3E-01	Min	5.7E+01	9.0E+02		1.6E-01	5.7E+01	2.5E+02	2.5E+02	LT
VOC	1,3,5-Trimethylbenzene	108-67-8	5.9E-01	Min	4.8E+01	1.8E+03		1.5E-01	1.0E+02	2.4E+02	2.4E+02	LT
VOC	Xylenes (total)	1330-20-7	8.6E-01	Min	1.7E+02	3.9E+02		2.5E-01	3.4E+01	3.4E+02	3.4E+02	LT
SVOC	Acenaphthene	83-32-9	9.0E+00	Min	4.2E+00	7.1E+03		3.4E-03	6.4E+03	3.6E+03		NA
SVOC	Anthracene	120-12-7	4.0E+01	Min	4.3E-02	3.0E+04		1.3E-03	1.2E+05	1.6E+04		NA
SVOC	Benzo(a)anthracene	56-55-3	1.3E-02	Min	9.4E-03	4.0E+05		5.6E-05	5.2E+02	5.2E+00		NA
SVOC	Benzo(a)pyrene	50-32-8	1.3E-03	Min	1.6E-03	1.0E+06		1.5E-05	1.3E+02	5.2E-01		NA
SVOC	Benzo(b)fluoranthene	205-99-2	1.3E-02	Min	1.5E-03	1.2E+06		1.7E-03	1.6E+03	5.2E+00		NA
SVOC	Benzo(g,h,i)perylene	191-24-2	1.2E-02	Min	2.6E-04	1.3E+07		1.1E-05	1.5E+04	4.8E+00		NA
SVOC	Benzo(k)fluoranthene	207-08-9	1.3E-01	Min	8.0E-04	1.2E+06		1.2E-05	1.6E+04	5.2E+01		NA
SVOC	Chrysene	218-01-9	1.3E+00	Min	1.6E-03	4.0E+05		1.5E-03	5.2E+04	5.2E+02		NA
SVOC	Dibenz(a,h)anthracene	53-70-3	1.3E-03	Min	2.5E-03	3.8E+06		9.6E-08	4.9E+02	5.2E-01		NA
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	3.9E-05	Min	2.5E-02	5.0E+05		1.0E-06	2.0E+00	1.6E-02	2.0E+00	EQ
SVOC	Ethanol	64-17-5	1.0E+04	Min		6.8E-01		2.0E-04	7.5E+03	4.2E+06	4.2E+06	LT
SVOC	Fluorene	86-73-7	7.0E+00	Min	2.0E+00	1.4E+04		1.4E-03	9.6E+03	2.8E+03		NA
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.3E-02	Min	2.2E-05	3.4E+06		2.0E-05	4.5E+03	5.2E+00		NA
SVOC	Naphthalene	91-20-3	6.7E-02	Min	3.1E+01	2.0E+03		1.2E-02	1.4E+01	2.7E+01	2.7E+01	LT
SVOC	Phenanthrene	85-01-8	1.0E+00	Min	1.2E+00	2.4E+04		1.4E-03	2.4E+03	4.0E+02		NA
SVOC	Pyrene	129-00-0	3.0E+00	Min	1.4E-01	1.1E+05		2.0E-04	3.2E+04	1.2E+03		NA
SVOC	Tetraethylene Glycol	112-60-7	2.9E+02	Min	1.0E+06	3.0E-02		1.6E-11	1.9E+02	1.2E+05	1.2E+05	LT
PCB	PCBs (total)	1336-36-3	6.4E-04	Min	1.2E-02	2.5E+06		6.6E-02	1.6E+02	2.6E-01		NA
INORG	Antimony	7440-36-0	2.2E-02	Min			4.5E+01		2.0E+01	8.9E+00	2.0E+01	EQ
INORG	Arsenic	7440-38-2	2.1E-02	Min			2.9E+01		1.2E+01	8.4E+00	1.2E+01	EQ
INORG	Chromium III	16065-83-1	1.1E+01	Min			1.8E+06		4.0E+08	4.5E+03	4.0E+08	EQ
INORG	Chromium VI	18540-29-9	3.9E-03	Min			1.9E+01		1.5E+00	1.5E+00	1.5E+00	LT
INORG	Cyanide (total)	57-12-5	2.5E-02	Min	9.5E+04		9.9E+00	2.0E-03	4.9E+00	9.9E+00	9.9E+00	LT
INORG	Lead	7439-92-1	2.5E+00	Min			9.0E+02		4.5E+04	1.0E+03	4.5E+04	EQ
INORG	Nickel	7440-02-0	1.3E+00	Min			6.5E+01		1.7E+03	5.3E+02	1.7E+03	EQ
INORG	Vanadium	7440-62-2	1.4E-01	Min			1.0E+03		2.8E+03	5.7E+01	2.8E+03	EQ

Attachment 4
Table 2
Soil Migration to Groundwater Criteria
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

f_{oc}	Fraction organic carbon	0.005
ρ_b	Soil bulk density	1.66
n	Total porosity	0.38
θ_w	Water-filled soil porosity	0.05
θ_a	Air-filled soil porosity	0.32
DAF	Dilution attenuation factor	20

Only chemicals detected in soil are shown.
$C_{soil\text{-}MtGW\text{-}Eq}$: Soil screening level based on equilibrium partitioning (EQ)
$C_{soil\text{-}MtGW\text{-}Lt}$: Soil screening level based on simulated worst-case leach test (LT)
NA: Not applicable - target groundwater concentration times DAF is greater than constituent's solubility.
The K_d for organic compounds is the K_{oc} times the f_{oc}.

Attachment 5

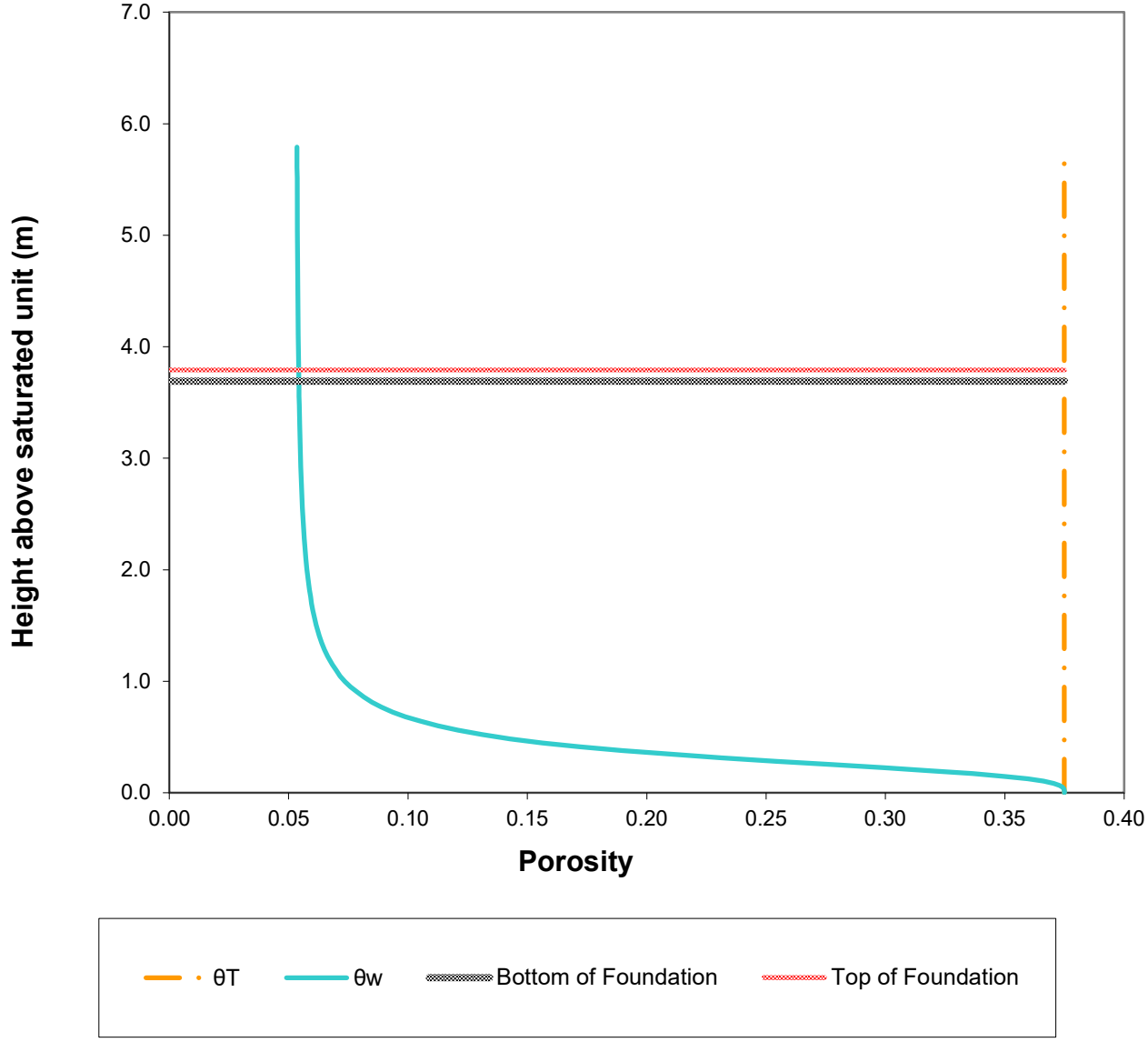
Off-Facility Resident Risk Based Screening Level Calculations

Figure 1 – Soil Moisture Profile for Default PADEP Residential Building (w/ Basement)

Table 1 – Normalized Indoor Air Concentrations in a Default PADEP Residential Building (with Basement) Due to Vapor Intrusion from Groundwater

Table 2 – Unit Risk, Unit HQ, and RBSLs for Groundwater Vapor Intrusion into a Default PADEP Residential Building (with Basement)

Attachment 5
Figure 1:Soil Moisture Profile for Default PADEP Residential Building (w/ Basement)
PESRM Philadelphia Refining Complex, Philadelphia, Pennsylvania



Attachment 5

Table 1:

Normalized Indoor Air Concentration in a Default PADEP Residential Building (w/ Basement) Due to Vapor Intrusion from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	D_{air} (m^2/day)	D_{water} (m^2/day)	H (unitless)	D_{crack} (m^2/day)	D_{eff}^T (m^2/day)	α_{soil}	α_{slab}	α_{∞}	$C_{b, norm}$ (L-water/m^3)
VOC	Benzene	71-43-2	7.60E-01	8.47E-05	1.68E-01	1.23E-01	2.49E-03	1.66E-02	4.55E-03	7.55E-05	1.27E-02
VOC	Cumene	98-82-8	5.62E-01	6.13E-05	3.28E-01	9.06E-02	1.03E-03	6.94E-03	4.55E-03	3.16E-05	1.04E-02
VOC	1,2-Dibromoethane	106-93-4	3.72E-01	7.29E-05	2.37E-02	5.99E-02	8.50E-03	5.45E-02	4.55E-03	2.48E-04	5.89E-03
VOC	1,2-Dichloroethane	107-06-2	8.99E-01	8.55E-05	2.92E-02	1.45E-01	1.06E-02	6.68E-02	4.55E-03	3.04E-04	8.87E-03
VOC	Ethyl Benzene	100-41-4	6.48E-01	6.74E-05	2.20E-01	1.05E-01	1.60E-03	1.07E-02	4.55E-03	4.89E-05	1.07E-02
VOC	Methyl tert-butyl ether	1634-04-4	7.42E-01	8.73E-05	1.83E-02	1.20E-01	1.43E-02	8.81E-02	4.55E-03	4.01E-04	7.36E-03
VOC	Toluene	108-88-3	7.52E-01	7.43E-05	1.93E-01	1.21E-01	1.99E-03	1.33E-02	4.55E-03	6.05E-05	1.17E-02
VOC	1,2,4-Trimethylbenzene	95-63-6	5.24E-01	6.84E-05	1.61E-01	8.45E-02	2.03E-03	1.36E-02	4.55E-03	6.19E-05	9.96E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	5.20E-01	7.49E-05	1.54E-01	8.39E-02	2.27E-03	1.52E-02	4.55E-03	6.90E-05	1.06E-02
VOC	Xylenes (total)	1330-20-7	6.74E-01	7.56E-05	2.52E-01	1.09E-01	1.58E-03	1.06E-02	4.55E-03	4.84E-05	1.22E-02
SVOC	Acenaphthene	83-32-9	3.64E-01	6.64E-05	3.40E-03	5.87E-02	2.34E-02	1.37E-01	4.55E-03	6.24E-04	2.12E-03
SVOC	Anthracene	120-12-7	2.80E-01	6.69E-05	1.30E-03	4.52E-02	2.73E-02	1.56E-01	4.55E-03	7.10E-04	9.26E-04
SVOC	Benzo(a)anthracene	56-55-3	4.41E-01	7.78E-05	5.55E-05	7.17E-02	6.73E-02	3.13E-01	4.55E-03	1.43E-03	
SVOC	Benzo(a)pyrene	50-32-8	3.72E-01	7.78E-05	1.49E-05	6.21E-02	6.63E-02	3.10E-01	4.55E-03	1.41E-03	
SVOC	Benzo(b)fluoranthene	205-99-2	1.95E-01	4.80E-05	1.66E-03	3.15E-02	1.80E-02	1.08E-01	4.55E-03	4.94E-04	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.88E-01	4.54E-05	1.10E-05	3.20E-02	3.54E-02	1.94E-01	4.55E-03	8.82E-04	
SVOC	Benzo(k)fluoranthene	207-08-9	1.95E-01	4.80E-05	1.16E-05	3.32E-02	3.67E-02	1.99E-01	4.55E-03	9.07E-04	
SVOC	Chrysene	218-01-9	2.14E-01	5.37E-05	1.48E-03	3.46E-02	2.04E-02	1.22E-01	4.55E-03	5.54E-04	
SVOC	Dibenz(a,h)anthracene	53-70-3	1.75E-01	4.48E-05	9.57E-08	2.24E-01	3.60E-01	7.09E-01	4.55E-03	3.23E-03	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	6.91E-01	6.91E-05	1.03E-06	1.40E-01	1.77E-01	5.45E-01	4.55E-03	2.48E-03	
SVOC	Ethanol	64-17-5	1.06E+00	1.12E-04	1.96E-04	1.72E-01	1.30E-01	4.68E-01	4.55E-03	2.13E-03	
SVOC	Fluorene	86-73-7	3.14E-01	6.81E-05	1.39E-03	5.06E-02	2.93E-02	1.65E-01	4.55E-03	7.54E-04	1.05E-03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.64E-01	4.89E-05	2.03E-05	2.75E-02	2.94E-02	1.66E-01	4.55E-03	7.57E-04	
SVOC	Naphthalene	91-20-3	5.10E-01	6.48E-05	1.20E-02	8.22E-02	1.37E-02	8.49E-02	4.55E-03	3.87E-04	4.66E-03
SVOC	Phenanthrene	85-01-8	3.24E-01	6.45E-05	1.41E-03	5.23E-02	2.94E-02	1.66E-01	4.55E-03	7.56E-04	1.06E-03
SVOC	Pyrene	129-00-0	2.35E-01	6.26E-05	2.00E-04	3.80E-02	3.26E-02	1.81E-01	4.55E-03	8.24E-04	
SVOC	Tetraethylene Glycol	112-60-7	4.39E-01	6.96E-05	1.62E-11	1.80E+03	2.97E+03	9.97E-01	3.14E-01	3.13E-01	
PCB	PCBs (total)	1336-36-3	1.75E-01	4.32E-05	6.64E-02	2.82E-02	2.27E-03	1.51E-02	4.55E-03	6.89E-05	
INORG	Antimony	7440-36-0									
INORG	Arsenic	7440-38-2									
INORG	Chromium III	16065-83-1									
INORG	Chromium VI	18540-29-9									
INORG	Cyanide (total)	57-12-5	1.35E+00	1.53E-04	1.97E-03	2.17E-01	8.92E-02	3.77E-01	4.55E-03	1.72E-03	3.38E-03
INORG	Lead	7439-92-1									
INORG	Nickel	7440-02-0									
INORG	Vanadium	7440-62-2									

Attachment 5

Table 1:

Normalized Indoor Air Concentration in a Default PADEP Residential Building (w/ Basement) Due to Vapor Intrusion from Groundwater

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:

Subsurface and Building Characteristics			**Crack Soil**
SCS Soil texture class			Sand
Bulk density	kg/L	ρ_b	1.66
Total porosity	L/L-soil	θ_T	0.375
Water-filled porosity	L/L-soil	θ_w	0.054
Air-filled porosity	L/L-soil	θ_a	0.321
Residual saturation	L/L-soil	θ_r	0.053
Hydraulic conductivity	cm/s	**K**	7.4E-03
Dynamic viscosity of water	g/cm-s	μ_w	0.01307
Density of water	g/cm^3	ρ_w	1.0
Gravitational acceleration	cm/s^2	**g**	980.7
Intrinsic permeability	cm^2	**k**	9.9E-08
Relative saturation	unitless	S_e	0.003
van Genuchten N	unitless	**N**	3.177
van Genuchten M	unitless	**M**	0.685
Relative air permeability	unitless	k_{rg}	0.998
Permeability to vapor	cm^2	k_v	9.90E-08
Distance from foundation to source	m	$L_{T\text{-}gw}$	3.69
Bldg foundation thickness	m	L_{crack}	0.1
Bldg foundation length	m		10.00
Bldg foundation width	m		10.00
Bldg occupied height	m		3.66
Bldg occupied volume	m^3		366.00
Occupied depth below ground	m		2.0
Bldg area for vapor intrusion	m^2	A_B	180.0
Ratio of A_{crack} to A_B		η	2E-04
Area of cracks	m^2	A_{crack}	4E-02
Air exchange rate	$hour^{-1}$	**ach**	0.18
Building ventilation rate	m^3/day	Q_{bldg}	1.6E+03
Pressure diff. outdoors-indoors	$kg/m\text{-}s^2$	ΔP	4.0
Viscosity of air	kg/m-s	μ_a	1.8E-05
Crack length (bldg perimeter)	m	X_{crack}	40
Crack depth below ground	m	Z_{crack}	2.10
Crack radius	m	r_{crack}	1E-03
Soil gas flow rate into bldg	m^3/day	Q_{soil}	7.20

Attachment 5
Table 2:
Unit Risk, Unit HQ, and RBSLs for Groundwater Vapor Intrusion into a Default PADEP Residential Building (w/ Basement)
Resident
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Cancer			Noncancer		
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**C_{gw}** (mg/L)	**C_{air}** (mg/m^3)	**URF** (mg/m^3)$^{-1}$	**Risk**	**RBSL** (mg/L)	**RfC** (mg/m^3)	**HQ**	**RBSL** (mg/L)
VOC	Benzene	71-43-2	A	1.00E+00	1.27E-02	7.8E-03	3.5E-05	2.8E-01	3.0E-02	4.1E-01	2.5E-01
VOC	Cumene	98-82-8	D	1.00E+00	1.04E-02				4.0E-01	2.5E-02	4.0E+00
VOC	1,2-Dibromoethane	106-93-4	LC	1.00E+00	5.89E-03	6.0E-01	1.3E-03	7.9E-03	9.0E-03	6.3E-01	1.6E-01
VOC	1,2-Dichloroethane	107-06-2	B2	1.00E+00	8.87E-03	2.6E-02	8.2E-05	1.2E-01	7.0E-03	1.2E+00	8.2E-02
VOC	Ethyl Benzene	100-41-4	D	1.00E+00	1.07E-02				1.0E+00	1.0E-02	9.7E+00
VOC	Methyl tert-butyl ether	1634-04-4	C	1.00E+00	7.36E-03	2.6E-04	6.8E-07	1.5E+01	3.0E+00	2.4E-03	4.2E+01
VOC	Toluene	108-88-3	ID	1.00E+00	1.17E-02				5.0E+00	2.2E-03	4.5E+01
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	1.00E+00	9.96E-03				6.0E-02	1.6E-01	6.3E-01
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	1.00E+00	1.06E-02				6.0E-02	1.7E-01	5.9E-01
VOC	Xylenes (total)	1330-20-7	ID	1.00E+00	1.22E-02				1.0E-01	1.2E-01	8.6E-01
SVOC	Acenaphthene	83-32-9	ID	1.00E+00	2.12E-03						
SVOC	Anthracene	120-12-7	ID	1.00E+00	9.26E-04						
SVOC	Benzo(a)anthracene	56-55-3	B2	1.00E+00		6.0E-02					
SVOC	Benzo(a)pyrene	50-32-8	HC	1.00E+00		6.0E-01			2.0E-06		
SVOC	Benzo(b)fluoranthene	205-99-2	B2	1.00E+00		6.0E-02					
SVOC	Benzo(g,h,i)perylene	191-24-2	D	1.00E+00							
SVOC	Benzo(k)fluoranthene	207-08-9	B2	1.00E+00		6.0E-03					
SVOC	Chrysene	218-01-9	B2	1.00E+00		6.0E-04					
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	1.00E+00		6.0E-01					
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	1.00E+00		7.1E+01					
SVOC	Ethanol	64-17-5		1.00E+00					1.9E+01		
SVOC	Fluorene	86-73-7	D	1.00E+00	1.05E-03						
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	1.00E+00		6.0E-02					
SVOC	Naphthalene	91-20-3	C	1.00E+00	4.66E-03	3.4E-02	5.6E-05	1.8E-01	3.0E-03	1.5E+00	6.7E-02
SVOC	Phenanthrene	85-01-8	D	1.00E+00	1.06E-03						
SVOC	Pyrene	129-00-0	NC	1.00E+00							
SVOC	Tetraethylene Glycol	112-60-7		1.00E+00							
PCB	PCBs (total)	1336-36-3	B2	1.00E+00		5.7E-01					
INORG	Antimony	7440-36-0	ID	1.00E+00							
INORG	Arsenic	7440-38-2	A	1.00E+00		4.3E+00			1.5E-05		
INORG	Chromium III	16065-83-1	D	1.00E+00					5.0E-03		
INORG	Chromium VI	18540-29-9	A	1.00E+00		1.2E+01			1.0E-04		
INORG	Cyanide (total)	57-12-5		1.00E+00	3.38E-03				8.0E-04	4.1E+00	2.5E-02
INORG	Lead	7439-92-1	B2	1.00E+00							

Attachment 5
Table 2:
Unit Risk, Unit HQ, and RBSLs for Groundwater Vapor Intrusion into a Default PADEP Residential Building (w/ Basement)
Resident
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Cancer			Noncancer		
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**C_{gw}** (mg/L)	**C_{air}** (mg/m^3)	**URF** (mg/m^3)$^{-1}$	**Risk**	**RBSL** (mg/L)	**RfC** (mg/m^3)	**HQ**	**RBSL** (mg/L)
INORG	Nickel	7440-02-0	A	1.00E+00		2.4E-01			9.0E-05		
INORG	Vanadium	7440-62-2	ID	1.00E+00					1.0E-04		

Notes:
Cancer RBSLs are calculated at a target cancer risk of 1E-05.
Noncancer RBSLs are calculated at a target HQ of 0.1.

Attachment 6

Nonpotable Groundwater Use Risk Based Screening Level Calculation

Table 1 – Normalized Vapor Flux to Outdoor Air from Residential Kiddie Pool

Table 2 – Nonsteady State Dermal Absorption of Chemicals from Water in Residential Kiddie Pool

Table 3 – Dispersion Factor to Outdoor Air

Table 4a – Unit Risk and Cancer-Based RBSLs for Exposure of Resident to Groundwater in Kiddie Pools

Table 4b – Unit HQ and Noncancer-Based RBSLs for Exposure of Resident to Groundwater in Kiddie Pools

Attachment 6

Table 1:

Normalized Vapor Flux to Outdoor Air from Residential Kiddie Pool

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	H (unitless)	D_{air} (m^2/d)	D_{water} (m^2/d)	Sc_L (unitless)	Sc_G (unitless)	k_L (m/s)	k_G (m/s)	K_L (cm/s)	C_{avg}/C_0 (unitless)	J_L (L/m^2-s)
VOC	Benzene	71-43-2	1.7E-01	7.6E-01	8.5E-05	9.1E+02	1.7E+00	5.73E-06	9.43E-03	5.71E-06	4.10E-01	2.34E-03
VOC	Cumene	98-82-8	3.3E-01	5.6E-01	6.1E-05	1.3E+03	2.3E+00	5.02E-06	7.69E-03	5.01E-06	4.48E-01	2.25E-03
VOC	1,2-Dibromoethane	106-93-4	2.4E-02	3.7E-01	7.3E-05	1.1E+03	3.5E+00	5.39E-06	5.83E-03	5.18E-06	4.38E-01	2.27E-03
VOC	1,2-Dichloroethane	107-06-2	2.9E-02	9.0E-01	8.6E-05	9.0E+02	1.5E+00	5.75E-06	1.05E-02	5.64E-06	4.13E-01	2.33E-03
VOC	Ethyl Benzene	100-41-4	2.2E-01	6.5E-01	6.7E-05	1.1E+03	2.0E+00	5.22E-06	8.47E-03	5.20E-06	4.37E-01	2.28E-03
VOC	Methyl tert-butyl ether	1634-04-4	1.8E-02	7.4E-01	8.7E-05	8.8E+02	1.8E+00	5.80E-06	9.28E-03	5.61E-06	4.15E-01	2.33E-03
VOC	Toluene	108-88-3	1.9E-01	7.5E-01	7.4E-05	1.0E+03	1.7E+00	5.43E-06	9.35E-03	5.41E-06	4.26E-01	2.30E-03
VOC	1,2,4-Trimethylbenzene	95-63-6	1.6E-01	5.2E-01	6.8E-05	1.1E+03	2.5E+00	5.25E-06	7.34E-03	5.23E-06	4.36E-01	2.28E-03
VOC	1,3,5-Trimethylbenzene	108-67-8	1.5E-01	5.2E-01	7.5E-05	1.0E+03	2.5E+00	5.45E-06	7.31E-03	5.42E-06	4.25E-01	2.30E-03
VOC	Xylenes (total)	1330-20-7	2.5E-01	6.7E-01	7.6E-05	1.0E+03	1.9E+00	5.46E-06	8.69E-03	5.45E-06	4.24E-01	2.31E-03
SVOC	Acenaphthene	83-32-9	3.4E-03	3.6E-01	6.6E-05	1.2E+03	3.6E+00	5.19E-06	5.75E-03	4.10E-06	5.08E-01	2.08E-03
SVOC	Anthracene	120-12-7	1.3E-03	2.8E-01	6.7E-05	1.2E+03	4.7E+00	5.20E-06	4.83E-03	2.85E-06	6.12E-01	1.74E-03
SVOC	Benzo(a)anthracene	56-55-3	5.6E-05	4.4E-01	7.8E-05	9.9E+02	3.0E+00	5.53E-06	6.54E-03	3.41E-07	9.38E-01	
SVOC	Benzo(a)pyrene	50-32-8	1.5E-05	3.7E-01	7.8E-05	9.9E+02	3.5E+00	5.53E-06	5.83E-03	8.58E-08	9.84E-01	
SVOC	Benzo(b)fluoranthene	205-99-2	1.7E-03	2.0E-01	4.8E-05	1.6E+03	6.7E+00	4.56E-06	3.79E-03	2.64E-06	6.32E-01	
SVOC	Benzo(g,h,i)perylene	191-24-2	1.1E-05	1.9E-01	4.5E-05	1.7E+03	6.9E+00	4.46E-06	3.69E-03	4.02E-08	9.92E-01	
SVOC	Benzo(k)fluoranthene	207-08-9	1.2E-05	2.0E-01	4.8E-05	1.6E+03	6.7E+00	4.56E-06	3.79E-03	4.34E-08	9.92E-01	
SVOC	Chrysene	218-01-9	1.5E-03	2.1E-01	5.4E-05	1.4E+03	6.1E+00	4.76E-06	4.03E-03	2.65E-06	6.32E-01	
SVOC	Dibenz(a,h)anthracene	53-70-3	9.6E-08	1.7E-01	4.5E-05	1.7E+03	7.5E+00	4.44E-06	3.52E-03	3.37E-10	1.00E+00	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.0E-06	6.9E-01	6.9E-05	1.1E+03	1.9E+00	5.27E-06	8.84E-03	9.12E-09	9.98E-01	
SVOC	Ethanol	64-17-5	2.0E-04	1.1E+00	1.1E-04	6.9E+02	1.2E+00	6.44E-06	1.18E-02	1.70E-06	7.38E-01	
SVOC	Fluorene	86-73-7	1.4E-03	3.1E-01	6.8E-05	1.1E+03	4.2E+00	5.24E-06	5.21E-03	3.04E-06	5.95E-01	1.81E-03
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.0E-05	1.6E-01	4.9E-05	1.6E+03	7.9E+00	4.59E-06	3.38E-03	6.75E-08	9.87E-01	
SVOC	Naphthalene	91-20-3	1.2E-02	5.1E-01	6.5E-05	1.2E+03	2.6E+00	5.13E-06	7.21E-03	4.85E-06	4.58E-01	2.22E-03
SVOC	Phenanthrene	85-01-8	1.4E-03	3.2E-01	6.5E-05	1.2E+03	4.0E+00	5.13E-06	5.32E-03	3.04E-06	5.94E-01	1.81E-03
SVOC	Pyrene	129-00-0	2.0E-04	2.4E-01	6.3E-05	1.2E+03	5.5E+00	5.06E-06	4.29E-03	7.35E-07	8.73E-01	
SVOC	Tetraethylene Glycol	112-60-7	1.6E-11	4.4E-01	7.0E-05	1.1E+03	3.0E+00	5.28E-06	6.52E-03	1.06E-13	1.00E+00	
PCB	PCBs (total)	1336-36-3	6.6E-02	1.7E-01	4.3E-05	1.8E+03	7.5E+00	4.38E-06	3.52E-03	4.30E-06	4.94E-01	
INORG	Antimony	7440-36-0										
INORG	Arsenic	7440-38-2										
INORG	Chromium III	16065-83-1										
INORG	Chromium VI	18540-29-9										
INORG	Cyanide (total)	57-12-5	2.0E-03	1.3E+00	1.5E-04	5.0E+02	9.7E-01	7.35E-06	1.38E-02	5.79E-06	4.06E-01	2.35E-03
INORG	Lead	7439-92-1										
INORG	Nickel	7440-02-0										
INORG	Vanadium	7440-62-2										

Attachment 6

Table 1:

Normalized Vapor Flux to Outdoor Air from Residential Kiddie Pool

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Notes:	Water density (g/cm^3)	ρ_w	1.00E+00
	Water viscosity (g/cm-s)	v_w	8.93E-03
	Air density (g/cm^3)	ρ_a	1.20E-03
	Air viscosity (g/cm-s)	v_a	1.81E-04
	Wind speed (mph)	u_{10}	9.3
	Wind speed (m/s)	u_{10}	4.2
	Friction velocity (m/s)	u	0.123
	Pool effective diameter (m)	d_e	2.1
	Pool water surface area (m^2)	A	3.3
	Pool water depth (m)	d	0.23
	Pool water volume (m^3)	V	0.76
	Fetch-to-depth ratio	F/D	9.0
	Averaging period (days)	t	1.0

Attachment 6
Table 2:
Nonsteady State Dermal Absorption of Chemicals from Water in Residential Kiddie Pool
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	MW (g/mole)	FA (unitless)	K_p (cm/hr)	B (unitless)	t (hr)	c	b	ts (hr)	DA (L/cm^2-event)
VOC	Benzene	71-43-2	7.8E+01	1.0E+00	1.5E-02	5.0E-02	2.9E-01	3.7E-01	3.3E-01	6.9E-01	3.70E-05
VOC	Cumene	98-82-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,2-Dibromoethane	106-93-4	1.9E+02	1.0E+00	1.6E-03	8.4E-03	1.2E+00	3.4E-01	3.1E-01	2.8E+00	6.81E-06
VOC	1,2-Dichloroethane	107-06-2	9.9E+01	1.0E+00	4.1E-03	1.6E-02	3.8E-01	3.4E-01	3.1E-01	9.0E-01	1.13E-05
VOC	Ethyl Benzene	100-41-4	1.1E+02	1.0E+00	4.8E-02	1.9E-01	4.1E-01	4.7E-01	4.3E-01	9.9E-01	1.27E-04
VOC	Methyl tert-butyl ether	1634-04-4	8.8E+01	1.0E+00	3.3E-03	1.2E-02	3.3E-01	3.4E-01	3.1E-01	7.9E-01	8.84E-06
VOC	Toluene	108-88-3	9.2E+01	1.0E+00	3.2E-02	1.2E-01	3.5E-01	4.2E-01	3.8E-01	8.3E-01	8.08E-05
VOC	1,2,4-Trimethylbenzene	95-63-6	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	1,3,5-Trimethylbenzene	108-67-8	1.2E+02	1.0E+00			5.0E-01	3.3E-01	3.0E-01	1.2E+00	
VOC	Xylenes (total)	1330-20-7	1.1E+02	1.0E+00	5.0E-02	2.0E-01	4.1E-01	4.8E-01	4.4E-01	9.9E-01	1.32E-04
SVOC	Acenaphthene	83-32-9	1.5E+02	1.0E+00			7.7E-01	3.3E-01	3.0E-01	1.8E+00	
SVOC	Anthracene	120-12-7	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Benzo(a)anthracene	56-55-3	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Benzo(a)pyrene	50-32-8	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(b)fluoranthene	205-99-2	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Benzo(g,h,i)perylene	191-24-2	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Benzo(k)fluoranthene	207-08-9	2.5E+02	8.0E-01			2.7E+00	3.3E-01	3.0E-01	6.5E+00	
SVOC	Chrysene	218-01-9	2.3E+02	9.0E-01			2.0E+00	3.3E-01	3.0E-01	4.8E+00	
SVOC	Dibenz(a,h)anthracene	53-70-3	2.8E+02	7.0E-01			3.8E+00	3.3E-01	3.0E-01	9.1E+00	
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	2.6E+02	1.0E+00			2.9E+00	3.3E-01	3.0E-01	6.9E+00	
SVOC	Ethanol	64-17-5	4.6E+01	1.0E+00	5.5E-04	1.4E-03	1.9E-01	3.3E-01	3.0E-01	4.6E-01	1.30E-06
SVOC	Fluorene	86-73-7	1.7E+02	1.0E+00			9.0E-01	3.3E-01	3.0E-01	2.2E+00	
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	2.8E+02	7.0E-01			3.7E+00	3.3E-01	3.0E-01	8.9E+00	
SVOC	Naphthalene	91-20-3	1.3E+02	1.0E+00			5.5E-01	3.3E-01	3.0E-01	1.3E+00	
SVOC	Phenanthrene	85-01-8	1.8E+02	1.0E+00			1.0E+00	3.3E-01	3.0E-01	2.5E+00	
SVOC	Pyrene	129-00-0	2.0E+02	1.0E+00			1.4E+00	3.3E-01	3.0E-01	3.4E+00	
SVOC	Tetraethylene Glycol	112-60-7	1.9E+02	1.0E+00			1.3E+00	3.3E-01	3.0E-01	3.1E+00	
PCB	PCBs (total)	1336-36-3	3.3E+02	7.0E-01			7.2E+00	3.3E-01	3.0E-01	1.7E+01	
INORG	Antimony	7440-36-0	1.2E+02		1.0E-03		5.1E-01	3.3E-01	3.0E-01	1.2E+00	2.00E-06
INORG	Arsenic	7440-38-2	7.5E+01		1.0E-03		2.8E-01	3.3E-01	3.0E-01	6.6E-01	2.00E-06
INORG	Chromium III	16065-83-1	5.2E+01		1.0E-03		2.1E-01	3.3E-01	3.0E-01	4.9E-01	2.00E-06
INORG	Chromium VI	18540-29-9	5.2E+01		2.0E-03		2.1E-01	3.3E-01	3.0E-01	4.9E-01	4.00E-06
INORG	Cyanide (total)	57-12-5	2.6E+01		1.0E-03		1.5E-01	3.3E-01	3.0E-01	3.5E-01	2.00E-06
INORG	Lead	7439-92-1	2.1E+02		1.0E-04		1.5E+00	3.3E-01	3.0E-01	3.7E+00	2.00E-07
INORG	Nickel	7440-02-0	5.9E+01		2.0E-04		2.2E-01	3.3E-01	3.0E-01	5.4E-01	4.00E-07
INORG	Vanadium	7440-62-2	5.1E+01		1.0E-03		2.0E-01	3.3E-01	3.0E-01	4.9E-01	2.00E-06

Notes:

Event Time hours **t** 2

K_p capped at 1 cm/hr (USEPA 1992).

The dermal absorbed dose for inorganic chemicals is estimated using a steady-state approach (USEPA 2004, Equation 3.4) and for organic chemicals is estimated using a nonsteady-state approach (USEPA 2004, Equations 3.2 and 3.3).

Attachment 6
Table 3:
Dispersion Factor to Outdoor Air
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Parameter	Units	Value
Correlation coefficient city		Philadelphia
Correlation coefficient A		14.0111
Correlation coefficient B		19.6154
Correlation coefficient C		225.3397

Source area	acres	0.0008
Groundwater averaging time for C/Q		1-Hour Max
C/Q	$(L/m^3)/(L/m^2\text{-}s)$	**15.83**

Note:
C/Q is estimated using the empirical correlation in USEPA's (2002) Supplemental Soil Screening Guidance.

Attachment 6

Table 4a:

Unit Risk and Cancer-Based RBSLs for Exposure of Residents to Groundwater in Kiddie Pools

Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

						Incidental Ingestion					Dermal Contact						Vapor Inhalation					All Routes	
Chem Group	Chemical	CASRN	Cancer Class	ADAF	C_{gw} (mg/l)	LADD (mg/kg/d)	SF_{oral} $(mg/kg/d)^{-1}$	f_{oral}	Risk	RBSL (mg/L)	DA (L/cm^2-event)	LADD (mg/kg/d)	SF_{derm} $(mg/kg/d)^{-1}$	f_{oral}	Risk	RBSL (mg/L)	C_{air} (mg/m^3)	URF $(mg/m^3)^{-1}$	f_{inh}	Risk	RBSL (mg/L)	Risk	RBSL (mg/L)
VOC	Benzene	71-43-2	A	N	1.00E+00	1.06E-04	5.5E-02		5.8E-06	1.7E+00	3.70E-05	4.65E-04	5.5E-02		2.6E-05	3.9E-01	3.70E-02	7.8E-03		2.4E-06	4.3E+00	3.4E-05	3.0E-01
VOC	Cumene	98-82-8	D	N	1.00E+00	1.16E-04											3.56E-02						
VOC	1,2-Dibromoethane	106-93-4	LC	N	1.00E+00	1.13E-04	2.0E+00		2.3E-04	4.4E-02	6.81E-06	9.15E-05	2.0E+00		1.8E-04	5.5E-02	3.60E-02	6.0E-01		1.8E-04	5.7E-02	5.8E-04	1.7E-02
VOC	1,2-Dichloroethane	107-06-2	B2	N	1.00E+00	1.06E-04	9.1E-02		9.7E-06	1.0E+00	1.13E-05	1.43E-04	9.1E-02		1.3E-05	7.7E-01	3.69E-02	2.6E-02		7.8E-06	1.3E+00	3.1E-05	3.3E-01
VOC	Ethyl Benzene	100-41-4	D	N	1.00E+00	1.13E-04					1.27E-04	1.70E-03					3.60E-02						
VOC	Methyl tert-butyl ether	1634-04-4	C	N	1.00E+00	1.07E-04	1.8E-03		1.9E-07	5.2E+01	8.84E-06	1.12E-04	1.8E-03		2.0E-07	4.9E+01	3.68E-02	2.6E-04		7.8E-08	1.3E+02	4.7E-07	2.1E+01
VOC	Toluene	108-88-3	ID	N	1.00E+00	1.10E-04					8.08E-05	1.05E-03					3.65E-02						
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	N	1.00E+00	1.12E-04											3.61E-02						
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	N	1.00E+00	1.10E-04											3.65E-02						
VOC	Xylenes (total)	1330-20-7	ID	N	1.00E+00	1.09E-04					1.32E-04	1.71E-03					3.65E-02						
SVOC	Acenaphthene	83-32-9	ID	N	1.00E+00	1.31E-04											3.30E-02						
SVOC	Anthracene	120-12-7	ID	N	1.00E+00	1.58E-04											2.76E-02						
SVOC	Benzo(a)anthracene	56-55-3	B2	Y	1.00E+00	2.42E-04	1.0E-01	1	9.5E-05	1.0E-01			1.0E-01	1				6.0E-02	1			9.5E-05	1.0E-01
SVOC	Benzo(a)pyrene	50-32-8	HC	Y	1.00E+00	2.54E-04	1.0E+00	1	1.0E-03	1.0E-02			1.0E+00	1				6.0E-01	1			1.0E-03	1.0E-02
SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y	1.00E+00	1.63E-04	1.0E-01	1	6.4E-05	1.6E-01			1.0E-01	1				6.0E-02	1			6.4E-05	1.6E-01
SVOC	Benzo(g,h,i)perylene	191-24-2	D	N	1.00E+00	2.56E-04																	
SVOC	Benzo(k)fluoranthene	207-08-9	B2	Y	1.00E+00	2.56E-04	1.0E-02	1	1.0E-05	9.9E-01			1.0E-02	1				6.0E-03	1			1.0E-05	9.9E-01
SVOC	Chrysene	218-01-9	B2	Y	1.00E+00	1.63E-04	1.0E-03	1	6.4E-07	1.6E+01			1.0E-03	1				6.0E-04	1			6.4E-07	1.6E+01
SVOC	Dibenz(a,h)anthracene	53-70-3	B2	Y	1.00E+00	2.58E-04	1.0E+00	1	1.0E-03	9.8E-03			1.0E+00	1				6.0E-01	1			1.0E-03	9.8E-03
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	C	Y	1.00E+00	2.57E-04	2.5E+02	1	2.5E-01	3.9E-05			2.5E+02	1				7.1E+01	1			2.5E-01	3.9E-05
SVOC	Ethanol	64-17-5		N	1.00E+00	1.90E-04					1.30E-06	2.94E-05											
SVOC	Fluorene	86-73-7	D	N	1.00E+00	1.53E-04											2.86E-02						
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y	1.00E+00	2.54E-04	1.0E-01	1	1.0E-04	1.0E-01			1.0E-01	1				6.0E-02	1			1.0E-04	1.0E-01
SVOC	Naphthalene	91-20-3	C	N	1.00E+00	1.18E-04	1.2E-01		1.4E-05	7.1E-01			1.2E-01				3.52E-02	3.4E-02		9.7E-06	1.0E+00	2.4E-05	4.2E-01
SVOC	Phenanthrene	85-01-8	D	N	1.00E+00	1.53E-04											2.86E-02						
SVOC	Pyrene	129-00-0	NC	N	1.00E+00	2.25E-04																	
SVOC	Tetraethylene Glycol	112-60-7		N	1.00E+00	2.58E-04																	
PCB	PCBs (total)	1336-36-3	B2	N	1.00E+00	1.27E-04	2.0E+00		2.5E-04	3.9E-02			2.0E+00					5.7E-01				2.5E-04	3.9E-02
INORG	Antimony	7440-36-0	ID	N	1.00E+00	2.58E-04					2.00E-06	6.13E-05											
INORG	Arsenic	7440-38-2	A	N	1.00E+00	2.58E-04	1.5E+00		3.9E-04	2.6E-02	2.00E-06	6.13E-05	1.5E+00		9.2E-05	1.1E-01		4.3E+00				4.8E-04	2.1E-02
INORG	Chromium III	16065-83-1	D	N	1.00E+00	2.58E-04					2.00E-06	6.13E-05											
INORG	Chromium VI	18540-29-9	A	N	1.00E+00	2.58E-04	5.0E-01		1.3E-04	7.8E-02	4.00E-06	1.23E-04	2.0E+01		2.5E-03	4.1E-03		1.2E+01				2.6E-03	3.9E-03
INORG	Cyanide (total)	57-12-5		N	1.00E+00	1.05E-04					2.00E-06	2.49E-05					3.72E-02						
INORG	Lead	7439-92-1	B2	N	1.00E+00	2.58E-04					2.00E-07	6.13E-06											
INORG	Nickel	7440-02-0	A	N	1.00E+00	2.58E-04					4.00E-07	1.23E-05						2.4E-01					
INORG	Vanadium	7440-62-2	ID	N	1.00E+00	2.58E-04					2.00E-06	6.13E-05											

Notes:

f_{oral} and f_{inh} are the fraction of the oral and inhalation toxicity values, respectively, that USEPA identified as having a mutagenic mode of action.

Cancer RBSLs are calculated at a target cancer risk of 1E-05.

Attachment 6
Table 4b:
Unit HQ and Noncancer-Based RBSLs for Exposure of Residents to Groundwater in Kiddie Pools
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

				Incidental Ingestion				Dermal Contact					Vapor Inhalation				All Routes	
Chem Group	Chemical	CASRN	C_{gw} (mg/L)	ADD (mg/kg/d)	RfD_{oral} (mg/kg/d)	HQ	RBSL (mg/L)	DA (L/cm^2-event)	ADD (mg/kg/d)	RfD_{derm} (mg/kg/d)	HQ	RBSL (mg/L)	C_{air} (mg/m^3)	RfC (mg/m^3)	HQ	RBSL (mg/L)	HQ	RBSL (mg/L)
VOC	Benzene	71-43-2	1.00E+00	2.84E-04	1.0E-02	2.8E-02	3.5E+00	3.70E-05	1.25E-03	1.0E-02	1.3E-01	8.0E-01	3.70E-02	9.0E-02	9.0E-03	1.1E+01	1.6E-01	6.1E-01
VOC	Cumene	98-82-8	1.00E+00	3.11E-04	4.0E-01	7.8E-04	1.3E+02			4.0E-01			3.56E-02	4.0E-01	1.9E-03	5.1E+01	2.7E-03	3.7E+01
VOC	1,2-Dibromoethane	106-93-4	1.00E+00	3.04E-04	9.0E-03	3.4E-02	3.0E+00	6.81E-06	2.46E-04	9.0E-03	2.7E-02	3.7E+00	3.60E-02	9.0E-03	8.8E-02	1.1E+00	1.5E-01	6.7E-01
VOC	1,2-Dichloroethane	107-06-2	1.00E+00	2.87E-04	2.0E-02	1.4E-02	7.0E+00	1.13E-05	3.85E-04	2.0E-02	1.9E-02	5.2E+00	3.69E-02	7.0E-02	1.2E-02	8.7E+00	4.5E-02	2.2E+00
VOC	Ethyl Benzene	100-41-4	1.00E+00	3.03E-04	1.0E-01	3.0E-03	3.3E+01	1.27E-04	4.58E-03	1.0E-01	4.6E-02	2.2E+00	3.60E-02	9.0E+00	8.8E-05	1.1E+03	4.9E-02	2.0E+00
VOC	Methyl tert-butyl ether	1634-04-4	1.00E+00	2.88E-04	3.0E-01	9.6E-04	1.0E+02	8.84E-06	3.03E-04	3.0E-01	1.0E-03	9.9E+01	3.68E-02	3.0E+00	2.7E-04	3.7E+02	2.2E-03	4.5E+01
VOC	Toluene	108-88-3	1.00E+00	2.95E-04	8.0E-01	3.7E-04	2.7E+02	8.08E-05	2.84E-03	8.0E-01	3.5E-03	2.8E+01	3.65E-02	5.0E+00	1.6E-04	6.3E+02	4.1E-03	2.5E+01
VOC	1,2,4-Trimethylbenzene	95-63-6	1.00E+00	3.02E-04	4.0E-02	7.6E-03	1.3E+01			4.0E-02			3.61E-02	2.0E-01	4.0E-03	2.5E+01	1.2E-02	8.7E+00
VOC	1,3,5-Trimethylbenzene	108-67-8	1.00E+00	2.95E-04	4.0E-02	7.4E-03	1.4E+01			4.0E-02			3.65E-02	2.0E-01	4.0E-03	2.5E+01	1.1E-02	8.8E+00
VOC	Xylenes (total)	1330-20-7	1.00E+00	2.94E-04	2.0E-01	1.5E-03	6.8E+01	1.32E-04	4.61E-03	2.0E-01	2.3E-02	4.3E+00	3.65E-02	3.0E-01	2.7E-03	3.7E+01	2.7E-02	3.7E+00
SVOC	Acenaphthene	83-32-9	1.00E+00	3.53E-04	2.0E-01	1.8E-03	5.7E+01			2.0E-01			3.30E-02				1.8E-03	5.7E+01
SVOC	Anthracene	120-12-7	1.00E+00	4.25E-04	1.0E+00	4.2E-04	2.4E+02			1.0E+00			2.76E-02				4.2E-04	2.4E+02
SVOC	Benzo(a)anthracene	56-55-3	1.00E+00	6.51E-04														
SVOC	Benzo(a)pyrene	50-32-8	1.00E+00	6.83E-04	3.0E-04	2.3E+00	4.4E-02			3.0E-04				2.0E-06			2.3E+00	4.4E-02
SVOC	Benzo(b)fluoranthene	205-99-2	1.00E+00	4.39E-04														
SVOC	Benzo(g,h,i)perylene	191-24-2	1.00E+00	6.88E-04	3.0E-01	2.3E-03	4.4E+01			3.0E-01							2.3E-03	4.4E+01
SVOC	Benzo(k)fluoranthene	207-08-9	1.00E+00	6.88E-04														
SVOC	Chrysene	218-01-9	1.00E+00	4.38E-04														
SVOC	Dibenz(a,h)anthracene	53-70-3	1.00E+00	6.94E-04														
SVOC	7,12-Dimethylbenz(a)anthracene	57-97-6	1.00E+00	6.92E-04														
SVOC	Ethanol	64-17-5	1.00E+00	5.12E-04	6.2E+01	8.3E-06	1.2E+04	1.30E-06	7.91E-05	6.2E+01	1.3E-06	7.8E+04		1.9E+01			9.5E-06	1.0E+04
SVOC	Fluorene	86-73-7	1.00E+00	4.13E-04	4.0E-01	1.0E-03	9.7E+01			4.0E-01			2.86E-02				1.0E-03	9.7E+01
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	1.00E+00	6.85E-04														
SVOC	Naphthalene	91-20-3	1.00E+00	3.18E-04	2.0E-01	1.6E-03	6.3E+01			2.0E-01			3.52E-02	3.0E-03	2.6E-01	3.9E-01	2.6E-01	3.9E-01
SVOC	Phenanthrene	85-01-8	1.00E+00	4.12E-04	3.0E-01	1.4E-03	7.3E+01			3.0E-01			2.86E-02				1.4E-03	7.3E+01
SVOC	Pyrene	129-00-0	1.00E+00	6.06E-04	3.0E-01	2.0E-03	5.0E+01			3.0E-01							2.0E-03	5.0E+01
SVOC	Tetraethylene Glycol	112-60-7	1.00E+00	6.94E-04	2.0E+00	3.5E-04	2.9E+02			2.0E+00							3.5E-04	2.9E+02
PCB	PCBs (total)	1336-36-3	1.00E+00	3.43E-04	5.0E-05	6.9E+00	1.5E-02			5.0E-05							6.9E+00	1.5E-02
INORG	Antimony	7440-36-0	1.00E+00	6.94E-04	4.0E-04	1.7E+00	5.8E-02	2.00E-06	1.65E-04	6.0E-05	2.8E+00	3.6E-02					4.5E+00	2.2E-02
INORG	Arsenic	7440-38-2	1.00E+00	6.94E-04	5.0E-03	1.4E-01	7.2E-01	2.00E-06	1.65E-04	5.0E-03	3.3E-02	3.0E+00		1.5E-05			1.7E-01	5.8E-01
INORG	Chromium III	16065-83-1	1.00E+00	6.94E-04	1.5E+00	4.6E-04	2.2E+02	2.00E-06	1.65E-04	2.0E-02	8.5E-03	1.2E+01		5.0E-03			8.9E-03	1.1E+01
INORG	Chromium VI	18540-29-9	1.00E+00	6.94E-04	5.0E-03	1.4E-01	7.2E-01	4.00E-06	3.30E-04	1.3E-04	2.6E+00	3.8E-02		1.0E-03			2.8E+00	3.6E-02
INORG	Cyanide (total)	57-12-5	1.00E+00	2.81E-04	6.0E-03	4.7E-02	2.1E+00	2.00E-06	6.70E-05	6.0E-03	1.1E-02	9.0E+00	3.72E-02	3.0E-03	2.7E-01	3.7E-01	3.3E-01	3.0E-01
INORG	Lead	7439-92-1	1.00E+00	6.94E-04				2.00E-07	1.65E-05									
INORG	Nickel	7440-02-0	1.00E+00	6.94E-04	2.0E-02	3.5E-02	2.9E+00	4.00E-07	3.30E-05	8.0E-04	4.1E-02	2.4E+00		2.0E-04			7.6E-02	1.3E+00
INORG	Vanadium	7440-62-2	1.00E+00	6.94E-04	1.0E-02	6.9E-02	1.4E+00	2.00E-06	1.65E-04	2.6E-04	6.4E-01	1.6E-01		1.0E-04			7.0E-01	1.4E-01

Notes:
Noncancer RBSLs are calculated at a target HQ of 0.1.

Appendix C

Analytical Data

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-191-01	PB-191-02	PB-191-03	PB-191-04	PB-191-05	PB-191-06	PB-191-07	PB-191-07
Field Sample ID					PB-191-01-SS01	PB-191-02-SS01	PB-191-03-SS01	PB-191-04-SS01	PB-191-05-SS01	PB-191-06-SS01	PB-191-07-SS01	DUP-25
Collection Depth (ft bgs)					4.0 - 4.5	3.5 - 4.0	3.0 - 3.5	1.5 - 2.0	3.0 - 3.5	0.5 - 1.0	4.5 - 5.0	4.5 - 5.0
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					12/9/2021	12/9/2021	7/15/2022	12/9/2021	12/9/2021	12/9/2021	12/9/2021	12/9/2021
Comments												Field Duplicate
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00073)	0.0094 (0.0012)	ND (0.00066)	0.0012 (0.00065)	ND (0.00058)	ND (0.00057)	ND (0.0011)	ND (0.00071)
Cumene	1000	6.1	87	1000	ND (0.0014)	0.0022 J (0.0024)	ND (0.0013)	0.0015 (0.0013)	0.00027 J (0.0012)	0.0036 (0.0011)	ND (0.0022)	0.0082 (0.0014)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00073)	ND (0.0012)	ND (0.00066)	ND (0.00065)	ND (0.00058)	ND (0.00057)	ND (0.0011)	ND (0.00071)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0014)	ND (0.0024)	ND (0.0013)	ND (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.0022)	ND (0.0014)
Ethyl Benzene	2300	15	1300	820	ND (0.0014)	0.0012 J (0.0024)	ND (0.0013)	0.001 J (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.0022)	ND (0.0014)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0029)	ND (0.0049)	ND (0.0026)	ND (0.0026)	ND (0.0023)	ND (0.0023)	ND (0.0043)	ND (0.0028)
Toluene	8000	76	650	9800	ND (0.0014)	0.0015 J (0.0024)	ND (0.0013)	ND (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.0022)	ND (0.0014)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0029)	0.0013 J (0.0049)	ND (0.0026)	0.0023 J (0.0026)	ND (0.0023)	0.00046 J (0.0023)	ND (0.0043)	ND (0.0028)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0029)	0.00054 J (0.0049)	ND (0.0026)	0.0013 J (0.0026)	ND (0.0023)	ND (0.0023)	ND (0.0043)	ND (0.0028)
Xylenes (total)	240	1.5	51	340	ND (0.0014)	0.0047 J (0.0024)	ND (0.0013)	0.0032 J (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.0022)	ND (0.0014)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.12)	0.049 J (0.13)	ND (0.1)	ND (0.6)	0.16 (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	0.17 (0.12)	0.077 J (0.12)	0.11 J (0.12)	0.095 J (0.13)	ND (0.1)	ND (0.6)	0.21 (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	0.15 J (0.16)	0.071 J (0.16)	0.12 J (0.17)	0.076 J (0.18)	ND (0.14)	ND (0.8)	0.18 (0.16)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	0.19 (0.12)	0.089 J (0.12)	0.13 (0.12)	0.099 J (0.13)	ND (0.1)	ND (0.6)	0.17 (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	0.088 J (0.16)	0.062 J (0.16)	0.06 J (0.17)	0.056 J (0.18)	ND (0.14)	ND (0.8)	0.19 (0.16)	ND (0.16)
Chrysene	43000	--	320000	--	0.16 (0.12)	0.08 J (0.12)	0.1 J (0.12)	0.095 J (0.13)	ND (0.1)	ND (0.6)	0.26 (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.2)	ND (0.21)	ND (0.21)	0.054 J (0.22)	ND (0.18)	ND (1)	0.061 J (0.2)	0.044 J (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.1 J (0.16)	0.055 J (0.16)	0.07 J (0.17)	0.056 J (0.18)	ND (0.14)	ND (0.8)	0.11 J (0.16)	ND (0.16)
Naphthalene	41	0.54	6	27	0.039 J (0.2)	0.063 J (0.21)	ND (0.21)	0.1 J (0.22)	ND (0.18)	ND (1)	0.23 (0.2)	ND (0.2)
Phenanthrene	4600	--	14000	--	0.11 J (0.12)	0.092 J (0.12)	ND (0.12)	0.19 (0.13)	ND (0.1)	ND (0.6)	0.77 (0.12)	ND (0.12)
Pyrene	4600	--	14000	--	0.22 (0.12)	0.1 J (0.12)	0.16 (0.12)	0.14 (0.13)	ND (0.1)	ND (0.6)	0.44 (0.12)	0.021 J (0.12)
Metals												
Lead	2520	--	2520	45000	110 (2.34)	46.8 (2.36)	19.8 (2.41)	295 (2.62)	12.8 (10.5)	26.5 (2.38)	176 (4.59)	218 (4.72)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-191-08	PB-826-01	PB-826-02	PB-826-03	PB-826-04	PB-826-05	PB-826-06	PB-826-07
Field Sample ID					PB-191-08-SS01	PB-826-01-SS01	PB-826-02-SS01	PB-826-03-SS01	PB-826-04-SS01	PB-826-05-SS01	PB-826-06-SS01	PB-826-07-SS01
Collection Depth (ft bgs)					4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					12/9/2021	7/13/2022	7/13/2022	7/13/2022	7/13/2022	7/13/2022	7/13/2022	7/13/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.0003 J (0.00057)	ND (0.00069)	ND (0.00052)	ND (0.00063)	ND (0.00097)	ND (0.00055)	ND (0.00075)	ND (0.00061)
Cumene	1000	6.1	87	1000	0.003 (0.0011)	ND (0.0014)	ND (0.001)	ND (0.0013)	ND (0.0019)	ND (0.0011)	ND (0.0015)	ND (0.0012)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00057)	ND (0.00069)	ND (0.00052)	ND (0.00063)	ND (0.00097)	ND (0.00055)	ND (0.00075)	ND (0.00061)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.0014)	ND (0.001)	ND (0.0013)	ND (0.0019)	ND (0.0011)	ND (0.0015)	ND (0.0012)
Ethyl Benzene	2300	15	1300	820	0.00021 J (0.0011)	ND (0.0014)	ND (0.001)	ND (0.0013)	ND (0.0019)	ND (0.0011)	ND (0.0015)	ND (0.0012)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0023)	0.00032 J (0.0028)	0.001 J (0.0021)	0.02 (0.0025)	0.0012 J (0.0039)	ND (0.0022)	0.013 (0.003)	0.016 (0.0024)
Toluene	8000	76	650	9800	ND (0.0011)	ND (0.0014)	ND (0.001)	ND (0.0013)	ND (0.0019)	ND (0.0011)	ND (0.0015)	ND (0.0012)
1,2,4-Trimethylbenzene	180	0.92	70	250	0.0031 (0.0023)	ND (0.0028)	ND (0.0021)	ND (0.0025)	ND (0.0039)	ND (0.0022)	ND (0.003)	ND (0.0024)
1,3,5-Trimethylbenzene	220	0.92	99	240	0.00066 J (0.0023)	ND (0.0028)	ND (0.0021)	ND (0.0025)	ND (0.0039)	ND (0.0022)	ND (0.003)	ND (0.0024)
Xylenes (total)	240	1.5	51	340	0.0023 (0.0011)	ND (0.0014)	ND (0.001)	ND (0.0013)	ND (0.0019)	ND (0.0011)	ND (0.0015)	ND (0.0012)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	0.047 J (0.12)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	0.054 J (0.12)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	0.043 J (0.16)	ND (0.16)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	0.052 J (0.12)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.19)	ND (0.2)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.18)	ND (0.17)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.031 J (0.16)	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.059 J (0.19)	ND (0.2)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.18)	ND (0.17)
Phenanthrene	4600	--	14000	--	0.084 J (0.12)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)
Pyrene	4600	--	14000	--	0.07 J (0.12)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)
Metals												
Lead	2520	--	2520	45000	84.5 (2.3)	3.14 J (4.68)	3.36 J (4.04)	3.14 J (4.08)	3.88 J (4.14)	3.46 J (4.14)	8.1 J (10.4)	3.19 J (10.3)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-826-08	PB-826-09	PB-826-10	PB-826-11	PB-826-12	PB-826-13	PB-826-14	PB-826-15
Field Sample ID					PB-826-08-SS01	PB-826-09-SS01	PB-826-10-SS01	PB-826-11-SS01	PB-826-12-SS01	PB-826-13-SS01	PB-826-14-SS01	PB-826-15-SS01
Collection Depth (ft bgs)					4.5 - 5.0	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/13/2022	7/13/2022	7/13/2022	7/14/2022	7/14/2022	7/14/2022	7/14/2022	7/14/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.00033 J (0.00051)	ND (0.00068)	ND (0.00073)	ND (0.00059)	ND (0.00055)	ND (0.0007)	ND (0.031)	ND (0.00086)
Cumene	1000	6.1	87	1000	ND (0.001)	ND (0.0014)	ND (0.0015)	ND (0.0012)	ND (0.0011)	ND (0.0014)	0.28 (0.062)	ND (0.0017)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00051)	ND (0.00068)	ND (0.00073)	ND (0.00059)	ND (0.00055)	ND (0.0007)	ND (0.031)	ND (0.00086)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.001)	ND (0.0014)	ND (0.0015)	ND (0.0012)	ND (0.0011)	ND (0.0014)	ND (0.062)	ND (0.0017)
Ethyl Benzene	2300	15	1300	820	ND (0.001)	ND (0.0014)	ND (0.0015)	ND (0.0012)	ND (0.0011)	ND (0.0014)	0.73 (0.062)	ND (0.0017)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.002)	ND (0.0027)	ND (0.0029)	ND (0.0024)	ND (0.0022)	ND (0.0028)	ND (0.12)	ND (0.0034)
Toluene	8000	76	650	9800	ND (0.001)	ND (0.0014)	ND (0.0015)	ND (0.0012)	ND (0.0011)	ND (0.0014)	ND (0.062)	ND (0.0017)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.002)	ND (0.0027)	ND (0.0029)	ND (0.0024)	ND (0.0022)	ND (0.0028)	12 (0.12)	ND (0.0034)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.002)	ND (0.0027)	ND (0.0029)	ND (0.0024)	ND (0.0022)	ND (0.0028)	4.4 (0.12)	ND (0.0034)
Xylenes (total)	240	1.5	51	340	ND (0.001)	ND (0.0014)	ND (0.0015)	ND (0.0012)	ND (0.0011)	ND (0.0014)	0.21 J (0.062)	ND (0.0017)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	0.061 J (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	0.03 J (0.12)	0.069 J (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	0.053 J (0.15)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	ND (0.12)	0.055 J (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	0.041 J (0.15)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	0.042 J (0.12)	0.095 J (0.12)
Fluorene	6200	--	18000	--	ND (0.2)	ND (0.2)	ND (0.18)	ND (0.18)	ND (0.17)	ND (0.18)	0.18 J (0.19)	ND (0.19)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.2)	ND (0.2)	ND (0.18)	ND (0.18)	ND (0.17)	ND (0.18)	0.32 (0.19)	0.052 J (0.19)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	0.64 (0.12)	0.15 (0.12)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	0.16 (0.12)	0.18 (0.12)
Metals												
Lead	2520	--	2520	45000	4.67 J (4.69)	5.55 (4.83)	3.72 J (4.13)	3.61 J (4.12)	3 J (4.04)	4.29 (4.12)	8.32 (2.23)	162 (2.2)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location					PB-826-15	PB-826-16	PB-840-01	PB-840-01	PB-840-02	PB-840-03	PB-840-04	PB-840-05
Field Sample ID					DUP-44	PB-826-16-SS01	PB-840-01-SS01	DUP-38	PB-840-02-SS01	PB-840-03-SS01	PB-840-04-SS01	PB-840-05-SS01
Collection Depth (ft bgs)	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/14/2022	7/14/2022	7/8/2022	7/8/2022	7/8/2022	7/8/2022	7/8/2022	7/8/2022
Comments					Field Duplicate			Field Duplicate				
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.068 (0.036)	ND (0.00089)	0.006 (0.0008)	ND (0.00057)	0.00021 J (0.00051)	ND (0.00048)	ND (0.00052)	ND (0.00072)
Cumene	1000	6.1	87	1000	1 (0.071)	ND (0.0018)	0.0092 (0.0016)	ND (0.0011)	0.00034 J (0.001)	0.00015 J (0.00095)	ND (0.001)	ND (0.0014)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.036)	ND (0.00089)	ND (0.0008)	ND (0.00057)	ND (0.00051)	ND (0.00048)	ND (0.00052)	ND (0.00072)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.071)	ND (0.0018)	ND (0.0016)	ND (0.0011)	ND (0.001)	ND (0.00095)	ND (0.001)	ND (0.0014)
Ethyl Benzene	2300	15	1300	820	0.56 (0.071)	ND (0.0018)	0.00068 J (0.0016)	ND (0.0011)	0.00019 J (0.001)	0.00028 J (0.00095)	ND (0.001)	ND (0.0014)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.14)	ND (0.0036)	ND (0.0032)	ND (0.0023)	ND (0.002)	ND (0.0019)	ND (0.0021)	ND (0.0029)
Toluene	8000	76	650	9800	0.051 J (0.071)	ND (0.0018)	0.0026 (0.0016)	ND (0.0011)	ND (0.001)	ND (0.00095)	ND (0.001)	ND (0.0014)
1,2,4-Trimethylbenzene	180	0.92	70	250	15 (0.14)	0.00061 J (0.0036)	0.0014 J (0.0032)	ND (0.0023)	0.0035 (0.002)	ND (0.0019)	ND (0.0021)	ND (0.0029)
1,3,5-Trimethylbenzene	220	0.92	99	240	4.8 (0.14)	0.00089 J (0.0036)	0.0023 J (0.0032)	ND (0.0023)	0.0059 (0.002)	0.00062 J (0.0019)	ND (0.0021)	0.00047 J (0.0029)
Xylenes (total)	240	1.5	51	340	29 (0.071)	ND (0.0018)	0.008 J (0.0016)	ND (0.0011)	0.002 (0.001)	ND (0.00095)	ND (0.001)	ND (0.0014)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.1)	ND (0.11)	ND (0.12)	0.092 J (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)
Benzo(a)anthracene	430	--	3200	--	0.027 J (0.1)	ND (0.11)	0.15 (0.12)	0.44 (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	0.03 J (0.11)
Benzo(a)pyrene	43	--	7.7	--	ND (0.14)	ND (0.15)	0.15 J (0.16)	0.4 (0.15)	ND (0.15)	ND (0.15)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	0.029 J (0.1)	ND (0.11)	0.18 (0.12)	0.52 (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	0.053 J (0.11)
Benzo(g,h,i)perylene	4600	--	14000	--	0.027 J (0.14)	ND (0.15)	0.12 J (0.16)	0.18 (0.15)	ND (0.15)	ND (0.15)	ND (0.14)	0.025 J (0.14)
Chrysene	43000	--	320000	--	0.15 (0.1)	ND (0.11)	0.22 (0.12)	0.43 (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	0.056 J (0.11)
Fluorene	6200	--	18000	--	0.39 (0.17)	ND (0.19)	ND (0.2)	0.052 J (0.19)	ND (0.18)	ND (0.19)	ND (0.17)	0.023 J (0.18)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	2.7 (0.17)	0.025 J (0.19)	0.046 J (0.2)	0.045 J (0.19)	ND (0.18)	ND (0.19)	ND (0.17)	0.075 J (0.18)
Phenanthrene	4600	--	14000	--	0.99 (0.1)	ND (0.11)	0.19 (0.12)	0.39 (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	0.073 J (0.11)
Pyrene	4600	--	14000	--	0.085 J (0.1)	ND (0.11)	0.21 (0.12)	0.53 (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	0.056 J (0.11)
Metals												
Lead	2520	--	2520	45000	1.7 J (2.11)	6.77 (2.22)	19.2 (4.58)	36.7 (2.2)	4.66 (2.26)	5.92 (2.29)	10.9 (2.02)	103 (2.12)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-840-06	PB-840-07	PB-840-08	PB-840-09	PB-840-09R	PB-840-10	PB-840-11	PB-840-12
Field Sample ID					PB-840-06-SS01	PB-840-07-SS01	PB-840-08-SS01	PB-840-09-SS01	ΓG04-MW-01-10.0-10.5	PB-840-10-SS01	PB-840-11-SS01	PB-840-12-SS01
Collection Depth (ft bgs)					4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	10.0 - 10.5	3.0 - 3.5	2.5 - 3.0	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/8/2022	7/8/2022	7/8/2022	7/8/2022	12/20/2022	7/8/2022	7/8/2022	7/8/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00046)	0.023 (0.00056)	0.00069 (0.00055)	4.4 (0.15)	ND (0.00052)	ND (0.00055)	0.0084 (0.00039)	ND (0.00053)
Cumene	1000	6.1	87	1000	0.0016 (0.00093)	0.002 (0.0011)	0.00015 J (0.0011)	15 (0.3)	ND (0.001)	ND (0.0011)	0.0058 (0.00078)	ND (0.0011)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00046)	ND (0.00056)	ND (0.00055)	ND (0.15)	NA	ND (0.00055)	ND (0.00039)	ND (0.00053)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.00093)	ND (0.0011)	ND (0.0011)	ND (0.3)	NA	ND (0.0011)	ND (0.00078)	ND (0.0011)
Ethyl Benzene	2300	15	1300	820	0.00058 J (0.00093)	0.016 (0.0011)	ND (0.0011)	66 (0.3)	ND (0.001)	ND (0.0011)	0.0097 (0.00078)	ND (0.0011)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0018)	ND (0.0022)	ND (0.0022)	ND (0.61)	ND (0.0021)	ND (0.0022)	ND (0.0016)	ND (0.0021)
Toluene	8000	76	650	9800	ND (0.00093)	0.00079 J (0.0011)	ND (0.0011)	0.3 (0.3)	NA	ND (0.0011)	ND (0.00078)	ND (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0018)	0.019 (0.0022)	ND (0.0022)	*92 (1.2)*	ND (0.0021)	0.012 (0.0022)	0.072 (0.0016)	ND (0.0021)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0018)	0.0056 (0.0022)	ND (0.0022)	33 (0.61)	ND (0.0021)	0.0038 (0.0022)	0.04 (0.0016)	ND (0.0021)
Xylenes (total)	240	1.5	51	340	ND (0.00093)	0.044 (0.0011)	ND (0.0011)	*200 (0.3)*	ND (0.001)	0.022 (0.0011)	0.059 (0.00078)	ND (0.0011)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.11)	ND (0.12)	ND (0.12)	0.16 (0.12)	NA	ND (0.11)	ND (0.12)	ND (0.11)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	ND (0.12)	ND (0.12)	0.97 (0.12)	NA	ND (0.11)	ND (0.12)	ND (0.11)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.16)	ND (0.16)	0.096 J (0.15)	NA	ND (0.15)	ND (0.16)	ND (0.15)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	ND (0.12)	ND (0.12)	0.12 (0.12)	NA	ND (0.11)	ND (0.12)	ND (0.11)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	ND (0.16)	ND (0.16)	0.072 J (0.15)	NA	ND (0.15)	ND (0.16)	ND (0.15)
Chrysene	43000	--	320000	--	ND (0.11)	ND (0.12)	ND (0.12)	0.22 (0.12)	NA	ND (0.11)	0.041 J (0.12)	ND (0.11)
Fluorene	6200	--	18000	--	ND (0.18)	ND (0.19)	ND (0.2)	1.9 (0.19)	NA	ND (0.19)	0.072 J (0.2)	ND (0.19)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.18)	ND (0.19)	ND (0.2)	*9.3 (1.9)*	ND (0.19)	ND (0.19)	0.09 J (0.2)	ND (0.19)
Phenanthrene	4600	--	14000	--	0.049 J (0.11)	ND (0.12)	ND (0.12)	4.8 (0.12)	NA	ND (0.11)	0.18 (0.12)	ND (0.11)
Pyrene	4600	--	14000	--	0.018 J (0.11)	ND (0.12)	ND (0.12)	0.48 (0.12)	NA	ND (0.11)	0.031 J (0.12)	ND (0.11)
Metals												
Lead	2520	--	2520	45000	6.05 (2.2)	4.94 (2.26)	5.75 (2.33)	4.3 (2.27)	9.99 (2.27)	5.38 (2.25)	7.06 (2.36)	5.21 (2.26)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-840-13	PB-840-14	PB-840-15	PB-840-16	PB-841-01	PB-841-02	PB-841-03	PB-841-04
Field Sample ID					PB-840-13-SS01	PB-840-14-SS01	PB-840-15-SS01	PB-840-16-SS01	PB-841-01-SS01	PB-841-02-SS01	PB-841-03-SS01	PB-841-04-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/8/2022	7/8/2022	7/8/2022	7/8/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00059)	ND (0.00054)	ND (0.00055)	ND (0.00044)	ND (0.00064)	ND (0.0006)	ND (0.00054)	ND (0.00039)
Cumene	1000	6.1	87	1000	ND (0.0012)	ND (0.0011)	ND (0.0011)	ND (0.00089)	ND (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.00078)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00059)	ND (0.00054)	ND (0.00055)	ND (0.00044)	ND (0.00064)	ND (0.0006)	ND (0.00054)	ND (0.00039)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0012)	ND (0.0011)	ND (0.0011)	ND (0.00089)	ND (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.00078)
Ethyl Benzene	2300	15	1300	820	ND (0.0012)	ND (0.0011)	ND (0.0011)	ND (0.00089)	ND (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.00078)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0024)	ND (0.0022)	ND (0.0022)	ND (0.0018)	ND (0.0025)	ND (0.0024)	ND (0.0021)	ND (0.0016)
Toluene	8000	76	650	9800	ND (0.0012)	ND (0.0011)	ND (0.0011)	ND (0.00089)	ND (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.00078)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0024)	ND (0.0022)	ND (0.0022)	ND (0.0018)	ND (0.0025)	ND (0.0024)	ND (0.0021)	ND (0.0016)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0024)	ND (0.0022)	ND (0.0022)	ND (0.0018)	ND (0.0025)	ND (0.0024)	ND (0.0021)	ND (0.0016)
Xylenes (total)	240	1.5	51	340	ND (0.0012)	ND (0.0011)	ND (0.0011)	ND (0.00089)	ND (0.0013)	ND (0.0012)	ND (0.0011)	ND (0.00078)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.11)	ND (0.11)	0.11 (0.11)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	0.18 (0.11)	0.48 (0.11)	0.12 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	0.18 (0.14)	0.46 (0.14)	0.14 J (0.15)	ND (0.14)	ND (0.14)	ND (0.13)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	0.22 (0.11)	0.57 (0.11)	0.18 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	0.099 J (0.14)	0.22 (0.14)	0.098 J (0.15)	ND (0.14)	ND (0.14)	ND (0.13)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.11)	0.17 (0.11)	0.44 (0.11)	0.13 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.18)	ND (0.18)	0.05 J (0.18)	ND (0.18)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.18)	ND (0.18)	0.091 J (0.18)	ND (0.18)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)
Phenanthrene	4600	--	14000	--	ND (0.11)	0.17 (0.11)	0.41 (0.11)	0.14 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Pyrene	4600	--	14000	--	ND (0.11)	0.28 (0.11)	0.68 (0.11)	0.18 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Metals												
Lead	2520	--	2520	45000	6.78 (2.1)	44.4 (2.09)	49.2 (4.3)	53.1 (2.22)	3.27 (2.07)	3.32 (1.98)	3.07 (2.01)	5.88 (2)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-841-05	PB-841-06	PB-841-07	PB-841-08	PB-841-09	PB-841-09	PB-841-10	PB-841-11
Field Sample ID					PB-841-05-SS01	PB-841-06-SS01	PB-841-07-SS01	PB-841-08-SS01	PB-841-09-SS01	DUP-42	PB-841-10-SS01	PB-841-11-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.0 - 4.5	4.5 - 5.0
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022
Comments										Field Duplicate		
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.0006)	ND (0.00059)	ND (0.00087)	ND (0.00065)	ND (0.0014)	ND (0.00059)	ND (0.00061)	ND (0.00069)
Cumene	1000	6.1	87	1000	ND (0.0012)	ND (0.0012)	ND (0.0017)	ND (0.0013)	ND (0.0027)	ND (0.0012)	ND (0.0012)	ND (0.0014)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.0006)	ND (0.00059)	ND (0.00087)	ND (0.00065)	ND (0.0014)	ND (0.00059)	ND (0.00061)	ND (0.00069)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0012)	ND (0.0012)	ND (0.0017)	ND (0.0013)	ND (0.0027)	ND (0.0012)	ND (0.0012)	ND (0.0014)
Ethyl Benzene	2300	15	1300	820	ND (0.0012)	ND (0.0012)	ND (0.0017)	ND (0.0013)	ND (0.0027)	ND (0.0012)	ND (0.0012)	ND (0.0014)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0024)	ND (0.0024)	ND (0.0035)	ND (0.0026)	ND (0.0055)	ND (0.0024)	ND (0.0024)	ND (0.0028)
Toluene	8000	76	650	9800	ND (0.0012)	ND (0.0012)	ND (0.0017)	ND (0.0013)	ND (0.0027)	ND (0.0012)	ND (0.0012)	ND (0.0014)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0024)	ND (0.0024)	ND (0.0035)	ND (0.0026)	ND (0.0055)	ND (0.0024)	ND (0.0024)	ND (0.0028)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0024)	ND (0.0024)	ND (0.0035)	ND (0.0026)	ND (0.0055)	ND (0.0024)	ND (0.0024)	ND (0.0028)
Xylenes (total)	240	1.5	51	340	ND (0.0012)	ND (0.0012)	ND (0.0017)	ND (0.0013)	ND (0.0027)	ND (0.0012)	ND (0.0012)	ND (0.0014)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.1)	ND (0.11)	ND (0.12)	ND (0.1)	0.062 J (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.1)	ND (0.11)	ND (0.12)	ND (0.1)	0.22 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.13)	ND (0.15)	ND (0.16)	ND (0.14)	0.23 (0.15)	ND (0.13)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.1)	ND (0.11)	0.037 J (0.12)	ND (0.1)	0.28 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.13)	ND (0.15)	ND (0.16)	ND (0.14)	0.11 J (0.15)	ND (0.13)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.1)	ND (0.11)	ND (0.12)	ND (0.1)	0.22 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.17)	ND (0.19)	ND (0.21)	ND (0.17)	0.026 J (0.19)	ND (0.17)	ND (0.17)	ND (0.18)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.17)	ND (0.19)	ND (0.21)	ND (0.17)	ND (0.19)	ND (0.17)	ND (0.17)	ND (0.18)
Phenanthrene	4600	--	14000	--	ND (0.1)	ND (0.11)	0.032 J (0.12)	ND (0.1)	0.2 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Pyrene	4600	--	14000	--	ND (0.1)	ND (0.11)	0.038 J (0.12)	ND (0.1)	0.35 (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Metals												
Lead	2520	--	2520	45000	3.54 (2)	4.07 (2.21)	8.11 (2.48)	5 (2.04)	5 (2.17)	3.6 (2)	2.76 (2.02)	2.51 (2.06)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-841-12	PB-841-13	PB-841-14	PB-843-01	PB-843-02	PB-843-03	PB-843-04	PB-843-05
Field Sample ID					PB-841-12-SS01	PB-841-13-SS01	PB-841-14-SS01	PB-843-01-SS01	PB-843-02-SS01	PB-843-03-SS01	PB-843-04-SS01	PB-843-05-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.0 - 4.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/12/2022	7/12/2022	7/12/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.0002 J (0.00046)	ND (0.00086)	0.00032 J (0.00058)	ND (0.0005)	0.00085 (0.00046)	ND (0.00067)	0.00078 (0.00061)	0.0067 (0.00054)
Cumene	1000	6.1	87	1000	ND (0.00092)	ND (0.0017)	ND (0.0012)	ND (0.001)	ND (0.00091)	ND (0.0013)	ND (0.0012)	0.00012 J (0.0011)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00046)	ND (0.00086)	ND (0.00058)	ND (0.0005)	ND (0.00046)	ND (0.00067)	ND (0.00061)	ND (0.00054)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.00092)	ND (0.0017)	ND (0.0012)	ND (0.001)	ND (0.00091)	ND (0.0013)	ND (0.0012)	ND (0.0011)
Ethyl Benzene	2300	15	1300	820	ND (0.00092)	ND (0.0017)	ND (0.0012)	ND (0.001)	ND (0.00091)	ND (0.0013)	ND (0.0012)	ND (0.0011)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0018)	ND (0.0035)	ND (0.0023)	ND (0.002)	ND (0.0018)	ND (0.0027)	ND (0.0024)	ND (0.0022)
Toluene	8000	76	650	9800	ND (0.00092)	ND (0.0017)	ND (0.0012)	ND (0.001)	ND (0.00091)	ND (0.0013)	ND (0.0012)	ND (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0018)	ND (0.0035)	ND (0.0023)	ND (0.002)	ND (0.0018)	ND (0.0027)	ND (0.0024)	ND (0.0022)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0018)	ND (0.0035)	ND (0.0023)	ND (0.002)	ND (0.0018)	ND (0.0027)	ND (0.0024)	ND (0.0022)
Xylenes (total)	240	1.5	51	340	ND (0.00092)	ND (0.0017)	ND (0.0012)	ND (0.001)	ND (0.00091)	ND (0.0013)	ND (0.0012)	ND (0.0011)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.11)	0.088 J (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	0.24 (0.11)	0.035 J (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	0.22 (0.14)	0.044 J (0.14)	ND (0.14)	ND (0.15)	ND (0.14)	ND (0.15)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	0.26 (0.11)	0.061 J (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	0.14 (0.14)	0.039 J (0.14)	ND (0.14)	ND (0.15)	ND (0.14)	ND (0.15)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.11)	0.21 (0.11)	0.044 J (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.19)	0.036 J (0.18)	ND (0.18)	ND (0.18)	ND (0.19)	ND (0.17)	ND (0.19)	ND (0.19)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.19)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.19)	ND (0.17)	ND (0.19)	ND (0.19)
Phenanthrene	4600	--	14000	--	ND (0.11)	0.39 (0.11)	0.032 J (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.12)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.11)	0.41 (0.11)	0.054 J (0.11)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.12)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	3.72 (2.24)	93.9 (2.1)	38.9 (2.08)	3.02 (2.08)	3.41 (2.18)	3.06 (2.08)	5.63 (2.26)	6.17 (4.48)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-843-06	PB-843-07	PB-843-08	PB-843-09	PB-843-10	PB-843-11	PB-843-11	PB-843-12
Field Sample ID					PB-843-06-SS01	PB-843-07-SS01	PB-843-08-SS01	PB-843-09-SS01	PB-843-10-SS01	PB-843-11-SS01	DUP-40	PB-843-12-SS01
Collection Depth (ft bgs)					4.0 - 4.5	2.0 - 2.5	3.0 - 3.5	4.0 - 4.5	2.0 - 2.5	4.5 - 5.0	4.5 - 5.0	4.0 - 4.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022
Comments											Field Duplicate	
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.0057 (0.00061)	0.00032 J (0.00048)	ND (0.00055)	0.0018 (0.00063)	0.082 (0.00052)	0.00024 J (0.00063)	ND (0.00066)	0.0017 (0.00051)
Cumene	1000	6.1	87	1000	0.00071 J (0.0012)	0.00016 J (0.00096)	ND (0.0011)	ND (0.0012)	0.00037 J (0.001)	0.00026 J (0.0013)	ND (0.0013)	0.00045 J (0.001)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00061)	ND (0.00048)	ND (0.00055)	ND (0.00063)	ND (0.00052)	ND (0.00063)	ND (0.00066)	ND (0.00051)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0012)	ND (0.00096)	ND (0.0011)	ND (0.0012)	ND (0.001)	ND (0.0013)	ND (0.0013)	ND (0.001)
Ethyl Benzene	2300	15	1300	820	ND (0.0012)	0.00071 J (0.00096)	ND (0.0011)	ND (0.0012)	ND (0.001)	ND (0.0013)	ND (0.0013)	ND (0.001)
Methyl tert-butyl ether	2400	16	390	5900	0.00037 J (0.0024)	0.00047 J (0.0019)	ND (0.0022)	ND (0.0025)	0.0012 J (0.0021)	0.00045 J (0.0025)	ND (0.0026)	0.0009 J (0.002)
Toluene	8000	76	650	9800	ND (0.0012)	0.002 (0.00096)	ND (0.0011)	ND (0.0012)	ND (0.001)	ND (0.0013)	ND (0.0013)	ND (0.001)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0024)	0.0018 J (0.0019)	ND (0.0022)	ND (0.0025)	ND (0.0021)	ND (0.0025)	ND (0.0026)	ND (0.002)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0024)	0.0011 J (0.0019)	ND (0.0022)	ND (0.0025)	ND (0.0021)	ND (0.0025)	ND (0.0026)	ND (0.002)
Xylenes (total)	240	1.5	51	340	ND (0.0012)	0.0049 (0.00096)	ND (0.0011)	ND (0.0012)	0.007 (0.001)	ND (0.0013)	ND (0.0013)	ND (0.001)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.11)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	0.037 J (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.11)	0.022 J (0.12)	ND (0.11)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.15)	ND (0.14)	ND (0.16)	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.15)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	0.033 J (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.11)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	ND (0.15)	ND (0.14)	ND (0.16)	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.15)
Chrysene	43000	--	320000	--	ND (0.11)	0.1 J (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.11)
Fluorene	6200	--	18000	--	ND (0.19)	ND (0.19)	ND (0.18)	ND (0.2)	ND (0.19)	ND (0.19)	ND (0.2)	ND (0.18)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.19)	0.038 J (0.19)	ND (0.18)	ND (0.2)	ND (0.19)	ND (0.19)	ND (0.2)	ND (0.18)
Phenanthrene	4600	--	14000	--	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.11)	0.026 J (0.12)	ND (0.11)
Pyrene	4600	--	14000	--	ND (0.11)	0.14 (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.11)	0.026 J (0.12)	ND (0.11)
Metals												
Lead	2520	--	2520	45000	6.13 (2.22)	14.2 (2.21)	3.99 (2.03)	18.3 (2.32)	5.3 (2.21)	5.83 (2.25)	18 (4.67)	8.48 (2.15)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location					PB-843-13	PB-843-14	PB-843-15	PB-843-16	PB-843-17	PB-847-01	PB-847-02	PB-847-02
Field Sample ID					PB-843-13-SS01	PB-843-14-SS01	PB-843-15-SS01	PB-843-16-SS01	PB-843-17-SS01	PB-847-01-SS01	PB-847-02-SS01	DUP-37
Collection Depth (ft bgs)	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	3.0 - 3.5	3.0 - 3.5	4.0 - 4.5	3.0 - 3.5	4.0 - 4.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/8/2022	7/8/2022	7/8/2022
Comments												Field Duplicate
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00051)	0.00035 J (0.00049)	ND (0.00048)	ND (0.00048)	0.00024 J (0.00057)	ND (0.00043)	ND (0.00046)	ND (0.00044)
Cumene	1000	6.1	87	1000	ND (0.001)	0.00017 J (0.00099)	ND (0.00097)	ND (0.00097)	ND (0.0011)	ND (0.00085)	ND (0.00093)	ND (0.00089)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00051)	ND (0.00049)	ND (0.00048)	ND (0.00048)	ND (0.00057)	ND (0.00043)	ND (0.00046)	ND (0.00044)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.001)	ND (0.00099)	ND (0.00097)	ND (0.00097)	ND (0.0011)	ND (0.00085)	ND (0.00093)	ND (0.00089)
Ethyl Benzene	2300	15	1300	820	ND (0.001)	ND (0.00099)	ND (0.00097)	ND (0.00097)	ND (0.0011)	ND (0.00085)	ND (0.00093)	ND (0.00089)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.002)	0.0006 J (0.002)	ND (0.0019)	ND (0.0019)	0.00055 J (0.0023)	ND (0.0017)	ND (0.0018)	ND (0.0018)
Toluene	8000	76	650	9800	ND (0.001)	ND (0.00099)	ND (0.00097)	ND (0.00097)	ND (0.0011)	ND (0.00085)	ND (0.00093)	ND (0.00089)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.002)	ND (0.002)	ND (0.0019)	ND (0.0019)	ND (0.0023)	ND (0.0017)	ND (0.0018)	ND (0.0018)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.002)	ND (0.002)	ND (0.0019)	ND (0.0019)	ND (0.0023)	ND (0.0017)	ND (0.0018)	ND (0.0018)
Xylenes (total)	240	1.5	51	340	ND (0.001)	ND (0.00099)	ND (0.00097)	ND (0.00097)	ND (0.0011)	ND (0.00085)	ND (0.00093)	ND (0.00089)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.11)	ND (0.12)	0.05 J (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	ND (0.12)	0.24 (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.14)	ND (0.15)	0.23 (0.16)	ND (0.16)	ND (0.16)	ND (0.16)	ND (0.16)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	ND (0.12)	0.27 (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.14)	ND (0.15)	0.12 J (0.16)	ND (0.16)	ND (0.16)	ND (0.16)	ND (0.16)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.11)	ND (0.12)	0.24 (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.18)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.18)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Phenanthrene	4600	--	14000	--	ND (0.11)	ND (0.12)	0.19 (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.11)	ND (0.12)	0.39 (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	3.21 (2.08)	11.2 (2.24)	92 (2.26)	48.6 (4.56)	11 (2.38)	6.08 (2.37)	4.67 (2.42)	4.52 (2.34)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-847-03	PB-847-04	PB-847-05	PB-847-06	PB-847-07	PB-847-08	PB-847-09	PB-847-10
Field Sample ID					PB-847-03-SS01	PB-847-04-SS01	PB-847-05-SS01	PB-847-06-SS01	PB-847-07-SS01	PB-847-08-SS01	PB-847-09-SS01	PB-847-10-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	4.0 - 4.5	3.5 - 4.0	4.0 - 4.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/8/2022	7/8/2022	7/8/2022	7/8/2022	7/8/2022	7/8/2022	7/8/2022	7/8/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00045)	ND (0.00044)	ND (0.00043)	ND (0.00043)	0.00029 J (0.00052)	ND (0.00045)	0.00024 J (0.00058)	ND (0.00049)
Cumene	1000	6.1	87	1000	ND (0.00089)	ND (0.00088)	ND (0.00087)	ND (0.00086)	ND (0.001)	ND (0.0009)	ND (0.0012)	ND (0.00098)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00045)	ND (0.00044)	ND (0.00043)	ND (0.00043)	ND (0.00052)	ND (0.00045)	ND (0.00058)	ND (0.00049)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.00089)	ND (0.00088)	ND (0.00087)	ND (0.00086)	ND (0.001)	ND (0.0009)	ND (0.0012)	ND (0.00098)
Ethyl Benzene	2300	15	1300	820	ND (0.00089)	ND (0.00088)	ND (0.00087)	ND (0.00086)	ND (0.001)	ND (0.0009)	ND (0.0012)	ND (0.00098)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0018)	ND (0.0018)	ND (0.0017)	ND (0.0017)	ND (0.0021)	ND (0.0018)	ND (0.0023)	ND (0.002)
Toluene	8000	76	650	9800	ND (0.00089)	ND (0.00088)	ND (0.00087)	ND (0.00086)	ND (0.001)	ND (0.0009)	ND (0.0012)	ND (0.00098)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0018)	ND (0.0018)	ND (0.0017)	ND (0.0017)	ND (0.0021)	ND (0.0018)	ND (0.0023)	ND (0.002)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0018)	ND (0.0018)	ND (0.0017)	ND (0.0017)	ND (0.0021)	ND (0.0018)	ND (0.0023)	ND (0.002)
Xylenes (total)	240	1.5	51	340	ND (0.00089)	ND (0.00088)	ND (0.00087)	ND (0.00086)	ND (0.001)	ND (0.0009)	ND (0.0012)	ND (0.00098)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.13)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.13)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.16)	ND (0.16)	ND (0.17)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.13)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.16)	ND (0.16)	ND (0.17)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.13)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.21)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.21)	ND (0.2)
Phenanthrene	4600	--	14000	--	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.13)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.13)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	4.07 (2.17)	3.69 (2.26)	3.51 (2.23)	4.69 (2.31)	5.3 (4.63)	4.46 (2.36)	4.13 (2.5)	5.37 (4.8)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-847-11	PB-847-12	PB-847-13	PB-847-14	PB-847-15	PB-847-15R	PB-847-15R	PB-847-16
Field Sample ID					PB-847-11-SS01	PB-847-12-SS01	PB-847-13-SS01	PB-847-14-SS01	PB-847-15-SS01	PB-847-15R-6.0-6.5	PB-847-15R-17.0-17.5	PB-847-16-SS01
Collection Depth (ft bgs)					3.0 - 3.5	4.5 - 5.0	4.0 - 4.5	3.5 - 4.0	4.0 - 4.5	6.0 - 6.5	17.0 - 17.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/8/2022	7/8/2022	7/8/2022	7/8/2022	7/8/2022	1/4/2023	1/4/2023	7/8/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.00047 J (0.00049)	ND (0.00043)	0.051 J (0.11)	ND (0.12)	0.063 J (0.12)	ND (0.032)	0.16 (0.026)	ND (0.00047)
Cumene	1000	6.1	87	1000	0.00012 J (0.00098)	0.013 (0.00087)	0.94 (0.21)	1.3 (0.25)	1.2 (0.23)	3.2 (0.064)	1.1 (0.051)	ND (0.00094)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00049)	ND (0.00043)	ND (0.11)	ND (0.12)	ND (0.12)	NA	NA	ND (0.00047)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.00098)	ND (0.00087)	ND (0.21)	ND (0.25)	ND (0.23)	NA	NA	ND (0.00094)
Ethyl Benzene	2300	15	1300	820	ND (0.00098)	0.0028 (0.00087)	0.2 J (0.21)	ND (0.25)	0.24 (0.23)	5.4 (0.064)	0.018 J (0.051)	ND (0.00094)
Methyl tert-butyl ether	2400	16	390	5900	0.0035 (0.002)	ND (0.0017)	ND (0.43)	ND (0.5)	ND (0.46)	ND (0.13)	ND (0.1)	ND (0.0019)
Toluene	8000	76	650	9800	ND (0.00098)	ND (0.00087)	ND (0.21)	ND (0.25)	ND (0.23)	NA	NA	ND (0.00094)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.002)	0.02 (0.0017)	2.2 (0.43)	ND (0.5)	2.8 (0.46)	5.1 (0.13)	ND (0.1)	ND (0.0019)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.002)	0.054 (0.0017)	1.4 (0.43)	ND (0.5)	1.8 (0.46)	3.2 (0.13)	0.016 J (0.1)	ND (0.0019)
Xylenes (total)	240	1.5	51	340	ND (0.00098)	0.0009 J (0.00087)	0.23 J (0.21)	ND (0.25)	0.27 J (0.23)	2.5 (0.064)	ND (0.051)	ND (0.00094)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	1.7 (1.1)	NA	NA	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (1.1)	NA	NA	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.16)	ND (1.5)	NA	NA	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (1.1)	NA	NA	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.16)	ND (1.5)	NA	NA	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (1.1)	NA	NA	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.19)	ND (0.19)	0.12 J (0.19)	ND (0.2)	5.3 (1.9)	NA	NA	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.19)	ND (0.19)	0.13 J (0.19)	0.043 J (0.2)	*7 (1.9)*	*7.5 (0.04)*	1.6 (0.038)	ND (0.2)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.12)	0.29 (0.12)	ND (0.12)	12 (1.1)	NA	NA	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	0.5 J (1.1)	NA	NA	ND (0.12)
Metals												
Lead	2520	--	2520	45000	4.97 (4.44)	6.35 (4.54)	3.88 (2.3)	5.24 (4.85)	5.06 (4.52)	6.75 (2.37)	5.9 (2.26)	5.17 (2.4)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-847-17	PB-848-01	PB-848-02	PB-848-03	PB-848-04	PB-848-05	PB-848-05	PB-848-06
Field Sample ID					PB-847-17-SS01	PB-848-01-SS01	PB-848-02-SS01	PB-848-03-SS01	PB-848-04-SS01	PB-848-05-SS01	DUP-39	PB-848-06-SS01
Collection Depth (ft bgs)					3.5 - 4.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.0 - 4.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/8/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022
Comments											Field Duplicate	
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.0042 (0.00053)	0.001 (0.00058)	ND (0.00047)	ND (0.00055)	1.8 (0.13)	ND (0.00056)	ND (0.00049)	ND (0.032)
Cumene	1000	6.1	87	1000	0.027 (0.0011)	0.00014 J (0.0012)	ND (0.00094)	ND (0.0011)	0.46 (0.25)	ND (0.0011)	ND (0.00098)	3 (0.064)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00053)	ND (0.00058)	ND (0.00047)	ND (0.00055)	ND (0.13)	ND (0.00056)	ND (0.00049)	ND (0.032)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.0012)	ND (0.00094)	ND (0.0011)	ND (0.25)	ND (0.0011)	ND (0.00098)	ND (0.064)
Ethyl Benzene	2300	15	1300	820	0.018 (0.0011)	ND (0.0012)	ND (0.00094)	ND (0.0011)	0.9 (0.25)	ND (0.0011)	ND (0.00098)	1 (0.064)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0021)	ND (0.0023)	ND (0.0019)	ND (0.0022)	ND (0.51)	0.00074 J (0.0022)	0.00057 J (0.002)	ND (0.13)
Toluene	8000	76	650	9800	0.00073 J (0.0011)	ND (0.0012)	ND (0.00094)	ND (0.0011)	ND (0.25)	ND (0.0011)	ND (0.00098)	ND (0.064)
1,2,4-Trimethylbenzene	180	0.92	70	250	0.11 (0.0021)	ND (0.0023)	ND (0.0019)	ND (0.0022)	4.3 (0.51)	ND (0.0022)	ND (0.002)	35 (1.3)
1,3,5-Trimethylbenzene	220	0.92	99	240	0.0088 (0.0021)	0.00026 J (0.0023)	ND (0.0019)	ND (0.0022)	2.7 (0.51)	ND (0.0022)	ND (0.002)	0.16 (0.13)
Xylenes (total)	240	1.5	51	340	0.017 (0.0011)	0.0016 J (0.0012)	ND (0.00094)	ND (0.0011)	3.8 (0.25)	ND (0.0011)	ND (0.00098)	ND (0.064)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	0.29 (0.12)	ND (0.12)	ND (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	0.055 J (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.16)	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.16)	0.048 J (0.16)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	0.053 J (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	ND (0.16)	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.16)	0.026 J (0.16)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	0.048 J (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.2)	ND (0.2)	ND (0.19)	ND (0.18)	2.3 (0.2)	0.069 J (0.2)	ND (0.2)	0.14 J (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.2)	ND (0.2)	ND (0.19)	ND (0.18)	1.4 (0.2)	0.034 J (0.2)	ND (0.2)	1.7 (0.2)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	1.9 (0.12)	0.054 J (0.12)	0.091 J (0.12)	0.15 (0.12)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.12)	0.029 J (0.12)	0.024 J (0.11)	ND (0.12)	ND (0.12)	0.08 J (0.12)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	5.26 (4.7)	6.75 (2.41)	26.2 (4.38)	51.6 (4.24)	716 (2.44)	8.21 (4.59)	18.8 (2.22)	7.2 (2.39)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-848-07	PB-848-07R	PB-848-08	PB-848-09	PB-848-10	PB-848-11	PB-848-12	PB-848-13
Field Sample ID					PB-848-07-SS01	TG04-MW-02-7.0-7.5	PB-848-08-SS01	PB-848-09-SS01	PB-848-10-SS01	PB-848-11-SS01	PB-848-12-SS01	PB-848-13-SS01
Collection Depth (ft bgs)					4.5 - 5.0	7.0 - 7.5	4.5 - 5.0	4.5 - 5.0	4.5 - 5.0	3.0 - 3.5	4.0 - 4.5	4.5 - 5.0
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/11/2022	12/19/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.14 (0.034)	0.0023 (0.00056)	0.0003 J (0.00046)	0.00022 J (0.00049)	0.00052 J (0.00063)	0.87 (0.034)	ND (0.00055)	ND (0.036)
Cumene	1000	6.1	87	1000	1.1 (0.067)	0.015 (0.0011)	0.0099 (0.00092)	0.0011 (0.00098)	0.0066 (0.0012)	0.29 (0.068)	ND (0.0011)	0.01 J (0.072)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.034)	NA	ND (0.00046)	ND (0.00049)	ND (0.00063)	ND (0.034)	ND (0.00055)	ND (0.036)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.067)	NA	ND (0.00092)	ND (0.00098)	ND (0.0012)	ND (0.068)	ND (0.0011)	ND (0.072)
Ethyl Benzene	2300	15	1300	820	1.6 (0.067)	0.028 (0.0011)	0.0067 (0.00092)	0.00046 J (0.00098)	0.0024 (0.0012)	0.16 (0.068)	ND (0.0011)	0.018 J (0.072)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.13)	0.00026 J (0.0022)	ND (0.0018)	ND (0.002)	ND (0.0025)	ND (0.14)	ND (0.0022)	ND (0.14)
Toluene	8000	76	650	9800	0.087 (0.067)	NA	ND (0.00092)	ND (0.00098)	ND (0.0012)	0.12 (0.068)	ND (0.0011)	0.039 J (0.072)
1,2,4-Trimethylbenzene	180	0.92	70	250	2.2 (0.13)	0.0016 J (0.0022)	0.037 (0.0018)	0.0013 J (0.002)	0.00081 J (0.0025)	0.12 J (0.14)	ND (0.0022)	ND (0.14)
1,3,5-Trimethylbenzene	220	0.92	99	240	1 (0.13)	0.0059 (0.0022)	0.0047 (0.0018)	0.00028 J (0.002)	0.00047 J (0.0025)	0.076 J (0.14)	ND (0.0022)	ND (0.14)
Xylenes (total)	240	1.5	51	340	0.56 J (0.067)	0.0027 J (0.0011)	0.0013 J (0.00092)	0.00093 J (0.00098)	ND (0.0012)	0.39 J (0.068)	ND (0.0011)	ND (0.072)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	NA	ND (0.12)	ND (0.12)	ND (0.14)	0.081 J (0.11)	0.19 (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	0.025 J (0.12)	NA	ND (0.12)	ND (0.12)	ND (0.14)	0.029 J (0.11)	0.33 (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	0.065 J (0.16)	NA	ND (0.16)	ND (0.16)	ND (0.18)	ND (0.15)	0.3 (0.16)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	0.049 J (0.12)	NA	ND (0.12)	ND (0.12)	ND (0.14)	0.037 J (0.11)	0.36 (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	0.064 J (0.16)	NA	ND (0.16)	ND (0.16)	ND (0.18)	0.039 J (0.15)	0.11 J (0.16)	ND (0.16)
Chrysene	43000	--	320000	--	0.028 J (0.12)	NA	ND (0.12)	ND (0.12)	ND (0.14)	0.034 J (0.11)	0.3 (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	0.089 J (0.2)	NA	ND (0.2)	ND (0.2)	ND (0.23)	0.25 (0.19)	0.13 J (0.21)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.26 (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.23)	ND (0.19)	0.043 J (0.21)	ND (0.2)
Phenanthrene	4600	--	14000	--	0.059 J (0.12)	NA	ND (0.12)	0.034 J (0.12)	ND (0.14)	0.35 (0.11)	0.68 (0.12)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.12)	NA	ND (0.12)	ND (0.12)	ND (0.14)	0.058 J (0.11)	0.51 (0.12)	0.022 J (0.12)
Metals												
Lead	2520	--	2520	45000	***3200 (4.73)***	7.5 (2.25)	246 (4.7)	1140 (2.41)	721 (5.48)	15 (2.24)	282 (2.36)	28.5 (2.46)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-848-14	PB-848-15	PB-848-16	PB-848-17	PB-848-18	PB-881-01	PB-881-02	PB-881-03
Field Sample ID					PB-848-14-SS01	PB-848-15-SS01	PB-848-16-SS01	PB-848-17-SS01	PB-848-18-SS01	PB-881-01-SS01	PB-881-02-SS01	PB-881-03-SS01
Collection Depth (ft bgs)					4.5 - 5.0	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/11/2022	7/12/2022	7/12/2022	7/12/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.00019 J (0.00056)	1.1 (0.028)	ND (0.0006)	ND (0.00077)	0.01 J (0.027)	ND (0.00043)	ND (0.00053)	ND (0.00046)
Cumene	1000	6.1	87	1000	0.00079 J (0.0011)	2.4 (0.055)	ND (0.0012)	ND (0.0015)	0.06 (0.054)	0.0032 (0.00087)	ND (0.001)	ND (0.00093)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00056)	ND (0.028)	ND (0.0006)	ND (0.00077)	ND (0.027)	ND (0.00043)	ND (0.00053)	ND (0.00046)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.055)	ND (0.0012)	ND (0.0015)	ND (0.054)	ND (0.00087)	ND (0.001)	ND (0.00093)
Ethyl Benzene	2300	15	1300	820	0.00017 J (0.0011)	16 (0.055)	ND (0.0012)	ND (0.0015)	0.017 J (0.054)	ND (0.00087)	ND (0.001)	ND (0.00093)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0023)	ND (0.11)	ND (0.0024)	ND (0.0031)	ND (0.11)	ND (0.0017)	ND (0.0021)	ND (0.0019)
Toluene	8000	76	650	9800	ND (0.0011)	0.078 (0.055)	ND (0.0012)	ND (0.0015)	ND (0.054)	ND (0.00087)	ND (0.001)	ND (0.00093)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0023)	7.7 (0.11)	ND (0.0024)	ND (0.0031)	0.058 J (0.11)	ND (0.13)	ND (0.0021)	ND (0.0019)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0023)	4 (0.11)	ND (0.0024)	ND (0.0031)	0.011 J (0.11)	0.091 (0.0017)	ND (0.0021)	ND (0.0019)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	38 J (0.055)	ND (0.0012)	ND (0.0015)	0.056 J (0.054)	0.055 (0.00087)	ND (0.001)	ND (0.00093)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.12)	0.09 J (0.12)	ND (0.12)	ND (0.52)	ND (0.1)	0.097 J (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	4.5 (0.12)	ND (0.12)	ND (0.52)	ND (0.1)	0.04 J (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.16)	ND (0.16)	7.2 (0.16)	ND (0.16)	ND (0.7)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	4.4 (0.12)	ND (0.12)	ND (0.52)	ND (0.1)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	ND (0.16)	ND (0.16)	5.2 (0.16)	ND (0.16)	ND (0.7)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.12)	ND (0.12)	4.4 (0.12)	ND (0.12)	0.22 J (0.52)	ND (0.1)	0.2 (0.1)
Fluorene	6200	--	18000	--	ND (0.21)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	0.19 J (0.88)	ND (0.17)	0.51 (0.17)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.21)	ND (0.2)	ND (0.2)	0.026 J (0.2)	ND (0.2)	0.26 J (0.88)	ND (0.17)	1.2 (0.17)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.12)	0.34 (0.12)	ND (0.12)	0.16 J (0.52)	ND (0.1)	1 (0.1)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.12)	0.79 (0.12)	ND (0.12)	0.15 J (0.52)	ND (0.1)	0.15 (0.1)
Metals												
Lead	2520	--	2520	45000	15.7 (2.42)	9.28 (2.29)	6.41 (2.32)	1840 (2.29)	60.7 (11.4)	1.62 J (2)	1.49 J (2.04)	1.78 J (4.15)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-881-04	PB-881-05	PB-881-06	PB-881-07	PB-881-07	PB-881-08	PB-881-09	PB-881-10
Field Sample ID					PB-881-04-SS01	PB-881-05-SS01	PB-881-06-SS01	PB-881-07-SS01	DUP-41	PB-881-08-SS01	PB-881-09-SS01	PB-881-10-SS01
Collection Depth (ft bgs)					2.5 - 3.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022
Comments									Field Duplicate			
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00051)	ND (0.00049)	ND (0.00056)	ND (0.021)	ND (0.032)	ND (0.00058)	ND (0.00058)	ND (0.052)
Cumene	1000	6.1	87	1000	ND (0.001)	ND (0.00098)	ND (0.0011)	0.0089 J (0.042)	0.012 J (0.065)	ND (0.0012)	ND (0.0012)	0.26 (0.1)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00051)	ND (0.00049)	ND (0.00056)	ND (0.021)	ND (0.032)	ND (0.00058)	ND (0.00058)	ND (0.052)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.001)	ND (0.00098)	ND (0.0011)	ND (0.042)	ND (0.065)	ND (0.0012)	ND (0.0012)	ND (0.1)
Ethyl Benzene	2300	15	1300	820	ND (0.001)	ND (0.00098)	ND (0.0011)	ND (0.042)	ND (0.065)	ND (0.0012)	ND (0.0012)	0.067 J (0.1)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.002)	0.0012 J (0.002)	ND (0.0022)	ND (0.084)	ND (0.13)	ND (0.0023)	ND (0.0023)	ND (0.21)
Toluene	8000	76	650	9800	ND (0.001)	ND (0.00098)	ND (0.0011)	ND (0.042)	ND (0.065)	ND (0.0012)	ND (0.0012)	ND (0.1)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.002)	ND (0.002)	ND (0.0022)	0.47 (0.084)	1 (0.13)	ND (0.0023)	ND (0.0023)	9.4 (0.21)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.002)	ND (0.002)	ND (0.0022)	0.22 (0.084)	0.45 (0.13)	ND (0.0023)	ND (0.0023)	3.6 (0.21)
Xylenes (total)	240	1.5	51	340	ND (0.001)	ND (0.00098)	ND (0.0011)	0.038 J (0.042)	0.037 J (0.065)	ND (0.0012)	ND (0.0012)	0.46 J (0.1)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	0.047 J (0.11)	ND (0.11)	ND (0.1)	0.04 J (0.1)	0.063 J (0.11)	ND (0.12)	ND (0.12)	ND (0.51)
Benzo(a)anthracene	430	--	3200	--	0.23 (0.11)	ND (0.11)	ND (0.1)	0.022 J (0.1)	0.031 J (0.11)	ND (0.12)	ND (0.12)	0.17 J (0.51)
Benzo(a)pyrene	43	--	7.7	--	0.25 (0.15)	ND (0.15)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	ND (0.16)	ND (0.69)
Benzo(b)fluoranthene	430	--	3200	--	0.29 (0.11)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.51)
Benzo(g,h,i)perylene	4600	--	14000	--	0.14 J (0.15)	ND (0.15)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	ND (0.16)	ND (0.69)
Chrysene	43000	--	320000	--	0.22 (0.11)	ND (0.11)	ND (0.1)	0.087 J (0.1)	0.15 (0.11)	ND (0.12)	ND (0.12)	0.34 J (0.51)
Fluorene	6200	--	18000	--	0.018 J (0.19)	ND (0.19)	ND (0.17)	0.23 (0.17)	0.41 (0.18)	ND (0.2)	ND (0.2)	1.1 (0.86)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.048 J (0.19)	ND (0.19)	ND (0.17)	0.048 J (0.17)	0.6 (0.18)	ND (0.2)	ND (0.2)	4.4 (0.86)
Phenanthrene	4600	--	14000	--	0.21 (0.11)	ND (0.11)	ND (0.1)	0.48 (0.1)	0.88 (0.11)	ND (0.12)	ND (0.12)	1.9 (0.51)
Pyrene	4600	--	14000	--	0.28 (0.11)	ND (0.11)	ND (0.1)	0.064 J (0.1)	0.1 J (0.11)	ND (0.12)	ND (0.12)	0.23 J (0.51)
Metals												
Lead	2520	--	2520	45000	89.2 (22.8)	7.7 (2.2)	1.45 J (2.02)	1.48 J (1.98)	1.48 J (2.05)	6.67 (2.43)	6.12 (2.29)	1.22 J (2.04)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-881-11	PB-881-12	PB-881-13	PB-881-14	PB-881-15	PB-881-16	PB-881-17	PB-881-18
Field Sample ID					PB-881-11-SS01	PB-881-12-SS01	PB-881-13-SS01	PB-881-14-SS01	PB-881-15-SS01	PB-881-16-SS01	PB-881-17-SS01	PB-881-18-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022	7/12/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00053)	ND (0.00051)	ND (0.00049)	ND (0.00045)	ND (0.00048)	ND (0.00051)	ND (0.0005)	ND (0.00049)
Cumene	1000	6.1	87	1000	ND (0.0011)	ND (0.001)	ND (0.00099)	ND (0.0009)	ND (0.00096)	0.00017 J (0.001)	ND (0.001)	ND (0.00098)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00053)	ND (0.00051)	ND (0.00049)	ND (0.00045)	ND (0.00048)	ND (0.00051)	ND (0.0005)	ND (0.00049)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.001)	ND (0.00099)	ND (0.0009)	ND (0.00096)	ND (0.001)	ND (0.001)	ND (0.00098)
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	ND (0.001)	ND (0.00099)	ND (0.0009)	ND (0.00096)	ND (0.001)	ND (0.001)	ND (0.00098)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0021)	ND (0.002)	ND (0.002)	ND (0.0018)	0.00054 J (0.0019)	ND (0.002)	ND (0.002)	ND (0.002)
Toluene	8000	76	650	9800	ND (0.0011)	ND (0.001)	ND (0.00099)	ND (0.0009)	ND (0.00096)	ND (0.001)	ND (0.001)	ND (0.00098)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0021)	ND (0.002)	ND (0.002)	ND (0.0018)	ND (0.0019)	ND (0.002)	ND (0.002)	ND (0.002)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0021)	ND (0.002)	ND (0.002)	ND (0.0018)	ND (0.0019)	ND (0.002)	ND (0.002)	ND (0.002)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	ND (0.001)	ND (0.00099)	ND (0.0009)	ND (0.00096)	ND (0.001)	ND (0.001)	ND (0.00098)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.2)	ND (0.2)	ND (0.18)	ND (0.17)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.2)	ND (0.2)	ND (0.18)	ND (0.17)
Phenanthrene	4600	--	14000	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.1)
Pyrene	4600	--	14000	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.1)
Metals												
Lead	2520	--	2520	45000	2.35 J (4.14)	1.4 J (2.06)	2.2 J (4.2)	2.02 J (3.98)	5.85 (2.36)	10.7 (4.8)	1.4 J (2.05)	1.46 J (2.05)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-882-01	PB-882-02	PB-882-03	PB-882-04	PB-882-05	PB-882-06	PB-882-07	PB-882-08
Field Sample ID					PB-882-01-SS01	PB-882-02-SS01	PB-882-03-SS01	PB-882-04-SS01	PB-882-05-SS01	PB-882-06-SS01	PB-882-07-SS01	PB-882-08-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/29/2021	7/29/2021	7/13/2022	7/13/2022	7/13/2022	7/13/2022	7/13/2022	7/13/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00052)	ND (0.00047)	ND (0.00045)	0.00058 (0.00048)	ND (0.0005)	ND (0.00045)	ND (0.00046)	ND (0.00045)
Cumene	1000	6.1	87	1000	ND (0.001)	ND (0.00095)	ND (0.0009)	ND (0.00095)	ND (0.001)	ND (0.00091)	ND (0.00091)	0.039 (0.00089)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00052)	ND (0.00047)	ND (0.00045)	ND (0.00048)	ND (0.0005)	ND (0.00045)	ND (0.00046)	ND (0.00045)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.001)	ND (0.00095)	ND (0.0009)	ND (0.00095)	ND (0.001)	ND (0.00091)	ND (0.00091)	ND (0.00089)
Ethyl Benzene	2300	15	1300	820	ND (0.001)	ND (0.00095)	ND (0.0009)	0.00014 J (0.00095)	ND (0.001)	ND (0.00091)	ND (0.00091)	0.017 (0.00089)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0021)	ND (0.0019)	ND (0.0018)	ND (0.0019)	ND (0.002)	ND (0.0018)	ND (0.0018)	ND (0.0018)
Toluene	8000	76	650	9800	ND (0.001)	ND (0.00095)	ND (0.0009)	ND (0.00095)	ND (0.001)	ND (0.00091)	ND (0.00091)	ND (0.00089)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0021)	ND (0.0019)	ND (0.0018)	0.00096 J (0.0019)	ND (0.002)	ND (0.0018)	ND (0.0018)	0.041 (0.0018)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0021)	ND (0.0019)	ND (0.0018)	0.00038 J (0.0019)	ND (0.002)	ND (0.0018)	ND (0.0018)	0.016 (0.0018)
Xylenes (total)	240	1.5	51	340	ND (0.001)	ND (0.00095)	ND (0.0009)	0.0006 J (0.00095)	ND (0.001)	ND (0.00091)	ND (0.00091)	0.0045 (0.00089)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.0078)	ND (0.0072)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	0.041 J (0.12)
Benzo(a)anthracene	430	--	3200	--	0.0014 J (0.0078)	0.00094 J (0.0072)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.0078)	ND (0.0072)	ND (0.16)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)
Benzo(b)fluoranthene	430	--	3200	--	0.00078 J (0.0078)	ND (0.0072)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.0078)	ND (0.0072)	ND (0.16)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)
Chrysene	43000	--	320000	--	0.00066 J (0.0078)	ND (0.0072)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.0078)	ND (0.0072)	ND (0.2)	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.19)	0.4 (0.19)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.0078)	ND (0.0072)	ND (0.2)	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.19)	1.6 (0.19)
Phenanthrene	4600	--	14000	--	0.00093 J (0.0078)	ND (0.0072)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	0.78 (0.12)
Pyrene	4600	--	14000	--	0.0014 J (0.0078)	ND (0.0072)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	4.2 (2.4)	5.3 (2.3)	9.65 (4.74)	6.1 (4.59)	5.09 (4.5)	5.96 (4.56)	5.62 (4.66)	3.78 J (4.65)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-882-09	PB-882-10	PB-882-11	PB-882-12	PB-882-13	PB-882-14	PB-882-15	PB-882-16
Field Sample ID					PB-882-09-SS01	PB-882-10-SS01	PB-882-11-SS01	PB-882-12-SS01	PB-882-13-SS01	PB-882-14-SS01	PB-882-15-SS01	PB-882-16-SS01
Collection Depth (ft bgs)					4.0 - 4.5	4.0 - 4.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.0 - 4.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/13/2022	7/30/2021	7/13/2022	7/13/2022	7/13/2022	7/30/2021	7/30/2021	7/30/2021
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00054)	ND (0.095)	0.00032 J (0.00043)	0.00037 J (0.00043)	ND (0.00046)	ND (0.0005)	ND (0.0005)	ND (0.05)
Cumene	1000	6.1	87	1000	0.042 (0.0011)	1.2 (0.19)	0.0001 J (0.00087)	ND (0.00085)	ND (0.00092)	0.0031 (0.001)	ND (0.001)	6.4 (0.1)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00054)	ND (0.095)	ND (0.00043)	ND (0.00043)	ND (0.00046)	ND (0.0005)	ND (0.0005)	ND (0.05)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.19)	ND (0.00087)	ND (0.00085)	ND (0.00092)	ND (0.001)	ND (0.001)	ND (0.1)
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	ND (0.19)	ND (0.00087)	ND (0.00085)	ND (0.00092)	ND (0.001)	ND (0.001)	17 (0.1)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0022)	ND (0.38)	0.0016 J (0.0017)	ND (0.0017)	ND (0.0018)	ND (0.002)	ND (0.002)	ND (0.2)
Toluene	8000	76	650	9800	0.00079 J (0.0011)	ND (0.19)	ND (0.00087)	ND (0.00085)	ND (0.00092)	ND (0.001)	ND (0.001)	ND (0.1)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0022)	ND (0.38)	ND (0.0017)	ND (0.0017)	ND (0.0018)	0.0077 (0.002)	ND (0.002)	64 (1)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0022)	ND (0.38)	ND (0.0017)	ND (0.0017)	ND (0.0018)	0.005 (0.002)	ND (0.002)	18 (0.2)
Xylenes (total)	240	1.5	51	340	0.0014 (0.0011)	ND (0.19)	ND (0.00087)	ND (0.00085)	ND (0.00092)	ND (0.001)	ND (0.001)	39 (0.1)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	0.076 J (0.12)	0.068 (0.036)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.016)	0.024 (0.008)	ND (0.077)
Benzo(a)anthracene	430	--	3200	--	0.024 J (0.12)	0.022 J (0.036)	ND (0.12)	ND (0.12)	ND (0.11)	0.035 (0.016)	0.03 (0.008)	0.07 J (0.077)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	0.014 J (0.036)	ND (0.15)	ND (0.15)	ND (0.15)	0.018 (0.016)	0.019 (0.008)	0.036 J (0.077)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	0.028 J (0.036)	ND (0.12)	ND (0.12)	ND (0.11)	0.02 (0.016)	0.024 (0.008)	0.047 J (0.077)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	0.018 J (0.036)	ND (0.15)	ND (0.15)	ND (0.15)	0.0097 J (0.016)	0.0076 J (0.008)	0.035 J (0.077)
Chrysene	43000	--	320000	--	0.094 J (0.12)	0.27 (0.036)	ND (0.12)	ND (0.12)	ND (0.11)	0.16 (0.016)	0.023 (0.008)	0.44 (0.077)
Fluorene	6200	--	18000	--	0.99 (0.2)	0.57 (0.036)	ND (0.19)	ND (0.19)	ND (0.19)	0.29 (0.016)	0.015 (0.008)	0.78 (0.077)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.06 J (0.2)	0.16 (0.036)	ND (0.19)	ND (0.19)	ND (0.19)	0.13 (0.016)	0.0094 (0.008)	4.2 (0.077)
Phenanthrene	4600	--	14000	--	1.7 (0.12)	1.4 (0.036)	ND (0.12)	ND (0.12)	ND (0.11)	0.84 (0.016)	0.079 (0.008)	2.3 (0.077)
Pyrene	4600	--	14000	--	0.062 J (0.12)	0.083 (0.036)	ND (0.12)	ND (0.12)	ND (0.11)	0.05 (0.016)	0.047 (0.008)	0.16 (0.077)
Metals												
Lead	2520	--	2520	45000	4.45 J (4.8)	ND (12)	5.69 (4.61)	7.37 (4.65)	5.83 (4.54)	7 (2.5)	19.4 (2.5)	11.3 (2.3)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-882-17	PB-882-18	PB-882-19	PB-882-20	PB-883-01	PB-883-02	PB-883-03	PB-883-04
Field Sample ID					PB-882-17-SS01	PB-882-18-SS01	PB-882-19-SS01	PB-882-20-SS01	PB-883-01-SS01	PB-883-02-SS01	PB-883-03-SS01	PB-883-04-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.0 - 4.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/30/2021	7/30/2021	7/30/2021	7/30/2021	7/14/2022	7/14/2022	7/14/2022	7/14/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00054)	ND (0.00054)	ND (0.00055)	ND (0.00051)	0.00026 J (0.00052)	ND (0.00051)	0.00041 (0.00041)	ND (0.00049)
Cumene	1000	6.1	87	1000	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.001)	0.00018 J (0.001)	ND (0.001)	ND (0.00082)	ND (0.00098)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00054)	ND (0.00054)	ND (0.00055)	ND (0.00051)	ND (0.00052)	ND (0.00051)	ND (0.00041)	ND (0.00049)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.00082)	ND (0.00098)
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.00082)	ND (0.00098)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0022)	ND (0.0022)	ND (0.0022)	ND (0.002)	0.00032 J (0.0021)	0.0018 J (0.002)	0.002 (0.0016)	ND (0.002)
Toluene	8000	76	650	9800	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.00082)	ND (0.00098)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0022)	ND (0.0022)	ND (0.0022)	ND (0.002)	ND (0.0021)	ND (0.002)	ND (0.0016)	ND (0.002)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0022)	ND (0.0022)	ND (0.0022)	ND (0.002)	ND (0.0021)	ND (0.002)	ND (0.0016)	ND (0.002)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.00082)	ND (0.00098)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.014)	0.00075 J (0.0079)	ND (0.0082)	ND (0.016)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	0.0069 J (0.014)	ND (0.0079)	ND (0.0082)	0.076 (0.016)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	0.002 J (0.014)	ND (0.0079)	ND (0.0082)	0.04 (0.016)	ND (0.16)	ND (0.16)	ND (0.15)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	0.0048 J (0.014)	ND (0.0079)	ND (0.0082)	0.074 (0.016)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	0.002 J (0.014)	ND (0.0079)	ND (0.0082)	0.038 (0.016)	ND (0.16)	ND (0.16)	ND (0.15)	ND (0.16)
Chrysene	43000	--	320000	--	0.028 (0.014)	ND (0.0079)	ND (0.0082)	0.42 (0.016)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Fluorene	6200	--	18000	--	0.088 (0.014)	ND (0.0079)	ND (0.0082)	0.46 (0.016)	ND (0.2)	ND (0.2)	ND (0.19)	ND (0.19)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.0096 J (0.014)	ND (0.0079)	ND (0.0082)	0.062 (0.016)	ND (0.2)	ND (0.2)	ND (0.19)	ND (0.19)
Phenanthrene	4600	--	14000	--	0.11 (0.014)	0.0041 J (0.0079)	0.0014 J (0.0082)	1.2 (0.016)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Pyrene	4600	--	14000	--	0.0089 J (0.014)	0.002 J (0.0079)	ND (0.0082)	0.14 (0.016)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	3.9 (2.3)	11.3 (2.4)	10 (2.6)	73.6 (2.5)	7.61 J (11.4)	6.88 (2.35)	5.82 (4.41)	6.16 (4.5)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-883-05	PB-883-06	PB-883-07	PB-883-08	PB-883-09	PB-883-10	PB-883-11	PB-883-12
Field Sample ID					PB-883-05-SS01	PB-883-06-SS01	PB-883-07-SS01	PB-883-08-SS01	PB-883-09-SS01	PB-883-10-SS01	PB-883-11-SS01	PB-883-12-SS01
Collection Depth (ft bgs)					3.0 - 3.5	4.0 - 4.5	3.0 - 3.5	3.0 - 3.5	4.0 - 4.5	3.0 - 3.5	3.5 - 4.0	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/14/2022	7/14/2022	7/14/2022	12/8/2021	12/8/2021	12/8/2021	12/8/2021	12/8/2021
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	0.0003 J (0.00045)	ND (0.00053)	0.00026 J (0.00056)	ND (0.00054)	ND (0.0005)	ND (0.00044)	ND (0.00048)	ND (0.00057)
Cumene	1000	6.1	87	1000	0.0002 J (0.00091)	ND (0.001)	0.00021 J (0.0011)	ND (0.0011)	ND (0.001)	ND (0.00089)	ND (0.00095)	ND (0.0011)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00045)	ND (0.00053)	ND (0.00056)	ND (0.00054)	ND (0.0005)	ND (0.00044)	ND (0.00048)	ND (0.00057)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.00091)	ND (0.001)	ND (0.0011)	ND (0.0011)	ND (0.001)	ND (0.00089)	ND (0.00095)	ND (0.0011)
Ethyl Benzene	2300	15	1300	820	ND (0.00091)	ND (0.001)	ND (0.0011)	ND (0.0011)	ND (0.001)	ND (0.00089)	ND (0.00095)	ND (0.0011)
Methyl tert-butyl ether	2400	16	390	5900	0.0042 (0.0018)	0.00048 J (0.0021)	0.0016 J (0.0023)	ND (0.0022)	ND (0.002)	ND (0.0018)	ND (0.0019)	ND (0.0023)
Toluene	8000	76	650	9800	ND (0.00091)	ND (0.001)	ND (0.0011)	ND (0.0011)	ND (0.001)	ND (0.00089)	ND (0.00095)	ND (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	0.00034 J (0.0018)	ND (0.0021)	0.00041 J (0.0023)	ND (0.0022)	ND (0.002)	ND (0.0018)	ND (0.0019)	ND (0.0023)
1,3,5-Trimethylbenzene	220	0.92	99	240	0.00084 J (0.0018)	ND (0.0021)	0.00025 J (0.0023)	ND (0.0022)	ND (0.002)	ND (0.0018)	ND (0.0019)	ND (0.0023)
Xylenes (total)	240	1.5	51	340	ND (0.00091)	ND (0.001)	ND (0.0011)	ND (0.0011)	ND (0.001)	ND (0.00089)	ND (0.00095)	ND (0.0011)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.15)	ND (0.16)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.15)	ND (0.16)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.19)	ND (0.19)	ND (0.2)	ND (0.2)	ND (0.17)	ND (0.18)	ND (0.19)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.19)	ND (0.19)	ND (0.2)	ND (0.2)	ND (0.17)	ND (0.18)	ND (0.19)	ND (0.2)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.12)	0.028 J (0.12)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.12)	0.021 J (0.12)
Metals												
Lead	2520	--	2520	45000	6.72 (2.24)	6.14 (2.28)	13.9 (2.29)	12.8 (2.48)	2.18 (2.03)	4.67 (2.14)	4.25 (2.32)	11 (2.27)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-883-13	PB-883-14	PB-883-15	PB-883-16	PB-883-17	PB-883-18	PB-883-19	PB-883-20
Field Sample ID					PB-883-13-SS01	PB-883-14-SS01	PB-883-15-SS01	PB-883-16-SS01	PB-883-17-SS01	PB-883-18-SS01	PB-883-19-SS01	PB-883-20-SS01
Collection Depth (ft bgs)					4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					12/8/2021	12/8/2021	7/14/2022	12/8/2021	12/8/2021	12/8/2021	12/8/2021	7/14/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00048)	ND (0.00062)	0.00025 J (0.00048)	ND (0.00056)	ND (0.00064)	ND (0.032)	ND (0.0005)	0.00045 J (0.00048)
Cumene	1000	6.1	87	1000	ND (0.00096)	ND (0.0012)	ND (0.00095)	0.00019 J (0.0011)	ND (0.0013)	0.82 (0.064)	ND (0.001)	0.00029 J (0.00097)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00048)	ND (0.00062)	ND (0.00048)	ND (0.00056)	ND (0.00064)	ND (0.032)	ND (0.0005)	ND (0.00048)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.00096)	ND (0.0012)	ND (0.00095)	ND (0.0011)	ND (0.0013)	ND (0.064)	ND (0.001)	ND (0.00097)
Ethyl Benzene	2300	15	1300	820	ND (0.00096)	ND (0.0012)	ND (0.00095)	ND (0.0011)	ND (0.0013)	ND (0.064)	ND (0.001)	ND (0.00097)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0019)	ND (0.0025)	0.0018 J (0.0019)	ND (0.0022)	ND (0.0026)	ND (0.13)	ND (0.002)	0.0051 (0.0019)
Toluene	8000	76	650	9800	ND (0.00096)	ND (0.0012)	ND (0.00095)	ND (0.0011)	ND (0.0013)	ND (0.064)	ND (0.001)	ND (0.00097)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0019)	ND (0.0025)	ND (0.0019)	ND (0.0022)	ND (0.0026)	0.04 J (0.13)	ND (0.002)	0.00089 J (0.0019)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0019)	ND (0.0025)	ND (0.0019)	ND (0.0022)	ND (0.0026)	ND (0.13)	ND (0.002)	0.00048 J (0.0019)
Xylenes (total)	240	1.5	51	340	ND (0.00096)	ND (0.0012)	0.0003 J (0.00095)	ND (0.0011)	ND (0.0013)	0.044 J (0.064)	ND (0.001)	ND (0.00097)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.59)	ND (0.54)	ND (0.54)	ND (0.1)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.59)	0.13 J (0.54)	ND (0.54)	ND (0.1)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.16)	ND (0.16)	ND (0.79)	ND (0.72)	ND (0.72)	ND (0.14)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.59)	ND (0.54)	ND (0.54)	ND (0.1)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	ND (0.16)	ND (0.16)	ND (0.79)	ND (0.72)	ND (0.72)	ND (0.14)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.12)	ND (0.12)	0.43 J (0.59)	0.36 J (0.54)	0.37 J (0.54)	0.027 J (0.1)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.2)	ND (0.21)	ND (0.2)	ND (0.99)	0.29 J (0.9)	0.25 J (0.91)	ND (0.18)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.2)	ND (0.21)	ND (0.2)	ND (0.99)	ND (0.9)	ND (0.91)	ND (0.18)	ND (0.2)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.59)	0.43 J (0.54)	0.52 J (0.54)	ND (0.1)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.12)	0.36 J (0.59)	0.2 J (0.54)	0.19 J (0.54)	ND (0.1)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	6.72 (2.44)	5.14 (2.35)	8.06 (2.27)	8.62 (2.28)	7.06 (4.2)	6.49 (4.24)	7.75 (4.24)	7.73 (2.28)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-883-21	PB-883-22	PB-883-23	PB-883-24	PB-884-01	PB-884-02	PB-884-03	PB-884-04
Field Sample ID					PB-883-21-SS01	PB-883-22-SS01	PB-883-23-SS01	PB-883-24-SS01	PB-884-01-SS01	PB-884-02-SS01	PB-884-03-SS01	PB-884-04-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/14/2022	12/8/2021	12/8/2021	12/8/2021	12/3/2021	12/3/2021	12/3/2021	12/3/2021
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00046)	ND (0.00052)	ND (0.00074)	ND (0.00051)	0.0003 J (0.00046)	ND (0.00049)	ND (0.00053)	ND (0.00052)
Cumene	1000	6.1	87	1000	0.00042 J (0.00091)	0.00024 J (0.001)	ND (0.0015)	ND (0.001)	0.00072 J (0.00092)	ND (0.00098)	ND (0.001)	0.078 (0.001)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00046)	ND (0.00052)	ND (0.00074)	ND (0.00051)	ND (0.00046)	ND (0.00049)	ND (0.00053)	ND (0.00052)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.00091)	ND (0.001)	ND (0.0015)	ND (0.001)	ND (0.00092)	ND (0.00098)	ND (0.001)	ND (0.001)
Ethyl Benzene	2300	15	1300	820	0.00034 J (0.00091)	ND (0.001)	ND (0.0015)	ND (0.001)	0.00023 J (0.00092)	ND (0.00098)	ND (0.001)	ND (0.001)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0018)	ND (0.0021)	ND (0.003)	ND (0.002)	ND (0.0018)	ND (0.002)	ND (0.0021)	0.0003 J (0.0021)
Toluene	8000	76	650	9800	ND (0.00091)	ND (0.001)	ND (0.0015)	ND (0.001)	0.001 (0.00092)	ND (0.00098)	ND (0.001)	ND (0.001)
1,2,4-Trimethylbenzene	180	0.92	70	250	0.0097 (0.0018)	ND (0.0021)	ND (0.003)	ND (0.002)	0.0024 (0.0018)	ND (0.002)	ND (0.0021)	0.015 (0.0021)
1,3,5-Trimethylbenzene	220	0.92	99	240	0.0032 (0.0018)	ND (0.0021)	ND (0.003)	ND (0.002)	0.00088 J (0.0018)	ND (0.002)	ND (0.0021)	0.0045 (0.0021)
Xylenes (total)	240	1.5	51	340	0.0023 J (0.00091)	ND (0.001)	ND (0.0015)	ND (0.001)	0.0048 (0.00092)	ND (0.00098)	ND (0.001)	0.00073 J (0.001)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	0.74 (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	0.053 J (0.12)	ND (0.12)	0.053 J (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.16)	0.055 J (0.16)	ND (0.16)	ND (0.17)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	0.077 J (0.12)	ND (0.12)	0.051 J (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	ND (0.15)	ND (0.16)	ND (0.16)	0.032 J (0.16)	ND (0.16)	ND (0.17)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	0.048 J (0.12)	ND (0.12)	0.048 J (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	1.2 (0.18)	ND (0.19)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.21)	0.35 (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	3 (0.18)	ND (0.19)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.21)	0.073 J (0.2)
Phenanthrene	4600	--	14000	--	3.7 (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	0.033 J (0.12)	0.32 (0.12)
Pyrene	4600	--	14000	--	0.23 (0.11)	ND (0.12)	ND (0.12)	ND (0.12)	0.031 J (0.12)	ND (0.12)	0.055 J (0.12)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	12.6 (10.6)	4.03 (2.25)	4.64 (2.26)	4.46 (2.27)	24.5 (2.28)	5.62 (2.36)	8.8 (2.49)	6.72 (2.43)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-884-05	PB-884-06	PB-884-07	PB-884-08	PB-884-09	PB-884-10	PB-884-11	PB-884-12
Field Sample ID					PB-884-05-SS01	PB-884-06-SS01	PB-884-07-SS01	PB-884-08-SS01	PB-884-09-SS01	PB-884-10-SS01	PB-884-11-SS01	PB-884-12-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.5 - 4.0	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					12/6/2021	12/6/2021	12/6/2021	7/14/2022	7/14/2022	12/6/2021	12/3/2021	12/3/2021
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.0008)	0.0003 J (0.00045)	ND (0.00066)	0.15 (0.033)	2 (0.034)	ND (0.00053)	ND (0.00051)	ND (0.00059)
Cumene	1000	6.1	87	1000	ND (0.0016)	0.00039 J (0.0009)	ND (0.0013)	0.08 (0.065)	2.8 (0.068)	ND (0.0011)	ND (0.001)	ND (0.0012)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.0008)	ND (0.00045)	ND (0.00066)	ND (0.033)	ND (0.034)	ND (0.00053)	ND (0.00051)	ND (0.00059)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0016)	ND (0.0009)	ND (0.0013)	ND (0.065)	ND (0.068)	ND (0.0011)	ND (0.001)	ND (0.0012)
Ethyl Benzene	2300	15	1300	820	ND (0.0016)	0.00052 J (0.0009)	ND (0.0013)	0.14 (0.065)	6.6 (0.068)	ND (0.0011)	ND (0.001)	ND (0.0012)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0032)	ND (0.0018)	ND (0.0027)	ND (0.13)	ND (0.14)	ND (0.0021)	ND (0.002)	ND (0.0023)
Toluene	8000	76	650	9800	ND (0.0016)	0.00069 J (0.0009)	ND (0.0013)	0.082 (0.065)	13 (0.068)	ND (0.0011)	ND (0.001)	ND (0.0012)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0032)	0.0064 (0.0018)	ND (0.0027)	2.1 (0.13)	12 (0.14)	ND (0.0021)	ND (0.002)	ND (0.0023)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0032)	0.0042 (0.0018)	ND (0.0027)	0.66 (0.13)	3.7 (0.14)	ND (0.0021)	ND (0.002)	ND (0.0023)
Xylenes (total)	240	1.5	51	340	ND (0.0016)	0.0019 J (0.0009)	ND (0.0013)	5.4 (0.065)	41 (0.068)	ND (0.0011)	ND (0.001)	ND (0.0012)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.1)	0.028 J (0.1)	0.03 J (0.1)	0.058 J (0.11)	0.022 J (0.1)	ND (0.1)	0.089 J (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.14)	ND (0.14)	ND (0.14)	0.055 J (0.15)	ND (0.14)	ND (0.14)	0.074 J (0.16)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.1)	ND (0.1)	ND (0.1)	0.08 J (0.11)	ND (0.1)	ND (0.1)	0.095 J (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.14)	ND (0.14)	ND (0.14)	0.041 J (0.15)	ND (0.14)	ND (0.14)	0.038 J (0.16)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.1)	0.027 J (0.1)	0.021 J (0.1)	0.11 (0.11)	0.092 J (0.1)	ND (0.1)	0.087 J (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.17)	ND (0.17)	ND (0.18)	0.25 (0.19)	0.25 (0.17)	ND (0.17)	ND (0.21)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.17)	ND (0.17)	ND (0.18)	0.84 (0.19)	3.2 (0.17)	ND (0.17)	0.068 J (0.21)	ND (0.2)
Phenanthrene	4600	--	14000	--	ND (0.1)	0.065 J (0.1)	ND (0.1)	0.45 (0.11)	0.7 (0.1)	ND (0.1)	0.065 J (0.12)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.1)	0.039 J (0.1)	0.043 J (0.1)	0.13 (0.11)	0.056 J (0.1)	ND (0.1)	0.091 J (0.12)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	2.38 (2.03)	89 (9.96)	2.61 (2.04)	60.2 (4.36)	1.95 J (1.99)	2.58 (1.99)	37 (2.43)	5.65 (2.4)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location					PB-884-12	PB-884-13	PB-884-14	PB-884-15	PB-884-16	PB-884-17	PB-884-18	PB-884-19
Field Sample ID					DUP-22	PB-884-13-SS01	PB-884-14-SS01	PB-884-15-SS01	PB-884-16-SS01	PB-884-17-SS01	PB-884-18-SS01	PB-884-19-SS01
Collection Depth (ft bgs)	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					12/3/2021	7/14/2022	7/14/2022	7/14/2022	7/14/2022	7/14/2022	7/14/2022	7/14/2022
Comments					Field Duplicate							
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00054)	ND (0.00052)	ND (0.00054)	2.6 (0.029)	ND (0.0009)	ND (0.00058)	0.035 (0.00055)	0.00036 J (0.00057)
Cumene	1000	6.1	87	1000	ND (0.0011)	ND (0.001)	ND (0.0011)	3.6 (0.059)	ND (0.0018)	ND (0.0012)	0.0053 (0.0011)	0.0044 (0.0011)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00054)	ND (0.00052)	ND (0.00054)	ND (0.029)	ND (0.0009)	ND (0.00058)	ND (0.00055)	ND (0.00057)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.001)	ND (0.0011)	ND (0.059)	ND (0.0018)	ND (0.0012)	ND (0.0011)	ND (0.0011)
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	ND (0.001)	ND (0.0011)	8.8 (0.059)	ND (0.0018)	ND (0.0012)	0.024 (0.0011)	0.0024 (0.0011)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0021)	ND (0.0021)	ND (0.0022)	ND (0.12)	ND (0.0036)	ND (0.0023)	0.00054 J (0.0022)	ND (0.0023)
Toluene	8000	76	650	9800	ND (0.0011)	ND (0.001)	ND (0.0011)	9 (0.059)	ND (0.0018)	ND (0.0012)	ND (0.0011)	ND (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0021)	ND (0.0021)	ND (0.0022)	14 (0.12)	ND (0.0036)	ND (0.0023)	0.033 (0.0022)	0.052 (0.0023)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0021)	ND (0.0021)	ND (0.0022)	4.5 (0.12)	ND (0.0036)	ND (0.0023)	0.01 (0.0022)	0.022 (0.0023)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	ND (0.001)	ND (0.0011)	47 (0.059)	ND (0.0018)	ND (0.0012)	0.028 (0.0011)	0.05 (0.0011)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.15)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	ND (0.15)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.11)	ND (0.1)	0.059 J (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.2)	ND (0.19)	ND (0.17)	0.13 J (0.17)	ND (0.17)	ND (0.18)	ND (0.2)	ND (0.17)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.2)	ND (0.19)	ND (0.17)	0.85 (0.17)	ND (0.17)	ND (0.18)	0.05 J (0.2)	0.085 J (0.17)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.11)	ND (0.1)	0.45 (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	0.04 J (0.1)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.11)	ND (0.1)	0.036 J (0.1)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.1)
Metals												
Lead	2520	--	2520	45000	54.3 (2.37)	3.2 (2.13)	2.63 (1.99)	1.68 J (2.02)	1.86 J (2)	1.99 J (2.01)	7.17 (4.64)	1.61 J (2.08)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-884-20	PB-884-21	PB-884-22	PB-884-23	PB-884-24	PB-884-25	PB-884-26	PB-884-27
Field Sample ID					PB-884-20-SS01	PB-884-21-SS01	PB-884-22-SS01	PB-884-23-SS01	PB-884-24-SS01	PB-884-25-SS01	PB-884-26-SS01	PB-884-27-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/14/2022	7/14/2022	12/6/2021	7/14/2022	7/15/2022	7/15/2022	12/6/2021	12/3/2021
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00055)	ND (0.00047)	ND (0.00066)	ND (0.0005)	0.034 (0.00063)	7.1 (0.027)	ND (0.0006)	ND (0.00025)
Cumene	1000	6.1	87	1000	ND (0.0011)	ND (0.00094)	ND (0.0013)	ND (0.001)	0.03 (0.0013)	3 (0.054)	ND (0.0012)	ND (0.0005)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00055)	ND (0.00047)	ND (0.00066)	ND (0.0005)	ND (0.00063)	ND (0.027)	ND (0.0006)	ND (0.00025)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.00094)	ND (0.0013)	ND (0.001)	ND (0.0013)	ND (0.054)	ND (0.0012)	ND (0.0005)
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	ND (0.00094)	ND (0.0013)	ND (0.001)	0.095 (0.0013)	9.4 (0.054)	ND (0.0012)	ND (0.0005)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0022)	ND (0.0019)	ND (0.0026)	ND (0.002)	ND (0.0025)	ND (0.11)	ND (0.0024)	ND (0.001)
Toluene	8000	76	650	9800	ND (0.0011)	ND (0.00094)	ND (0.0013)	ND (0.001)	ND (0.0013)	15 (0.11)	ND (0.0012)	ND (0.0005)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0022)	ND (0.0019)	ND (0.0026)	ND (0.002)	0.13 (0.0025)	12 (0.11)	ND (0.0024)	ND (0.001)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0022)	ND (0.0019)	ND (0.0026)	ND (0.002)	0.042 (0.0025)	3.8 (0.11)	ND (0.0024)	ND (0.001)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	ND (0.00094)	ND (0.0013)	ND (0.001)	0.36 (0.0013)	41 (0.054)	ND (0.0012)	ND (0.0005)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)	ND (0.12)	0.035 J (0.11)	ND (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)	0.048 J (0.12)	0.022 J (0.11)	ND (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)	0.046 J (0.12)	ND (0.11)	ND (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)	0.04 J (0.12)	0.084 J (0.11)	ND (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.17)	ND (0.17)	ND (0.18)	ND (0.17)	ND (0.2)	0.31 (0.18)	ND (0.19)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.17)	ND (0.17)	ND (0.18)	ND (0.17)	0.082 J (0.2)	2.1 (0.18)	ND (0.19)	ND (0.2)
Phenanthrene	4600	--	14000	--	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)	0.042 J (0.12)	0.53 (0.11)	ND (0.12)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.1)	ND (0.1)	ND (0.11)	ND (0.1)	0.051 J (0.12)	0.048 J (0.11)	0.025 J (0.12)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	1.04 J (2.06)	1.98 J (2.05)	2.77 (2.16)	1.61 J (2.08)	45.9 (11.7)	3.11 (2.13)	26.5 (2.31)	11.5 (2.41)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-884-28	PB-884-29	PB-885-01	PB-885-02	PB-885-03	PB-885-04	PB-885-05	PB-885-06
Field Sample ID					PB-884-28-SS01	PB-884-29-SS01	PB-885-01-SS01	PB-885-02-SS01	PB-885-03-SS01	PB-885-04-SS01	PB-885-05-SS01	PB-885-06-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					12/3/2021	12/3/2021	12/6/2021	12/6/2021	12/6/2021	7/14/2022	7/14/2022	12/7/2021
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00048)	ND (0.00045)	ND (0.00051)	ND (0.0005)	ND (0.00054)	ND (0.00046)	ND (0.00047)	ND (0.00056)
Cumene	1000	6.1	87	1000	ND (0.00096)	ND (0.0009)	ND (0.001)	ND (0.00099)	ND (0.0011)	ND (0.00091)	ND (0.00095)	ND (0.0011)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00048)	ND (0.00045)	ND (0.00051)	ND (0.0005)	ND (0.00054)	ND (0.00046)	ND (0.00047)	ND (0.00056)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.00096)	ND (0.0009)	ND (0.001)	ND (0.00099)	ND (0.0011)	ND (0.00091)	ND (0.00095)	ND (0.0011)
Ethyl Benzene	2300	15	1300	820	ND (0.00096)	ND (0.0009)	ND (0.001)	ND (0.00099)	ND (0.0011)	ND (0.00091)	ND (0.00095)	ND (0.0011)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0019)	ND (0.0018)	ND (0.002)	ND (0.002)	ND (0.0022)	ND (0.0018)	ND (0.0019)	ND (0.0022)
Toluene	8000	76	650	9800	ND (0.00096)	ND (0.0009)	ND (0.001)	ND (0.00099)	ND (0.0011)	ND (0.00091)	ND (0.00095)	ND (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0019)	ND (0.0018)	ND (0.002)	ND (0.002)	ND (0.0022)	ND (0.0018)	ND (0.0019)	ND (0.0022)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0019)	ND (0.0018)	ND (0.002)	ND (0.002)	ND (0.0022)	ND (0.0018)	ND (0.0019)	ND (0.0022)
Xylenes (total)	240	1.5	51	340	ND (0.00096)	ND (0.0009)	ND (0.001)	ND (0.00099)	ND (0.0011)	ND (0.00091)	ND (0.00095)	ND (0.0011)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)
Benzo(a)anthracene	430	--	3200	--	0.042 J (0.12)	ND (0.12)	ND (0.11)	0.031 J (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.16)	ND (0.15)	0.054 J (0.15)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	0.039 J (0.12)	ND (0.12)	ND (0.11)	0.075 J (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	ND (0.16)	ND (0.15)	0.048 J (0.15)	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	0.038 J (0.12)	ND (0.12)	ND (0.11)	0.036 J (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)
Fluorene	6200	--	18000	--	ND (0.2)	ND (0.21)	ND (0.19)	ND (0.19)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.18)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.2)	ND (0.21)	ND (0.19)	ND (0.19)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.18)
Phenanthrene	4600	--	14000	--	0.045 J (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)
Pyrene	4600	--	14000	--	0.06 J (0.12)	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.11)
Metals												
Lead	2520	--	2520	45000	9.37 (2.39)	4.49 (2.47)	150 (11.1)	43.9 (11.3)	2.68 (2.05)	1.56 J (2)	1.39 J (1.97)	2.41 (2.07)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-885-07	PB-885-08	PB-885-09	PB-885-10	PB-885-11	PB-885-12	PB-885-13	PB-885-14
Field Sample ID					PB-885-07-SS01	PB-885-08-SS01	PB-885-09-SS01	PB-885-10-SS01	PB-885-11-SS01	PB-885-12-SS01	PB-885-13-SS01	PB-885-14-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					12/6/2021	12/6/2021	12/6/2021	12/6/2021	12/6/2021	7/14/2022	7/14/2022	7/14/2022
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00056)	ND (0.00042)	ND (0.0005)	ND (0.00058)	ND (0.00053)	ND (0.00043)	ND (0.00048)	ND (0.00042)
Cumene	1000	6.1	87	1000	ND (0.0011)	ND (0.00083)	ND (0.001)	ND (0.0012)	ND (0.0011)	ND (0.00087)	ND (0.00095)	ND (0.00084)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00056)	ND (0.00042)	ND (0.0005)	ND (0.00058)	ND (0.00053)	ND (0.00043)	ND (0.00048)	ND (0.00042)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0011)	ND (0.00083)	ND (0.001)	ND (0.0012)	ND (0.0011)	ND (0.00087)	ND (0.00095)	ND (0.00084)
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	ND (0.00083)	ND (0.001)	ND (0.0012)	ND (0.0011)	ND (0.00087)	ND (0.00095)	ND (0.00084)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0022)	ND (0.0017)	ND (0.002)	ND (0.0023)	ND (0.0021)	ND (0.0017)	ND (0.0019)	ND (0.0017)
Toluene	8000	76	650	9800	ND (0.0011)	ND (0.00083)	ND (0.001)	ND (0.0012)	ND (0.0011)	ND (0.00087)	ND (0.00095)	ND (0.00084)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0022)	ND (0.0017)	ND (0.002)	ND (0.0023)	ND (0.0021)	ND (0.0017)	ND (0.0019)	ND (0.0017)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0022)	ND (0.0017)	ND (0.002)	ND (0.0023)	ND (0.0021)	ND (0.0017)	ND (0.0019)	ND (0.0017)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	ND (0.00083)	ND (0.001)	ND (0.0012)	ND (0.0011)	ND (0.00087)	ND (0.00095)	ND (0.00084)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.11)	ND (0.21)	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	ND (0.21)	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.28)	ND (0.16)	ND (0.14)	ND (0.17)	ND (0.14)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	ND (0.21)	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	ND (0.28)	ND (0.16)	ND (0.14)	ND (0.17)	ND (0.14)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.11)	ND (0.21)	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.18)	ND (0.35)	ND (0.2)	ND (0.18)	ND (0.21)	ND (0.17)	ND (0.17)	ND (0.17)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.18)	ND (0.35)	ND (0.2)	ND (0.18)	ND (0.21)	ND (0.17)	ND (0.17)	ND (0.17)
Phenanthrene	4600	--	14000	--	ND (0.11)	ND (0.21)	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)
Pyrene	4600	--	14000	--	ND (0.11)	ND (0.21)	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.1)	ND (0.1)	ND (0.1)
Metals												
Lead	2520	--	2520	45000	17.4 (2.15)	9.07 (2.01)	7.61 (2.39)	3.04 (2.03)	6.43 (2.5)	1.33 J (1.97)	1.72 J (1.99)	1.45 J (1.95)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-885-15	PB-885-16	PB-885-17	PB-885-17	PB-885-18	PB-885-19	PB-885-20	PB-885-21
Field Sample ID					PB-885-15-SS01	PB-885-16-SS01	PB-885-17-SS01	DUP-45	PB-885-18-SS01	PB-885-19-SS01	PB-885-20-SS01	PB-885-21-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/14/2022	12/6/2021	7/15/2022	7/15/2022	7/15/2022	7/15/2022	7/14/2022	12/7/2021
Comments								Field Duplicate				
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00045)	ND (0.00056)	ND (0.00041)	ND (0.00046)	ND (0.00045)	ND (0.00044)	ND (0.00049)	ND (0.00056)
Cumene	1000	6.1	87	1000	ND (0.0009)	ND (0.0011)	ND (0.00082)	ND (0.00093)	ND (0.0009)	ND (0.00087)	ND (0.00099)	ND (0.0011)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00045)	ND (0.00056)	ND (0.00041)	ND (0.00046)	ND (0.00045)	ND (0.00044)	ND (0.00049)	ND (0.00056)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0009)	ND (0.0011)	ND (0.00082)	ND (0.00093)	ND (0.0009)	ND (0.00087)	ND (0.00099)	ND (0.0011)
Ethyl Benzene	2300	15	1300	820	ND (0.0009)	ND (0.0011)	ND (0.00082)	ND (0.00093)	ND (0.0009)	ND (0.00087)	ND (0.00099)	ND (0.0011)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0018)	ND (0.0022)	ND (0.0016)	ND (0.0018)	ND (0.0018)	ND (0.0017)	ND (0.002)	ND (0.0022)
Toluene	8000	76	650	9800	ND (0.0009)	ND (0.0011)	ND (0.00082)	ND (0.00093)	ND (0.0009)	ND (0.00087)	ND (0.00099)	ND (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0018)	ND (0.0022)	ND (0.0016)	ND (0.0018)	ND (0.0018)	ND (0.0017)	ND (0.002)	ND (0.0022)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0018)	ND (0.0022)	ND (0.0016)	ND (0.0018)	ND (0.0018)	ND (0.0017)	ND (0.002)	ND (0.0022)
Xylenes (total)	240	1.5	51	340	ND (0.0009)	ND (0.0011)	ND (0.00082)	ND (0.00093)	ND (0.0009)	ND (0.00087)	ND (0.00099)	ND (0.0011)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.1)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	ND (0.1)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.1)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	ND (0.1)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.14)	ND (0.16)	ND (0.15)	ND (0.15)	ND (0.14)	ND (0.15)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.1)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	ND (0.1)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.14)	ND (0.16)	ND (0.15)	ND (0.15)	ND (0.14)	ND (0.15)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.1)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	ND (0.1)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.17)	ND (0.2)	ND (0.19)	ND (0.18)	ND (0.18)	ND (0.19)	ND (0.17)	ND (0.17)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.17)	ND (0.2)	ND (0.19)	ND (0.18)	ND (0.18)	ND (0.19)	ND (0.17)	ND (0.17)
Phenanthrene	4600	--	14000	--	ND (0.1)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	ND (0.1)	ND (0.1)
Pyrene	4600	--	14000	--	ND (0.1)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.11)	ND (0.1)	ND (0.1)
Metals												
Lead	2520	--	2520	45000	1.48 J (1.98)	8.76 J (11.4)	1.53 J (2.21)	2.24 (2.16)	1.49 J (2.06)	1.93 J (2.13)	1.63 J (1.97)	3.11 (2.06)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-885-22	PB-885-23	PB-885-23	PB-885-24	PB-885-25	PB-885-26	PB-886-01	PB-886-02
Field Sample ID					PB-885-22-SS01	PB-885-23-SS01	DUP-23	PB-885-24-SS01	PB-885-25-SS01	PB-885-26-SS01	PB-886-01-SS01	PB-886-02-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					12/7/2021	12/7/2021	12/7/2021	7/15/2022	7/14/2022	12/7/2021	10/7/2021	10/7/2021
Comments							Field Duplicate					
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.0005)	ND (0.00058)	ND (0.034)	ND (0.00058)	ND (0.00042)	ND (0.0006)	ND (0.00048)	ND (0.00046)
Cumene	1000	6.1	87	1000	ND (0.001)	ND (0.0012)	2 (0.067)	ND (0.0012)	ND (0.00085)	ND (0.0012)	ND (0.00097)	ND (0.00091)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.0005)	ND (0.00058)	ND (0.034)	ND (0.00058)	ND (0.00042)	ND (0.0006)	ND (0.00048)	ND (0.00046)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.001)	ND (0.0012)	ND (0.067)	ND (0.0012)	ND (0.00085)	ND (0.0012)	ND (0.00097)	ND (0.00091)
Ethyl Benzene	2300	15	1300	820	ND (0.001)	ND (0.0012)	0.016 J (0.067)	ND (0.0012)	ND (0.00085)	ND (0.0012)	ND (0.00097)	ND (0.00091)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.002)	ND (0.0023)	ND (0.13)	ND (0.0023)	ND (0.0017)	ND (0.0024)	ND (0.0019)	ND (0.0018)
Toluene	8000	76	650	9800	ND (0.001)	ND (0.0012)	ND (0.067)	ND (0.0012)	ND (0.00085)	ND (0.0012)	ND (0.00097)	ND (0.00091)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.002)	ND (0.0023)	0.054 J (0.13)	ND (0.0023)	ND (0.0017)	ND (0.0024)	ND (0.0019)	ND (0.0018)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.002)	ND (0.0023)	ND (0.13)	ND (0.0023)	ND (0.0017)	ND (0.0024)	ND (0.0019)	ND (0.0018)
Xylenes (total)	240	1.5	51	340	ND (0.001)	ND (0.0012)	0.036 J (0.067)	ND (0.0012)	ND (0.00085)	ND (0.0012)	ND (0.00097)	ND (0.00091)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.1)	3.7 (2.4)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.1)	ND (2.4)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.14)	ND (3.2)	ND (0.15)	ND (0.14)	ND (0.14)	ND (0.15)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.1)	ND (2.4)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	ND (0.14)	ND (3.2)	ND (0.15)	ND (0.14)	ND (0.14)	ND (0.15)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.1)	ND (2.4)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)
Fluorene	6200	--	18000	--	ND (0.2)	ND (0.17)	14 (4)	ND (0.19)	ND (0.17)	ND (0.17)	ND (0.19)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.2)	ND (0.17)	ND (4)	ND (0.19)	ND (0.17)	ND (0.17)	ND (0.19)	ND (0.2)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.1)	29 (2.4)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.1)	2.9 (2.4)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.12)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	4.76 (4.73)	2.8 (2.08)	6.69 (2.29)	1.63 J (2.16)	1.5 J (1.97)	2.28 (2.05)	6.35 (4.55)	5.8 (4.64)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-886-03	PB-886-04	PB-886-05	PB-886-06	PB-886-07	PB-886-08	PB-886-09	PB-886-09
Field Sample ID					PB-886-03-SS01	PB-886-04-SS01	PB-886-05-SS01	PB-886-06-SS01	PB-886-07-SS01	PB-886-08-SS01	PB-886-09-SS01	DUP-21
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	4.5 - 5.0	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					10/7/2021	10/7/2021	10/7/2021	7/15/2022	7/15/2022	10/7/2021	10/7/2021	10/7/2021
Comments												Field Duplicate
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00051)	ND (0.0005)	ND (0.00042)	ND (0.00054)	ND (0.0012)	ND (0.038)	ND (0.00045)	ND (0.00063)
Cumene	1000	6.1	87	1000	ND (0.001)	0.00018 J (0.001)	ND (0.00084)	ND (0.0011)	ND (0.0024)	0.015 J (0.075)	ND (0.0009)	0.00098 J (0.0013)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00051)	ND (0.0005)	ND (0.00042)	ND (0.00054)	ND (0.0012)	ND (0.038)	ND (0.00045)	ND (0.00063)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.001)	ND (0.001)	ND (0.00084)	ND (0.0011)	ND (0.0024)	ND (0.075)	ND (0.0009)	ND (0.0013)
Ethyl Benzene	2300	15	1300	820	ND (0.001)	0.00014 J (0.001)	ND (0.00084)	ND (0.0011)	ND (0.0024)	ND (0.075)	ND (0.0009)	0.00033 J (0.0013)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.002)	ND (0.002)	ND (0.0017)	ND (0.0021)	ND (0.0047)	ND (0.15)	ND (0.0018)	ND (0.0025)
Toluene	8000	76	650	9800	ND (0.001)	ND (0.001)	ND (0.00084)	ND (0.0011)	ND (0.0024)	ND (0.075)	ND (0.0009)	ND (0.0013)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.002)	ND (0.002)	ND (0.0017)	ND (0.0021)	ND (0.0047)	ND (0.15)	ND (0.0018)	0.025 (0.0025)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.002)	ND (0.002)	ND (0.0017)	ND (0.0021)	ND (0.0047)	ND (0.15)	ND (0.0018)	0.024 (0.0025)
Xylenes (total)	240	1.5	51	340	ND (0.001)	ND (0.001)	ND (0.00084)	ND (0.0011)	ND (0.0024)	ND (0.075)	ND (0.0009)	0.0021 J (0.0013)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.11)	0.32 (0.1)	ND (0.1)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.15)	ND (0.15)	ND (0.14)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.16)	ND (0.16)	ND (0.14)	ND (0.15)	ND (0.15)	ND (0.14)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.11)	ND (0.1)	ND (0.1)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.2)	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.19)	0.88 (0.18)	ND (0.18)	ND (0.18)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.2)	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.19)	0.062 J (0.18)	ND (0.18)	ND (0.18)
Phenanthrene	4600	--	14000	--	ND (0.12)	0.043 J (0.12)	ND (0.1)	ND (0.11)	ND (0.11)	1.7 (0.1)	ND (0.1)	ND (0.1)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.11)	ND (0.11)	0.1 (0.1)	ND (0.1)	ND (0.1)
Metals												
Lead	2520	--	2520	45000	6.5 (4.81)	8.09 (4.65)	2.94 J (4.12)	2.26 (2.2)	2.62 (2.23)	81.9 (2.1)	1.76 J (2.1)	1.87 J (2.09)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location					PB-886-10	PB-886-11	PB-886-12	PB-886-13	PB-886-14	PB-886-14	PB-886-15	PB-886-16
Field Sample ID					PB-886-10-SS01	PB-886-11-SS01	PB-886-12-SS01	PB-886-13-SS01	PB-886-14-SS01	DUP-46	PB-886-15-SS01	PB-886-16-SS01
Collection Depth (ft bgs)	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	3.0 - 3.5	3.5 - 4.0	4.0 - 4.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/15/2022	10/7/2021	10/7/2021	7/15/2022	7/15/2022	7/15/2022	7/15/2022	7/15/2022
Comments										Field Duplicate		
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.0006)	ND (0.00059)	ND (0.00072)	ND (0.0011)	ND (0.00061)	ND (0.00083)	ND (0.00087)	ND (0.00043)
Cumene	1000	6.1	87	1000	ND (0.0012)	ND (0.0012)	ND (0.0014)	ND (0.0021)	ND (0.0012)	ND (0.0017)	ND (0.0017)	ND (0.00087)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.0006)	ND (0.00059)	ND (0.00072)	ND (0.0011)	ND (0.00061)	ND (0.00083)	ND (0.00087)	ND (0.00043)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0012)	ND (0.0012)	ND (0.0014)	ND (0.0021)	ND (0.0012)	ND (0.0017)	ND (0.0017)	ND (0.00087)
Ethyl Benzene	2300	15	1300	820	ND (0.0012)	ND (0.0012)	ND (0.0014)	ND (0.0021)	ND (0.0012)	ND (0.0017)	ND (0.0017)	ND (0.00087)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0024)	ND (0.0024)	ND (0.0029)	ND (0.0043)	ND (0.0024)	ND (0.0033)	ND (0.0035)	ND (0.0017)
Toluene	8000	76	650	9800	ND (0.0012)	ND (0.0012)	ND (0.0014)	ND (0.0021)	ND (0.0012)	ND (0.0017)	ND (0.0017)	ND (0.00087)
1,2,4-Trimethylbenzene	180	0.92	70	250	0.00084 J (0.0024)	ND (0.0024)	0.0011 J (0.0029)	ND (0.0043)	ND (0.0024)	ND (0.0033)	ND (0.0035)	ND (0.0017)
1,3,5-Trimethylbenzene	220	0.92	99	240	0.0014 J (0.0024)	ND (0.0024)	0.0014 J (0.0029)	ND (0.0043)	ND (0.0024)	ND (0.0033)	ND (0.0035)	ND (0.0017)
Xylenes (total)	240	1.5	51	340	0.00053 J (0.0012)	ND (0.0012)	0.00049 J (0.0014)	ND (0.0021)	ND (0.0012)	ND (0.0017)	ND (0.0017)	ND (0.00087)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	0.16 (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
Benzo(a)pyrene	43	--	7.7	--	ND (0.14)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.14)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
Fluorene	6200	--	18000	--	0.35 (0.18)	ND (0.18)	0.044 J (0.19)	ND (0.19)	ND (0.18)	ND (0.18)	ND (0.19)	ND (0.18)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.041 J (0.18)	ND (0.18)	ND (0.19)	ND (0.19)	ND (0.18)	ND (0.18)	ND (0.19)	ND (0.18)
Phenanthrene	4600	--	14000	--	0.78 (0.11)	ND (0.11)	0.12 (0.12)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
Pyrene	4600	--	14000	--	0.049 J (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
Metals												
Lead	2520	--	2520	45000	1.97 J (2.11)	11.7 (2.14)	5.66 (4.58)	3.04 (2.26)	2.16 J (2.18)	2.04 J (2.14)	2.56 (2.2)	1.82 J (2.13)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-886-17	PB-886-18	PB-886-19	PB-886-20	PB-886-21	PB-886-22	PB-886-23	PB-886-24
Field Sample ID					PB-886-17-SS01	PB-886-18-SS01	PB-886-19-SS01	PB-886-20-SS01	PB-886-21-SS01	PB-886-22-SS01	PB-886-23-SS01	PB-886-24-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date					7/15/2022	10/7/2021	7/15/2022	7/15/2022	7/15/2022	7/15/2022	7/15/2022	10/7/2021
Comments												
Volatile Organic Compounds												
Benzene	63	0.46	8.7	98	ND (0.00052)	ND (0.00057)	ND (0.00066)	ND (0.00063)	ND (0.00044)	ND (0.0005)	ND (0.0005)	ND (0.00053)
Cumene	1000	6.1	87	1000	0.00012 J (0.001)	ND (0.0011)	ND (0.0013)	ND (0.0012)	ND (0.00089)	ND (0.001)	ND (0.001)	ND (0.001)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00052)	ND (0.00057)	ND (0.00066)	ND (0.00063)	ND (0.00044)	ND (0.0005)	ND (0.0005)	ND (0.00053)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.001)	ND (0.0011)	ND (0.0013)	ND (0.0012)	ND (0.00089)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2300	15	1300	820	ND (0.001)	ND (0.0011)	ND (0.0013)	ND (0.0012)	ND (0.00089)	ND (0.001)	ND (0.001)	ND (0.001)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0021)	ND (0.0023)	ND (0.0026)	ND (0.0025)	ND (0.0018)	ND (0.002)	ND (0.002)	ND (0.0021)
Toluene	8000	76	650	9800	ND (0.001)	ND (0.0011)	ND (0.0013)	ND (0.0012)	ND (0.00089)	ND (0.001)	ND (0.001)	ND (0.001)
1,2,4-Trimethylbenzene	180	0.92	70	250	0.0025 (0.0021)	ND (0.0023)	ND (0.0026)	ND (0.0025)	ND (0.0018)	ND (0.002)	ND (0.002)	ND (0.0021)
1,3,5-Trimethylbenzene	220	0.92	99	240	0.00082 J (0.0021)	ND (0.0023)	ND (0.0026)	ND (0.0025)	ND (0.0018)	ND (0.002)	ND (0.002)	ND (0.0021)
Xylenes (total)	240	1.5	51	340	ND (0.001)	ND (0.0011)	ND (0.0013)	ND (0.0012)	ND (0.00089)	ND (0.001)	ND (0.001)	ND (0.001)
Semivolatile Organic Compounds												
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	0.022 J (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.16)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	0.036 J (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	0.027 J (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.16)
Chrysene	43000	--	320000	--	ND (0.12)	0.093 J (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.12)
Fluorene	6200	--	18000	--	0.046 J (0.19)	0.03 J (0.18)	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.19)	ND (0.18)	ND (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.092 J (0.19)	0.14 J (0.18)	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.19)	ND (0.18)	ND (0.2)
Phenanthrene	4600	--	14000	--	0.13 (0.12)	0.12 (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.12)
Pyrene	4600	--	14000	--	ND (0.12)	0.11 (0.11)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.11)	ND (0.11)	ND (0.12)
Metals												
Lead	2520	--	2520	45000	1.8 J (2.27)	1.92 J (2.1)	2.28 (2.24)	2.19 J (2.22)	1.82 J (2.23)	2.06 J (2.24)	1.95 J (2.21)	4.51 (2.35)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 1
Summary of PESRM Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-886-25	PB-886-26	PB-886-27
Field Sample ID					PB-886-25-SS01	PB-886-26-SS01	PB-886-27-SS01
Collection Depth (ft bgs)					3.0 - 3.5	3.0 - 3.5	3.0 - 3.5
Sample Method					Grab	Grab	Grab
Sample Date					7/15/2022	10/7/2021	10/7/2021
Comments							
Volatile Organic Compounds							
Benzene	63	0.46	8.7	98	ND (0.00045)	0.00025 J (0.00057)	ND (0.00047)
Cumene	1000	6.1	87	1000	ND (0.0009)	0.0089 (0.0011)	0.00021 J (0.00095)
1,2-Dibromoethane	1.2	0.0071	1.8	3.2	ND (0.00045)	ND (0.00057)	ND (0.00047)
1,2-Dichloroethane	16	0.11	8.1	33	ND (0.0009)	ND (0.0011)	ND (0.00095)
Ethyl Benzene	2300	15	1300	820	ND (0.0009)	0.0032 (0.0011)	0.00018 J (0.00095)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0018)	ND (0.0023)	ND (0.0019)
Toluene	8000	76	650	9800	ND (0.0009)	0.0012 (0.0011)	ND (0.00095)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0018)	0.17 (0.0023)	0.051 (0.0019)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0018)	0.14 (0.0023)	ND (0.12)
Xylenes (total)	240	1.5	51	340	ND (0.0009)	0.025 (0.0011)	0.0011 J (0.00095)
Semivolatile Organic Compounds							
Anthracene	46000	--	46000	--	ND (0.11)	0.034 J (0.11)	ND (0.1)
Benzo(a)anthracene	430	--	3200	--	ND (0.11)	ND (0.11)	ND (0.1)
Benzo(a)pyrene	43	--	7.7	--	ND (0.15)	ND (0.14)	ND (0.14)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.11)	ND (0.11)	ND (0.1)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.15)	ND (0.14)	ND (0.14)
Chrysene	43000	--	320000	--	ND (0.11)	0.031 J (0.11)	ND (0.1)
Fluorene	6200	--	18000	--	ND (0.18)	0.054 J (0.18)	ND (0.17)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.18)	0.022 J (0.18)	ND (0.17)
Phenanthrene	4600	--	14000	--	ND (0.11)	0.12 (0.11)	ND (0.1)
Pyrene	4600	--	14000	--	ND (0.11)	0.045 J (0.11)	ND (0.1)
Metals							
Lead	2520	--	2520	45000	1.81 J (2.18)	2.15 (2.08)	2.28 (2.04)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Boldfaced concentrations exceed the Routine Worker Soil Direct Contact.
3 Underlined concentrations exceed the Routine Worker Soil VI.
4 Italicized concentrations exceed the Construction Worker Soil Direct Contact.
5 No concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 2
Summary of PESRM Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Marketing and Refining, LLC, Philadelphia, PA

Location Field Sample ID Sample Method Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-219 S-219-230106 Grab 1/6/2023	S-219 S-219-230209 Grab 2/9/2023	TG04-MW-01 TG04-MW-01-230106 Grab 1/6/2023	TG04-MW-01 TG04-MW-01-230209 Grab 2/9/2023	TG04-MW-01 TG04-MW-01-230209D Grab 2/9/2023 Field Duplicate	TG04-MW-03 TG04-MW-03-230104 Grab 1/4/2023	TG04-MW-03 TG04-MW-03-230104D Grab 1/4/2023 Field Duplicate	TG04-MW-03 TG04-MW-03-230209 Grab 2/9/2023
Volatile Organic Compounds														
Benzene	300	550000	3800	4000	250	130000	ND (0.5)	ND (0.5)	**580 (2.5)**	**530 (2.5)**	**510 (2.5)**	ND (0.5)	ND (0.5)	ND (0.5)
Cumene	37000	9100000	63000	30000	4000	2600	0.28 J (0.5)	ND (0.5)	75 (2.5)	64 (2.5)	58 (2.5)	ND (0.5)	ND (0.5)	ND (0.5)
1,2-Dibromoethane	17	16000	110	910	160	--	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
1,2-Dichloroethane	330	170000	1200	4900	82	3100000	ND (0.5)	ND (0.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (0.5)	ND (0.5)	ND (0.5)
Ethyl Benzene	2000	22000000	150000	40000	9700	13000	ND (0.5)	ND (0.5)	110 (2.5)	96 (2.5)	89 (2.5)	ND (0.5)	ND (0.5)	ND (0.5)
Methyl tert-butyl ether	21000	29000000	210000	190000	42000	11000000	ND (1)	ND (1)	ND (5)	ND (5)	ND (5)	ND (1)	ND (1)	ND (1)
Toluene	25000	100000000	700000	200000	45000	52000	ND (0.75)	0.34 J (0.75)	11 (3.8)	10 (3.8)	9.6 (3.8)	ND (0.75)	ND (0.75)	0.34 J (0.75)
1,2,4-Trimethylbenzene	8700	1400000	9700	15000	630	33000	ND (2.5)	ND (2.5)	54 (12)	47 (12)	45 (12)	ND (2.5)	ND (2.5)	ND (2.5)
1,3,5-Trimethylbenzene	8800	1300000	9100	15000	590	71000	ND (2.5)	ND (2.5)	13 (12)	12 (12)	11 J (12)	ND (2.5)	ND (2.5)	ND (2.5)
Xylenes (total)	3700	1900000	13000	17000	860	210000	ND (1)	ND (1)	186 J (5)	196 J (5)	186 J (5)	ND (1)	ND (1)	ND (1)
Semivolatile Organic Compounds														
Anthracene	240000	--	--	19000000	--	40000	ND (0.1)	ND (0.1)	0.11 (0.1)	0.23 (0.1)	0.32 (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)anthracene	100	--	--	1400000	--	13	0.18 (0.05)	ND (0.05)	0.1 (0.05)	0.02 J (0.05)	0.02 J (0.05)	ND (0.05)	0.03 J (0.05)	ND (0.05)
Benzo(a)pyrene	10	--	--	5800	--	1.3	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(b)fluoranthene	160	--	--	1400000	--	13	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Benzo(g,h,i)perylene	44000	--	--	5800000	--	12	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Chrysene	16000	--	--	140000000	--	1300	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Fluorene	97000	--	--	7800000	--	7000	ND (0.1)	ND (0.1)	0.92 (0.1)	0.5 (0.1)	0.55 (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Indeno(1,2,3-cd)pyrene	100	--	--	1400000	--	13	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Naphthalene	390	120000	880	280	67	43000	ND (0.1)	ND (0.1)	9.4 (0.1)	0.19 (0.1)	1.5 (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Phenanthrene	73000	--	--	5800000	--	1000	ND (0.05)	ND (0.05)	0.25 (0.05)	0.04 J (0.05)	0.04 J (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Pyrene	50000	--	--	5800000	--	3000	ND (0.1)	ND (0.1)	0.06 J (0.1)	0.02 J (0.1)	0.03 J (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Metals														
Lead	--	--	--	--	--	2500	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)

Notes:
1 All concentrations reported in ug/L (ppb); detection limits in parentheses.
2 Boldfaced concentrations exceed the Nonpotable GW Use.
3 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
4 No concentrations exceed the Routine Worker GW VI.
5 No concentrations exceed the Construction Worker GW Direct Contact.
6 Underlined concentrations exceed the Off-Facility Resident GW VI.
7 No concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location					AOI4_BH-13-81	AOI4_BH-13-90	AOI4-BH-13-100	AOI4-BH-13-100	AOI4-BH-13-101	AOI4-BH-13-101
Field Sample ID	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI-4_BH-13-81_8-10'	AOI-4_BH-13-90_8-10'_031513	AOI4-BH-13-100_0-1_31813	AOI4-BH-13-100_5-6_31813	AOI4-BH-13-101_0-1_31813	AOI4-BH-13-101_7-8_31813
Collection Depth (ft bgs)					8.0 - 10.0	8.0 - 10.0	0.0 - 1.0	5.0 - 6.0	0.0 - 1.0	7.0 - 8.0
Sample Date					3/20/2013	3/15/2013	3/18/2013	3/18/2013	3/18/2013	3/18/2013
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.00091)	ND (0.0012)	ND (0.00088)	ND (0.0011)	ND (0.001)	ND (0.0013)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0046)	ND (0.0058)	ND (0.0044)	ND (0.0057)	ND (0.0051)	ND (0.0063)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.00091)	ND (0.0012)	ND (0.00088)	ND (0.0011)	ND (0.001)	ND (0.0013)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.00091)	ND (0.0012)	ND (0.00088)	ND (0.0011)	ND (0.001)	ND (0.0013)
Toluene	8000	76	650	9800	ND (0.00091)	ND (0.0012)	ND (0.00088)	ND (0.0011)	ND (0.001)	ND (0.0013)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0046)	ND (0.0058)	ND (0.0044)	ND (0.0057)	ND (0.0051)	ND (0.0063)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0046)	ND (0.0058)	ND (0.0044)	ND (0.0057)	ND (0.0051)	ND (0.0063)
Xylenes (total)	240	1.5	51	340	ND (0.00091)	ND (0.0012)	ND (0.00088)	ND (0.0011)	ND (0.001)	ND (0.0013)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.036)	ND (0.12)	ND (0.038)	ND (0.037)	0.0182 J (0.037)	ND (0.04)
Benzo(a)anthracene	430	--	3200	--	ND (0.036)	ND (0.12)	0.0231 J (0.038)	ND (0.037)	0.0559 (0.037)	ND (0.04)
Benzo(a)pyrene	43	--	7.7	--	ND (0.036)	ND (0.12)	0.0243 J (0.038)	ND (0.037)	0.0449 (0.037)	ND (0.04)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.036)	ND (0.12)	0.0303 J (0.038)	ND (0.037)	0.0544 (0.037)	ND (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.036)	ND (0.12)	0.0274 J (0.038)	ND (0.037)	0.0408 (0.037)	ND (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.036)	ND (0.12)	0.0263 J (0.038)	ND (0.037)	0.0787 (0.037)	ND (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.036)	ND (0.12)	ND (0.038)	ND (0.037)	ND (0.037)	ND (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.036)	ND (0.12)	ND (0.038)	ND (0.037)	ND (0.037)	ND (0.04)
Phenanthrene	4600	--	14000	--	ND (0.036)	ND (0.12)	0.0235 J (0.038)	ND (0.037)	0.104 (0.037)	ND (0.04)
Pyrene	4600	--	14000	--	ND (0.036)	ND (0.12)	0.0297 J (0.038)	ND (0.037)	0.12 (0.037)	ND (0.04)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	2.5 (2.3)	8.6 (1.1)	399 (2.3)	12.8 (2.4)	494 (2.4)	10.2 (2.1)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-BH-13-102	AOI4-BH-13-102	AOI4-BH-13-103	AOI4-BH-13-103	AOI4-BH-13-104	AOI4-BH-13-104
Field Sample ID					AOI4-BH-13-102_0-1_31813	AOI4-BH-13-102_6-7_31813	AOI4-BH-13-103_0-1_31813	AOI4-BH-13-103_2-3_31813	AOI4-BH-13-104_0-.5_31513	AOI4-BH-13-104_6-7_31513
Collection Depth (ft bgs)					0.0 - 1.0	6.0 - 7.0	0 - 1	2.0 - 3.0	0.0 - 0.5	6.0 - 7.0
Sample Date					3/18/2013	3/18/2013	3/18/2013	3/18/2013	3/15/2013	3/15/2013
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.0011)	ND (0.001)	ND (0.0015)	ND (0.0011)	ND (0.001)	1.96 (0.27)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0056)	ND (0.005)	ND (0.0076)	ND (0.0055)	ND (0.005)	7.31 (1.4)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	ND (0.001)	ND (0.0015)	ND (0.0011)	ND (0.001)	29.5 (0.27)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0011)	ND (0.001)	ND (0.0015)	ND (0.0011)	ND (0.001)	ND (0.27)
Toluene	8000	76	650	9800	ND (0.0011)	ND (0.001)	ND (0.0015)	ND (0.0011)	ND (0.001)	6.55 (0.27)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0056)	ND (0.005)	ND (0.0076)	ND (0.0055)	ND (0.005)	*75.4 (5.5)*
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0056)	ND (0.005)	ND (0.0076)	ND (0.0055)	ND (0.005)	27.3 (1.4)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	ND (0.001)	ND (0.0015)	ND (0.0011)	ND (0.001)	*65.6 (0.27)*
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.036)	ND (0.037)	0.0731 (0.038)	ND (0.04)	ND (0.12)	2.56 (0.12)
Benzo(a)anthracene	430	--	3200	--	0.0292 J (0.036)	ND (0.037)	0.0807 (0.038)	ND (0.04)	ND (0.12)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.036)	ND (0.037)	0.0794 (0.038)	ND (0.04)	ND (0.12)	ND (0.12)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.036)	ND (0.037)	0.0607 (0.038)	ND (0.04)	ND (0.12)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.036)	ND (0.037)	0.111 (0.038)	ND (0.04)	ND (0.12)	ND (0.12)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.0338 J (0.036)	ND (0.037)	0.122 (0.038)	ND (0.04)	ND (0.12)	ND (0.12)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.036)	ND (0.037)	ND (0.038)	ND (0.04)	ND (0.12)	6.14 (0.12)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.036)	ND (0.037)	0.0654 (0.038)	ND (0.04)	ND (0.12)	*21.2 (0.61)*
Phenanthrene	4600	--	14000	--	0.0401 (0.036)	ND (0.037)	0.285 (0.038)	0.0341 J (0.04)	ND (0.12)	21.7 (0.61)
Pyrene	4600	--	14000	--	0.0476 (0.036)	ND (0.037)	0.261 (0.038)	ND (0.04)	ND (0.12)	0.697 (0.12)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	1620 (2.4)	9.2 (2.1)	***3020 (2.5)***	34 (2)	7 (1.1)	7.9 (1.1)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-BH-13-82	AOI4-BH-13-84	AOI4-BH-13-85	AOI4-BH-13-86	AOI4-BH-13-86	AOI4-BH-13-88
Field Sample ID					AOI4-BH-13-82_6.5-7_031813	AOI4-BH-13-84_5.5-6_031513	AOI4-BH-13-85_5.5-6_031513	AOI4-BH-13-86_2-2.5_031513	AOI4-BH-13-86_5.5-6_031513	AOI4-BH-13-88_1.5-2_31413
Collection Depth (ft bgs)					6.5 - 7.0	5.5 - 6.0	5.5 - 6.0	2.0 - 2.5	5.5 - 6.0	1.5 - 2.0
Sample Date					3/18/2013	3/15/2013	3/15/2013	3/15/2013	3/15/2013	3/14/2013
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.099)	ND (0.00088)	ND (0.00088)	ND (0.00085)	ND (0.00088)	ND (0.11)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	0.129 J (0.5)	ND (0.0044)	ND (0.0044)	0.0143 (0.0043)	ND (0.0044)	0.694 (0.55)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	0.186 (0.099)	ND (0.00088)	ND (0.00088)	0.0206 (0.00085)	ND (0.00088)	ND (0.11)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.099)	ND (0.00088)	ND (0.00088)	ND (0.00085)	ND (0.00088)	ND (0.11)
Toluene	8000	76	650	9800	ND (0.099)	ND (0.00088)	ND (0.00088)	ND (0.00085)	ND (0.00088)	ND (0.11)
1,2,4-Trimethylbenzene	180	0.92	70	250	0.362 J (0.5)	ND (0.0044)	ND (0.0044)	0.0437 (0.0043)	ND (0.0044)	13.6 (0.55)
1,3,5-Trimethylbenzene	220	0.92	99	240	0.147 J (0.5)	ND (0.0044)	ND (0.0044)	0.0169 (0.0043)	ND (0.0044)	ND (0.55)
Xylenes (total)	240	1.5	51	340	0.339 (0.099)	ND (0.00088)	ND (0.00088)	0.0109 (0.00085)	ND (0.00088)	ND (0.11)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(a)anthracene	430	--	3200	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	0.0692 J (0.11)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	0.0431 J (0.11)	ND (0.12)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	0.122 (0.11)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	0.0634 J (0.11)	ND (0.12)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.11)	2.53 (0.12)
Phenanthrene	4600	--	14000	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	0.107 J (0.11)	0.622 (0.12)
Pyrene	4600	--	14000	--	ND (0.04)	ND (0.12)	ND (0.12)	ND (0.12)	0.147 (0.11)	0.0608 J (0.12)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	13.3 (2.5)	6.6 (1)	6.9 (1.1)	7.8 (1.1)	2140 (5.4)	10 (1.2)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-BH-13-88	AOI4-BH-13-88	AOI4-BH-13-89	AOI4-BH-13-92	AOI4-BH-13-93	AOI4-BH-13-95
Field Sample ID					AOI4-BH-13-88_3.5-4_031413	AOI4-BH-13-88_5.5-6_031413	AOI4-BH-13-89_5.5-6_031913	AOI4-BH-13-92_8-10'	AOI4-BH-13-93_8-10'	AOI4-BH-13-95_8-10'
Collection Depth (ft bgs)					3.5 - 4.0	5.5 - 6.0	5.5 - 6.0	8.0 - 10.0	8.0 - 10.0	8.0 - 10.0
Sample Date					3/14/2013	3/14/2013	3/19/2013	3/18/2013	3/18/2013	3/18/2013
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.1)	ND (0.001)	ND (0.00089)	ND (0.00089)	ND (0.00077)	ND (0.0009)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	0.993 (0.5)	ND (0.0051)	ND (0.0045)	ND (0.0045)	ND (0.0038)	ND (0.0045)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.1)	ND (0.001)	ND (0.00089)	ND (0.00089)	ND (0.00077)	ND (0.0009)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.1)	ND (0.001)	ND (0.00089)	ND (0.00089)	ND (0.00077)	ND (0.0009)
Toluene	8000	76	650	9800	ND (0.1)	ND (0.001)	ND (0.00089)	ND (0.00089)	ND (0.00077)	ND (0.0009)
1,2,4-Trimethylbenzene	180	0.92	70	250	6.95 (0.5)	ND (0.0051)	ND (0.0045)	ND (0.0045)	ND (0.0038)	ND (0.0045)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.5)	ND (0.0051)	ND (0.0045)	ND (0.0045)	ND (0.0038)	ND (0.0045)
Xylenes (total)	240	1.5	51	340	ND (0.1)	ND (0.001)	ND (0.00089)	ND (0.00089)	ND (0.00077)	ND (0.0009)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Benzo(a)pyrene	43	--	7.7	--	ND (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.894 (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Phenanthrene	4600	--	14000	--	0.393 (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.12)	ND (0.037)	ND (0.071)	ND (0.036)	ND (0.033)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	7.1 (1.1)	6.2 (1.1)	6.7 (2)	11.6 (2.4)	10.7 (2.3)	5.5 (2.3)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-BH-13-97	AOI4-BH-13-97	AOI4-BH-13-98	AOI4-BH-13-98	AOI4-BH-13-99	AOI4-BH-13-99
Field Sample ID					AOI4-BH-13-97.0-1_31413	AOI4-BH-13-97-8.5-9.5_31413	AOI4-BH-13-98_6-7_31413	AOI4-BH-13-98-1-2_31413	AOI4-BH-13-99_1.5-2_031813	AOI4-BH-13-99_2.5-3_031813
Collection Depth (ft bgs)					0.0 - 1.0	8.5 - 9.5	6.0 - 7.0	1.0 - 2.0	1.5 - 2	2.5 - 3.0
Sample Date					3/14/2013	3/14/2013	3/14/2013	3/14/2013	3/18/2013	3/18/2013
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.00095)	ND (0.001)	0.127 (0.00096)	ND (0.001)	0.00024 J (0.0012)	0.245 (0.15)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0047)	ND (0.005)	0.015 (0.0048)	ND (0.0051)	0.00071 J (0.0059)	0.122 J (0.73)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.00095)	ND (0.001)	0.581 (0.098)	ND (0.001)	ND (0.0012)	0.11 J (0.15)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.00095)	ND (0.001)	ND (0.00096)	ND (0.001)	ND (0.0012)	ND (0.15)
Toluene	8000	76	650	9800	ND (0.00095)	ND (0.001)	0.702 (0.098)	ND (0.001)	ND (0.0012)	0.182 (0.15)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0047)	ND (0.005)	1.15 (0.49)	ND (0.0051)	ND (0.0059)	0.169 J (0.73)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0047)	ND (0.005)	0.0948 (0.0048)	ND (0.0051)	ND (0.0059)	0.0611 J (0.73)
Xylenes (total)	240	1.5	51	340	ND (0.00095)	ND (0.001)	2.42 (0.098)	ND (0.001)	ND (0.0012)	0.671 (0.15)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.12)	0.0675 (0.039)	ND (0.037)
Benzo(a)anthracene	430	--	3200	--	ND (0.12)	ND (0.1)	ND (0.12)	0.105 J (0.12)	0.111 (0.039)	0.0652 (0.037)
Benzo(a)pyrene	43	--	7.7	--	ND (0.12)	ND (0.1)	ND (0.12)	0.0823 J (0.12)	0.157 (0.039)	0.0875 (0.037)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.12)	ND (0.1)	ND (0.12)	0.189 (0.12)	0.109 (0.039)	0.0954 (0.037)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.12)	ND (0.1)	ND (0.12)	0.0753 J (0.12)	0.215 (0.039)	0.109 (0.037)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.12)	ND (0.1)	ND (0.12)	0.112 J (0.12)	0.145 (0.039)	0.114 (0.037)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.12)	ND (0.039)	0.191 (0.037)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.12)	0.0334 J (0.039)	0.0933 (0.037)
Phenanthrene	4600	--	14000	--	ND (0.12)	ND (0.1)	ND (0.12)	0.0619 J (0.12)	0.237 (0.039)	0.38 (0.037)
Pyrene	4600	--	14000	--	ND (0.12)	ND (0.1)	ND (0.12)	0.201 (0.12)	0.196 (0.039)	0.14 (0.037)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	81.5 (1.1)	2.9 (1)	8 (1.1)	136 (1.1)	***11600 (12)***	1870 (2.4)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-BH-16-003 AOI4-BH-16-003-0-2-20160824 0.0 - 2.0 8/24/2016	AOI4-BH-16-003 AOI4-BH-16-003-14-15-20160824 14.0 - 15.0 8/24/2016	AOI4-BH-16-004 AOI4-BH-16-004-0-2-20160824 0.0 - 2.0 8/24/2016	AOI4-BH-16-004 AOI4-BH-16-004-14-15-20160824 14.0 - 15.0 8/24/2016	AOI4-BH-16-008 AOI4-BH-16-008-0-2-20160614 0.0 - 2.0 6/14/2016	AOI4-BH-16-009 AOI4-BH-16-009-0-2-20160614 0.0 - 2.0 6/14/2016
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.00126)	0.00122 (0.0011)	ND (0.00121)	0.00135 (0.0012)	NA	NA
sec-Butylbenzene	--	--	--	--	ND (0.00126)	ND (0.0011)	ND (0.00121)	ND (0.0012)	NA	NA
tert-Butylbenzene	--	--	--	--	ND (0.00126)	ND (0.0011)	ND (0.00121)	ND (0.0012)	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0126)	ND (0.011)	ND (0.0121)	ND (0.012)	NA	NA
Cyclohexane	--	--	--	--	ND (0.00126)	0.0291 (0.0011)	ND (0.00121)	0.00201 (0.0012)	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.00126)	ND (0.0011)	ND (0.00121)	ND (0.0012)	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	0.00155 (0.00126)	0.0177 (0.0011)	ND (0.00121)	ND (0.0012)	NA	NA
Toluene	8000	76	650	9800	ND (0.00629)	ND (0.0055)	ND (0.00604)	ND (0.00602)	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.00126)	ND (0.0011)	ND (0.00121)	ND (0.0012)	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.00126)	ND (0.0011)	ND (0.00121)	ND (0.0012)	NA	NA
Xylenes (total)	240	1.5	51	340	ND (0.00377)	ND (0.0033)	ND (0.00362)	ND (0.00361)	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Anthracene	46000	--	46000	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Benzo(a)anthracene	430	--	3200	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Benzo(a)pyrene	43	--	7.7	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Chrysene	43000	--	320000	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Fluoranthene	--	--	--	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Fluorene	6200	--	18000	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Naphthalene	41	0.54	6	27	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Phenanthrene	4600	--	14000	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Pyrene	4600	--	14000	--	ND (0.0415)	ND (0.0363)	ND (0.0398)	ND (0.0397)	NA	NA
Metals										
Cobalt	--	--	--	--	9.05 (1.26)	7.02 (1.1)	8.42 (1.21)	9.13 (1.2)	NA	NA
Lead	2520	--	2520	45000	8.18 (0.629)	6.69 (0.55)	12.2 (0.604)	10.8 (0.602)	1760 J (0.561)	1490 J (0.583)
Nickel	6200	--	700	1700	11.6 (2.52)	11.3 (2.2)	12 (2.41)	6.2 (2.41)	NA	NA
Vanadium	1600	--	350	2800	25.9 (2.52)	22.1 (2.2)	39 (2.41)	21.9 (2.41)	NA	NA
Zinc	--	--	--	--	29.9 (6.29)	29 (5.5)	46.2 (6.04)	17.9 (6.02)	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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ND - Not Detected
NA - Not Analyzed
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-BH-16-010 AOI4-BH-16-010-0-2-20160614 0.0 - 2.0 6/14/2016	AOI4-BH-16-012 AOI4-BH-16-012-0-2-20160613 0.0 - 2.0 6/13/2016	AOI4-BH-16-013 AOI4-BH-16-013-0-2-20160630 0.0 - 2.0 6/30/2016	AOI4-BH-16-013 AOI4-BH-16-013-13-14-20160630 13.0 - 14.0 6/30/2016	AOI4-BH-16-014 AOI4-BH-16-014-0-2-20160629 0.0 - 2.0 6/29/2016	AOI4-BH-16-014 AOI4-BH-16-014-13-14-20160629 13.0 - 14.0 6/29/2016
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	0.00349 (0.00118)	ND (0.0528)	0.0626 (0.00114)	ND (0.122)
sec-Butylbenzene	--	--	--	--	NA	NA	0.0208 (0.00118)	0.405 (0.0528)	ND (0.00114)	0.837 (0.122)
tert-Butylbenzene	--	--	--	--	NA	NA	0.00214 (0.00118)	0.131 (0.0528)	ND (0.00114)	ND (0.122)
Cumene	1000	6.1	87	1000	NA	NA	0.0415 (0.0118)	ND (0.528)	ND (0.0114)	ND (1.22)
Cyclohexane	--	--	--	--	NA	NA	0.0443 (0.00118)	0.306 (0.0528)	0.00987 (0.00114)	ND (0.122)
Ethyl Benzene	2300	15	1300	820	NA	NA	ND (0.00118)	ND (0.0528)	0.00835 (0.00114)	ND (0.122)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	0.0452 (0.00118)	0.205 (0.0528)	0.0017 (0.00114)	ND (0.122)
Toluene	8000	76	650	9800	NA	NA	ND (0.00589)	ND (0.264)	ND (0.00568)	ND (0.611)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	ND (0.00118)	0.327 (0.0528)	ND (0.00114)	ND (0.122)
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	ND (0.00118)	0.0551 (0.0528)	ND (0.00114)	ND (0.122)
Xylenes (total)	240	1.5	51	340	NA	NA	ND (0.00353)	ND (0.159)	ND (0.00341)	ND (0.366)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Anthracene	46000	--	46000	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Benzo(a)anthracene	430	--	3200	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Benzo(a)pyrene	43	--	7.7	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Chrysene	43000	--	320000	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Fluoranthene	--	--	--	--	NA	NA	0.33 (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Fluorene	6200	--	18000	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Naphthalene	41	0.54	6	27	NA	NA	ND (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Phenanthrene	4600	--	14000	--	NA	NA	0.262 (0.194)	0.303 (0.21)	ND (0.375)	ND (0.0403)
Pyrene	4600	--	14000	--	NA	NA	0.292 (0.194)	ND (0.21)	ND (0.375)	ND (0.0403)
Metals										
Cobalt	--	--	--	--	NA	NA	10.2 (1.18)	7.43 (1.27)	8.37 (1.14)	8.32 (1.22)
Lead	2520	--	2520	45000	160 J (0.574)	1080 J (0.678)	255 (0.589)	65.1 (0.637)	57.6 (0.568)	13.9 (0.611)
Nickel	6200	--	700	1700	NA	NA	18.6 (2.35)	12.1 (2.55)	14.6 (2.27)	13.4 (2.44)
Vanadium	1600	--	350	2800	NA	NA	38.2 (2.35)	30.1 (2.55)	47.5 (2.27)	37.1 (2.44)
Zinc	--	--	--	--	NA	NA	102 (5.89)	113 (6.37)	80.2 (5.68)	37.6 (6.11)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-BH-16-015 AOI4-BH-16-015-0-2-20160622 0.0 - 2.0 6/22/2016	AOI4-BH-16-015 AOI4-BH-16-015-13-15-20160622 13.0 - 15.0 6/22/2016	AOI4-BH-16-018 AOI4-BH-16-018-0-2-20160628 0.0 - 2.0 6/28/2016	AOI4-BH-16-018 AOI4-BH-16-018-14-15-20160628 14.0 - 15.0 6/28/2016	AOI4-BH-16-022 AOI4-BH-16-022-0-2-20160623 0.0 - 2.0 6/23/2016	AOI4-GP-1 GP-1(1.5-2) 1.5 - 2.0 5/28/2003
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.0023 (0.0012)	ND (0.00107)	ND (0.00129)	ND (0.202)	NA	ND (0.25)
sec-Butylbenzene	--	--	--	--	0.00291 (0.0012)	ND (0.00107)	ND (0.00129)	17.5 (0.202)	NA	NA
tert-Butylbenzene	--	--	--	--	ND (0.0012)	ND (0.00107)	ND (0.00129)	1.06 (0.202)	NA	NA
Cumene	1000	6.1	87	1000	ND (0.012)	ND (0.0107)	ND (0.0129)	7.88 (2.02)	NA	NA
Cyclohexane	--	--	--	--	0.00525 (0.0012)	ND (0.00107)	ND (0.00129)	8.1 (0.202)	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.0012)	ND (0.00107)	ND (0.00129)	ND (0.202)	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0012)	ND (0.00107)	ND (0.00129)	ND (0.202)	NA	NA
Toluene	8000	76	650	9800	ND (0.00601)	ND (0.00533)	ND (0.00646)	ND (1.01)	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0012)	ND (0.00107)	ND (0.00129)	ND (0.202)	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0012)	ND (0.00107)	ND (0.00129)	ND (0.202)	NA	NA
Xylenes (total)	240	1.5	51	340	ND (0.00361)	ND (0.0032)	ND (0.00388)	ND (0.605)	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	ND (0.198)	ND (0.0352)	ND (0.0426)	0.272 (0.0392)	NA	NA
Anthracene	46000	--	46000	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	0.5
Benzo(a)anthracene	430	--	3200	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	2
Benzo(a)pyrene	43	--	7.7	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	2.2
Benzo(b)fluoranthene	430	--	3200	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	1.8
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	0.67
Benzo(k)fluoranthene	4300	--	32000	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	NA
Chrysene	43000	--	320000	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	1.8
Fluoranthene	--	--	--	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	NA
Fluorene	6200	--	18000	--	ND (0.198)	ND (0.0352)	ND (0.0426)	0.426 (0.0392)	NA	ND (0.4)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	NA
Naphthalene	41	0.54	6	27	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	0.2 J
Phenanthrene	4600	--	14000	--	ND (0.198)	ND (0.0352)	ND (0.0426)	0.76 (0.0392)	NA	1.7
Pyrene	4600	--	14000	--	ND (0.198)	ND (0.0352)	ND (0.0426)	ND (0.0392)	NA	1.8
Metals										
Cobalt	--	--	--	--	9.36 (1.2)	4.92 (1.07)	8.76 (1.29)	5.96 (1.19)	NA	NA
Lead	2520	--	2520	45000	310 (0.601)	17.9 (0.533)	6.97 (0.646)	5.91 (0.593)	644 (0.617)	NA
Nickel	6200	--	700	1700	29.4 (2.41)	11.6 (2.13)	12.8 (2.58)	10.2 (2.37)	NA	NA
Vanadium	1600	--	350	2800	206 (2.41)	10.3 (2.13)	27.3 (2.58)	14.9 (2.37)	NA	NA
Zinc	--	--	--	--	696 (6.01)	38.3 (5.33)	30.7 (6.46)	29.4 (5.93)	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-GP-1 GP-1(15-15.5) 15.0 - 15.5 5/28/2003	AOI4-GP-2 GP-2(1.5-2) 1.5 - 2.0 5/28/2003	AOI4-GP-2 GP-2(15-15.5) 15.0 - 15.5 5/28/2003	AOI4-GP-3 GP-3(0-2) 0.0 - 2.0 5/28/2003	AOI4-GP-3 GP-3(15-15.5) 15.0 - 15.5 5/28/2003	AOI4-GP-4 GP-4(1.5-2)~5/28/03~75559 1.5 - 2.0 5/28/2003
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.11 J	ND (0.23)	ND (0.26)	ND (0.31)	ND (0.25)	ND (0.24)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.36)	ND (1.8)	ND (0.36)	0.31 J	ND (0.36)	1.9 J
Benzo(a)anthracene	430	--	3200	--	ND (0.36)	5	ND (0.36)	1.6	ND (0.36)	4.1
Benzo(a)pyrene	43	--	7.7	--	ND (0.36)	4.8	ND (0.36)	1.4	ND (0.36)	3.5
Benzo(b)fluoranthene	430	--	3200	--	ND (0.36)	3.8	ND (0.36)	1.1	ND (0.36)	3.2
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.36)	1.7 J	ND (0.36)	0.41 J	ND (0.36)	1.2 J
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.36)	4.4	ND (0.36)	1.4	ND (0.36)	4
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.4	ND (1.8)	0.2 J	ND (0.42)	ND (0.36)	ND (0.19)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	3.7	0.72	2.2	ND (0.31)	0.42	ND (0.24)
Phenanthrene	4600	--	14000	--	0.99	2.1	0.48	1.1	0.35 J	10
Pyrene	4600	--	14000	--	ND (0.36)	5.4	ND (0.36)	2	ND (0.36)	7.3
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-GP-4 GP-4(15-15.5) 15.0 - 15.5 5/28/2003	AOI4-GP-5 GP-5(1.5-2)~5/28/03~75559 1.5 - 2.0 5/28/2003	AOI4-GP-5 GP-5(15-15.5) 15.0 - 15.5 5/28/2003	AOI4-GP-6 GP-6(1.5-2) 1.5 - 2.0 5/28/2003	AOI4-GP-6 GP-6(15.5-16) 15.5 - 16.0 5/28/2003	AOI4-GP-7 GP-7(1.5-2) 1.5 - 2.0 5/29/2003
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.25)	ND (0.31)	0.14 J	ND (0.27)	ND (0.26)	ND (0.26)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.37)	0.61 J	ND (0.37)	1.3	ND (0.42)	ND (2)
Benzo(a)anthracene	430	--	3200	--	ND (0.37)	2.1	ND (0.37)	2.7	ND (0.42)	ND (2)
Benzo(a)pyrene	43	--	7.7	--	ND (0.37)	2.3	ND (0.37)	2.3	ND (0.42)	ND (2)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.37)	1.8	ND (0.37)	2	ND (0.42)	1.3 J
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.37)	0.88 J	ND (0.37)	0.77 J	ND (0.42)	ND (2)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.37)	2	ND (0.37)	2.4	ND (0.42)	ND (2)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.27 J	ND (0.95)	0.25 J	0.5 J	ND (0.42)	ND (2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.24 J	ND (0.31)	0.37	0.13 J	ND (0.26)	ND (0.26)
Phenanthrene	4600	--	14000	--	0.69	1.9	0.66	4.7	ND (0.42)	ND (2)
Pyrene	4600	--	14000	--	ND (0.37)	2.4	ND (0.37)	3.6	ND (0.42)	ND (2)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-GP-7 GP-7(15.5-16) 15.5 - 16.0 5/29/2003	AOI4-GP-7 GP-7(6.5-7) 6.5 - 7.0 5/29/2003	AOI4-GP-8 GP-8(1.5-2) 1.5 - 2.0 5/29/2003	AOI4-GP-8 GP-8(15-15.5) 15.0 - 15.5 5/29/2003	AOI4-GP-8 GP-8(7.5-8) 7.5 - 8.0 5/29/2003	AOI4-GP-9 GP-9(Surface) 0 5/29/2003
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.34 J	0.16 J	ND (0.28)	ND (0.24)	ND (0.26)	0.054 J
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (3.7)	ND (4.7)	ND (8.1)	ND (0.37)	0.5 J	ND (57)
Benzo(a)anthracene	430	--	3200	--	ND (3.7)	ND (4.7)	ND (8.1)	ND (0.37)	ND (0.76)	ND (57)
Benzo(a)pyrene	43	--	7.7	--	ND (3.7)	ND (4.7)	ND (8.1)	ND (0.37)	ND (0.76)	ND (57)
Benzo(b)fluoranthene	430	--	3200	--	ND (3.7)	ND (4.7)	ND (8.1)	ND (0.37)	ND (0.76)	ND (57)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (3.7)	ND (4.7)	ND (8.1)	ND (0.37)	ND (0.76)	ND (57)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (3.7)	ND (4.7)	ND (8.1)	ND (0.37)	0.63 J	ND (57)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	2.2 J	17	7.6 J	ND (0.37)	0.82	ND (57)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	*25*	*9.4*	*40 D*	ND (0.24)	0.91	0.46
Phenanthrene	4600	--	14000	--	5	49	22	0.38	3.4	230
Pyrene	4600	--	14000	--	ND (3.7)	10	4.1 J	ND (0.37)	1.3	37 J
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
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Tank Group 04
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Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-PE-01 AOI4-PE-01 2.0 - 2.5 7/13/2018	AOI4-PE-02 AOI4-PE-02 2 7/13/2018	AOI4-PE-03 AOI4-PE-03 2.0 - 2.5 7/13/2018	AOI4-PE-04 AOI4-PE-04 2 7/13/2018	AOI4-PE-05 AOI4-PE-05 0.5 - 1.0 7/13/2018	AOI4-PE-06 AOI4-PE-06 0.5 7/13/2018
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	***8400 (8.23)***	734 (1.44)	***3490 (8.65)***	***36800 (37.9)***	***5690 (6.11)***	***6380 (7.27)***
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
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4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
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Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	11.3 (1.73)	134 (1.61)	529 (6.23)	***4530 (6.53)***	***7460 (12.6)***	***27100 (76.1)***
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
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Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	***16000 (31.7)***	***28600 (27.4)***	55.3 (1.36)	105 (1.43)	***4240 (13.2)***	***25600 (62.4)***
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-PE-19 AOI4-PE-19 2 8/7/2018	AOI4-PE-20 AOI4-PE-20 2 8/7/2018	AOI4-PE-21 AOI4-PE-21 2 8/7/2018	AOI4-PE-22 AOI4-PE-22 2 8/7/2018	AOI4-PE-23 AOI4-PE-23 2 8/7/2018	AOI4-PE-24 AOI4-PE-24 2 8/7/2018
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	***31700 (62)***	***38300 (73.5)***	***35600 (71.4)***	***7500 (12.7)***	132 (1.23)	295 (1.36)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
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Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-PE-25 AOI4-PE-25 2 8/7/2018	AOI4-PE-26 AOI4-PE-26 2 8/7/2018	AOI4-PE-27 AOI4-PE-27 2 8/7/2018	AOI4-PE-28 AOI4-PE-28 2 8/7/2018	AOI4-PE-29 AOI4-PE-29 2 8/7/2018	AOI4-PE-30 AOI4-PE-30 2 8/7/2018
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	1020 (1.42)	48.6 (1.85)	162 (1.82)	126 (1.84)	855 (1.76)	97.5 (1.77)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
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Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-PE-31 AOI4-PE-31 2 8/7/2018	AOI4-PE-32 AOI4-PE-32 2 8/7/2018	AOI4-PE-33 AOI4-PE-33 2 8/7/2018	AOI4-PE-41 AOI4-PE-41 2 8/9/2018	AOI4-PE-43 AOI4-PE-43 2 8/9/2018	AOI4-PE-44 AOI4-PE-44 2 8/9/2018
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	***28100 (37)***	***17400 (34.6)***	82.8 (1.76)	368 (1.77)	***8050 (7.06)***	***66400 (100)***
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
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Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-PE-45 AOI4-PE-45 2 8/9/2018	AOI4-PE-46 AOI4-PE-46 2 8/9/2018	AOI4-PE-49 AOI4-PE-49 2 8/9/2018	AOI4-PE-51 AOI4-PE-51 2 8/9/2018	AOI4-PE-52 AOI4-PE-52 2 8/9/2018	AOI4-PE-53 AOI4-PE-53 2 8/9/2018
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	***2720 (6.41)***	64.4 (1.77)	205 (1.69)	***13300 (35.1)***	***3310 (8.68)***	***6310 (8.88)***
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
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Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AOI4-PE-54 AOI4-PE-54 2 8/9/2018	AOI4-PE-55 AOI4-PE-55 2 8/9/2018	AOI4-PE-56 AOI4-PE-56 2 8/9/2018	AOI4-PE-57 AOI4-PE-57 2 8/9/2018	AOI4-PE-58 AOI4-PE-58 2 8/9/2018	AOI4-PE-60 AOI4-PE-60 2 8/15/2018
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	***17400 (16.8)***	***11800 (16.2)***	183 (9.02)	***6040 (13.3)***	1590 (17.4)	***59600 (76.2)***
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
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Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	NA	NA	NA	NA	NA	ND,D (0.097)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	ND,D (0.097)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	ND,D (0.097)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	ND,D (0.097)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	ND,D (0.097)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	ND (0.42)
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	ND (0.42)
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	ND (0.42)
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	ND (0.42)
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	ND (0.42)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	ND (0.42)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	ND (0.42)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	ND (0.42)
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	ND,D (0.097)
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	ND (0.42)
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	ND (0.42)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	2130 (145)	***29100 (74.4)***	1370 (13.6)	***10600 (16.9)***	***22500 (34.9)***	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	AST-845-LINE-2 AST-845-LINE-2 0.0 - 0.5 3/14/2007	AST-845-LINE-3 AST-845-LINE-3 0.0 - 0.5 3/14/2007	AST-845-LINE-4 AST-845-LINE-4 0.0 - 0.5 3/14/2007	AST-845-LINE-5 AST-845-LINE-5 0.0 - 0.5 3/14/2007	MW-1 MW-1(1.5-2) 1.5 - 2.0 5/29/2003	MW-1 MW-1(11.5-12) 11.5 - 12.0 5/29/2003
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND,D (0.12)	ND,D (0.1)	ND,D (0.12)	ND,D (0.13)	ND (0.24)	ND (0.26)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND,D (0.12)	ND,D (0.1)	ND,D (0.12)	ND,D (0.13)	NA	NA
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	0.068 J,D (0.12)	ND,D (0.1)	ND,D (0.12)	ND,D (0.13)	NA	NA
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND,D (0.12)	ND,D (0.1)	ND,D (0.12)	ND,D (0.13)	NA	NA
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	0.077 J,D (0.12)	ND,D (0.1)	0.09 J,D (0.12)	ND,D (0.13)	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.41)	ND (0.39)	ND (0.4)	ND (0.37)	0.88	ND (0.36)
Benzo(a)anthracene	430	--	3200	--	ND (0.41)	ND (0.39)	ND (0.4)	0.49 (0.37)	2.1	ND (0.36)
Benzo(a)pyrene	43	--	7.7	--	ND (0.41)	ND (0.39)	ND (0.4)	ND (0.37)	1.9	ND (0.36)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.41)	ND (0.39)	0.47 (0.4)	0.53 (0.37)	2	ND (0.36)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.41)	ND (0.39)	ND (0.4)	ND (0.37)	0.71	ND (0.36)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.45 (0.41)	ND (0.39)	ND (0.4)	0.49 (0.37)	2.1	ND (0.36)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.41)	ND (0.39)	ND (0.4)	ND (0.37)	0.39	ND (0.36)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.41)	ND (0.39)	ND (0.4)	ND (0.37)	NA	NA
Naphthalene	41	0.54	6	27	ND,D (0.12)	ND,D (0.1)	ND,D (0.12)	ND,D (0.13)	ND (0.24)	ND (0.26)
Phenanthrene	4600	--	14000	--	0.64 (0.41)	ND (0.39)	ND (0.4)	0.66 (0.37)	3.1	ND (0.36)
Pyrene	4600	--	14000	--	0.64 (0.41)	0.45 (0.39)	0.62 (0.4)	1 (0.37)	3.2	ND (0.36)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	MW-2 MW-2(0-2) 0.0 - 2.0 5/29/2003	MW-3 MW-3(1.5-2) 1.5 - 2.0 5/29/2003	MW-3 MW-3(15.5-16) 15.5 - 16.0 5/29/2003	MW-4 MW-4(1.5-2) 1.5 - 2.0 5/29/2003	MW-4 MW-4(11.5-12) 11.5 - 12.0 5/29/2003	PB-252-LINE-1 PB-252-LINE-1 0.0 - 0.5 5/30/2007
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.087 J	ND (0.25)	0.065 J	0.054 J	ND (0.25)	ND,D (0.28)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	NA	NA	NA	NA	NA	ND,D (0.28)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	NA	NA	NA	NA	NA	0.15 J,D (0.28)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	NA	NA	NA	NA	NA	ND,D (0.28)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.29 J	0.35 J	ND (0.36)	0.33 J	ND (0.41)	NA
Benzo(a)anthracene	430	--	3200	--	0.73	2.7	ND (0.36)	0.93	ND (0.41)	NA
Benzo(a)pyrene	43	--	7.7	--	0.8	5 D	ND (0.36)	1.1	ND (0.41)	NA
Benzo(b)fluoranthene	430	--	3200	--	0.69	3.9	ND (0.36)	0.98	ND (0.41)	NA
Benzo(g,h,i)perylene	4600	--	14000	--	0.37 J	1.8	ND (0.36)	0.5	ND (0.41)	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.73	2.5	ND (0.36)	0.91	ND (0.41)	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.39)	ND (0.37)	0.6	ND (0.39)	ND (0.41)	ND (0.36)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.055 J	ND (0.25)	3.4	0.075 J	ND (0.25)	ND,D (0.28)
Phenanthrene	4600	--	14000	--	1.1	0.86	1.4	1.2	ND (0.41)	ND (0.36)
Pyrene	4600	--	14000	--	1.2	1.8	ND (0.36)	1.1	0.26 J	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-252-LINE-2 PB-252-LINE-2 0.0 - 0.5 5/30/2007	PB-252-LINE-4 PB-252-LINE-4 6.0 - 6.5 5/30/2007	PB-252-LINE-5 PB-252-LINE-5 6.0 - 6.5 5/30/2007	PB-252-LINE-6 PB-252-LINE-6 6.0 - 6.5 5/30/2007	PB-252-PER-1 PB-252-PER-1 3.0 - 3.5 5/30/2007	PB-252-PER-2 PB-252-PER-2 3.0 - 3.5 5/30/2007
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND,D (0.21)	*22 D (1.7)*	1.6 D (0.15)	0.71 D (0.18)	*10 D (1.7)*	2.2 D (0.17)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND,D (0.21)	11 D (1.7)	9.9 D (1.5)	14 D (0.18)	7.5 D (1.7)	12 D (0.17)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND,D (0.21)	73 D (1.7)	63 D (1.5)	6.7 D (0.18)	37 D (1.7)	35 D (1.7)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND,D (0.21)	94 D (1.7)	51 D (1.5)	0.45 D (0.18)	7.5 D (1.7)	0.42 D (0.17)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.36)	1.6 (0.42)	2.6 (0.41)	2.1 (0.41)	ND (0.4)	ND (0.38)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.17 J,D (0.21)	***49 D (1.7)***	***43 D (1.5)***	*7.9 D (0.18)*	*29 D (1.7)*	4.8 D (0.17)
Phenanthrene	4600	--	14000	--	0.55 (0.36)	2.5 (0.42)	4.4 (0.41)	4.1 (0.41)	7.9 D (0.79)	0.48 (0.38)
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
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Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-252-PER-3 PB-252-PER-3 3.0 - 3.5 5/30/2007	PB-252-PER-4 PB-252-PER-4 3.0 - 3.5 5/30/2007	PB-252-PER-5 PB-252-PER-5 3.0 - 3.5 5/30/2007	PB-252-PER-6 PB-252-PER-6 3.0 - 3.5 5/30/2007	PB-252-SUB-1 PB-252-SUB-1 5.0 - 5.5 5/30/2007	PB-252-SUB-2 PB-252-SUB-2 5.0 - 5.5 5/30/2007
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.72 D (0.19)	1.7 D (0.18)	2.1 D (0.16)	4.7 D (0.18)	ND,D (0.26)	4.7 D (0.31)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	11 D (0.19)	6.4 D (0.18)	2.7 D (0.16)	2.3 D (0.18)	ND,D (0.26)	11 D (0.31)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	23 D (1.9)	18 D (1.8)	6.4 D (0.16)	9.3 D (0.18)	ND,D (0.26)	44 D (3.1)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	0.59 D (0.19)	0.72 D (0.18)	0.3 D (0.16)	2.7 D (0.18)	ND,D (0.26)	5.2 D (0.31)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.42)	ND (0.42)	4.2 (0.39)	0.42 (0.39)	ND (0.38)	ND (0.41)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	*29 D (1.9)*	*12 D (0.18)*	*26 D (1.6)*	3.8 D (0.18)	0.26 J,D (0.26)	*24 D (0.31)*
Phenanthrene	4600	--	14000	--	0.23 J (0.42)	3.9 (0.42)	14 D (2)	1 (0.39)	ND (0.38)	ND (0.41)
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
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Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND,D (0.3)	ND (0.0019)	ND (0.002)	ND (0.0019)	ND (0.002)	ND (0.0019)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND,D (0.3)	ND (0.0047)	ND (0.0049)	ND (0.0048)	ND (0.005)	ND (0.0049)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND,D (0.3)	ND (0.0019)	0.0025 J (0.002)	0.0022 J (0.0019)	ND (0.002)	ND (0.0019)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND,D (0.3)	0.0027 J (0.0019)	0.0054 (0.002)	0.0043 J (0.0019)	ND (0.002)	0.0027 J (0.0019)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	0.068 (0.0034)	0.23 (0.0035)	0.023 J (0.0034)	0.016 (0.00072)	0.0056 J (0.00069)
Benzo(a)anthracene	430	--	3200	--	NA	0.24 (0.0075)	0.88 (0.031)	0.11 (0.0076)	0.083 (0.0016)	0.027 (0.0015)
Benzo(a)pyrene	43	--	7.7	--	NA	0.25 (0.011)	0.8 (0.046)	0.16 (0.011)	0.1 (0.0024)	0.032 (0.0023)
Benzo(b)fluoranthene	430	--	3200	--	NA	0.21 (0.015)	0.71 (0.062)	0.13 (0.015)	0.086 (0.0032)	0.027 (0.0031)
Benzo(g,h,i)perylene	4600	--	14000	--	NA	0.42 (0.015)	1 (0.015)	0.28 (0.015)	0.17 (0.0032)	0.052 (0.0031)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	0.23 (0.011)	0.82 (0.012)	0.13 (0.011)	0.089 (0.0024)	0.028 (0.0023)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.43)	0.033 J (0.023)	0.11 J (0.023)	ND (0.023)	0.012 J (0.0048)	ND (0.0046)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	0.097 (0.019)	0.5 (0.019)	0.071 J (0.019)	0.046 (0.004)	0.024 (0.0039)
Naphthalene	41	0.54	6	27	ND,D (0.3)	ND (0.0095)	0.016 J (0.0098)	0.015 J (0.0096)	ND (0.01)	ND (0.0097)
Phenanthrene	4600	--	14000	--	ND (0.43)	0.39 (0.011)	1.5 (0.012)	0.15 (0.011)	0.12 (0.0024)	0.031 (0.0023)
Pyrene	4600	--	14000	--	NA	0.78 (0.026)	2.4 (0.027)	0.44 (0.027)	0.25 (0.0056)	0.076 (0.0054)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-826-6	PB-826-7	PB-826-8	PB-826-9	PB-843 LINE 1	PB-843 LINE 2
Field Sample ID					826-6	826-7	826-8	826-9	843 Line 1	843 Line 2
Collection Depth (ft bgs)					0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	5.5 - 6.0	5.5 - 6.0
Sample Date					9/7/2004	9/7/2004	9/7/2004	9/7/2004	8/23/2006	8/23/2006
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.0021)	ND (0.0021)	ND (0.0021)	ND (0.002)	ND (0.028)	ND (0.028)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0052)	ND (0.0052)	ND (0.0052)	ND (0.005)	0.11 J (0.056)	ND (0.055)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.0021)	ND (0.0021)	0.0048 J (0.0021)	ND (0.002)	ND (0.056)	ND (0.055)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.0021)	ND (0.0021)	0.0081 (0.0021)	0.0036 J (0.002)	ND (0.056)	ND (0.055)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.00085 J (0.0007)	ND (0.00071)	0.023 J (0.0034)	0.025 (0.00068)	0.14 J (0.038)	ND (0.04)
Benzo(a)anthracene	430	--	3200	--	0.0056 J (0.0016)	0.0041 J (0.0016)	0.11 (0.0075)	0.048 (0.0015)	0.12 J (0.038)	ND (0.04)
Benzo(a)pyrene	43	--	7.7	--	0.0085 J (0.0023)	0.0061 J (0.0024)	0.11 (0.011)	0.047 (0.0023)	0.067 J (0.038)	ND (0.04)
Benzo(b)fluoranthene	430	--	3200	--	0.0069 J (0.0031)	0.0048 J (0.0031)	0.11 (0.015)	0.047 (0.003)	0.086 J (0.038)	ND (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	0.013 J (0.0031)	0.011 J (0.0031)	0.17 (0.015)	0.068 (0.003)	ND (0.038)	ND (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.0064 J (0.0023)	0.0053 J (0.0024)	0.098 (0.011)	0.074 (0.0023)	0.1 J (0.038)	ND (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.0047)	ND (0.0047)	ND (0.023)	0.021 J (0.0045)	0.39 (0.038)	ND (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.004 J (0.0039)	ND (0.0039)	0.06 J (0.019)	0.02 (0.0038)	ND (0.038)	ND (0.04)
Naphthalene	41	0.54	6	27	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.0099)	ND (0.056)	ND (0.055)
Phenanthrene	4600	--	14000	--	0.0059 J (0.0023)	0.0051 J (0.0024)	0.13 (0.011)	0.18 (0.0023)	0.8 (0.038)	ND (0.04)
Pyrene	4600	--	14000	--	0.017 J (0.0055)	0.014 J (0.0055)	0.28 (0.026)	0.17 (0.0053)	0.31 (0.038)	ND (0.04)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
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Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-843 LINE 3 843 Line 3 5.5 - 6.0 8/23/2006	PB-843 LINE 4 843 Line 4 5.5 - 6.0 8/23/2006	PB-843 LINE 5 843 Line 5 5.5 - 6.0 8/23/2006	PB-843 LINE 6 843 Line 6 5.5 - 6.0 8/23/2006	PB-843 LINE 7 843 Line 7 0.0 - 0.5 8/23/2006	PB-843 LINE 8 843 Line 8 0.0 - 0.5 8/23/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.026)	ND (0.025)	ND (0.027)	ND (0.029)	ND (0.025)	ND (0.027)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.052)	ND (0.05)	ND (0.055)	1.4 (0.057)	ND (0.049)	ND (0.055)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.052)	ND (0.05)	ND (0.055)	ND (0.057)	ND (0.049)	ND (0.055)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.052)	ND (0.05)	ND (0.055)	ND (0.057)	ND (0.049)	ND (0.055)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.04)	ND (0.039)	ND (0.039)	ND (0.078)	ND (0.037)	ND (0.18)
Benzo(a)anthracene	430	--	3200	--	ND (0.04)	ND (0.039)	ND (0.039)	0.13 J (0.078)	0.31 (0.037)	0.34 J (0.18)
Benzo(a)pyrene	43	--	7.7	--	ND (0.04)	ND (0.039)	ND (0.039)	0.1 J (0.078)	0.34 (0.037)	0.4 J (0.18)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.04)	ND (0.039)	ND (0.039)	0.1 J (0.078)	0.49 (0.037)	0.62 J (0.18)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.04)	ND (0.039)	ND (0.039)	ND (0.078)	0.28 (0.037)	0.57 J (0.18)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.04)	ND (0.039)	ND (0.039)	0.23 J (0.078)	0.41 (0.037)	0.47 J (0.18)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.04)	ND (0.039)	ND (0.039)	1 (0.078)	ND (0.037)	ND (0.18)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.04)	ND (0.039)	ND (0.039)	ND (0.078)	0.3 (0.037)	0.4 J (0.18)
Naphthalene	41	0.54	6	27	ND (0.052)	ND (0.05)	ND (0.055)	0.067 J (0.057)	ND (0.049)	ND (0.055)
Phenanthrene	4600	--	14000	--	ND (0.04)	ND (0.039)	ND (0.039)	2.2 (0.078)	0.14 J (0.037)	0.26 J (0.18)
Pyrene	4600	--	14000	--	ND (0.04)	ND (0.039)	ND (0.039)	0.37 J (0.078)	0.49 (0.037)	0.53 J (0.18)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-843 LINE 9 843 Line 9 0.0 - 0.5 8/23/2006	PB-843 PERIMETER 1 843 Perimeter 1 3.0 - 3.5 8/23/2006	PB-843 PERIMETER 2 843 Perimeter 2 3.0 - 3.5 8/23/2006	PB-843 PERIMETER 3 843 Perimeter 3 3.0 - 3.5 8/23/2006	PB-843 PERIMETER 4 843 Perimeter 4 3.0 - 3.5 8/23/2006	PB-843 PERIMETER 5 843 Perimeter 5 3.0 - 3.5 8/23/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.035 J (0.026)	ND (0.031)	0.037 J (0.028)	ND (0.026)	ND (0.024)	ND (0.024)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.052)	ND (0.063)	ND (0.055)	ND (0.053)	ND (0.049)	ND (0.047)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.052)	ND (0.063)	ND (0.055)	ND (0.053)	ND (0.049)	ND (0.047)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.052)	ND (0.063)	ND (0.055)	ND (0.053)	ND (0.049)	ND (0.047)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.037)	ND (0.04)	0.6 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Benzo(a)anthracene	430	--	3200	--	0.087 J (0.037)	ND (0.04)	0.86 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Benzo(a)pyrene	43	--	7.7	--	0.065 J (0.037)	ND (0.04)	0.51 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Benzo(b)fluoranthene	430	--	3200	--	0.099 J (0.037)	ND (0.04)	0.64 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Benzo(g,h,i)perylene	4600	--	14000	--	0.085 J (0.037)	ND (0.04)	0.23 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.11 J (0.037)	ND (0.04)	0.77 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.037)	ND (0.04)	0.3 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.054 J (0.037)	ND (0.04)	0.28 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Naphthalene	41	0.54	6	27	ND (0.052)	ND (0.063)	ND (0.055)	ND (0.053)	ND (0.049)	ND (0.047)
Phenanthrene	4600	--	14000	--	0.16 J (0.037)	ND (0.04)	2.1 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Pyrene	4600	--	14000	--	0.17 J (0.037)	ND (0.04)	1.5 (0.039)	ND (0.038)	ND (0.036)	ND (0.036)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
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Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.024)	ND (0.023)	ND (0.024)	ND (0.023)	2.4 (0.096)	ND (0.027)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.048)	ND (0.045)	ND (0.048)	ND (0.047)	4.2 (0.19)	ND (0.055)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.048)	ND (0.045)	ND (0.048)	ND (0.047)	8.3 (0.19)	ND (0.055)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.048)	ND (0.045)	ND (0.048)	ND (0.047)	ND (0.19)	ND (0.055)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	4 (0.036)	ND (0.041)
Benzo(a)anthracene	430	--	3200	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	0.54 (0.036)	ND (0.041)
Benzo(a)pyrene	43	--	7.7	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	0.1 J (0.036)	ND (0.041)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	0.066 J (0.036)	ND (0.041)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	ND (0.036)	ND (0.041)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	0.56 (0.036)	ND (0.041)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	2.2 (0.036)	ND (0.041)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	0.038 J (0.036)	ND (0.041)
Naphthalene	41	0.54	6	27	ND (0.048)	ND (0.045)	ND (0.048)	ND (0.047)	*12 (0.19)*	ND (0.055)
Phenanthrene	4600	--	14000	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	4.1 (0.036)	ND (0.041)
Pyrene	4600	--	14000	--	ND (0.038)	ND (0.035)	ND (0.037)	ND (0.037)	0.43 (0.036)	ND (0.041)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-844 LINE 2 844 Line 2 5.5 - 6.0 8/23/2006	PB-844 LINE 3 844 Line 3 5.5 - 6.0 8/23/2006	PB-844 LINE 4 844 Line 4 5.5 - 6.0 8/23/2006	PB-844 LINE 5 844 Line 5 5.5 - 6.0 8/23/2006	PB-844 LINE 6 844 Line 6 5.5 - 6.0 8/23/2006	PB-844 LINE 7 844 Line 7 5.5 - 6.0 8/23/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.026)	ND (0.029)	ND (0.03)	0.034 J (0.029)	ND (0.03)	ND (0.029)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.053)	ND (0.057)	ND (0.06)	ND (0.058)	ND (0.061)	ND (0.058)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.053)	ND (0.057)	ND (0.06)	ND (0.058)	ND (0.061)	ND (0.058)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.053)	ND (0.057)	ND (0.06)	ND (0.058)	ND (0.061)	ND (0.058)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.037)	ND (0.041)	ND (0.041)	0.078 J (0.041)	ND (0.041)	ND (0.04)
Benzo(a)anthracene	430	--	3200	--	ND (0.037)	ND (0.041)	ND (0.041)	0.31 (0.041)	ND (0.041)	0.057 J (0.04)
Benzo(a)pyrene	43	--	7.7	--	ND (0.037)	ND (0.041)	ND (0.041)	0.31 (0.041)	ND (0.041)	0.054 J (0.04)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.037)	ND (0.041)	ND (0.041)	0.32 (0.041)	ND (0.041)	0.054 J (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.037)	ND (0.041)	ND (0.041)	0.17 J (0.041)	ND (0.041)	ND (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.037)	ND (0.041)	ND (0.041)	0.27 (0.041)	ND (0.041)	0.056 J (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.037)	ND (0.041)	ND (0.041)	ND (0.041)	ND (0.041)	ND (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.037)	ND (0.041)	ND (0.041)	0.16 J (0.041)	ND (0.041)	ND (0.04)
Naphthalene	41	0.54	6	27	ND (0.053)	ND (0.057)	ND (0.06)	ND (0.058)	ND (0.061)	ND (0.058)
Phenanthrene	4600	--	14000	--	ND (0.037)	ND (0.041)	ND (0.041)	0.23 (0.041)	ND (0.041)	0.056 J (0.04)
Pyrene	4600	--	14000	--	ND (0.037)	ND (0.041)	ND (0.041)	0.29 (0.041)	ND (0.041)	0.069 J (0.04)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-844 LINE 8 844 Line 8 5.5 - 6.0 8/23/2006	PB-844 LINE 9 844 Line 9 5.5 - 6.0 8/23/2006	PB-844 PERIMETER 1 844 Perimeter 1 3.0 - 3.5 8/23/2006	PB-844 PERIMETER 2 844 Perimeter 2 3.0 - 3.5 8/23/2006	PB-844 PERIMETER 3 844 Perimeter 3 3.0 - 3.5 8/23/2006	PB-844 PERIMETER 4 844 Perimeter 4 3.0 - 3.5 8/23/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.067 J (0.027)	0.035 J (0.027)	ND (0.026)	ND (0.029)	ND (0.026)	0.38 (0.031)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.054)	0.34 (0.054)	ND (0.052)	ND (0.058)	ND (0.053)	ND (0.061)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.054)	0.22 J (0.054)	ND (0.052)	ND (0.058)	ND (0.053)	0.32 (0.061)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.054)	ND (0.054)	ND (0.052)	ND (0.058)	ND (0.053)	0.52 (0.061)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.04)	ND (0.041)	0.17 J (0.038)	0.25 (0.039)	0.15 J (0.039)	0.92 (0.042)
Benzo(a)anthracene	430	--	3200	--	0.11 J (0.04)	0.17 J (0.041)	0.57 (0.038)	0.64 (0.039)	0.53 (0.039)	2.3 (0.042)
Benzo(a)pyrene	43	--	7.7	--	0.11 J (0.04)	0.2 (0.041)	0.68 (0.038)	0.51 (0.039)	0.5 (0.039)	1.8 (0.042)
Benzo(b)fluoranthene	430	--	3200	--	0.13 J (0.04)	0.19 J (0.041)	0.72 (0.038)	0.56 (0.039)	0.53 (0.039)	2.1 (0.042)
Benzo(g,h,i)perylene	4600	--	14000	--	0.082 J (0.04)	0.15 J (0.041)	0.44 (0.038)	0.32 (0.039)	0.28 (0.039)	1 (0.042)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.12 J (0.04)	0.45 (0.041)	0.52 (0.038)	0.6 (0.039)	0.49 (0.039)	1.9 (0.042)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.04)	0.97 (0.041)	0.075 J (0.038)	0.1 J (0.039)	0.075 J (0.039)	0.42 (0.042)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.073 J (0.04)	0.14 J (0.041)	0.54 (0.038)	0.35 (0.039)	0.32 (0.039)	1.2 (0.042)
Naphthalene	41	0.54	6	27	ND (0.054)	0.95 (0.054)	ND (0.052)	ND (0.058)	ND (0.053)	0.13 J (0.061)
Phenanthrene	4600	--	14000	--	0.076 J (0.04)	1.9 (0.041)	0.55 (0.038)	0.71 (0.039)	0.6 (0.039)	3 (0.042)
Pyrene	4600	--	14000	--	0.14 J (0.04)	0.32 (0.041)	0.62 (0.038)	0.9 (0.039)	0.66 (0.039)	3 (0.042)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-844 PERIMETER 5 844 Perimeter 5 3.0 - 3.5 8/23/2006	PB-844 PERIMETER 6 844 Perimeter 6 3.0 - 3.5 8/23/2006	PB-844 SUB 1 844 Sub 1 5.0 - 5.5 8/23/2006	PB-844 SUB 2 844 Sub 2 5.0 - 5.5 8/23/2006	PB-844 SUB 3 844 Sub 3 5.0 - 5.5 8/23/2006	PB-845 PERIMETER 1 845 Perimeter 1 3.0 - 3.5 8/24/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.027)	ND (0.027)	0.031 J (0.026)	ND (0.028)	0.095 J (0.027)	ND (0.028)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	0.073 J (0.053)	ND (0.054)	ND (0.052)	ND (0.056)	ND (0.054)	ND (0.057)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.053)	ND (0.054)	ND (0.052)	ND (0.056)	ND (0.054)	ND (0.057)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.053)	ND (0.054)	ND (0.052)	ND (0.056)	0.078 J (0.054)	ND (0.057)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.48 (0.039)	0.32 (0.038)	0.14 J (0.04)	ND (0.04)	0.078 J (0.039)	ND (0.04)
Benzo(a)anthracene	430	--	3200	--	0.11 J (0.039)	0.78 (0.038)	0.21 (0.04)	ND (0.04)	0.11 J (0.039)	ND (0.04)
Benzo(a)pyrene	43	--	7.7	--	0.068 J (0.039)	0.69 (0.038)	0.14 J (0.04)	ND (0.04)	0.089 J (0.039)	0.044 J (0.04)
Benzo(b)fluoranthene	430	--	3200	--	0.093 J (0.039)	0.87 (0.038)	0.15 J (0.04)	ND (0.04)	0.097 J (0.039)	0.05 J (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.039)	0.42 (0.038)	0.073 J (0.04)	ND (0.04)	0.13 J (0.039)	0.056 J (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.12 J (0.039)	0.74 (0.038)	0.2 (0.04)	ND (0.04)	0.15 J (0.039)	0.068 J (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	1.2 (0.039)	0.15 J (0.038)	0.067 J (0.04)	ND (0.04)	ND (0.039)	ND (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.048 J (0.039)	0.49 (0.038)	0.087 J (0.04)	ND (0.04)	0.088 J (0.039)	ND (0.04)
Naphthalene	41	0.54	6	27	ND (0.053)	ND (0.054)	ND (0.052)	ND (0.056)	ND (0.054)	ND (0.057)
Phenanthrene	4600	--	14000	--	3.4 (0.039)	1 (0.038)	0.52 (0.04)	ND (0.04)	0.18 J (0.039)	ND (0.04)
Pyrene	4600	--	14000	--	0.38 (0.039)	1.1 (0.038)	0.37 (0.04)	ND (0.04)	0.17 J (0.039)	0.057 J (0.04)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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ND - Not Detected
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-845 PERIMETER 2 845 Perimeter 2 3.0 - 3.5 8/24/2006	PB-845 PERIMETER 3 845 Perimeter 3 3.0 - 3.5 8/24/2006	PB-845 PERIMETER 4 845 Perimeter 4 3.0 - 3.5 8/24/2006	PB-845 PERIMETER 5 845 Perimeter 5 3.0 - 3.5 8/24/2006	PB-845 SUB 1 845 Sub 1 5.0 - 5.5 8/24/2006	PB-845 SUB 2 845 Sub 2 5.0 - 5.5 8/24/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.026)	ND (0.029)	ND (0.028)	ND (0.029)	ND (0.028)	ND (0.029)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.052)	ND (0.057)	ND (0.056)	0.18 J (0.057)	ND (0.055)	ND (0.058)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.052)	ND (0.057)	ND (0.056)	ND (0.057)	ND (0.055)	ND (0.058)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.052)	ND (0.057)	ND (0.056)	ND (0.057)	ND (0.055)	ND (0.058)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	1.2 (0.039)	0.43 (0.039)	0.24 (0.038)	ND (0.2)	0.4 (0.039)	0.11 J (0.04)
Benzo(a)anthracene	430	--	3200	--	2.8 (0.039)	1.5 (0.039)	0.75 (0.038)	0.59 J (0.2)	1.2 (0.039)	0.11 J (0.04)
Benzo(a)pyrene	43	--	7.7	--	2.3 (0.039)	1.4 (0.039)	0.68 (0.038)	0.65 J (0.2)	0.86 (0.039)	0.085 J (0.04)
Benzo(b)fluoranthene	430	--	3200	--	2.8 (0.039)	1.6 (0.039)	0.88 (0.038)	1.2 (0.2)	1.2 (0.039)	0.12 J (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	1.4 (0.039)	0.84 (0.039)	0.46 (0.038)	0.72 J (0.2)	0.48 (0.039)	0.051 J (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	2.8 (0.039)	1.5 (0.039)	0.74 (0.038)	3.1 (0.2)	1.2 (0.039)	0.14 J (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.51 (0.039)	0.18 J (0.039)	0.13 J (0.038)	0.59 J (0.2)	0.19 J (0.039)	0.19 J (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	1.4 (0.039)	0.81 (0.039)	0.43 (0.038)	0.48 J (0.2)	0.53 (0.039)	0.061 J (0.04)
Naphthalene	41	0.54	6	27	0.12 J (0.052)	ND (0.057)	ND (0.056)	1.2 (0.057)	0.067 J (0.055)	0.31 (0.058)
Phenanthrene	4600	--	14000	--	4.3 (0.078)	2 (0.039)	0.97 (0.038)	1.8 (0.2)	1.7 (0.039)	0.62 (0.04)
Pyrene	4600	--	14000	--	4.4 (0.078)	2.6 (0.039)	1.3 (0.038)	2 (0.2)	2.2 (0.039)	0.28 (0.04)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-845 SUB 3	PB-845-PER-6	PB-846 LINE 1	PB-846 LINE 2	PB-846 LINE 3	PB-846 LINE 4
Field Sample ID					845 Sub 3	PB-845-PER-6	846 Line 1	846 Line 2	846 Line 3	846 Line 4
Collection Depth (ft bgs)					5.0 - 5.5	3.0 - 3.5	5.5 - 6.0	5.5 - 6.0	5.5 - 6.0	5.5 - 6.0
Sample Date					8/24/2006	2/12/2008	8/24/2006	8/24/2006	8/24/2006	8/24/2006
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.027)	ND (0.025)	ND (0.026)	ND (0.027)	ND (0.028)	0.037 J (0.029)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.054)	ND (0.05)	ND (0.051)	ND (0.054)	ND (0.055)	0.16 J (0.059)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.054)	ND (0.05)	ND (0.051)	ND (0.054)	ND (0.055)	ND (0.059)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.054)	ND (0.05)	ND (0.051)	ND (0.054)	ND (0.055)	ND (0.059)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.59 (0.038)	ND (0.036)	0.038 J (0.035)	ND (0.036)	ND (0.039)	0.12 J (0.036)
Benzo(a)anthracene	430	--	3200	--	0.64 (0.038)	ND (0.036)	0.066 J (0.035)	ND (0.036)	ND (0.039)	0.1 J (0.036)
Benzo(a)pyrene	43	--	7.7	--	0.44 (0.038)	0.052 J (0.036)	0.05 J (0.035)	ND (0.036)	ND (0.039)	0.038 J (0.036)
Benzo(b)fluoranthene	430	--	3200	--	0.65 (0.038)	0.064 J (0.036)	0.063 J (0.035)	ND (0.036)	ND (0.039)	0.061 J (0.036)
Benzo(g,h,i)perylene	4600	--	14000	--	0.25 (0.038)	0.074 J (0.036)	ND (0.035)	ND (0.036)	ND (0.039)	ND (0.036)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.66 (0.038)	0.064 J (0.036)	0.067 J (0.035)	ND (0.036)	ND (0.039)	0.29 (0.036)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.52 (0.038)	ND (0.036)	ND (0.035)	ND (0.036)	ND (0.039)	0.73 (0.036)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.27 (0.038)	0.039 J (0.036)	ND (0.035)	ND (0.036)	ND (0.039)	ND (0.036)
Naphthalene	41	0.54	6	27	0.45 (0.054)	0.074 J (0.05)	0.14 J (0.051)	ND (0.054)	ND (0.055)	0.14 J (0.059)
Phenanthrene	4600	--	14000	--	1.9 (0.038)	ND (0.036)	0.12 J (0.035)	ND (0.036)	ND (0.039)	1.9 (0.036)
Pyrene	4600	--	14000	--	1.3 (0.038)	0.046 J (0.036)	0.12 J (0.035)	0.045 J (0.036)	ND (0.039)	0.3 (0.036)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-846 LINE 5 846 Line 5 5.5 - 6.0 8/24/2006	PB-846 LINE 6 846 Line 6 5.5 - 6.0 8/24/2006	PB-846 LINE 7 846 Line 7 5.5 - 6.0 8/24/2006	PB-846 PERIMETER 1 846 Perimeter 1 3.0 - 3.5 8/24/2006	PB-846 PERIMETER 2 846 Perimeter 2 3.0 - 3.5 8/24/2006	PB-846 PERIMETER 3 846 Perimeter 3 3.0 - 3.5 8/24/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.22 J (0.027)	0.12 J (0.026)	0.029 J (0.028)	5 (0.027)	0.039 J (0.026)	ND (0.027)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	0.29 (0.054)	ND (0.052)	ND (0.056)	6.5 (0.053)	ND (0.052)	ND (0.054)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	0.62 (0.054)	ND (0.052)	ND (0.056)	1.8 (0.053)	ND (0.052)	ND (0.054)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	0.12 J (0.054)	0.1 J (0.052)	ND (0.056)	0.28 (0.053)	ND (0.052)	ND (0.054)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.16 J (0.039)	0.24 (0.035)	0.22 (0.038)	2 (0.038)	0.086 J (0.039)	1.5 (0.039)
Benzo(a)anthracene	430	--	3200	--	0.38 (0.039)	0.37 (0.035)	0.58 (0.038)	3.4 (0.038)	0.17 J (0.039)	3.9 (0.039)
Benzo(a)pyrene	43	--	7.7	--	0.32 (0.039)	0.2 (0.035)	0.49 (0.038)	2.6 (0.038)	0.16 J (0.039)	3.3 (0.039)
Benzo(b)fluoranthene	430	--	3200	--	0.43 (0.039)	0.3 (0.035)	0.65 (0.038)	3.1 (0.038)	0.26 (0.039)	4.4 (0.039)
Benzo(g,h,i)perylene	4600	--	14000	--	0.21 (0.039)	0.12 J (0.035)	0.34 (0.038)	1.4 (0.038)	0.2 (0.039)	1.8 (0.039)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.51 (0.039)	0.85 (0.035)	0.55 (0.038)	4 (0.038)	0.28 (0.039)	3.6 (0.039)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.38 (0.039)	0.55 (0.035)	0.14 J (0.038)	4.2 (0.038)	0.09 J (0.039)	0.57 (0.039)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.2 (0.039)	0.096 J (0.035)	0.33 (0.038)	1.4 (0.038)	0.13 J (0.039)	1.9 (0.039)
Naphthalene	41	0.54	6	27	0.76 (0.054)	0.062 J (0.052)	0.1 J (0.056)	2.3 (0.053)	0.095 J (0.052)	0.16 J (0.054)
Phenanthrene	4600	--	14000	--	1.6 (0.039)	1.4 (0.035)	0.73 (0.038)	9.3 (0.19)	0.3 (0.039)	4.9 (0.19)
Pyrene	4600	--	14000	--	0.68 (0.039)	0.88 (0.035)	1 (0.038)	4.1 (0.038)	0.35 (0.039)	6.3 (0.19)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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ND - Not Detected
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-846 PERIMETER 4 846 Perimeter 4 3.0 - 3.5 8/24/2006	PB-846 PERIMETER 5 846 Perimeter 5 3.0 - 3.5 8/24/2006	PB-846 PERIMETER 6 846 Perimeter 6 3.0 - 3.5 8/24/2006	PB-846 SUB 1 846 Sub 1 5.0 - 5.5 8/24/2006	PB-846 SUB 2 846 Sub 2 5.0 - 5.5 8/24/2006	PB-846 SUB 3 846 Sub 3 5.0 - 5.5 8/24/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.028)	ND (0.026)	0.12 J (0.026)	ND (0.025)	ND (0.025)	0.027 J (0.026)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.057)	ND (0.052)	0.063 J (0.052)	ND (0.049)	ND (0.05)	ND (0.053)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.057)	ND (0.052)	0.063 J (0.052)	ND (0.049)	ND (0.05)	ND (0.053)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.057)	ND (0.052)	ND (0.052)	ND (0.049)	ND (0.05)	ND (0.053)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.19 J (0.039)	ND (0.039)	2 (0.039)	ND (0.038)	ND (0.036)	1.6 (0.04)
Benzo(a)anthracene	430	--	3200	--	1.3 (0.039)	ND (0.039)	3.5 (0.039)	ND (0.038)	ND (0.036)	3.8 (0.04)
Benzo(a)pyrene	43	--	7.7	--	1.4 (0.039)	ND (0.039)	2.4 (0.039)	ND (0.038)	ND (0.036)	2.9 (0.04)
Benzo(b)fluoranthene	430	--	3200	--	1.8 (0.039)	ND (0.039)	3.2 (0.039)	ND (0.038)	ND (0.036)	3.6 (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	0.63 (0.039)	ND (0.039)	1.4 (0.039)	ND (0.038)	ND (0.036)	2 (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	1.1 (0.039)	ND (0.039)	3.4 (0.039)	ND (0.038)	ND (0.036)	3.7 (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.11 J (0.039)	ND (0.039)	1.7 (0.039)	ND (0.038)	ND (0.036)	1.1 (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.73 (0.039)	ND (0.039)	1.4 (0.039)	ND (0.038)	ND (0.036)	1.8 (0.04)
Naphthalene	41	0.54	6	27	ND (0.057)	ND (0.052)	1.1 (0.052)	ND (0.049)	ND (0.05)	0.16 J (0.053)
Phenanthrene	4600	--	14000	--	0.69 (0.039)	ND (0.039)	9.1 (0.2)	ND (0.038)	ND (0.036)	6.2 (0.12)
Pyrene	4600	--	14000	--	1.1 (0.039)	ND (0.039)	7.2 (0.2)	ND (0.038)	ND (0.036)	6.4 (0.12)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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ND - Not Detected
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-847-1 AST-847-1/0-0.5 0.0 - 0.5 10/16/2006	PB-847-2 AST-847-2/0-0.5 0.0 - 0.5 10/16/2006	PB-847-3 AST-847-3/0-0.5 0.0 - 0.5 10/16/2006	PB-847-4 AST-847-4/0-0.5 0.0 - 0.5 10/16/2006	PB-847-5 AST-847-5/0-0.5 0.0 - 0.5 10/16/2006	PB-847-6 AST-847-6/0-0.5 0.0 - 0.5 10/16/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.028)	ND (0.028)	ND (0.027)	ND (0.028)	ND (0.028)	ND (0.028)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.056)	ND (0.057)	ND (0.054)	ND (0.057)	ND (0.055)	ND (0.056)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.056)	ND (0.057)	ND (0.054)	ND (0.057)	ND (0.055)	ND (0.056)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.056)	ND (0.057)	ND (0.054)	ND (0.057)	ND (0.055)	ND (0.056)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	ND (0.056)	ND (0.057)	ND (0.054)	ND (0.057)	ND (0.055)	ND (0.056)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.036)	0.061 J (0.038)	ND (0.038)	ND (0.039)	ND (0.038)	ND (0.039)
Benzo(a)anthracene	430	--	3200	--	ND (0.036)	0.17 J (0.038)	ND (0.038)	ND (0.039)	ND (0.038)	ND (0.039)
Benzo(a)pyrene	43	--	7.7	--	ND (0.036)	0.18 J (0.038)	ND (0.038)	ND (0.039)	ND (0.038)	ND (0.039)
Benzo(b)fluoranthene	430	--	3200	--	0.046 J (0.036)	0.16 J (0.038)	ND (0.038)	ND (0.039)	0.043 J (0.038)	ND (0.039)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.036)	0.091 J (0.038)	ND (0.038)	ND (0.039)	ND (0.038)	ND (0.039)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.079 J (0.036)	0.13 J (0.038)	ND (0.038)	ND (0.039)	0.048 J (0.038)	ND (0.039)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.036)	ND (0.038)	ND (0.038)	ND (0.039)	ND (0.038)	ND (0.039)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.036)	0.091 J (0.038)	ND (0.038)	ND (0.039)	ND (0.038)	ND (0.039)
Naphthalene	41	0.54	6	27	ND (0.056)	ND (0.057)	ND (0.054)	ND (0.057)	ND (0.055)	0.063 J (0.056)
Phenanthrene	4600	--	14000	--	0.043 J (0.036)	0.3 (0.038)	ND (0.038)	ND (0.039)	0.081 J (0.038)	ND (0.039)
Pyrene	4600	--	14000	--	0.05 J (0.036)	0.31 (0.038)	ND (0.038)	ND (0.039)	0.085 J (0.038)	ND (0.039)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	268 (0.464)	185 (0.493)	177 (0.497)	35.1 (0.516)	154 (0.492)	15.8 (0.505)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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ND - Not Detected
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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-848 LINE 1 848 Line 1 0.0 - 0.5 8/24/2006	PB-848 LINE 2 848 Line 2 0.0 - 0.5 8/24/2006	PB-848 LINE 3 848 Line 3 0.0 - 0.5 8/24/2006	PB-848 LINE 6 848 Line 6 5.5 - 6.0 8/24/2006	PB-848 LINE 7 848 Line 7 5.5 - 6.0 8/24/2006	PB-848 PERIMETER 1 848 Perimeter 1 3.0 - 3.5 8/24/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.025)	ND (0.028)	ND (0.027)	ND (0.028)	0.1 J (0.028)	ND (0.028)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.05)	ND (0.055)	ND (0.054)	0.81 (0.055)	4.6 (0.055)	ND (0.055)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.05)	ND (0.055)	ND (0.054)	ND (0.055)	0.26 J (0.055)	ND (0.055)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.05)	ND (0.055)	ND (0.054)	ND (0.055)	ND (0.055)	ND (0.055)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.18)	ND (0.037)	ND (0.039)	0.11 J (0.041)	0.35 (0.041)	ND (0.04)
Benzo(a)anthracene	430	--	3200	--	ND (0.18)	0.075 J (0.037)	ND (0.039)	0.071 J (0.041)	0.16 J (0.041)	ND (0.04)
Benzo(a)pyrene	43	--	7.7	--	0.23 J (0.18)	0.058 J (0.037)	ND (0.039)	ND (0.041)	0.14 J (0.041)	ND (0.04)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.18)	0.067 J (0.037)	ND (0.039)	ND (0.041)	0.12 J (0.041)	ND (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.18)	0.059 J (0.037)	ND (0.039)	ND (0.041)	0.067 J (0.041)	ND (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.36 J (0.18)	0.083 J (0.037)	ND (0.039)	0.16 J (0.041)	0.53 (0.041)	ND (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.18)	ND (0.037)	ND (0.039)	0.51 (0.041)	1.3 (0.041)	ND (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.18)	0.044 J (0.037)	ND (0.039)	ND (0.041)	0.059 J (0.041)	ND (0.04)
Naphthalene	41	0.54	6	27	ND (0.05)	ND (0.055)	0.071 J (0.054)	ND (0.055)	ND (0.055)	ND (0.055)
Phenanthrene	4600	--	14000	--	ND (0.18)	0.048 J (0.037)	ND (0.039)	0.87 (0.041)	3.1 (0.041)	ND (0.04)
Pyrene	4600	--	14000	--	ND (0.18)	0.1 J (0.037)	0.042 J (0.039)	0.15 J (0.041)	0.44 (0.041)	ND (0.04)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-848 PERIMETER 2 848 Perimeter 2 3.0 - 3.5 8/24/2006	PB-848 PERIMETER 3 848 Perimeter 3 3.0 - 3.5 8/24/2006	PB-848 PERIMETER 6 848 Perimeter 6 3.0 - 3.5 8/24/2006	PB-848 SUB 1 848 Sub 1 5.0 - 5.5 8/24/2006	PB-848 SUB 2 848 Sub 2 5.0 - 5.5 8/24/2006	PB-848 SUB 3 848 Sub 3 5.0 - 5.5 8/24/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.027)	ND (0.027)	ND (0.028)	ND (0.03)	ND (0.027)	*20 (0.28)*
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.053)	0.15 J (0.053)	ND (0.057)	ND (0.059)	ND (0.055)	8.9 (0.056)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.053)	ND (0.053)	ND (0.057)	ND (0.059)	ND (0.055)	46 (0.56)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.053)	ND (0.053)	ND (0.057)	ND (0.059)	ND (0.055)	1.5 (0.056)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.04)	0.06 J (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	0.21 (0.039)
Benzo(a)anthracene	430	--	3200	--	ND (0.04)	ND (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	ND (0.039)
Benzo(a)pyrene	43	--	7.7	--	ND (0.04)	ND (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	ND (0.039)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.04)	ND (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	ND (0.039)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.04)	ND (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	ND (0.039)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.04)	0.15 J (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	ND (0.039)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.04)	0.59 (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	2.2 (0.039)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.04)	ND (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	ND (0.039)
Naphthalene	41	0.54	6	27	ND (0.053)	0.059 J (0.053)	ND (0.057)	ND (0.059)	ND (0.055)	4.9 (0.056)
Phenanthrene	4600	--	14000	--	ND (0.04)	0.88 (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	1.9 (0.039)
Pyrene	4600	--	14000	--	ND (0.04)	0.12 J (0.039)	ND (0.039)	ND (0.04)	ND (0.041)	ND (0.039)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
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J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB848-18-1-1 PB848-001G (1-1) 0.5 - 1.0 5/7/2018	PB848-18-1-2 PB848-002G (1-2) 0.5 - 1.0 5/7/2018	PB848-18-1-4 PB848-003G (1-4) 0.5 - 1.0 5/7/2018	PB848-18-2-11 PB848-006G (2-11) 0.5 - 1.0 5/8/2018	PB848-18-2-2 PB848-004G (2-2) 0.5 - 1.0 5/8/2018	PB848-18-2-5 PB848-005G (2-5) 0.5 - 1.0 5/8/2018
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.018 (0.004)	0.03 (0.005)	0.042 (0.005)	0.003 J (0.005)	0.001 J (0.005)	0.0009 J (0.006)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.004)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.006)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.004)	0.0009 J (0.005)	0.001 J (0.005)	ND (0.005)	ND (0.005)	ND (0.006)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.004)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.006)
Toluene	8000	76	650	9800	0.009 (0.004)	0.011 (0.005)	0.018 (0.005)	0.005 J (0.005)	ND (0.005)	ND (0.006)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.004)	ND (0.005)	0.001 J (0.005)	ND (0.005)	ND (0.005)	ND (0.006)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.004)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.006)
Xylenes (total)	240	1.5	51	340	0.003 J (0.004)	0.005 (0.005)	0.007 (0.005)	0.002 J (0.005)	ND (0.005)	ND (0.006)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	43	--	7.7	--	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	NA	NA	NA	NA	NA	NA
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	NA	NA	NA	NA	NA	NA
Phenanthrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Pyrene	4600	--	14000	--	NA	NA	NA	NA	NA	NA
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
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6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-848-LINE-10 PB-848-LINE-10 5.5 - 6.0 5/30/2007	PB-848-LINE-11 PB-848-LINE-11 5.5 - 6.0 5/30/2007	PB-848-LINE-12 PB-848-LINE-12 5.5 - 6.0 5/30/2007	PB-848-LINE-13 PB-848-LINE-13 5.5 - 6.0 5/30/2007	PB-848-LINE-4 PB-848-LINE-4 5.5 - 6.0 5/30/2007	PB-848-LINE-5 PB-848-LINE-5 5.5 - 6.0 5/30/2007
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND,D (0.15)	ND,D (0.16)	ND,D (0.33)	0.13 J,D (0.21)	ND,D (0.19)	ND,D (0.3)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	2.5 D (0.15)	ND,D (0.16)	0.41 D (0.33)	ND,D (0.21)	8.5 D (0.19)	0.94 D (0.3)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	0.69 D (0.15)	0.084 J,D (0.16)	0.24 J,D (0.33)	0.16 J,D (0.21)	ND,D (0.19)	ND,D (0.3)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND,D (0.15)	0.1 J,D (0.16)	ND,D (0.33)	ND,D (0.21)	ND,D (0.19)	ND,D (0.3)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	ND (0.43)	ND (0.43)
Benzo(a)anthracene	430	--	3200	--	ND (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	ND (0.43)	ND (0.43)
Benzo(a)pyrene	43	--	7.7	--	ND (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	ND (0.43)	ND (0.43)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	ND (0.43)	ND (0.43)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	ND (0.43)	ND (0.43)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	ND (0.43)	ND (0.43)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.66 (0.43)	0.38 J (0.4)	ND (0.42)	ND (0.39)	0.75 (0.43)	ND (0.43)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	ND (0.43)	ND (0.43)
Naphthalene	41	0.54	6	27	0.28 D (0.15)	0.3 D (0.16)	1.9 D (0.33)	ND,D (0.21)	ND,D (0.19)	ND,D (0.3)
Phenanthrene	4600	--	14000	--	1.5 (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	1.7 (0.43)	ND (0.43)
Pyrene	4600	--	14000	--	ND (0.43)	ND (0.4)	ND (0.42)	ND (0.39)	ND (0.43)	ND (0.43)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
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Table 3
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-848-LINE-8 PB-848-LINE-8 5.5 - 6.0 5/30/2007	PB-848-LINE-9 PB-848-LINE-9 5.5 - 6.0 5/30/2007	PB-848-PER-4 PB-848-PER-4 3.0 - 3.5 5/30/2007	PB-848-PER-5 PB-848-PER-5 3.0 - 3.5 5/30/2007	PB-849-LINE-1 PB-849-LINE-1 0.0 - 0.5 9/4/2007	PB-849-LINE-2 PB-849-LINE-2 0.0 - 0.5 9/4/2007
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND,D (0.27)	ND,D (0.18)	0.93 D (0.18)	ND,D (0.18)	ND (0.0056)	ND (0.0061)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	8.6 D (0.27)	0.9 D (0.18)	0.63 D (0.18)	ND,D (0.18)	ND (0.0056)	ND (0.0061)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	1.7 D (0.27)	0.2 D (0.18)	0.27 D (0.18)	ND,D (0.18)	ND (0.0056)	ND (0.0061)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND,D (0.27)	0.14 J,D (0.18)	ND,D (0.18)	ND,D (0.18)	ND (0.0056)	ND (0.0061)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.41)	ND (0.42)	ND,D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Benzo(a)anthracene	430	--	3200	--	ND (0.41)	ND (0.42)	ND,D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Benzo(a)pyrene	43	--	7.7	--	ND (0.41)	ND (0.42)	ND,D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.41)	ND (0.42)	ND,D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.41)	ND (0.42)	ND,D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.41)	ND (0.42)	ND,D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.83 (0.41)	0.48 (0.42)	10 D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.41)	ND (0.42)	ND,D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Naphthalene	41	0.54	6	27	0.33 D (0.27)	0.9 D (0.18)	ND,D (0.18)	ND,D (0.18)	0.0039 J (0.0056)	0.002 J (0.0061)
Phenanthrene	4600	--	14000	--	1.5 (0.41)	0.79 (0.42)	13 D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Pyrene	4600	--	14000	--	ND (0.41)	ND (0.42)	ND,D (2.3)	ND (0.37)	ND,D (3.7)	ND (0.4)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
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Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-849-LINE-3 PB-849-LINE-3 0.0 - 0.5 9/4/2007	PB-849-LINE-4 PB-849-LINE-4 0.0 - 0.5 9/4/2007	PB-849-PER1 PB-849-PER1 3.0 - 3.5 5/25/2007	PB-849-PER2 PB-849-PER2 3.0 - 3.5 5/25/2007	PB-849-PER3 PB-849-PER3 3.0 - 3.5 5/25/2007	PB-849-PER4 PB-849-PER4 3.0 - 3.5 5/25/2007
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.0046 J (0.0061)	ND (0.0058)	ND,D (0.18)	ND,D (0.16)	ND,D (0.29)	ND,D (0.16)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0061)	ND (0.0058)	ND,D (0.18)	ND,D (0.16)	ND,D (0.29)	ND,D (0.16)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.0061)	ND (0.0058)	ND,D (0.18)	ND,D (0.16)	ND,D (0.29)	ND,D (0.16)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	0.0047 J (0.0061)	ND (0.0058)	ND,D (0.18)	ND,D (0.16)	ND,D (0.29)	ND,D (0.16)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Benzo(a)anthracene	430	--	3200	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Benzo(a)pyrene	43	--	7.7	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Naphthalene	41	0.54	6	27	0.0036 J (0.0061)	0.002 J (0.0058)	ND,D (0.18)	ND,D (0.16)	ND,D (0.29)	ND,D (0.16)
Phenanthrene	4600	--	14000	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Pyrene	4600	--	14000	--	ND (0.41)	ND (0.38)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.37)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-849-PER5 PB-849-PER5 3.0 - 3.5 5/25/2007	PB-849-SUB1 PB-849-SUB1 5.0 - 5.5 5/25/2007	PB-880-10 880-10 0.0 - 0.5 4/24/2004	PB-880-11 880-11 0.0 - 0.5 4/24/2004	PB-880-1 880-1 0.0 - 0.5 4/8/2004	PB-880-12 880-12 0.0 - 0.5 4/24/2004
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND,D (0.15)	ND,D (0.31)	0.33 (0.028)	1.1 (0.029)	0.42 (0.01)	0.034 J (0.028)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND,D (0.15)	ND,D (0.31)	0.3 (0.056)	2.7 (0.057)	0.35 (0.02)	0.069 J (0.056)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND,D (0.15)	ND,D (0.31)	0.72 (0.056)	6.3 (0.057)	1 (0.02)	0.15 J (0.056)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND,D (0.15)	ND,D (0.31)	1.7 (0.056)	12 (0.057)	2.7 (0.02)	0.26 J (0.056)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.4)	ND (0.42)	ND (1)	ND (2)	ND (0.19)	ND (2)
Benzo(a)anthracene	430	--	3200	--	ND (0.4)	ND (0.42)	ND (1)	ND (2)	ND (0.19)	ND (2)
Benzo(a)pyrene	43	--	7.7	--	ND (0.4)	ND (0.42)	ND (1)	ND (2)	ND (0.19)	ND (2)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.4)	ND (0.42)	ND (1)	ND (2)	ND (0.19)	ND (2)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.4)	ND (0.42)	ND (1)	ND (2)	ND (0.19)	ND (2)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.4)	ND (0.42)	ND (1)	ND (2)	ND (0.19)	ND (2)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.4)	ND (0.42)	1.4 J (1)	2.8 J (2)	0.46 J (0.19)	ND (2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.4)	ND (0.42)	ND (1)	ND (2)	ND (0.19)	ND (2)
Naphthalene	41	0.54	6	27	ND,D (0.15)	ND,D (0.31)	1.3 (0.056)	*13 (0.057)*	2 (0.02)	0.41 (0.056)
Phenanthrene	4600	--	14000	--	ND (0.4)	ND (0.42)	3.3 J (1)	5.9 J (2)	0.86 J (0.19)	ND (2)
Pyrene	4600	--	14000	--	ND (0.4)	ND (0.42)	ND (1)	ND (2)	0.2 J (0.19)	ND (2)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-880-13 880-13 0.0 - 0.5 4/24/2004	PB-880-14 880-14 0.0 - 0.5 9/7/2004	PB-880-2 880-2 0.0 - 0.5 4/8/2004	PB-880-3 880-3 0.0 - 0.5 4/8/2004	PB-880-4 880-4 0.0 - 0.5 4/8/2004	PB-880-5 880-5 0.0 - 0.5 4/8/2004
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	8 (0.029)	0.014 (0.0021)	ND (0.012)	ND (0.013)	0.14 (0.013)	0.22 (0.013)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	1.6 (0.057)	0.031 (0.0054)	ND (0.023)	ND (0.027)	0.27 (0.025)	0.49 (0.027)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	3.3 (0.057)	ND (0.024)	ND (0.023)	ND (0.027)	0.66 (0.025)	1.3 (0.027)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	24 (0.23)	0.037 (0.0021)	ND (0.023)	ND (0.027)	1.3 (0.025)	2.4 (0.027)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (2)	0.021 J (0.0036)	ND (0.039)	ND (0.41)	ND (0.2)	0.22 J (0.04)
Benzo(a)anthracene	430	--	3200	--	ND (2)	0.063 (0.0081)	ND (0.039)	ND (0.41)	ND (0.2)	0.16 J (0.04)
Benzo(a)pyrene	43	--	7.7	--	ND (2)	0.099 (0.012)	ND (0.039)	ND (0.41)	ND (0.2)	0.17 J (0.04)
Benzo(b)fluoranthene	430	--	3200	--	ND (2)	0.085 (0.016)	ND (0.039)	ND (0.41)	ND (0.2)	0.2 J (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (2)	0.1 (0.016)	ND (0.039)	ND (0.41)	ND (0.2)	0.1 J (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (2)	0.085 (0.012)	ND (0.039)	ND (0.41)	ND (0.2)	0.2 J (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (2)	0.026 J (0.024)	ND (0.039)	ND (0.41)	0.34 J (0.2)	0.57 (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (2)	ND (0.02)	ND (0.039)	ND (0.41)	ND (0.2)	0.1 J (0.04)
Naphthalene	41	0.54	6	27	*10 (0.057)*	0.22 (0.011)	ND (0.023)	ND (0.027)	1.1 (0.025)	2.1 (0.027)
Phenanthrene	4600	--	14000	--	2 J (2)	0.16 (0.012)	ND (0.039)	ND (0.41)	0.59 J (0.2)	1.2 (0.04)
Pyrene	4600	--	14000	--	ND (2)	0.19 (0.028)	ND (0.039)	ND (0.41)	ND (0.2)	0.36 J (0.04)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
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Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-880-6	PB-880-7	PB-880-8	PB-880-9	PB-880-SURFACE	PB-881-1_2004
Field Sample ID					880-6	880-7	880-8	880-9	880-Surface	881-1_07/22/2004
Collection Depth (ft bgs)					0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0	0.0 - 0.5
Sample Date					4/8/2004	4/8/2004	4/8/2004	4/24/2004	4/8/2004	7/22/2004
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.012)	0.018 J (0.012)	0.58 (0.015)	3.1 (0.026)	*36 (0.26)*	ND (0.0012)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.025)	ND (0.024)	0.39 (0.03)	4.6 (0.051)	13 (0.52)	ND (0.0031)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.025)	ND (0.024)	1.2 (0.03)	13 (0.051)	41 (0.52)	ND (0.0012)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	0.034 J (0.025)	0.03 J (0.024)	3.2 (0.03)	29 (0.26)	140 (0.52)	0.0024 J (0.0012)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.04)	ND (0.39)	0.74 J (0.44)	ND (2)	3.6 J (0.36)	0.019 (0.000011)
Benzo(a)anthracene	430	--	3200	--	ND (0.04)	ND (0.39)	0.52 J (0.44)	ND (2)	ND (0.36)	0.077 (0.0016)
Benzo(a)pyrene	43	--	7.7	--	ND (0.04)	ND (0.39)	0.59 J (0.44)	ND (2)	ND (0.36)	0.091 (0.0024)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.04)	ND (0.39)	0.68 J (0.44)	ND (2)	0.88 J (0.36)	0.067 (0.0031)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.04)	ND (0.39)	ND (0.44)	ND (2)	ND (0.36)	0.12 (0.0031)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.04)	ND (0.39)	1 J (0.44)	ND (2)	2.1 J (0.36)	0.075 (0.0024)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.04)	ND (0.39)	1.9 J (0.44)	ND (2)	12 (0.36)	0.0057 J (0.0047)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.04)	ND (0.39)	ND (0.44)	ND (2)	ND (0.36)	0.043 (0.0039)
Naphthalene	41	0.54	6	27	ND (0.025)	0.038 J (0.024)	1.4 (0.03)	*22 (0.26)*	***52 (0.52)***	ND (0.0061)
Phenanthrene	4600	--	14000	--	ND (0.04)	ND (0.39)	4.1 J (0.44)	4.1 J (2)	28 (0.36)	0.096 (0.000035)
Pyrene	4600	--	14000	--	ND (0.04)	ND (0.39)	1.3 J (0.44)	ND (2)	3.1 J (0.36)	0.21 (0.0055)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
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5 Underlined concentrations exceed the Routine Worker VI.
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Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.023)	0.011 (0.001)	ND (0.028)	ND (0.02)	ND (0.025)	ND (0.0011)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.045)	0.084 (0.0026)	ND (0.056)	0.85 (0.049)	ND (0.051)	ND (0.0028)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.045)	0.023 (0.001)	ND (0.056)	0.3 (0.02)	ND (0.051)	ND (0.0011)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.045)	0.032 (0.001)	ND (0.056)	0.25 (0.02)	ND (0.051)	0.0027 J (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.037)	0.057 (0.0036)	ND (0.039)	0.17 J (0.033)	ND (0.039)	ND (0.035)
Benzo(a)anthracene	430	--	3200	--	0.2 (0.037)	0.018 J (0.0079)	0.046 J (0.039)	ND (0.073)	ND (0.039)	0.078 J (0.077)
Benzo(a)pyrene	43	--	7.7	--	ND (0.037)	0.021 J (0.012)	0.06 J (0.039)	ND (0.11)	ND (0.039)	ND (0.12)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.037)	0.019 J (0.016)	0.042 J (0.039)	ND (0.15)	ND (0.039)	ND (0.15)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.037)	ND (0.016)	0.065 J (0.039)	ND (0.15)	0.057 J (0.039)	ND (0.15)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.15 J (0.037)	0.065 J (0.012)	0.14 J (0.039)	ND (0.74)	ND (0.039)	ND (0.12)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.069 J (0.037)	0.069 J (0.024)	ND (0.039)	0.24 J (0.22)	ND (0.039)	ND (0.23)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.037)	ND (0.02)	ND (0.039)	ND (0.18)	0.052 J (0.039)	ND (0.19)
Naphthalene	41	0.54	6	27	ND (0.045)	ND (1.2)	ND (0.056)	3.4 (0.098)	ND (0.051)	0.013 (0.0055)
Phenanthrene	4600	--	14000	--	0.13 J (0.037)	0.25 (0.012)	0.058 J (0.039)	0.61 J (0.11)	ND (0.039)	ND (0.12)
Pyrene	4600	--	14000	--	0.11 J (0.037)	0.12 J (0.028)	0.1 J (0.039)	0.39 J (0.26)	0.054 J (0.039)	ND (0.27)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
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Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-881-4_2005 881-4_10/26/2005 0.0 - 0.5 10/26/2005	PB-881-5_2004 881-5_07/22/2004 0.0 - 0.5 7/22/2004	PB-881-5_2005 881-5_10/26/2005 0.0 - 0.5 10/26/2005	PB-881-6_2004 881-6_07/22/2004 0.0 - 0.5 7/22/2004	PB-881-6_2005 881-6_10/26/2005 0.0 - 0.5 10/26/2005	PB-881-7_2004 881-7_07/22/2004 0.0 - 0.5 7/22/2004
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.027)	ND (0.18)	ND (0.027)	ND (0.32)	ND (0.024)	ND (0.2)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.053)	5.8 (0.45)	ND (0.054)	ND (0.81)	ND (0.047)	2.9 (0.5)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.053)	ND (0.18)	ND (0.054)	ND (0.32)	ND (0.047)	ND (0.5)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.053)	1.7 (0.18)	ND (0.054)	ND (0.32)	ND (0.047)	0.33 J (0.2)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.041)	0.89 (0.065)	ND (0.041)	0.36 J (0.064)	ND (0.039)	0.24 J (0.031)
Benzo(a)anthracene	430	--	3200	--	0.058 J (0.041)	ND (0.14)	ND (0.041)	ND (0.14)	0.044 J (0.039)	ND (0.069)
Benzo(a)pyrene	43	--	7.7	--	0.049 J (0.041)	ND (0.22)	0.05 J (0.041)	ND (0.21)	0.058 J (0.039)	ND (0.1)
Benzo(b)fluoranthene	430	--	3200	--	0.047 J (0.041)	ND (0.29)	0.061 J (0.041)	ND (0.29)	0.057 J (0.039)	ND (0.14)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.041)	ND (0.29)	0.053 J (0.041)	ND (0.29)	0.078 J (0.039)	ND (0.14)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.087 J (0.041)	ND (0.22)	0.051 J (0.041)	ND (0.21)	0.064 J (0.039)	ND (0.1)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.041)	1.8 J (0.43)	ND (0.041)	ND (0.43)	ND (0.039)	0.49 J (0.21)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.041)	ND (0.36)	ND (0.041)	ND (0.36)	0.042 J (0.039)	ND (0.17)
Naphthalene	41	0.54	6	27	ND (0.053)	*31 (0.91)*	ND (0.054)	*20 (1.6)*	ND (0.047)	*18 (1)*
Phenanthrene	4600	--	14000	--	0.059 J (0.041)	4.2 (0.22)	ND (0.041)	0.66 J (0.21)	ND (0.039)	1.1 (0.1)
Pyrene	4600	--	14000	--	0.098 J (0.041)	1.6 J (0.5)	0.081 J (0.041)	0.92 J (0.5)	0.082 J (0.039)	0.54 J (0.24)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-884-SS-1 AST-884-SS-1 0.0 - 0.5 11/30/2006	PB-884-SS-2 AST-884-SS-2 0.0 - 0.5 11/30/2006	PB-885-CS-10 AST-885-CS-10 0.0 - 0.5 3/14/2007	PB-885-CS-11 AST-885-CS-11 0.0 - 0.5 3/14/2007	PB-885-CS-1 AST-885-CS-1 0.0 - 0.5 3/14/2007	PB-885-CS-12 AST-885-CS-12 0.0 - 0.5 3/14/2007
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.031)	0.055 J (0.029)	ND,D (0.09)	ND,D (0.095)	ND,D (0.096)	ND,D (0.094)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	0.49 (0.063)	ND (0.059)	0.099 D (0.09)	0.089 J,D (0.095)	0.054 J,D (0.096)	ND,D (0.094)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	0.74 (0.063)	ND (0.059)	ND,D (0.09)	ND,D (0.095)	0.11 D (0.096)	ND,D (0.094)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	0.12 J (0.063)	ND (0.059)	ND,D (0.09)	ND,D (0.095)	ND,D (0.096)	ND,D (0.094)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	6.4 (0.063)	ND (0.059)	0.15 D (0.09)	ND,D (0.095)	2.1 D (0.096)	ND,D (0.094)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.045 J (0.043)	ND (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Benzo(a)anthracene	430	--	3200	--	0.073 J (0.043)	0.14 J (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Benzo(a)pyrene	43	--	7.7	--	0.081 J (0.043)	0.14 J (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Benzo(b)fluoranthene	430	--	3200	--	0.088 J (0.043)	0.15 J (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Benzo(g,h,i)perylene	4600	--	14000	--	0.058 J (0.043)	0.096 J (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.1 J (0.043)	0.15 J (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.39 (0.043)	ND (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	0.047 J (0.043)	0.1 J (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Naphthalene	41	0.54	6	27	2.7 (0.063)	ND (0.059)	0.1 D (0.09)	ND,D (0.095)	0.52 D (0.096)	0.16 D (0.094)
Phenanthrene	4600	--	14000	--	0.66 (0.043)	0.17 J (0.04)	ND (0.4)	ND (0.41)	0.6 (0.39)	0.5 (0.38)
Pyrene	4600	--	14000	--	0.11 J (0.043)	0.24 (0.04)	ND (0.4)	ND (0.41)	ND (0.39)	ND (0.38)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

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Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-885-CS-13 AST-885-CS-13 0.0 - 0.5 3/14/2007	PB-885-CS-14 AST-885-CS-14 0.0 - 0.5 3/14/2007	PB-885-CS-15 AST-885-CS-15 0.0 - 0.5 3/14/2007	PB-885-CS-2 AST-885-CS-2 0.0 - 0.5 3/14/2007	PB-885-CS-3 AST-885-CS-3 0.0 - 0.5 3/14/2007	PB-885-CS-4 AST-885-CS-4 0.0 - 0.5 3/14/2007
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND,D (0.094)	ND,D (0.089)	ND,D (0.096)	0.55 D (0.083)	0.065 J,D (0.09)	0.19 D (0.081)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND,D (0.094)	ND,D (0.089)	ND,D (0.096)	0.44 D (0.083)	0.48 D (0.09)	1.1 D (0.081)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND,D (0.094)	ND,D (0.089)	ND,D (0.096)	1.6 D (0.083)	0.44 D (0.09)	1.7 D (0.081)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	0.05 J,D (0.094)	ND,D (0.089)	ND,D (0.096)	1.1 D (0.083)	0.61 D (0.09)	3.4 D (0.081)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	1.9 D (0.094)	ND,D (0.089)	ND,D (0.096)	7.9 D (0.083)	18 D (0.09)	21 D (0.081)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.38)	ND (0.43)	0.45 (0.4)	ND (0.41)	ND (0.38)	ND (0.38)
Benzo(a)anthracene	430	--	3200	--	ND (0.38)	ND (0.43)	0.76 (0.4)	ND (0.41)	ND (0.38)	ND (0.38)
Benzo(a)pyrene	43	--	7.7	--	ND (0.38)	ND (0.43)	0.46 (0.4)	ND (0.41)	ND (0.38)	ND (0.38)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.38)	ND (0.43)	0.68 (0.4)	ND (0.41)	ND (0.38)	ND (0.38)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.38)	ND (0.43)	ND (0.4)	ND (0.41)	ND (0.38)	ND (0.38)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.38)	ND (0.43)	0.56 (0.4)	ND (0.41)	ND (0.38)	ND (0.38)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.38)	ND (0.43)	ND (0.4)	0.49 (0.41)	3.3 (0.38)	ND (0.38)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.38)	ND (0.43)	ND (0.4)	ND (0.41)	ND (0.38)	ND (0.38)
Naphthalene	41	0.54	6	27	0.48 D (0.094)	ND,D (0.089)	ND,D (0.096)	1.4 D (0.083)	4.1 D (0.09)	4.6 D (0.081)
Phenanthrene	4600	--	14000	--	1.2 (0.38)	ND (0.43)	1.6 (0.4)	0.61 (0.41)	3.9 (0.38)	ND (0.38)
Pyrene	4600	--	14000	--	ND (0.38)	ND (0.43)	1.1 (0.4)	ND (0.41)	ND (0.38)	ND (0.38)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Appendix C
Table 3
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-885-CS-5 AST-885-CS-5 0.0 - 0.5 3/14/2007	PB-885-CS-6 AST-885-CS-6 0.0 - 0.5 3/14/2007	PB-885-CS-7 AST-885-CS-7 0.0 - 0.5 3/14/2007	PB-885-CS-8 AST-885-CS-8 0.0 - 0.5 3/14/2007	PB-885-CS-9 AST-885-CS-9 0.0 - 0.5 3/14/2007	PB-885-SS-10 AST-885-SS-10 0.0 - 0.5 11/30/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.11 D (0.095)	ND,D (0.092)	ND,D (0.1)	ND,D (0.11)	ND,D (0.11)	0.11 J (0.034)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	1.1 D (0.095)	ND,D (0.092)	0.35 D (0.1)	0.25 D (0.11)	0.11 J,D (0.11)	1.2 (0.068)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	1.8 D (0.095)	ND,D (0.092)	0.51 D (0.1)	0.34 D (0.11)	ND,D (0.11)	2.2 (0.068)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	3.3 D (0.095)	ND,D (0.092)	0.23 D (0.1)	0.1 J,D (0.11)	ND,D (0.11)	0.85 (0.068)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	22 D (0.095)	0.81 D (0.092)	7.3 D (0.1)	3.1 D (0.11)	1 D (0.11)	17 (0.068)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	ND (0.21)
Benzo(a)anthracene	430	--	3200	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	ND (0.21)
Benzo(a)pyrene	43	--	7.7	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	ND (0.21)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	ND (0.21)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	ND (0.21)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	ND (0.21)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	1.2 (0.21)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	ND (0.21)
Naphthalene	41	0.54	6	27	4.3 D (0.095)	0.19 D (0.092)	1.2 D (0.1)	0.74 D (0.11)	0.21 D (0.11)	*6.5 (0.068)*
Phenanthrene	4600	--	14000	--	2.5 (0.38)	0.72 (0.42)	ND (0.41)	1.9 (0.45)	1.2 (0.45)	2 (0.21)
Pyrene	4600	--	14000	--	ND (0.38)	ND (0.42)	ND (0.41)	ND (0.45)	ND (0.45)	ND (0.21)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
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Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-885-SS-1 AST-885-SS-1 0.0 - 0.5 11/30/2006	PB-885-SS-2 AST-885-SS-2 0.0 - 0.5 11/30/2006	PB-885-SS-3 AST-885-SS-3 0.0 - 0.5 11/30/2006	PB-885-SS-4 AST-885-SS-4 0.0 - 0.5 11/30/2006	PB-885-SS-5 AST-885-SS-5 0.0 - 0.5 11/30/2006	PB-885-SS-6 AST-885-SS-6 0.0 - 0.5 11/30/2006
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.028)	0.1 J (0.031)	ND (0.033)	0.068 J (0.026)	0.35 (0.031)	2.6 (0.031)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.057)	1.2 (0.063)	ND (0.065)	ND (0.052)	1.7 (0.061)	5.4 (0.061)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.057)	2.1 (0.063)	ND (0.065)	ND (0.052)	3.4 (0.061)	13 (0.061)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	NA	NA	NA
Toluene	8000	76	650	9800	ND (0.057)	1.6 (0.063)	ND (0.065)	0.1 J (0.052)	3.3 (0.061)	26 (0.61)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	NA
Xylenes (total)	240	1.5	51	340	ND (0.057)	21 (0.063)	ND (0.065)	4.4 (0.052)	27 (0.061)	*97 (0.61)*
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.18)	ND (0.2)	ND (0.038)	ND (0.18)	ND (0.2)	ND (0.2)
Benzo(a)anthracene	430	--	3200	--	ND (0.18)	ND (0.2)	0.076 J (0.038)	ND (0.18)	ND (0.2)	ND (0.2)
Benzo(a)pyrene	43	--	7.7	--	ND (0.18)	ND (0.2)	0.069 J (0.038)	ND (0.18)	ND (0.2)	ND (0.2)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.18)	ND (0.2)	0.075 J (0.038)	ND (0.18)	ND (0.2)	ND (0.2)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.18)	ND (0.2)	0.046 J (0.038)	ND (0.18)	ND (0.2)	ND (0.2)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.18)	ND (0.2)	0.077 J (0.038)	ND (0.18)	ND (0.2)	ND (0.2)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.18)	ND (0.2)	ND (0.038)	ND (0.18)	ND (0.2)	1.2 (0.2)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.18)	ND (0.2)	0.046 J (0.038)	ND (0.18)	ND (0.2)	ND (0.2)
Naphthalene	41	0.54	6	27	ND (0.057)	4.8 (0.063)	ND (0.065)	0.11 J (0.052)	5.6 (0.061)	*15 (0.061)*
Phenanthrene	4600	--	14000	--	ND (0.18)	0.88 J (0.2)	0.12 J (0.038)	0.5 J (0.18)	1.5 (0.2)	2 (0.2)
Pyrene	4600	--	14000	--	0.18 J (0.18)	ND (0.2)	0.092 J (0.038)	ND (0.18)	ND (0.2)	ND (0.2)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	NA	NA	NA
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	PB-885-SS-7 AST-885-SS-7 0.0 - 0.5 11/30/2006	PB-885-SS-8 AST-885-SS-8 0.0 - 0.5 11/30/2006	PB-885-SS-9 AST-885-SS-9 0.0 - 0.5 11/30/2006	S-119D BHS119D-040105-1-1.5 1.0 - 1.5 4/1/2005	S-216 BH-S216-032505-1-1.5 1.0 - 1.5 3/25/2005	S-218D AOI4-S218D-6-6.5-20160114 6.0 - 6.5 1/14/2016
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.16 J (0.031)	ND (0.035)	ND (0.029)	ND (0.005)	ND (0.005)	0.0114 (0.00053)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	2.9 (0.061)	ND (0.069)	0.11 J (0.059)	ND (0.005)	ND (0.005)	0.088 (0.0021)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	2.4 (0.061)	ND (0.069)	ND (0.059)	ND (0.005)	ND (0.005)	0.207 (0.12)
Methyl tert-butyl ether	2400	16	390	5900	NA	NA	NA	ND (0.005)	ND (0.005)	ND (0.0011)
Toluene	8000	76	650	9800	3.4 (0.061)	ND (0.069)	ND (0.059)	ND (0.005)	ND (0.005)	0.0234 (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	NA	NA	NA	NA	NA	1.17 (0.24)
1,3,5-Trimethylbenzene	220	0.92	99	240	NA	NA	NA	NA	NA	0.434 (0.24)
Xylenes (total)	240	1.5	51	340	*66 (0.61)*	ND (0.069)	1.8 (0.059)	ND (0.005)	ND (0.005)	0.418 (0.12)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.2)	ND (0.2)	0.2 J (0.2)	ND (0.38)	ND (0.38)	ND (0.038)
Benzo(a)anthracene	430	--	3200	--	0.22 J (0.2)	ND (0.2)	0.49 J (0.2)	ND (0.38)	ND (0.38)	ND (0.038)
Benzo(a)pyrene	43	--	7.7	--	ND (0.2)	0.22 J (0.2)	0.36 J (0.2)	ND (0.38)	ND (0.38)	ND (0.038)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.2)	0.24 J (0.2)	0.46 J (0.2)	ND (0.38)	ND (0.38)	ND (0.038)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.2)	ND (0.2)	0.26 J (0.2)	ND (0.38)	ND (0.38)	ND (0.038)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.22 J (0.2)	ND (0.2)	0.55 J (0.2)	ND (0.38)	ND (0.38)	ND (0.038)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	1.2 (0.2)	ND (0.2)	0.47 J (0.2)	ND (0.38)	ND (0.38)	0.231 (0.038)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	ND (0.2)	ND (0.2)	0.3 J (0.2)	NA	NA	NA
Naphthalene	41	0.54	6	27	*11 (0.061)*	ND (0.069)	0.55 (0.059)	ND (0.38)	ND (0.38)	2.44 (0.038)
Phenanthrene	4600	--	14000	--	2.3 (0.2)	ND (0.2)	1.4 (0.2)	ND (0.38)	ND (0.38)	0.371 (0.038)
Pyrene	4600	--	14000	--	ND (0.2)	0.24 J (0.2)	0.82 J (0.2)	ND (0.38)	ND (0.38)	0.022 J (0.038)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	NA	NA	NA	24.9 (2.24)	60.8 (2.26)	13.3 (2.2)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location Field Sample ID Collection Depth (ft bgs) Sample Date Comments	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	S-218D AOI4-S218D-0.5-1.0-20160205 0.5 - 1.0 2/5/2016	S-219 BH-S219-032505-1-1.5 1.0 - 1.5 3/25/2005	S-229 BH-S229-032505-1.5-2 1.5 - 2.0 3/25/2005	S-282 S-282_1-2 1.0 - 2.0 4/27/2010	S-364 AOI4_S-364_.5-1_30413 0.5 - 1.0 3/4/2013	S-364 AOI4_S-364_4-5_30413 4.0 - 5.0 3/4/2013
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.00055)	ND (0.005)	ND (0.005)	ND (0.004)	ND (0.00074)	0.189 J (0.21)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0022)	ND (0.005)	ND (0.005)	ND (0.004)	ND (0.0037)	0.755 J (1)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	ND (0.005)	ND (0.005)	ND (0.004)	ND (0.00074)	1.43 (0.21)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0011)	ND (0.005)	0.014 (0.005)	ND (0.004)	ND (0.00074)	ND (0.21)
Toluene	8000	76	650	9800	ND (0.0011)	ND (0.005)	ND (0.005)	ND (0.004)	ND (0.00074)	ND (0.21)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0022)	NA	NA	ND (0.004)	ND (0.0037)	4.3 (1)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0022)	NA	NA	ND (0.004)	ND (0.0037)	1.88 (1)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	ND (0.005)	ND (0.005)	ND (0.004)	ND (0.00074)	2.25 (0.21)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.0207 J (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	ND (0.041)
Benzo(a)anthracene	430	--	3200	--	0.0748 (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	ND (0.041)
Benzo(a)pyrene	43	--	7.7	--	0.0952 (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	ND (0.041)
Benzo(b)fluoranthene	430	--	3200	--	0.106 (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	ND (0.041)
Benzo(g,h,i)perylene	4600	--	14000	--	0.0794 (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	ND (0.041)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.0966 (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	ND (0.041)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	ND (0.041)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.0317 J (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	ND (0.041)
Phenanthrene	4600	--	14000	--	0.11 (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	ND (0.035)	0.0402 J (0.041)
Pyrene	4600	--	14000	--	0.127 (0.039)	ND (0.4)	ND (0.37)	ND (0.2)	0.0237 J (0.035)	0.0243 J (0.041)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	500 (2.4)	8.99 (2.37)	16.7 (2.16)	87.3 (0.229)	13 (2.3)	15.2 (2.3)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location					S-364	S-365	S-365	S-365	S-366	S-366
Field Sample ID	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	S-364 @ 19'_031913	S-365_0-2'	S-365_4-6'	S-365 @ 12'-14'_031813	AOI4_S-366_0-1_30513	AOI4_S-366_4.5-5.5_30513
Collection Depth (ft bgs)					18.5 - 19.0	0.0 - 2.0	4.0 - 6.0	12.0 - 14.0	0.0 - 1.0	4.5 - 5.5
Sample Date					3/19/2013	3/4/2013	3/4/2013	3/18/2013	3/5/2013	3/5/2013
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.241 (0.1)	ND (0.00055)	0.0269 (0.00057)	0.0004 J (0.0011)	ND (0.0009)	ND (0.0011)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	2.36 (0.5)	ND (0.0028)	0.0063 (0.0028)	ND (0.0053)	ND (0.0045)	ND (0.0053)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	0.14 (0.1)	ND (0.00055)	0.0085 (0.00057)	ND (0.0011)	ND (0.0009)	ND (0.0011)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.1)	ND (0.00055)	0.00024 J (0.00057)	ND (0.0011)	ND (0.0009)	ND (0.0011)
Toluene	8000	76	650	9800	ND (0.1)	ND (0.00055)	0.0025 (0.00057)	ND (0.0011)	ND (0.0009)	ND (0.0011)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.5)	ND (0.0028)	0.0025 J (0.0028)	ND (0.0053)	ND (0.0045)	ND (0.0053)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.5)	ND (0.0028)	0.0027 J (0.0028)	ND (0.0053)	ND (0.0045)	ND (0.0053)
Xylenes (total)	240	1.5	51	340	0.222 (0.1)	ND (0.00055)	0.0098 (0.00057)	ND (0.0011)	ND (0.0009)	ND (0.0011)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.039)	ND (0.033)	0.356 (0.039)	ND (0.034)	ND (0.035)	ND (0.04)
Benzo(a)anthracene	430	--	3200	--	ND (0.039)	0.02 J (0.033)	0.841 (0.039)	ND (0.034)	0.0154 J (0.035)	ND (0.04)
Benzo(a)pyrene	43	--	7.7	--	ND (0.039)	0.0242 J (0.033)	0.825 (0.039)	ND (0.034)	0.0169 J (0.035)	ND (0.04)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.039)	0.035 (0.033)	0.802 (0.039)	ND (0.034)	0.0177 J (0.035)	ND (0.04)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.039)	0.0292 J (0.033)	0.545 (0.039)	ND (0.034)	0.0212 J (0.035)	ND (0.04)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.039)	0.0279 J (0.033)	0.983 (0.039)	ND (0.034)	0.0139 J (0.035)	ND (0.04)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.0934 (0.039)	ND (0.033)	0.386 (0.039)	ND (0.034)	ND (0.035)	ND (0.04)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.039)	ND (0.033)	0.314 (0.039)	ND (0.034)	ND (0.035)	ND (0.04)
Phenanthrene	4600	--	14000	--	0.172 (0.039)	ND (0.033)	2.18 (0.039)	ND (0.034)	ND (0.035)	ND (0.04)
Pyrene	4600	--	14000	--	0.0583 (0.039)	0.0295 J (0.033)	1.97 (0.039)	ND (0.034)	ND (0.035)	ND (0.04)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	18.5 (2)	79.1 (2.2)	222 (2.3)	4.2 (2.2)	14.2 (11)	10.9 (2.7)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location					S-366	S-367	S-367	S-367	S-373	S-379
Field Sample ID	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	S-366@14-16_031513	S-367_0-2'	S-367@14'_031313	S-367_031313@6'	AOI4-S-373_4-6'	S-379_0-2'
Collection Depth (ft bgs)					14.0 - 16.0	0.0 - 2.0	13.5 - 14.0	5.5 - 6.0	4.0 - 6.0	0.0 - 2.0
Sample Date					3/15/2013	3/5/2013	3/13/2013	3/13/2013	3/19/2013	2/28/2013
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.00041 J (0.0011)	ND (0.00055)	0.00054 J (0.0012)	ND (0.095)	1.25 (0.11)	ND (0.00088)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0056)	0.0135 (0.0028)	0.017 (0.0058)	0.431 J (0.47)	0.718 (0.54)	ND (0.0044)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.0011)	0.00081 (0.00055)	ND (0.0012)	ND (0.095)	2.12 (0.11)	ND (0.00088)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0011)	ND (0.00055)	ND (0.0012)	ND (0.095)	ND (0.11)	ND (0.00088)
Toluene	8000	76	650	9800	ND (0.0011)	0.00067 (0.00055)	ND (0.0012)	ND (0.095)	0.339 (0.11)	ND (0.00088)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0056)	0.00059 J (0.0028)	ND (0.0058)	ND (0.47)	2.56 (0.54)	ND (0.0044)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0056)	0.00027 J (0.0028)	ND (0.0058)	ND (0.47)	2.88 (0.54)	ND (0.0044)
Xylenes (total)	240	1.5	51	340	ND (0.0011)	0.005 (0.00055)	ND (0.0012)	ND (0.095)	3.76 (0.11)	ND (0.00088)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	ND (0.1)	0.209 (0.036)	ND (0.1)	ND (0.11)	ND (0.039)	ND (0.035)
Benzo(a)anthracene	430	--	3200	--	ND (0.1)	0.468 (0.036)	ND (0.1)	ND (0.11)	ND (0.039)	ND (0.035)
Benzo(a)pyrene	43	--	7.7	--	ND (0.1)	0.402 (0.036)	ND (0.1)	ND (0.11)	ND (0.039)	ND (0.035)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.1)	0.409 (0.036)	ND (0.1)	ND (0.11)	ND (0.039)	ND (0.035)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.1)	0.346 (0.036)	ND (0.1)	ND (0.11)	ND (0.039)	ND (0.035)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	ND (0.1)	0.729 (0.036)	ND (0.1)	ND (0.11)	ND (0.039)	ND (0.035)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	ND (0.1)	0.394 (0.036)	ND (0.1)	ND (0.11)	0.221 (0.039)	ND (0.035)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	ND (0.1)	ND (0.036)	ND (0.1)	ND (0.11)	0.362 (0.039)	ND (0.035)
Phenanthrene	4600	--	14000	--	ND (0.1)	0.839 (0.036)	ND (0.1)	ND (0.11)	0.59 (0.039)	ND (0.035)
Pyrene	4600	--	14000	--	ND (0.1)	1.04 (0.036)	ND (0.1)	ND (0.11)	ND (0.039)	ND (0.035)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	4.3 (0.99)	258 (2.3)	2.6 (1)	6.3 (1)	8.5 (1.9)	1.5 J (2.2)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location					S-379	S-379	S-381	S-381	S-381	S-381
Field Sample ID	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	S-379_4-5'	S-379_8-9'	AOI4-S-381_0-.5_31513	AOI4-S-381_2-3_31513	S-381 @ 12'_04242013	S-381 @ 24'_04252013
Collection Depth (ft bgs)					4.0 - 5.0	8.0 - 9.0	0 - 0.5	2.0 - 3.0	11.5 - 12.0	23.5 - 24.0
Sample Date					2/28/2013	2/28/2013	3/15/2013	3/15/2013	4/24/2013	4/24/2013
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	0.00024 J (0.00089)	ND (0.00045)	ND (0.001)	0.242 J (0.59)	0.0403 (0.00089)	1.11 (0.5)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	NA	NA
Cumene	1000	6.1	87	1000	ND (0.0044)	ND (0.0022)	ND (0.0051)	1.97 J (2.9)	0.0033 J (0.0045)	11.7 (2.5)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	NA	NA
Ethyl Benzene	2300	15	1300	820	ND (0.00089)	ND (0.00045)	ND (0.001)	5.54 (0.59)	0.0021 (0.00089)	0.439 J (0.5)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.00089)	ND (0.00045)	ND (0.001)	ND (0.59)	ND (0.00089)	ND (0.5)
Toluene	8000	76	650	9800	ND (0.00089)	ND (0.00045)	ND (0.001)	0.419 J (0.59)	0.0076 (0.00089)	0.2 J (0.5)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0044)	ND (0.0022)	ND (0.0051)	29.9 (2.9)	0.0032 J (0.0045)	0.518 J (2.5)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0044)	ND (0.0022)	ND (0.0051)	11.9 (2.9)	ND (0.0045)	0.543 J (2.5)
Xylenes (total)	240	1.5	51	340	ND (0.00089)	ND (0.00045)	ND (0.001)	17.7 (0.59)	0.0056 (0.00089)	1.01 (0.5)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	NA	NA
Anthracene	46000	--	46000	--	0.0977 (0.036)	ND (0.041)	0.0439 J (0.12)	ND (0.12)	ND (0.11)	1.79 (0.12)
Benzo(a)anthracene	430	--	3200	--	0.223 (0.036)	ND (0.041)	0.143 (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(a)pyrene	43	--	7.7	--	0.194 (0.036)	ND (0.041)	0.0854 J (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(b)fluoranthene	430	--	3200	--	0.225 (0.036)	ND (0.041)	0.143 (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(g,h,i)perylene	4600	--	14000	--	0.12 (0.036)	ND (0.041)	0.0814 J (0.12)	ND (0.12)	ND (0.11)	ND (0.12)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	NA	NA
Chrysene	43000	--	320000	--	0.229 (0.036)	ND (0.041)	0.158 (0.12)	ND (0.12)	ND (0.11)	0.0624 J (0.12)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	NA	NA
Fluorene	6200	--	18000	--	0.043 (0.036)	ND (0.041)	ND (0.12)	ND (0.12)	ND (0.11)	5.02 (0.12)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	NA	NA
Naphthalene	41	0.54	6	27	0.0194 J (0.036)	ND (0.041)	ND (0.12)	1.18 (0.12)	ND (0.11)	5.48 (0.12)
Phenanthrene	4600	--	14000	--	0.296 (0.036)	ND (0.041)	0.598 (0.12)	ND (0.12)	ND (0.11)	13 (0.58)
Pyrene	4600	--	14000	--	0.351 (0.036)	ND (0.041)	0.381 (0.12)	ND (0.12)	ND (0.11)	1.11 (0.12)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	NA	NA
Lead	2520	--	2520	45000	206 (2.4)	10 (2.4)	***25800 (110)***	***2650 (5.6)***	8.5 (0.9)	5.6 (0.9)
Nickel	6200	--	700	1700	NA	NA	NA	NA	NA	NA
Vanadium	1600	--	350	2800	NA	NA	NA	NA	NA	NA
Zinc	--	--	--	--	NA	NA	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 3
Summary of Historical Soil Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennslyvania

Location	Routine Worker Soil Direct Contact	Routine Worker Soil VI	Construction Worker Soil Direct Contact	Soil Migration to GW	S-39D	S-39D	S-415	S-415	S-416	S-416
Field Sample ID					AOI4-S-39D-1.5-2-20160121	AOI4-S39D-7.5-8.0-20160208	AOI4_S-415_0-2_101215	AOI4_S-415_16-18_101215	AOI4-S-416-0-2-20160620	AOI4-S-416-14-15-20160711
Collection Depth (ft bgs)					1.5 - 2.0	7.5 - 8.0	0.0 - 2.0	16.0 - 18.0	0.0 - 2.0	14.0 - 15.0
Sample Date					1/21/2016	2/8/2016	10/12/2015	10/12/2015	6/20/2016	7/11/2016
Comments										
Volatile Organic Compounds										
Benzene	63	0.46	8.7	98	ND (0.00065)	ND (0.00068)	0.0013 (0.00052)	ND (0.25)	0.00315 (0.00118)	ND (0.00112)
sec-Butylbenzene	--	--	--	--	NA	NA	NA	NA	ND (0.00118)	ND (0.00112)
tert-Butylbenzene	--	--	--	--	NA	NA	NA	NA	ND (0.00118)	ND (0.00112)
Cumene	1000	6.1	87	1000	ND (0.0026)	ND (0.0027)	ND (0.0021)	5.65 (1)	ND (0.0118)	ND (0.0112)
Cyclohexane	--	--	--	--	NA	NA	NA	NA	ND (0.00118)	0.00791 (0.00112)
Ethyl Benzene	2300	15	1300	820	ND (0.0013)	ND (0.0014)	ND (0.001)	ND (0.51)	ND (0.00118)	ND (0.00112)
Methyl tert-butyl ether	2400	16	390	5900	ND (0.0013)	ND (0.0014)	ND (0.001)	ND (0.51)	ND (0.00118)	ND (0.00112)
Toluene	8000	76	650	9800	ND (0.0013)	ND (0.0014)	0.00035 J (0.001)	ND (0.51)	ND (0.00591)	ND (0.00562)
1,2,4-Trimethylbenzene	180	0.92	70	250	ND (0.0026)	ND (0.0027)	ND (0.0021)	ND (1)	ND (0.00118)	ND (0.00112)
1,3,5-Trimethylbenzene	220	0.92	99	240	ND (0.0026)	ND (0.0027)	ND (0.0021)	ND (1)	ND (0.00118)	ND (0.00112)
Xylenes (total)	240	1.5	51	340	ND (0.0013)	ND (0.0014)	0.0007 J (0.001)	ND (0.51)	ND (0.00355)	ND (0.00337)
Semivolatile Organic Compounds										
Acenaphthene	9300	--	9200	--	NA	NA	NA	NA	ND (0.039)	ND (0.0371)
Anthracene	46000	--	46000	--	ND (0.035)	ND (0.034)	0.0698 (0.037)	0.156 (0.035)	ND (0.039)	0.0505 (0.0371)
Benzo(a)anthracene	430	--	3200	--	ND (0.035)	ND (0.034)	0.249 (0.037)	0.0595 (0.035)	ND (0.039)	0.137 (0.0371)
Benzo(a)pyrene	43	--	7.7	--	ND (0.035)	ND (0.034)	0.316 (0.037)	0.0379 (0.035)	ND (0.039)	0.104 (0.0371)
Benzo(b)fluoranthene	430	--	3200	--	ND (0.035)	ND (0.034)	0.395 (0.037)	0.0258 J (0.035)	0.0446 (0.039)	0.13 (0.0371)
Benzo(g,h,i)perylene	4600	--	14000	--	ND (0.035)	ND (0.034)	0.228 (0.037)	0.0143 J (0.035)	ND (0.039)	0.0548 (0.0371)
Benzo(k)fluoranthene	4300	--	32000	--	NA	NA	NA	NA	ND (0.039)	0.0489 (0.0371)
Chrysene	43000	--	320000	--	ND (0.035)	ND (0.034)	0.245 (0.037)	0.0736 (0.035)	ND (0.039)	0.118 (0.0371)
Fluoranthene	--	--	--	--	NA	NA	NA	NA	0.0419 (0.039)	0.252 OE (0.0371)
Fluorene	6200	--	18000	--	ND (0.035)	ND (0.034)	0.0196 J (0.037)	0.536 (0.035)	ND (0.039)	ND (0.0371)
Indeno(1,2,3-cd)pyrene	430	--	3200	--	NA	NA	NA	NA	ND (0.039)	0.0516 (0.0371)
Naphthalene	41	0.54	6	27	ND (0.035)	ND (0.034)	0.0651 (0.037)	ND (0.035)	ND (0.039)	ND (0.0371)
Phenanthrene	4600	--	14000	--	ND (0.035)	ND (0.034)	0.254 (0.037)	1.04 (0.035)	ND (0.039)	0.164 (0.0371)
Pyrene	4600	--	14000	--	ND (0.035)	ND (0.034)	0.329 (0.037)	0.143 (0.035)	ND (0.039)	0.219 (0.0371)
Metals										
Cobalt	--	--	--	--	NA	NA	NA	NA	6.02 (1.18)	5.04 (1.12)
Lead	2520	--	2520	45000	49.5 (6.6)	5.2 (2.1)	241 (2.2)	3.9 (2.1)	86.2 (0.591)	63.5 (0.562)
Nickel	6200	--	700	1700	NA	NA	NA	NA	20.9 (2.37)	11.3 (2.25)
Vanadium	1600	--	350	2800	NA	NA	NA	NA	46.4 (2.37)	26.3 (2.25)
Zinc	--	--	--	--	NA	NA	NA	NA	175 (5.91)	60.7 (5.62)

Notes:
1 All concentrations reported in mg/kg (ppm); detection limits in parentheses.
2 Only compounds with at least one detection are shown.
4 Boldfaced concentrations exceed the Routine Worker Direct Contact.
5 Underlined concentrations exceed the Routine Worker VI.
6 Italicized concentrations exceed the Construction Worker Direct Contact.
7 Grey shaded concentrations exceed the Soil Migration to GW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	MW-1 MW1-050605 5/6/2005	MW-1 MW-4_06_17_2013 6/17/2013	MW-4 MW4-050605 5/6/2005	S-103 S-103-20161012-WG 10/12/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.1 (0.005)	0.128 MS (0.001)	ND (0.005)	ND,SL (0.01)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.01)
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.01)
Cumene	37	9100	63	30	4	2.6	0.01 (0.005)	0.0035 MS (0.002)	ND (0.005)	0.0235 SL (0.01)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.01)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000028)	ND,MS (0.00002)	ND (0.000028)	ND,SL (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND,MS (0.001)	ND (0.005)	ND,SL (0.01)
Ethyl Benzene	2	22000	150	40	9.7	13	0.019 (0.005)	0.00091 J,MS (0.001)	ND (0.005)	ND,SL (0.01)
Hexane	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.01)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.005)	0.0112 MS (0.001)	ND (0.005)	ND,SL (0.01)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.01 (0.005)	0.0101 MS (0.001)	ND (0.005)	ND,SL (0.05)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	0.0015 J,MS (0.002)	NA	ND,SL (0.01)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	0.0037 MS (0.002)	NA	ND,SL (0.01)
Xylenes (total)	3.7	1900	13	17	0.86	210	0.027 (0.005)	0.0081 MS (0.001)	ND (0.005)	ND,SL (0.03)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	0.00449 SL (0.0005)
Anthracene	240	--	--	19000	--	40	NA	ND,MS (0.00011)	NA	ND,SL (0.0005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	0.00244 MS (0.00011)	NA	ND,SL (0.0005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	0.00245 MS (0.00011)	NA	ND,SL (0.0005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	0.00248 MS (0.00011)	NA	ND,SL (0.0005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	0.00183 MS (0.00011)	NA	ND,SL (0.0005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	ND,SL (0.0005)
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.2)
Chrysene	16	--	--	140000	--	1.3	ND (0.01)	0.00294 MS (0.00011)	ND (0.01)	ND,SL (0.0005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	ND,SL (0.0005)
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	0.000579 SL (0.0005)
Fluorene	97	--	--	7800	--	7	ND (0.01)	ND,MS (0.00011)	ND (0.01)	0.00518 SL (0.0005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	ND,SL (0.0005)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	0.0101 SL (0.0025)
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.2)
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.032 (0.01)	0.0277 MS (0.0011)	ND (0.01)	0.00329 B,SL (0.0025)
Phenanthrene	73	--	--	5800	--	1	ND (0.01)	0.00454 MS (0.00011)	ND (0.01)	0.0101 SL (0.0005)
Phenol	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.2)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.06)
Pyrene	50	--	--	5800	--	3	ND (0.01)	0.00372 MS (0.00011)	ND (0.01)	0.00228 SL (0.0005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	MW-1 MW1-050605 5/6/2005	MW-1 MW-4_06_17_2013 6/17/2013	MW-4 MW4-050605 5/6/2005	S-103 S-103-20161012-WG 10/12/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.001)	NA	ND (0.001)	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.002)
Lead	--	--	--	--	--	2.5	NA	ND,MS (0.003)	NA	ND,SL (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	ND,SL (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	ND,SL (0.005)
Zinc	--	--	--	--	--	--	NA	NA	NA	ND,SL (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-119 S-119 10/20/2004	S-119 S119-050305 5/3/2005	S-119 S-119_06_12_2013 6/12/2013	S-119 S-119-20160812-WG 8/12/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	0.005 (0.005)	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	ND (0.001)
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	ND (0.001)
Cumene	37	9100	63	30	4	2.6	ND (0.005)	ND (0.005)	ND (0.002)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	ND (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	ND (0.000028)	ND (0.00002)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND (0.005)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.005)	ND (0.005)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	NA	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.005)	ND (0.005)	ND (0.001)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.005)	ND (0.005)	ND (0.001)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	NA	ND (0.002)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	NA	ND (0.002)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.01)	ND (0.005)	ND (0.001)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	ND (0.00005)
Anthracene	240	--	--	19000	--	40	NA	NA	ND (0.0001)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	NA	ND (0.0001)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	NA	ND (0.0001)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	NA	ND (0.0001)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	ND (0.0001)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.00014)	ND (0.01)	ND (0.0001)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	ND (0.00005)
Fluorene	97	--	--	7800	--	7	ND (0.01)	ND (0.01)	ND (0.0001)	ND (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.005)	ND (0.01)	ND (0.0001)	ND (0.00025)
Phenanthrene	73	--	--	5800	--	1	ND (0.01)	ND (0.01)	ND (0.0001)	ND (0.00005)
Phenol	--	--	--	--	--	--	NA	NA	NA	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	ND (0.003)
Pyrene	50	--	--	5800	--	3	ND (0.01)	ND (0.01)	ND (0.0001)	ND (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-119 S-119 10/20/2004	S-119 S119-050305 5/3/2005	S-119 S-119_06_12_2013 6/12/2013	S-119 S-119-20160812-WG 8/12/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	0.00415 (0.002)
Lead	--	--	--	--	--	2.5	ND (0.005)	NA	ND (0.003)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	0.00305 (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	ND (0.005)
Zinc	--	--	--	--	--	--	NA	NA	NA	0.04 (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
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Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-119 S-119-20161010-WG 10/10/2016	S-119D S119D-050305 5/3/2005	S-119D S-119D_04062011 4/6/2011	S-119D S-119D_04062011 FILTERED 4/6/2011
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.00283 (0.001)	ND (0.005)	ND (0.001)	NA
sec-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.001)	ND (0.005)	ND (0.002)	NA
Cyclohexane	--	--	--	--	--	--	ND (0.001)	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.000029)	ND (0.000029)	NA
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.005)	ND (0.001)	NA
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.005)	ND (0.001)	NA
Hexane	--	--	--	--	--	--	ND (0.001)	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	ND (0.005)	0.0005 J (0.001)	NA
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.005)	ND (0.005)	ND (0.001)	NA
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.001)	NA	ND (0.002)	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.001)	NA	ND (0.002)	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.003)	ND (0.005)	ND (0.001)	NA
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	ND (0.00005)	NA	NA	NA
Anthracene	240	--	--	19000	--	40	ND (0.00005)	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	NA	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	NA	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	NA	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.00005)	ND (0.01)	ND (0.005)	NA
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	ND (0.00005)	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.00005)	ND (0.01)	ND (0.005)	NA
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	ND (0.00025)	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.00025)	ND (0.01)	ND (0.005)	NA
Phenanthrene	73	--	--	5800	--	1	ND (0.00005)	ND (0.01)	ND (0.005)	NA
Phenol	--	--	--	--	--	--	ND (0.01)	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.00005)	ND (0.01)	ND (0.005)	NA
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-119 S-119-20161010-WG 10/10/2016	S-119D S119D-050305 5/3/2005	S-119D S-119D_04062011 4/6/2011	S-119D S-119D_04062011 FILTERED 4/6/2011
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	0.0051 (0.002)	NA
Cobalt	--	--	--	--	--	--	NA	NA	0.0079 (0.005)	NA
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	0.0012 (0.001)	NA
Manganese	--	--	--	--	--	--	NA	NA	0.287 (0.005)	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	0.0046 (0.002)
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	0.00365 (0.002)	NA	NA	0.0074 (0.005)
Lead	--	--	--	--	--	2.5	ND (0.002)	NA	NA	ND (0.001)
Manganese	--	--	--	--	--	--	NA	NA	NA	0.282 (0.005)
Nickel	1.3	--	--	86	--	52	0.00262 B (0.002)	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	NA	NA	NA
Zinc	--	--	--	--	--	--	ND (0.025)	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-119D S-119D_06282011 6/28/2011	S-119D S-119D_06282011 FILTERED 6/28/2011	S-119D S-119D_52312 5/23/2012	S-119D S-119D_081612 8/16/2012
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	NA	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.002)	NA	ND (0.002)	ND (0.002)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000029)	NA	ND (0.000029)	ND (0.000029)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	NA	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	NA	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.0006 J (0.001)	NA	ND (0.001)	0.0005 J (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.001)	NA	ND (0.001)	ND (0.001)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	NA	ND (0.002)	ND (0.002)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	NA	ND (0.002)	ND (0.002)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.001)	NA	ND (0.001)	ND (0.001)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	ND (0.0005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	NA	NA	ND (0.0005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	NA	NA	ND (0.0005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	NA	NA	ND (0.0005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	NA	ND (0.0005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.005)	NA	ND (0.0005)	ND (0.0005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.005)	NA	ND (0.0005)	ND (0.0005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.005)	NA	0.0002 J (0.0005)	0.0001 J (0.0005)
Phenanthrene	73	--	--	5800	--	1	ND (0.005)	NA	ND (0.0005)	ND (0.0005)
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.005)	NA	ND (0.0005)	ND (0.0005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-119D S-119D_06282011 6/28/2011	S-119D S-119D_06282011 FILTERED 6/28/2011	S-119D S-119D_52312 5/23/2012	S-119D S-119D_081612 8/16/2012
Metals										
Arsenic	0.021	--	--	53	--	1.4	0.005 (0.002)	NA	0.004 (0.002)	0.0042 (0.002)
Cobalt	--	--	--	--	--	--	0.0075 (0.005)	NA	0.0068 (0.005)	0.0072 (0.005)
Lead	--	--	--	--	--	2.5	0.001 (0.001)	NA	0.00028 J (0.001)	0.00063 J (0.001)
Manganese	--	--	--	--	--	--	0.286 (0.005)	NA	0.259 (0.005)	0.255 (0.005)
Mercury	--	--	--	--	--	--	NA	NA	NA	0.000057 J (0.0002)
Arsenic	0.021	--	--	53	--	1.4	NA	0.0046 (0.002)	ND (0.002)	0.0029 (0.002)
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	0.0066 (0.005)	0.0063 (0.005)	0.0068 (0.005)
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	ND (0.001)	ND (0.001)
Manganese	--	--	--	--	--	--	NA	0.277 (0.005)	0.253 (0.005)	0.251 (0.005)
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-119D S-119D_102512 10/25/2012	S-119D S-119D_032613 3/26/2013	S-119D S-119D-20160819-WG 8/19/2016	S-119D S-119D-20161011-WG 10/11/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	ND (0.001)	ND (0.001)	0.0022 (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
Cumene	37	9100	63	30	4	2.6	ND (0.002)	ND (0.002)	ND (0.001)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	ND (0.00002)	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	0.00043 J (0.001)	ND (0.001)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.001)	ND (0.001)	ND (0.005)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	ND (0.002)	ND (0.001)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	ND (0.002)	ND (0.001)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.001)	ND (0.001)	ND (0.003)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	ND (0.00005)	ND (0.00005)
Anthracene	240	--	--	19000	--	40	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	ND (0.00005)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	ND (0.00005)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	NA	NA	ND (0.00005)	ND (0.00005)
Fluorene	97	--	--	7800	--	7	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	ND (0.00005)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	ND (0.00025)	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.005)	ND (0.0001)	ND (0.00025)	ND (0.00025)
Phenanthrene	73	--	--	5800	--	1	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Phenol	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	ND (0.003)	ND (0.003)
Pyrene	50	--	--	5800	--	3	ND (0.001)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-119D S-119D_102512 10/25/2012	S-119D S-119D_032613 3/26/2013	S-119D S-119D-20160819-WG 8/19/2016	S-119D S-119D-20161011-WG 10/11/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	0.0033 (0.003)	0.0034 (0.003)	NA	NA
Cobalt	--	--	--	--	--	--	ND (0.05)	0.006 J (0.05)	NA	NA
Lead	--	--	--	--	--	2.5	0.0048 (0.003)	ND (0.003)	NA	NA
Manganese	--	--	--	--	--	--	0.256 (0.015)	0.268 (0.015)	NA	NA
Mercury	--	--	--	--	--	--	ND (0.0002)	ND (0.0002)	NA	NA
Arsenic	0.021	--	--	53	--	1.4	0.0036 (0.003)	0.0021 J (0.003)	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	ND (0.05)	0.0057 J (0.05)	ND (0.002)	0.00574 (0.002)
Lead	--	--	--	--	--	2.5	ND (0.003)	ND (0.003)	ND (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	0.283 (0.015)	0.277 (0.015)	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	0.00466 B (0.002)	0.00501 B (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	NA	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	NA	NA	0.0412 (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120~10/20/2004 10/20/2004	S-120 S120-050305 5/3/2005	S-120 S-120~11/29/2006 11/29/2006	S-120 S-120~12/14/2007 12/14/2007
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	ND (0.005)	ND (0.0005)	ND (0.0005)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.005)	ND (0.005)	ND (0.001)	ND (0.0005)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	ND (0.000029)	ND (0.0000097)	ND (0.0000095)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND (0.005)	ND (0.001)	ND (0.0005)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.005)	ND (0.005)	ND (0.0008)	ND (0.0005)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.005)	ND (0.005)	ND (0.0005)	NA
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.005)	ND (0.005)	ND (0.0007)	ND (0.0005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	NA	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	NA	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.01)	ND (0.005)	ND (0.0008)	ND (0.0005)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	NA	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	NA	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.00014)	ND (0.01)	ND (0.001)	ND (0.0009)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.01)	ND (0.01)	ND (0.001)	ND (0.0009)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.005)	ND (0.01)	ND (0.001)	ND (0.001)
Phenanthrene	73	--	--	5800	--	1	ND (0.01)	ND (0.01)	ND (0.001)	ND (0.0009)
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.01)	ND (0.01)	ND (0.001)	ND (0.0009)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120~10/20/2004 10/20/2004	S-120 S120-050305 5/3/2005	S-120 S-120~11/29/2006 11/29/2006	S-120 S-120~12/14/2007 12/14/2007
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.005)	NA	0.00016 J	0.0001 J
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120_110508 11/5/2008	S-120 S-120~11/11/2010 11/11/2010	S-120 S-120_20150518 5/18/2015	S-120 S-120~11/18/2011 11/18/2011
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.0005 J (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.002)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000029)	ND (0.0000098)	ND (0.0000097)	ND (0.0000096)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	NA	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	NA	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.005)	ND (0.000057)	ND (0.001)	ND (0.000076)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	NA	NA	ND (0.001)	ND (0.000095)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.004)	ND (0.001)	ND (0.001)	ND (0.00095)
Phenanthrene	73	--	--	5800	--	1	ND (0.005)	ND (0.000038)	ND (0.001)	ND (0.000076)
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.005)	ND (0.000095)	ND (0.001)	ND (0.000095)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120_110508 11/5/2008	S-120 S-120~11/11/2010 11/11/2010	S-120 S-120_20150518 5/18/2015	S-120 S-120~11/18/2011 11/18/2011
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.000001)	ND (0.00005)	ND (0.000052)	ND (0.00008)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
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9 Grey shaded concentrations exceed the GW Migration to SW.

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J - Estimated Concentration
B - Analyte found in sample and associated blank

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Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120~11/13/2009 11/13/2009	S-120 S-120~4/2/2013 4/2/2013	S-120 S-120_040213 4/2/2013	S-120 S-120~JB67626 5/21/2014
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	NA	ND (0.001)	0.0078 (0.0005)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.002)	NA	ND (0.002)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	NA	ND (0.00002)	ND (0.00002)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	NA	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	NA	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	NA	ND (0.001)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.001)	NA	ND (0.001)	0.0011 (0.001)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	NA	ND (0.002)	ND (0.002)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	NA	ND (0.002)	ND (0.002)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.001)	NA	ND (0.001)	ND (0.001)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.00139 (0.0001)	NA	ND (0.0001)	ND (0.0001)
Phenanthrene	73	--	--	5800	--	1	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.0001)	NA	ND (0.0001)	ND (0.0001)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120~11/13/2009 11/13/2009	S-120 S-120~4/2/2013 4/2/2013	S-120 S-120_040213 4/2/2013	S-120 S-120~JB67626 5/21/2014
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	ND (0.003)	ND (0.003)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120_06_12_2013 6/12/2013	S-120 S-120-20160518 5/18/2016	S-120 S-120-20160812-WG 8/12/2016	S-120 S-120-20161011-WG 10/11/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
Cumene	37	9100	63	30	4	2.6	ND (0.002)	ND (0.002)	ND (0.001)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000029)	ND (0.000029)	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.001)	ND (0.001)	ND (0.005)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	ND (0.002)	ND (0.001)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	ND (0.002)	ND (0.001)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.001)	ND (0.001)	ND (0.003)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	ND (0.00005)	ND (0.00005)
Anthracene	240	--	--	19000	--	40	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	ND (0.00005)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	ND (0.00005)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	NA	NA	ND (0.00005)	ND (0.00005)
Fluorene	97	--	--	7800	--	7	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	ND (0.00005)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	ND (0.00025)	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.0005)	ND (0.0005)	ND (0.00025)	ND (0.00025)
Phenanthrene	73	--	--	5800	--	1	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Phenol	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	ND (0.003)	ND (0.003)
Pyrene	50	--	--	5800	--	3	ND (0.0005)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120_06_12_2013 6/12/2013	S-120 S-120-20160518 5/18/2016	S-120 S-120-20160812-WG 8/12/2016	S-120 S-120-20161011-WG 10/11/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	ND (0.002)	ND (0.002)
Lead	--	--	--	--	--	2.5	ND (0.001)	ND (0.001)	ND (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	0.00569 (0.002)	0.00563 B (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	NA	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	NA	NA	0.0266 (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
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Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120-20161011-WG-DUP 10/11/2016 Field Duplicate	S-121 S-121 10/20/2004	S-121 S121-050405 5/4/2005	S-121 S-121_06_13_2013 6/13/2013
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	ND (0.001)	ND (0.005)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.001)	ND (0.005)	ND (0.005)	ND (0.002)
Cyclohexane	--	--	--	--	--	--	ND (0.001)	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.00002)	ND (0.000028)	ND (0.00002)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.005)	ND (0.005)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.005)	ND (0.005)	ND (0.001)
Hexane	--	--	--	--	--	--	ND (0.001)	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	ND (0.005)	ND (0.005)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.001)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.001)	NA	NA	ND (0.002)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.001)	NA	NA	ND (0.002)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.003)	ND (0.01)	ND (0.005)	ND (0.001)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	ND (0.00005)	NA	NA	NA
Anthracene	240	--	--	19000	--	40	ND (0.00005)	NA	NA	ND (0.0001)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	NA	ND (0.0001)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	NA	NA	ND (0.0001)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	NA	NA	ND (0.0001)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	NA	NA	ND (0.0001)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.00005)	ND (0.00014)	ND (0.01)	ND (0.0001)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	ND (0.00005)	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.00005)	ND (0.01)	ND (0.01)	ND (0.0001)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	ND (0.00025)	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.00025)	ND (0.005)	ND (0.01)	ND (0.0001)
Phenanthrene	73	--	--	5800	--	1	ND (0.00005)	ND (0.01)	ND (0.01)	ND (0.0001)
Phenol	--	--	--	--	--	--	ND (0.01)	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.00005)	ND (0.01)	ND (0.01)	ND (0.0001)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-120 S-120-20161011-WG-DUP 10/11/2016 Field Duplicate	S-121 S-121 10/20/2004	S-121 S121-050405 5/4/2005	S-121 S-121_06_13_2013 6/13/2013
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	ND (0.001)	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	ND (0.002)	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.002)	ND (0.005)	NA	ND (0.003)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	0.00506 B (0.002)	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	NA	NA	NA
Zinc	--	--	--	--	--	--	ND (0.025)	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
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ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-121 S-121-20160815 8/15/2016	S-123 S-123 10/20/2004	S-123 S123-050405 5/4/2005	S-123 S-123-20160818-WG 8/18/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	0.15	0.008 (0.005)	0.00486 (0.001)
sec-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	ND (0.001)
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	ND (0.001)
Cumene	37	9100	63	30	4	2.6	ND (0.001)	0.019	0.01 (0.005)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	ND (0.001)	NA	NA	0.0118 (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.00002)	ND (0.000028)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.0037)	ND (0.005)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	0.28	0.068 (0.005)	0.0107 (0.001)
Hexane	--	--	--	--	--	--	ND (0.001)	NA	NA	0.00472 (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	ND (0.0044)	ND (0.005)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.005)	0.26	0.19 (0.005)	0.0208 (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.001)	NA	NA	0.0125 (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.001)	NA	NA	0.00222 (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.003)	*1.3*	0.25 (0.005)	0.0434 (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	ND (0.00005)	NA	NA	0.00243 (0.00005)
Anthracene	240	--	--	19000	--	40	ND (0.00005)	NA	NA	0.00131 (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	NA	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	NA	NA	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	NA	NA	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	NA	NA	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	NA	NA	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.00005)	ND (0.00014)	ND (0.01)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	NA	NA	ND,OE (0.00005)
Fluoranthene	--	--	--	--	--	--	ND (0.00005)	NA	NA	0.00017 (0.00005)
Fluorene	97	--	--	7800	--	7	ND (0.00005)	0.013	0.013 (0.01)	0.00251 (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	NA	ND,OE (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	ND (0.00025)	NA	NA	0.00304 (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.00025)	*0.22*	0.026 (0.01)	0.00241 (0.00025)
Phenanthrene	73	--	--	5800	--	1	ND (0.00005)	0.024	0.034 (0.01)	0.00517 (0.00005)
Phenol	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	NA	NA	ND (0.003)
Pyrene	50	--	--	5800	--	3	ND (0.00005)	ND (0.01)	ND (0.01)	0.00116 (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	ND (0.001)	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	ND (0.002)	NA	NA	0.00599 (0.002)
Lead	--	--	--	--	--	2.5	ND (0.002)	ND (0.005)	NA	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	0.00219 (0.002)	NA	NA	ND (0.002)
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	NA	NA	ND (0.005)
Zinc	--	--	--	--	--	--	ND (0.025)	NA	NA	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
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Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-123 S-123-20161013-WG 10/13/2016	S-216 S216-042805 4/28/2005	S-216 S-216_06_12_2013 6/12/2013	S-216 S-216-20160816-WG 8/16/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.00614 (0.001)	*0.29 (0.01)*	0.0237 (0.001)	0.0182 (0.001)
sec-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	0.00596 (0.001)
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	0.0021 (0.001)
Cumene	37	9100	63	30	4	2.6	0.00233 (0.001)	0.073 (0.01)	0.0262 (0.002)	0.0288 (0.001)
Cyclohexane	--	--	--	--	--	--	0.04 (0.001)	NA	NA	0.0251 (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.000029)	ND (0.00002)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.01)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	0.049 (0.001)	0.11 (0.01)	0.00085 J (0.001)	0.00105 (0.001)
Hexane	--	--	--	--	--	--	0.00929 (0.001)	NA	NA	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	0.21 (0.01)	0.0006 J (0.001)	0.00417 (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.0955 (0.005)	0.048 (0.01)	0.0046 (0.001)	0.00611 (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	0.032 (0.001)	NA	0.00034 J (0.002)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	0.00318 (0.001)	NA	ND (0.002)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	0.134 (0.003)	0.24 (0.01)	0.0037 (0.001)	0.00522 (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	0.000908 (0.00005)	NA	NA	0.00177 (0.00005)
Anthracene	240	--	--	19000	--	40	0.00034 (0.00005)	NA	0.000246 (0.0001)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	NA	NA	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.00005)	ND (0.01)	ND (0.0001)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	NA	NA	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	ND (0.00005)	NA	NA	0.0000961 (0.00005)
Fluorene	97	--	--	7800	--	7	0.00122 (0.00005)	0.06 (0.01)	0.00347 (0.0001)	0.00296 (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	NA	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	0.000802 (0.00025)	NA	NA	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.00423 (0.00025)	*0.15 (0.05)*	ND (0.0001)	0.00136 (0.00025)
Phenanthrene	73	--	--	5800	--	1	0.00185 (0.00005)	0.087 (0.01)	0.00271 (0.0001)	0.00361 (0.00005)
Phenol	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	NA	NA	0.03 (0.003)
Pyrene	50	--	--	5800	--	3	0.000279 (0.00005)	ND (0.01)	ND (0.0001)	0.00017 (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-123 S-123-20161013-WG 10/13/2016	S-216 S216-042805 4/28/2005	S-216 S-216_06_12_2013 6/12/2013	S-216 S-216-20160816-WG 8/16/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	0.00297 (0.002)	NA	NA	0.0116 (0.002)
Lead	--	--	--	--	--	2.5	ND (0.002)	NA	ND (0.003)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	ND (0.002)	NA	NA	0.0426 (0.002)
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	NA	NA	ND (0.005)
Zinc	--	--	--	--	--	--	ND (0.025)	NA	NA	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-216 S-216-20161012-WG 10/12/2016	S-218 S218-042805 4/28/2005	S-218 S-218_06_14_2013 6/14/2013	S-218 S-218-20160817-WG 8/17/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.0194 (0.005)	***2.2 (0.05)***	***0.682 (0.005)***	***0.638 (0.01)***
sec-Butylbenzene	--	--	--	--	--	--	ND (0.005)	NA	NA	ND (0.01)
tert-Butylbenzene	--	--	--	--	--	--	ND (0.005)	NA	NA	ND (0.01)
Cumene	37	9100	63	30	4	2.6	0.0223 (0.005)	ND (0.05)	0.0157 (0.01)	0.0221 (0.01)
Cyclohexane	--	--	--	--	--	--	0.0181 (0.005)	NA	NA	0.118 (0.01)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	0.000052 (0.000029)	ND (0.00002)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND (0.05)	ND (0.005)	ND (0.01)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.005)	1.3 (0.05)	0.0415 (0.005)	0.103 (0.01)
Hexane	--	--	--	--	--	--	ND (0.005)	NA	NA	ND (0.01)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.005)	ND (0.05)	0.0183 (0.005)	ND (0.01)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.025)	0.36 (0.05)	0.0242 (0.005)	0.0623 (0.05)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	0.0125 (0.005)	NA	0.0891 (0.01)	0.119 (0.01)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.005)	NA	0.117 (0.01)	0.106 (0.01)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.015)	*2.4 (0.05)*	0.267 (0.005)	0.307 (0.03)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	0.00158 J- (0.00005)	NA	NA	0.000661 (0.00005)
Anthracene	240	--	--	19000	--	40	ND,J (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND,J (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND,J (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND,J (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND,J (0.00005)	NA	ND (0.0001)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND,J (0.00005)	NA	NA	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND,J (0.00005)	ND (0.01)	ND (0.0001)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND,J (0.00005)	NA	NA	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	0.0000701 J- (0.00005)	NA	NA	ND (0.00005)
Fluorene	97	--	--	7800	--	7	0.00268 J- (0.00005)	ND (0.01)	0.000424 (0.0001)	0.000814 (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND,J (0.00005)	NA	NA	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	0.0114 J- (0.00025)	NA	NA	0.0524 (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.00648 J- (0.00025)	*0.25 (0.051)*	*0.0827 (0.001)*	*0.0854 (0.00025)*
Phenanthrene	73	--	--	5800	--	1	0.00353 J- (0.00005)	ND (0.01)	0.000386 (0.0001)	0.000723 (0.00005)
Phenol	--	--	--	--	--	--	ND (0.01)	NA	NA	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	0.00523 (0.003)	NA	NA	ND (0.003)
Pyrene	50	--	--	5800	--	3	0.000122 J- (0.00005)	ND (0.01)	ND (0.0001)	ND (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-216 S-216-20161012-WG 10/12/2016	S-218 S218-042805 4/28/2005	S-218 S-218_06_14_2013 6/14/2013	S-218 S-218-20160817-WG 8/17/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	0.00545 (0.002)	NA	NA	0.0147 (0.002)
Lead	--	--	--	--	--	2.5	ND (0.002)	NA	ND (0.003)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	0.00563 (0.002)	NA	NA	0.00329 (0.002)
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	NA	NA	ND (0.005)
Zinc	--	--	--	--	--	--	ND (0.025)	NA	NA	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-218 S-218-20160817-WG-DUP 8/17/2016 Field Duplicate	S-218 S-218-20161012-WG 10/12/2016	S-218D S-218D-20160426 4/26/2016	S-218D S-218D-HS-20160830-WG 8/30/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	***0.636 (0.005)***	***0.498 (0.01)***	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	0.00689 (0.005)	ND (0.01)	ND (0.005)	ND (0.001)
tert-Butylbenzene	--	--	--	--	--	--	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.001)
Cumene	37	9100	63	30	4	2.6	0.0216 (0.005)	0.0138 (0.01)	ND (0.005)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	0.113 (0.005)	0.074 (0.01)	ND (0.005)	ND (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.00001)	ND (0.000028)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND (0.01)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	0.0958 (0.005)	0.0487 (0.01)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	ND (0.005)	0.0386 (0.01)	ND (0.005)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.005)	ND (0.01)	0.065 (0.001)	0.0925 (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.0612 (0.025)	ND (0.05)	0.006 (0.001)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	0.112 (0.005)	0.0286 (0.01)	ND (0.005)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	0.0986 (0.005)	0.0546 (0.01)	ND (0.005)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	0.286 (0.015)	0.132 (0.03)	ND (0.001)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	0.00064 (0.00005)	0.000768 (0.00005)	ND (0.0005)	ND (0.00005)
Anthracene	240	--	--	19000	--	40	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	ND (0.01)	ND (0.001)	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Fluorene	97	--	--	7800	--	7	0.00071 (0.00005)	0.000917 (0.00005)	ND (0.0005)	ND (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	0.041 (0.00025)	0.044 (0.00025)	ND (0.0005)	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	ND (0.01)	ND (0.001)	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.0495 (0.00025)	0.0206 (0.00025)	ND (0.0005)	ND (0.00025)
Phenanthrene	73	--	--	5800	--	1	0.00063 (0.00005)	0.000817 (0.00005)	ND (0.0005)	ND (0.00005)
Phenol	--	--	--	--	--	--	ND (0.01)	ND (0.01)	ND (0.001)	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	ND (0.003)	ND (0.005)	ND (0.003)
Pyrene	50	--	--	5800	--	3	ND (0.00005)	ND (0.00005)	ND (0.0005)	ND (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-218 S-218-20160817-WG-DUP 8/17/2016 Field Duplicate	S-218 S-218-20161012-WG 10/12/2016	S-218D S-218D-20160426 4/26/2016	S-218D S-218D-HS-20160830-WG 8/30/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	0.0165 (0.002)	0.0252 (0.002)	0.0168 (0.005)	0.0193 (0.002)
Lead	--	--	--	--	--	2.5	ND (0.002)	ND (0.002)	0.0127 J (0.015)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	0.00341 (0.002)	0.00492 (0.002)	0.0073 J (0.01)	0.00844 (0.002)
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	ND (0.025)	ND (0.025)	0.106 (0.02)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-218D S-218D-20160831-WG 8/31/2016	S-218D S-218D-20161011-WG 10/11/2016	S-218D S-218D-HS-20161011-WG 10/11/2016	S-218D S-218D_20180628 6/28/2018
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	ND (0.001)	ND (0.001)	NA
sec-Butylbenzene	--	--	--	--	--	--	ND (0.001)	ND (0.001)	ND (0.001)	NA
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	ND (0.001)	ND (0.001)	NA
Cumene	37	9100	63	30	4	2.6	ND (0.001)	ND (0.001)	ND (0.001)	NA
Cyclohexane	--	--	--	--	--	--	ND (0.001)	ND (0.001)	ND (0.001)	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.00001)	ND (0.00001)	NA
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.001)	NA
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.001)	ND (0.001)	NA
Hexane	--	--	--	--	--	--	ND (0.001)	ND (0.001)	ND (0.001)	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.0537 (0.001)	0.0553 (0.001)	0.0511 (0.001)	0.0486 (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	ND,OE (0.005)
Toluene	25	100000	700	200	45	52	ND (0.005)	ND (0.005)	ND (0.005)	NA
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.001)	ND (0.001)	ND (0.001)	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.001)	ND (0.001)	ND (0.001)	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.003)	ND (0.003)	ND (0.003)	NA
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Anthracene	240	--	--	19000	--	40	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	ND (0.01)	ND (0.01)	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Fluoranthene	--	--	--	--	--	--	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Fluorene	97	--	--	7800	--	7	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
2-Methylnaphthalene	--	--	--	--	--	--	0.000302 (0.00025)	ND (0.00025)	ND (0.00025)	NA
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	ND (0.01)	ND (0.01)	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.000529 (0.00025)	ND (0.00025)	ND (0.00025)	NA
Phenanthrene	73	--	--	5800	--	1	0.000192 (0.00005)	ND (0.00005)	ND (0.00005)	NA
Phenol	--	--	--	--	--	--	ND (0.01)	ND (0.01)	ND (0.01)	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	ND (0.003)	ND (0.003)	NA
Pyrene	50	--	--	5800	--	3	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-218D S-218D-20160831-WG 8/31/2016	S-218D S-218D-20161011-WG 10/11/2016	S-218D S-218D-HS-20161011-WG 10/11/2016	S-218D S-218D_20180628 6/28/2018
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	0.0161 (0.002)	0.00407 (0.002)	0.00392 (0.002)	NA
Lead	--	--	--	--	--	2.5	ND (0.002)	ND (0.002)	ND (0.002)	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	0.00445 (0.002)	ND (0.002)	0.00213 (0.002)	NA
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	ND (0.005)	ND (0.005)	NA
Zinc	--	--	--	--	--	--	ND (0.025)	ND (0.025)	ND (0.025)	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-218D S-218D-HS_20180628 6/28/2018	S-218D S-218D_20190626 6/26/2019	S-218D S-218D_20191029 10/29/2019	S-218D S-218D_20210430 4/30/2021
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	NA	ND (0.001)	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	NA	ND (0.005)	ND (0.005)	ND (0.005)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	NA	ND (0.000028)	ND (0.000028)	ND (0.000029)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	NA	ND (0.005)	ND (0.005)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	NA	ND (0.001)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.0506 (0.001)	0.041 (0.001)	0.037 (0.001)	0.036 (0.001)
tert Butyl alcohol	--	--	--	--	--	--	ND,OE (0.005)	ND (0.025)	ND (0.025)	ND (0.05)
Toluene	25	100000	700	200	45	52	NA	ND (0.001)	ND (0.001)	ND (0.001)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	ND (0.005)	ND (0.005)	ND (0.005)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	ND (0.005)	ND (0.005)	ND (0.005)
Xylenes (total)	3.7	1900	13	17	0.86	210	NA	ND (0.005)	ND (0.003)	ND (0.006)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Phenanthrene	73	--	--	5800	--	1	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	NA	ND (0.0005)	ND (0.0005)	ND (0.00054)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-218D S-218D-HS_20180628 6/28/2018	S-218D S-218D_20190626 6/26/2019	S-218D S-218D_20191029 10/29/2019	S-218D S-218D_20210430 4/30/2021
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	ND (0.003)	ND (0.0005)	ND (0.00052)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-219 S219-042805 4/28/2005	S-219 S-219_06_12_2013 6/12/2013	S-219 S-219-20160815 8/15/2016	S-219 S-219-20161011-WG 10/11/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.023 (0.005)	ND (0.001)	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
Cumene	37	9100	63	30	4	2.6	ND (0.005)	ND (0.002)	ND (0.001)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000029)	ND (0.00002)	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.005)	ND (0.001)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.005)	ND (0.001)	ND (0.001)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.005)	ND (0.001)	ND (0.005)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	ND (0.002)	ND (0.001)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	ND (0.002)	ND (0.001)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	0.006 (0.005)	ND (0.001)	ND (0.003)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	ND (0.00005)	ND (0.00005)
Anthracene	240	--	--	19000	--	40	NA	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	ND (0.00005)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.01)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	ND (0.00005)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	NA	NA	ND (0.00005)	ND (0.00005)
Fluorene	97	--	--	7800	--	7	ND (0.01)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	ND (0.00005)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	ND (0.00025)	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.01)	ND (0.0001)	ND (0.00025)	ND (0.00025)
Phenanthrene	73	--	--	5800	--	1	ND (0.01)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Phenol	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	ND (0.003)	ND (0.003)
Pyrene	50	--	--	5800	--	3	ND (0.01)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-219 S219-042805 4/28/2005	S-219 S-219_06_12_2013 6/12/2013	S-219 S-219-20160815 8/15/2016	S-219 S-219-20161011-WG 10/11/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.001)	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	0.00331 B (0.002)	0.00217 (0.002)
Lead	--	--	--	--	--	2.5	NA	ND (0.003)	ND (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	0.00395 B (0.002)	ND (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	NA	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	NA	NA	ND (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-225 S225-042805 4/28/2005	S-225 S-225_06_12_2013 6/12/2013	S-225 S-225-20160815 8/15/2016	S-225 S-225-20161011-WG 10/11/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.024 (0.005)	0.0044 (0.001)	ND (0.01)	0.0058 (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	0.0127 (0.01)	0.00962 (0.001)
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.01)	0.00242 (0.001)
Cumene	37	9100	63	30	4	2.6	0.087 (0.005)	0.05 (0.002)	0.0682 (0.01)	0.0487 (0.001)
Cyclohexane	--	--	--	--	--	--	NA	NA	0.105 (0.01)	0.0289 (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000029)	ND (0.00002)	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND (0.001)	ND (0.01)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.005)	0.0009 J (0.001)	ND (0.01)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.005)	ND (0.001)	ND (0.01)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.01 (0.005)	0.0029 (0.001)	ND (0.05)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	0.00038 J (0.002)	ND (0.01)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	ND (0.002)	ND (0.01)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	0.011 (0.005)	0.0027 (0.001)	ND (0.03)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	0.00146 (0.00005)	0.00104 (0.00005)
Anthracene	240	--	--	19000	--	40	NA	0.000436 (0.0001)	0.000279 (0.00005)	0.000217 (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	0.000153 (0.0001)	0.0000828 (0.00005)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	ND (0.00005)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.01)	0.000208 (0.0001)	0.0000713 (0.00005)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	ND (0.00005)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	NA	NA	0.000269 (0.00005)	0.000109 (0.00005)
Fluorene	97	--	--	7800	--	7	0.056 (0.01)	0.00274 (0.0001)	0.00249 (0.00005)	0.00208 (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	ND (0.00005)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	ND (0.00025)	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.01)	ND (0.0001)	ND (0.00025)	0.000999 (0.00025)
Phenanthrene	73	--	--	5800	--	1	0.071 (0.01)	0.00202 (0.0001)	0.000591 (0.00005)	0.00161 (0.00005)
Phenol	--	--	--	--	--	--	NA	NA	ND (0.01)	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	ND (0.003)	ND (0.003)
Pyrene	50	--	--	5800	--	3	ND (0.01)	0.000407 (0.0001)	0.000323 (0.00005)	0.000102 (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-225 S225-042805 4/28/2005	S-225 S-225_06_12_2013 6/12/2013	S-225 S-225-20160815 8/15/2016	S-225 S-225-20161011-WG 10/11/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.001)	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	ND (0.002)	ND (0.002)
Lead	--	--	--	--	--	2.5	NA	ND (0.003)	ND (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	ND (0.002)	ND (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	NA	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	NA	NA	ND (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
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J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-229 S229-042805 4/28/2005	S-34 S-34_06_14_2013 6/14/2013	S-35 S-35-20160818-WG 8/18/2016	S-35 S-35-20161012-WG 10/12/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	***1.9 (0.05)***	NA	ND (0.005)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.005)	ND (0.001)
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.005)	ND (0.001)
Cumene	37	9100	63	30	4	2.6	0.15 (0.05)	NA	ND (0.005)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	NA	NA	ND (0.005)	ND (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	0.000033 (0.000029)	NA	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.05)	NA	ND (0.005)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	0.35 (0.05)	NA	ND (0.005)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	ND (0.005)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.05)	NA	ND (0.005)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.05)	NA	ND (0.025)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	NA	ND (0.005)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	NA	ND (0.005)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	0.63 (0.05)	NA	ND (0.015)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	0.0424 (0.00267)	ND (0.00005)
Anthracene	240	--	--	19000	--	40	NA	NA	ND (0.00267)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	NA	ND (0.00267)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	NA	ND (0.00267)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	NA	ND (0.00267)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	ND (0.00267)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	ND (0.00267)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	ND (0.2)	ND (0.4)
Chrysene	16	--	--	140000	--	1.3	ND (0.01)	NA	ND (0.00267)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	ND,OE (0.00267)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	NA	NA	0.00413 (0.00267)	ND (0.00005)
Fluorene	97	--	--	7800	--	7	0.011 (0.01)	NA	ND (0.00267)	ND (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	ND,OE (0.00267)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	ND (0.0133)	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	ND (0.2)	ND (0.4)
Naphthalene	0.39	120	0.88	0.28	0.067	43	*0.22 (0.051)*	NA	ND (0.0133)	ND (0.00025)
Phenanthrene	73	--	--	5800	--	1	0.015 (0.01)	NA	0.11 (0.00267)	ND (0.00005)
Phenol	--	--	--	--	--	--	NA	NA	ND (0.2)	ND (0.4)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	ND (0.06)	0.188 (0.12)
Pyrene	50	--	--	5800	--	3	ND (0.01)	NA	0.0716 (0.00267)	0.00032 J (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
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Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-229 S229-042805 4/28/2005	S-34 S-34_06_14_2013 6/14/2013	S-35 S-35-20160818-WG 8/18/2016	S-35 S-35-20161012-WG 10/12/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.001)	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	ND (0.002)	ND (0.002)
Lead	--	--	--	--	--	2.5	NA	0.0034 (0.003)	ND (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	ND (0.002)	ND (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	NA	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	NA	NA	ND (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-35 S-35-20161012-WG-DUP 10/12/2016 Field Duplicate	S-36 S-36_06_14_2013 6/14/2013	S-364 S-364_06_12_2013 6/12/2013	S-365 S-365-20160818-WG 8/18/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	*0.288 (0.005)*	0.0098 (0.001)	0.00704 SL (0.005)
sec-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	ND,SL (0.005)
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	NA	NA	ND,SL (0.005)
Cumene	37	9100	63	30	4	2.6	ND (0.001)	0.0418 (0.002)	0.0577 (0.002)	0.0109 SL (0.005)
Cyclohexane	--	--	--	--	--	--	ND (0.001)	NA	NA	0.293 SL (0.005)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.00002)	ND (0.00002)	ND,SL (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.001)	ND,SL (0.005)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	0.0369 (0.001)	0.0408 (0.001)	ND,SL (0.005)
Hexane	--	--	--	--	--	--	ND (0.001)	NA	NA	ND,SL (0.005)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	0.0219 (0.001)	0.00054 J (0.001)	ND,SL (0.005)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.005)	0.071 (0.001)	0.0027 (0.001)	ND,SL (0.025)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.001)	0.003 (0.002)	0.0148 (0.002)	ND,SL (0.005)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.001)	0.0555 (0.002)	0.0135 (0.002)	0.0125 SL (0.005)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.003)	0.121 (0.001)	0.0167 (0.001)	ND,SL (0.015)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	0.000731 (0.00005)	NA	NA	0.00211 SL (0.00005)
Anthracene	240	--	--	19000	--	40	ND (0.00005)	ND (0.0001)	0.000278 (0.0001)	0.000963 SL (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	0.0000527 (0.00005)	ND (0.0001)	ND (0.0001)	0.000515 SL (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	0.0000684 (0.00005)	ND (0.0001)	ND (0.0001)	0.000244 SL (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	ND (0.0001)	ND (0.0001)	0.000244 SL (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	ND (0.0001)	ND (0.0001)	0.000129 SL (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	NA	NA	0.0000639 SL (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	ND (0.2)	NA	NA	ND,SL (0.05)
Chrysene	16	--	--	140000	--	1.3	0.000244 (0.00005)	ND (0.0001)	ND (0.0001)	0.000497 SL (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	NA	NA	0.0000611 OE,SL (0.00005)
Fluoranthene	--	--	--	--	--	--	0.000123 (0.00005)	NA	NA	0.00106 SL (0.00005)
Fluorene	97	--	--	7800	--	7	ND (0.00005)	0.0115 (0.001)	0.00121 (0.0001)	0.00239 SL (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	NA	NA	0.0000626 OE,SL (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	ND (0.00025)	NA	NA	0.00206 SL (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	ND (0.2)	NA	NA	ND,SL (0.05)
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.000627 B (0.00025)	ND (0.0001)	0.0199 (0.001)	0.00443 SL (0.00025)
Phenanthrene	73	--	--	5800	--	1	ND (0.00005)	0.0165 (0.001)	0.00129 (0.0001)	0.00273 SL (0.00005)
Phenol	--	--	--	--	--	--	ND (0.2)	NA	NA	ND,SL (0.05)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.06)	NA	NA	ND,SL (0.015)
Pyrene	50	--	--	5800	--	3	0.00178 J (0.00005)	0.000802 (0.0001)	0.00021 (0.0001)	0.00224 SL (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-35 S-35-20161012-WG-DUP 10/12/2016 Field Duplicate	S-36 S-36_06_14_2013 6/14/2013	S-364 S-364_06_12_2013 6/12/2013	S-365 S-365-20160818-WG 8/18/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	ND (0.002)	NA	NA	ND,SL (0.002)
Lead	--	--	--	--	--	2.5	ND (0.002)	NA	ND (0.003)	ND,SL (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	ND (0.002)	NA	NA	0.0041 B,SL (0.002)
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	NA	NA	ND,SL (0.005)
Zinc	--	--	--	--	--	--	ND (0.025)	NA	NA	ND,SL (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-365 S-365-20161012-WG 10/12/2016	S-366 S-366_06_12_2013 6/12/2013	S-366 S-366-20160816-WG 8/16/2016	S-366 S-366-20161011-WG 10/11/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.0645 SL (0.05)	0.232 (0.005)	0.00651 (0.001)	0.00762 (0.001)
sec-Butylbenzene	--	--	--	--	--	--	ND,SL (0.05)	NA	0.00992 (0.001)	0.00696 (0.001)
tert-Butylbenzene	--	--	--	--	--	--	ND,SL (0.05)	NA	0.00269 (0.001)	0.00209 (0.001)
Cumene	37	9100	63	30	4	2.6	0.0674 SL (0.05)	0.0529 (0.002)	0.0496 (0.001)	0.0459 (0.001)
Cyclohexane	--	--	--	--	--	--	0.712 SL (0.05)	NA	0.21 (0.01)	0.141 (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND,SL (0.00001)	ND (0.00002)	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND,SL (0.05)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND,SL (0.05)	0.13 (0.001)	0.00381 (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	0.0527 SL (0.05)	NA	0.00108 (0.001)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND,SL (0.05)	0.00046 J (0.001)	ND (0.001)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND,SL (0.25)	0.0037 (0.001)	ND (0.005)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND,SL (0.05)	0.148 (0.002)	0.0351 (0.001)	0.0137 (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND,SL (0.05)	0.0451 (0.002)	0.0229 (0.001)	0.0134 (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND,SL (0.15)	0.335 (0.001)	0.0103 (0.003)	0.00317 (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	0.00468 SL (0.000057)	NA	0.00184 (0.00005)	0.000843 (0.00005)
Anthracene	240	--	--	19000	--	40	0.00243 SL (0.000057)	0.000605 (0.0001)	0.000385 (0.00005)	0.000177 (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	0.000916 SL (0.000057)	0.000327 (0.0001)	0.000111 (0.00005)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	0.000421 SL (0.000057)	ND (0.0001)	0.0000559 (0.00005)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	0.000351 SL (0.000057)	ND (0.0001)	0.0000637 (0.00005)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	0.000194 SL (0.000057)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	0.000123 SL (0.000057)	NA	ND (0.00005)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	ND,SL (0.05)	NA	ND (0.01)	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	0.000856 SL (0.000057)	0.000429 (0.0001)	0.0000864 (0.00005)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	0.0000979 SL (0.000057)	NA	ND (0.00005)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	0.0021 SL (0.000057)	NA	0.000396 (0.00005)	0.0000766 (0.00005)
Fluorene	97	--	--	7800	--	7	0.00607 SL (0.000057)	0.00324 (0.0001)	0.00293 (0.00005)	0.00141 (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	0.0001 SL (0.000057)	NA	ND (0.00005)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	0.0734 SL (0.00573)	NA	0.0218 (0.00025)	0.00765 (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	ND,SL (0.05)	NA	ND (0.01)	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.0235 SL (0.00573)	NA	0.00754 (0.00025)	0.00135 (0.00025)
Phenanthrene	73	--	--	5800	--	1	0.0125 SL (0.000057)	0.00261 (0.0001)	0.00323 (0.00005)	0.000981 (0.00005)
Phenol	--	--	--	--	--	--	ND,SL (0.05)	NA	ND (0.01)	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND,SL (0.015)	NA	ND (0.003)	ND (0.003)
Pyrene	50	--	--	5800	--	3	0.0031 SL (0.000057)	0.000711 (0.0001)	0.000504 (0.00005)	0.0000679 (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-365 S-365-20161012-WG 10/12/2016	S-366 S-366_06_12_2013 6/12/2013	S-366 S-366-20160816-WG 8/16/2016	S-366 S-366-20161011-WG 10/11/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	ND,SL (0.002)	NA	0.0115 (0.002)	0.00414 (0.002)
Lead	--	--	--	--	--	2.5	ND,SL (0.002)	ND (0.003)	ND (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	ND,SL (0.002)	NA	ND (0.002)	ND (0.002)
Vanadium	0.14	--	--	6.9	--	100	ND,SL (0.005)	NA	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	ND,SL (0.025)	NA	ND (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-366 S-366_20220328 3/28/2022	S-367 S-367_06_12_2013 6/12/2013	S-367 S-367-20160815 8/15/2016	S-367 S-367-20161011-WG 10/11/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.005)	0.00083 J (0.001)	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	ND (0.001)	0.00159 (0.001)
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	0.00214 (0.001)	0.00221 (0.001)
Cumene	37	9100	63	30	4	2.6	0.0368 (0.01)	0.0458 (0.002)	ND (0.001)	0.00475 (0.001)
Cyclohexane	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	ND (0.00002)	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.01)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.01)	0.0576 (0.001)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	ND (0.001)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.01)	0.00038 J (0.001)	ND (0.001)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	15.8 (0.5)	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.01)	0.00028 J (0.001)	ND (0.005)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.02)	0.0539 (0.002)	ND (0.001)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.02)	0.0147 (0.002)	ND (0.001)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.01)	0.0453 (0.001)	ND (0.003)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	0.000651 (0.00005)	0.000579 (0.00005)
Anthracene	240	--	--	19000	--	40	0.000403 (0.000074)	ND (0.0001)	0.000176 (0.00005)	0.0000819 (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	0.0000405 (0.000037)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	0.0000253 J (0.000037)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	0.0000293 J (0.000037)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.000074)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	ND (0.00005)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	ND (0.0111)	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	0.0000594 J (0.000074)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	ND (0.00005)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	NA	NA	0.000101 (0.00005)	ND (0.00005)
Fluorene	97	--	--	7800	--	7	0.000542 (0.000074)	0.000873 (0.0001)	0.00153 (0.00005)	0.00146 (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	ND (0.00005)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	ND (0.00025)	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	ND (0.0111)	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.000074)	0.00134 (0.0001)	ND (0.00025)	ND (0.00025)
Phenanthrene	73	--	--	5800	--	1	ND (0.000074)	ND (0.0001)	ND (0.00005)	ND (0.00005)
Phenol	--	--	--	--	--	--	NA	NA	ND (0.0111)	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	ND (0.00333)	ND (0.003)
Pyrene	50	--	--	5800	--	3	0.000154 (0.000074)	ND (0.0001)	0.000135 (0.00005)	ND (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-366 S-366_20220328 3/28/2022	S-367 S-367_06_12_2013 6/12/2013	S-367 S-367-20160815 8/15/2016	S-367 S-367-20161011-WG 10/11/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	ND (0.002)	ND (0.002)
Lead	--	--	--	--	--	2.5	ND (0.001)	ND (0.003)	ND (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	ND (0.002)	ND (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	NA	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	NA	NA	ND (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
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J - Estimated Concentration
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-373 S-373-20161014-WG 10/14/2016	S-379 S-379_06_12_2013 6/12/2013	S-381 S-381_06_14_2013 6/14/2013	S-381 S-381-20160817-WG 8/17/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	***3.33 SL (0.2)***	0.0199 (0.001)	*0.296 (0.01)*	0.0103 (0.001)
sec-Butylbenzene	--	--	--	--	--	--	ND,SL (0.2)	NA	NA	0.00141 (0.001)
tert-Butylbenzene	--	--	--	--	--	--	ND,SL (0.2)	NA	NA	ND (0.001)
Cumene	37	9100	63	30	4	2.6	ND,SL (0.2)	0.0034 (0.002)	0.0606 (0.02)	0.00415 (0.001)
Cyclohexane	--	--	--	--	--	--	ND,SL (0.2)	NA	NA	0.0302 (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND,SL (0.00001)	ND (0.00002)	ND (0.00002)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND,SL (0.2)	ND (0.001)	ND (0.01)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	0.752 SL (0.2)	0.0015 (0.001)	0.554 (0.01)	0.0652 (0.001)
Hexane	--	--	--	--	--	--	ND,SL (0.2)	NA	NA	0.0564 (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND,SL (0.2)	ND (0.001)	0.026 (0.01)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND,SL (1)	0.00054 J (0.001)	1.77 (0.01)	0.109 (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	*1.01 SL (0.2)*	0.00053 J (0.002)	*1.13 (0.02)*	0.088 (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	0.295 SL (0.2)	0.0039 (0.002)	0.374 (0.02)	0.0216 (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	***3.84 SL (0.6)***	0.0013 (0.001)	*3.6 (0.01)*	0.217 (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	0.894 SL (0.025)	NA	NA	0.000912 (0.0001)
Anthracene	240	--	--	19000	--	40	0.355 SL (0.025)	ND (0.0001)	0.000898 (0.0001)	0.000173 (0.0001)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND,SL (0.025)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	0.000289 SL (0.00005)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	0.000323 SL (0.00005)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	0.000238 SL (0.00005)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	0.0000957 SL (0.00005)	NA	NA	ND (0.0001)
1,1-Biphenyl	--	--	--	--	--	--	0.255 SL (0.05)	NA	NA	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND,SL (0.025)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND,SL (0.00005)	NA	NA	ND (0.0001)
Fluoranthene	--	--	--	--	--	--	ND,SL (0.025)	NA	NA	ND (0.0001)
Fluorene	97	--	--	7800	--	7	0.748 SL (0.025)	ND (0.0001)	0.00973 (0.002)	0.00125 (0.0001)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	0.000144 SL (0.00005)	NA	NA	ND (0.0001)
2-Methylnaphthalene	--	--	--	--	--	--	8.37 SL (0.125)	NA	NA	0.0136 (0.0005)
3&4-Methylphenol	--	--	--	--	--	--	ND,SL (0.01)	NA	NA	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	***2.41 SL (0.125)***	ND (0.0001)	*0.136 (0.002)*	0.0215 (0.0005)
Phenanthrene	73	--	--	5800	--	1	2.25 SL (0.025)	0.000199 (0.0001)	0.0137 (0.0002)	0.00164 (0.0001)
Phenol	--	--	--	--	--	--	0.0131 SL (0.01)	NA	NA	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	0.0395 SL (0.003)	NA	NA	ND (0.003)
Pyrene	50	--	--	5800	--	3	0.112 SL (0.025)	ND (0.0001)	0.000677 (0.0001)	0.000129 (0.0001)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-373 S-373-20161014-WG 10/14/2016	S-379 S-379_06_12_2013 6/12/2013	S-381 S-381_06_14_2013 6/14/2013	S-381 S-381-20160817-WG 8/17/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	ND,SL (0.002)	NA	NA	ND (0.002)
Lead	--	--	--	--	--	2.5	ND,SL (0.002)	ND (0.003)	ND (0.003)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	ND,SL (0.002)	NA	NA	ND (0.002)
Vanadium	0.14	--	--	6.9	--	100	ND,SL (0.005)	NA	NA	ND (0.005)
Zinc	--	--	--	--	--	--	23.2 SL (0.5)	NA	NA	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
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Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-381 S-381-20161013-WG 10/13/2016	S-39D S-39D-20160426 4/26/2016	S-39D S-39D-HS-20160830-WG 8/30/2016	S-39D S-39D-20160831-WG 8/31/2016
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.0194 (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	0.00243 (0.001)	ND (0.005)	ND (0.001)	ND (0.001)
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	ND (0.005)	ND (0.001)	ND (0.001)
Cumene	37	9100	63	30	4	2.6	0.00697 (0.001)	ND (0.005)	ND (0.001)	ND (0.001)
Cyclohexane	--	--	--	--	--	--	0.0455 (0.001)	ND (0.005)	ND (0.001)	ND (0.001)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.000028)	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	0.101 (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	0.0563 (0.001)	ND (0.005)	ND (0.001)	ND (0.001)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	0.07 (0.001)	0.0329 (0.001)	0.0638 (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.172 (0.005)	ND (0.001)	ND (0.005)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	0.15 (0.001)	ND (0.005)	ND (0.001)	ND (0.001)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	0.0408 (0.001)	ND (0.005)	ND (0.001)	ND (0.001)
Xylenes (total)	3.7	1900	13	17	0.86	210	0.352 (0.003)	ND (0.001)	ND (0.003)	ND (0.003)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	0.00168 (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Anthracene	240	--	--	19000	--	40	0.000381 (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
1,1-Biphenyl	--	--	--	--	--	--	ND,OE (0.01)	ND (0.001)	ND (0.01)	ND (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Fluoranthene	--	--	--	--	--	--	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Fluorene	97	--	--	7800	--	7	0.00245 (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
2-Methylnaphthalene	--	--	--	--	--	--	0.0283 (0.0005)	ND (0.0005)	ND (0.00025)	ND (0.00025)
3&4-Methylphenol	--	--	--	--	--	--	ND,OE (0.01)	ND (0.001)	ND (0.01)	ND (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	0.0335 (0.0005)	ND (0.0005)	ND (0.00025)	ND (0.00025)
Phenanthrene	73	--	--	5800	--	1	0.00352 (0.0001)	ND (0.0005)	ND (0.00005)	0.000196 (0.00005)
Phenol	--	--	--	--	--	--	ND,OE (0.01)	ND (0.001)	ND (0.01)	ND (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	ND (0.005)	ND (0.003)	ND (0.003)
Pyrene	50	--	--	5800	--	3	0.000382 (0.0001)	ND (0.0005)	ND (0.00005)	ND (0.00005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-381 S-381-20161013-WG 10/13/2016	S-39D S-39D-20160426 4/26/2016	S-39D S-39D-HS-20160830-WG 8/30/2016	S-39D S-39D-20160831-WG 8/31/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	0.00267 (0.002)	0.0046 J (0.005)	0.00561 (0.002)	0.00505 (0.002)
Lead	--	--	--	--	--	2.5	ND (0.002)	0.0079 J (0.015)	ND (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	ND (0.002)	0.0031 J (0.01)	0.00431 B (0.002)	0.00323 B (0.002)
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	ND (0.025)	0.0346 (0.02)	ND (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-39D S-39D-20161011-WG 10/11/2016	S-39D S-39D-HS-20161011-WG 10/11/2016	S-39D S-39D_20180628 6/28/2018	S-39D S-39D-HS_20180628 6/28/2018
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	ND (0.001)	NA	NA
sec-Butylbenzene	--	--	--	--	--	--	ND (0.001)	ND (0.001)	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	ND (0.001)	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.001)	ND (0.001)	NA	NA
Cyclohexane	--	--	--	--	--	--	ND (0.001)	ND (0.001)	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.00001)	NA	NA
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	NA	NA
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.001)	NA	NA
Hexane	--	--	--	--	--	--	ND (0.001)	ND (0.001)	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.0511 (0.001)	0.0175 (0.001)	0.0551 (0.001)	0.0282 (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	ND,OE (0.005)	ND,OE (0.005)
Toluene	25	100000	700	200	45	52	ND (0.005)	ND (0.005)	NA	NA
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.001)	ND (0.001)	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.001)	ND (0.001)	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.003)	ND (0.003)	NA	NA
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	ND (0.00005)	ND (0.00005)	NA	NA
Anthracene	240	--	--	19000	--	40	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	ND (0.00005)	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	ND (0.01)	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.00005)	ND (0.00005)	NA	NA
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	ND (0.00005)	NA	NA
Fluoranthene	--	--	--	--	--	--	ND (0.00005)	ND (0.00005)	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.00005)	ND (0.00005)	NA	NA
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	ND (0.00025)	ND (0.00025)	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	ND (0.01)	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.00025)	ND (0.00025)	NA	NA
Phenanthrene	73	--	--	5800	--	1	ND (0.00005)	ND (0.00005)	NA	NA
Phenol	--	--	--	--	--	--	ND (0.01)	ND (0.01)	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	ND (0.003)	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.00005)	ND (0.00005)	NA	NA
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-39D S-39D-20161011-WG 10/11/2016	S-39D S-39D-HS-20161011-WG 10/11/2016	S-39D S-39D_20180628 6/28/2018	S-39D S-39D-HS_20180628 6/28/2018
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	ND (0.002)	ND (0.002)	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.002)	ND (0.002)	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	0.00211 (0.002)	0.00358 (0.002)	NA	NA
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	ND (0.005)	NA	NA
Zinc	--	--	--	--	--	--	ND (0.025)	ND (0.025)	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-39D S-39D_20190620 6/20/2019	S-39D S-39D_20191029 10/29/2019	S-39D DUP-2_20191029 10/29/2019 Field Duplicate	S-39D S-39D_20210507_410-39177-1 5/7/2021
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.0002 J (0.001)	ND (0.001)	ND (0.001)	0.00069 J (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000029)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.091 (0.001)	0.031 (0.001)	0.033 (0.001)	0.024 (0.001)
tert Butyl alcohol	--	--	--	--	--	--	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)
Toluene	25	100000	700	200	45	52	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.005)	ND (0.003)	ND (0.003)	ND (0.006)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Phenanthrene	73	--	--	5800	--	1	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.00055)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-39D S-39D_20190620 6/20/2019	S-39D S-39D_20191029 10/29/2019	S-39D DUP-2_20191029 10/29/2019 Field Duplicate	S-39D S-39D_20210507_410-39177-1 5/7/2021
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.003)	ND (0.0005)	ND (0.0005)	ND (0.00052)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-39D S-39D 7/21/2021	S-39D S-39D_20220405_42610 4/5/2022	S-40 S-40~1/1/1985 1/1/1985	S-40 S-40~1/1/1986 1/1/1986
Physical Parameters										
pH [SU]	--	--	--	--	--	--	6.96	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	NA	ND (0.0005)	***2.8***	***0.6***
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	NA	ND (0.001)	NA	NA
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	NA	ND (0.00002)	NA	NA
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	NA	ND (0.001)	NA	NA
Ethyl Benzene	2	22000	150	40	9.7	13	NA	ND (0.001)	1.2	0.21
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	NA	0.0596 (0.001)	NA	NA
tert Butyl alcohol	--	--	--	--	--	--	NA	ND (0.01)	NA	NA
Toluene	25	100000	700	200	45	52	NA	ND (0.001)	ND	ND
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	ND (0.002)	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	ND (0.002)	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	NA	ND (0.001)	***6.1***	*1.52*
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	0.0000442 JB (0.000082)	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	ND (0.000041)	ND	ND
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	ND (0.000041)	ND	ND
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	ND (0.000041)	ND	ND
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	ND (0.000082)	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	NA	ND (0.000082)	ND	ND
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	ND	ND
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	NA	ND (0.000082)	NA	NA
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	ND	ND
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	NA	ND (0.000082)	NA	NA
Phenanthrene	73	--	--	5800	--	1	NA	ND (0.000082)	NA	NA
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	ND	ND
Pyrene	50	--	--	5800	--	3	NA	0.0000513 J (0.000082)	NA	NA
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	0.00002 (0.00002)	NA	NA	NA

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Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-39D S-39D 7/21/2021	S-39D S-39D_20220405_42610 4/5/2022	S-40 S-40~1/1/1985 1/1/1985	S-40 S-40~1/1/1986 1/1/1986
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	ND	0.19
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	ND	**0.0229**
Barium	--	--	--	--	--	--	NA	NA	0.15	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	ND	NA
Cobalt	--	--	--	--	--	--	NA	NA	ND	ND
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-40 S-40~1/1/1988 1/1/1988	S-40 S-40~1/1/1993 1/1/1993	S-40 S-40~1/1/1994 1/1/1994	S-40 S-40~12/28/1995 12/28/1995
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	***2***	0.078	*0.28*	0.15
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	NA	NA	NA	NA
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	NA	NA	NA	NA
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	NA	NA	NA	NA
Ethyl Benzene	2	22000	150	40	9.7	13	**2.9**	0.012	0.14 J	0.029
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	NA	NA	NA	NA
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND	0.006	0.055 J	0.023
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	NA	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	NA	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	***4.1***	0.016	0.075 J	0.0512
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.01)	ND	ND (0.001)	0.001
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.01)	ND	ND (0.001)	ND (0.001)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.01)	ND	ND (0.001)	0.001
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND	ND	ND (0.01)	ND
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.01)	ND	ND (0.001)	ND (0.001)
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND	ND	ND (0.01)	ND
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	NA	NA	NA	NA
Phenanthrene	73	--	--	5800	--	1	NA	NA	NA	NA
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.01)	0.001 J	0.003	0.004
Pyrene	50	--	--	5800	--	3	NA	NA	NA	NA
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Table 4
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-40 S-40~1/1/1988 1/1/1988	S-40 S-40~1/1/1993 1/1/1993	S-40 S-40~1/1/1994 1/1/1994	S-40 S-40~12/28/1995 12/28/1995
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.2)	0.0411	0.022	0.099
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	ND (0.005)	0.0113	0.021	**0.025**
Barium	--	--	--	--	--	--	0.086	0.163	0.16	0.25
Chromium (total)	--	--	--	--	--	--	ND (0.02)	0.03	ND (0.02)	0.11
Cobalt	--	--	--	--	--	--	ND (0.02)	ND	ND (0.02)	ND (0.05)
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
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Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-40 S-40~1/1/1996 1/1/1996	S-40 S-40~11/19/1997 11/19/1997	S-40 S-40~11/12/1998 11/12/1998	S-40 S-40~12/2/1999 12/2/1999
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.012	***0.35***	***0.63***	***1***
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	NA	NA	NA	NA
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	NA	NA	NA	NA
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	NA	NA	NA	NA
Ethyl Benzene	2	22000	150	40	9.7	13	0.0034	ND (0.1)	ND (0.1)	ND (0.1)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	NA	NA	NA	NA
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.0018	ND (0.1)	ND (0.1)	ND (0.1)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	NA	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	NA	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	0.0019	0.056 J	ND (0.1)	ND (0.2)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.001)	ND (0.001)	0.002	0.002
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.001)	ND (0.001)	ND (0.002)	ND (0.002)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.001)	ND (0.001)	ND (0.003)	ND (0.003)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.001)	0.001	ND (0.001)	ND (0.001)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.001)	ND (0.001)	ND (0.004)	ND (0.004)
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	NA	NA	NA	NA
Phenanthrene	73	--	--	5800	--	1	NA	NA	NA	NA
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.001)	0.005	0.008	0.007
Pyrene	50	--	--	5800	--	3	NA	NA	NA	NA
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-40 S-40~1/1/1996 1/1/1996	S-40 S-40~11/19/1997 11/19/1997	S-40 S-40~11/12/1998 11/12/1998	S-40 S-40~12/2/1999 12/2/1999
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	0.1	0.049	0.238	0.099
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	**0.029**	0.02	**0.037**	ND (0.008)
Barium	--	--	--	--	--	--	0.38	0.26	0.738	0.974
Chromium (total)	--	--	--	--	--	--	0.13	0.068	0.337	0.114
Cobalt	--	--	--	--	--	--	0.028	0.018	0.093	0.045
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-40 S-40~11/16/2000 11/16/2000	S-40 S-40~11/14/2001 11/14/2001	S-40 S-40~11/12/2002 11/12/2002	S-40 S-40-1 11/13/2003
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	***0.6***	***1.2***	0.24	***0.987***
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	NA	NA	NA	NA
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	NA	NA	NA	NA
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	NA	NA	NA	NA
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.1)	0.068	0.007	0.0195
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.1)	1.2	ND (0.005)	ND (0.005)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.1)	0.076	0.009	0.0369
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	NA	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	NA	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.2)	ND (0.1)	0.008	0.0209
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.013)	ND (0.002)	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.01)	ND (0.002)	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.014)	ND (0.002)	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	0.003	0.004	ND (0.015)	ND (0.002)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.017)	ND (0.002)	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.01)	ND (0.01)	ND (0.1)	ND (0.002)
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	NA	NA	NA	NA
Phenanthrene	73	--	--	5800	--	1	NA	NA	NA	NA
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.009)	0.0041	NA	NA
Pyrene	50	--	--	5800	--	3	NA	NA	NA	NA
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-40 S-40~11/16/2000 11/16/2000	S-40 S-40~11/14/2001 11/14/2001	S-40 S-40~11/12/2002 11/12/2002	S-40 S-40-1 11/13/2003
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	0.057	0.029	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	0.015	**0.0222**	NA	NA
Barium	--	--	--	--	--	--	0.187	ND (0.2)	NA	NA
Chromium (total)	--	--	--	--	--	--	0.036	0.0207	NA	NA
Cobalt	--	--	--	--	--	--	0.013	ND (0.05)	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
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Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-40 S40-050305 5/3/2005	S-40 S-40_11_8_2005 11/8/2005	S-40 S-40~12/6/2006 12/6/2006	S-40 S-40~12/18/2007 12/18/2007
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	***0.37 (0.025)***	***0.436 (0.01)***	0.22	0.003
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	0.04 (0.005)	NA	0.017	0.001 J
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00003)	ND (0.00002)	ND (0.0000097)	ND (0.0000095)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.005)	ND (0.01)	ND (0.001)	ND (0.0005)
Ethyl Benzene	2	22000	150	40	9.7	13	0.021 (0.005)	0.028 (0.01)	0.008	ND (0.0005)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	0.117 (0.01)	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.005)	ND (0.01)	ND (0.0005)	NA
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.014 (0.005)	0.017 (0.01)	0.009	ND (0.0005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	NA	NA	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	NA	NA	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	0.01 (0.005)	0.056 (0.01)	0.005 J	ND (0.0005)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	ND (0.0001)	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	ND (0.0001)	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	ND (0.0001)	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	ND (0.0001)	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.01)	ND (0.0001)	ND (0.001)	ND (0.0009)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.01)	0.0009 (0.0001)	0.003 J	0.001 J
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	ND (0.0001)	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.01)	0.012 (0.01)	ND (0.001)	ND (0.001)
Phenanthrene	73	--	--	5800	--	1	0.016 (0.01)	0.0011 (0.0001)	0.005 J	0.002 J
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.01)	0.0001 (0.0001)	ND (0.001)	ND (0.0009)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Table 4
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Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.001)	ND (0.01)	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	0.00018 J	0.00012 J
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
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Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	0.005	0.072	ND (0.0005)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.002)	0.004	0.012	0.0006 J
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000029)	ND (0.0000099)	ND (0.0000095)	ND (0.0000099)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	0.0007 J	0.002	ND (0.0005)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.001)	0.0005 J	0.003	0.002
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	0.0005 J	0.0007 J	ND (0.0005)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.001)	ND (0.0005)	0.001	ND (0.0005)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	NA	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	NA	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.005)	0.00037	0.001 J	0.006
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	NA	NA	0.006	0.0067
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.004)	ND (0.001)	ND (0.001)	ND (0.0096)
Phenanthrene	73	--	--	5800	--	1	ND (0.005)	0.0016	0.012	0.0092
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.005)	ND (0.0001)	0.002 J	ND (0.000096)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	0.00034 J (0.000001)	0.00025 J	0.000074 J	ND (0.00008)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
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Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	0.00058 J (0.001)	0.01 (0.001)	0.018 (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.002)	0.0013 J (0.002)	0.006 (0.002)	0.016 (0.002)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	ND (0.00002)	ND (0.000029)	ND (0.000029)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.001)	ND (0.001)	0.001 (0.001)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.001)	ND (0.001)	0.002 (0.001)	0.004 (0.001)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.001)	ND (0.001)	ND (0.001)	0.001 (0.001)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	ND (0.0001)	0.000307 (0.0001)	0.0002 J (0.0005)	0.0005 J (0.0005)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.0001)	0.000236 (0.0001)	ND (0.0005)	0.0002 J (0.0005)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.0001)	ND (0.0001)	ND (0.0005)	ND (0.0005)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.0001)	ND (0.0001)	ND (0.0005)	ND (0.0005)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.0001)	ND (0.0001)	ND (0.0005)	ND (0.0005)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.0001)	0.00031 (0.0001)	ND (0.0005)	0.0002 J (0.0005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	0.000135 (0.0001)	0.000586 (0.0001)	0.0004 J (0.0005)	0.001 (0.0005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.0001)	ND (0.0001)	0.0006 (0.0005)	ND (0.0005)
Phenanthrene	73	--	--	5800	--	1	0.000255 (0.0001)	0.00127 (0.0001)	0.0006 (0.0005)	0.002 (0.0005)
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.0001)	0.000418 (0.0001)	0.0002 J (0.0005)	0.0004 J (0.0005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-40 S-40_040813 4/8/2013	S-40 S-40_06_17_2013 6/17/2013	S-40 S-40_20150518 5/18/2015	S-40 S-40-20160519 5/19/2016
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.003)	ND (0.003)	0.00019 J (0.001)	ND (0.001)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
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Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-415 AOI3_S-415_121715 12/17/2015	S-416 S-416-20160817-WG 8/17/2016	S-416 S-416-20161012-WG 10/12/2016	S-59D S59D-050605 5/6/2005
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	***0.694 (0.005)***	0.00722 (0.001)	ND (0.001)	ND (0.005)
sec-Butylbenzene	--	--	--	--	--	--	NA	0.00101 (0.001)	0.00112 (0.001)	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	ND (0.001)	ND (0.001)	NA
Cumene	37	9100	63	30	4	2.6	0.0445 (0.001)	0.00388 (0.001)	0.00499 (0.001)	ND (0.005)
Cyclohexane	--	--	--	--	--	--	NA	0.129 (0.001)	0.073 (0.001)	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	ND (0.00001)	ND (0.00001)	ND (0.000028)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.005)
Ethyl Benzene	2	22000	150	40	9.7	13	0.0015 (0.001)	0.00141 (0.001)	0.00125 (0.001)	ND (0.005)
Hexane	--	--	--	--	--	--	NA	0.00494 (0.001)	ND (0.001)	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.0039 (0.001)	ND (0.001)	ND (0.001)	ND (0.005)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.29 (0.01)	ND (0.005)	ND (0.005)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	0.00023 J (0.002)	0.00203 (0.001)	0.00134 (0.001)	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	ND (0.001)	ND (0.001)	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	0.0016 (0.001)	ND (0.003)	ND (0.003)	ND (0.005)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	0.000181 (0.00005)	0.000102 (0.00005)	NA
Anthracene	240	--	--	19000	--	40	0.000204 (0.0001)	0.000083 (0.00005)	ND (0.00005)	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	ND (0.00005)	ND (0.00005)	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.0001)	ND (0.00005)	ND (0.00005)	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.0001)	ND (0.00005)	ND (0.00005)	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	ND (0.00005)	ND (0.00005)	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	ND (0.01)	ND (0.01)	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.0001)	ND (0.00005)	ND (0.00005)	ND (0.01)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	ND (0.00005)	ND (0.00005)	NA
Fluoranthene	--	--	--	--	--	--	NA	ND (0.00005)	ND (0.00005)	NA
Fluorene	97	--	--	7800	--	7	0.00151 (0.0001)	0.000225 (0.00005)	0.00011 (0.00005)	ND (0.01)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	ND (0.00005)	ND (0.00005)	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	0.000437 (0.00025)	ND (0.00025)	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	ND (0.01)	ND (0.01)	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.0001)	0.00129 (0.00025)	0.000874 (0.00025)	ND (0.01)
Phenanthrene	73	--	--	5800	--	1	0.000186 (0.0001)	0.000156 (0.00005)	0.0000621 B (0.00005)	ND (0.01)
Phenol	--	--	--	--	--	--	NA	ND (0.01)	ND (0.01)	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	ND (0.003)	ND (0.003)	NA
Pyrene	50	--	--	5800	--	3	ND (0.0001)	0.0000663 (0.00005)	ND (0.00005)	ND (0.01)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-415 AOI3_S-415_121715 12/17/2015	S-416 S-416-20160817-WG 8/17/2016	S-416 S-416-20161012-WG 10/12/2016	S-59D S59D-050605 5/6/2005
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	ND (0.001)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	0.00202 (0.002)	ND (0.002)	NA
Lead	--	--	--	--	--	2.5	ND (0.003)	ND (0.002)	ND (0.002)	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	0.00293 (0.002)	ND (0.002)	NA
Vanadium	0.14	--	--	6.9	--	100	NA	ND (0.005)	ND (0.005)	NA
Zinc	--	--	--	--	--	--	NA	ND (0.025)	ND (0.025)	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-59D S-59D_04072011 4/7/2011	S-59D S-59D_04072011 FILTERED 4/7/2011	S-59D S-59D_06292011 6/29/2011	S-59D S-59D_06292011 FILTERED 6/29/2011
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	NA	ND (0.001)	NA
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.002)	NA	ND (0.002)	NA
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000029)	NA	ND (0.000029)	NA
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	NA	ND (0.001)	NA
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	NA	ND (0.001)	NA
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.002 (0.001)	NA	0.002 (0.001)	NA
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.0005 J (0.001)	NA	ND (0.001)	NA
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	NA	ND (0.002)	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	NA	ND (0.002)	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	0.002 (0.001)	NA	ND (0.001)	NA
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	NA	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	NA	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	NA	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	NA	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.005)	NA	ND (0.005)	NA
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.005)	NA	ND (0.005)	NA
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.005)	NA	ND (0.005)	NA
Phenanthrene	73	--	--	5800	--	1	ND (0.005)	NA	ND (0.005)	NA
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.005)	NA	ND (0.005)	NA
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-59D S-59D_04072011 4/7/2011	S-59D S-59D_04072011 FILTERED 4/7/2011	S-59D S-59D_06292011 6/29/2011	S-59D S-59D_06292011 FILTERED 6/29/2011
Metals										
Arsenic	0.021	--	--	53	--	1.4	**0.0551 (0.002)**	NA	**0.0493 (0.002)**	NA
Cobalt	--	--	--	--	--	--	0.0127 (0.005)	NA	0.0112 (0.005)	NA
Lead	--	--	--	--	--	2.5	0.0015 (0.001)	NA	0.00016 J (0.001)	NA
Manganese	--	--	--	--	--	--	3.01 (0.005)	NA	2.46 (0.005)	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	0.0133 (0.002)	NA	0.0132 (0.002)
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	0.0119 (0.005)	NA	0.0108 (0.005)
Lead	--	--	--	--	--	2.5	NA	ND (0.001)	NA	ND (0.001)
Manganese	--	--	--	--	--	--	NA	2.91 (0.005)	NA	2.44 (0.005)
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

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Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-59D S-59D_52512 5/25/2012	S-59D S-59D_081612 8/16/2012	S-59D S-59D_102512 10/25/2012	S-59D S-59D_32913 3/29/2013
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
sec-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	NA	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Cyclohexane	--	--	--	--	--	--	NA	NA	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.000029)	ND (0.000029)	ND (0.00002)	ND (0.00002)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Hexane	--	--	--	--	--	--	NA	NA	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.004 (0.001)	0.005 (0.001)	0.0044 (0.001)	0.0027 (0.001)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	NA	NA	NA
Anthracene	240	--	--	19000	--	40	NA	ND (0.0005)	ND (0.001)	ND (0.0001)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	NA	ND (0.0005)	ND (0.001)	ND (0.0001)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	NA	ND (0.0005)	ND (0.001)	ND (0.0001)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	NA	ND (0.0005)	ND (0.001)	ND (0.0001)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	NA	ND (0.0005)	ND (0.001)	ND (0.0001)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	NA	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	NA	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.0005)	ND (0.0005)	ND (0.001)	ND (0.0001)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	NA	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	NA	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.0005)	ND (0.0005)	ND (0.001)	ND (0.0001)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	NA	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	NA	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	NA	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.0005)	ND (0.0005)	ND (0.005)	ND (0.0001)
Phenanthrene	73	--	--	5800	--	1	ND (0.0005)	ND (0.0005)	ND (0.001)	ND (0.0001)
Phenol	--	--	--	--	--	--	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	NA	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.0005)	ND (0.0005)	ND (0.001)	ND (0.0001)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-59D S-59D_52512 5/25/2012	S-59D S-59D_081612 8/16/2012	S-59D S-59D_102512 10/25/2012	S-59D S-59D_32913 3/29/2013
Metals										
Arsenic	0.021	--	--	53	--	1.4	**0.0553 (0.002)**	**0.0515 (0.002)**	**0.0543 (0.003)**	**0.0518 (0.003)**
Cobalt	--	--	--	--	--	--	0.0117 (0.005)	0.0112 (0.005)	ND (0.05)	0.0107 J (0.05)
Lead	--	--	--	--	--	2.5	0.0005 J (0.001)	0.000099 J (0.001)	0.0041 (0.003)	0.0093 (0.003)
Manganese	--	--	--	--	--	--	2.54 (0.005)	2.2 (0.005)	1.74 (0.015)	1.82 (0.015)
Mercury	--	--	--	--	--	--	NA	0.000056 J (0.0002)	ND (0.0002)	ND (0.0002)
Arsenic	0.021	--	--	53	--	1.4	0.0125 (0.002)	0.0166 (0.002)	**0.0346 (0.003)**	**0.0331 (0.003)**
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	0.0108 (0.005)	0.0112 (0.005)	ND (0.05)	0.0098 J (0.05)
Lead	--	--	--	--	--	2.5	ND (0.001)	ND (0.001)	0.0047 (0.003)	0.0036 (0.003)
Manganese	--	--	--	--	--	--	2.43 (0.005)	2.12 (0.005)	1.98 (0.015)	1.95 (0.015)
Nickel	1.3	--	--	86	--	52	NA	NA	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	NA	NA	NA
Zinc	--	--	--	--	--	--	NA	NA	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
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Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-59D S-59D-20160819-WG 8/19/2016	S-59D S-59D-20161011-WG 10/11/2016	S-96 S-96 10/20/2004	S-96 S96-080105 8/1/2005
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.005)
sec-Butylbenzene	--	--	--	--	--	--	ND (0.001)	ND (0.001)	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	ND (0.001)	0.00152 (0.001)	NA	NA
Cumene	37	9100	63	30	4	2.6	ND (0.001)	ND (0.001)	ND (0.005)	ND (0.005)
Cyclohexane	--	--	--	--	--	--	ND (0.001)	ND (0.001)	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00001)	ND (0.00001)	NA	ND (0.000029)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.001)	ND (0.005)	ND (0.005)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	ND (0.001)	ND (0.005)	ND (0.005)
Hexane	--	--	--	--	--	--	ND (0.001)	ND (0.001)	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.00111 (0.001)	0.00313 (0.001)	ND (0.005)	ND (0.005)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.001)	ND (0.001)	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.001)	ND (0.001)	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	ND (0.003)	ND (0.003)	ND (0.01)	ND (0.005)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	ND (0.00005)	0.000088 (0.00005)	NA	NA
Anthracene	240	--	--	19000	--	40	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.00005)	ND (0.00005)	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	ND (0.00005)	ND (0.00005)	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	ND (0.01)	ND (0.01)	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.00005)	ND (0.00005)	NA	ND (0.005)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	ND (0.00005)	ND (0.00005)	NA	NA
Fluoranthene	--	--	--	--	--	--	ND (0.00005)	ND (0.00005)	NA	NA
Fluorene	97	--	--	7800	--	7	ND (0.00005)	ND (0.00005)	NA	ND (0.005)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	ND (0.00005)	ND (0.00005)	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	ND (0.00025)	ND (0.00025)	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	ND (0.01)	ND (0.01)	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.00025)	ND (0.00025)	ND (0.005)	ND (0.005)
Phenanthrene	73	--	--	5800	--	1	ND (0.00005)	ND (0.00005)	NA	ND (0.005)
Phenol	--	--	--	--	--	--	ND (0.01)	ND (0.01)	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	ND (0.003)	ND (0.003)	NA	NA
Pyrene	50	--	--	5800	--	3	ND (0.00005)	ND (0.00005)	NA	ND (0.005)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-59D S-59D-20160819-WG 8/19/2016	S-59D S-59D-20161011-WG 10/11/2016	S-96 S-96 10/20/2004	S-96 S96-080105 8/1/2005
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	ND (0.001)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	ND (0.002)	0.007 (0.002)	NA	NA
Lead	--	--	--	--	--	2.5	ND (0.002)	ND (0.002)	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	0.00285 B (0.002)	0.00248 B (0.002)	NA	NA
Vanadium	0.14	--	--	6.9	--	100	ND (0.005)	ND (0.005)	NA	NA
Zinc	--	--	--	--	--	--	ND (0.025)	ND (0.025)	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-96 S-96_06_14_2013 6/14/2013	S-96 S-96-20160817-WG 8/17/2016	S-97 S-97 10/20/2004	S-97 S97-050405 5/4/2005
Physical Parameters										
pH [SU]	--	--	--	--	--	--	NA	NA	NA	NA
Volatile Organic Compounds										
Benzene	0.3	550	3.8	4	0.25	130	0.00046 J (0.001)	0.0454 (0.005)	*0.29*	***0.6 (0.05)***
sec-Butylbenzene	--	--	--	--	--	--	NA	ND (0.005)	NA	NA
tert-Butylbenzene	--	--	--	--	--	--	NA	ND (0.005)	NA	NA
Cumene	37	9100	63	30	4	2.6	0.00046 J (0.002)	0.0259 (0.005)	0.023	ND (0.05)
Cyclohexane	--	--	--	--	--	--	NA	0.168 (0.005)	NA	NA
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	ND (0.00001)	ND (0.00002)	ND (0.000028)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.005)	0.004	ND (0.05)
Ethyl Benzene	2	22000	150	40	9.7	13	ND (0.001)	0.0601 (0.005)	0.055	0.063 (0.05)
Hexane	--	--	--	--	--	--	NA	0.109 (0.005)	NA	NA
2-Hexanone	--	--	--	--	--	--	NA	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	0.0012 (0.001)	ND (0.005)	ND (0.0018)	ND (0.05)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.0011 (0.001)	0.0511 (0.025)	0.019	ND (0.05)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	ND (0.002)	0.00843 (0.005)	NA	NA
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	ND (0.002)	0.0192 (0.005)	NA	NA
Xylenes (total)	3.7	1900	13	17	0.86	210	0.00025 J (0.001)	0.082 (0.015)	0.16	0.23 (0.05)
Semivolatile Organic Compounds										
Acenaphthene	57	--	--	3900	--	9	NA	0.00181 (0.001)	NA	NA
Anthracene	240	--	--	19000	--	40	ND (0.001)	ND (0.001)	NA	NA
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.001)	ND (0.001)	NA	NA
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.001)	ND (0.001)	NA	NA
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.001)	ND (0.001)	NA	NA
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.001)	ND (0.001)	NA	NA
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	ND (0.001)	NA	NA
1,1-Biphenyl	--	--	--	--	--	--	NA	ND (0.01)	NA	NA
Chrysene	16	--	--	140000	--	1.3	ND (0.001)	ND (0.001)	ND (0.00014)	ND (0.01)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	ND (0.001)	NA	NA
Fluoranthene	--	--	--	--	--	--	NA	ND (0.001)	NA	NA
Fluorene	97	--	--	7800	--	7	0.00416 (0.001)	0.00247 (0.001)	ND (0.01)	0.025 (0.01)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	ND (0.001)	NA	NA
2-Methylnaphthalene	--	--	--	--	--	--	NA	0.0162 (0.005)	NA	NA
3&4-Methylphenol	--	--	--	--	--	--	NA	ND (0.01)	NA	NA
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.001)	0.00577 (0.005)	0.055	*0.11 (0.01)*
Phenanthrene	73	--	--	5800	--	1	ND (0.001)	0.00321 (0.001)	ND (0.01)	0.047 (0.01)
Phenol	--	--	--	--	--	--	NA	ND (0.01)	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	ND (0.003)	NA	NA
Pyrene	50	--	--	5800	--	3	0.00311 (0.001)	ND (0.001)	ND (0.01)	ND (0.01)
Perfluoroalkyl and Polyfluoroalkyl Substances										
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA	NA

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Table 4
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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-96 S-96_06_14_2013 6/14/2013	S-96 S-96-20160817-WG 8/17/2016	S-97 S-97 10/20/2004	S-97 S97-050405 5/4/2005
Metals										
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA	ND (0.001)
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	ND (0.002)	NA	NA
Lead	--	--	--	--	--	2.5	0.0029 J (0.003)	ND (0.002)	ND (0.005)	NA
Manganese	--	--	--	--	--	--	NA	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	0.00235 (0.002)	NA	NA
Vanadium	0.14	--	--	6.9	--	100	NA	ND (0.005)	NA	NA
Zinc	--	--	--	--	--	--	NA	ND (0.025)	NA	NA

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
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J - Estimated Concentration
B - Analyte found in sample and associated blank

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Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-97 S-97_06_13_2013 6/13/2013	S-97 S-97-20160817-WG 8/17/2016	S-97 S-97-20161013-WG 10/13/2016
Physical Parameters									
pH [SU]	--	--	--	--	--	--	NA	NA	NA
Volatile Organic Compounds									
Benzene	0.3	550	3.8	4	0.25	130	0.0028 (0.001)	ND (0.005)	ND (0.005)
sec-Butylbenzene	--	--	--	--	--	--	NA	ND (0.005)	ND (0.005)
tert-Butylbenzene	--	--	--	--	--	--	NA	ND (0.005)	ND (0.005)
Cumene	37	9100	63	30	4	2.6	0.0048 (0.002)	0.00592 (0.005)	ND (0.005)
Cyclohexane	--	--	--	--	--	--	NA	0.0325 (0.005)	0.0242 (0.005)
1,2-Dibromoethane	0.017	16	0.11	0.91	0.16	--	ND (0.00002)	ND (0.00001)	ND (0.00001)
1,2-Dichloroethane	0.33	170	1.2	4.9	0.082	3100	ND (0.001)	ND (0.005)	ND (0.005)
Ethyl Benzene	2	22000	150	40	9.7	13	0.0019 (0.001)	ND (0.005)	ND (0.005)
Hexane	--	--	--	--	--	--	NA	0.0153 (0.005)	0.00735 (0.005)
2-Hexanone	--	--	--	--	--	--	NA	NA	NA
Methyl tert-butyl ether	21	29000	210	190	42	11000	ND (0.001)	ND (0.005)	ND (0.005)
tert Butyl alcohol	--	--	--	--	--	--	NA	NA	NA
Toluene	25	100000	700	200	45	52	0.00068 J (0.001)	ND (0.025)	ND (0.025)
1,2,4-Trimethylbenzene	8.7	1400	9.7	15	0.63	33	0.0093 (0.002)	0.00642 (0.005)	ND (0.005)
1,3,5-Trimethylbenzene	8.8	1300	9.1	15	0.59	71	0.01 (0.002)	0.0122 (0.005)	0.0058 (0.005)
Xylenes (total)	3.7	1900	13	17	0.86	210	0.0047 (0.001)	ND (0.015)	ND (0.015)
Semivolatile Organic Compounds									
Acenaphthene	57	--	--	3900	--	9	NA	0.00314 (0.0001)	0.00228 (0.0001)
Anthracene	240	--	--	19000	--	40	ND (0.0001)	0.00117 (0.0001)	ND (0.0001)
Benzo(a)anthracene	0.1	--	--	1400	--	0.013	ND (0.0001)	ND (0.0001)	ND (0.0001)
Benzo(a)pyrene	0.01	--	--	5.8	--	0.0013	ND (0.0001)	ND (0.0001)	ND (0.0001)
Benzo(b)fluoranthene	0.16	--	--	1400	--	0.013	ND (0.0001)	ND (0.0001)	ND (0.0001)
Benzo(g,h,i)perylene	44	--	--	5800	--	0.012	ND (0.0001)	ND (0.0001)	ND (0.0001)
Benzo(k)fluoranthene	0.99	--	--	14000	--	0.13	NA	ND (0.0001)	ND (0.0001)
1,1-Biphenyl	--	--	--	--	--	--	NA	ND (0.01)	ND,OE (0.01)
Chrysene	16	--	--	140000	--	1.3	ND (0.0001)	ND (0.0001)	ND (0.0001)
Dibenz(a,h)anthracene	0.0098	--	--	140	--	0.0013	NA	ND (0.0001)	ND (0.0001)
Fluoranthene	--	--	--	--	--	--	NA	0.000199 (0.0001)	ND (0.0001)
Fluorene	97	--	--	7800	--	7	0.00139 (0.0001)	0.00319 (0.0001)	0.00268 (0.0001)
Indeno(1,2,3-cd)pyrene	0.1	--	--	1400	--	0.013	NA	ND (0.0001)	ND (0.0001)
2-Methylnaphthalene	--	--	--	--	--	--	NA	0.0081 (0.0005)	ND (0.0005)
3&4-Methylphenol	--	--	--	--	--	--	NA	0.0158 (0.01)	ND,OE (0.01)
Naphthalene	0.39	120	0.88	0.28	0.067	43	ND (0.0001)	0.0009 (0.0005)	ND (0.0005)
Phenanthrene	73	--	--	5800	--	1	0.00221 (0.0001)	0.00535 (0.0001)	0.00364 (0.0001)
Phenol	--	--	--	--	--	--	NA	ND (0.01)	ND,OE (0.01)
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	NA	ND (0.003)	ND (0.003)
Pyrene	50	--	--	5800	--	3	0.000434 (0.0001)	0.00151 (0.0001)	0.000577 (0.0001)
Perfluoroalkyl and Polyfluoroalkyl Substances									
Perfluorooctanoic Acid	--	--	--	--	--	--	NA	NA	NA

Appendix C
Table 4
Summary of Historical Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

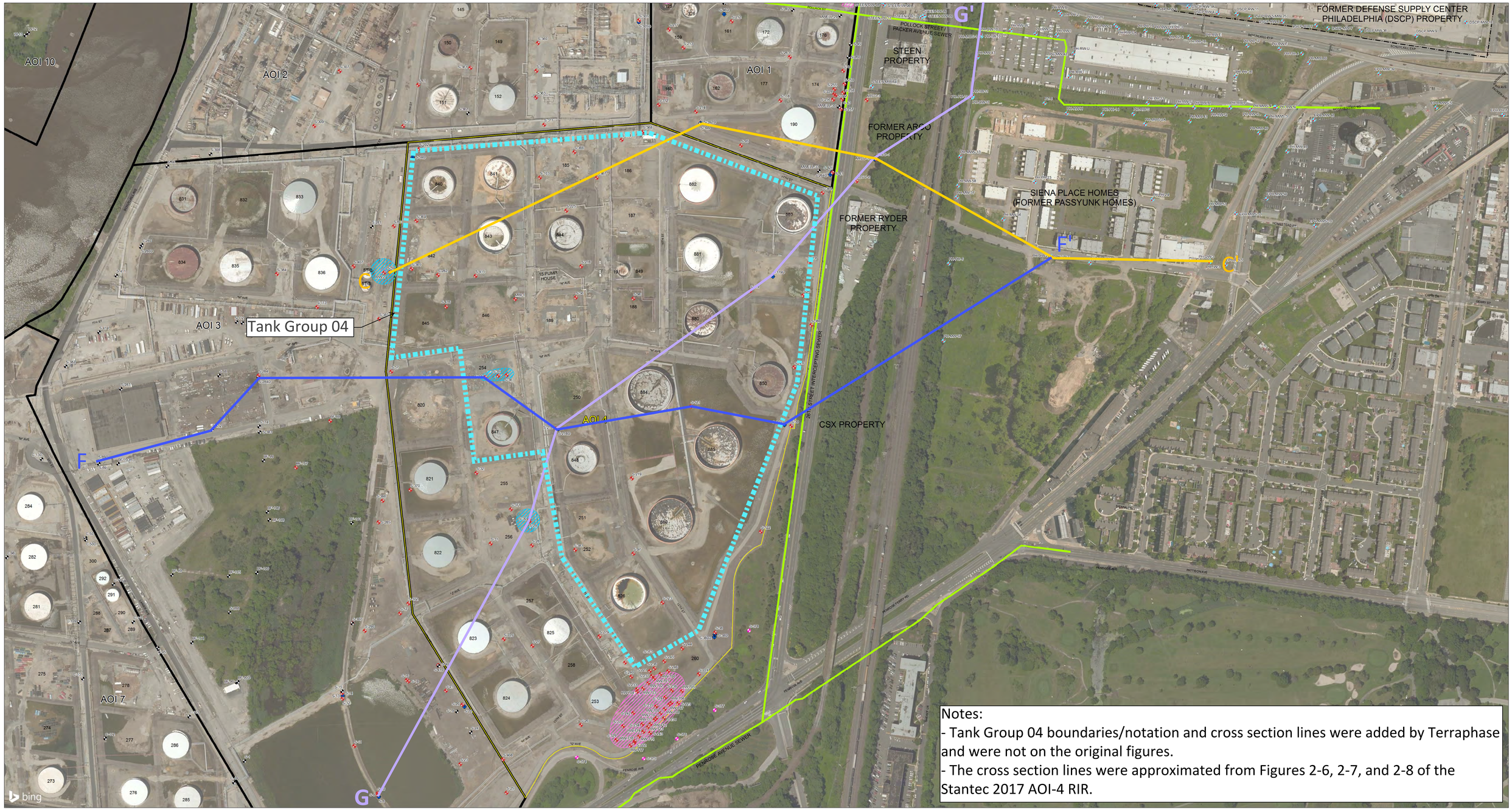
Location Field Sample ID Sample Date Comments	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-97 S-97_06_13_2013 6/13/2013	S-97 S-97-20160817-WG 8/17/2016	S-97 S-97-20161013-WG 10/13/2016
Metals									
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	NA	NA
Lead	--	--	--	--	--	2.5	NA	NA	NA
Manganese	--	--	--	--	--	--	NA	NA	NA
Mercury	--	--	--	--	--	--	NA	NA	NA
Arsenic	0.021	--	--	53	--	1.4	NA	NA	NA
Barium	--	--	--	--	--	--	NA	NA	NA
Chromium (total)	--	--	--	--	--	--	NA	NA	NA
Cobalt	--	--	--	--	--	--	NA	ND (0.002)	ND (0.002)
Lead	--	--	--	--	--	2.5	0.0214 (0.003)	0.00491 (0.002)	ND (0.002)
Manganese	--	--	--	--	--	--	NA	NA	NA
Nickel	1.3	--	--	86	--	52	NA	0.00489 (0.002)	ND (0.002)
Vanadium	0.14	--	--	6.9	--	100	NA	0.0145 (0.005)	ND (0.005)
Zinc	--	--	--	--	--	--	NA	0.186 (0.025)	ND (0.025)

Notes:
1 All concentrations reported in mg/L; detection limits in parentheses.
2 Only compounds with at least one detection are shown.
3 MS, OE, and SL are unknown qualifiers.
4 Boldfaced concentrations exceed the Nonpotable GW Use.
5 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
6 No concentrations exceed the Routine Worker GW VI.
7 Underlined concentrations exceed the Construction Worker GW Direct Contact.
8 Italicized concentrations exceed the Off-Facility Resident GW VI.
9 Grey shaded concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration
B - Analyte found in sample and associated blank

Appendix D

Select Figures from the AOI 4 RIR



Notes:
- Tank Group 04 boundaries/notation and cross section lines were added by Terraphase and were not on the original figures.
- The cross section lines were approximated from Figures 2-6, 2-7, and 2-8 of the Stantec 2017 AOI-4 RIR.

Stantec

EVERGREEN

Notes
1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
North American Vertical Datum of 1988 (NAVD 88)
2. Data Sources: Stantec and Defense Logistics Agency (DLA)
3. Aerial & Topo Image courtesy of USGS Earthstar Geographics SIO © 2017 Microsoft Corporation
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Legend

- OFFSITE MONITORING WELL - FORMER DSCP, PASSYUNK HOMES, STEEN, AND CSX PROPERTIES
- FACILITY MONITORING WELL (AREAS OUTSIDE OF AOI 4)
- PROPOSED MONITORING WELL

AOI 4 MONITORING WELL (INCLUDING A PORTION OF OFFSITE WELLS MONITORED BY STANTEC)

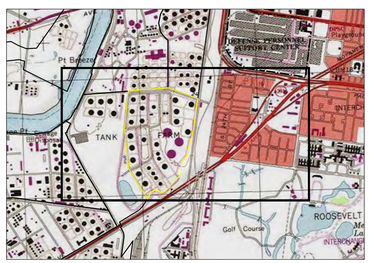
HYDROSTRATIGRAPHIC UNIT

- UNCONFINED AQUIFER
- LOWER AQUIFER
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- REMEDIATION SYSTEMS DESIGNATED AS CURRENTLY ACTIVE
- REMEDIATION SYSTEMS DESIGNATED AS INACTIVE

- AREA OF INTEREST (AOI)
- AOI 4
- FORMER DEFENSE SUPPLY CENTER PHILADELPHIA (DSCP) PROPERTY

0 200 400 Feet
1:2,400 (At original document size of 24x36)

N



Project Location
City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by GWC on 1/27/2017
Technical Review by ADK on 1/31/2017
Independent Review by JLM on 1/31/2017

Client/Project
PHILADELPHIA REFINERY OPERATIONS, A SERIES OF
EVERGREEN RESOURCES GROUP, LLC
PHILADELPHIA REFINING COMPLEX
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Figure No.
1-2

Title
AOI 4 SITE PLAN

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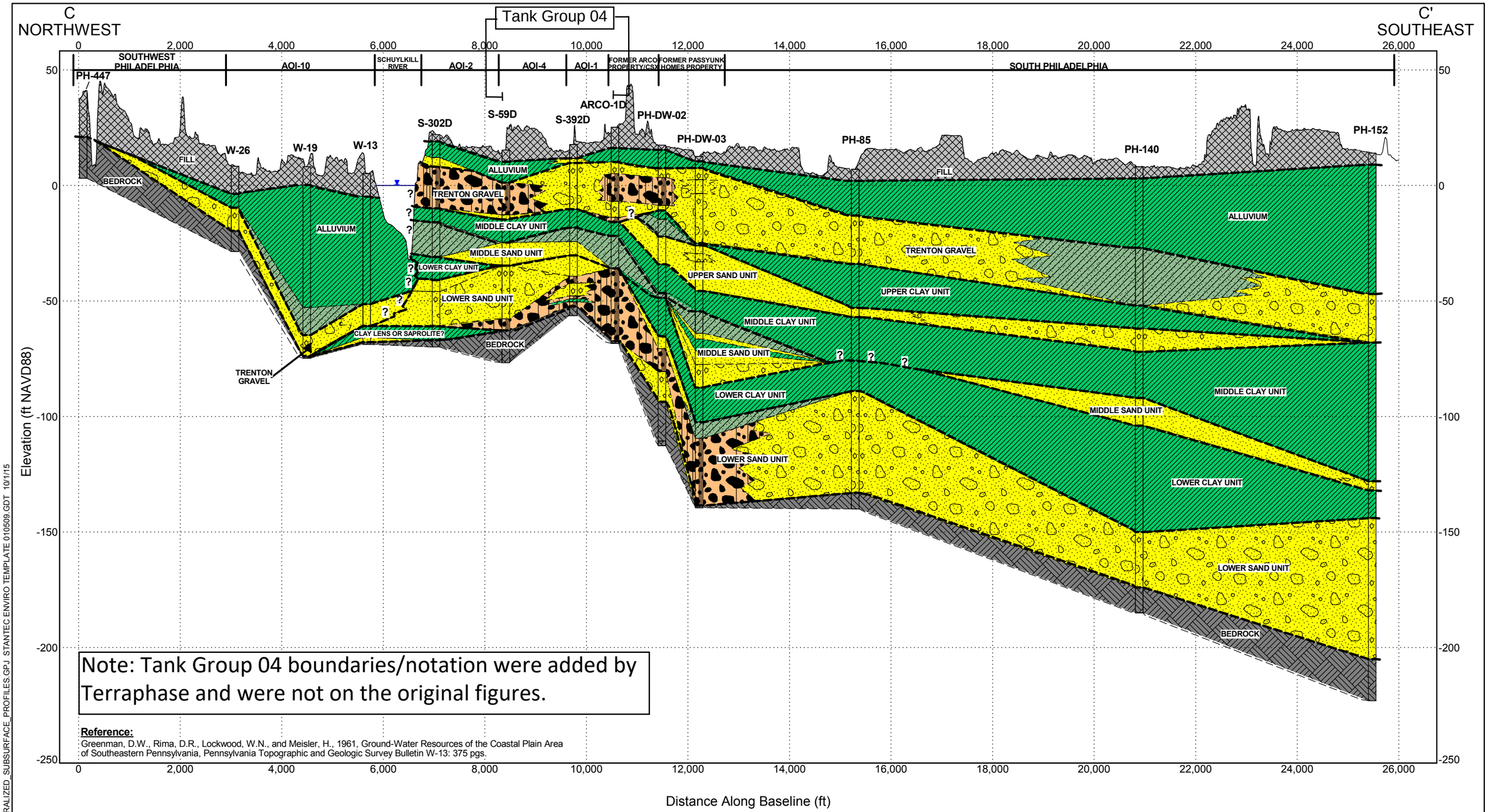


Note: Tank Group 04 boundaries/notation were added by Terraphase and were not on the original figures.

Reference:

Greenman, D.W., Rima, D.R., Lockwood, W.N., and Meisler, H., 1961, Ground-Water Resources of the Coastal Plain Area of Southeastern Pennsylvania, Pennsylvania Topographic and Geologic Survey Bulletin W-13: 375 pgs.

Stantec

GENERALIZED LITHOLOGY GRAPHICS

- Apparent Fill
- Sandy Gravel
- Gravelly Sand
- Sand (incl. trace to little silt/clay/gravel)
- "Muddy" Sand
- "Mud" (silt/clay, incl. trace to little sand/gravel)
- Bedrock (incl. saprolite where indicated)

Notes:

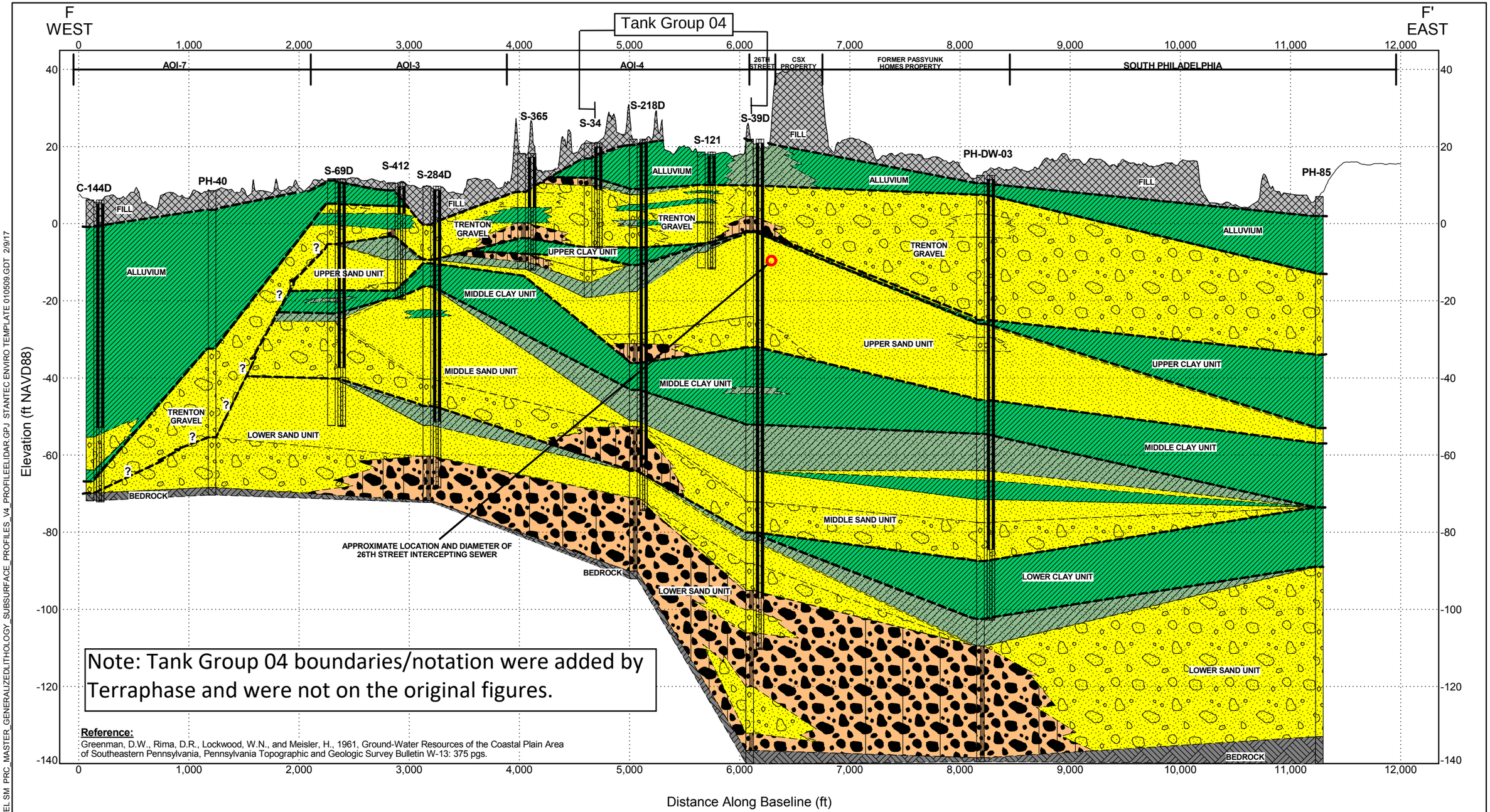
1. Land surface profile obtained from a 2010 light detection and ranging (LiDAR) elevation model available from the United States Geological Survey (USGS).
2. Lithologic logs for borings PH-85, PH-140, PH-152, and PH-447 were obtained from Tables 13 and 14 of Greenman et al., 1961. Geographic locations for those borings were digitized on-screen by Stantec using a georeferenced image of Greenman et al., 1961, Plate 1.
3. Water depths for the Schuylkill River were estimated using soundings provided on the National Oceanic and Atmospheric Administration (NOAA) navigation chart for the Delaware River, Philadelphia and Camden Waterfronts (Chart 12313). Mean lower low water (MLLW) depths were transformed to the North American Vertical Datum of 1988 (NAVD 88).
4. Stantec generalized lithologic data from available borehole logs into 8 categories as indicated for interpretive purposes. "Mud" is utilized in these profiles to generally represent clay/silt mixtures, or clay and silt-rich sandy sediments.
5. Correlation between lithologies and, where applicable, geologic units is based on the straight-line method. Actual conditions between boreholes may vary from what is shown on this profile. Contacts dashed where inferred.
6. Vertical Exaggeration ~ 45 X

Figure 2-6. Stratigraphic Profile C - C'

Philadelphia Refinery Operations
a series of Evergreen Resources Group, LLC
3144 Passyunk Avenue
Philadelphia, PA 19145

Project Number: 213402602

STRAT COLUMN SMALL AOI1_GENERALIZED_SUBSURFACE_PROFILES.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 10/1/15



STRAT COLUMN WELL AND WAT LEVEL SM PRO_MASTER_GENERALIZEDLITHOLOGY_SUBSURFACE_PROFILES_V4_PROFILEELIDAR.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 2/9/17

Stantec

GENERALIZED LITHOLOGY GRAPHICS

- Apparent Fill
- Sandy Gravel
- Gravelly Sand
- Sand (incl. trace to little silt/clay/gravel)
- "Muddy" Sand
- "Mud" (silt/clay, incl. trace to little sand/gravel)
- Bedrock (incl. saprolite where indicated)

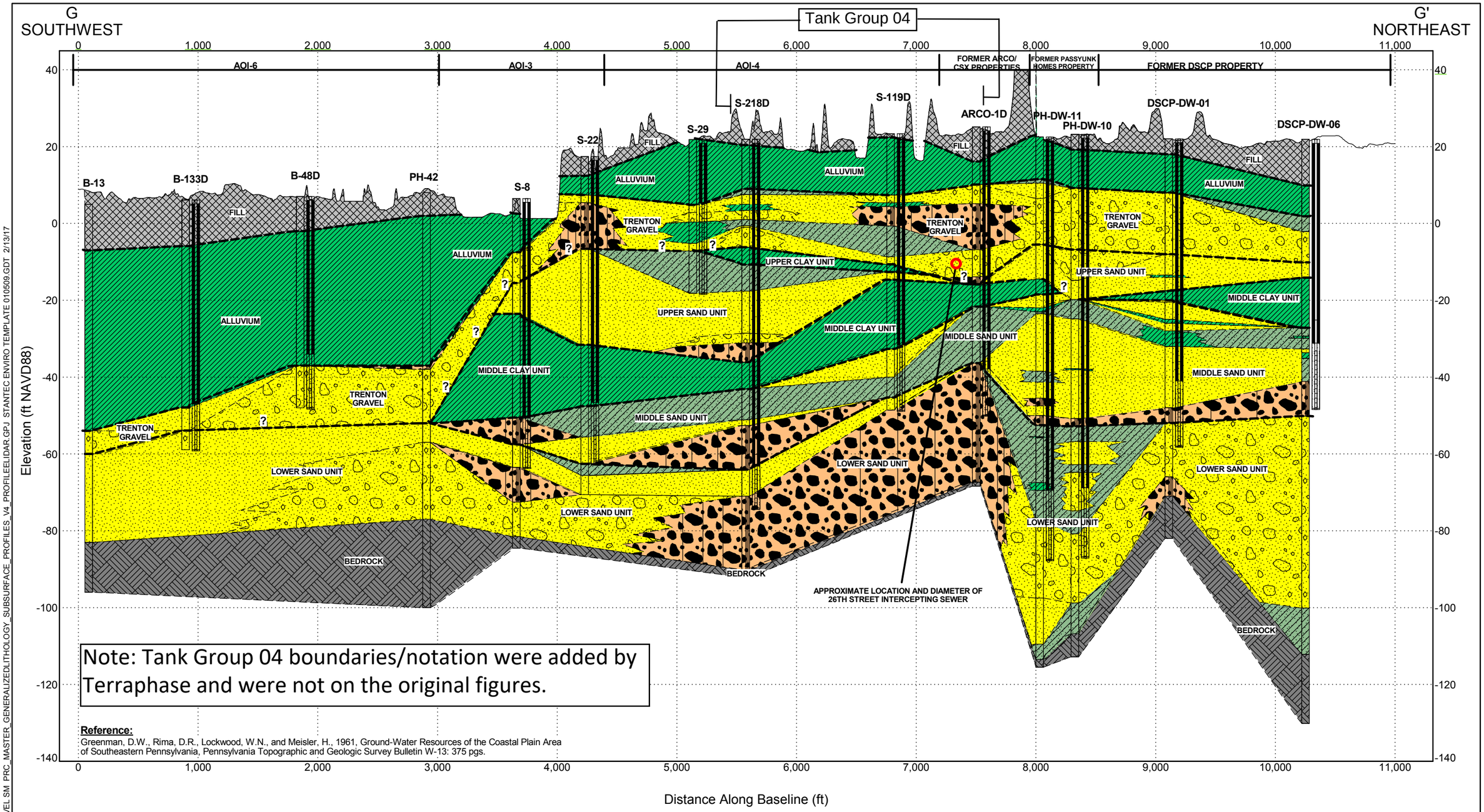
Notes:

1. Land surface profile obtained from a 2010 light detection and ranging (LiDAR) elevation model available from the United States Geological Survey (USGS).
2. Lithologic logs for borings PH-40 and PH-85 were obtained from Tables 13 and 14 of Greenman et al., 1961. Geographic locations for those borings were digitized on-screen by Stantec using a georeferenced image of Greenman et al., 1961, Plate 1.
3. Stantec generalized lithologic data from available borehole logs into 8 categories as indicated for interpretive purposes. "Mud" is utilized in these profiles to generally represent clay/silt mixtures, or clay and silt-rich sandy sediments.
4. Correlation between lithologies and, where applicable, geologic units is based on the straight-line method. Actual conditions between boreholes may vary from what is shown on this profile. Contacts are dashed (inferred).
5. Vertical Exaggeration ~ 36 X

Figure 2-7. Stratigraphic Profile F - F'

Philadelphia Refinery Operations
a series of Evergreen Resources Group, LLC
3144 Passyunk Avenue
Philadelphia, PA 19145

Project Number: 213402602



Stantec

GENERALIZED LITHOLOGY GRAPHICS

- Apparent Fill
- Sandy Gravel
- Gravelly Sand
- Sand (incl. trace to little silt/clay/gravel)
- "Muddy" Sand
- "Mud" (silt/clay, incl. trace to little sand/gravel)
- Bedrock (incl. saprolite where indicated)

Notes:

1. Land surface profile obtained from a 2010 light detection and ranging (LiDAR) elevation model available from the United States Geological Survey (USGS).
2. Lithologic logs for borings B-13 and PH-42 were obtained from Tables 13 and 14 of Greenman et al., 1961. Geographic locations for those borings were digitized on-screen by Stantec using a georeferenced image of Greenman et al., 1961, Plate 1.
3. Stantec generalized lithologic data from available borehole logs into 8 categories as indicated for interpretive purposes. "Mud" is utilized in these profiles to generally represent clay/silt mixtures, or clay and silt-rich sandy sediments.
4. Correlation between lithologies and, where applicable, geologic units is based on the straight-line method. Actual conditions between boreholes may vary from what is shown on this profile. Contacts are dashed (inferred).
5. Vertical Exaggeration ~ 32 X

Figure 2-8. Stratigraphic Profile G - G'

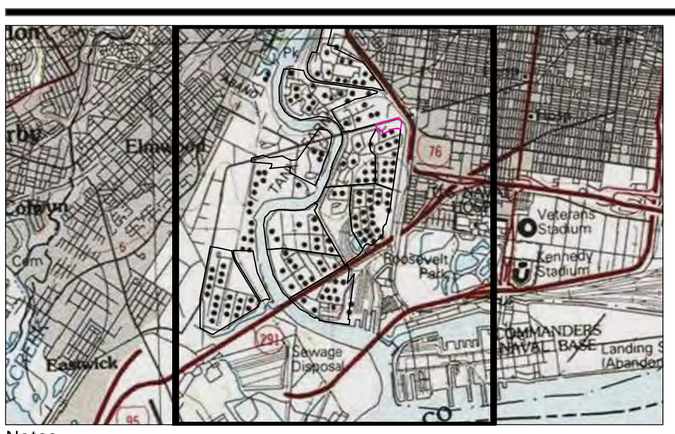
Philadelphia Refinery Operations
a series of Evergreen Resources Group, LLC
3144 Passyunk Avenue
Philadelphia, PA 19145

Project Number: 213402602

STRAT COLUMN WELL AND WAT LEVEL SM PRC_MASTER_GENERALIZEDLITHOLOGY_SUBSURFACE_PROFILES_V4_PROFILEELIDAR.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 2/13/17

Tank Group 04

Note: Tank Group 04 boundaries/notation were added by Terraphase and were not on the original figures.



Notes
1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec, Philadelphia Gas Works (PGW), and Defense Logistics Agency (DLA)
3. Depth to groundwater and LNAPL, where present, were measured in each well to the nearest one-hundredth of a foot using an interface probe.
4. FT NAVD88 = feet referenced to the North American Vertical Datum of 1988
5. Groundwater elevation data was interpolated using point kriging with a linear variogram model in Surfer to produce a surface model. The model is interpreted to be a reasonable approximation of the water-table elevation within the limits of the available well data.
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LEGEND

- WELL UTILIZED FOR THE JUNE 2018 WATER-TABLE ELEVATION SURFACE
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- APPROXIMATE LOCATION OF RAMBO CREEK STORM SEWER
- PHILADELPHIA GAS WORKS (PGW) PASSYUNK FACILITY
- VERIZON SOUTH DISTRICT WORK CENTER (SDWC) PROPERTY
- AREA OF INTEREST (AOI) BOUNDARY
- BELMONT TERMINAL
- APPROXIMATE LIMITS OF WATER-TABLE WELL CONTROL

JUNE 2018 WATER-TABLE ELEVATION
FT NAVD88

- 14 - 16
- 12 - 14
- 10 - 12
- 8 - 10
- 6 - 8
- 4 - 6
- 2 - 4
- 0 - 2
- -2 - 0
- -4 - -2
- -6 - -4
- -8 - -6
- -10 - -8

0 500 1,000 1,500 Feet
1:8,100 (At original document size of 24x36)

N

Figure No.
3-29

Title
JUNE 2018 WATER-TABLE ELEVATION

Client/Project
PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Project Location
City of Philadelphia, Philadelphia County, Pennsylvania

213402454
Prepared by ADK on 8/14/2018
Technical Review by ANP on 9/20/2018
Independent Review by JLM on 10/19/2018

Stantec

EVERGREEN

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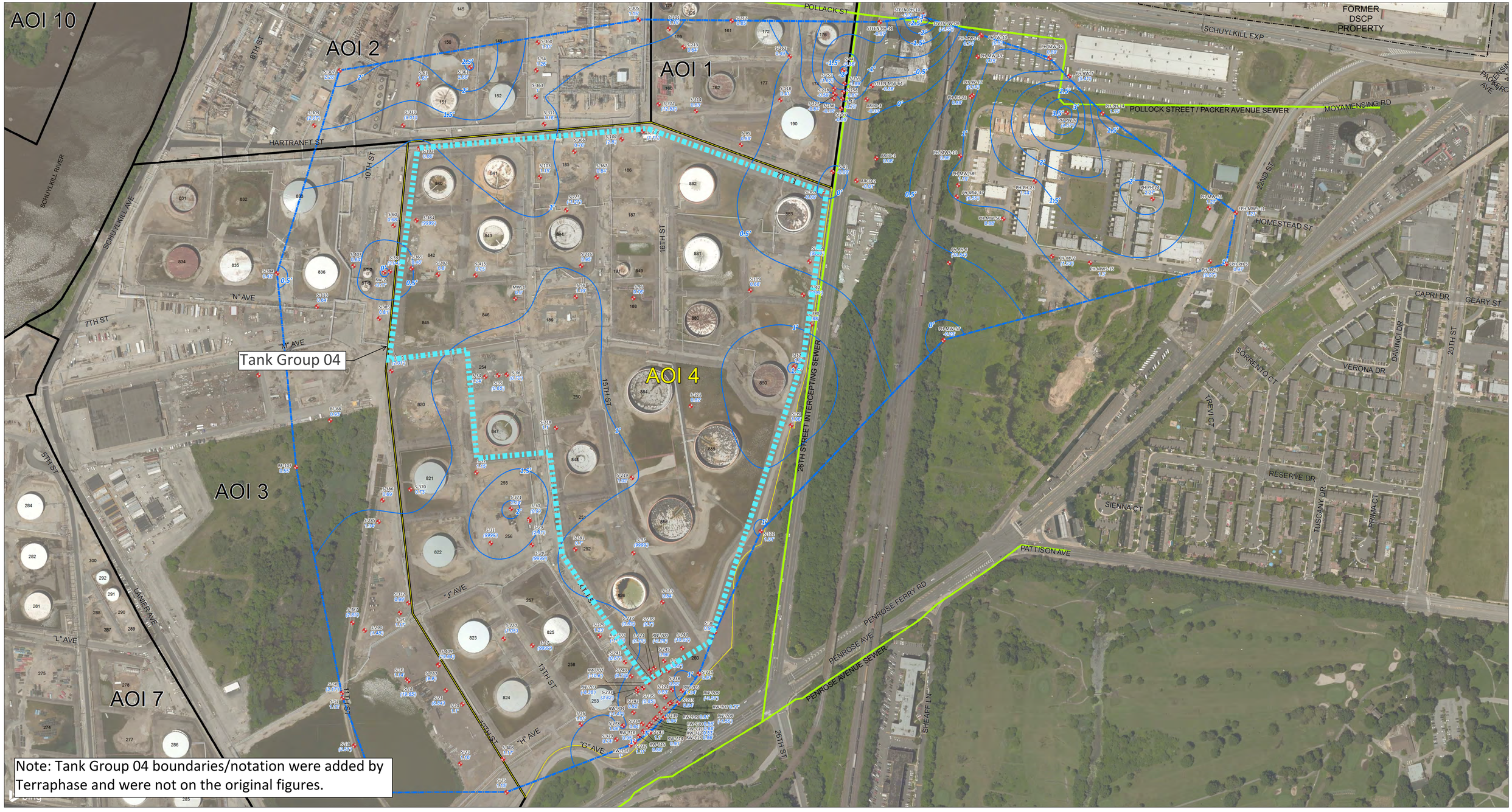


Note: Tank Group 04 boundaries/notation were added by Terraphase and were not on the original figures.

Stantec

EVERGREEN

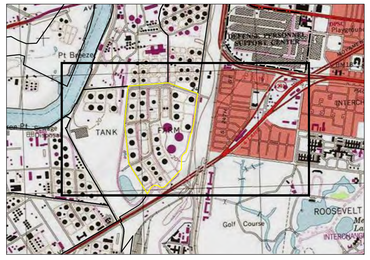
Legend

- 2016 Well Gauging Data - Unconfined Aquifer
- 2016 WATER-TABLE ELEVATION (ft NAVD 88)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- LIMITS OF UNCONFINED AQUIFER WELL CONTROL
- AREA OF INTEREST (AOI)
- AOI 4
- FORMER DSCP PROPERTY
- NM NOT MEASURED
- S-11 (3.52) WELLS NOT USED FOR GROUNDWATER CONTOURING
- 1.46' GROUNDWATER ELEVATION (FEET NAVD 88)

0 200 400 Feet

1:2,400 (At original document size of 24x36)

N



Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec and Defense Logistics Agency (DLA)
3. Labels denote groundwater elevation in feet. Depth to groundwater was measured in each well to the nearest one-hundredth of a foot using an interface probe.
4. Contour Interval = 0.5 feet
5. Gauging data for DSCP property wells obtained from the DLA. Rigorous evaluation of that data not performed by Stantec.
6. Groundwater elevation data was interpolated using block kriging with a linear variogram model in Surfer.
7. Aerial & Topo: Service Layer Credits: Image courtesy of USGS Earthstar Geographics SIO © 2017 Microsoft Corporation
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Project Location 213402602

City of Philadelphia,
Philadelphia County,
Pennsylvania

Prepared by GWC on 1/12/2017
Technical Review by ADK on 2/23/2017
Independent Review by JKD on 3/6/2017

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF
EVERGREEN RESOURCES GROUP, LLC
PHILADELPHIA REFINING COMPLEX
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Figure No.

5-4

Title

MAY 2016 WATER-TABLE ELEVATION - INCLUDING SYNOPTIC DSCP GAUGING DATA

Appendix B

Updated Site Characterization Groundwater Results

Table B1
Summary of Groundwater Analytical Results
Tank Group 04
Philadelphia Energy Solutions Marketing and Refining, LLC, Philadelphia, PA

Location	Nonpotable GW Use	Routine Worker GW Vol to Outdoor Air	Routine Worker GW VI	Construction Worker GW Direct Contact	Off-Facility Resident GW VI	GW Migration to SW	S-219	S-219	TG04-MW-01	TG04-MW-01	TG04-MW-01	TG04-MW-03	TG04-MW-03	TG04-MW-03
Field Sample ID							S-219-230106	S-219-230209	TG04-MW-01-230106	TG04-MW-01-230209	TG04-MW-01-230209D	TG04-MW-03-230104	TG04-MW-03-230104D	TG04-MW-03-230209
Sample Method							Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Date							1/6/2023	2/9/2023	1/6/2023	2/9/2023	2/9/2023	1/4/2023	1/4/2023	2/9/2023
Comments											Field Duplicate		Field Duplicate	
Volatile Organic Compounds														
Benzene	300	550000	3800	4000	250	130000	ND (0.5)	ND (0.5)	**580 (2.5)**	**530 (2.5)**	**510 (2.5)**	ND (0.5)	ND (0.5)	ND (0.5)
Cumene	37000	9100000	63000	30000	4000	2600	0.28 J (0.5)	ND (0.5)	75 (2.5)	64 (2.5)	58 (2.5)	ND (0.5)	ND (0.5)	ND (0.5)
1,2-Dibromoethane	17	16000	110	910	160	--	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
1,2-Dichloroethane	330	170000	1200	4900	82	3100000	ND (0.5)	ND (0.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (0.5)	ND (0.5)	ND (0.5)
Ethyl Benzene	2000	22000000	150000	40000	9700	13000	ND (0.5)	ND (0.5)	110 (2.5)	96 (2.5)	89 (2.5)	ND (0.5)	ND (0.5)	ND (0.5)
Methyl tert-butyl ether	21000	29000000	210000	190000	42000	11000000	ND (1)	ND (1)	ND (5)	ND (5)	ND (5)	ND (1)	ND (1)	ND (1)
Toluene	25000	100000000	700000	200000	45000	52000	ND (0.75)	0.34 J (0.75)	11 (3.8)	10 (3.8)	9.6 (3.8)	ND (0.75)	ND (0.75)	0.34 J (0.75)
1,2,4-Trimethylbenzene	8700	1400000	9700	15000	630	33000	ND (2.5)	ND (2.5)	54 (12)	47 (12)	45 (12)	ND (2.5)	ND (2.5)	ND (2.5)
1,3,5-Trimethylbenzene	8800	1300000	9100	15000	590	71000	ND (2.5)	ND (2.5)	13 (12)	12 (12)	11 J (12)	ND (2.5)	ND (2.5)	ND (2.5)
Xylenes (total)	3700	1900000	13000	17000	860	210000	ND (1)	ND (1)	186 J (5)	196 J (5)	186 J (5)	ND (1)	ND (1)	ND (1)
Semivolatile Organic Compounds														
Anthracene	240000	--	--	19000000	--	40000	ND (0.1)	ND (0.1)	0.11 (0.1)	0.23 (0.1)	0.32 (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(a)anthracene	100	--	--	1400000	--	13	0.18 (0.05)	ND (0.05)	0.1 (0.05)	0.02 J (0.05)	0.02 J (0.05)	ND (0.05)	0.03 J (0.05)	ND (0.05)
Benzo(a)pyrene	10	--	--	5800	--	1.3	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Benzo(b)fluoranthene	160	--	--	1400000	--	13	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Benzo(g,h,i)perylene	44000	--	--	5800000	--	12	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Chrysene	16000	--	--	140000000	--	1300	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Fluorene	97000	--	--	7800000	--	7000	ND (0.1)	ND (0.1)	0.92 (0.1)	0.5 (0.1)	0.55 (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Indeno(1,2,3-cd)pyrene	100	--	--	1400000	--	13	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Naphthalene	390	120000	880	280	67	43000	ND (0.1)	ND (0.1)	9.4 (0.1)	0.19 (0.1)	1.5 (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Phenanthrene	73000	--	--	5800000	--	1000	ND (0.05)	ND (0.05)	0.25 (0.05)	0.04 J (0.05)	0.04 J (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Pyrene	50000	--	--	5800000	--	3000	ND (0.1)	ND (0.1)	0.06 J (0.1)	0.02 J (0.1)	0.03 J (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Metals														
Lead	--	--	--	--	--	2500	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)

Notes:
1 All concentrations reported in ug/L (ppb); detection limits in parentheses.
2 Boldfaced concentrations exceed the Nonpotable GW Use.
3 No concentrations exceed the Routine Worker GW Vol to Outdoor Air.
4 No concentrations exceed the Routine Worker GW VI.
5 No concentrations exceed the Construction Worker GW Direct Contact.
6 Underlined concentrations exceed the Off-Facility Resident GW VI.
7 No concentrations exceed the GW Migration to SW.

Abbreviations:
ND - Not Detected
NA - Not Analyzed
J - Estimated Concentration

Table B2
Summary of Groundwater QAQC Analytical Results
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location	QAQC	QAQC	QAQC
Field Sample ID	**TB-230106-2**	**FB-230209-2**	**TB-230209-2**
Sample Date	**1/6/2023**	**2/9/2023**	**2/9/2023**
Comments	**Trip Blank**	**Field Blank**	**Trip Blank**
Volatile Organic Compounds			
Ethyl Benzene	ND (0.5)	0.91 (0.5)	ND (0.5)
Toluene	ND (0.75)	1.7 (0.75)	ND (0.75)
Xylenes (total)	ND (1)	4.7 (1)	ND (1)
Semivolatile Organic Compounds			
Naphthalene	NA	0.11 (0.1)	NA
Metals			
Lead	NA	ND (1)	NA

Notes:
1 All concentrations reported in ug/L (ppb); detection limits in parentheses.
Abbreviations:
ND - Not Detected
NA - Not Analyzed

Table B3
Quality Control Methodology
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Multiple VOC Runs Data Quality	Solution
If the surrogate recoveries for one run are **within acceptance criteria** and the other run has **3-4 surrogates outside of acceptance criteria**:	The run with surrogate recoveries within acceptance criteria is selected as reportable.
If the surrogate recoveries for one run are **within acceptance criteria** and has some **detections** and the other run has **1-2 surrogates outside of acceptance criteria**:	The run with surrogate recoveries within acceptance criteria is selected as reportable.
If one run has surrogate recoveries **within acceptance critera** but is **non-detect** and the other run has **1-2 surrogates outside of acceptance** criteria but has **detections**:	The run with detections is selected as reportable and the run with non-detects is not reported.
If both runs have **detections** and **surrogate recoveries outside of acceptance criteria**:	The run with more surrogates recoveries outside acceptance criteria is not reported and the run with fewer surrogate recoveries outside of acceptance criteria is selected as reportable.
If one run has surrogate recoveries **outside of acceptance critera** but is **non-detect** and the other run has **1-2 more surrogates outside of acceptance** criteria but has **detections**:	The run with detections is selected as reportable and the run with non-detects is not reported.
If both runs have the **same number of surrogates** with recovery outside the acceptance criteria:	If both results are detected, the higher of detections is selected as reportable; if one result is detected and one is non-detect, the detection is selected as reportable; if both results are non-detect, the lower reporting limit is selected as reportable .
If two VOC runs are reported and there are no QC issues for both runs:	If both results are detected, the higher of detections is selected as reportable; if one result is detected and one is non-detect, the detection is selected as reportable; if both results are non-detect, the lower reporting limit is selected as reportable .

Table B4
Quality Control Checklist
Former Philadelphia Refinery, Philadelphia, PA

	Keyfile-Related		EDD-Related											
							Multiple Results							
Date Sampled	Check Lab Login and Keyfile	Check COC/Field Notes Uploaded	Check Sample IDs	Check Analyte List Reported	Review EDD for Issues	Check Dates, Matrix and Sample Type	Reported	Surrogate Recovery	Data Qualifiers	Reasonable Limits	Other	Resolved	Check for Concerning Qualifiers	Comments
1/3/2023, 1/4/2023	Pass	Pass	Pass	Pass	Pass	Pass	No						Pass	L2300373-21 (PB-847-15R-17.0-17.5): VOCs reported for two runs. The IS response for fluorobenzene (479%) and the surrogate recoveries for dibromofluoromethane (35%) and 4-bromofluorobenzene (675%) were outside the acceptance criteria due to obvious interferences. The run with more surrogates recoveries outside acceptance criteria is not reported and the run with fewer surrogate recoveries outside of acceptance criteria is selected as reportable. The high run is reported and the low run is not reportable.
1/4/2023	Pass	Pass	Pass	Pass	Pass	Pass	Yes	Yes	Yes	Yes	Yes	Yes	Pass	L2300364-01 through -06 (TG04-MW-03-230104, TG04-MW-03-230104D, TG07-MW-02-230104, TB-230104-2, FB-230104-2, TG07-MW-03-230104): VOCs (1,2-Dibromomethane) reported for two runs. The WG1730299-2 LCS recovery for 1,2-dibromoethane (130%), associated with L2300364-01 through -06, is outside Alpha's acceptance criteria, but within the acceptance criteria specified in the method. The WG1730299-4 MSD recovery for 1,2-dibromoethane (125%), performed on L2300364-03, is outside Alpha's acceptance criteria, but within the acceptance criteria specified in the method. If both results are non-detect, the lower reporting limit is selected as reportable.
1/5/2023, 1/6/2023	Pass	Pass	Pass	Pass	Pass	Pass	No						Pass	

Table B5
Groundwater PESRM RPD Calculations
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Code	Sample Name	Sample Date	Chem Group	PARAMNAME	CASRN	Total or Dissolved	RPD	Ratio	Primary Result	Primary Qualifier	Primary Limit	Duplicate Result	Duplicate Qualifier	Duplicate Limit	Average Result	Average Qualifier	Average Limit	Result Unit
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Benzene	71-43-2	T	4%	1.0	5.30E-01		2.50E-03	5.10E-01		2.50E-03	5.20E-01		2.50E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Benzene	71-43-2	T	4%	1.0	5.30E-01		2.50E-03	5.10E-01		2.50E-03	5.20E-01		2.50E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Cumene	98-82-8	T	10%	1.1	6.40E-02		2.50E-03	5.80E-02		2.50E-03	6.10E-02		2.50E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Cumene	98-82-8	T	10%	1.1	6.40E-02		2.50E-03	5.80E-02		2.50E-03	6.10E-02		2.50E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	1,2-Dibromoethane	106-93-4	T	0%	1.0		U	1.00E-05		U	1.00E-05		U	1.00E-05	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	1,2-Dibromoethane	106-93-4	T	0%	1.0		U	1.00E-05		U	1.00E-05		U	1.00E-05	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	1,2-Dichloroethane	107-06-2	T	0%	1.0		U	2.50E-03		U	2.50E-03		U	2.50E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	1,2-Dichloroethane	107-06-2	T	0%	1.0		U	2.50E-03		U	2.50E-03		U	2.50E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Ethyl Benzene	100-41-4	T	8%	1.1	9.60E-02		2.50E-03	8.90E-02		2.50E-03	9.25E-02		2.50E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Ethyl Benzene	100-41-4	T	8%	1.1	9.60E-02		2.50E-03	8.90E-02		2.50E-03	9.25E-02		2.50E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Methyl tert-butyl ether	1634-04-4	T	0%	1.0		U	5.00E-03		U	5.00E-03		U	5.00E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Methyl tert-butyl ether	1634-04-4	T	0%	1.0		U	5.00E-03		U	5.00E-03		U	5.00E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Toluene	108-88-3	T	4%	1.0	1.00E-02		3.80E-03	9.60E-03		3.80E-03	9.80E-03		3.80E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Toluene	108-88-3	T	4%	1.0	1.00E-02		3.80E-03	9.60E-03		3.80E-03	9.80E-03		3.80E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	1,2,4-Trimethylbenzene	95-63-6	T	4%	1.0	4.70E-02		1.20E-02	4.50E-02		1.20E-02	4.60E-02		1.20E-02	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	1,2,4-Trimethylbenzene	95-63-6	T	4%	1.0	4.70E-02		1.20E-02	4.50E-02		1.20E-02	4.60E-02		1.20E-02	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	1,3,5-Trimethylbenzene	108-67-8	T	9%	1.1	1.20E-02		1.20E-02	1.10E-02	J	1.20E-02	1.15E-02	J	1.20E-02	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	1,3,5-Trimethylbenzene	108-67-8	T	9%	1.1	1.20E-02		1.20E-02	1.10E-02	J	1.20E-02	1.15E-02	J	1.20E-02	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Xylenes (total)	1330-20-7	T	5%	1.1	1.96E-01	J	5.00E-03	1.86E-01	J	5.00E-03	1.91E-01	J	5.00E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	VOC	Xylenes (total)	1330-20-7	T	5%	1.1	1.96E-01	J	5.00E-03	1.86E-01	J	5.00E-03	1.91E-01	J	5.00E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Anthracene	120-12-7	T	33%	1.4	2.30E-04		1.00E-04	3.20E-04		1.00E-04	2.75E-04		1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Anthracene	120-12-7	T	33%	1.4	2.30E-04		1.00E-04	3.20E-04		1.00E-04	2.75E-04		1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Benzo(a)anthracene	56-55-3	T	0%	1.0	2.00E-05	J	5.00E-05	2.00E-05	J	5.00E-05	2.00E-05	J	5.00E-05	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Benzo(a)anthracene	56-55-3	T	0%	1.0	2.00E-05	J	5.00E-05	2.00E-05	J	5.00E-05	2.00E-05	J	5.00E-05	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Benzo(a)pyrene	50-32-8	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Benzo(a)pyrene	50-32-8	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Benzo(b)fluoranthene	205-99-2	T	0%	1.0		U	5.00E-05		U	5.00E-05		U	5.00E-05	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Benzo(b)fluoranthene	205-99-2	T	0%	1.0		U	5.00E-05		U	5.00E-05		U	5.00E-05	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Benzo(g,h,i)perylene	191-24-2	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Benzo(g,h,i)perylene	191-24-2	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Chrysene	218-01-9	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Chrysene	218-01-9	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Fluorene	86-73-7	T	10%	1.1	5.00E-04		1.00E-04	5.50E-04		1.00E-04	5.25E-04		1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Fluorene	86-73-7	T	10%	1.1	5.00E-04		1.00E-04	5.50E-04		1.00E-04	5.25E-04		1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Naphthalene	91-20-3	T	155%	7.9	1.90E-04		1.00E-04	1.50E-03		1.00E-04	8.45E-04		1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Naphthalene	91-20-3	T	155%	7.9	1.90E-04		1.00E-04	1.50E-03		1.00E-04	8.45E-04		1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Phenanthrene	85-01-8	T	0%	1.0	4.00E-05	J	5.00E-05	4.00E-05	J	5.00E-05	4.00E-05	J	5.00E-05	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Phenanthrene	85-01-8	T	0%	1.0	4.00E-05	J	5.00E-05	4.00E-05	J	5.00E-05	4.00E-05	J	5.00E-05	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Pyrene	129-00-0	T	40%	1.5	2.00E-05	J	1.00E-04	3.00E-05	J	1.00E-04	2.50E-05	J	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	SVOC	Pyrene	129-00-0	T	40%	1.5	2.00E-05	J	1.00E-04	3.00E-05	J	1.00E-04	2.50E-05	J	1.00E-04	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	INORG	Lead	7439-92-1	D	0%	1.0		U	1.00E-03		U	1.00E-03		U	1.00E-03	MG/L
TG04-MW-01	TG04-MW-01-230209	2/9/2023	INORG	Lead	7439-92-1	D	0%	1.0		U	1.00E-03		U	1.00E-03		U	1.00E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Benzene	71-43-2	T	0%	1.0		U	5.00E-04		U	5.00E-04		U	5.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Benzene	71-43-2	T	0%	1.0		U	5.00E-04		U	5.00E-04		U	5.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Cumene	98-82-8	T	0%	1.0		U	5.00E-04		U	5.00E-04		U	5.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Cumene	98-82-8	T	0%	1.0		U	5.00E-04		U	5.00E-04		U	5.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	1,2-Dibromoethane	106-93-4	T	0%	1.0		U	1.00E-05		U	1.00E-05		U	1.00E-05	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	1,2-Dibromoethane	106-93-4	T	0%	1.0		U	1.00E-05		U	1.00E-05		U	1.00E-05	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	1,2-Dichloroethane	107-06-2	T	0%	1.0		U	5.00E-04		U	5.00E-04		U	5.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	1,2-Dichloroethane	107-06-2	T	0%	1.0		U	5.00E-04		U	5.00E-04		U	5.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Ethyl Benzene	100-41-4	T	0%	1.0		U	5.00E-04		U	5.00E-04		U	5.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Ethyl Benzene	100-41-4	T	0%	1.0		U	5.00E-04		U	5.00E-04		U	5.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Methyl tert-butyl ether	1634-04-4	T	0%	1.0		U	1.00E-03		U	1.00E-03		U	1.00E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Methyl tert-butyl ether	1634-04-4	T	0%	1.0		U	1.00E-03		U	1.00E-03		U	1.00E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Toluene	108-88-3	T	0%	1.0		U	7.50E-04		U	7.50E-04		U	7.50E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Toluene	108-88-3	T	0%	1.0		U	7.50E-04		U	7.50E-04		U	7.50E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	1,2,4-Trimethylbenzene	95-63-6	T	0%	1.0		U	2.50E-03		U	2.50E-03		U	2.50E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	1,2,4-Trimethylbenzene	95-63-6	T	0%	1.0		U	2.50E-03		U	2.50E-03		U	2.50E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	1,3,5-Trimethylbenzene	108-67-8	T	0%	1.0		U	2.50E-03		U	2.50E-03		U	2.50E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	1,3,5-Trimethylbenzene	108-67-8	T	0%	1.0		U	2.50E-03		U	2.50E-03		U	2.50E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Xylenes (total)	1330-20-7	T	0%	1.0		U	1.00E-03		U	1.00E-03		U	1.00E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	VOC	Xylenes (total)	1330-20-7	T	0%	1.0		U	1.00E-03		U	1.00E-03		U	1.00E-03	MG/L

Table B5
Groundwater PESRM RPD Calculations
Tank Group 04
Philadelphia Energy Solutions Refining and Marketing, LLC, Philadelphia, PA

Location Code	Sample Name	Sample Date	Chem Group	PARAMNAME	CASRN	Total or Dissolved	RPD	Ratio	Primary Result	Primary Qualifier	Primary Limit	Duplicate Result	Duplicate Qualifier	Duplicate Limit	Average Result	Average Qualifier	Average Limit	Result Unit
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Anthracene	120-12-7	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Anthracene	120-12-7	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Benzo(a)anthracene	56-55-3	T	50%	1.7		U	5.00E-05	3.00E-05	J	5.00E-05	2.75E-05	J	5.00E-05	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Benzo(a)anthracene	56-55-3	T	50%	1.7		U	5.00E-05	3.00E-05	J	5.00E-05	2.75E-05	J	5.00E-05	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Benzo(a)pyrene	50-32-8	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Benzo(a)pyrene	50-32-8	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Benzo(b)fluoranthene	205-99-2	T	0%	1.0		U	5.00E-05		U	5.00E-05		U	5.00E-05	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Benzo(b)fluoranthene	205-99-2	T	0%	1.0		U	5.00E-05		U	5.00E-05		U	5.00E-05	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Benzo(g,h,i)perylene	191-24-2	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Benzo(g,h,i)perylene	191-24-2	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Chrysene	218-01-9	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Chrysene	218-01-9	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Fluorene	86-73-7	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Fluorene	86-73-7	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Naphthalene	91-20-3	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Naphthalene	91-20-3	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Phenanthrene	85-01-8	T	0%	1.0		U	5.00E-05		U	5.00E-05		U	5.00E-05	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Phenanthrene	85-01-8	T	0%	1.0		U	5.00E-05		U	5.00E-05		U	5.00E-05	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Pyrene	129-00-0	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	SVOC	Pyrene	129-00-0	T	0%	1.0		U	1.00E-04		U	1.00E-04		U	1.00E-04	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	INORG	Lead	7439-92-1	D	0%	1.0		U	1.00E-03		U	1.00E-03		U	1.00E-03	MG/L
TG04-MW-03	TG04-MW-03-230104	1/4/2023	INORG	Lead	7439-92-1	D	0%	1.0		U	1.00E-03		U	1.00E-03		U	1.00E-03	MG/L

Appendix C

Updated Laboratory Reports

ANALYTICAL REPORT

Lab Number:	L2300364
Client:	Terraphase Engineering Inc. 1100 East Hector Street Suite 416 Conshohocken, PA 19428
ATTN:	Nick Scala
Phone:	(215) 297-3502
Project Name:	FORMER PHILADELPHIA REFINERY
Project Number:	P044.001.002
Report Date:	01/06/23

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-17-00196).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2300364-01	TG04-MW-03-230104	WATER	3144 W PASSYUNK AVE.	01/04/23 09:40	01/04/23
L2300364-02	TG04-MW-03-230104D	WATER	3144 W PASSYUNK AVE.	01/04/23 09:40	01/04/23
L2300364-03	TG07-MW-02-230104	WATER	3144 W PASSYUNK AVE.	01/04/23 13:20	01/04/23
L2300364-04	TB-230104-2	WATER	3144 W PASSYUNK AVE.	01/04/23 00:00	01/04/23
L2300364-05	FB-230104-2	WATER	3144 W PASSYUNK AVE.	01/04/23 11:10	01/04/23
L2300364-06	TG07-MW-03-230104	WATER	3144 W PASSYUNK AVE.	01/04/23 14:05	01/04/23

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300364
Project Number:	P044.001.002	**Report Date:**	01/06/23

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300364
Project Number:	P044.001.002	**Report Date:**	01/06/23

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

Sample Receipt

The analyses performed were specified by the client.

Volatile Organics

L2300364-03 and WG1730461-6/-7: The pH was greater than two; however, the sample was analyzed within the method required holding time.

Microextractables

The WG1730299-2 LCS recovery for 1,2-dibromoethane (130%), associated with L2300364-01 through -06, is outside Alpha's acceptance criteria, but within the acceptance criteria specified in the method.

The WG1730299-4 MSD recovery for 1,2-dibromoethane (125%), performed on L2300364-03, is outside Alpha's acceptance criteria, but within the acceptance criteria specified in the method.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Cristin Walker

Title: Technical Director/Representative

Date: 01/06/23

ORGANICS

VOLATILES

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-01
Client ID: TG04-MW-03-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 09:40
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/05/23 12:32
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/05/23 10:44

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300364

Project Number: P044.001.002 **Report Date:** 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-01
Client ID: TG04-MW-03-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 09:40
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/05/23 11:27
Analyst: LAC

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	97		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	95		70-130
Dibromofluoromethane	98		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-02
Client ID: TG04-MW-03-230104D
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 09:40
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/05/23 12:40
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/05/23 10:44

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300364

Project Number: P044.001.002 **Report Date:** 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-02
Client ID: TG04-MW-03-230104D
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 09:40
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/05/23 11:53
Analyst: LAC

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	97		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	97		70-130
Dibromofluoromethane	99		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-03
Client ID: TG07-MW-02-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 13:20
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/05/23 12:49
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/05/23 10:44

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300364

Project Number: P044.001.002 **Report Date:** 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-03
Client ID: TG07-MW-02-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 13:20
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/05/23 12:18
Analyst: LAC

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	0.36	J	ug/l	1.0	0.17	1
Benzene	17		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	1.4		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	0.42	J	ug/l	0.50	0.17	1
p/m-Xylene	0.73	J	ug/l	1.0	0.33	1
o-Xylene	0.80	J	ug/l	1.0	0.39	1
Xylenes, Total	1.5	J	ug/l	1.0	0.33	1
Isopropylbenzene	67		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	0.24	J	ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	0.50	J	ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	95		70-130
Toluene-d8	102		70-130
4-Bromofluorobenzene	112		70-130
Dibromofluoromethane	94		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2300364
Project Number: P044.001.002
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-04
Client ID: TB-230104-2
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 00:00
Date Received: 01/04/23
Field Prep: Not Specified

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/05/23 12:57
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/05/23 10:44

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300364

Project Number: P044.001.002 **Report Date:** 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-04
Client ID: TB-230104-2
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 00:00
Date Received: 01/04/23
Field Prep: Not Specified

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/05/23 10:35
Analyst: LAC

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	96		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	97		70-130
Dibromofluoromethane	98		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-05
Client ID: FB-230104-2
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 11:10
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/05/23 13:05
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/05/23 10:44

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300364

Project Number: P044.001.002 **Report Date:** 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-05
Client ID: FB-230104-2
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 11:10
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/05/23 11:01
Analyst: LAC

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	98		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	96		70-130
Dibromofluoromethane	98		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-06
Client ID: TG07-MW-03-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 14:05
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/05/23 13:13
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/05/23 10:44

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300364

Project Number: P044.001.002 **Report Date:** 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-06
Client ID: TG07-MW-03-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 14:05
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/05/23 12:45
Analyst: LAC

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	0.36	J	ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	0.23	J	ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	0.67	J	ug/l	1.0	0.33	1
o-Xylene	0.55	J	ug/l	1.0	0.39	1
Xylenes, Total	1.2	J	ug/l	1.0	0.33	1
Isopropylbenzene	4.0		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	3.4		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	95		70-130
Toluene-d8	100		70-130
4-Bromofluorobenzene	103		70-130
Dibromofluoromethane	95		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8011
Analytical Date: 01/05/23 11:42
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/05/23 10:44

Parameter	Result	Qualifier	Units	RL	MDL	
Microextractables by GC - Westborough Lab for sample(s): 01-06 Batch: WG1730299-1						
1,2-Dibromoethane	ND		ug/l	0.010	0.005	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300364

Project Number: P044.001.002 **Report Date:** 01/06/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 01/05/23 09:43
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01-06 Batch: WG1730461-5					
Methyl tert butyl ether	ND		ug/l	1.0	0.17
Benzene	ND		ug/l	0.50	0.16
1,2-Dichloroethane	ND		ug/l	0.50	0.13
Toluene	ND		ug/l	0.75	0.20
1,2-Dibromoethane	ND		ug/l	2.0	0.19
Ethylbenzene	ND		ug/l	0.50	0.17
p/m-Xylene	ND		ug/l	1.0	0.33
o-Xylene	ND		ug/l	1.0	0.39
Xylenes, Total	ND		ug/l	1.0	0.33
Isopropylbenzene	ND		ug/l	0.50	0.19
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	95		70-130
Toluene-d8	97		70-130
4-Bromofluorobenzene	95		70-130
Dibromofluoromethane	97		70-130

Lab Control Sample Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2300364

Report Date: 01/06/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Microextractables by GC - Westborough Lab Associated sample(s): 01-06 Batch: WG1730299-2									
1,2-Dibromoethane	**130**	Q	-		80-120	-		20	A

Lab Control Sample Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300364
Report Date: 01/06/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-06 Batch: WG1730461-3 WG1730461-4								
Methyl tert butyl ether	97		95		63-130	2		20
Benzene	110		110		70-130	0		20
1,2-Dichloroethane	100		100		70-130	0		20
Toluene	110		100		70-130	10		20
1,2-Dibromoethane	100		100		70-130	0		20
Ethylbenzene	110		100		70-130	10		20
p/m-Xylene	110		105		70-130	5		20
o-Xylene	105		105		70-130	0		20
Isopropylbenzene	110		110		70-130	0		20
1,3,5-Trimethylbenzene	110		110		64-130	0		20
1,2,4-Trimethylbenzene	110		100		70-130	10		20

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
1,2-Dichloroethane-d4	98		98		70-130
Toluene-d8	99		99		70-130
4-Bromofluorobenzene	96		96		70-130
Dibromofluoromethane	98		96		70-130

Matrix Spike Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2300364

Report Date: 01/06/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits	Column
Microextractables by GC - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG1730299-3 WG1730299-4 QC Sample: L2300364-03 Client ID: TG07-MW-02-230104													
1,2-Dibromoethane	ND	0.247	0.276	112		0.314	**125**	Q	80-120	13		20	A

Matrix Spike Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2300364

Report Date: 01/06/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG1730461-6 WG1730461-7 QC Sample: L2300364-03 Client ID: TG07-MW-02-230104												
Methyl tert butyl ether	0.36J	10	9.7	97		9.8	98		63-130	1		20
Benzene	17	10	27	100		27	100		70-130	0		20
1,2-Dichloroethane	ND	10	10	100		10	100		70-130	0		20
Toluene	1.4	10	12	106		12	106		70-130	0		20
1,2-Dibromoethane	ND	10	10	100		10	100		70-130	0		20
Ethylbenzene	0.42J	10	11	110		11	110		70-130	0		20
p/m-Xylene	0.73J	20	22	110		22	110		70-130	0		20
o-Xylene	0.80J	20	22	110		22	110		70-130	0		20
Isopropylbenzene	67	10	72	**50**	Q	72	**50**	Q	70-130	0		20
1,3,5-Trimethylbenzene	0.24J	10	11	110		11	110		64-130	0		20
1,2,4-Trimethylbenzene	0.50J	10	11	110		11	110		70-130	0		20

Surrogate	MS % Recovery	MS Qualifier	MSD % Recovery	MSD Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	98		97		70-130
4-Bromofluorobenzene	112		113		70-130
Dibromofluoromethane	95		94		70-130
Toluene-d8	102		102		70-130

SEMIVOLATILES

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-01
Client ID: TG04-MW-03-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 09:40
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/05/23 15:25
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 01/05/23 05:54

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	ND		ug/l	0.10	0.05	1
Fluorene	ND		ug/l	0.10	0.01	1
Phenanthrene	ND		ug/l	0.05	0.02	1
Anthracene	ND		ug/l	0.10	0.01	1
Pyrene	ND		ug/l	0.10	0.02	1
Benzo(a)anthracene	ND		ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	91		23-120
2-Fluorobiphenyl	69		15-120
4-Terphenyl-d14	74		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-02
Client ID: TG04-MW-03-230104D
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 09:40
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/05/23 15:42
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 01/05/23 05:54

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	ND		ug/l	0.10	0.05	1
Fluorene	ND		ug/l	0.10	0.01	1
Phenanthrene	ND		ug/l	0.05	0.02	1
Anthracene	ND		ug/l	0.10	0.01	1
Pyrene	ND		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.03	J	ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	100		23-120
2-Fluorobiphenyl	76		15-120
4-Terphenyl-d14	78		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-03
Client ID: TG07-MW-02-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 13:20
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/05/23 15:09
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 01/05/23 05:54

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	0.90		ug/l	0.10	0.05	1
Fluorene	2.2		ug/l	0.10	0.01	1
Phenanthrene	1.8		ug/l	0.05	0.02	1
Anthracene	0.24		ug/l	0.10	0.01	1
Pyrene	0.36		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.11		ug/l	0.05	0.02	1
Chrysene	0.07	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.07		ug/l	0.05	0.01	1
Benzo(a)pyrene	0.07	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.04	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	0.04	J	ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	89		23-120
2-Fluorobiphenyl	68		15-120
4-Terphenyl-d14	60		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-05
Client ID: FB-230104-2
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 11:10
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/05/23 15:58
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 01/05/23 05:54

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	0.09	J	ug/l	0.10	0.05	1
Fluorene	ND		ug/l	0.10	0.01	1
Phenanthrene	ND		ug/l	0.05	0.02	1
Anthracene	ND		ug/l	0.10	0.01	1
Pyrene	ND		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.04	J	ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	92		23-120
2-Fluorobiphenyl	71		15-120
4-Terphenyl-d14	79		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300364
Report Date: 01/06/23

SAMPLE RESULTS

Lab ID: L2300364-06
Client ID: TG07-MW-03-230104
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/04/23 14:05
Date Received: 01/04/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/05/23 16:14
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 01/05/23 05:54

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	0.13		ug/l	0.10	0.05	1
Fluorene	0.58		ug/l	0.10	0.01	1
Phenanthrene	0.63		ug/l	0.05	0.02	1
Anthracene	0.10		ug/l	0.10	0.01	1
Pyrene	0.11		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.04	J	ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	82		23-120
2-Fluorobiphenyl	62		15-120
4-Terphenyl-d14	60		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300364
Report Date: 01/06/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270E-SIM
Analytical Date: 01/05/23 14:20
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 01/05/23 05:54

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS-SIM - Westborough Lab for sample(s): 01-03,05-06 Batch: WG1730130-1					
Naphthalene	ND		ug/l	0.10	0.05
Fluorene	ND		ug/l	0.10	0.01
Phenanthrene	ND		ug/l	0.05	0.02
Anthracene	ND		ug/l	0.10	0.01
Pyrene	ND		ug/l	0.10	0.02
Benzo(a)anthracene	0.03	J	ug/l	0.05	0.02
Chrysene	ND		ug/l	0.10	0.01
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01
Benzo(a)pyrene	ND		ug/l	0.10	0.02
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01
Benzo(ghi)perylene	ND		ug/l	0.10	0.01

Surrogate	%Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	83		23-120
2-Fluorobiphenyl	62		15-120
4-Terphenyl-d14	67		41-149

Lab Control Sample Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300364
Report Date: 01/06/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS-SIM - Westborough Lab Associated sample(s): 01-03,05-06 Batch: WG1730130-2 WG1730130-3								
Naphthalene	67		67		40-140	0		40
Fluorene	68		70		40-140	3		40
Phenanthrene	63		66		40-140	5		40
Anthracene	70		72		40-140	3		40
Pyrene	75		78		26-127	4		40
Benzo(a)anthracene	70		78		40-140	11		40
Chrysene	66		66		40-140	0		40
Benzo(b)fluoranthene	73		77		40-140	5		40
Benzo(a)pyrene	75		80		40-140	6		40
Indeno(1,2,3-cd)pyrene	77		80		40-140	4		40
Benzo(ghi)perylene	67		71		40-140	6		40

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
Nitrobenzene-d5	92		91		23-120
2-Fluorobiphenyl	68		69		15-120
4-Terphenyl-d14	73		78		41-149

Matrix Spike Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2300364

Report Date: 01/06/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS-SIM - Westborough Lab Associated sample(s): 01-03,05-06 QC Batch ID: WG1730130-4 WG1730130-5 QC Sample: L2300364-03 Client ID: TG07-MW-02-230104												
Naphthalene	0.90	3.64	3.0	58		3.5	72		40-140	15		40
Fluorene	2.2	3.64	4.4	61		4.3	58		40-140	2		40
Phenanthrene	1.8	3.64	4.0	61		3.8	55		40-140	5		40
Anthracene	0.24	3.64	2.6	65		2.6	65		40-140	0		40
Pyrene	0.36	3.64	3.0	73		2.9	70		26-127	3		40
Benzo(a)anthracene	0.11	3.64	2.5	66		2.5	66		40-140	0		40
Chrysene	0.07J	3.64	2.3	63		2.2	61		40-140	4		40
Benzo(b)fluoranthene	0.07	3.64	2.5	67		2.6	70		40-140	4		40
Benzo(a)pyrene	0.07J	3.64	2.5	69		2.5	69		40-140	0		40
Indeno(1,2,3-cd)pyrene	0.04J	3.64	2.3	63		2.3	63		40-140	0		40
Benzo(ghi)perylene	0.04J	3.64	2.1	58		2.0	55		40-140	5		40

Surrogate	MS % Recovery	MS Qualifier	MSD % Recovery	MSD Qualifier	Acceptance Criteria
2-Fluorobiphenyl	66		67		15-120
4-Terphenyl-d14	66		64		41-149
Nitrobenzene-d5	87		89		23-120

METALS

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300364
Project Number:	P044.001.002	**Report Date:**	01/06/23

SAMPLE RESULTS

Lab ID:	L2300364-01	Date Collected:	01/04/23 09:40
Client ID:	TG04-MW-03-230104	Date Received:	01/04/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/05/23 08:56	01/05/23 16:09	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300364
Project Number:	P044.001.002	**Report Date:**	01/06/23

SAMPLE RESULTS

Lab ID:	L2300364-02	Date Collected:	01/04/23 09:40
Client ID:	TG04-MW-03-230104D	Date Received:	01/04/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/05/23 08:56	01/05/23 17:06	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300364
Project Number:	P044.001.002	**Report Date:**	01/06/23

SAMPLE RESULTS

Lab ID:	L2300364-03	Date Collected:	01/04/23 13:20
Client ID:	TG07-MW-02-230104	Date Received:	01/04/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	7.913		ug/l	1.000	0.3430	1	01/05/23 08:56	01/05/23 17:01	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300364
Project Number:	P044.001.002	**Report Date:**	01/06/23

SAMPLE RESULTS

Lab ID:	L2300364-05	Date Collected:	01/04/23 11:10
Client ID:	FB-230104-2	Date Received:	01/04/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/05/23 08:56	01/05/23 15:25	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300364
Project Number:	P044.001.002	**Report Date:**	01/06/23

SAMPLE RESULTS

Lab ID:	L2300364-06	Date Collected:	01/04/23 14:05
Client ID:	TG07-MW-03-230104	Date Received:	01/04/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/05/23 08:56	01/05/23 17:11	EPA 3005A	1,6020B	SV

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300364

Project Number: P044.001.002 **Report Date:** 01/06/23

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab for sample(s): 01-03,05-06 Batch: WG1730153-1										
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/05/23 08:56	01/05/23 14:24	1,6020B	SV

Prep Information

Digestion Method: EPA 3005A

Lab Control Sample Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2300364

Report Date: 01/06/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Dissolved Metals - Mansfield Lab Associated sample(s): 01-03,05-06 Batch: WG1730153-2								
Lead, Dissolved	97		-		80-120	-		

Matrix Spike Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300364
Report Date: 01/06/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Dissolved Metals - Mansfield Lab Associated sample(s): 01-03,05-06 QC Batch ID: WG1730153-3 WG1730153-4 QC Sample: L2300364-03 Client ID: TG07-MW-02-230104												
Lead, Dissolved	7.913	530	528.9	98		518.5	96		75-125	2		20

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2300364-01A	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-01B	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-01C	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-01D	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-01E	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-01F	Plastic 250ml HNO3 preserved	A	<2	<2	3.9	Y	Absent		PB-6020S-PPB(180)
L2300364-01G	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-01H	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-02A	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-02B	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-02C	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-02D	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-02E	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-02F	Plastic 250ml HNO3 preserved	A	<2	<2	3.9	Y	Absent		PB-6020S-PPB(180)
L2300364-02G	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-02H	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-03A	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-03A1	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-03A2	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-03B	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-03B1	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-03B2	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-03C	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2300364-03C1	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-03C2	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-03D	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-03D1	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-03D2	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-03E	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-03E1	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-03E2	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-03F	Plastic 250ml HNO3 preserved	A	<2	<2	3.9	Y	Absent		PB-6020S-PPB(180)
L2300364-03F1	Plastic 250ml HNO3 preserved	A	<2	<2	3.9	Y	Absent		PB-6020S-PPB(180)
L2300364-03F2	Plastic 250ml HNO3 preserved	A	<2	<2	3.9	Y	Absent		PB-6020S-PPB(180)
L2300364-03G	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-03G1	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-03G2	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-03H	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-03H1	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-03H2	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-04A	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-04B	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-04C	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-04D	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-05A	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-05B	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-05C	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-05D	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-05E	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-05F	Plastic 250ml HNO3 preserved	A	<2	<2	3.9	Y	Absent		PB-6020S-PPB(180)
L2300364-05G	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300364
Report Date: 01/06/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2300364-05H	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-06A	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-06B	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-06C	Vial HCl preserved	A	NA		3.9	Y	Absent		PA-8260(14)
L2300364-06D	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-06E	Vial Na2S2O3 preserved	A	NA		3.9	Y	Absent		8011(14)
L2300364-06F	Plastic 500ml HNO3 preserved	A	<2	<2	3.9	Y	Absent		PB-6020S-PPB(180)
L2300364-06G	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)
L2300364-06H	Amber 250ml unpreserved	A	7	7	3.9	Y	Absent		PA-PAHSIM-LVI(7)

Container Comments

L2300364-02H Cap cracked, sample intact.

*Values in parentheses indicate holding time in days

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GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.) Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: DU Report with 'J' Qualifiers

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300364
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Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA,this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

A - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

F - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

J - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively

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Data Qualifiers

Identified Compounds (TICs).

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

ND - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

V - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Z - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

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REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - VI, 2018.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624/624.1: m/p-xylene, o-xylene, Naphthalene
EPA 625/625.1: alpha-Terpineol
EPA 8260C/8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270D/8270E: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine, alpha-Terpineol; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.
SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS
EPA 8082A: NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B**
EPA 332: Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603, SM9222D.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522, EPA 537.1.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE ____ OF ____

ALPHA ANALYTICAL
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab: 1/5/23

ALPHA Job #: L2300364

Client Information

Client: Terraphase Engineering
Address: 100 Canal Pointe Blvd
Princeton NJ 08540 Suite 108
Phone: 215 297 3502
Fax:
Email: nick.scala@terraphase.com
☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Former Philadelphia Refinery
Project Location: 3144 W Passyunk Ave.
Project #: P044.001.002
Project Manager: Nick Scala
ALPHA Quote #:

Turn-Around Time

☐ Standard ☒ RUSH (only confirmed if pre-approved!) 48 hour
Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

Other Project Specific Requirements/Comments/Detection Limits:
EDD @ terraphase.com
Equis EDD

SAMPLE HANDLING
Filtration ____
☐ Done
☒ Not needed all lead samples
☐ Lab to do
Preservation field filtered
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	8260 - Benzene, Ethylbenzene, methyl tert-butyl	1,2,4/1,3,5 TMB	1,2 - Dibromoethane	8011 - 1,2 - Dibromoethane	8270 (SIM) - Naphthalene	6020 - (Lead)	Sample Specific Comments	TOTAL # BOTTLES
00364-01	TG04-MW-03-230104	1/4/22	9:40	GW	KSO	X	X	X	X	X		48 hour TAT	8
-02	TG04-MW-03-230104D	1/4/22	9:40	GW	KSO	X	X	X	X	X		48 hour TAT	8
-03	TG07-MW-02-230104	1/4/22	13:20	GW	KSO	X	X	X	X	X		48 hour TAT	8
	~~TG07-MW-02-230~~ KSO 1/4 23 KSO 1/4				KSO								
-03	TG07-MW-02-230104MS	1/4/22	13:20	GW	KSO	X	X	X	X	X		48 hour TAT	8
-03	TG07-MW-02-230104MSD	1/4/22	13:20	GW	KSO	X	X	X	X	X		48 hour TAT	8
-04	TB-230104-2	1/4/22	13:04	TB	KSO	X	X	X				48 hour TAT	4
-05	FB-230104-2	1/4/22	11:10	FB	KSO	X	X	X	X	X		48 hour TAT	8
-06	TG07-MW-03-230104	1/4/22	14:05	GW	AJS	X	X	X	X	X		48 hour TAT	8

Container Type													
Preservative													

Relinquished By:	Date/Time	Received By:	Date/Time
[illegible]	1/4/23 1510	[illegible] AAL	1/4/23 15:10
[illegible]	1/4/23 1800	[illegible]	1/4/23 1800
[illegible]	1/4/23 2200	[illegible]	1-4-23 2200

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO. 01-01 (rev. 14-OCT-07)

ANALYTICAL REPORT

Lab Number:	L2300961
Client:	Terraphase Engineering Inc. 100 Canal Pointe Boulevard Suite 100 Princeton, NJ 08540
ATTN:	Nick Scala
Phone:	(609) 236-8171
Project Name:	FORMER PHILADELPHIA REFINERY
Project Number:	P044.001.002
Report Date:	03/01/23

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-17-00196).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300961
Report Date: 03/01/23

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2300961-01	TG07-MW-05-230105	WATER	3144 W PASSYUNK AVE.	01/05/23 09:50	01/06/23
L2300961-02	TG07-MW-04-230105	WATER	3144 W PASSYUNK AVE.	01/05/23 11:05	01/06/23
L2300961-03	TG07-MW-01-230105	WATER	3144 W PASSYUNK AVE.	01/05/23 14:20	01/06/23
L2300961-04	TG07-MW-08-230105	WATER	3144 W PASSYUNK AVE.	01/05/23 15:05	01/06/23
L2300961-05	TG04-MW-01-230106	WATER	3144 W PASSYUNK AVE.	01/06/23 10:30	01/06/23
L2300961-06	S-219-230106	WATER	3144 W PASSYUNK AVE.	01/06/23 09:50	01/06/23
L2300961-07	TB-230106-2	WATER	3144 W PASSYUNK AVE.	01/06/23 00:00	01/06/23

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
Project Number:	P044.001.002	**Report Date:**	03/01/23

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
Project Number:	P044.001.002	**Report Date:**	03/01/23

Case Narrative (continued)

Report Revision

March 01, 2023: The Semivolatile Organics by SIM analyte list has been amended on L2300961-05 and -06.

January 11, 2023: This report includes the results of the 1,2-Dibromoethane by Method 8260D performed on L2300961-01 through -07.

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Caitlin Walukevich

Title: Technical Director/Representative

Date: 03/01/23

ORGANICS

VOLATILES

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2300961
Project Number: P044.001.002
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-01
Client ID: TG07-MW-05-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 09:50
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/09/23 13:59
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/09/23 10:06

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-01 D
Client ID: TG07-MW-05-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 09:50
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/07/23 17:50
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	100	17.	100
Benzene	11000		ug/l	50	16.	100
1,2-Dichloroethane	ND		ug/l	50	13.	100
Toluene	200		ug/l	75	20.	100
1,2-Dibromoethane	ND		ug/l	200	19.	100
Ethylbenzene	34	J	ug/l	50	17.	100
p/m-Xylene	41	J	ug/l	100	33.	100
o-Xylene	ND		ug/l	100	39.	100
Xylenes, Total	41	J	ug/l	100	33.	100
Isopropylbenzene	7200		ug/l	50	19.	100
1,3,5-Trimethylbenzene	ND		ug/l	250	22.	100
1,2,4-Trimethylbenzene	30	J	ug/l	250	19.	100

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	91		70-130
Toluene-d8	103		70-130
4-Bromofluorobenzene	109		70-130
Dibromofluoromethane	93		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300961
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-02
Client ID: TG07-MW-04-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 11:05
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/09/23 14:07
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/09/23 10:06

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-02 D
Client ID: TG07-MW-04-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 11:05
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/07/23 17:27
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	2.0	0.33	2
Benzene	36		ug/l	1.0	0.32	2
1,2-Dichloroethane	ND		ug/l	1.0	0.26	2
Toluene	3.8		ug/l	1.5	0.41	2
1,2-Dibromoethane	ND		ug/l	4.0	0.39	2
Ethylbenzene	1.9		ug/l	1.0	0.33	2
p/m-Xylene	4.7		ug/l	2.0	0.66	2
o-Xylene	2.0		ug/l	2.0	0.78	2
Xylenes, Total	6.7		ug/l	2.0	0.66	2
Isopropylbenzene	290		ug/l	1.0	0.37	2
1,3,5-Trimethylbenzene	0.72	J	ug/l	5.0	0.43	2
1,2,4-Trimethylbenzene	1.4	J	ug/l	5.0	0.38	2

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	97		70-130
Toluene-d8	105		70-130
4-Bromofluorobenzene	109		70-130
Dibromofluoromethane	83		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2300961
Project Number: P044.001.002
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-03
Client ID: TG07-MW-01-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 14:20
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/09/23 14:16
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/09/23 10:06

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-03
Client ID: TG07-MW-01-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 14:20
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/07/23 17:04
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	0.34	J	ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	0.25	J	ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	97		70-130
Toluene-d8	102		70-130
4-Bromofluorobenzene	107		70-130
Dibromofluoromethane	99		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2300961
Project Number: P044.001.002
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-04
Client ID: TG07-MW-08-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 15:05
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/09/23 14:24
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/09/23 10:06

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-04 D
Client ID: TG07-MW-08-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 15:05
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/07/23 16:41
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	25	4.2	25
Benzene	ND		ug/l	12	4.0	25
1,2-Dichloroethane	ND		ug/l	12	3.3	25
Toluene	ND		ug/l	19	5.1	25
1,2-Dibromoethane	ND		ug/l	50	4.8	25
Ethylbenzene	ND		ug/l	12	4.2	25
p/m-Xylene	ND		ug/l	25	8.3	25
o-Xylene	ND		ug/l	25	9.8	25
Xylenes, Total	ND		ug/l	25	8.3	25
Isopropylbenzene	4400		ug/l	12	4.7	25
1,3,5-Trimethylbenzene	ND		ug/l	62	5.4	25
1,2,4-Trimethylbenzene	ND		ug/l	62	4.8	25

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	96		70-130
Toluene-d8	102		70-130
4-Bromofluorobenzene	110		70-130
Dibromofluoromethane	96		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2300961
Project Number: P044.001.002
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-05
Client ID: TG04-MW-01-230106
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/06/23 10:30
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/09/23 14:33
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/09/23 10:06

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-05 D
Client ID: TG04-MW-01-230106
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/06/23 10:30
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/07/23 16:18
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	5.0	0.83	5
Benzene	580		ug/l	2.5	0.80	5
1,2-Dichloroethane	ND		ug/l	2.5	0.66	5
Toluene	11		ug/l	3.8	1.0	5
1,2-Dibromoethane	ND		ug/l	10	0.96	5
Ethylbenzene	110		ug/l	2.5	0.84	5
p/m-Xylene	170		ug/l	5.0	1.7	5
o-Xylene	16		ug/l	5.0	2.0	5
Xylenes, Total	190		ug/l	5.0	1.7	5
Isopropylbenzene	75		ug/l	2.5	0.94	5
1,3,5-Trimethylbenzene	13		ug/l	12	1.1	5
1,2,4-Trimethylbenzene	54		ug/l	12	0.96	5

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	94		70-130
Toluene-d8	105		70-130
4-Bromofluorobenzene	108		70-130
Dibromofluoromethane	91		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2300961
Project Number: P044.001.002
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-06
Client ID: S-219-230106
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/06/23 09:50
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/09/23 14:41
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/09/23 10:06

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-06
Client ID: S-219-230106
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/06/23 09:50
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/07/23 15:54
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	0.28	J	ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	96		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	107		70-130
Dibromofluoromethane	98		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2300961
Project Number: P044.001.002
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-07
Client ID: TB-230106-2
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/06/23 00:00
Date Received: 01/06/23
Field Prep: None

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 01/09/23 14:50
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/09/23 10:06

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-07
Client ID: TB-230106-2
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/06/23 00:00
Date Received: 01/06/23
Field Prep: None

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 01/07/23 15:31
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	97		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	107		70-130
Dibromofluoromethane	98		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300961
Report Date: 03/01/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8011
Analytical Date: 01/09/23 11:35
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 01/09/23 10:06

Parameter	Result	Qualifier	Units	RL	MDL	
Microextractables by GC - Westborough Lab for sample(s): 01-07 Batch: WG1730665-1						
1,2-Dibromoethane	ND		ug/l	0.010	0.005	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 01/07/23 13:35
Analyst: LAC

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01-07 Batch: WG1731384-5					
Methyl tert butyl ether	ND		ug/l	1.0	0.17
Benzene	ND		ug/l	0.50	0.16
1,2-Dichloroethane	ND		ug/l	0.50	0.13
Toluene	ND		ug/l	0.75	0.20
1,2-Dibromoethane	ND		ug/l	2.0	0.19
Ethylbenzene	ND		ug/l	0.50	0.17
p/m-Xylene	ND		ug/l	1.0	0.33
o-Xylene	ND		ug/l	1.0	0.39
Xylenes, Total	ND		ug/l	1.0	0.33
Isopropylbenzene	ND		ug/l	0.50	0.19
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	98		70-130
Toluene-d8	102		70-130
4-Bromofluorobenzene	108		70-130
Dibromofluoromethane	97		70-130

Lab Control Sample Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2300961

Report Date: 03/01/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Microextractables by GC - Westborough Lab Associated sample(s): 01-07 Batch: WG1730665-2									
1,2-Dibromoethane	117		-		80-120	-		20	A

Lab Control Sample Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300961
Report Date: 03/01/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-07 Batch: WG1731384-3 WG1731384-4								
Methyl tert butyl ether	84		92		63-130	9		20
Benzene	95		98		70-130	3		20
1,2-Dichloroethane	88		91		70-130	3		20
Toluene	99		100		70-130	1		20
1,2-Dibromoethane	97		99		70-130	2		20
Ethylbenzene	96		97		70-130	1		20
p/m-Xylene	95		95		70-130	0		20
o-Xylene	95		95		70-130	0		20
Isopropylbenzene	99		100		70-130	1		20
1,3,5-Trimethylbenzene	99		100		64-130	1		20
1,2,4-Trimethylbenzene	99		100		70-130	1		20

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
1,2-Dichloroethane-d4	95		99		70-130
Toluene-d8	105		105		70-130
4-Bromofluorobenzene	107		110		70-130
Dibromofluoromethane	94		95		70-130

SEMIVOLATILES

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300961
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-01
Client ID: TG07-MW-05-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 09:50
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/10/23 16:29
Analyst: JJW

Extraction Method: EPA 3510C
Extraction Date: 01/10/23 12:08

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	17		ug/l	0.10	0.05	1
Fluorene	2.7		ug/l	0.10	0.01	1
Phenanthrene	2.4		ug/l	0.05	0.02	1
Anthracene	0.27		ug/l	0.10	0.01	1
Pyrene	0.22		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.07		ug/l	0.05	0.02	1
Chrysene	0.04	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.03	J	ug/l	0.05	0.01	1
Benzo(a)pyrene	0.04	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.01	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	110		23-120
2-Fluorobiphenyl	66		15-120
4-Terphenyl-d14	57		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300961
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-02
Client ID: TG07-MW-04-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 11:05
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/08/23 13:53
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 01/07/23 07:42

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	ND		ug/l	0.10	0.05	1
Fluorene	4.8		ug/l	0.10	0.01	1
Phenanthrene	4.6		ug/l	0.05	0.02	1
Anthracene	0.43		ug/l	0.10	0.01	1
Pyrene	0.42		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.14		ug/l	0.05	0.02	1
Chrysene	0.11		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.07		ug/l	0.05	0.01	1
Benzo(a)pyrene	0.07	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.02	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	0.02	J	ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	116		23-120
2-Fluorobiphenyl	91		15-120
4-Terphenyl-d14	102		41-149

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-03
Client ID: TG07-MW-01-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 14:20
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/08/23 14:09
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 01/07/23 07:42

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	ND		ug/l	0.10	0.05	1
Fluorene	0.13		ug/l	0.10	0.01	1
Phenanthrene	0.20		ug/l	0.05	0.02	1
Anthracene	0.05	J	ug/l	0.10	0.01	1
Pyrene	0.14		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.08		ug/l	0.05	0.02	1
Chrysene	0.03	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.02	J	ug/l	0.05	0.01	1
Benzo(a)pyrene	0.02	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	0.01	J	ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	116		23-120
2-Fluorobiphenyl	88		15-120
4-Terphenyl-d14	81		41-149

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-04
Client ID: TG07-MW-08-230105
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/05/23 15:05
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/08/23 14:25
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 01/07/23 07:42

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	3.1		ug/l	0.10	0.05	1
Fluorene	2.9		ug/l	0.10	0.01	1
Phenanthrene	1.8		ug/l	0.05	0.02	1
Anthracene	0.24		ug/l	0.10	0.01	1
Pyrene	0.86		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.18		ug/l	0.05	0.02	1
Chrysene	0.07	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.03	J	ug/l	0.05	0.01	1
Benzo(a)pyrene	0.02	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.01	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	113		23-120
2-Fluorobiphenyl	87		15-120
4-Terphenyl-d14	104		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300961
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-05
Client ID: TG04-MW-01-230106
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/06/23 10:30
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/08/23 15:14
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 01/07/23 07:42

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	9.4		ug/l	0.10	0.05	1
Fluorene	0.92		ug/l	0.10	0.01	1
Phenanthrene	0.25		ug/l	0.05	0.02	1
Anthracene	0.11		ug/l	0.10	0.01	1
Pyrene	0.06	J	ug/l	0.10	0.02	1
Benzo(a)anthracene	0.10		ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	**135**	Q	23-120
2-Fluorobiphenyl	99		15-120
4-Terphenyl-d14	96		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300961
Report Date: 03/01/23

SAMPLE RESULTS

Lab ID: L2300961-06
Client ID: S-219-230106
Sample Location: 3144 W PASSYUNK AVE.

Date Collected: 01/06/23 09:50
Date Received: 01/06/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 01/08/23 15:30
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 01/07/23 07:42

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	ND		ug/l	0.10	0.05	1
Fluorene	ND		ug/l	0.10	0.01	1
Phenanthrene	ND		ug/l	0.05	0.02	1
Anthracene	ND		ug/l	0.10	0.01	1
Pyrene	ND		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.18		ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	**121**	Q	23-120
2-Fluorobiphenyl	92		15-120
4-Terphenyl-d14	93		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300961
Report Date: 03/01/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270E-SIM
Analytical Date: 01/06/23 18:22
Analyst: AH

Extraction Method: EPA 3510C
Extraction Date: 01/06/23 08:28

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS-SIM - Westborough Lab for sample(s): 02-06 Batch: WG1730640-1					
Naphthalene	ND		ug/l	0.10	0.05
Fluorene	ND		ug/l	0.10	0.01
Phenanthrene	0.03	J	ug/l	0.05	0.02
Anthracene	ND		ug/l	0.10	0.01
Pyrene	0.04	J	ug/l	0.10	0.02
Benzo(a)anthracene	0.02	J	ug/l	0.05	0.02
Chrysene	0.02	J	ug/l	0.10	0.01
Benzo(b)fluoranthene	0.01	J	ug/l	0.05	0.01
Benzo(a)pyrene	ND		ug/l	0.10	0.02
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01
Benzo(ghi)perylene	ND		ug/l	0.10	0.01

Surrogate	%Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	111		23-120
2-Fluorobiphenyl	71		15-120
4-Terphenyl-d14	88		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300961
Report Date: 03/01/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270E-SIM
Analytical Date: 01/10/23 16:12
Analyst: JJW

Extraction Method: EPA 3510C
Extraction Date: 01/10/23 12:08

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS-SIM - Westborough Lab for sample(s): 01 Batch: WG1731825-1					
Naphthalene	ND		ug/l	0.10	0.05
Fluorene	ND		ug/l	0.10	0.01
Phenanthrene	ND		ug/l	0.05	0.02
Anthracene	ND		ug/l	0.10	0.01
Pyrene	ND		ug/l	0.10	0.02
Benzo(a)anthracene	ND		ug/l	0.05	0.02
Chrysene	ND		ug/l	0.10	0.01
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01
Benzo(a)pyrene	ND		ug/l	0.10	0.02
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01
Benzo(ghi)perylene	ND		ug/l	0.10	0.01

Surrogate	%Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	104		23-120
2-Fluorobiphenyl	69		15-120
4-Terphenyl-d14	67		41-149

Lab Control Sample Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300961
Report Date: 03/01/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS-SIM - Westborough Lab Associated sample(s): 02-06 Batch: WG1730640-2 WG1730640-3								
Naphthalene	51		81		40-140	**45**	Q	40
Fluorene	65		86		40-140	28		40
Phenanthrene	70		87		40-140	22		40
Anthracene	72		89		40-140	21		40
Pyrene	83		100		26-127	19		40
Benzo(a)anthracene	78		92		40-140	16		40
Chrysene	78		91		40-140	15		40
Benzo(b)fluoranthene	77		95		40-140	21		40
Benzo(a)pyrene	81		97		40-140	18		40
Indeno(1,2,3-cd)pyrene	86		101		40-140	16		40
Benzo(ghi)perylene	79		93		40-140	16		40

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
Nitrobenzene-d5	84		**125**	Q	23-120
2-Fluorobiphenyl	56		80		15-120
4-Terphenyl-d14	85		101		41-149

Lab Control Sample Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2300961
Report Date: 03/01/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS-SIM - Westborough Lab Associated sample(s): 01 Batch: WG1731825-2 WG1731825-3								
Naphthalene	55		66		40-140	18		40
Fluorene	60		69		40-140	14		40
Phenanthrene	61		68		40-140	11		40
Anthracene	62		70		40-140	12		40
Pyrene	61		66		26-127	8		40
Benzo(a)anthracene	65		73		40-140	12		40
Chrysene	64		70		40-140	9		40
Benzo(b)fluoranthene	66		71		40-140	7		40
Benzo(a)pyrene	69		76		40-140	10		40
Indeno(1,2,3-cd)pyrene	77		81		40-140	5		40
Benzo(ghi)perylene	70		75		40-140	7		40

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
Nitrobenzene-d5	90		113		23-120
2-Fluorobiphenyl	59		70		15-120
4-Terphenyl-d14	60		65		41-149

METALS

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
Project Number:	P044.001.002	**Report Date:**	03/01/23

SAMPLE RESULTS

Lab ID:	L2300961-01	Date Collected:	01/05/23 09:50
Client ID:	TG07-MW-05-230105	Date Received:	01/06/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/09/23 09:06	01/09/23 16:35	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
Project Number:	P044.001.002	**Report Date:**	03/01/23

SAMPLE RESULTS

Lab ID:	L2300961-02	Date Collected:	01/05/23 11:05
Client ID:	TG07-MW-04-230105	Date Received:	01/06/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/09/23 09:06	01/09/23 16:40	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
Project Number:	P044.001.002	**Report Date:**	03/01/23

SAMPLE RESULTS

Lab ID:	L2300961-03	Date Collected:	01/05/23 14:20
Client ID:	TG07-MW-01-230105	Date Received:	01/06/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	0.5930	J	ug/l	1.000	0.3430	1	01/09/23 09:06	01/09/23 16:45	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
Project Number:	P044.001.002	**Report Date:**	03/01/23

SAMPLE RESULTS

Lab ID:	L2300961-04	Date Collected:	01/05/23 15:05
Client ID:	TG07-MW-08-230105	Date Received:	01/06/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/09/23 09:06	01/09/23 17:10	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
Project Number:	P044.001.002	**Report Date:**	03/01/23

SAMPLE RESULTS

Lab ID:	L2300961-05	Date Collected:	01/06/23 10:30
Client ID:	TG04-MW-01-230106	Date Received:	01/06/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/09/23 09:06	01/09/23 17:15	EPA 3005A	1,6020B	SV

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
Project Number:	P044.001.002	**Report Date:**	03/01/23

SAMPLE RESULTS

Lab ID:	L2300961-06	Date Collected:	01/06/23 09:50
Client ID:	S-219-230106	Date Received:	01/06/23
Sample Location:	3144 W PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/09/23 09:06	01/09/23 17:21	EPA 3005A	1,6020B	SV

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2300961

Project Number: P044.001.002 **Report Date:** 03/01/23

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab for sample(s): 01-06 Batch: WG1731110-1										
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	01/09/23 09:06	01/09/23 15:53	1,6020B	SV

Prep Information

Digestion Method: EPA 3005A

Lab Control Sample Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2300961

Report Date: 03/01/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Dissolved Metals - Mansfield Lab Associated sample(s): 01-06 Batch: WG1731110-2								
Lead, Dissolved	100		-		80-120	-		

Matrix Spike Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300961
Report Date: 03/01/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Dissolved Metals - Mansfield Lab Associated sample(s): 01-06 QC Batch ID: WG1731110-3 QC Sample: L2300961-01 Client ID: TG07-MW-05-230105												
Lead, Dissolved	ND	530	539.3	102		-	-		75-125	-		20

Lab Duplicate Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2300961

Report Date: 03/01/23

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Dissolved Metals - Mansfield Lab Associated sample(s): 01-06 QC Batch ID: WG1731110-4 QC Sample: L2300961-01 Client ID: TG07-MW-05-230105						
Lead, Dissolved	ND	ND	ug/l	NC		20

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300961
Report Date: 03/01/23

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2300961-01A	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-01B	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-01C	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-01D	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-01E	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-01F	Plastic 250ml HNO3 preserved	A	<2	<2	4.3	Y	Absent		PB-6020S-PPB(180)
L2300961-01G	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-01H	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-02A	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-02B	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-02C	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-02D	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-02E	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-02F	Plastic 250ml HNO3 preserved	A	<2	<2	4.3	Y	Absent		PB-6020S-PPB(180)
L2300961-02G	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-02H	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-03A	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-03B	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-03C	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-03D	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-03E	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-03F	Plastic 250ml HNO3 preserved	A	<2	<2	4.3	Y	Absent		PB-6020S-PPB(180)
L2300961-03G	Amber 250ml unpreserved	A	9	9	4.3	Y	Absent		PA-PAHSIM-LVI(7)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300961
Report Date: 03/01/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2300961-03H	Amber 250ml unpreserved	A	9	9	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-04A	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-04B	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-04C	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-04D	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-04E	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-04F	Plastic 250ml HNO3 preserved	A	<2	<2	4.3	Y	Absent		PB-6020S-PPB(180)
L2300961-04G	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-04H	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-05A	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-05B	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-05C	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-05D	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-05E	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-05F	Plastic 250ml HNO3 preserved	A	<2	<2	4.3	Y	Absent		PB-6020S-PPB(180)
L2300961-05G	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-05H	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-06A	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-06B	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-06C	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-06D	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-06E	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)
L2300961-06F	Plastic 250ml HNO3 preserved	A	<2	<2	4.3	Y	Absent		PB-6020S-PPB(180)
L2300961-06G	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-06H	Amber 250ml unpreserved	A	7	7	4.3	Y	Absent		PA-PAHSIM-LVI(7)
L2300961-07A	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-07B	Vial HCl preserved	A	NA		4.3	Y	Absent		PA-8260(14)
L2300961-07C	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2300961
Report Date: 03/01/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2300961-07D	Vial Na2S2O3 preserved	A	NA		4.3	Y	Absent		8011(14)

*Values in parentheses indicate holding time in days

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2300961
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GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.) Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: DU Report with 'J' Qualifiers

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Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA,this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

A - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

F - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

J - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively

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Data Qualifiers

Identified Compounds (TICs).

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

ND - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

V - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Z - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Report Format: DU Report with 'J' Qualifiers

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - VI, 2018.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624/624.1: m/p-xylene, o-xylene, Naphthalene
EPA 625/625.1: alpha-Terpineol
EPA 8260C/8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270D/8270E: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine, alpha-Terpineol; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.
SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS
EPA 8082A: NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B**
EPA 332: Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603, SM9222D.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522, EPA 537.1.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 1/7/23

ALPHA Job #: L23009601

ALPHA ANALYTICAL
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Client Information

Client: Terraphase Engineering
Address: 100 Canal Pointe Blvd
Princeton NJ 08540 Suite 108
Phone: 215 297 3502
Fax:
Email: nick.scala@terraphase.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Former Philadelphia Refinery.
Project Location: 3144 Passyunk Ave
Project #: P044.001.002
Project Manager: Nick Scala
ALPHA Quote #:

Turn-Around Time

☐ Standard ☒ RUSH (only confirmed if pre-approved!)
Date Due: 48 hour TAT Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

Other Project Specific Requirements/Comments/Detection Limits:
EDD@Terraphase.com
Equis EDD
* See attatched sheet for Short List compounds.

SAMPLE HANDLING
Filtration
☐ Done
☒ Not needed (lead)
☐ Lab to do (fixed)
Preservation (filtered)
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS: VOC's - Short List 1-5	SVOC's - Short List 1-5	VOC's - Short List 1-6	SVOC's - Short List 1-6	Lead	Sample Specific Comments	TOTAL # BOTTLES
009601-01	TG07-MW-05-230105	1/5/23	0950	GW	KJO			X	X	X	48 hour Rush	8
02	TG07-MW-04-230105	1/5/23	1105	GW	KJO			X	X	X	48 hour Rush	8
03	TG07-MW-01-230105	1/5/23	1420	GW	NAK			X	X	X	48 hour Rush	8
04	TG07-MW-08-230105	1/5/23	1505	GW	KJO			X	X	X	48 hour Rush	8
05	TG04-MW-01-230106	1/6/23	1030	GW	KJO	X	X			X	48 hour Rush	8
06	S-219-230106	1/6/23	0950	GW	NAK	X	X			X	48 hour Rush	8
07	TB-230106-2	1/6/23	1120	TB	KJO	X		X			48 hour Rush	8

Container Type
Preservative

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	1/6/23 1455	[signature]	1/6/23 14:55
[signature]	1/6/23 1800	[signature]	1/6/23 1800
[signature]	1/6/23 2100	[signature]	1.6.23 2100

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO. 01-01 (rev. 14-OCT-07)

- **Short List 1**. *Leaded Gasoline, Aviation Gasoline and Jet Fuel*: benzene, toluene, ethyl benzene, xylenes (total), cumene, naphthalene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 1,2-dichloroethane, 1,2-dibromoethane, and lead.
- **Short List 2**. *Unleaded Gasoline*: benzene, toluene, ethyl benzene, xylenes (total), cumene, methyl tert-butyl ether, naphthalene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.
- **Short List 3**. *Kerosene, Fuel Oil No. 1*: benzene, toluene, ethyl benzene, cumene, methyl tert-butyl ether, naphthalene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.
- **Short List 4**. *Diesel Fuel and Fuel Oil No. 2*: benzene, toluene, ethyl benzene, cumene, methyl tert-butyl ether, naphthalene, 1,2,4-trimethyl benzene, and 1,3,5-trimethyl benzene.
- **Short List 5**. *Fuel Oil Nos. 4, 5, and 6, and Lubricating Oils and Fluids*: benzene, naphthalene, fluorene, anthracene, phenanthrene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, and benzo(g,h,i)perylene.
- **Short List 6**. *Waste Oil*: benzene, toluene, ethyl benzene, cumene, naphthalene (Method 8270), pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)pyrene, and lead.

Serial_No:03012314:15

ANALYTICAL REPORT

Lab Number:	L2307343
Client:	Terraphase Engineering Inc. 100 Canal Pointe Boulevard Suite 108 Princeton, NJ 08540
ATTN:	Nick Scala
Phone:	(609) 236-8171
Project Name:	FORMER PHILADELPHIA REFINERY
Project Number:	P044.001.002
Report Date:	02/17/23

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-17-00196).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2307343-01	TG07-MW-03-230208	WATER	3144 W. PASSYUNK AVE.	02/08/23 09:55	02/10/23
L2307343-02	TG07-MW-02-230208	WATER	3144 W. PASSYUNK AVE.	02/08/23 10:05	02/10/23
L2307343-03	TG07-MW-01-230208	WATER	3144 W. PASSYUNK AVE.	02/08/23 12:10	02/10/23
L2307343-04	TG07-MW-08-230208	WATER	3144 W. PASSYUNK AVE.	02/08/23 12:35	02/10/23
L2307343-05	TG07-MW-04-230208	WATER	3144 W. PASSYUNK AVE.	02/08/23 14:40	02/10/23
L2307343-06	TG04-MW-03-230209	WATER	3144 W. PASSYUNK AVE.	02/09/23 08:45	02/10/23
L2307343-07	TG07-MW-05-230209	WATER	3144 W. PASSYUNK AVE.	02/09/23 10:10	02/10/23
L2307343-08	TG07-MW-05-230209D	WATER	3144 W. PASSYUNK AVE.	02/09/23 10:10	02/10/23
L2307343-09	S-219-230209	WATER	3144 W. PASSYUNK AVE.	02/09/23 12:00	02/10/23
L2307343-10	TG04-MW-01-230209	WATER	3144 W. PASSYUNK AVE.	02/09/23 13:30	02/10/23
L2307343-11	TG04-MW-01-230209D	WATER	3144 W. PASSYUNK AVE.	02/09/23 13:30	02/10/23
L2307343-12	FB-230209-1	WATER	3144 W. PASSYUNK AVE.	02/09/23 14:06	02/10/23
L2307343-13	TB-230209-1	WATER	3144 W. PASSYUNK AVE.	02/09/23 14:06	02/10/23
L2307343-14	FB-230209-2	WATER	3144 W. PASSYUNK AVE.	02/09/23 14:15	02/10/23
L2307343-15	TB-230209-2	WATER	3144 W. PASSYUNK AVE.	02/09/23 14:15	02/10/23

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

Volatile Organics

L2307343-12 and -14: The Field Blank has results for toluene, ethylbenzene, p/m-Xylene, and o-Xylene present above the reporting limit. The samples were re-analyzed and confirmed the original results. The results of the original analyses are reported.

Microextractables

The WG1744376-2 LCS recovery for 1,2-dibromoethane (130%), associated with L2307343-01 through -15, is outside Alpha's acceptance criteria, but within the acceptance criteria specified in the method.
The WG1744376-3/-4 MS/MSD recoveries for 1,2-dibromoethane (132%/132%), performed on L2307343-06, are outside Alpha's acceptance criteria, but within the acceptance criteria specified in the method.

Semivolatile Organics by SIM

L2307343-14: The Field Blank has a result for Naphthalene present above the reporting limit; however, re-extraction achieved similar results. Only the results of the original analysis are reported.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Caitlin Walukevich

Caitlin Walukevich

Title: Technical Director/Representative

Date: 02/17/23

ORGANICS

VOLATILES

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-01
Client ID: TG07-MW-03-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 09:55
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 16:38
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-01
Client ID: TG07-MW-03-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 09:55
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 11:11
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	0.23	J	ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	0.89		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	0.23	J	ug/l	0.50	0.17	1
p/m-Xylene	1.0		ug/l	1.0	0.33	1
o-Xylene	0.55	J	ug/l	1.0	0.39	1
Xylenes, Total	1.6	J	ug/l	1.0	0.33	1
Isopropylbenzene	2.4		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	2.8		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	104		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	106		70-130
Dibromofluoromethane	100		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-02
Client ID: TG07-MW-02-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 10:05
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 16:46
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-02
Client ID: TG07-MW-02-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 10:05
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 11:38
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	0.35	J	ug/l	1.0	0.17	1
Benzene	19		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	3.7		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	0.65		ug/l	0.50	0.17	1
p/m-Xylene	2.3		ug/l	1.0	0.33	1
o-Xylene	1.1		ug/l	1.0	0.39	1
Xylenes, Total	3.4		ug/l	1.0	0.33	1
Isopropylbenzene	30		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	0.30	J	ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	1.0	J	ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	101		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	111		70-130
Dibromofluoromethane	96		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-03
Client ID: TG07-MW-01-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 12:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 16:54
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-03
Client ID: TG07-MW-01-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 12:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 12:04
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	0.31	J	ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	107		70-130
Toluene-d8	99		70-130
4-Bromofluorobenzene	98		70-130
Dibromofluoromethane	100		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-04
Client ID: TG07-MW-08-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 12:35
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 17:03
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-04 D
Client ID: TG07-MW-08-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 12:35
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 13:23
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	40	6.6	40
Benzene	ND		ug/l	20	6.4	40
1,2-Dichloroethane	ND		ug/l	20	5.3	40
Toluene	ND		ug/l	30	8.1	40
1,2-Dibromoethane	ND		ug/l	80	7.7	40
Ethylbenzene	ND		ug/l	20	6.7	40
p/m-Xylene	ND		ug/l	40	13.	40
o-Xylene	ND		ug/l	40	16.	40
Xylenes, Total	ND		ug/l	40	13.	40
Isopropylbenzene	4600		ug/l	20	7.5	40
1,3,5-Trimethylbenzene	ND		ug/l	100	8.7	40
1,2,4-Trimethylbenzene	ND		ug/l	100	7.6	40

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	108		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	105		70-130
Dibromofluoromethane	102		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-05
Client ID: TG07-MW-04-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 14:40
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 17:11
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-05 D
Client ID: TG07-MW-04-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 14:40
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 13:49
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	4.0	0.66	4
Benzene	64		ug/l	2.0	0.64	4
1,2-Dichloroethane	ND		ug/l	2.0	0.53	4
Toluene	4.6		ug/l	3.0	0.81	4
1,2-Dibromoethane	ND		ug/l	8.0	0.77	4
Ethylbenzene	2.7		ug/l	2.0	0.67	4
p/m-Xylene	4.1		ug/l	4.0	1.3	4
o-Xylene	1.6	J	ug/l	4.0	1.6	4
Xylenes, Total	5.7	J	ug/l	4.0	1.3	4
Isopropylbenzene	360		ug/l	2.0	0.75	4
1,3,5-Trimethylbenzene	ND		ug/l	10	0.87	4
1,2,4-Trimethylbenzene	ND		ug/l	10	0.76	4

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	104		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	101		70-130
Dibromofluoromethane	90		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-06
Client ID: TG04-MW-03-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 08:45
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 17:19
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-06
Client ID: TG04-MW-03-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 08:45
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 12:30
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	0.34	J	ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	106		70-130
Toluene-d8	99		70-130
4-Bromofluorobenzene	99		70-130
Dibromofluoromethane	100		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-07
Client ID: TG07-MW-05-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 10:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 17:28
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-07 D
Client ID: TG07-MW-05-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 10:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 14:14
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	200	33.	200
Benzene	17000		ug/l	100	32.	200
1,2-Dichloroethane	ND		ug/l	100	26.	200
Toluene	350		ug/l	150	41.	200
1,2-Dibromoethane	ND		ug/l	400	39.	200
Ethylbenzene	ND		ug/l	100	33.	200
p/m-Xylene	ND		ug/l	200	66.	200
o-Xylene	ND		ug/l	200	78.	200
Xylenes, Total	ND		ug/l	200	66.	200
Isopropylbenzene	8400		ug/l	100	37.	200
1,3,5-Trimethylbenzene	ND		ug/l	500	43.	200
1,2,4-Trimethylbenzene	ND		ug/l	500	38.	200

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	104		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	103		70-130
Dibromofluoromethane	96		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-08
Client ID: TG07-MW-05-230209D
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 10:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 17:36
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-08 D
Client ID: TG07-MW-05-230209D
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 10:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 14:41
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	200	33.	200
Benzene	17000		ug/l	100	32.	200
1,2-Dichloroethane	130		ug/l	100	26.	200
Toluene	340		ug/l	150	41.	200
1,2-Dibromoethane	ND		ug/l	400	39.	200
Ethylbenzene	ND		ug/l	100	33.	200
p/m-Xylene	ND		ug/l	200	66.	200
o-Xylene	ND		ug/l	200	78.	200
Xylenes, Total	ND		ug/l	200	66.	200
Isopropylbenzene	8400		ug/l	100	37.	200
1,3,5-Trimethylbenzene	ND		ug/l	500	43.	200
1,2,4-Trimethylbenzene	ND		ug/l	500	38.	200

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	103		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	103		70-130
Dibromofluoromethane	96		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-09
Client ID: S-219-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 12:00
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 17:44
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-09
Client ID: S-219-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 12:00
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 12:56
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	0.34	J	ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	107		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	101		70-130
Dibromofluoromethane	102		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-10
Client ID: TG04-MW-01-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 13:30
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 17:52
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-10 D
Client ID: TG04-MW-01-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 13:30
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 15:07
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	5.0	0.83	5
Benzene	530		ug/l	2.5	0.80	5
1,2-Dichloroethane	ND		ug/l	2.5	0.66	5
Toluene	10		ug/l	3.8	1.0	5
1,2-Dibromoethane	ND		ug/l	10	0.96	5
Ethylbenzene	96		ug/l	2.5	0.84	5
p/m-Xylene	180		ug/l	5.0	1.7	5
o-Xylene	16		ug/l	5.0	2.0	5
Xylenes, Total	200		ug/l	5.0	1.7	5
Isopropylbenzene	64		ug/l	2.5	0.94	5
1,3,5-Trimethylbenzene	12		ug/l	12	1.1	5
1,2,4-Trimethylbenzene	47		ug/l	12	0.96	5

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	102		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	101		70-130
Dibromofluoromethane	95		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-11
Client ID: TG04-MW-01-230209D
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 13:30
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 18:01
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-11 D
Client ID: TG04-MW-01-230209D
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 13:30
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 15:33
Analyst: MJV

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	5.0	0.83	5
Benzene	510		ug/l	2.5	0.80	5
1,2-Dichloroethane	ND		ug/l	2.5	0.66	5
Toluene	9.6		ug/l	3.8	1.0	5
1,2-Dibromoethane	ND		ug/l	10	0.96	5
Ethylbenzene	89		ug/l	2.5	0.84	5
p/m-Xylene	170		ug/l	5.0	1.7	5
o-Xylene	16		ug/l	5.0	2.0	5
Xylenes, Total	190		ug/l	5.0	1.7	5
Isopropylbenzene	58		ug/l	2.5	0.94	5
1,3,5-Trimethylbenzene	11	J	ug/l	12	1.1	5
1,2,4-Trimethylbenzene	45		ug/l	12	0.96	5

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	102		70-130
Toluene-d8	100		70-130
4-Bromofluorobenzene	101		70-130
Dibromofluoromethane	94		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-12
Client ID: FB-230209-1
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:06
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 18:09
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-12
Client ID: FB-230209-1
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:06
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 09:27
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	1.4		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	0.77		ug/l	0.50	0.17	1
p/m-Xylene	2.8		ug/l	1.0	0.33	1
o-Xylene	1.6		ug/l	1.0	0.39	1
Xylenes, Total	4.4		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	108		70-130
Toluene-d8	99		70-130
4-Bromofluorobenzene	101		70-130
Dibromofluoromethane	103		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-13
Client ID: TB-230209-1
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:06
Date Received: 02/10/23
Field Prep: None

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 18:17
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-13
Client ID: TB-230209-1
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:06
Date Received: 02/10/23
Field Prep: None

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 09:54
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	106		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	102		70-130
Dibromofluoromethane	102		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-14
Client ID: FB-230209-2
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:15
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 18:26
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-14
Client ID: FB-230209-2
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:15
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 10:20
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	1.7		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	0.91		ug/l	0.50	0.17	1
p/m-Xylene	3.0		ug/l	1.0	0.33	1
o-Xylene	1.7		ug/l	1.0	0.39	1
Xylenes, Total	4.7		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	107		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	100		70-130
Dibromofluoromethane	101		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-15
Client ID: TB-230209-2
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:15
Date Received: 02/10/23
Field Prep: None

Sample Depth:
Matrix: Water
Analytical Method: 1,8011
Analytical Date: 02/14/23 18:34
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Microextractables by GC - Westborough Lab							
1,2-Dibromoethane	ND		ug/l	0.010	0.005	1	A

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-15
Client ID: TB-230209-2
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:15
Date Received: 02/10/23
Field Prep: None

Sample Depth:
Matrix: Water
Analytical Method: 1,8260D
Analytical Date: 02/13/23 10:46
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	1.0	0.17	1
Benzene	ND		ug/l	0.50	0.16	1
1,2-Dichloroethane	ND		ug/l	0.50	0.13	1
Toluene	ND		ug/l	0.75	0.20	1
1,2-Dibromoethane	ND		ug/l	2.0	0.19	1
Ethylbenzene	ND		ug/l	0.50	0.17	1
p/m-Xylene	ND		ug/l	1.0	0.33	1
o-Xylene	ND		ug/l	1.0	0.39	1
Xylenes, Total	ND		ug/l	1.0	0.33	1
Isopropylbenzene	ND		ug/l	0.50	0.19	1
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22	1
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	108		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	100		70-130
Dibromofluoromethane	102		70-130

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 02/13/23 09:01
Analyst: PID

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01-15 Batch: WG1744149-5					
Methyl tert butyl ether	ND		ug/l	1.0	0.17
Benzene	ND		ug/l	0.50	0.16
1,2-Dichloroethane	ND		ug/l	0.50	0.13
Toluene	ND		ug/l	0.75	0.20
1,2-Dibromoethane	ND		ug/l	2.0	0.19
Ethylbenzene	ND		ug/l	0.50	0.17
p/m-Xylene	ND		ug/l	1.0	0.33
o-Xylene	ND		ug/l	1.0	0.39
Xylenes, Total	ND		ug/l	1.0	0.33
Isopropylbenzene	ND		ug/l	0.50	0.19
1,3,5-Trimethylbenzene	ND		ug/l	2.5	0.22
1,2,4-Trimethylbenzene	ND		ug/l	2.5	0.19

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	106		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	101		70-130
Dibromofluoromethane	100		70-130

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8011
Analytical Date: 02/14/23 15:48
Analyst: AMM

Extraction Method: EPA 8011
Extraction Date: 02/14/23 14:40

Parameter	Result	Qualifier	Units	RL	MDL	
Microextractables by GC - Westborough Lab for sample(s): 01-15 Batch: WG1744376-1						
1,2-Dibromoethane	ND		ug/l	0.010	0.005	A

Lab Control Sample Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-15 Batch: WG1744149-3 WG1744149-4								
Methyl tert butyl ether	74		91		63-130	**21**	Q	20
Benzene	90		97		70-130	7		20
1,2-Dichloroethane	92		100		70-130	8		20
Toluene	95		100		70-130	5		20
1,2-Dibromoethane	87		100		70-130	14		20
Ethylbenzene	96		100		70-130	4		20
p/m-Xylene	95		105		70-130	10		20
o-Xylene	95		105		70-130	10		20
Isopropylbenzene	99		110		70-130	11		20
1,3,5-Trimethylbenzene	98		110		64-130	12		20
1,2,4-Trimethylbenzene	97		100		70-130	3		20

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
1,2-Dichloroethane-d4	105		107		70-130
Toluene-d8	101		100		70-130
4-Bromofluorobenzene	101		100		70-130
Dibromofluoromethane	97		97		70-130

Lab Control Sample Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2307343

Report Date: 02/17/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Microextractables by GC - Westborough Lab Associated sample(s): 01-15 Batch: WG1744376-2									
1,2-Dibromoethane	**130**	Q	-		80-120	-		20	A

Matrix Spike Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2307343

Report Date: 02/17/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-15 QC Batch ID: WG1744149-6 WG1744149-7 QC Sample: L2307343-06 Client ID: TG04-MW-03-230209												
Methyl tert butyl ether	ND	10	11	110		11	110		63-130	0		20
Benzene	ND	10	12	120		12	120		70-130	0		20
1,2-Dichloroethane	ND	10	12	120		12	120		70-130	0		20
Toluene	0.34J	10	12	120		12	120		70-130	0		20
1,2-Dibromoethane	ND	10	10	100		11	110		70-130	10		20
Ethylbenzene	ND	10	12	120		11	110		70-130	9		20
p/m-Xylene	ND	20	23	115		22	110		70-130	4		20
o-Xylene	ND	20	23	115		23	115		70-130	0		20
Isopropylbenzene	ND	10	12	120		11	110		70-130	9		20
1,3,5-Trimethylbenzene	ND	10	11	110		11	110		64-130	0		20
1,2,4-Trimethylbenzene	ND	10	11	110		11	110		70-130	0		20

Surrogate	MS % Recovery	MS Qualifier	MSD % Recovery	MSD Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	108		106		70-130
4-Bromofluorobenzene	99		98		70-130
Dibromofluoromethane	100		98		70-130
Toluene-d8	98		98		70-130

Matrix Spike Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2307343

Report Date: 02/17/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-15 QC Batch ID: WG1744149-8 WG1744149-9 QC Sample: L2307343-07 Client ID: TG07-MW-05-230209												
Methyl tert butyl ether	ND	2000	1900	95		2200	110		63-130	15		20
Benzene	17000	2000	19000	100		20000	**150**	Q	70-130	5		20
1,2-Dichloroethane	ND	2000	2000	100		2400	120		70-130	18		20
Toluene	350	2000	2300	98		2600	113		70-130	12		20
1,2-Dibromoethane	ND	2000	1800	90		2200	110		70-130	20		20
Ethylbenzene	ND	2000	2000	100		2200	110		70-130	10		20
p/m-Xylene	ND	4000	3900	98		4300	108		70-130	10		20
o-Xylene	ND	4000	3900	98		4500	113		70-130	14		20
Isopropylbenzene	8400	2000	10000	80		10000	80		70-130	0		20
1,3,5-Trimethylbenzene	ND	2000	1900	95		2100	105		64-130	10		20
1,2,4-Trimethylbenzene	ND	2000	1900	95		2100	105		70-130	10		20

Surrogate	MS % Recovery	MS Qualifier	MSD % Recovery	MSD Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	105		105		70-130
4-Bromofluorobenzene	99		99		70-130
Dibromofluoromethane	97		97		70-130
Toluene-d8	98		97		70-130

Matrix Spike Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2307343

Report Date: 02/17/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits	Column
Microextractables by GC - Westborough Lab Associated sample(s): 01-15 QC Batch ID: WG1744376-3 WG1744376-4 QC Sample: L2307343-06 Client ID: TG04-MW-03-230209													
1,2-Dibromoethane	ND	0.248	0.327	**132**	Q	0.330	**132**	Q	80-120	1		20	A

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits	Column
Microextractables by GC - Westborough Lab Associated sample(s): 01-15 QC Batch ID: WG1744376-5 WG1744376-6 QC Sample: L2307343-07 Client ID: TG07-MW-05-230209													
1,2-Dibromoethane	ND	0.25	0.281	112		0.287	115		80-120	2		20	A

SEMIVOLATILES

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-01
Client ID: TG07-MW-03-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 09:55
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 14:09
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 16:33

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	0.13		ug/l	0.10	0.05	1
Fluorene	0.41		ug/l	0.10	0.01	1
Phenanthrene	0.43		ug/l	0.05	0.02	1
Anthracene	0.09	J	ug/l	0.10	0.01	1
Pyrene	0.11		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.03	J	ug/l	0.05	0.02	1
Chrysene	0.02	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.01	J	ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	23		23-120
2-Fluorobiphenyl	68		15-120
4-Terphenyl-d14	71		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-02
Client ID: TG07-MW-02-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 10:05
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 14:26
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 16:33

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	0.33		ug/l	0.10	0.05	1
Fluorene	0.83		ug/l	0.10	0.01	1
Phenanthrene	0.83		ug/l	0.05	0.02	1
Anthracene	0.13		ug/l	0.10	0.01	1
Pyrene	0.26		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.09		ug/l	0.05	0.02	1
Chrysene	0.09	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.08		ug/l	0.05	0.01	1
Benzo(a)pyrene	0.09	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.06	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	0.06	J	ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	79		23-120
2-Fluorobiphenyl	73		15-120
4-Terphenyl-d14	63		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-03
Client ID: TG07-MW-01-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 12:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 14:42
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 16:33

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	ND		ug/l	0.10	0.05	1
Fluorene	0.02	J	ug/l	0.10	0.01	1
Phenanthrene	0.03	J	ug/l	0.05	0.02	1
Anthracene	0.02	J	ug/l	0.10	0.01	1
Pyrene	0.07	J	ug/l	0.10	0.02	1
Benzo(a)anthracene	0.05	J	ug/l	0.05	0.02	1
Chrysene	0.02	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.02	J	ug/l	0.05	0.01	1
Benzo(a)pyrene	0.02	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	87		23-120
2-Fluorobiphenyl	75		15-120
4-Terphenyl-d14	76		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-04
Client ID: TG07-MW-08-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 12:35
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 14:58
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 16:33

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	1.6		ug/l	0.10	0.05	1
Fluorene	1.9		ug/l	0.10	0.01	1
Phenanthrene	1.2		ug/l	0.05	0.02	1
Anthracene	0.18		ug/l	0.10	0.01	1
Pyrene	0.69		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.12		ug/l	0.05	0.02	1
Chrysene	0.10		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.06		ug/l	0.05	0.01	1
Benzo(a)pyrene	0.06	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.03	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	0.03	J	ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	89		23-120
2-Fluorobiphenyl	72		15-120
4-Terphenyl-d14	72		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-05
Client ID: TG07-MW-04-230208
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/08/23 14:40
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 15:14
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 16:33

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	1.1		ug/l	0.10	0.05	1
Fluorene	5.6		ug/l	0.10	0.01	1
Phenanthrene	4.4		ug/l	0.05	0.02	1
Anthracene	0.33		ug/l	0.10	0.01	1
Pyrene	0.31		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.10		ug/l	0.05	0.02	1
Chrysene	0.09	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.05	J	ug/l	0.05	0.01	1
Benzo(a)pyrene	0.06	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.02	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	0.02	J	ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	111		23-120
2-Fluorobiphenyl	88		15-120
4-Terphenyl-d14	69		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-06
Client ID: TG04-MW-03-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 08:45
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 15:31
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 23:37

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	ND		ug/l	0.10	0.05	1
Fluorene	ND		ug/l	0.10	0.01	1
Phenanthrene	ND		ug/l	0.05	0.02	1
Anthracene	ND		ug/l	0.10	0.01	1
Pyrene	ND		ug/l	0.10	0.02	1
Benzo(a)anthracene	ND		ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	89		23-120
2-Fluorobiphenyl	75		15-120
4-Terphenyl-d14	79		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-07
Client ID: TG07-MW-05-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 10:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 16:19
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 23:37

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	19		ug/l	0.10	0.05	1
Fluorene	2.7		ug/l	0.10	0.01	1
Phenanthrene	2.0		ug/l	0.05	0.02	1
Anthracene	0.22		ug/l	0.10	0.01	1
Pyrene	0.15		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.05	J	ug/l	0.05	0.02	1
Chrysene	0.03	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.03	J	ug/l	0.05	0.01	1
Benzo(a)pyrene	0.03	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.01	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	94		23-120
2-Fluorobiphenyl	74		15-120
4-Terphenyl-d14	68		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-08
Client ID: TG07-MW-05-230209D
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 10:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 17:08
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 23:37

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	21		ug/l	0.10	0.05	1
Fluorene	3.1		ug/l	0.10	0.01	1
Phenanthrene	2.3		ug/l	0.05	0.02	1
Anthracene	0.26		ug/l	0.10	0.01	1
Pyrene	0.16		ug/l	0.10	0.02	1
Benzo(a)anthracene	0.05	J	ug/l	0.05	0.02	1
Chrysene	0.03	J	ug/l	0.10	0.01	1
Benzo(b)fluoranthene	0.03	J	ug/l	0.05	0.01	1
Benzo(a)pyrene	0.03	J	ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	0.02	J	ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	112		23-120
2-Fluorobiphenyl	89		15-120
4-Terphenyl-d14	83		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-09
Client ID: S-219-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 12:00
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 17:25
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 23:37

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	ND		ug/l	0.10	0.05	1
Fluorene	ND		ug/l	0.10	0.01	1
Phenanthrene	ND		ug/l	0.05	0.02	1
Anthracene	ND		ug/l	0.10	0.01	1
Pyrene	ND		ug/l	0.10	0.02	1
Benzo(a)anthracene	ND		ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	91		23-120
2-Fluorobiphenyl	77		15-120
4-Terphenyl-d14	73		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-10
Client ID: TG04-MW-01-230209
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 13:30
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 17:41
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 23:37

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	0.19		ug/l	0.10	0.05	1
Fluorene	0.50		ug/l	0.10	0.01	1
Phenanthrene	0.04	J	ug/l	0.05	0.02	1
Anthracene	0.23		ug/l	0.10	0.01	1
Pyrene	0.02	J	ug/l	0.10	0.02	1
Benzo(a)anthracene	0.02	J	ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	97		23-120
2-Fluorobiphenyl	74		15-120
4-Terphenyl-d14	62		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-11
Client ID: TG04-MW-01-230209D
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 13:30
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 17:57
Analyst: DV

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 23:37

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	1.5		ug/l	0.10	0.05	1
Fluorene	0.55		ug/l	0.10	0.01	1
Phenanthrene	0.04	J	ug/l	0.05	0.02	1
Anthracene	0.32		ug/l	0.10	0.01	1
Pyrene	0.03	J	ug/l	0.10	0.02	1
Benzo(a)anthracene	0.02	J	ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	26		23-120
2-Fluorobiphenyl	90		15-120
4-Terphenyl-d14	74		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-12
Client ID: FB-230209-1
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:06
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 18:14
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 23:37

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	0.07	J	ug/l	0.10	0.05	1
Fluorene	ND		ug/l	0.10	0.01	1
Phenanthrene	ND		ug/l	0.05	0.02	1
Anthracene	ND		ug/l	0.10	0.01	1
Pyrene	ND		ug/l	0.10	0.02	1
Benzo(a)anthracene	ND		ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	92		23-120
2-Fluorobiphenyl	78		15-120
4-Terphenyl-d14	85		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-14
Client ID: FB-230209-2
Sample Location: 3144 W. PASSYUNK AVE.

Date Collected: 02/09/23 14:15
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water
Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 18:30
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 23:37

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS-SIM - Westborough Lab						
Naphthalene	0.11		ug/l	0.10	0.05	1
Fluorene	ND		ug/l	0.10	0.01	1
Phenanthrene	ND		ug/l	0.05	0.02	1
Anthracene	ND		ug/l	0.10	0.01	1
Pyrene	ND		ug/l	0.10	0.02	1
Benzo(a)anthracene	ND		ug/l	0.05	0.02	1
Chrysene	ND		ug/l	0.10	0.01	1
Benzo(b)fluoranthene	ND		ug/l	0.05	0.01	1
Benzo(a)pyrene	ND		ug/l	0.10	0.02	1
Indeno(1,2,3-cd)pyrene	ND		ug/l	0.10	0.01	1
Benzo(ghi)perylene	ND		ug/l	0.10	0.01	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	80		23-120
2-Fluorobiphenyl	69		15-120
4-Terphenyl-d14	75		41-149

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270E-SIM
Analytical Date: 02/12/23 13:53
Analyst: WR

Extraction Method: EPA 3510C
Extraction Date: 02/11/23 16:33

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS-SIM - Westborough Lab for sample(s): 01-12,14 Batch: WG1743500-1					
Naphthalene	ND		ug/l	0.10	0.05
Fluorene	0.03	J	ug/l	0.10	0.01
Phenanthrene	0.03	J	ug/l	0.05	0.02
Anthracene	0.02	J	ug/l	0.10	0.01
Pyrene	0.03	J	ug/l	0.10	0.02
Benzo(a)anthracene	0.04	J	ug/l	0.05	0.02
Chrysene	0.02	J	ug/l	0.10	0.01
Benzo(b)fluoranthene	0.02	J	ug/l	0.05	0.01
Benzo(a)pyrene	0.02	J	ug/l	0.10	0.02
Indeno(1,2,3-cd)pyrene	0.03	J	ug/l	0.10	0.01
Benzo(ghi)perylene	0.03	J	ug/l	0.10	0.01

Surrogate	%Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	76		23-120
2-Fluorobiphenyl	66		15-120
4-Terphenyl-d14	74		41-149

Lab Control Sample Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2307343

Report Date: 02/17/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS-SIM - Westborough Lab Associated sample(s): 01-12,14 Batch: WG1743500-2 WG1743500-3								
Naphthalene	57		59		40-140	3		40
Fluorene	62		67		40-140	8		40
Phenanthrene	58		63		40-140	8		40
Anthracene	65		70		40-140	7		40
Pyrene	66		71		26-127	7		40
Benzo(a)anthracene	67		73		40-140	9		40
Chrysene	62		65		40-140	5		40
Benzo(b)fluoranthene	64		73		40-140	13		40
Benzo(a)pyrene	70		75		40-140	7		40
Indeno(1,2,3-cd)pyrene	75		85		40-140	13		40
Benzo(ghi)perylene	65		72		40-140	10		40

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
Nitrobenzene-d5	78		81		23-120
2-Fluorobiphenyl	65		68		15-120
4-Terphenyl-d14	73		76		41-149

Matrix Spike Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2307343

Report Date: 02/17/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS-SIM - Westborough Lab Associated sample(s): 01-12,14 QC Batch ID: WG1743500-4 WG1743500-5 QC Sample: L2307343-07 Client ID: TG07-MW-05-230209												
Naphthalene	19	3.64	23	110		24	140		40-140	4		40
Fluorene	2.7	3.64	5.5	77		5.8	85		40-140	5		40
Phenanthrene	2.0	3.64	4.8	77		5.1	85		40-140	6		40
Anthracene	0.22	3.64	3.1	79		3.4	87		40-140	9		40
Pyrene	0.15	3.64	3.1	81		3.3	87		26-127	6		40
Benzo(a)anthracene	0.05J	3.64	2.5	69		2.7	74		40-140	8		40
Chrysene	0.03J	3.64	2.3	63		2.5	69		40-140	8		40
Benzo(b)fluoranthene	0.03J	3.64	2.0	55		2.2	61		40-140	10		40
Benzo(a)pyrene	0.03J	3.64	2.0	55		2.2	61		40-140	10		40
Indeno(1,2,3-cd)pyrene	0.01J	3.64	1.8	50		2.0	55		40-140	11		40
Benzo(ghi)perylene	ND	3.64	1.7	47		1.8	50		40-140	6		40

Surrogate	MS % Recovery	MS Qualifier	MSD % Recovery	MSD Qualifier	Acceptance Criteria
2-Fluorobiphenyl	77		82		15-120
4-Terphenyl-d14	68		74		41-149
Nitrobenzene-d5	103		108		23-120

Matrix Spike Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2307343

Report Date: 02/17/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS-SIM - Westborough Lab Client ID: TG04-MW-03-230209	Associated sample(s): 01-12,14			QC Batch ID: WG1743500-6		WG1743500-7			QC Sample: L2307343-06			
Naphthalene	ND	3.64	2.5	69		2.4	66		40-140	4		40
Fluorene	ND	3.64	2.7	74		2.6	72		40-140	4		40
Phenanthrene	ND	3.64	2.5	69		2.4	66		40-140	4		40
Anthracene	ND	3.64	2.8	77		2.7	74		40-140	4		40
Pyrene	ND	3.64	2.8	77		2.8	77		26-127	0		40
Benzo(a)anthracene	ND	3.64	2.8	77		2.7	74		40-140	4		40
Chrysene	ND	3.64	2.5	69		2.5	69		40-140	0		40
Benzo(b)fluoranthene	ND	3.64	2.5	69		2.5	69		40-140	0		40
Benzo(a)pyrene	ND	3.64	2.6	72		2.6	72		40-140	0		40
Indeno(1,2,3-cd)pyrene	ND	3.64	1.3	**36**	Q	1.5	41		40-140	14		40
Benzo(ghi)perylene	ND	3.64	1.1	**30**	Q	1.2	**33**	Q	40-140	9		40

Surrogate	MS % Recovery	MS Qualifier	MSD % Recovery	MSD Qualifier	Acceptance Criteria
2-Fluorobiphenyl	74		72		15-120
4-Terphenyl-d14	78		76		41-149
Nitrobenzene-d5	89		86		23-120

METALS

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-01
Client ID: TG07-MW-03-230208
Sample Location: 3144 W. PASSYUNK AVE.
Date Collected: 02/08/23 09:55
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:09	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-02	Date Collected:	02/08/23 10:05
Client ID:	TG07-MW-02-230208	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:15	EPA 3005A	1,6020B	NTB

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-03
Client ID: TG07-MW-01-230208
Sample Location: 3144 W. PASSYUNK AVE.
Date Collected: 02/08/23 12:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	0.6628	J	ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:20	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-04	Date Collected:	02/08/23 12:35
Client ID:	TG07-MW-08-230208	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:25	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-05	Date Collected:	02/08/23 14:40
Client ID:	TG07-MW-04-230208	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:31	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-06	Date Collected:	02/09/23 08:45
Client ID:	TG04-MW-03-230209	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 17:07	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-07	Date Collected:	02/09/23 10:10
Client ID:	TG07-MW-05-230209	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	0.7672	J	ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 17:13	EPA 3005A	1,6020B	NTB

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-08
Client ID: TG07-MW-05-230209D
Sample Location: 3144 W. PASSYUNK AVE.
Date Collected: 02/09/23 10:10
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	0.6277	J	ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:36	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-09	Date Collected:	02/09/23 12:00
Client ID:	S-219-230209	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:42	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-10	Date Collected:	02/09/23 13:30
Client ID:	TG04-MW-01-230209	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:47	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-11	Date Collected:	02/09/23 13:30
Client ID:	TG04-MW-01-230209D	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 18:52	EPA 3005A	1,6020B	NTB

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

SAMPLE RESULTS

Lab ID:	L2307343-12	Date Collected:	02/09/23 14:06
Client ID:	FB-230209-1	Date Received:	02/10/23
Sample Location:	3144 W. PASSYUNK AVE.	Field Prep:	Refer to COC
Sample Depth:			
Matrix:	Water		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 19:17	EPA 3005A	1,6020B	NTB

Project Name: FORMER PHILADELPHIA REFINERY
Lab Number: L2307343
Project Number: P044.001.002
Report Date: 02/17/23

SAMPLE RESULTS

Lab ID: L2307343-14
Client ID: FB-230209-2
Sample Location: 3144 W. PASSYUNK AVE.
Date Collected: 02/09/23 14:15
Date Received: 02/10/23
Field Prep: Refer to COC

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab											
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 19:23	EPA 3005A	1,6020B	NTB

Project Name: FORMER PHILADELPHIA REFINERY **Lab Number:** L2307343

Project Number: P044.001.002 **Report Date:** 02/17/23

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Dissolved Metals - Mansfield Lab for sample(s): 01-12,14 Batch: WG1743590-1										
Lead, Dissolved	ND		ug/l	1.000	0.3430	1	02/13/23 10:40	02/13/23 16:30	1,6020B	NTB

Prep Information

Digestion Method: EPA 3005A

Lab Control Sample Analysis

Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY

Project Number: P044.001.002

Lab Number: L2307343

Report Date: 02/17/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Dissolved Metals - Mansfield Lab Associated sample(s): 01-12,14 Batch: WG1743590-2								
Lead, Dissolved	97		-		80-120	-		

Matrix Spike Analysis
Batch Quality Control

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002
Lab Number: L2307343
Report Date: 02/17/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Dissolved Metals - Mansfield Lab Associated sample(s): 01-12,14 QC Batch ID: WG1743590-3 WG1743590-4 QC Sample: L2307343-06 Client ID: TG04-MW-03-230209												
Lead, Dissolved	ND	530	508.6	96		523.9	99		75-125	3		20
Dissolved Metals - Mansfield Lab Associated sample(s): 01-12,14 QC Batch ID: WG1743590-7 WG1743590-8 QC Sample: L2307343-07 Client ID: TG07-MW-05-230209												
Lead, Dissolved	0.7672J	530	510.8	96		508.3	96		75-125	0		20

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent
B	Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2307343-01A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-01B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-01C	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-01D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-01E	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-01F	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-01G	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-01H	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-02A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-02B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-02C	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-02D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-02E	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-02F	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-02G	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-02H	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-03A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-03B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-03C	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-03D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-03E	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-03F	Amber 250ml unpreserved	A	9	9	2.1	Y	Absent		PA-PAHSIM-LVI(7)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2307343-03G	Amber 250ml unpreserved	A	9	9	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-03H	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-04A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-04B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-04C	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-04D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-04E	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-04F	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-04G	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-04H	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-05A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-05B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-05C	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-05D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-05E	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-05F	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-05G	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-05H	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-06A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-06A1	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-06A2	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-06B	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-06B1	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-06B2	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-06C	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-06C1	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-06C2	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-06D	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2307343-06D1	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-06D2	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-06E	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-06E1	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-06E2	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-06F	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-06F1	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-06F2	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-06G	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-06G1	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-06G2	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-06H	Plastic 250ml HNO3 preserved	B	<2	<2	2.2	Y	Absent		PB-6020S-PPB(180)
L2307343-06H1	Plastic 250ml HNO3 preserved	B	<2	<2	2.2	Y	Absent		PB-6020S-PPB(180)
L2307343-06H2	Plastic 250ml HNO3 preserved	B	<2	<2	2.2	Y	Absent		PB-6020S-PPB(180)
L2307343-07A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07A1	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07A2	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07B1	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07B2	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07C	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07C1	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07C2	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-07D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-07D1	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-07D2	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-07E	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-07E1	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2307343-07E2	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-07F	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-07F1	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-07F2	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-07G	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-07G1	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-07G2	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-07H	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-07H1	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-07H2	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-08A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-08B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-08C	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-08D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-08E	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-08F	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-08G	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-08H	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-09A	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-09B	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-09C	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-09D	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-09E	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-09F	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-09G	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-09H	Plastic 250ml HNO3 preserved	B	<2	<2	2.2	Y	Absent		PB-6020S-PPB(180)
L2307343-10A	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-10B	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2307343-10C	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-10D	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-10E	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-10F	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-10G	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-10H	Plastic 250ml HNO3 preserved	B	<2	<2	2.2	Y	Absent		PB-6020S-PPB(180)
L2307343-11A	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-11B	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-11C	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-11D	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-11E	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-11F	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-11G	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-11H	Plastic 250ml HNO3 preserved	B	<2	<2	2.2	Y	Absent		PB-6020S-PPB(180)
L2307343-12A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-12B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-12C	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-12D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-12E	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-12F	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-12G	Amber 250ml unpreserved	A	7	7	2.1	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-12H	Plastic 250ml HNO3 preserved	A	<2	<2	2.1	Y	Absent		PB-6020S-PPB(180)
L2307343-13A	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-13B	Vial HCl preserved	A	NA		2.1	Y	Absent		PA-8260(14)
L2307343-13C	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-13D	Vial Na2S2O3 preserved	A	NA		2.1	Y	Absent		8011(14)
L2307343-14A	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-14B	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)

*Values in parentheses indicate holding time in days

Project Name: FORMER PHILADELPHIA REFINERY
Project Number: P044.001.002

Lab Number: L2307343
Report Date: 02/17/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2307343-14C	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-14D	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-14E	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-14F	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-14G	Amber 250ml unpreserved	B	7	7	2.2	Y	Absent		PA-PAHSIM-LVI(7)
L2307343-14H	Plastic 250ml HNO3 preserved	B	<2	<2	2.2	Y	Absent		PB-6020S-PPB(180)
L2307343-15A	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-15B	Vial HCl preserved	B	NA		2.2	Y	Absent		PA-8260(14)
L2307343-15C	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)
L2307343-15D	Vial Na2S2O3 preserved	B	NA		2.2	Y	Absent		8011(14)

Container Comments

L2307343-05F cap received cracked, sample is intact

*Values in parentheses indicate holding time in days

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.) Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: DU Report with 'J' Qualifiers

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA,this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

A - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

F - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

J - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

Data Qualifiers

Identified Compounds (TICs).

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

ND - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

V - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Z - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Report Format: DU Report with 'J' Qualifiers

Project Name:	FORMER PHILADELPHIA REFINERY	**Lab Number:**	L2307343
Project Number:	P044.001.002	**Report Date:**	02/17/23

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - VI, 2018.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624/624.1: m/p-xylene, o-xylene, Naphthalene
EPA 625/625.1: alpha-Terpineol
EPA 8260C/8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270D/8270E: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine, alpha-Terpineol; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.
SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS
EPA 8082A: NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B**
EPA 332: Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603, SM9222D.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522, EPA 537.1.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE 1 OF 2

Date Rec'd in Lab: 2/10/23

ALPHA Job #: L2307343

ALPHA ANALYTICAL
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Client Information

Client: Terraphase Engineering
Address: 100 Canal Pointe Blvd. Princeton, NJ 08540 St. 110
Phone: 215-297-3502
Fax:
Email: nick.scala@terraphase.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Former Philadelphia Refinery
Project Location: 3144 Passyunk Ave.
Project #: P044.001.002
Project Manager: Nick Scala
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)
Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

Other Project Specific Requirements/Comments/Detection Limits:

EDD@terraphase.com

Equis EDD

SAMPLE HANDLING

Filtration
☐ Done
☒ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

lead field filtered

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	VOC's-Short List 1-6	SVOC's-Short List 1-6	Lead	Sample Specific Comments	TOTAL # BOTTLES
07343-01	TG07-MW-03-230208	2/8/23	9:55	GW	EJ	X	X	X		
02	TG07-MW-02-230208	2/8/23	10:05	GW	KJO	X	X	X		
03	TG07-MW-01-230208	2/8/23	12:10 KJO	GW	EJ	X	X	X		
04	TG07-MW-08-230208	2/8/23	12:35	GW	KJO	X	X	X		
	~~TG07-MW-05-230208~~	~~2/8/23~~	~~14:40~~	~~GW~~	~~KJO~~ KJO	X	X	X		
05	TG07-MW-04-230208	2/8/23	14:40	GW	EJ	X	X	X		
06	TG04-MW-03-230209	2/9/23	8:45	GW	EJ	X	X	X		
06	TG04-MW-03-230209MS	2/9/23	8:45	GW	EJ	X	X	X		
06	TG04-MW-03-230209MSD	2/9/23	8:45	GW	EJ	X	X	X		
07	TG07-MW-05-230209	2/9/23	10:10	GW	KJO	X	X	X		

Container Type	
Preservative	

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	2/10/23 1400	[signature]	2/10/23 900
Paul Maggella	2/10/23	Paul Maggella	2/10/23 1640
[signature]		[signature]	2/10/23 2030

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 14-OCT-07)

CHAIN OF CUSTODY

PAGE 2 OF 2

Date Rec'd in Lab: 2/10/23

ALPHA Job #: L2307343

ALPHA ANALYTICAL
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Client Information

Client: Terraphase Engineering
Address: 100 Canal Pointe Blvd. St. 110
Princeton, NJ 08540
Phone: 215-297-3502
Fax:
Email: nick.scala@terraphase.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Former Philadelphia Refinery
Project Location: 3144 Passyunk Ave.
Project #: P044.001.002
Project Manager: Nick Scala
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)
Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

Other Project Specific Requirements/Comments/Detection Limits:
EDD@terraphase.com
Equis EDD

ANALYSIS: VOC's - Short List 1-6; SVOC's - Short List 1-6; Lead

SAMPLE HANDLING
Filtration ____
☐ Done
☒ Not needed lead
☐ Lab to do
Preservation Lead filtered
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	VOC's - Short List 1-6	SVOC's - Short List 1-6	Lead	Sample Specific Comments	TOTAL # BOTTLES
07343-07	TG07-MW-05-230209MS	2/9/23	10:10	GW	KJO	X	X	X		
07	TG07-MW-05-230209MSD	2/9/23	10:10	GW	KJO	X	X	X		
08	TG07-MW-05-230209D	2/9/23	10:10	GW	KJO	X	X	X		
09	S-219-230209	2/9/23	12:00	GW	EJ	X	X	X		
10	TG04-MW-01-230209	2/9/23	13:30	GW	KJO	X	X	X		
11	TG04-MW-01-230209D	2/9/23	13:30	GW	KJO	X	X	X		
12	FB-230209-1	2/9/23	14:06	FB	EJ	X	X	X		
13	TB-230209-1	2/9/23	14:06	TB	EJ	X				
14	FB-230209-2	2/9/23	14:15	FB	KJO	X	X	X		
15	TB-230209-2	2/9/23	14:15	TB	KJO	X				

Container Type
Preservative

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	2/10/23 14:00	[signature]	2/10/23 9:00
Paul Maggella	2/10/23	Paul Maggella	2/10/23 1690
[signature]		[signature]	2/10/23 2030

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 14-OCT-07)