Remedial Investigation Report Addendum Area of Interest 4

Former Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, Pennsylvania
Sitewide PADEP Facility ID No. 780190
Area of Interest 4 PADEP Facility ID No. 770318

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Prepared for:

Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Prepared by:

Stantec Consulting Services Inc.

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EXECUTIVE SUMMARY

This Remedial Investigation Report (RIR) Addendum has been prepared by Stantec Consulting Services Inc. (Stantec) for Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC (Evergreen) for Area of Interest (AOI) 4, also known as the No. 4 Tank Farm, at the former Philadelphia Refinery. The RIR Addendum was prepared in response to Pennsylvania Department of Environmental Protection (PADEP) comments to the AOI 4 RIR. PADEP disapproved the RIR in a letter dated June 21, 2017, citing the following deficiency: groundwater contamination at the southeast property boundary of AOI 4 has not been delineated, and the fate and transport modeling used to estimate the plume extent lacks sufficient downgradient data to support the analysis. The PADEP and United States Environmental Protection Agency (USEPA) also provided comments on the RIR that Evergreen addressed in a response to comments dated August 30, 2017.

This RIR Addendum documents the work performed by and on behalf of Evergreen in the time since the RIR disapproval. The primary objective was to address the noted deficiency through refinement and offsite expansion of the conceptual site model (CSM) dataset. Initial activities required establishing offsite access by way of agreements with the Pennsylvania Department of Transportation (PennDOT) for the Right-of-Way (ROW) area along Penrose Avenue near South 26th Street, and with Provco Penrose LLC for an eastern portion of the former SPC Corporation Act 2 facility (Provco property) south of Penrose Avenue for offsite characterization. Five monitoring wells (S-374 through S-378) were installed offsite and screened in the water-table (unconfined) aquifer to address delineation of groundwater contamination along the AOI 4 southeastern boundary. Groundwater sampling indicated that offsite petroleum contamination was present, and sufficient delineation could not be demonstrated with the expanded well dataset. Compound specific isotope analysis (CSIA) was performed on selected petroleum compounds in groundwater samples and indicated that at least three unique petroleum sources were present, warranting additional investigation of source locations concerning the AOI 4 boundary.

A high-resolution site characterization (HRSC) was performed in the area utilizing geophysics (electrical resistivity imaging) to scan the subsurface for indications of contamination sources and to select optimal locations for additional media sampling and well placement. The electrical resistivity imaging survey denoted several anomalous zones likely related to contamination, and 13 locations were chosen for targeted drilling, media sampling, and well installations. Fourteen soil borings were performed, ten of which were completed as monitoring wells (S-440 through S-449). Additional activities conducted to support the AOI 4 CSM refinement included PADEP informal file reviews for nearby properties, desktop review of publicly available data, review of historic refinery drawings, cross-section development, review of Philadelphia Water Department (PWD) sewer plans, multiple rounds of groundwater gauging, numerous rounds of groundwater sampling, soil sampling, light nonaqueous phase liquid (LNAPL) sampling, an updated vapor intrusion (VI) assessment, onsite air sampling, surface soil sampling for lead, removal of lead-impacted soil, passive carbon dioxide flux (E-Flux) sampling, additional CSIA analysis, and implementation of an environmental forensics program to explore the complex mixtures of contamination sources and relationships.

Results of the characterization activities indicate that offsite subsurface deposits within the investigation area are like what was previously described beneath AOI 4 near its southeastern boundary. Boring logs suggest that up to approximately 15 feet of urban fill is present in the shallow subsurface and may contain local areas of perched groundwater. The fill is thickest along the axis of the Penrose Avenue sewer, installed and completed in an open trench in the early to mid-1900s. Underlying the fill is a sequence of primarily muddy deposits that transition to sands and gravels to depths of up to 45 feet below ground surface (ft bgs). The deposits are interpreted to correlate to a Quaternary-age, river terrace of alluvium previously mapped to underly AOI 4. Beneath the terrace, the uppermost Cretaceous-age deposits [upper clay and upper sand units of the Potomac-Raritan-Magothy (PRM) hydrostratigraphic sequence] are generally sandy and comprise the lower part of the unconfined aquifer. Twelve of the 14 borings were performed deeply enough to confirm the presence of a regional mud layer (aquitard) correlated to the PRM middle clay unit. Boring AOI4-BH-20-03 and well S-449 were drilled through the middle clay to explore a deeper water-bearing unit (the PRM lower aquifer) and indicated that the middle clay is approximately 15 feet thick in the offsite area. Beneath the middle clay, the lower aquifer is primarily sandy and gravelly and present to a depth of at least 103 feet; the maximum depth explored offsite of AOI 4.

Well gauging and data analysis performed in support of the RIR Addendum with expansion to new offsite wells indicates that the groundwater flow patterns near the AOI 4 southeastern boundary are consistent with previous RIR datasets. In the offsite perimeter, the water table is relatively flat, with elevations just above sea level. The prevailing flow direction in this area is inferred to be south/southeast across the AOI 4 boundary, generally following topography. Although elusive, there is some indication in available datasets that groundwater may be converging near the intersection of Penrose Avenue and South 26th Street where the Penrose Avenue and Lower Schuylkill East Side Intercepting Sewers (interceptor) connect. These sewers are below the water table, and the presence of leaks in the sewer pipes would support groundwater convergence in the vicinity. In the lower aquifer, southern to southwesterly flow direction is confirmed under a shallow hydraulic gradient. Water levels from co-located well pairs support that the middle clay aquitard locally separates the water table and lower aquifer in this area.

A comprehensive analytical dataset has been compiled for soil and groundwater samples collected since the beginning of 2017 that supports the underlying complexity of the petroleum hydrocarbon contamination in the AOI 4 southeastern boundary area. In the offsite unconfined aquifer, seven constituents of concern (COCs) (benzene, ethylbenzene, 1,2,4-trimethylbenzene, MTBE, toluene, ethylene dibromide, and naphthalene) were detected in wells at concentrations above the Statewide Health Standard (SHS). Many of these COCs exceed the SHS within AOI 4 near the boundary. In the AOI 4 lower aquifer, MTBE was the only compound detected in wells at concentrations exceeding the SHS. However, at offsite lower aquifer well S-449, installed at the southern limit of investigation with water-table well S-448, concentrations of MTBE and benzene exceed the SHS.

The pattern of groundwater contamination for key indicator compounds benzene and MTBE was suggestive of offsite sources. It was found that there were documented releases of petroleum containing benzene in AOI 4, but there were no recognized MTBE sources. Potential offsite sources in reasonable proximity to the AOI 4 southeastern boundary are numerous. They could have included releases of petroleum from up to three historic service stations, an existing service station to the east currently in the

PADEP Storage Tank Corrective Action program for past petroleum releases, a refinery condensate drain line sourced in AOI 7, adjacent Act 2 Facilities with common groundwater COCs, and distal areas of the former Philadelphia Refinery outside of AOI 4. The primary mechanism for potential contaminant transport from more distal petroleum sources would be preferential flow, backups, and leakage to groundwater through the City of Philadelphia (City) combined and intercepting sewer system.

An environmental forensics sampling program was completed to bolster the routine chemistry data with a comprehensive characterization and statistical analysis of chemical compositional patterns exploring all sample media to support the characterization and delineation of AOI 4 contaminant sources. Additional CSIA samples were collected to support the forensics lines of information, and sucralose, an artificial sweetener, was analyzed in groundwater samples as a tracer for sewage intrusions. Fingerprinting of soil, LNAPL, and water samples indicate gasoline-range and light to middle distillate-range petroleum (gasoline, kerosene, #2 fuel oil, naphtha, and possibly petroleum condensate) mixtures are present in the area. A preponderance of forensics evidence supports that the petroleum signatures in select offsite soil samples and LNAPL are dissimilar to AOI 4 LNAPL (e.g., primarily offsite severely-weathered and degraded gasoline versus onsite degraded middle distillate petroleum). Similarities in groundwater petroleum signatures across the AOI 4 boundary indicate a likelihood of mixing sources, characterized by benzene and MTBE enrichment, concerning the shallower tank farm LNAPL/soil sources. Sucralose was identified in groundwater at most of the wells sampled in the area, supporting a sewer to groundwater connection in the unconfined aquifer. The highest sucralose concentration was reported for Penrose Avenue Remediation System (Penrose system) recovery well RW-703. RW-703 and other system wells were pumped for several years, removing significant quantities of groundwater and LNAPL. It is postulated and supported by the data that operation of the Penrose system was substantial enough and of sufficient duration to have actively transported contaminants onsite, from offsite locations.

The additional CSIA analyses support the presence of multiple water-table petroleum sources that are variably biodegraded across the area. Benzene CSIA data indicates that onsite wells S-223, S-240, and RW-703 contain biodegraded benzene from offsite sources near wells S-376 and S-374. Toluene CSIA data shows that onsite wells S-223, S-240, and offsite well S-378 exhibit biodegraded toluene from an offsite source area near wells S-375 and S-376. Ethylbenzene and xylene CSIA data suggest multiple sources are present, but the biodegradation pathways are less clear. MTBE CSIA analyses, which were expanded geographically to include wells from former Philadelphia Refinery and Sunoco sources outside of AOI 4 (e.g., AOI 1 and Belmont Terminal), indicate that the MTBE present in the water-table aquifer near the former Penrose remediation system (well S-240) is the least biodegraded of the samples and may be closest to an MTBE source that is distinct from a source common to points north. Lastly, CSIA analysis of key biomarker compounds cyclohexane and methylcyclohexane was performed on groundwater samples from five wells along 26th Street from AOI 8, near Maiden Lane, south to Penrose Avenue. These data indicate a common, single source of these compounds is present, and concentration data supports that the source area is most likely near the intersection of 26th and Hartranft Streets where the interceptor has a documented history of leaking.

CSIA analyses are more ambiguous in the lower aquifer but generally indicate that multiple petroleum sources have impacted the offsite AOI 4 perimeter. A key finding of the HRSC was that groundwater conditions and stratigraphy do not support a local connection between the water-table and lower aquifers.

Benzene and toluene CSIA indicate that the contamination found in well S-449 could be related to the offsite, water-table sources along Penrose Avenue or represent a mixture of these with other sources. Lastly, CSIA analysis of ethylbenzene and xylene in the lower aquifer supports an offsite source unrelated to AOI 4 and its perimeter.

The updated VI assessment was performed to evaluate the potential VI pathway to offsite receptors and present results of additional onsite air sampling completed after submitting the RIR. Indoor air and ambient air samples did not exceed the USEPA Regional Screening Levels (RSL). An initial evaluation of the potential VI pathway to offsite receptors included a review of groundwater analytical data and elevations, evaluation of LNAPL distribution, and an initial assessment of preferential pathways. This assessment identified petroleum impacts that may concern VI to the area immediately adjacent to the offsite impacted area; however, the preponderance of forensics data supports that the source(s) of contamination of potential VI concern is not from past AOI 4 releases that require offsite delineation. The initial evaluation of known utilities potentially serving as preferential pathways is presented, and it is anticipated that a more detailed analysis will be conducted and presented in a future Act 2 deliverable.

Surface soil samples were collected in 2021 for lead delineation at AOI 4 property boundary areas where previous samples contained lead above the current non-residential direct contact (NRDC) medium specific concentration (MSC) of 1,000 milligrams per kilogram (mg/kg). The sampling was performed in anticipation of a potential future change in the selected standard from the current site-specific standard (SSS) of 2,240 mg/kg to a “new” lead PADEP NRDC MSC in surface soil, which, if adopted by the PADEP, is anticipated to be close to 1,000 mg/kg. One additional soil sample was collected in AOI 4, and the goal of delineating to 1,000 mg/kg was achieved. This Addendum also describes a remedial action performed by Evergreen to remove lead-impacted soil in an area where earthwork was planned. During the project, 53.5 tons of soil were removed and disposed offsite.

Multiple weights of evidence were applied in this Addendum to address the noted deficiency in the AOI 4 RIR. The initial work supplemented by HRSC tasks and a comprehensive environmental forensics program indicates that multiple petroleum releases have impacted the AOI 4 southeastern boundary area through time. Enhanced understanding of the nature, extent, and potential transport of contamination outside AOI 4 strongly supports that most offsite impacts originated from offsite releases. Migration into AOI 4 by way of groundwater pumping at the former Penrose system is supported by CSIA, forensics, contaminant trends, and sucralose distribution. Undocumented petroleum releases from historic service stations appear to have been possible in the offsite area. The CSM dataset also supports that the Penrose Avenue sewer and interceptor are inherently leaky and are likely to function as preferential pathways for contaminant transport, allowing for more distal contamination sources to be a factor. The source assessment indicates that more soluble constituents such as benzene, toluene, and MTBE are elevated in concentration in AOI 4 and surrounding groundwater and may represent a disjoint source(s) introduced to the area by way of the City sewer system.

Based on the expanded CSM dataset presented, Evergreen and Stantec’s opinion is that sufficient delineation of AOI 4 contamination is demonstrated. A sitewide assessment of the fate and transport of petroleum related COCs in AOI 4 and other areas of the former Philadelphia Refinery will be documented in a 2022 Fate and Transport RIR. The sitewide RIR will include estimates of groundwater discharges to

City sewers and contamination sources attributed to Sunoco's operation of the former Philadelphia Refinery. Evergreen intends to install additional offsite wells in the lower aquifer downgradient of well S-449 on Conrail property to inform the sitewide fate and transport source assessment; however, property access has not yet been granted as of this RIR addendum submission. Additional forensics and CSIA analyses are in progress and will be included in the sitewide RIR to evaluate contamination sources further.

1.0 INTRODUCTION AND BACKGROUND

This Remedial Investigation Report (RIR) Addendum has been prepared by Stantec Consulting Services Inc. (Stantec) for Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC (Evergreen) for Area of Interest (AOI) 4, also known as the No. 4 Tank Farm, at the former Philadelphia Refinery (facility). A site location map is included as **Figure 1-1** and a site plan is included as **Figure 1-2**. This Addendum was prepared in response to Pennsylvania Department of Environmental Protection (PADEP) comments to the AOI 4 RIR.

The RIR was submitted to the PADEP and the United States Environmental Protection Agency (USEPA) on March 24, 2017. On June 21, 2017, PADEP issued a disapproval letter for the RIR which stated the following deficiency:

> *Offsite groundwater contamination at the southeast property boundary of AOI 4 has not been delineated as required by Title 25 Pa. Code Sections 250.408(a), (b), and (e). The plume is inferred to extend a significant distance offsite, but no offsite wells were installed. Evergreen used fate-and-transport modeling to estimate the plume extent; however, insufficient data on downgradient groundwater elevations and contaminant concentrations are available to support the analysis. The modeling involves excessive extrapolation from the source area.*

In addition to the disapproval letter, the PADEP provided other comments to the RIR for AOI 4 via electronic mail on June 29, 2017. Stantec, on behalf of Evergreen, prepared a response letter dated August 30, 2017. The document addressed a majority of the PADEP comments and stated the remaining comments would: 1) require the collection of offsite groundwater monitoring data or, 2) were to be addressed in forthcoming Act 2 reports.

The main goal of this RIR Addendum is to address the deficiencies cited in the June 21, 2017 disapproval letter. Since the submission of the 2017 RIR Addendum, Evergreen has performed additional investigation activities to support the objective of better understanding hydrogeology, groundwater flow, and contaminant distribution in groundwater at and near the southeastern boundary of AOI 4. Field activities have also been conducted in other locations along 26th Street. This report will present these data and provide a detailed analysis in an updated conceptual site model (CSM) for AOI 4 and nearby areas. Additionally, other data collected in support of the characterization of AOI 4 since March 2017 will be presented and discussed. It should be noted that this submission is not inclusive of all site investigation data collected in AOI 4 and does not include historical analyses performed for AOI 4. Only new information and updates are included in this RIR Addendum. The 2017 RIR should be referenced for previously collected data, reported background information and copies of previously referenced reports. In accordance with Act 2, the required public and municipal notices for this RIR Addendum have been prepared and issued. **Appendix A** includes a copy of the report notices and their proof of receipt/publication for this report.

At the time of the submission of the 2017 RIR, the 2012 Buyer-Seller Agreement, which was executed following the September 8, 2012 purchase and transfer of the former Philadelphia Refinery to Philadelphia Energy Solutions Refining & Marketing LLC (PESRM), was the governing legal document outlining environmental liabilities at the facility. It established that environmental conditions existing at the time of the 2012 purchase were to be managed by Sunoco (now Evergreen) and those that came into existence following the purchase date are to be managed by PESRM. On June 26, 2019, PESRM announced the closure of the facility which was referred to as the PES Philadelphia Refining Complex. As of June 26, 2020, Hilco Redevelopment Partners (HRP) completed its purchase of PESRM. HRP plans to redevelop the area of the facility on the east side of the Schuylkill River (AOIs 1-8) as a multimodal industrial park with ancillary rail infrastructure, energy infrastructure, marine capabilities, and commercial uses. Demolition activities are currently underway. HRP has no plans to operate the facility as a refinery. A 2020 amendment to the Buyer-Seller Agreement lays out an updated schedule for Act 2 submissions designed to accommodate the planned site redevelopment and acknowledges HRP's purchase of PESRM, which retains its environmental liability. Based on the change in ownership and future use of the facility, forthcoming Act 2 reports will be prepared specific to the proposed commercial/industrial use. The site constituents of concern (COCs) remain the Evergreen Petroleum Short List (**Table 1-1**).

2.0 INVESTIGATION ACTIVITES AND RESULTS

The following sections summarize the site investigation activities completed as part the remedial investigation for AOI 4 since the submittal of the 2017 RIR. Based on the findings of the RIR and the comments received from the PADEP, additional site characterization activities were completed between May 2017 and July 2021. GHD Group (GHD), Aquaterra Technologies, Inc. (Aquaterra), and Stantec completed field investigation activities in coordination with Evergreen. The fieldwork was executed in accordance with the *Evergreen Field Procedures Manual* provided in **Appendix B**. This section outlines the completed activities and briefly summarizes the results. Locations of completed activities are shown on **Figure 2-1**.

2.1 PENNDOT PROPERTY ACCESS/WELL INSTALLATION

On June 26, 2017, Evergreen, Stantec, and PADEP participated in a telephone discussion regarding the RIR disapproval. The parties discussed locations for installation of offsite monitoring wells within the Pennsylvania Department of Transportation (PennDOT) right-of-way (ROW). A figure showing the proposed locations of five monitoring wells was shared via electronic mail with PADEP on June 28, 2017 and was included in in the August 30, 2017 comment response letter. The goal of additional well installation in this area was to delineate dissolved phase impacts observed near the property boundary of AOI 4. Evergreen had been attempting since 2016 to gain access to the PennDOT property adjacent to AOI 4.

In October 2018, a drilling program was completed in the PennDOT ROW property and Provco Penrose, LLC property (Provco property). Evergreen contractors installed five monitoring wells screened in the unconfined aquifer (S-374 through S-378). Three wells are located north of Penrose Avenue on the PennDOT ROW and two are located on the south side of Penrose Avenue on the Provco property (**Figure 2-1**). Prior to the commencement of drilling, each location was cleared for subsurface utilities to a depth of 8 feet below ground surface (ft bgs) using a hydroexcavator. Utility clearing was performed by HEPACO of Philadelphia, Pennsylvania, with oversight by Aquaterra. Soil borings and monitoring well installations were performed by Total Quality Drilling LLC (TQD) of Mullica Hill, New Jersey. Drilling oversight was performed by Aquaterra. Hollow stem auger drilling methodology was utilized for the unconfined aquifer wells, and a combination of hollow stem auger and mud rotary drilling methods was utilized for the lower aquifer well. The wells were developed by TQD until groundwater produced was relatively free of turbidity. Groundwater and sediment generated during well development was temporarily staged in plastic totes. The totes were emptied by TQD using a vacuum truck and the water was treated at the facility’s wastewater treatment plant.

During drilling, split-spoon soil sampling for geologic characterization was performed on regular intervals, supplemented by continuous sampling in places at the discretion of the field technician. Soils were field screened for volatile organic compounds (VOCs) with a photoionization detector (PID), and lithologies were logged by an Aquaterra technician. Well construction details are summarized on **Table 2-1**. Well logs, including both lithologic and well construction details, are included in **Appendix C**.

Details of the groundwater sampling program will be discussed in additional detail in **Section 2.6;** however, initial sampling events conducted for the wells installed in 2018 and 2019 revealed Statewide Health Standard (SHS) exceedances of several COCs including benzene, ethylbenzene, toluene, 1,2,4-trimethylbenzene (1,2,4-TMB), 1,2-dibromoethane (EDB), and naphthalene. It was determined that additional characterization work would be necessary to delineate dissolved phase impacts observed near the property boundary of AOI 4.

2.2 GEOPHYSICAL SURVEY

In May 2019, Aquaterra oversaw a geophysical survey of the PennDOT ROW area performed by EPI Geophysics. EPI Geophysics utilized ground penetrating radar in accessible areas of the property with the goal of searching for potential underground storage tanks (USTs) or other evidence of the historic gasoline service stations that were formerly located at the property. The survey did not find evidence of these historic features. A map showing the areas scanned is included in **Appendix P**.

2.3 ELECTRICAL RESISTIVITY IMAGING

To develop a high-resolution CSM for the AOI 4 southern property boundary and adjoining offsite perimeter area, Aestus, LLC (Aestus) was contracted to conduct electrical resistivity imaging. The goal of imaging was to refine, update, and geographically expand upon the existing CSM presented in the 2017 RIR by acquiring ultra-high resolution subsurface imagery detailing the geologic framework, potential preferential pathways, and distribution of petroleum hydrocarbon related contamination. Imaging performed in the southern area of AOI 4 and at offsite properties near Penrose Avenue supported delineation of impacts to groundwater from AOI 4 sources.

The process used by Aestus to collect and analyze subsurface imagery is discussed in detail in their report provided as **Appendix N,** including supporting figures. Stantec and Evergreen worked with Aestus through review of onsite and offsite data to select areas for imaging onsite near the AOI 4 property boundary, in the PennDOT ROW, and on Provco property. Stantec oversight of Aestus for installation of 16 GeoTrax Survey™ lines (PBF-1 through PBF-16) was completed from February 24 through 29, 2020. Prior to subsurface work, PA One Call was notified and Master Locators, a subsidiary of GPRS Inc., (Master Locators) performed private utility clearance. To collect the resistivity data along each survey line, Aestus drilled small-diameter (½-inch) holes through which 3/8-inch diameter stainless steel electrodes were driven to a maximum depth of approximately 14 inches bgs to make adequate soil contact. Nominal electrode spacing ranged from 1 meter to 4 meters resulting in total line lengths of approximately 180 feet to 722 feet, allowing for imaging depths ranging from approximately 36 ft bgs to 144 ft bgs. Cables were placed at the land surface connecting the electrodes, and a 12-volt deep cycle marine battery was used to inject a current into the ground.

The results of the GeoTrax Survey™ included in **Appendix N** were used to select follow up locations for the confirmation drilling program to be described in **Section 2.4** and further discussed in **Section 4**.

2.4 CONFIRMATION DRILLING PROGRAM

Stantec designed and implemented a field program to collect subsurface data in general accordance with the suggestions provided by Aestus following the GeoTrax Survey™. Confirmation drilling activities were conducted in June through August 2020. Stantec field personnel located and staked 14 confirmation drilling locations utilizing distances from survey markers placed by Aestus during implementation of the electrical resistivity profiling. Prior to subsurface work, PA One Call was notified, and Master Locators performed private utility clearance.

A Stantec geologist oversaw drilling and performed logging of the advancement of 14 standard penetration test borings at the confirmation drilling locations. Drilling was performed by Parratt Wolff, Inc. (PWI). Test borings were continuously sampled with a split-barrel sampler to the terminal depths recommended by Aestus, except for borings CD-03/AOI4-BH-20-03 and CD-14D/S-449. These borings were sampled at regular intervals from 64 to 103 ft bgs and 49 to 87 ft bgs, respectively. Soil boring logs are included in **Appendix C**. The CD-14D/S-449 location was selected as a co-located well for delineation purposes and to take the place of deeper confirmation boring CD-03/AOI4-BH-20-03, which could not be completed as a permanent well due to ongoing construction at the Provco property.

During test boring advancement, Stantec scanned core samples with a combination PID and flame ionization detector to assess for presence or absence of organic/inorganic vapor compounds, including methane. Stantec collected 12 soil and 22 groundwater samples from discrete depths/depth intervals following Aestus' suggestions and field observations to sufficiently characterize and calibrate electrical anomalies identified in interim reporting. Soil samples were collected from the standard penetration test cores after they were split/measured/scanned. Groundwater was sampled via low-flow methodology through a two-inch diameter, three-foot long stainless-steel temporary well point installed by PWI.

A Stantec geologist specified well construction based on the boring data and performed field oversight of well installation and well development activities of ten two-inch permanent monitoring wells (S-440 through S-449). S-440 through S-448 were installed with screens in the water-table (unconfined) aquifer, and S-449 was screened in the lower (semi-confined) aquifer. Wells were developed by PWI following installation via pump/surge until the groundwater was observed to be free of turbidity. Well logs for S-440 through S-449 are included in **Appendix C**, well locations are shown on **Figure 2-1,** and well details are summarized on **Table 2-1**. Confirmation drilling locations not receiving permanent wells were tremie-grouted in place by PWI with bentonite-amended cement.

Groundwater and sediment generated during well development was temporarily staged in plastic totes. The totes were emptied by Total Quality Drilling of Mullica Hill, New Jersey using a vacuum truck and the water was treated at the facility's wastewater treatment plant. Soil cuttings and drilling mud were containerized in 55-gallon drums and disposed offsite at Clean Earth of North Jersey in Kearny, New Jersey. Disposal documentation is included in **Appendix O**.

In general, soil and groundwater samples collected during the confirmation drilling program were analyzed for the Evergreen Petroleum Short List (plus tertiary butyl alcohol [TBA]) and total petroleum hydrocarbons [TPH], separated by carbon number into the gasoline, diesel, and heavier ranges for crude oil. The groundwater samples were additionally analyzed for the general chemistry parameters nitrate, chloride, sulfate, total sulfide, ammonia as nitrogen, total iron, major ions, alkalinity as calcium carbonate, and for dissolved gasses (headspace hydrocarbons methane, ethane, and ethene). Select soil and groundwater samples were also analyzed as part of the forensics sampling program which will be described in further detail in **Section 2.8**. At a subset of temporary well points, molecular biological (DNA) samples were collected by passing purged groundwater through laboratory provided bio-flo filters. These samples were sent to Microbial Insights to be analyzed for total eubacteria (EBAC) by CENSUS® and, if warranted based on the presence of significant EBAC, the QuantArray®-Petro microarray to understand petroleum biodegradation potential and pathways through quantitative polymerase chain reaction (qPCR) functional gene analysis. Groundwater results for the depth-discrete groundwater samples are summarized on **Table 2-5** with general chemistry results included on **Table 2-7,** and total iron and major ions presented on **Table 2-9**. Soil sample results are summarized on **Table 2-11**. Soil results are screened against the soil to groundwater (S to GW) MSC and the non-residential direct contact (NRDC) MSC. Note that some samples were collected in the permanently saturated zone; therefore, the S to GW MSCs are not applicable but are shown for comparison purposes.

2.5 INVESTIGATION AT FORMER ARCO STATION

As a part of the effort to differentiate various source(s) of petroleum hydrocarbons being explored in the southern area of AOI 4 and at offsite properties near Penrose Avenue, additional investigation activities were performed at the former ARCO property located on the eastern side of 26th Street (**Figure 2-1**). The property is a former retail gasoline station and is located adjacent to and downgradient of the former Defense Supply Center Philadelphia (DSCP) facility. On January 25, 2021, soil boring ARCO-BH-21-01 was advanced on the property. Overseen by a Stantec geologist, PWI completed the soil boring to 30 ft bgs using direct push methods. Soils were field screened for VOCs with a PID, and lithologies were logged by the Stantec geologist. A soil sample was collected for forensic analysis from 28 to 30 ft bgs, in the saturated zone, near the elevation of the water table. Field observations including elevated PID readings, staining, and sheen indicated impacts at this depth. The location of ARCO-BH-21-01 is displayed on **Figure 2-1,** and the soil boring log is included in **Appendix C**. The laboratory analytical results are included in **Appendix D** and are results discussed in **Section 4.6**.

2.6 WELL GAUGING

To better assess groundwater flow patterns in the unconfined and lower aquifers, additional groundwater gauging events were conducted. Eleven groundwater gauging events were performed between May 2017 and May 2021 (see **Table 2-2**). Data was obtained for the nearby DSCP facility for four of these gauging events. Field personnel collected liquid level data, including depth to water and where applicable depth to light nonaqueous phase liquid (LNAPL) measurements, in accordance with the *Evergreen Field Procedures Manual* (see **Appendix B**). Liquid level measurements for AOI 4 collected since 2017 are summarized in **Table 2-3**. Gauging data for select lower aquifer wells in areas adjacent to AOI 4 are also included in **Table 2-4**. Note that both gauging tables contain some data from 2016 that was not reported in the RIR.

2.7 GROUNDWATER SAMPLING

Select monitoring wells were sampled during 14 events conducted between 2017 and 2021 in accordance with the *Evergreen Field Procedures Manual* (**Appendix B**). Samples were generally collected via the low flow method or the sub-LNAPL sampling method (see **Appendix B**). Refer to **Table 2-2** for a summary of the scope of work of each of the sampling events. Some of the key events are as follows:

- In 2017 through the second quarter of 2019, quarterly groundwater sampling for benzene, toluene, ethylbenzene, and xylenes (BTEX) was conducted as part of monitoring for the Penrose Remediation System.
- Evergreen conducted routine annual groundwater sampling events in 2017, 2018, 2019, and 2021. As new strategically placed wells were installed, they were added to the groundwater sampling list. Generally during these events, wells were sampled for the Evergreen Petroleum Short List of COCs. To gather more lines of information about petroleum compound distributions, potential sources, and geochemistry related to groundwater conditions, additional parameters were implemented as follows:
  - In 2018, TBA was added to the list of VOCs reported for several wells to better understand the potential for ongoing degradation of methyl tertiary butyl ether (MTBE).
  - During the 2018 annual groundwater sampling event, three wells (RW-701, S-39D, and S-218D) were sampled via two methods. In addition to sampling by the routine low flow or sub-LNAPL method, the wells were also sampled using the Speedbag HYDRASleeve™ (HydraSleeve) no purge groundwater sampling method at discrete depths. This method involves inserting the HydraSleeve, which is a weighted bag with a check valve, into the well screen to a targeted depth. The bag is designed to cause minimal disturbance to the water column when inserted and is removed rapidly using continuous upward motion, collecting an undisturbed “core” of groundwater from the desired depth in the well screen. The Hydrasleeve samples were collected for comparative purposes to investigate alternate groundwater sampling options for future events.
  - In 2021, the list of analytical parameters was expanded for investigation in the AOI 4 southeastern boundary area during confirmation drilling. In addition to the Evergreen Petroleum Short List plus TBA, the following general chemistry analyses were added: dissolved gasses, total iron, total calcium, total carbon, total inorganic carbon, total Kjeldahl nitrogen, and total alkalinity. Select monitoring wells in proximity to City of Philadelphia (City) combined sewers were also sampled for sucralose as a line of information supporting groundwater and sewage interactions (sewer leaks) (see **Appendix H** memo “AOI 4 Sucralose Monitoring and Implications for Geochemistry, Transport, and Sources”). Sucralose samples were analyzed by the Environmental Analysis Research Laboratory Southeast Environmental Research Center at Florida International University of Miami, Florida. Select wells sampled for sucralose were also sampled for pesticides (DDT and degradation products) as an additional tracer for a possible source in proximity. For enhanced understanding of the fate and transport and potential source

for petroleum compounds in the Penrose area, select wells were sampled for compound specific isotope analysis (CSIA). CSIA samples were analyzed at the University of Oklahoma, School of Geosciences (OU).

- The first sampling event to include offsite Penrose area wells conducted in November 2018 included CSIA analyses on several wells.
- In December 2019, a forensics sampling program was implemented that included soil, LNAPL, and groundwater sample characterization. This program is discussed in additional detail in **Section 2.8** and **Appendix H**.
- As described in **Section 2.4**, the 2020 confirmation drilling program included groundwater sampling from temporary, depth-discrete well points in the open borehole by low-flow methods. This was trailed by sampling of the permanent wells installed in the boreholes at completion. In addition to the Evergreen Petroleum Short List plus TBA, the following analyses were added to the sampling program and analyzed by Eurofins Lancaster Laboratories: major ions, TPH (separated by carbon number into the gasoline, diesel, and heavier ranges for crude oil), sulfide, sulfate, chloride, nitrate nitrogen, total alkalinity, ammonia nitrogen, and dissolved gases. Select samples were also analyzed for EBAC and gene expression (qPCR) by Microbial Insights.

Analytical methods used for the sampling events are as follows:

- VOCs: 8260*
- SVOCs: 8270*
- EDB: 8011
- Dissolved lead: 6010/6020
- Dissolved gasses: RSK-175
- Total inorganic carbon and total carbon: 5310
- Total Kjeldahl nitrogen: 351.2
- Total iron and major ions (calcium, magnesium, potassium, sodium): 6010
- Total alkalinity: 2320
- Pesticides: 8081
- Sulfate, chloride, nitrate nitrogen: 300.0
- TPH separated by carbon number into the gasoline, diesel, and heavier ranges for crude oil: 8260 or 8015*
- Sulfide and ammonia nitrogen: 4500
- DNA: EBAC, QuantArray®-Petro microarray
- Sucralose: Environmental Analysis Research Laboratory Southeast Environmental Research Center at Florida International University SOP-201-1-130.1
- CSIA: Hunkeler et al., 2008, OU proprietary method

* Note that modified versions of these methods were implemented by Alpha Analytical, Inc. on behalf of ChemQuants, LLC (ChemQuants) to provide more detailed scans for environmental forensics

A summary of Evergreen Petroleum Short List COCs and TBA concentrations (including stabilized field parameters) in groundwater samples collected for the AOI 4 investigation program since the beginning of

2017 is presented in **Table 2-6a** (unconfined) and **Table 2-6b** (lower aquifer wells). To aid in the analysis of contaminant distribution in the lower aquifer, groundwater sampling results from select lower aquifer wells in nearby areas outside of AOI 4 are presented on **Table 2-6c**. Groundwater sampling results for the depth-discrete temporary wells are presented on **Table 2-5**. These tables show the groundwater analytical results screened against PADEP Medium Specific Concentrations (MSCs) for non-residential properties overlying used aquifers with TDS less than or equal to 2,500 milligrams per liter (SHS). General chemistry results for monitoring wells sampled in 2021 are presented in **Table 2-7**. Sucralose results are presented on **Table 2-8,** total iron and major ions results are presented on **Table 2-9**, and pesticide results are presented on **Table 2-10**. CSIA results and environmental forensics analytical data reports are presented in **Appendix H**. Monitoring well locations are shown on **Figure 1-2**. Laboratory analytical reports for groundwater are included in **Appendix D**.

Since the beginning of 2017, up to seven COCs (benzene, ethylbenzene, 1,2,4-TMB, MTBE, toluene, EDB, and naphthalene) have been detected above the SHS in wells screened in the onsite and offsite unconfined aquifer. Lead and benzo(a)pyrene each had single detections slightly above their respective SHS in depth-discrete groundwater samples. In the lower aquifer, the only compound detected at concentrations exceeding the SHS within AOI 4 was MTBE. Outside of AOI 4, the lower aquifer well installed on the Provco property (S-449) has elevated concentrations of both MTBE and benzene.

A detailed discussion of groundwater sampling results in the context of delineation and petroleum sources will be discussed in **Section 4.6**.

2.8 ENVIRONMENTAL FORENSICS PROGRAM

An environmental forensics sampling program was completed to bolster the routine chemistry data with a comprehensive characterization and statistical analysis of chemical compositional patterns exploring all sample media to support the characterization and delineation of AOI 4 contaminant sources. CSIA samples were collected to support the forensics lines of information by investigating forensic differences in stable isotope chemistry of groundwater samples.

2.8.1 Molecular Data Exploration and Interpretive Reporting

ChemQuants was retained by Stantec on behalf of Evergreen to perform an environmental forensics investigation in support of the RIR Addendum. The initial objective was to fingerprint selected samples from the drilling program to explore the various sources identified in initial CSIA samples and where possible, to age-constrain the timing of petroleum releases. As the project evolved and the magnitude of complexity was recognized, additional samples from other areas of the former Philadelphia Refinery were added to the program, and historical forensics data from both onsite and offsite locations were digitized from paper by Stantec and provided to ChemQuants.

In its entirety, the forensics dataset explored by ChemQuants for this RIR Addendum included 30 groundwater samples, 33 LNAPL samples, and 7 soil samples. A detailed characterization report is included in **Appendix H**. Significant findings of the forensics program are presented throughout the updated CSM as a line of information supporting the conclusions presented (see **Section 4.6**).

2.8.2 CSIA Petroleum Source Implications and Biodegradation

CSIA is a powerful forensics tool that complements environmental forensics as an additional line of information regarding differentiation of sources, extent of biodegradation, and biodegradation pathways which often associate with other pathways of groundwater flow. Stantec retained MES, LLC (MES) on behalf of Evergreen to interpret the CSIA dataset and provide expertise in geochemistry on the project.

In its entirety, the CSIA dataset interpreted by MES for this RIR Addendum included 17 groundwater samples. Compounds analyzed for CSIA of carbon and hydrogen stable isotopes included BTEX, MTBE, methylcyclohexane, and cyclohexane. A detailed interpretation report is included in **Appendix H**. Significant findings of the CSIA results are presented throughout the updated CSM as a line of information supporting the conclusions presented (see **Section 4.6**).

2.9 LNAPL TRANSMISSIVITY TESTING

In 2018 and 2019, GHD performed LNAPL transmissivity testing throughout the former Philadelphia Refinery to collect data on LNAPL recoverability. Wells were selected for transmissivity testing based on the following criteria:

- Review of logs and gauging plots to identify hydrogeologic condition (confined, unconfined) and determine position of fluid levels relative to well screen intervals.
- Review of historic well gauging data to determine if any wells had either new/first-time appearance of LNAPL where a well was installed in clean soil (i.e., no evidence of petroleum hydrocarbon presence in corresponding boring log).
- Review of historic well gauging data to determine if any wells with historical LNAPL observations exhibited significant increases in apparent NAPL thickness (ANT) over time that did not correlate with water table elevation changes.
- Review of potential test well locations to ensure spatial distribution of wells.
- Review of RIRs for conclusions regarding wells with potentially mobile LNAPL.
- Review of gauging data to determine if wells met the test requirements for minimum in-well LNAPL thickness as recommended by American Society for Testing and Materials (ASTM).
- Review of 2018 and 2019 groundwater elevation data prior to LNAPL transmissivity testing in early spring 2019 to identify wells tested in late summer 2018 that exhibited significant seasonal variation in the water table.

For wells exhibiting ANT greater than 0.5 foot, transmissivity testing was performed using baildown techniques detailed in ASTM E2856-13 *Standard Guide for Evaluation of LNAPL Transmissivity* (May 2013). The LNAPL baildown testing was conducted as follows:

1. The well was gauged with an oil/water interface probe before removal of any LNAPL, and the data was recorded on a test field sheet (see **Appendix F**). Note: although the field sheet title indicates it is for a manual skimming test, this form was also used for baildown testing documentation.
2. As much LNAPL as possible was removed from the well via bailing or pumping, with care taken to minimize removal of groundwater. The LNAPL removed was placed in a container to measure and record the volume of LNAPL removed.
3. The post-evacuation monitoring (well gauging) was initially performed at high frequency, with the time between monitoring points adjusted as appropriate based on observed LNAPL recharge rates. In general, wells were initially gauged approximately ten times in the first 1-2 hours post-evacuation, then gauging frequency was reduced to half hour or hour increments with the goal of collecting at least 15 data points over the course of at least 4 to 5 hours.

For wells with ANT of between 0.2 and 0.5 foot, manual skimming tests were conducted using the techniques detailed in ASTM E2856-13. The LNAPL manual skimming tests were conducted as follows:

1. Each well was gauged with an oil/water interface probe before removal of any LNAPL, and the data was recorded on a manual skimming test field sheet, included in **Appendix F**.
2. As much LNAPL as possible was removed from the well via bailing or pumping, with care taken to minimize removal of groundwater. The LNAPL removed was placed in a container to measure and record the volume of LNAPL removed on the field sheet.
3. The post-evacuation monitoring (well gauging) was initially performed at high frequency to ensure that the LNAPL did not recover to 25% of the original in-well LNAPL thickness. Removal of LNAPL from the well was repeated before the in-well thickness had recovered to 25% of its pre-purging value. Start and stop times and volume of LNAPL purged were recorded for each purge event. If LNAPL recharge rate was slow, the well was re-purged when enough LNAPL accumulated to allow purging (typically 1 hour). The well was purged several times.

Analysis of LNAPL transmissivity results was performed following ASTM method E2856-13. For baildown tests, LNAPL transmissivity was estimated by GHD using the American Petroleum Institute *LNAPL Transmissivity Workbook: Calculation of LNAPL Transmissivity from Baildown Test Data* (API Workbook, September 2012). For manual skimming tests, a GHD-developed worksheet was used to calculate LNAPL transmissivity based on the respective calculation methodology detailed in ASTM method E2856-13. Calculations are included in **Appendix F**. The resulting LNAPL transmissivity estimates were evaluated against a de minimis LNAPL transmissivity criterion recommended by the Interstate Technology & Regulatory Council (ITRC) of 0.8 square feet per day (ft^2/day) to assist in assessing the practicability/necessity of LNAPL mass recovery.

Based on the review criteria described above, GHD selected three wells within the Penrose Avenue Remediation System (Penrose System) area (S-220, S-221, and S-241), two wells within the S-30 Remediation System area (S-29 and S-30), and two wells that had recent increases in ANT (S-104 and S-366) for transmissivity testing. The Penrose System and S-30 Remediation System were both shut down two weeks prior to the planned start of transmissivity testing events. Estimated LNAPL transmissivity values for these wells and a comparison to the ITRC de minimis criterion are presented in **Appendix F**.

Potentially recoverable LNAPL was identified at the Penrose System well S-241 in August 2018. Estimated LNAPL transmissivity at this well fell below the ITRC de minimis criterion during the subsequent testing event in April 2019, which may be attributable to ongoing LNAPL recovery and/or seasonal variations in hydraulic conditions. Estimated LNAPL transmissivity at the other targeted wells in AOI 4 tested in both 2018 and 2019 did not exceed the ITRC de minimis criterion. Further discussion of transmissivity results can be found in **Section 5.4**.

2.10 AIR SAMPLING

As a part of the continued assessment of the potential for vapor intrusion to onsite occupied buildings, an air sampling event was conducted in March 2017. A letter prepared by GHD dated August 27, 2017 summarizing the sitewide air sampling event is included as **Appendix G**. In AOI 4, one indoor air sample (AOI4-AI-17-01) and one ambient air sample (AOI4-AA-17-01) were collected. The sample locations are shown on **Figure 2-1**. GHD collected 8-hour air samples from the breathing zone which were analyzed by TO-15 for the Evergreen Petroleum Short List of VOCs by Pace Analytical Services, LLC. Field sampling forms and weather information are included in **Appendix G**. The laboratory analytical data report is included in **Appendix D**.

Laboratory analytical results of the indoor and ambient air samples screened against state, federal, occupational, and background values are presented on **Table 2-12**. Benzene, ethylbenzene, naphthalene, toluene, 1,2,4-TMB, m,p-xylenes, and o-xylenes were detected in the indoor air sample. Benzene, naphthalene, toluene, 1,2,4-TMB, and m,p-xylenes were detected in the ambient air sample. Discussion of these air sampling results will be presented in **Section 3.1**.

2.11 SOIL SAMPLING – LEAD IN SURFACE SOIL

On November 19, 2019, the PADEP Environmental Quality Board adopted a proposal to move forward in the process to update MSCs per 25 Pa. Code §250.11, which requires PADEP to periodically review MSCs and propose appropriate changes based on current published scientific information. The proposed changes included an update to the model used to evaluate non-residential exposure to lead. The update would discontinue the use of the 1991 Society for Environmental Geochemistry and Health model, commonly considered to be outdated, in favor of the widely accepted Adult Lead Methodology developed by the USEPA and published 2001. The result was a proposed change in the 0 to 2 ft bgs NRDC MSC for lead from 1,000 milligrams per kilogram (mg/kg) to 2,517 mg/kg. The new proposed NRDC MSC for lead in surface soil was similar to the site-specific standard (SSS) calculated by Evergreen in its February 24, 2015 Human Health Risk Assessment Report that used the Adult Lead Methodology model with similar inputs. During a public comment period in 2020, PADEP received many comments opposing the proposed increase in the NRDC MSC for lead, and as a result, decided to reconsider the target blood lead level of 10 micrograms per deciliter (μg/dL). This value is currently used in the PADEP's NRDC MSC calculations and Evergreen's SSS calculations. PADEP is currently considering decreasing the target blood lead level in its NRDC MSC calculations to 5 μg/dL which would result in a value close to the current surface soil NRDC MSC for lead of 1,000 mg/kg. Although Evergreen has not yet changed its selection of the SSS for lead of 2,240 mg/kg as previously approved by the PADEP, it anticipates either recalculating the value to be consistent with future changes made to the PADEP calculations or using the anticipated updated NRDC MSC. Although it would be calculated using a different model and altered inputs, the potential future 0 to 2 ft bgs NRDC MSC is anticipated to be close in magnitude to the current value of 1,000 mg/kg.

In anticipation of these potentially forthcoming changes, Evergreen identified areas near the perimeter of the former Philadelphia Refinery where lead in shallow soil may require delineation to the “new” lead NRDC MSC in surface soil for future Act 2 activities beyond remedial investigations. On April 7 and 8, 2021, Stantec used a stainless-steel hand auger to collect shallow (0 to 2 ft bgs) soil samples as close as practicable to property boundaries. One soil sample (AOI4-BH-21-01) was collected at the southwest border of AOI 4 (see **Figure 2-1**) and was submitted to Eurofins Lancaster Laboratories for analysis of lead via USEPA Method 6010. Analytical results and a comparison to the non-residential S to GW MSC and the current NRDC MSC, as a stand-in for the potential “new” selected standard, can be found in **Table 2-11**. Laboratory analytical results can be found in **Appendix D**. Lead was detected at a concentration of 250 mg/kg, which is well below the current SSS (2,240 mg/kg) and the NRDC MSC (1,000 mg/kg). Based on these analytical results, delineation to applicable standards within the boundary of AOI 4 has been achieved for lead in shallow soil.

2.12 INTERIM REMEDIAL ACTION

In May of 2018, Stantec conducted soil sampling activities on behalf of PESRM in association with the reactivation of Tank PB 848 in AOI 4. The tank reactivation project area included the extents within the containment berm for Tank PB 848 and Tank PB 252. Soil sampling was conducted in accordance with the *Onsite Soil Reuse Plan* dated January 31, 2014, and concentrations of lead in soil were below the SSS of 2,240 mg/kg. Prior to reactivation of Tank PB 848, Evergreen chose to initiate interim remedial actions to address historic lead exceedances of the SSS in soil at the following locations: AOI4-BH-13-99 (11,600 mg/kg), AOI4-BH-13-103 (3,020 mg/kg), S-381 (25,800 mg/kg), and AOI4-BH-16-011 (6,000 mg/kg). A technical memo summarizing the remedial action is included as **Appendix L**. Refer to **Appendix L** for figures showing sample and excavation locations and tables summarizing laboratory analytical results.

In July 2018, Stantec on behalf of Evergreen directed the excavation of soil within the Tank PB 848 containment dike at boring location AOI4-BH-13-99 to a depth of 2 ft bgs and collected two post-excavation soil samples. In accordance with 25 Pa. Code §250.707(b)(1)(iii) and (vi) for petroleum release sampling and excavations less than 50 cubic yards, two soil samples (AOI4-PE-01 and AOI4-PE-02) were collected from the excavated area and analyzed for lead. The soil sample results were compared to the lead SSS for shallow soil samples (0-2 ft bgs) or to the NRDC MSC for deep soil samples (greater than 2 ft bgs) and were below the applicable standards. Attainment of the SSS or SHS was demonstrated, and no further action is required with respect to AOI4-BH-13-99.

In July and August of 2018, Stantec directed the excavation of soil within the Tank PB 252 containment dike at boring locations AOI4-BH-13-103, S-381, and AOI4-BH-16-011. At AOI4-BH-13-103, soil was excavated to a depth of approximately 1 ft bgs and two post-excavation soil samples (AOI4-PE-07 and AOI4-PE-08) were collected. Lead concentrations in both samples were below the SSS, and attainment was demonstrated for this area.

Soil was excavated to a depth of approximately 2 ft bgs in the area of S-381 and AOI4-BH-16-011. Characterization and attainment samples were collected in an iterative manner, and lead concentrations in 20 post-excavation samples served to delineate and demonstrate attainment up to the toe of the tank containment berm. No further samples or excavation were conducted of the tank berm in order to maintain secondary containment integrity for the reactivation of Tank PB 848.

A total of 53.5 tons of soil was removed during the excavations and transported by SJ Transportation Co., Inc. to Clean Earth of North Jersey, Inc. in Kearny, New Jersey for treatment and disposal. Disposal documentation is included in the technical memo in **Appendix L**.

As will be described further in **Section 4.7**, Hilco Redevelopment Partners (HRP) plans to cap soils at the facility with concentrations of COCs detected above the NRDC standards, pursuant to the *Soil Management Plan* dated June 15, 2020 and approved by the PADEP and USEPA in a letter dated June 18, 2020. This cap is anticipated to demonstrate that the direct contact exposure pathway is incomplete, and attainment of the SSS through pathway elimination is anticipated to be the selected standard.

2.13 DESKTOP REVIEW OF ADDITIONAL DATA RESOURCES

2.13.1 Environmental Data Resources Review

Several parcels of land surrounding AOI 4 historically operated as gas stations or facilitated activities involving the storage and/or use of petroleum products. Stantec reviewed historic aerial imagery, Sanborn maps, United States Geological Survey (USGS) topographic maps, environmental records, and property ownership information obtained via Environmental Data Resources, Inc. in 2020 (**Appendix R**) to identify these properties.

Pertinent findings from Stantec's review of aerial imagery (fifteen maps representing the period 1940-2017), Sanborn maps (eight maps representing the period 1922-2005), and USGS topographic maps (fifteen maps representing the period 1891-2013) have been summarized below:

- A structure, identified as a filling station on Sanborn maps between 1975 and 1989 (Volume 16, Sheet 1594), is visible on aerial imagery at the southeastern corner of the South 26th Street/Penrose Avenue intersection between 1951 and 1988.
- A structure, identified as a filling station on a 1975 Sanborn map (Volume 16, Sheet 1589), is visible on aerial imagery south of AOI 4 and north of Penrose Avenue between 1962 and 1971. This structure is present on USGS topographic maps between 1967 and 1995.
- A structure, identified as a filling station on Sanborn maps between 1975 and 1989 (Volume 16, Sheet 1589), is visible on aerial imagery at the northeastern intersection of South 26th

Street/Hartranft Street between 1974 and 1981. This structure is present on USGS topographic maps between 1973 and 1985. This is the former ARCO property location (**Figure 2-1**).

- A structure, identified by the words “oil stge” (oil storage) on Sanborn maps between 1978 and 2005 (Volume 16, Sheet 1591), is present on the Provco property (**Figure 2-1**). This structure is present on USGS topographic maps between 1973 and 1995.
- A structure is visible at the eastern corner of the Pattison Avenue/Penrose Avenue intersection beginning in 1965. Sanborn maps depicting this area were not obtained. This structure does not appear on USGS topographic maps. This is the location of the current 7-Eleven Station at 2601 Penrose Avenue (**Figure 2-2**).
- A structure is visible on aerial imagery at the northwestern corner of the South 26th Street/Penrose Avenue intersection between 1953 and 1981. Two structures are present in this area, but not identified on Sanborn maps (Volume 16, Sheet 1589) between 1975 and 1978. This structure appears on USGS topographic maps between 1967 and 1985.
- A structure is visible on aerial imagery at the northeastern corner of the South 26th Street/Penrose Avenue intersection between 1945 and 1988. This structure is identified by the words “stone cutting” on a 1951 Sanborn map (Volume 16, Sheet 1589). The size of the structure appears to have been reduced in Sanborn maps between 1978 and 2005 and lacks identification. There is no structure present in this area in the corresponding 1975 Sanborn map. A structure appears in this area on a 1949 USGS topographic map, although is absent in topographic maps for subsequent years.
- An approximately 575-foot long trench south of Penrose Avenue is visible on a 1962 aerial image.

2.13.2 Records Review

Between 2018 and 2020, Stantec conducted informal file reviews at the PADEP Southeast Regional Office to obtain information on hydrogeologic and environmental conditions for bordering offsite facilities. Stantec requested environmental cleanup records and related documents for the following neighboring properties: former SPC Corporation (2600 Penrose Avenue), former Passyunk Homes (24th Street and Penrose Avenue), and a former residual waste landfill (3700 South 26th Street) as identified on **Figure 2-2**.

2.13.2.1 Provco Property (2600 Penrose Avenue)

Documents reviewed by Stantec concerning the Provco property (formerly the SPC Corporation property) include: Underground Storage Tank Closure Report Form (ELM, 1999); Site Characterization Report/Remedial Action Completion Report (Penn E&R, 2015); Site Characterization Report/Remedial Action Plan (Penn E&R, 2016a); Ground Water Attainment Demonstration letter (Penn E&R, 2016b); Remedial Action Completion Report (Penn E&R, 2017); RIR/Cleanup Plan (Vertex, 2019); and miscellaneous correspondence between SPC Corporation, their consultants, and PADEP (1991-2019).

Located to the south of AOI 4 on the southern side of Penrose Avenue, the Provco property represents a 6.65-acre parcel of commercial land that is in the process of being redeveloped. Approximately 3 acres of the western portion of the parcel is currently occupied by a Wawa food market and fueling station, while the remainder is vacant as it is being developed by the current owners, Provco Penrose, LLC. Pursuant to Vertex's 2019 RIR/Cleanup Plan, the site most recently operated as a scrap metal shredding yard (1970s up to 2013). Prior to the 1970s, it was used as railyard (mid-1900s) and a park (1920s). SPC Corporation purchased the site from Camden Iron and Metal in the mid-1980s and maintained operation as a metal shredding yard until 2013. At that time shredding operations were terminated but they continued to accept metal scrap for recycling purposes through 2016.

A deteriorated 4,000-gallon gasoline UST and a 6,000-gallon diesel UST were identified as the source of petroleum contamination in soil and groundwater during tank closure activities conducted by ELM (ELM, 1999). Both USTs were removed in 1999, and approximately 178 tons of petroleum hydrocarbon-impacted soil was excavated in 2000 (Penn E&R, 2015). The excavation area was backfilled with clean soil, though no post-excavation samples were collected prior to backfilling. Penn E&R completed additional soil characterization activities in 2015 to confirm the effectiveness of the soil remediation performed by ELM in 2000, the results of which revealed a single exceedance of the PADEP non-residential S to GW MSC for benzene. Field observations noted elevated PID measurements and sheening in the vadose zone.

The 2019 Vertex RIR/Cleanup Plan reported soils on the property were impacted by tetrachlorethylene, bis(2-ethylhexyl)phthalate, PCBs (Aroclor 1242), and metals (antimony, arsenic, lead, and mercury) at concentrations exceeding PADEP non-residential S to GW MSCs. In groundwater, several VOCs (including benzene and MTBE), SVOCs, and dissolved metals (antimony, arsenic, and lead) exceeded applicable PADEP non-residential used aquifer MSCs (Vertex, 2019).

Reports for the Provco property posed varied representations of groundwater flow direction in the unconfined aquifer. Vertex (2019) presented groundwater flow on the property to be in a northerly direction; not northwest toward the Schuylkill River or west-southwest as previously reported by Penn E&R (2016a & 2016b).

2.13.2.2 Former Passyunk Homes Property (24th Street and Penrose Avenue)

Documents reviewed by Stantec for the former Passyunk Homes property, also known as Sienna Place Homes, include a Final Report for Groundwater (Pennoni, 2006) and the Passyunk Homes Sewer Inspection Final Report (RJN Group, 2000).

The former Passyunk Homes property was a 54-acre parcel of developed residential land located east of AOI 4. The parcel was partially vacant following the demolition of public housing circa 2000, up to its redevelopment following the completion of the 2006 Final Report. The property was entered into the Act 2 program to demonstrate attainment of the Background Standard for groundwater. As had been documented by others, a petroleum hydrocarbon plume is known to exist beneath the site, with exceedances of the PADEP residential used aquifer MSC having been noted for VOCs (benzene and ethylbenzene) and SVOCs (naphthalene, bis(2-ethylhexyl)phthalate, benzo(a)anthracene, and chrysene). MTBE and chloroform detections have also been noted by Pennoni (2006) and were attributed to a leaking UST at a neighboring gas station (2601 Penrose Avenue). A 550-gallon gasoline UST is known to have existed on the site.

As was documented by others, the LNAPL plume has been attributed to offsite sources (Pennoni, 2006). An LNAPL recovery system is currently operated at the DSCP by the Defense Logistics Agency (DLA). During an inspection of the Packer Avenue Sewer (RJN, 2000), evidence of petroleum was found to exist in the combined sanitary and storm sewer pipe running beneath the site. As reported in previous RIRs for the former Philadelphia Refinery, a vapor mitigation system is currently operated to remediate vapors in the Packer Avenue Sewer.

Pennoni reported that groundwater flows to the southeast in the unconfined aquifer and lower aquifer, which is referred to as the semi-confined to artesian Farrington Sand. Pennoni noted that historical groundwater elevation figures (1920s) show a northwesterly direction of groundwater flow in the lower aquifer. Pennoni interpreted that pumping of groundwater associated with LNAPL recovery at the DSCP and former Philadelphia Refinery may be influencing flow direction.

2.13.2.3 Former Residual Landfill (3700 South 26th Street)

Documents reviewed by Stantec concerning the former residual landfill (also called Danbro, L.P.) include: Remedial Investigation and Final Report (RT Environmental, 2011) in addition to boring/well logs and data tables from various time periods.

The former residual landfill is located to the south of AOI 4 and on the southern side of Penrose Avenue. It was a 15.66-acre industrial parcel of land that operated as a rail yard from the late 1800s through the 1960s (RT Environmental, 2011). Auto shredder fluff material was later stored adjacent to the railroad embankments in the late 1970s through the early 1980s by the parties who leased the former SPC Corporation property. Historic fill, deposits of auto shredder fluff, and PCB soil impacts were found to exist onsite following several environmental investigations carried out between 1982 and 1999. Excavation and offsite disposal were conducted to remediate PCB impacts, and the site underwent a residual waste landfill closure. According to RT Environmental (2011), a 1983 site investigation report by Weston Solutions, Inc. indicated a lagoon may have been present on the property.

Groundwater at the former residual landfill was reported to be impacted by chloride, metals, MTBE, and TBA. A Final Report to address metals and chloride in groundwater was submitted in 2007. Both MTBE and TBA were detected at elevated concentrations in monitoring wells downgradient of the former residual landfill. According to a groundwater analytical results table obtained during Stantec’s file review, the maximum detected concentration of MTBE at the site was 900 micrograms per liter (µg/L) in 2007. For TBA, the maximum concentration was 32,000 µg/L in 2009. The impacts were attributed to mobile and/or construction equipment stored onsite. RT Environmental (2011) interpreted groundwater flow as trending south-southwest in the unconfined aquifer.

2.13.2.4 The 2601 Penrose Avenue 7-Eleven Station

Stantec reviewed documents submitted to PADEP for the 2601 Penrose Avenue 7-Eleven Station (formerly Sunoco). The property had multiple documented releases and is currently in the Storage Tank Corrective Action program. According to a 2006 Remedial Action Progress Report prepared by Groundwater & Environmental Services, Inc., a release was reported to PADEP in 1993 following impacts observed during UST removal. Soil and groundwater investigations were conducted, and a groundwater remediation system and soil vapor extraction system were installed. In 2001, a flex line release was detected and reported to the PADEP. According to a recent Remedial Action Progress Report prepared by Groundwater & Environmental Services, Inc. and dated September 13, 2021, the recovery systems were deactivated in 2008. Correspondence to PADEP dated September 7, 2012, titled "Request for Permission for Remediation System Decommissioning", described the history of the remediation systems. The liquid phase recovery system consisted of flow through an oil/water separator, then treatment of groundwater with multiple bag filters, an air stripper, and carbon vessels prior to release to the storm sewer through a permitted groundwater discharge. COCs in soil and groundwater at the site consist primarily of BTEX compounds, MTBE, 1,2,4-TMB, and naphthalene. Notably, benzene has been detected in soil at concentrations up to 19 mg/kg, and MTBE has been detected at concentrations up to 150 mg/kg (pre-remediation concentrations). In groundwater, benzene has been detected at concentrations up to 43,000 µg/L, and MTBE has been detected at concentrations up to 410,000 µg/L (prior to completion of remediation). In the most recent groundwater sampling event conducted in July 2021, the following COCs were detected above the SHS: benzene (1,600 µg/L), MTBE (240 µg/L), naphthalene (310 µg/L) and 1,2,4-TMB (560 µg/L). Direction of groundwater flow was mapped to the northwest toward Penrose Avenue.

2.13.2.5 Historical Tank Farm Drawings – No. 4 Tank Farm

Stantec reviewed available historical drawings related to AOI 4 tankage with respect to sources of petroleum to refine the understanding of potential fate and transport from AOI 4 sources versus offsite sources and groundwater plume locations. The following drawings are discussed in this RIR Addendum:

- Survey of South End of No. 4 Farm – Showing Property Required for Approach to the New Penrose Ferry Bridge, Phila Refinery Atlantic Yard by The Atlantic Refining Co. Engineering & Construction Dept. (Drawing 37-69B) (February 1948)
- Phila. Refinery South Yard No. 4 Farm Plan of Gulf Oil Corp. Property West Side of 26th Street by The Atlantic Refining Co. Engineering & Construction Dept. (Drawing 37-80) (May 1957)
- Phila. Refinery South Yard #4 Tank Farm, Location & Cross Section of Test Borings – Penrose Ave. by The Atlantic Refining Co. Engineering & Construction Dept. (Drawing 37-85) (August 1961)
- Details of City Steam Connection on Water Line at Penrose Ave - #4 Tank Farm by Atlantic Refining Co. (Drawing 62-19) (1961)

Of importance to informing the RIR objectives the following information was incorporated from the drawings:

- Historic Tank Farm No. 4 ASTs PB 259 and PB 260 are shown in 1948 and indicate the tanks were used to store furnace oil, gas oil, or kerosene at the time.
- The approximate eastern half of AOI 4 was owned by Gulf Oil Corporation in 1957 and was mostly undeveloped land, with the exception of the Gulf service station at 26th Street and Penrose Avenue.
- The 1961 drawings provided offsite test boring logs for the CSM and insight into the potential source of leaking water near an area of groundwater mounding in AOI 4 (see **Section 4.2.2**).

2.13.3 PA One Call Response Information

PA One Calls were performed prior to invasive field work as a part of the field programs for the RIR Addendum. Member responses indicated that an underground drain line traversed the project drilling area for which a design drawing was obtained:

- Waste Disposal Location Plan South of Tank # 253, Sunoco Inc. (R&S) (Drawing No. 9-0-3D/14002D dated March 7, 2007)

Correspondence with former refinery personnel indicated that the line drained steam condensate from the 1232 Fluidized Catalytic Cracking Unit (FCCU) in AOI 7 of the former Girard Point Refinery. This is the same line that was used to discharge the Penrose System effluent by way of permit to the City storm sewer in Penrose Avenue.

2.13.4 Philadelphia Water Department Correspondence

In early 2021, Stantec and Evergreen corresponded with the Philadelphia Water Department (PWD) to generally discuss the City's sewer system in proximity to the former Philadelphia Refinery and gain a better understanding of the sewer flows between combined (trunk) sewers, the Schuylkill River, and the intercepting sewer beneath South 26th Street. In September 2021, additional correspondence with the PWD was completed to obtain information on the Penrose Avenue Sewer.

In general, the City sewer system in the project area includes an intercepting sewer (26th Street Interceptor), a shallow, combined or trunk sewer (Penrose Avenue Sewer), and a storm sewer that captures runoff from catch basins and inlets along the roadways. The intercepting sewer was constructed in the 1960s and the objective was to have that sewer intercept or capture and divert sewage away from the Schuylkill River and to one of the City's wastewater plants for treatment. The chamber where the flow is diverted from Penrose Avenue Sewer into the 26th Street Interceptor is located near the southwestern corner of the roadway intersection. The shallow storm sewer that received the refinery drain line and Penrose system discharges drains into the Penrose sewer east of the intercepting chamber. The City keeps track of combined sewer overflows to the Schuylkill River when the intercepting sewer is unable to accept more flow, generally during rainfall events.

Additional detail on these sewers was provided in the AOI 4 RIR. Drawings recently received by Stantec from the PWD in the time since the AOI 4 RIR are included in **Appendix S**.

2.14 NATURAL SOURCE ZONE DEPLETION

To support the sitewide CSM and provide data to be used for decision-making with respect to future remedial measures at the site, Evergreen completed a sampling event to collect data on estimated rates of natural source zone depletion (NSZD). E-Flux, LLC (E-Flux) supplied samplers (Fossil Fuel Traps) and associated field components for deployment and retrieval by Stantec. On April 26, 2021, Stantec deployed ten samplers at selected locations across the facility to passively measure carbon dioxide (CO_2) fluxes. One of the traps, AOI4-FFT-21-09, was deployed in AOI 4, near well RW-705 (**Figure 2-1**). Stantec installed the 4-inch diameter receiver approximately 2 inches into the subsurface, inserted the sampler, and attached a protective rain cover. Generally, a two-week sampling period is recommended; however, following consultation with E-Flux, the sampling period was extended to three weeks with the goal of obtaining representative samples during the rainy season. Following the three-week sampling period, the traps were removed, packed, and shipped to E-Flux for analysis of total sorbed CO_2 based on ASTM Method D4373-14 and fossil fuel-based CO_2 contribution by radiocarbon analysis based on ASTM Method D6966-18. CO_2 flux, which was calculated based on deployment time, was converted to a LNAPL depletion rate in gallons/(acre-year). Additional details regarding the Fossil Fuel Traps and deployment procedures are outlined in E-Flux's report and Deployment Standard Operating Procedure (SOP) (**Appendix M**). The measured rate of NSZD at location AOI4-FFT-21-09 (lab sample ID 10193-R1-CO2-09) was 615 gallons/(acre-year).

2.15 REMEDIATION SYSTEM UPDATE

The 2017 RIR included a summary of the history of the operation of remediation systems in AOI 4. Updates on operational status and recovery continues to be submitted to PADEP on a semi-annual basis in Evergreen's Groundwater Remediation Status Reports for the facility. Changes in the remediation systems operation since the submission of the 2017 RIR are summarized in this section.

2.15.1 S-30 Remediation System

At the time of the RIR submission in March 2017, the S-30 Remediation System was inactive, having been operated from 1996 through 2010. On March 28, 2018, the system was reactivated due to an accumulation of LNAPL. The S-30 Remediation System consists of an LNAPL pump, probe assembly, and control panel. The recovered LNAPL is stored in a 2,500-gallon holding tank, the contents of which are pumped out as needed and placed in an onsite slop tank. As indicated in the *Former Philadelphia Refinery Remediation Program Groundwater Remediation Status Report, First Half 2021* submitted July 30, 2021, the system had recovered 40,359 gallons of LNAPL through the end of June 2021. A total of 709 gallons have been recovered since the system was restarted in 2018 (1.7% of the total).

2.15.2 Penrose Avenue Remediation System

The installation of an in-situ Submerged Oxygen Curtain (iSOC) was initiated at the Penrose Avenue Remediation System during the second half of 2018. The system consisted of seven oxygen injection points located in RW-706, RW-709, RW-711, RW-712, RW-713, RW-714, and RW-715 with the purpose of creating an oxygen barrier to accelerate the natural degradation of petroleum hydrocarbons. The iSOC system was turned off April 7, 2020.

The Penrose System was operated until March 10, 2020, when the groundwater remediation system was taken out of service pending approval of the PWD discharge permit renewal. The permit was later renewed by PWD; however, the groundwater remediation system remained out of service for monitoring of rebound conditions. System evaluation indicates that the existing technology has remediated the area to within its limits and future cleanup plans will provide additional evaluation of the area to determine if other remediation technologies are necessary.

Groundwater and LNAPL recoveries over the lifetime of the Penrose System are presented in **Figure 4-16** and **Figure 4-17**, respectively. Hydrographs showing groundwater elevations of the recovery wells and selected observation wells are shown on **Figure 4-15**.

3.0 UPDATED VAPOR INTRUSION ASSESSMENT

Previous reporting has presented data and discussions regarding the potential vapor intrusion pathway for onsite receptors. This section will add to the discussion by providing analysis of onsite data collected since submittal of the 2017 RIR. PADEP comments to previous reports have pointed out that an examination of the potential vapor intrusion pathway for offsite receptors has not been previously presented. An additional purpose of this section is to conduct an initial assessment of the potential for vapor intrusion to offsite receptors through review and evaluation of both onsite and offsite data. This assessment is guided by PADEP Land Recycling Program Technical Guidance Manual, Section IV: Vapor Intrusion (VI Guidance) and includes a review of groundwater analytical data and elevations, evaluation of LNAPL distribution, and an initial assessment of preferential pathways.

3.1 ONSITE AIR SAMPLING RESULTS

As described in **Section 2.10**, additional onsite vapor intrusion investigation activities were conducted in 2017. With input from PADEP on an air sampling work plan, a sitewide air sampling event was conducted in 2017. The buildings included in the sampling were occupied (defined as being occupied for at least 15 minutes daily), were unvented, and were in contact with the ground or were skirted buildings. A table of the buildings is presented in **Appendix G**. In AOI 4, the building sampled was:

- Building 15: 15 Pump House (AOI4-AI-17-01)

Building and sample locations are shown on **Figure 3-1**. An ambient air sample (AOI4-AA-17-01) was collected in an upwind location which, on the day of the sampling, was southeast of 15 Pump House.

Table 2-12 presents the air sampling results compared to the following risk-based screening levels and occupational criteria:

- USEPA Regional Screening Levels (RSL) for Composite Worker Air; Target Risk (TR)=1E-5, Target Hazard Quotient (THQ)=0.1
- PADEP vapor intrusion non-residential SHS indoor air screening values (SVIA-NR SHS)
- PADEP vapor intrusion non-residential SSS indoor air screening values (SVIA-NR SSS), 1/10 of the SVIA-NR SHS
- Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL)
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV)
- National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (REL)

Also shown on **Table 2-12** are comparisons to USEPA's background residential indoor air values and PADEP background levels. PADEP has operated a network of air toxics monitoring stations that analyze for VOCs. Regional ambient air quality in the Philadelphia area where the former Philadelphia Refinery is located is best represented by data from the Marcus Hook monitoring station.

The VI Guidance establishes the EPA RSLs, TR=1E-5, THQ=0.1 as appropriate screening values when it can be demonstrated that vapor intrusion is the only complete exposure pathway for a receptor. Upon the completion of remediation activities, it is anticipated that volatilization to the breathing zone will be the only potentially complete pathway onsite for petroleum impacts in AOI 4. SSS for VOCs are not anticipated to be calculated for onsite receptors. There were no exceedances of the EPA RSLs in the sample collected from 15 Pump House (AOI4-AI-17-01) or the ambient air sample (AOI4-AA-17-01). Additionally, no COCs were detected in either sample above USEPA's background residential indoor air values or occupational criteria.

It should be noted that buildings in former Point Breeze Refinery are planned to be demolished as part of the redevelopment process including 15 Pump House. As outlined in their *Soil Management Plan* dated June 15, 2020, HRP intends to install vapor mitigation measures on newly constructed buildings or conduct sampling to demonstrate that controls are not necessary.

3.2 GROUNDWATER TO VAPOR INTRUSION SCREENING

Since the groundwater to indoor air pathway is potentially of concern for offsite receptors in proximity to AOI 4, a review of groundwater elevations and analytical results were conducted to evaluate this pathway.

3.2.1 Groundwater Elevations and Subsurface Composition

As described in the VI Guidance, the vertical proximity distance from ground surface to dissolved phase impacts can be used to evaluate whether COC impacts are at a distance from a potential receptor that could present a concern for exposure. The vertical proximity distance for petroleum hydrocarbons is five feet for hydrocarbon dissolved phase impacts and LNAPL, and its application requires the presence of acceptable soil or soil-like material, as defined in the VI Guidance. Generally, in southeastern AOI 4 and nearby offsite areas, shallow subsurface materials consist of silts, clays, and sands. Fill is present in some places and can contain coarser debris but does not appear to be widespread in extent or thickness. The VI Guidance notes "Natural soils and fill (including gravel) coarser than sand or with air-filled porosity greater than silt may not constitute acceptable soil." According to this distinction, subsurface materials in the offsite area near AOI 4 appear to meet the condition of "acceptable soil" meaning that the vertical proximity distance can be used. In the offsite Penrose area, the shallowest groundwater has been observed in S-440 (approximately 8 to 10 ft bgs) and on the Provco property at S-377 and S-378 (approximately 9 to 12 ft bgs). This would indicate that in areas near the site, the vertical proximity distance could be used for dissolved phase impacts, but not for impacts from LNAPL.

3.2.2 Groundwater Analytical Results – VI Screening

As an additional line of evidence, concentrations of dissolved COCs in wells near the downgradient property boundaries were reviewed to support the evaluation of the potential vapor intrusion pathway to offsite receptors. **Table 3-1** shows concentrations of VOCs in groundwater in wells screened in the unconfined aquifer. These results are compared to the PADEP non-residential groundwater statewide health standard vapor intrusion screening values (SVGW-NR). The non-residential criteria were selected because the offsite areas in the immediate vicinity of AOI 4 are zoned for industrial use as presented in the zoning map submitted as a part of Evergreen's August 28, 2021 response to PADEP comments on the Public Involvement RIR, and the statewide health standard screening value was selected because the VI Guidance identifies this value as appropriate for use in defining a potential vapor intrusion source, even when the selected standard is the SSS. Groundwater results since 2017 for Evergreen Short List VOCs in monitoring wells located near the property boundary and offsite show exceedances of the SVGW-NR only for benzene, ethylbenzene, and 1,2,4-TMB. The locations of the exceedances are shown on **Figure 3-1**. As noted in **Section 3.2.1**, the dissolved phase impacts in this area would be outside of the vertical proximity distance for petroleum impacts. However, it should be noted that the offsite impacts in shallow groundwater are not delineated. As will be discussed in detail in **Section 4**, data collected in the RIR Addendum effort suggest that the dissolved hydrocarbon impacts in this area do not originate from a release in AOI 4.

3.2.3 LNAPL Distribution

As described in the VI Guidance, the vertical proximity distance for petroleum hydrocarbons is 15 feet for separate phase liquids including LNAPL. **Figure 3-1** shows the maximum ANT values from 2017 through 2021 for wells in and adjacent to AOI 4. No current buildings are present within the horizontal proximity distance (30 feet) of wells showing ANT. However, well S-377 has shown ANT in the past at a depth that is not deep enough to satisfy the vertical proximity distance (15 feet), and the property is currently under redevelopment. Controls will be needed to mitigate any potential vapor intrusion to planned buildings. Vertex (2019) indicates that Provco intends to install vapor barriers for buildings planned as part of the property redevelopment. These mitigation actions are presented in Provco's reporting as a part of the Act 2 process for releases at the property in pursuit of attainment of the SSS via pathway elimination for the Provco property Act 2 site.

3.2.4 Assessment of Preferential Pathways

Preferential pathways can serve as conduits for the migration of hydrocarbon vapors, and to perform a complete vapor intrusion assessment, an assessment of their presence/absence must be conducted. This section describes an initial evaluation of known utilities that may have the potential to act as preferential pathways. **Figure 3-1** shows the locations of currently known utilities within and near AOI 4 that may serve as preferential pathways. Some of utilities are in proximity to areas of COCs in groundwater above the SVGW-NR. The assessment of preferential pathways should not be considered complete at this time. It is anticipated that a more detailed analysis of the potential for these utilities to act as preferential pathways for the migration of VOCs will be conducted and presented in a future Act 2 deliverable.

4.0 UPDATES TO CONCEPTUAL SITE MODEL

This section outlines updates to and expansion of the CSM provided in the AOI 4 RIR to incorporate new data collected since the previous submittal with refined interpretations. The primary objective of the CSM update is to provide information supporting characterization and delineation of AOI 4 contamination near the southeastern AOI 4 boundary, primarily within offsite PennDOT ROW property. Updates to the conceptual understanding of past and present conditions identified at AOI 4 and nearby proximity are summarized in this section.

4.1 DESCRIPTION AND SITE USE

- As of June 26, 2020, HRP completed its purchase of PESRM.
- HRP plans to redevelop the area of the facility on the east side of the Schuylkill River (AOIs 1-8) as a multimodal industrial park with ancillary rail infrastructure, energy infrastructure, marine capabilities, and commercial uses. HRP has no plans to operate the facility as a refinery and is currently conducting decommissioning and demolition activities at the former Philadelphia Refinery.
- Current site use of areas near AOI 4 that are relevant to the additional investigation field activities include:
    - PennDOT ROW: located adjacent to the southeast of AOI 4, north of Penrose Avenue, and west of 26th Street, currently unoccupied vegetated property
    - Provco property: located south of Penrose Avenue and AOI 4, currently being redeveloped for commercial use
- Historical aerial imagery, fire insurance maps, and city directory information indicate that retail service stations (filling stations) were present in the offsite AOI 4 area (see **Section 2.13.1** and **Appendix R**). Two of the stations were present near the northwestern corner of Penrose Avenue and South 26th Street. Historical refinery drawings in **Appendix Q** confirm the Environmental Data Resources, Inc. report findings that the western station was owned by ARCO, and the eastern station was owned by Gulf. An additional, un-named filling station was present on the southeastern corner of the same intersection but slightly outside of the investigation area. Also of note is the apparent construction or repair of the Penrose Avenue sewer in a 1962 aerial photograph near 26th Street and Lanier Avenue.

4.2 GEOLOGY AND HYDROGEOLOGY

4.2.1 Depositional Sequences and Lithologies

Lithologic logs for wells installed since the AOI 4 RIR were reviewed in context with previous RIR findings to refine the CSM and compare AOI 4 offsite conditions to those previously characterized onsite. Up to approximately 15 feet of urban fill is apparent in the shallow subsurface and may contain local areas of perched groundwater. The fill is thickest along the axis of the Penrose Avenue sewer and in historically low areas, generally south of Penrose Avenue. The fill is heterogeneous in nature and consists of an admixture of sediment with debris including stones, coal, cinders, glass, wood, and bricks. Approximately two to four feet of Holocene-age alluvium (mostly soft, marsh mud with occasional sand and gravel) is interpreted to be present beneath the thickest filled areas representing where marshland was reclaimed.

Pleistocene-age deposits were interpreted through correlation to be present beneath the fill and Holocene-age deposits, where present. The Pleistocene-age deposits form a subtle river terrace that consists of a sequence of alluvium beginning with an upper, two to 18-foot thick, muddy (admixture of clay and silt with occasional very fine to fine sand) layer underlain by granular deposits of mostly sand and heterogeneous gravel (varicolored mudstone, siltstone, quartz, metamorphic rocks) to depths of up to approximately 42 ft bgs. Wells S-374 through S-378, S-440, and S-448 were installed in this layer as it commonly contains the water table, and its character and extent are consistent with the layer in which most onsite contaminants are located.

Cretaceous-age deposits are interpreted to be present below Pleistocene-age deposits and were observed to be predominantly sandy to the depth of the Potomac-Raritan-Magothy (PRM) middle clay unit aquitard (middle clay). The sands are generally denser, more well-sorted, and on average contain less matrix fines (less silt/clay) than the Pleistocene-age deposits. Like AOI 4, the PRM upper clay unit is fine-grained but thin and discontinuous across the offsite AOI 4 area. A discontinuous upper clay allows the PRM upper sand unit to be in direct hydraulic connection with Pleistocene-age deposits so that they form part of the water-table aquifer in this area. Wells S-441 through S-447 were constructed to intersect the upper sand and where feasible, co-located with wells screened across the water table (e.g., S-374 and S-444) so that vertical gradients and contaminant distributions could be evaluated between the depositional units in the water table (i.e., the water-table is comprised of two depositional units and the new wells were installed to characterize each).

Twelve of 14 borings performed in the project area were drilled deeply enough to confirm the presence of the middle clay. The middle clay in the investigation area is generally a white, red, and dark gray mud layer that has a low moisture content and a medium to high plasticity with some lignite zones. Boring AOI4-BH-20-03 and well S-449 were drilled through the middle clay to explore the lower aquifer and indicated that the middle clay is approximately 15 feet thick in the offsite area. Beneath the middle clay, the lower aquifer is primarily sandy and gravelly and present to a depth of at least 103 feet; the maximum depth explored offsite of AOI 4. Well S-449 was co-located with water-table well S-448 and installed to intersect the sandy interval below the interpreted middle clay to support characterization of a geophysical anomaly observed by Aestus at AOI4-BH-20-03 (CD-03) where a permanent well could not be installed due to ongoing Provco property development.

Stratigraphic profiles F – F' and G – G' (see **Figures 4-11, 4-12, and 4-13**) were developed by Stantec as part of a facility-wide mapping effort to inform the fate and transport assessment expected to be completed in 2022. The profiles were included in the AOI 4 RIR, updated for the response to PADEP comments, and have been further updated for this addendum to include more recent groundwater surfaces and updated geologic unit terminology (e.g., distinguished between Holocene-age and Pleistocene-age alluvium). The locations of these two profiles were chosen to better understand AOI 4 subsurface conditions with respect to neighboring AOIs and adjacent properties, with a primary goal of understanding middle clay continuity. The profiles were also chosen to explore possible interactions between groundwater, the Schuylkill River, and possible exchanges of groundwater between aquifers and sewers.

Figure 4-14 presents an estimation of the middle clay's thickness in and around AOI 4 from picks made by Stantec on boring logs. The middle clay is a regional aquitard previously presented to separate and define the facility's two mappable aquifers (see **Section 4.2.2.**). The figure indicates that the middle clay varies in thickness but is generally 10 to 20 feet thick beneath the southeastern and southern AOI 4 area. The middle clay is thinner towards northwestern AOI 4 in a pattern that orients northeast to southwest to areas in the former Girard Point Refinery and offsite, where the middle clay is absent (see **Figure 4-13**). As to the AOI 4 Addendum area near Penrose Avenue, the middle clay unit aquitard appears to be of sufficient thickness to locally separate the aquifers which is key to understanding pathways of contaminant transport being considered (see **Section 4.7**).

4.2.2 Hydrostratigraphic Units

4.2.2.1 Water-Table (Unconfined) Aquifer

The AOI 4 RIR provided the basis for characterization of water-table conditions at AOI 4. This RIR Addendum includes a set of five figures (**Figures 4-1a through 4-1e**) for 2018 to 2021 gauging events that included the newly installed offsite wells as they became available. It is noted that for the first gauging event in November 2018, water level and well survey data was pulled from available records for the Provco property (Provco wells LMW-2, LMW-3, LMW-4, LMW-6, LMW-7, LMW-11) and utilized in conjunction with Evergreen data. It is also noted that some gauging events were area-specific, so the extents shown in the figures are not always the same. An effort was made to present data from sitewide gauging events that captured AOI 4 plus outside perimeter areas, including data from the former DSCP facility where available. When reviewing the maps, it should be noted that the Penrose System (see **Section 2.15.2**) was pumped near-continuously in the area up until March 10, 2020; therefore, the 2018 and 2019 datasets were collected during an active pumping period (pumping wells are not used in contouring).

The water-table figure set indicates groundwater flow patterns near the AOI 4 southeastern boundary are consistent with previous RIR datasets. In the offsite perimeter, the water table is relatively flat and vertical gradients are minimal with near-equal elevations indicated by the water-table well pairs. The prevailing flow direction in this area is inferred to be south/southeast across the AOI 4 boundary, generally following topography. Within central AOI 4, there is an area of higher groundwater related to higher topography that forms a divide in the pattern of flow. Another prominent feature on the AOI 4 water-table maps is a persistent area of groundwater mounding near well S-233 that is thought to be caused by a leaky underground, high-pressure water line. A capture zone is suggested by the data enveloping the Penrose System pumping wells (when operating), although the mounding tends to obscure some of the area data.

Although elusive, there is some indication in available datasets that groundwater may be converging near the intersection of Penrose Avenue and South 26th Street where the Penrose Avenue and Lower Schuylkill East Side Intercepting Sewers (interceptor) connect. These sewers are below the water table and the presence of leaks in the sewer pipes would support groundwater convergence in the vicinity. Another example of persistent groundwater convergence is shown in the larger datasets near a presumed sewer leak in AOI 1 along 26th Street, in the vicinity of well S-44. This is an area where the interceptor is suspected to be leaky as presented in the AOI 1 RIR (Stantec, 2016).

4.2.2.2 Lower (Semi-Confined) Aquifer

Like the water table beneath AOI 4, the more recent groundwater flow pattern in the lower aquifer is consistent with conditions presented in the AOI 4 RIR. **Figures 4-2a** through **4-2d** indicate an overall southerly flow direction under a shallow hydraulic gradient. New offsite well S-449 is included in the December 2020 and April 2021 datasets. There is some variability in the pattern to note, including component of southwesterly and southeasterly flow, and convergence of flow east of AOI 4 along 26th Street.

4.2.3 Inter-aquifer Interactions

Vertical slices of the June 2018 water table and lower aquifer surfaces are shown on the stratigraphic profiles. In northwestern AOI 4 and to points north and east where the middle clay is thin (see **Figure 4-14**), hydraulic heads between the water table and lower aquifer are nearly equal because the water pressures can equilibrate between units through vertical leakage or a direct hydraulic connection. In southeastern AOI 4 and at offsite well pair S-448/S-449, water levels support that the middle clay aquitard is effective at separating the aquifers (lower aquifer is semi-confined by the middle clay).

4.3 CONSITUENTS OF CONCERN

4.3.1 Groundwater

- Since the beginning of 2017, seven COCs (benzene, ethylbenzene, 1,2,4-TMB, MTBE, toluene, ethylene dibromide, and naphthalene) were detected at concentrations above the SHS in wells screened in the unconfined aquifer. Many of these COCs exceed the SHS within AOI 4 near the boundary.

- In the AOI 4 lower aquifer, MTBE was the only compound detected in wells at concentrations exceeding the SHS. However, at offsite lower aquifer well S-449, installed at the southern limit of investigation with water-table well S-448, concentrations of MTBE and benzene exceed the SHS.

A detailed discussion of COC distribution and trends will be conveyed in **Section 4.6**.

4.3.2 Soil

- In 2021, surface soil was collected and analyzed for lead to delineate property boundary areas to a potential “new” lead NRDC MSC in surface soil, which is anticipated to be close to 1,000 mg/kg. The goal of delineating to 1,000 mg/kg was achieved.

- Evergreen performed remedial action in 2018 to remove lead-impacted soil in an area where earthwork was planned. During the project, 53.5 tons of soil were removed and disposed offsite.

- Concentrations of lead in surface soil are delineated to the current selected standard of 2,240 mg/kg.

- Soil samples were collected in 2020 as a part of the confirmation drilling program to investigate potential source areas in southern AOI 4 and in the offsite Penrose area. Many of these samples were collected in the permanently saturated zone and were intended to be used for screening only. No COCs were detected above the SHS at depths where the SHS is applicable to soil samples.

A detailed discussion of lead in surface soil is presented in **Section 4.4**.

4.4 LEAD IN SURFACE SOIL

Due to public interest and concern regarding lead in soil at the former Philadelphia Refinery, this section provides additional dialogue regarding lead in surface soil with respect to the S to GW MSC, NRDC MSC, and the SSS. **Figure 4-8** shows the AOI 4 lead soil samples collected from 0-2 ft bgs interval compared to these three values. Samples below all three standards are shown in green, samples above the S to GW MSC only (450 mg/kg) are shown in yellow, samples above the NRDC MSC (1,000 mg/kg) but below the SSS (2,240 mg/kg) are shown orange, and samples above the SSS only (2,240 mg/kg) are shown in red.

4.4.1 Soil to Groundwater Comparison

Figure 4-8 shows concentrations of lead in surface soil below the S to GW MSC for lead (450 mg/kg) as green symbols. Yellow, orange, and red symbols show locations of soil samples above the S to GW MSC. Lead is present in some areas of the site above the S to GW MSC. Groundwater results were reviewed to evaluate whether these concentrations of lead in soil are influencing groundwater. In AOI 4, there is an extensive and representative monitoring well network in AOI 4 downgradient of the exceedances of the S to GW MSC. In 2017 through 2021, 109 groundwater samples were collected from wells within and downgradient form AOI 4. None of the samples had concentrations of lead above the SHS of 5 µg/L (**Table 2-6a and Table 2-6b**). Based on the groundwater analytical data, lead leaching from soil to groundwater is not a significant pathway of concern in AOI 4.

4.4.2 Non-Residential Direct Contact Comparison

As detailed in **Section 2.11**, Evergreen performed additional soil sampling for lead near property boundaries in anticipation of a possible future change of Evergreen's selected standard from 2,240 mg/kg to a value expected to be close to 1,000 mg/kg, the current NRDC MSC. **Figure 4-8** shows the locations of lead samples in surface soil (historic and recent) compared to 1,000 mg/kg to give sense of the distribution of elevated lead concentrations. Orange and red symbols represent sample locations where the concentration of lead is above 1,000 mg/kg. Samples that have been excavated and removed from the site are not shown. In areas near the property boundary where lead detected above the NRDC MSC was not delineated, Evergreen collected samples in 2021. In AOI 4, Evergreen collected sample AOI4-BH-21-01 to delineate surface soil sample S-408. On **Figure 4-8**, the data box shows the 2021 sample result of 250 mg/kg. As discussed in **Section 4.3.2**, the goal of delineating to 1,000 mg/kg was achieved.

4.4.3 Site-Specific Standard Comparison

Although this is likely to change in the future, the current selected standard for lead in surface soil at the former Philadelphia Refinery is 2,240 mg/kg as approved by the PADEP in 2015. At this time, Evergreen has not elected to change the selected standard due to the uncertainty regarding which model inputs PADEP will deem acceptable default values in its own calculations for direct contact exposure. **Figure 4-8** shows surface soil lead results above the SSS of 2,240 mg/kg in red. As described in **Section 2.11**, Evergreen performed a remedial action in 2018 to remove surface soil with concentrations of lead above the SSS. No samples showing lead at concentrations above the SSS remain within AOI 4.

4.5 LNAPL DISTRIBUTION AND MOBILITY

Three main areas of LNAPL have been observed within AOI 4 over the period of 2017 to 2021: the area south of 870 Unit, the S-30 area, and the Penrose System area. The following is a discussion of LNAPL distribution and mobility by area. **Figure 4-3** shows ANT maximum values for the 2017 to 2021 period. Hydrographs that support the discussion are included as **Appendix I**. The ChemQuants report presenting expert interpretation of LNAPL forensics samples is included in **Appendix H**. Laboratory analytical reports including LNAPL sample results from 2017 to 2021 are included in **Appendix E**. LNAPL transmissivity testing results are included in **Appendix F**.

<u>Area South of 870 Unit</u>: Monitoring well S-104 (located south of 870 Unit across Hartranft Street) historically had LNAPL thicknesses ranging from 0.26 feet to 1.5 feet. The well was gauged as part of the sitewide LNAPL transmissivity testing and soon after ANT was measured at 6.94 feet on April 22, 2019. Nearby wells were gauged at that time, and ANT measurements were observed to be consistent with past readings except for S-366, where LNAPL had not previously been observed and was measured at 0.34 feet.

In 2004, the product in S-104 was analyzed and reported as 100% extremely-weathered middle distillate with a density of 0.8787. Well S-368 was installed to delineate that LNAPL body to the east. The product in S-368 was analyzed in 2017 by another laboratory whose interpretation was a “mixture of diesel or #2 with a small amount of naphtha or gasoline”. Stantec collected additional samples from S-104 and S-366 on April 22, 2019. S-104 results were interpreted to be “slightly-weathered middle distillate, either diesel fuel or fuel oil and perhaps a small amount of unidentified light material”. The middle distillate portion of the sample was estimated to have been released approximately 2 +/- 2 years ago (sample density of 0.8796). According to the laboratory, the S-366 sample is most likely a refinery intermediate stream, probably ultraformate or something similar in composition.

Additional samples were collected from S-104 and S-368 in 2020, and the results were interpreted by ChemQuants. For the S-104 sample, ChemQuants’ interpretation was consistent with the 2019 characterization, although the polycyclic aromatic hydrocarbons suggest that the petroleum was sulfur-rich, implying that the product was not a finished fuel oil. ChemQuants also noted that SVOC biodegradation modeling indicates a release time of 4 to 8 years ago. For the S-368 sample, ChemQuants noted that there appeared to be an addition of a naphtha range product in 2020 that was not present in the sample analyzed in 2017. The light to middle distillate range petroleum appeared the same in the two samples, but a lighter naphtha range component may have emerged after 2016.

Samples were collected from well S-96 in 2019 and 2020. These were interpreted in both cases to be a weathered heavier material likely with an older release date. The 2019 interpretation estimated the S-96 sample was released about 13 +/- 2 years ago.

Hydrographs are included in **Appendix I** for wells S-104, S-366, S-368, and S-96, which show material increases or recent first occurrences of LNAPL in the area. LNAPL transmissivity testing for wells S-104 and S-366 performed in 2019 showed values less than the ITRC de minimis criterion.

<u>S-30 Area</u>: As described in **Section 2.15.1**, Evergreen continues to operate an LNAPL recovery system in the S-30 area after restarting recovery activities in 2018. LNAPL transmissivity testing for wells S-30 and S-29 performed in 2019 showed values less than the ITRC de minimis criterion.

<u>Penrose System Area</u>: Evergreen operated the Penrose System until March 2020. The remediation system was originally used as a groundwater recovery system at the property boundary and recovered little LNAPL through 2016 (**Figure 4-17**). It was around this time that PESRM acknowledged a suspected release related to piping associated with storage tank PB 253. Evergreen continued to operate the remediation system to recover the increased LNAPL in wells observed after the release. In recent years, ANT measurements have decreased, and LNAPL recovery slowed significantly. LNAPL transmissivity testing for S-241, located upgradient of the remediation system showed results above the ITRC de minimis criterion for testing in 2018, but below the criterion in 2019. Other wells tested in the area (S-220 and S-221) showed results below the ITRC de minimis criterion.

4.6 QUALITATIVE FATE AND TRANSPORT

The AOI 4 RIR presented a qualitative discussion of the fate and transport of benzene and MTBE contamination present in AOI 4 to proxy future simulations and inform the migration pathway and receptor discussion. The discussion was supported by Stantec's conservative fate and transport assessment for benzene utilizing Quick Domenico near AOI 4's southeastern boundary in the water table (AOI 4 RIR; Appendix L). The Quick Domenico assessment indicated that benzene contamination had the potential to migrate or have migrated offsite, and PADEP's disapproval of the AOI 4 RIR cited the potential condition of offsite groundwater contamination as a deficiency. The characterization work completed by Stantec and Evergreen in the time since RIR disapproval was tailored primarily to address delineation of potential offsite groundwater contamination in the area. The following findings related to meeting the Act 2 deficiency are summarized herein.

4.6.1 Onsite Source Potential

To inform decisions regarding AOI 4 sources for petroleum, Stantec reviewed tank storage and release incident documents and available historical drawings on tank farm history, some of which indicate tank contents. PA One Call response information from PESRM and Sunoco Pipeline also provided information on petroleum pipelines that enter AOI 4 west of the project area, and on a refinery drain line running from AOI 7. The following summarizes findings.

- AOI 4 ASTs in proximity to the Penrose area are indicated to have historically stored crude oil and primarily middle distillates, such as kerosene, heating oil, low-sulfur diesel (15MV2), and light cycle oil (LCO). Release incident documents indicate that tank PB 243 was overfilled in August 1998 and spilled an estimated 120 barrels of diesel fuel into the tank's containment area. In November 2007, a small release of LCO (2-3 gallons) was reported in central AOI 4 while LCO was being transferred from tank PB 243 to tank PB 821. Other release incidents document generally small releases of crude oil in the area. Historical drawings included in **Appendix Q** show that two former ASTs were located along the southeastern AOI 4 boundary (tanks PB 259 and PB 260) and in the late 1940s the tanks were used to store furnace oil, gas oil, or kerosene. A consistent history of middle distillate storage is documented.

- Two 30-inch petroleum pipelines enter AOI 4 from the west and run around the western and northern perimeter of tank PB 253. The lines run north to 15 Pump House and are documented to have transferred naphtha and crude oil. No documents were found indicating that past releases have occurred from these lines; however, repairs along the crude line were reportedly conducted by PESRM.

4.6.2 Offsite Source Potential

An extensive effort was performed by Stantec to explore the potential for offsite AOI 4 sources of petroleum hydrocarbon contamination that could have contributed to the complexity of impacts observed in the subsurface. Several possible offsite petroleum sources were identified and are considered within reasonable proximity to the area of investigation. It is important to note that the more distal locations (e.g., Belmont Terminal, former DSCP) are considered because of their similarities in molecular chemistry to offsite AOI 4 (see ChemQuants report in **Appendix H**), and they are connected by a preferential pathway with a documented history of groundwater and petroleum infiltration (26th Street Interceptor). It is also important to consider that the more distal sources could be attributable to Sunoco legacy from other AOIs at the facility (considered here as offsite). However, this information is needed to inform demonstration of AOI 4 delineation and for the fate and transport concepts being explored. The following possible source areas outside of AOI 4 are considered.

- Belmont Terminal (characterization in progress)
- AOI 1 (No. 1 and No. 2 Tank Farms) (Stantec, 2016)
- AOI 7 (1232 FCCU drain line conveyance through AOI 4) (see **Section 2.13.4**).
- Former ARCO Retail Station (26th and Hartranft Streets)
- Former DSCP facility (see AOI 4 RIR)
- Former Ryder Truck Rental property (3400 South 26th Street) (see AOI 4 RIR)
- 7-Eleven Retail Station (2601 Penrose Avenue) (see **Section 2.13.3.1**)
- Three former retail stations (filling stations) located at the intersection of Penrose Avenue and South 26th Street (see **Section 2.13.1**)
- Former SPC Corporation facility (Provco property) (see **Section 2.13.2.1**)
- Former Residual Landfill (3700 South 26th Street) (also called Danbro, L.P.) (see **Section 2.13.2.3**)

4.6.3 Petroleum Distribution in Soil and Groundwater

- Evergreen installed 13 water-table monitoring wells to the southeast of AOI 4 in the offsite PennDOT ROW along Penrose Avenue and South 26th Street. One additional water-table monitoring well was installed in AOI 4. Multiple rounds of groundwater sampling were completed.
- LNAPL has been observed in two offsite wells, S-376 and S-377 (see **Figure 4-3**). The LNAPL was fingerprinted in well S-376 to be most likely a severely-weathered and degraded gasoline. This well is in proximity to the former offsite ARCO retail station near Penrose Avenue and South 26th Street.

- Since the beginning of 2017, up to seven COCs (benzene, ethylbenzene, 1,2,4-TMB, MTBE, toluene, EDB, and naphthalene) have been detected above the SHS in wells screened in the onsite and offsite unconfined aquifer. Lead and benzo(a)pyrene each had single detections slightly above their respective SHS in depth-discrete groundwater samples.

- Lower aquifer well S-449 and lower aquifer discrete groundwater sample CD-3-W-82.0-20200730 (boring AOI4-BH-20-03) indicate that benzene and MTBE exceed the SHS offsite in the lower aquifer to the south of Penrose Avenue.

- **Figure 4-4** presents an updated maximum benzene concentration map for the AOI 4 unconfined aquifer for the period 2014-2021 (period overlaps previous RIR datasets but is consistent with the data being used for Evergreen's Sitewide Fate and Transport RIR). **Figure 4-7a** displays benzene and other exceedances for samples collected since the AOI 4 RIR. The pattern of benzene impacts above the SHS indicate source(s) spatially related to areas where LNAPL has previously been observed in wells, and where tankage records indicate a long history of refinery product storage. In the area southeast of AOI 4, the estimation of benzene concentration has been extended offsite using the new sample dataset maximums. The well data consistently indicates an offsite area of elevated benzene in groundwater with an offsite core centered across Penrose Avenue including wells S-375, S-377, and S-378. Decreases in benzene maximum concentrations of up to three orders of magnitude to concentrations below the SHS are demonstrated for wells S-440, S-448, S-444, and S-446. Groundwater data from Provco property wells for November 2018 indicate flow towards Penrose Avenue converging around the Penrose Avenue Sewer (see **Figure 4-1a**), and 2017 Provco well analytical data, available for select wells shown in the figure, indicate non-detects or low-level benzene detections. These conditions support delineation in that direction. Given benzene concentration data alone, wells S-378 and S-445 may not demonstrate sufficient delineation on the east side of the area; however, the forensics data discussed in the next two bullets provides the important lines of information supporting the presence of offsite benzene source(s).

- The environmental forensics program dataset presented in **Appendix H** consisted of comprehensive characterization and statistical analysis of chemical compositional patterns exploring soil, LNAPL, and groundwater samples with the objective of informing mixtures and understanding sources. CSIA was performed on groundwater samples to supplement the petroleum characterization. ChemQuants multivariate analysis (MVA) of VOC range hydrocarbons from forensics samples establishes up to 5 groups with VOC similarities. The largest group is MVA Group 4 (see ChemQuants report in **Appendix H**; **Figure 1**) which spatially correlates with the configuration of benzene in **Figure 4-1a**. The MVA for soil/LNAPL samples suggests up to 13 groups over a large area (see ChemQuants report in **Appendix H**; **Figure 2**) with five groups present near the southeastern AOI 4 border. There is distinction between onsite and offsite groupings. More detail regarding the MVA and characteristics of sample groups is in **Appendix H**.

- CSIA for benzene indicates up to three or more benzene sources are present (see MES report in **Appendix H**). Importantly one of the source groupings includes wells S-375, S-378, and S-377 where the offsite benzene core of elevated concentrations is observed. Onsite wells S-223, S-240, and RW-703 contain biodegraded benzene from offsite sources near wells S-376 and S-374. In the northeastern corner of AOI 4, well S-369 benzene is indicated to be unrelated to other wells in the area including those at the offsite former ARCO property (further supports Stantec's previous response to a PADEP comment regarding offsite delineation for benzene). Toluene CSIA data shows that onsite wells S-223, S-240, and offsite well S-378 exhibit biodegraded toluene from an offsite source area near wells S-375 and S-376. Ethylbenzene and xylene CSIA data suggest multiple sources are present, but the biodegradation pathways are less clear. Notably the BTEX stable isotope data collected to date are supportive of a biodegradation pathway from offsite AOI 4 sources to the water table onsite with exception of possibly xylenes, where aqueous partitioned aspects from known light to middle distillate source may have migrated to the offsite perimeter. Moreover, the forensics data and other lines of evidence presented in the RIR Addendum suggest transport of offsite groundwater contaminants onsite creating a mixture (see **Section 4.7**). Lastly, CSIA analysis of key biomarker compounds cyclohexane and methylcyclohexane was performed on groundwater samples from five wells along 26th Street from AOI 8, near Maiden Lane, south to Penrose Avenue. These data indicate a common, single source of these compounds is present, and concentration data supports that the source area is most likely near the intersection of 26th and Hartranft Streets where the interceptor has a documented history of leaking (persistent, convergent groundwater flow pattern).

- **Figure 4-5** presents an updated maximum MTBE concentration map for the AOI 4 unconfined aquifer for the period 2014-2021. The pattern of MTBE impacts above the SHS indicates a relatively small area of elevated MTBE is present close to the northern leg of former Penrose System recovery wells. There is no documented MTBE or finished gasoline storage in this area of AOI 4. No MTBE SHS exceedances have been observed in the offsite water-table wells except for depth-discrete sample CD-15-W-40.0-20200617. MTBE CSIA analyses were performed to explore other source potential over a geographically large area to include wells from former Philadelphia Refinery and Sunoco sources outside of AOI 4 where elevated MTBE has been observed (e.g., AOI 1 and Belmont Terminal) (see MES report in **Appendix H**). The CSIA results indicate that the MTBE present in the water-table aquifer near the former Penrose System (well S-240) is the least biodegraded of the samples and may be closest to the MTBE source present in the area that is distinct from a source common to points north.

- **Figure 4-7b** displays lower aquifer exceedances for samples collected in AOI 4 since the AOI 4 RIR and includes data from the former DSCP where available. MTBE was the only compound detected in wells at concentrations exceeding the SHS. However, at offsite lower aquifer well S-449, installed at the southern limit of investigation, concentrations of MTBE and benzene exceed the SHS. Well S-449 groundwater was included in the forensics dataset and analyzed for MTBE and benzene CSIA. Well S-449 groundwater fingerprints to the aqueous phase expression of a naphtha range to light distillate range petroleum in MVA Group 5.

- CSIA analyses are more ambiguous in the lower aquifer but generally indicate that multiple petroleum sources have impacted the offsite AOI 4 perimeter. Benzene and toluene CSIA indicate that the contamination found in well S-449 could be related to the offsite, water-table sources along Penrose Avenue or represent a mixture of these with other sources. CSIA analysis of ethylbenzene and xylene in the lower aquifer supports an offsite source unrelated to AOI 4 and its perimeter. MTBE CSIA results indicate that the MTBE present in lower aquifer wells near AOI 4 (S-449, S-13, ARCO-1D) is not from a source common to points north in the water table and is unrelated to the S-240 MTBE. Within the lower aquifer, the samples suggest the MTBE is not related amongst samples (see MES CSIA report in **Appendix H**).

- **Figure 4-10**, **Appendix H**, and **Appendix D** present data and include information related to the potential degradation of petroleum and geochemical conditions at AOI 4 and offsite. Oxidation reduction potential data indicate general reducing conditions in most of AOI 4 and surrounding offsite area and are supported by the commonality of low dissolved oxygen in groundwater, indicating elevated biological oxygen demand (also supported by elevated groundwater temperatures). Elevated methane dissolved in groundwater samples supports that the biodegradation has progressed to methanogenesis due to sulfate depletion; however, sulfate seems to have a continued source onsite. The sulfate source is postulated to be leakage from the City sewers just offsite AOI 4 which may be episodic in nature. Leaking sewage from the combined sewer system is supported by sucralose data presented on **Figure 4-9** and in **Table 2-8**. Microbial Insights QuantArray®-Petro microbial assay reports (see **Appendix D**) indicate that sulfate reducing bacteria, anaerobic BTEX, and aerobic BTEX microbial populations are active. Lastly, the rate of NSZD was estimated at 615 gallons/(acre-year) in the area as passively measured by E-flux (see **Appendix M**).

4.7 POTENTIAL MIGRATION PATHWAYS AND RECEPTORS

- Access to AOI 4 is restricted by fencing and security measures. HRP is responsible for overall security and oversight of contractor safety including implementation of PPE and work plan/permitting protocols that mitigate the potential for worker exposure to impacted soil, groundwater, and/or LNAPL through the direct contact pathway.

- Surface soil identified within AOI 4 to exhibit exceedances of the SSS for lead have been removed. Further discussion of remedies to maintain pathway elimination will be presented in future Act 2 submissions, including a Cleanup Plan, and HRP plans to manage the direct contact pathway onsite as outlined in their 2020 Soil Management Plan. Evergreen is considering revising the selected standard in the future. Within AOI 4, surface soils are delineated to the current NRDC MSC of 1,000 mg/kg at the property boundary.

- Concentrations of Evergreen Petroleum Short List COCs identified through indoor and ambient air sampling were below the EPA RSLs.

- LNAPL remaining in AOI 4 from historical Sunoco releases near the southeastern boundary is interpreted to be present at or near residual saturation in the water table. This LNAPL area was remediated from 2013 to 2020 by the Penrose System. Residual, functionally immobile LNAPL is not anticipated to migrate, however the residual LNAPL can continue to be a hydrocarbon source to groundwater until it becomes depleted. LNAPL in well S-376 near the AOI 4 boundary is forensically interpreted to be depleted and based on indicated age and ANT observations through time, not expected to migrate.

- The most significant contaminant migration pathways to consider in this Addendum include flow into and out of the City combined sewer system offsite AOI 4, and migration towards historical operational/pumping wells of the Penrose System. Sucralose was identified in groundwater at most of the wells sampled in the area (see **Figure 4-9**), supporting a sewer to groundwater connection in the unconfined aquifer. Chloride concentrations are elevated in many wells and chloride is postulated to have a sewer water/wastewater source (see **Figure 4-6**). See **Appendix H** for additional analysis of sucralose and discussion of sewers. The primary mechanism for potential contaminant transport from more distal petroleum sources would be preferential flow, backups, and leakage to groundwater through the City combined and intercepting sewer system.

- The highest sucralose concentration was reported for Penrose system recovery well RW-703. RW-703 and other system wells were pumped for several years, removing significant quantities of groundwater and LNAPL. **Figures 4-15** through **4-17** indicate that between approximately 2013 and

2020, nearly 25 million gallons of groundwater and over 7,000 gallons of LNAPL were recovered by the system. Daily pumping rates and pumping well water levels support that the southern recovery wells near the property boundary were pumped from near the bottom of the wells mainly in 2013 while the northern wells, such as RW-702 and RW-703, pumped from an elevation near -10 ft NAVD 88 up until 2019. Given AOI 4's hydraulic conditions and permeabilities in proximity, pumping of this magnitude is reasonably assumed to have been capable of pulling offsite contaminants onsite from deeper in the water table (offsite well logs north of Penrose Avenue indicate some of the highest PID readings are in this zone from approximately 22 to 24 ft bgs. Because MTBE is not documented to have an AOI 4 source but presumed to have an offsite source, MTBE trends can be used to understand a pattern. MTBE concentration trends for selected Penrose System recovery wells increased, generally from non-detects, as pumping progressed (see **Appendix T**) suggesting that MTBE migrated to the system capture zone.

- Infiltration of groundwater into underground utilities has the potential to generate vapors along subsurface corridors, or direct vapor migration into the vadose zone. The 26th Street and Penrose Avenue sewers were identified as potential vapor migration (external preferential) pathways for petroleum hydrocarbon sources identified in AOI 4 because they either do not meet the 30-foot horizontal proximity distance from identified groundwater impacts or are submerged beneath the water table in areas of potential groundwater impacts (do not meet the vertical separation distance). A vapor mitigation system (Point Breeze Biofilter System) is currently in operation in AOI 1 to remove and treat potential vapors from the 26th Street Sewer. Other utilities are present onsite, and Evergreen intends to further evaluate preferential pathways as a part of a future Act 2 submission.

- Groundwater and LNAPL impacts of concern to potential receptors were identified offsite, particularly at the Provco property, as dissolved phase Evergreen Petroleum Short List COCs are present in unconfined aquifer groundwater at concentrations above their respective MSCs. However, a preponderance of forensic data indicate that the source(s) of the offsite impacts is not from migration of AOI 4 historic releases, and plume expansion from aging Sunoco sources is not expected.

- MTBE and benzene were detected above the SHS in lower aquifer groundwater offsite. CSIA analyses generally indicate that multiple petroleum sources have impacted the offsite AOI 4 perimeter. A key finding of the HRSC was that groundwater conditions and stratigraphy do not support a local connection between the water-table and lower aquifers. Benzene and toluene CSIA indicate that the contamination found in well S-449 could be related to the offsite, water-table sources along Penrose Avenue or represent a mixture of these with other sources. Lastly, CSIA analysis of ethylbenzene and xylene in the lower aquifer supports an offsite source unrelated to AOI 4 and its perimeter. Petroleum impacts and groundwater flow pathways in the lower aquifer will be evaluated in the Sitewide Fate and Transport RIR.

- Evergreen plans to include additional assessment of vapor intrusion in future Act 2 submissions.

- An updated version of the sitewide well search including details regarding reconnaissance site visits is included as **Appendix J**. No active water supply wells were identified within a 1-mile radius of the former Philadelphia Refinery. The updated well search also includes references to the Philadelphia Health Code and Philadelphia Plumbing Code which both outline restrictions on potable water supply. According to the 2016 well search, the unconfined aquifer is not utilized for municipal or nearby communal, potable water supply in south Philadelphia. Additional efforts to confirm area groundwater is not used as drinking water were included as described in Evergreen's August 28, 2021 response to PADEP comments on the Public Involvement RIR.

- Evergreen has prepared a sitewide ecological risk assessment report for AOIs 1 through 9. This report evaluates risk from site COCs to threatened species, endangered species, and species of concern that have been identified through the Pennsylvania Natural Diversity Inventory program searches previously completed and submitted to PADEP. Species evaluated in AOIs 1 through 9 include bird species (marsh wren, peregrine falcon, and least bittern), fish species (Atlantic sturgeon, shortnose sturgeon, and hickory shad), reptile species (eastern redbelly turtle), and plant species (waterhemp ragweed, eastern baccharis, Walter’s barnyard-grass, multiflowered mudplantain, bugleweed, shrubby camphor-weed, and river bullrush). This report is anticipated to submitted following the approval of the RIRs.

- Surface water bodies that intersect the water table are not present in, or directly adjacent to, AOI 4. The Penrose Avenue sewer intersects the water table and is connected to the Schuylkill River and could convey contaminants to the river during combined sewer overflow events. The data presented in this RIR Addendum supports that most contamination in and around the Penrose Avenue Sewer in the investigation area is from areas outside of AOI 4 that could include other former Philadelphia Refinery AOIs. Evergreen will continue to investigate offsite AOI 4 sources that could be attributable to Sunoco legacy, and the results will be incorporated into the Sitewide Fate and Transport RIR.

5.0 COMMUNITY RELATIONS ACTIVITIES

As outlined in previous RIRs, Evergreen submitted a Notice of Intent to Remediate (NIR) to the PADEP in 2006, formally entering the facility into the Act 2 Program. At the request of the City, Evergreen developed a Public Involvement Plan (PIP) in 2006. A public meeting was conducted on September 19, 2007. Notifications regarding the submittal of NIRs and Act 2 Reports were provided to the City via letter to the Department of Public Health and to the public via notices in the local newspaper. Since the submittal of the 2017 AOI 4 RIR, there have been significant changes to the PIP and increased involvement with the community. This section briefly summarizes these changes.

5.1 UPDATES TO PUBLIC INVOLVEMENT PLAN

In August 2018, Evergreen began preparing a revised PIP at the request of DEP and the City. The updated PIP was completed in 2019 (**Appendix K**) following several communications with the City, USEPA and PADEP. PADEP requested that Evergreen prepare a Public Comment RIR to complete the public involvement process for the past Act 2 reports that were previously submitted to the state. The updated PIP outlines that each Act 2 report will have a 30-day public comment period at the time of their submittal, and the City requested an additional 120-day comment period to allow the public time to review the past reports that had been re-opened for public comment. A Public Comment RIR providing responses to questions and comments received during the 120-day comment period was submitted by Evergreen on March 31, 2021, and was disapproved by PADEP in a letter dated June 29, 2021. Evergreen provided additional information to the PADEP in correspondence dated August 28, 2021, which is still under review by PADEP. Following the submittal of this RIR Addendum for AOI 4, the public will have 30 days to provide comments to Evergreen. Evergreen will address all comments and questions related to the AOI 4 RIR Addendum in correspondence to PADEP that will be incorporated into their review as they will not consider the report final until any comments/questions have been addressed.

Evergreen also created a Community Outreach Plan on August 11, 2020 (**Appendix K**). This plan outlines both completed and planned activities. Since the submission of the last AOI-specific RIR in 2018, Evergreen has taken many actions to engage the public including, but not limited to:

Public Meetings

- Attempted in-person public meeting on November 7, 2019 to start the 120-day comment period and provide a summary of the data contained within the reports which was stopped by a community group from commencing
- Virtual Public Information Session on August 27, 2020 officially opening the 120-day comment period
- Virtual Public Information Session on January 14, 2021 officially ending the 120-day comment period
- Virtual Public Discussion on Community Outreach and Involvement Plan on March 31, 2021 in which Evergreen held small group discussions to allow individuals to be heard and interact directly in real time with Evergreen representatives
- Virtual Joint Evergreen/HRP Public Meeting on June 3, 2021
- Virtual Public Meeting on September 28, 2021 to review the AOI 4 and AOI 9 RIR Addendums and provide an update of Evergreen's continued outreach activities conducted with the assistance of Hummingbird Firm

Other Public Outreach Activities

- Creation and hosting of a website to serve as a resource to the public and to provide access to information and documents (https://phillyrefinerycleanup.info)
- Creation of a contact email address for the public to use to submit comments **(**phillyrefinerycleanup@ghd.com**)**
- Creation of an email distribution list for individuals, civic groups, and local businesses with input from the City, community leaders, environmental groups, PADEP, and USEPA to be used to send notifications of report submissions, public involvement activities, and general communications
- Creation of Plain Language Summaries to assist the public with understanding the content of technical Act 2 reports
- Hard copy mailer (**Appendix K**) was sent in June 2020 to residents and businesses near the facility to provide notification of Evergreen's investigations and remediation activities
- Electronic copies of all of the Act 2 reports were made available at two branches of Free Library of Philadelphia: Thomas F. Donatucci, Sr. Library at 1935 Shunk Street and Eastwick Library at 2851 Island Avenue
- Evergreen hired Hummingbird Firm, who was contracted to further develop outreach and engagement strategies

5.2 PUBLIC COMMENTS

In accordance with Pa. Code § 250.408(f), a RIR should include public comments obtained as a part of a public involvement plan and responses to those comments. The 2021 Public Comment RIR outlined questions and responses received on previous AOI-specific RIRs. Comments and responses specifically pertaining to AOI 4 are included below, and additional information has been provided as part of this report. Note that other general comments/concerns that were addressed in the Public Comment RIR may pertain to AOI 4 indirectly but have not been reiterated here and/or may be generally addressed in other sections of this document. In addition, comments/questions collected during the public review of this document will be addressed by Evergreen and submitted for review as part of this report.

- Question (p. 8-9 of 2021 Public Comment RIR): "*What investigation has been done to identify contamination to soil or groundwater beyond the property boundary (offsite)? If so, when? If not, why not??"*

  Response provided in 2021 Public Comment RIR: "*RIRs must include delineation of contamination in soil and groundwater be approved. Soil impacts have been delineated across the Site and up to the fence lines as noted in each of the RIRs, meaning soil impacts are not shown to extend off-site. The RIRs for AOIs 4 and 9 were not approved due to the need for additional off-site delineation of groundwater impacts. Thus, we have installed off-site wells beyond the property boundaries of both AOIs 4 and 9. Results will be presented in forthcoming RIR Addendums.*

  Note that the presentation graphics from the August 27, 2020 Public Information Session included the off-site data collected up to the time of the presentation, including new off-site wells. We have collected additional data since the presentation for the AOI 4 off-site wells, which will be included in the AOI 4 RIR Addendum. The RIR Addendums for both AOI 4 and AOI 9 must be submitted by September 2021 to meet interim goals outlined in the First Amendment to Consent Order and Agreement."

  Additional Response: *As described in **Section 2.2** through **Section 2.8**, after Evergreen was able to gain access to offsite properties, an extensive investigation was performed outside the property boundary. These activities performed in 2018 through 2021, included installation of 15 new monitoring wells, electrical resistivity imaging, groundwater gauging, groundwater sampling, and soil sampling.*

  *Figures for groundwater, including some with data boxes, clearly showing the groundwater quality at each well location, including at or beyond property boundaries, are included in this report. This includes **Figures 4-4, 4-5,***

***4-7a and 4-7b**. Certain graphical presentations of data were included based on past comments from the public and PADEP. This also includes adjustments made to soil figures to illustrate results in comparison to all standards (**Figure 4-8**).*

- Question (p. 43 of 2021 Public Comment RIR): Off-Site Contamination - Benzene pools extend beyond the property fence line but have not been mapped. Evergreen fails to acknowledge potential responsibility for cleaning up off-site contamination of benzene or other contaminants.

  Response provided in 2021 Public Comment RIR: "*The RIRs and figures presented during the August 27, 2020, Public Information Session show the known extent of dissolved benzene on- and off-site. Evergreen will be including additional off-site groundwater information in the AOI 9 and AOI 4 RIR Addendums. As addressed in previous comments, no off-site air impacts have been identified from off-site groundwater related to historic environmental impacts that Evergreen is evaluating under Act 2. Evergreen has acknowledged the benzene due to on-site sources and identified that there are other neighboring, contaminated sites that are also contributing to the observed off-site site groundwater impacts.*"

  Additional Response: *Evergreen presented additional information in response to this comment in the correspondence to PADEP dated August 28, 2021 (Evergreen Response to Comment #5). The submittal included additional figures showing benzene distribution. In this RIR Addendum, depictions of benzene results in groundwater are shown on **Figure 4-4, Figure 4-7a and Figure 4-7b**. The updated vapor intrusion assessment presented in **Section 3.1** did identify groundwater and LNAPL impacts of concern to potential receptors identified offsite, particularly at the Provco property, and not residential properties. In addition, forensic data indicate that the source(s) of most of these impacts is not from releases in AOI 4. Evergreen plans to include additional assessment of vapor intrusion in future Act 2 submissions. The fate and transport of benzene and other petroleum compounds will be further assessed as part of the sitewide fate and transport RIR for the former Philadelphia Refinery. The sitewide RIR will include analysis of groundwater discharges to surface water using groundwater models.*

6.0 CONCLUSIONS AND RECOMMENDATIONS

Multiple weights of evidence were applied in this Addendum to address the noted deficiency in the AOI 4 RIR. The initial work supplemented by HRSC and a comprehensive environmental forensics program indicates that multiple petroleum releases have impacted the AOI 4 southeastern boundary area through time. Enhanced understanding of the nature, extent, and potential transport of contamination outside AOI 4 strongly supports that most offsite impacts originated from offsite releases. Migration into AOI 4 by way of groundwater pumping at the former Penrose System is supported by CSIA, forensics, contaminant trends, and sucralose distribution. Undocumented petroleum releases from historic service stations appear to have been possible in the offsite area. The CSM dataset also supports that the Penrose Avenue sewer and interceptor are inherently leaky and are likely to function as preferential pathways for contaminant transport, allowing for more distal contamination sources to be a factor. The source assessment indicates that more soluble constituents such as benzene, toluene, and MTBE are elevated in concentration in AOI 4 and surrounding groundwater and may represent a disjoint source(s) introduced to the area by way of the City sewer system. The City sewer system as a transport mechanism is further supported by biomarker CSIA data presented in this report.

Based on the expanded CSM dataset presented, Evergreen and Stantec's opinion is that sufficient delineation of AOI 4 contamination is demonstrated. A sitewide assessment of the fate and transport of petroleum related COCs in AOI 4 and other areas of the former Philadelphia Refinery will be documented in a 2022 Fate and Transport RIR. The sitewide RIR will include estimates of groundwater discharges to City sewers and contamination sources attributed to Sunoco's operation of the former Philadelphia Refinery. Evergreen intends to install additional offsite wells in the lower aquifer downgradient of well S-449 on Conrail property to inform the sitewide fate and transport source assessment; however, property access has not yet been granted as of this RIR addendum submission. Additional forensics and CSIA analyses are in progress and will be included in the sitewide RIR to evaluate contamination sources further.

Additional future work is expected to include the following beyond the scope of this remedial investigation:

- Evaluation of utilities (sewers, pipelines, etc.) as potential preferential pathways for migration of VOCs to offsite receptors will need to be completed.
- If Evergreen changes the selected standards for lead in surface soil in the future, additional sampling may be needed as part of future Act 2 reports. A remedy, which will be presented in a future Cleanup Plan, will be needed for AOI 4 to attain a potentially lower future standard which is anticipated to also be based on the direct contact exposure pathway.
- Evergreen will continue to perform routine groundwater monitoring including well gauging and sampling. Evergreen intends to collect additional forensics samples to further explore offsite source potential.

- The Sitewide Fate and Transport RIR is expected for completion in 2022. The sitewide assessment will be quantitative and will utilize two numerical models to predict potential migration of petroleum-related contaminants in groundwater and into surface water.
- To document the assessment of risks to potential ecological receptors of concern, Evergreen plans to submit a sitewide ecological risk assessment following the approval of the RIRs.

7.0 SIGNATURES

The following parties are participating in the remediation at this time and are seeking relief of liability under Act 2 of 1995.

Tiffani L. Doerr, P.G.

Project Manager

Evergreen Resources Management Operations

This RIR has been prepared in accordance with the final provisions of Act 2 and the June 8, 2002 Land Recycling Program Technical Guidance Manual.

8.0 REFERENCES

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TABLES

Table 1-1
Constituents of Concern
Evergreen Petroleum Short List
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Volatile Organic Compounds	**CAS No.**
Benzene	71-43-2
Cumene	98-82-8
Dichloroethane, 1,2-	107-06-2
Ethylbenzene	100-41-4
Ethylene Dibromide	106-93-4
Methyl Tertiary Butyl Ether	1634-04-4
Toluene	108-88-3
Trimethylbenzene, 1,2,4-	95-63-6
Trimethylbenzene, 1,3,5-	108-67-8
Xylenes	1330-20-7
Semi Volatile Organic Compounds	**CAS No.**
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Benzo(a)pyrene	50-32-8
Benzo(b)fluroranthene	205-99-2
Benzo(g,h,i)perylene	191-24-2
Chrysene	218-01-9
Fluorene	86-73-7
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0
Metals	**CAS No.**
Lead	7439-92-1

Constituents are from Pennsylvania Department of Environmental Protection Short List of Petroleum Products (leaded and unleaded gasoline and No. 1, 2, 4, 5, 6 fuel oils) published as Table III-5 in Section III of the Land Recycling Program Technical Guidance Manual, effective June 8, 2002 and revised January 19, 2019.

Table 2-1
Monitoring and Recovery Well Summary
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Former Well ID[2]	Well Status	Northing[3]	Easting[3]	Hydrostratigraphic Unit[4]	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details[1]							
									Well Completion Depth (ft bgs)	Well Diameter (in)	Top of Inner Casing Elevation (ft NAVD88)	Ground Surface Elevation (ft NAVD88)	Top of Screen Elevation (ft NAVD88)	Bottom of Screen Elevation (ft NAVD88)	Depth to Screen (ft bgs)	Screen Length (ft)
AS-9					unconfined	Y	Y	2/15/1982	33.25	3	19.51	17.76	-5.49	-15.49	23.25	10
MW-1		Destroyed	220715.37	2684313.635	unconfined	Y	Y	5/29/2003	17.5		16.38	13.68	11.18	-3.82	2.50	15
MW-3		Destroyed	220543.28	2684079.1	not assigned	Y	Y	5/29/2003	18		16.9	14.94	11.94	-3.06	3.00	15
MW-4		Destroyed	220728.9	2684127.4	not assigned	Y	Y	5/29/2003	17		14.87	14.11	7.11	-2.89	7.00	10
RW-700			218992.453	2684981.922	unconfined	Y	Y	8/27/2010	38	4	18.0079	19.248	6.248	-13.752	13.00	20
RW-701			218971.722	2684953.125	unconfined	N	Y	8/25/2010	37	4	18.2698	19.338	12.338	-12.662	7.00	25
RW-702			218950.611	2684925.932	unconfined	N	Y	8/25/2010	39	4	20.955	21.24	7.24	-12.76	14.00	20
RW-703			218926.348	2684901.738	unconfined	N	Y	8/24/2010	34	4	20.6167	21.613	12.613	-7.387	9.00	20
RW-704			218911.609	2684874.651	unconfined	N	Y	8/25/2010	26	4	20.2297	22.131	16.131	-3.869	6.00	20
RW-705			218913.478	2685079.748	unconfined	Y	Y	10/5/2010	38	4	15.9171	16.91	8.91	-16.09	8.00	25
RW-706			218860.524	2685031.831	unconfined	N	Y	10/4/2010	39.5	4	15.8917	16.813	7.313	-17.687	9.50	25
RW-707			218852.306	2685021.118	unconfined	Y	Y	8/31/2010	36.5	4	16.2939	16.828	5.328	-14.672	11.50	20
RW-708			218831.233	2685001.282	unconfined	N	Y	9/2/2010	38	4	15.487	16.765	3.765	-16.235	13.00	20
RW-709			218811.61	2684982.036	unconfined	N	Y	9/2/2010	38	4	15.3001	16.522	3.522	-16.478	13.00	20
RW-710			218789.946	2684962.497	unconfined	N	Y	9/7/2010	37	4	15.8815	16.711	4.711	-15.289	12.00	20
RW-711			218781.924	2684954.779	unconfined	N	Y	9/21/2010	41	4	15.4917	16.715	5.715	-19.285	11.00	25
RW-712			218762.108	2684935.875	unconfined	N	Y	9/21/2010	39	4	15.5572	16.676	7.676	-17.324	9.00	25
RW-713			218747.899	2684924.041	unconfined	Y	Y	9/7/2010	37	4	15.0175	16.589	4.589	-15.411	12.00	20
RW-714			218727.602	2684903.439	unconfined	N	Y	9/8/2010	37	4	15.2073	16.474	4.474	-15.526	12.00	20
RW-715			218705.631	2684883.28	unconfined	Y	Y	9/15/2010	40	4	15.3694	16.864	6.864	-18.136	10.00	25
RW-716			218684.362	2684863.557	unconfined	Y	Y	9/16/2010	40	4	15.5448	16.905	6.905	-18.095	10.00	25
RW-717			218663.443	2684843.755	unconfined	N	Y	9/17/2010	40	4	15.6121	16.863	6.863	-18.137	10.00	25
S-26	SM-33		218758.26	2684615.95	unconfined	Y	N	12/17/1984	24		20.76	17.6				
S-27	SM-42		219121.695	2684393.051	unconfined	Y	Y	3/19/1985	34.75		24.607	24.478				30
S-28	SM-29	Damaged	219583.4	2684391.35	unconfined	Y	N	12/17/1984	25		25.74	22.66				
S-29	59		219694.79	2684380.2	unconfined	Y	Y	12/8/1986	40		23.3	21.83	3.83	-18.17	18.00	22
S-30			219702.61	2684379.56	unconfined	N	N				23.13	21.64				
S-31	SM-53	Damaged	219592.262	2684202.251	unconfined	Y	N	7/31/1985	25		21.297	21.279				
S-32	SM-27		219917.06	2684135.82	unconfined	Y	N	12/17/1984	25		24.2	21.29				
S-33	SM-54	Destroyed	220311.98	2684149.27	not assigned	Y	N	7/30/1985	28		21.45	21.25				
S-34	PN-1		220356.691	2684176.992	unconfined	Y	Y	5/25/1987	29	6	20.894	20.893	3.893	-6.107	17.00	10
S-35	PN-2		220363.967	2684236.72	unconfined	Y	Y	5/28/1987	29	6	20.941	21.552	4.552	-5.448	17.00	10
S-36	SM-34		220366.090	2684276.100	unconfined	Y	N	12/18/1984	21.5		24.23	21.91				
S-37	SM-25	Destroyed	220370.42	2684325.96	not assigned	Y	N	12/17/1985	30		25.9	23.42				
S-38	SM-31		219183.83	2685232.49	unconfined	Y	N	12/19/1984	23.2		18.95	15.97				
S-38D			219173.76	2685231.04	lower aquifer	Y	Y	3/14/1994	130	2	17.7	15.88	-104.12	-114.12	120.00	10
S-38D2	S-38I		219162.59	2685229.49	lower aquifer	N	Y	3/17/1994	80	2	18.19	15.84	-54.16	-64.16	70.00	10
S-39	AS-7		220133.11	2685582.26	unconfined	Y	Y	2/4/1982	37	3	22.88	21.35	-3.65	-15.15	25.00	11.5
S-39D			220137.681	2685551.203	lower aquifer	Y	Y	2/24/2016	132	4	24.51	21.9	-100.1	-110.1	122.00	10
S-40	SM-55		220733.63	2685637.31	unconfined	Y	N	7/31/1985	28		24.46	21.67				

Table 2-1
Monitoring and Recovery Well Summary
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Former Well ID[2]	Well Status	Northing[3]	Easting[3]	Hydrostratigraphic Unit[4]	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details[1]							
									Well Completion Depth (ft bgs)	Well Diameter (in)	Top of Inner Casing Elevation (ft NAVD88)	Ground Surface Elevation (ft NAVD88)	Top of Screen Elevation (ft NAVD88)	Bottom of Screen Elevation (ft NAVD88)	Depth to Screen (ft bgs)	Screen Length (ft)
S-55	SM-20	Destroyed	221232.26	2684841.22	not assigned	Y	N	12/17/1984	19.6		15.98	12.93				
S-56	62	Destroyed	220723.49	2684592.77	unconfined	Y	Y	12/13/1986	29	2	15	13.45	-0.55	-15.55	14.00	15
S-57	SM-24		220382.650	2683745.490	unconfined	Y	N	12/18/1984	14		12.5	10.13				
S-58	RW-1				not assigned	Y	Y	6/23/1987	33						10.00	20
S-59D	S-58D		221368.111	2683843.107	lower aquifer	Y	Y	4/13/2005	56	2	17.13	15.26	-25.74	-40.74	41.00	15
S-67	SM-22				not assigned	Y	N	12/18/1984	20							
S-96			220718.53	2684857.12	unconfined	N	N				19.77					
S-97			219546.08	2684857.01	unconfined	Y	Y	4/4/1994	35	4	27.951	28.74	8.74	-6.26	20.00	15
S-102			221406.75	2683873.83	unconfined	Y	Y	10/17/1995	20	2	18.22	15.63	10.63	-4.37	5.00	15
S-103			221274.57	2684427.94	unconfined	Y	Y	10/17/1995	25	2	26.11	23.55	13.55	-1.45	10.00	15
S-104			221448.27	2684803.51	unconfined	Y	Y	10/17/1995	20	2	18.56	15.63	5.63	-4.37	10.00	10
S-111		Destroyed	220875.56	2684175.79	not assigned	Y	Y	7/23/1996	39.58	2					4.50	35
S-115		Destroyed			not assigned	N	N					18.43				
S-119	MW-E		220752.86	2685393.24	unconfined	Y	Y	8/15/2002	34	4	26.6	23.82	9.82	-10.18	14.00	20
S-119D			220820.25	2685497.8	lower aquifer	Y	Y	4/4/2005	72	2	25.1	23.36	-33.64	-48.64	57.00	15
S-120	MW-F		220402.98	2685596.68	unconfined	Y	Y	8/16/2002	30	4	19.82	16.47	6.47	-13.53	10.00	20
S-121	MW-G	Damaged	220221.94	2685120.47	unconfined	Y	Y	8/22/2002	30	4	21.12	18.53	8.53	-11.47	10.00	20
S-122	MW-H		219646.6	2685442.91	unconfined	Y	Y	8/19/2002	34.6	4	25.71	22.92	7.92	-12.08	15.00	20
S-123	MW-I		219320.35	2684990.32	unconfined	Y	Y	8/20/2002	30	4	22.13	19.23	9.23	-10.77	10.00	20
S-124	MW-J		218884.83	2685003.67	unconfined	Y	Y	8/22/2002	30	4	23.2	20.46	10.46	-9.54	10.00	20
S-216			220866.96	2684617.94	unconfined	Y	Y	4/19/2005	26	4	15.76	14.57	3.57	-11.43	11.00	15
S-217		Destroyed	220147.23	2683893.13	not assigned	Y	Y	3/29/2005	27	4	11.53	8.87	-3.13	-18.13	12.00	15
S-218			220121.84	2684500.98	unconfined	Y	Y	4/20/2005	30	4	25.74	22.46	7.46	-7.54	15.00	15
S-218D			220117.664	2684511.91	lower aquifer	Y	Y	2/1/2016	96	4	24.52	21.85	-64.15	-74.15	86.00	10
S-219			219892	2684850.33	unconfined	Y	Y	3/25/2005	27	4	23.09	19.88	7.88	-7.12	12.00	15
S-220			219151.9	2684262.28	unconfined	Y	Y	4/20/2005	30	4	20.81	18.5	3.5	-11.5	15.00	15
S-221			219006.13	2684933.43	unconfined	Y	Y	4/21/2005	30	4	23	20.02	5.02	-9.98	15.00	15
S-222			218676.906	2684861.776	unconfined	Y	Y	6/9/2005	28	4	16.29	16.89	3.89	-11.11	13.00	15
S-223			218858.534	2685063.585	unconfined	Y	Y	6/8/2005	30	4	15.88	16.48	1.48	-13.52	15.00	15
S-224			218991.351	2685158.159	unconfined	Y	Y	6/6/2005	32	4	16.03	16.53	4.53	-15.47	12.00	20
S-225			221123.01	2684549.16	unconfined	Y	Y	3/29/2005	27	4	14.99	12.0	0	-15	12.00	15
S-229		Destroyed	220933.27	2683981.01	not assigned	Y	Y	3/23/2005	30	4	22.73	19.5	4.5	-10.5	15.00	15
S-233			218922.835	2684873.793	unconfined	Y	Y	10/17/2005	30	4	24.35	21.63	6.63	-8.37	15.00	15
S-234			218761.786	2684898.540	unconfined	Y	Y	10/18/2008	27	4	21.23	18.04	6.04	-8.96	12.00	15
S-235			218843.84	2684961.527	unconfined	y	Y	10/18/2005	30	4	23.126	20.21	5.21	-9.79	15.00	15
S-236			219018.432	2684953.845	unconfined	Y	Y	10/19/2005	32	4	22.973	19.72	2.72	-12.28	17.00	15
S-237			218984.401	2684943.306	unconfined	Y	Y	10/19/2005	32	4	22.815	19.39	2.39	-12.61	17.00	15
S-238			218916.689	2685034.493	unconfined	Y	Y	10/21/2005	30	4	22.915	19.87	4.87	-10.13	15.00	15
S-239			218788.677	2684997.324	unconfined	Y	Y	10/24/2005	25	4	15.818	16.19	6.19	-8.81	10.00	15
S-240			218980.39	2684848.14	unconfined	Y	Y	10/24/2005	30	4	23.864	20.97	5.97	-9.03	15.00	15

Table 2-1
Monitoring and Recovery Well Summary
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Former Well ID[2]	Well Status	Northing[3]	Easting[3]	Hydrostratigraphic Unit[4]	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details[1]							
									Well Completion Depth (ft bgs)	Well Diameter (in)	Top of Inner Casing Elevation (ft NAVD88)	Ground Surface Elevation (ft NAVD88)	Top of Screen Elevation (ft NAVD88)	Bottom of Screen Elevation (ft NAVD88)	Depth to Screen (ft bgs)	Screen Length (ft)
S-241			219044.987	2684818.765	unconfined	Y	Y	10/24/2005	30	4	26.084	23.09	8.09	-6.91	15.00	15
S-242			218813.239	2684857.203	unconfined	N	N				21.89	19.15				
S-243			218722.241	2684934.273	unconfined	N	N				15.74	16.181				
S-244			219110.021	2685081.871	unconfined	N	N				21.94	18.734				
S-245			219051.042	2684999.415	unconfined	N	N				22.211	19.655				
S-246			219005.316	2685017.554	unconfined	N	N				21.564	19.335				
S-278			218752.79	2684809.98	unconfined	Y	Y	11/18/2009	29	4	21.03	17.7	3.7	-11.3	14.00	15
S-279			219165.257	2684701.995	unconfined	Y	Y	11/18/2009	29	4	26.38	23.36	9.36	-5.64	14.00	15
S-282			220826.502	2683959.5	unconfined	Y	Y	4/27/2010	20	2	20.788	18.492	13.492	-1.508	5.00	15
S-329			218689.633	2684779.003	unconfined	N	Y	9/20/2010	40	4	20.921	18.2	8.2	-16.8	10.00	25
S-364		Damaged	221075.288	2683860.891	unconfined	Y	Y	3/19/2013	30	4	21.26	19	4	-11	15.00	15
S-365			220854.887	2683838.929	unconfined	Y	Y	3/18/2013	30	4	20.91	18.22	3.22	-11.78	15.00	15
S-366			221391.626	2684586.165	unconfined	Y	Y	3/15/2013	30	4	22.255	20.505	5.505	-9.495	15.00	15
S-367			221273.785	2684688.494	unconfined	Y	Y	3/13/2013	28	4	16.023	13.507	0.507	-14.493	13.00	15
S-368			221485.158	2684900.542	unconfined	Y	Y	3/14/2013	28	4	18.021	15.454	2.454	-12.546	13.00	15
S-369			221204.234	2685725.712	unconfined	Y	Y	4/2/2013	42	4	29.423	29.807	9.807	-10.193	20.00	20
S-370			219838.794	2683832.63	unconfined	Y	Y	4/22/2013	26	4	12.061	9.556	-0.444	-15.444	10.00	15
S-371			219749.715	2684294.869	unconfined	Y	Y	4/1/2013	30	4	22.047	19.498	4.498	-10.502	15.00	15
S-373			219072.964	2684927.143	unconfined	Y	Y	3/22/2013	25	4	20.77	18.39	8.39	-6.61	10.00	15
S-374			219014.2065	2685397.9292	unconfined	Y	Y	10/15/2018	35	2	15.66	13.1	3.1	-21.9	10.00	25
S-375			218827.8	2685210.5	unconfined	Y	Y	10/22/2018	35	2	15.96	13.5	3.5	-21.5	10.00	25
S-376			218734.5	2685068.6	unconfined	Y	Y	10/18/2018	35	2	15.64	13.5	3.5	-21.5	10.00	25
S-377		Destroyed	218559.1691	2685254.3658	unconfined	Y	Y	10/23/2018	35	2	12.55	13.04	3.04	-21.96	10.00	25
S-378			218658.1	2685380.6	unconfined	Y	Y	10/22/2018	35	2	11.99	12.25	2.25	-22.75	10.00	25
S-379		Damaged	220886.524	2685665.992	unconfined	Y	Y	3/12/2013	30	4	25.646	23.244	8.244	-6.756	15.00	15
S-380			220595.994	2685673.673	unconfined	Y	Y	3/20/2013	30	4	21.318	21.786	6.786	-8.214	15.00	15
S-381			219563.419	2684589.82	unconfined	Y	Y	4/25/2013	32	4	25.856	23.189	6.189	-8.811	17.00	15
S-408			218599.95	2684258.89	unconfined	Y	Y	10/23/2015	30	4	15.88	13.35	3.35	-16.65	10.00	20
S-415			220822.22	2684131.69	unconfined	Y	Y	10/13/2015	30	4	19.23	16.47	6.47	-13.53	10.00	20
S-416			220681.079	2683997.482	unconfined	Y	Y	7/13/2016	27	4	19.18	15.44	3.44	-11.56	12.00	15
S-440	CD-15		218486.7991	2684591.073	unconfined	Y	Y	6/17/2020	27	2	12.34	10.23	2.23	-16.77	8.00	19
S-441	CD-06A		218647.1572	2684941.911	unconfined	Y	Y	7/23/2020	44	2	16	13.7	-20.3	-30.3	34.00	10
S-442	CD-05		218836.869	2685250.4098	unconfined	Y	Y	7/15/2020	46	2	15.51	12.95	-22.05	-33.05	35.00	11
S-443	CD-06C		218798.555	2685093.3156	unconfined	Y	Y	7/21/2020	49	2	16.2	14.24	-19.76	-34.76	34.00	15
S-444	CD-13A		218994.3538	2685451.31	unconfined	Y	Y	7/9/2020	48	2	15.92	13.17	-19.83	-34.83	33.00	15
S-445	CD-13B		219178.0433	2685477.9677	unconfined	Y	Y	7/7/2020	48	2	16.74	14.2	-17.8	-33.8	32.00	16
S-446	CD-12		219489.2053	2685467.6139	unconfined	Y	Y	6/19/2020	46	2	19.54	16.88	-19.12	-29.12	36.00	10
S-447	CD-10		219067.5793	2685199.6022	unconfined	Y	Y	6/24/2020	46	2	18.68	16.18	-13.82	-29.82	30.00	16
S-448	CD-14		218464.2376	2685365.0751	unconfined	Y	Y	8/12/2020	26	2	15.34	12.65	-3.35	-13.35	16.00	10
S-449	CD-14D		218463.198	2685360.1063	lower aquifer	Y	Y	8/13/2020	85	2	15.25	12.28	-57.72	-72.72	70.00	15

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Area of Interest 4, Former Philadelphia Refining Complex
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Well ID	Former Well ID[2]	Well Status	Northing[3]	Easting[3]	Hydrostratigraphic Unit[4]	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details[1]							
									Well Completion Depth (ft bgs)	Well Diameter (in)	Top of Inner Casing Elevation (ft NAVD88)	Ground Surface Elevation (ft NAVD88)	Top of Screen Elevation (ft NAVD88)	Bottom of Screen Elevation (ft NAVD88)	Depth to Screen (ft bgs)	Screen Length (ft)

Notes:
1. Well construction details were obtained from well boring logs provided by Handex, SECOR, Aquaterra or other historic reports for wells not logged/installed by Stantec.
2. Former Well IDs were derived from handwritten notes on boring logs or as referenced in historic reports.
3. Coordinate pairs are projected in the Pennsylvania State Plane Coordinate System (feet), referenced to the North American Datum of 1983 (NAD83).
4. The hydrostratigraphic unit denotes the aquifer and/or mappable water-bearing stratum in which the well is interpreted to be screened by Stantec. Historic wells without lithologic logs, wells without as-built information, and/or destroyed wells were not assigned hydrostratigraphic units.
ft = feet
ft bgs = feet below ground surface
in = inches
NAVD88 = North American Vertical Datum of 1988
Y = Yes; N = No
General Note:
Stantec presently maintains an electronic database from which these well records were extracted. Many of the well records in that database were translated from historic paper records, or from electronic tables received from other consultants. Maintenance of the electronic well database, including revisions to anamalous or missing information, is ongoing and as such this table may be subject to future revision.

Table 2-2
Summary of Groundwater Sampling and Gauging Events, 2017 - 2021
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a Series of Evergreen Resources Group, LLC

Timeframe		Gauging Events	Sampling Events		Consultant
			Scope	Selected Analyses	
2017	May	Annual, Sitewide + DSCP	6 Wells	Evergreen Petroleum Short List	Stantec
2018	January		4 Perimeter Penrose Area Wells	BTEX	Stantec
	April		4 Perimeter Penrose Area Wells	BTEX	
	June	Annual, Sitewide + DSCP	8 Wells, HyrdaSleeve Samples Collected in Select Wells	Evergreen Petroleum Short List, select wells for MTBE + TBA only	
	November	Quarterly O&M Gauging included New Offsite Wells	5 New Offsite Wells, 2 Onsite Wells	Offsite- Evergreen Petroleum Short List VOCs + CSIA, Onsite - CSIA	Aquaterra
			4 Perimeter Penrose Area Wells	BTEX	Stantec
2019	January	Quarterly O&M Gauging included New Offsite Wells	5 New Offsite Wells + 4 Perimeter Penrose Area Wells	Evergreen Petroleum Short List VOCs + TBA	Aquaterra
	April	LNAPL Transmissivity Testing	4 Perimeter Penrose Area Wells	BTEX, MTBE, TBA	Stantec
	June - July	Annual, Sitewide + DSCP	15 Wells	Evergreen Petroleum Short List + TBA	
	October - November	Sitewide	15 Wells	Evergreen Petroleum Short List + TBA	
	December	Forensics Program Sampling Event	Select Penrose Perimeter Area Wells	Base Level Forensics, CSIA	
2020	June	Annual, Sitewide + DSCP	4 Temporary Well Points	Evergreen Petroleum Short List + TBA, Metals, Gasoline, Diesel and Heavy Range Organics, Total Petroleum Hydrocarbons, Sulfide, Sulfate, Chloride, Nitrate Nitrogen, Total Alkalinity, Ammonia Nitrogen, Dissolved Gases, DNA*	Stantec
	July - September	Confirmation Drilling	9 Temporary Well Points, 18 Wells		
	December	New Offsite Wells and Select Existing Wells			
2021	April - May	Annual, Sitewide	25 Wells	Evergreen Petroleum Short List + TBA, Dissolved Gasses, Total Iron, Total Calcium, Total Kjeldahl Nitrogen, Total Alkalinity, Total Orangic/Inorganic Carbon, Sulfate; Select Well Sets: Sucralose, Pesticides, CSIA	Stantec

Notes
O&M = operations and maintenance
BTEX = benzene, toluene, ethylbenzene, and xylenes
TBA = tertiary buytl alcohol
VOCs = volatile organic compounds
MTBE = methyl tertiary butyl ether
CSIA = compound specific isotope analysis
DSCP = Defense Supply Center Philadelphia
DNA = Deoxyribonucleic acid
Minor gauging events and routine gauging events for the remediation systems are not listed.
DSCP gauging data collected is by the Defense Logistics Agency's consultant and provided to Evergreen through data-sharing exchanges.
* Some samples were not analyzed for all parameters

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
AOI4-BH-20-01	8/5/2020	---	15.05	---		CD-1-W-18, temporary well data - corrected water levels not calculated
AOI4-BH-20-01	8/7/2020	---	18.50	---		CD-1-W-41.5, temporary well, 4' standpipe, temporary well data - corrected water levels not calculated
AOI4-BH-20-02	8/3/2020	---	16.22	---		CD-2-W-25, temporary well, 4.08' standpipe, temporary well data - corrected water levels not calculated
AOI4-BH-20-03	7/28/2020	---	17.80	---		CD-3-W-25, temporary well, 6.75' standpipe, temporary well data - corrected water levels not calculated
AOI4-BH-20-03	7/29/2020	---	5.70	---		CD-3-W-46, temporary well, 3.5' standpipe, temporary well data - corrected water levels not calculated
AOI4-BH-20-03	7/30/2020	---	14.70	---		CD-3-W-82, temporary well, 7' standpipe, temporary well data - corrected water levels not calculated
AOI4-BH-20-04	6/30/2020	---	24.21	---		CD-6B-W-45, temporary well, 3.9' standpipe, temporary well data - corrected water levels not calculated
MW-1	8/17/2016	---	15.90	---	0.48	
MW-1	10/6/2016	---	16.10	---	0.28	
MW-1	5/8/2017	---	15.74	---	0.64	
MW-1	6/3/2020	NM	NM	NM	NM	Destroyed
MW-2	5/8/2017	NM	NM	NM	NM	Destroyed
MW-3	5/8/2017	NM	NM	NM	NM	Destroyed
MW-4	5/8/2017	NM	NM	NM	NM	Destroyed
RW-700	6/9/2016	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	7/6/2016	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	8/3/2016	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	8/12/2016	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	8/17/2016	---	17.97	---	0.04	
RW-700	10/3/2016	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	10/10/2016	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	11/15/2016	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	11/15/2016	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	1/10/2017	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	3/1/2017	---	20.30	---	-2.29	Water level is at top of pump intake level.
RW-700	4/5/2017	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	5/8/2017	---	29.90	---	-11.89	Water level is at top of pump intake level.
RW-700	6/6/2017	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	7/6/2017	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	8/2/2017	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	9/5/2017	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	10/2/2017	NM	NM	NM	NM	Top of pump at 20.9 ft btoc
RW-700	11/9/2017	NM	NM	NM	NM	Top of pump at 20.9 ft btoc
RW-700	12/5/2017	NM	NM	NM	NM	Top of pump at 20.9 ft btoc
RW-700	1/10/2018	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	2/7/2018	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	3/14/2018	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	6/18/2018	---	16.43	---	1.58	
RW-700	8/21/2018	---	17.06	---	0.95	
RW-700	9/24/2018	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	10/24/2018	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	11/27/2018	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	1/23/2019	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	2/12/2019	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	3/6/2019	---	20.90	---	-2.89	Water level is at top of pump intake level.
RW-700	4/3/2019	---	15.70	---	2.31	
RW-700	4/15/2019	---	15.97	---	2.04	
RW-700	5/6/2019	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	6/5/2019	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	7/10/2019	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	8/6/2019	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	9/11/2019	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	10/10/2019	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	12/5/2019	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	2/5/2020	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	3/2/2020	---	19.00	---	-0.99	Water level is at top of pump intake level.
RW-700	4/28/2020	---	16.67	---	1.34	
RW-700	5/18/2020	---	16.87	---	1.14	
RW-700	6/4/2020	---	16.93	---	1.08	
RW-700	7/8/2020	---	17.25	---	0.76	
RW-700	8/5/2020	---	17.11	---	0.90	
RW-700	9/14/2020	---	16.60	---	1.41	
RW-700	10/27/2020	---	17.04	---	0.97	
RW-700	11/17/2020	---	16.93	---	1.08	
RW-700	12/28/2020	15.14	15.14	<0.01	2.88	
RW-700	12/30/2020	---	15.14	---	2.87	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-700	1/28/2021	---	16.34	---	1.67	
RW-700	4/16/2021	---	15.83	---	2.18	
RW-701	6/9/2016	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	7/6/2016	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	8/3/2016	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	8/12/2016	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	8/17/2016	---	18.45	---	-0.18	Water level is at top of pump intake level.
RW-701	10/3/2016	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	10/10/2016	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	11/15/2016	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	11/15/2016	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	1/10/2017	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	3/1/2017	---	19.60	---	-1.33	Water level is at top of pump intake level.
RW-701	4/5/2017	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	5/8/2017	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	6/6/2017	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	7/6/2017	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	8/2/2017	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	9/5/2017	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	10/2/2017	NM	NM	NM	NM	Top of pump at 20.3 ft btoc
RW-701	11/9/2017	NM	NM	NM	NM	Top of pump at 20.3 ft btoc
RW-701	12/5/2017	NM	NM	NM	NM	Top of pump at 20.3 ft btoc
RW-701	1/10/2018	---	20.30	---	-2.03	Water level is at the top of the pump
RW-701	2/7/2018	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	3/14/2018	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	6/18/2018	---	16.92	---	1.35	
RW-701	6/29/2018	---	16.66	---	1.61	
RW-701	8/21/2018	---	17.22	---	1.05	
RW-701	9/24/2018	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	10/24/2018	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	11/27/2018	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	1/23/2019	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	2/12/2019	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	3/6/2019	---	20.30	---	-2.03	Water level is at top of pump intake level.
RW-701	4/3/2019	---	16.00	---	2.27	
RW-701	4/15/2019	---	16.23	---	2.04	
RW-701	5/6/2019	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	6/6/2019	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	7/10/2019	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	8/6/2019	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	9/11/2019	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	9/28/2019	---	18.10	---	0.17	
RW-701	10/10/2019	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	12/5/2019	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	2/5/2020	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	3/2/2020	---	20.80	---	-2.53	Water level is at top of pump intake level.
RW-701	4/28/2020	---	16.85	---	1.42	
RW-701	5/18/2020	---	16.73	---	1.54	
RW-701	6/4/2020	---	17.17	---	1.10	
RW-701	7/8/2020	---	17.41	---	0.86	
RW-701	8/5/2020	---	17.36	---	0.91	
RW-701	9/14/2020	---	16.75	---	1.52	
RW-701	10/27/2020	---	17.35	---	0.92	
RW-701	11/17/2020	---	17.12	---	1.15	
RW-701	12/30/2020	---	15.09	---	3.18	
RW-701	1/28/2021	---	16.52	---	1.75	
RW-701	4/16/2021	---	15.99	---	2.28	
RW-701	5/10/2021	---	16.44	---	1.83	
RW-702	6/9/2016	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	7/6/2016	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	8/3/2016	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	8/12/2016	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	8/17/2016	---	37.62	---	-16.67	Water level is at top of pump intake level.
RW-702	10/3/2016	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	10/10/2016	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	11/15/2016	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	11/15/2016	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	1/10/2017	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	3/1/2017	---	31.55	---	-10.60	Water level is at top of pump intake level.
RW-702	4/5/2017	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	5/8/2017	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	6/6/2017	---	33.80	---	-12.85	Water level is at top of pump intake level.

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-702	7/6/2017	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	8/2/2017	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	9/5/2017	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	10/2/2017	NM	NM	NM	NM	Top of pump at 33.8 ft btoc
RW-702	11/9/2017	NM	NM	NM	NM	Top of pump at 33.8 ft btoc
RW-702	12/5/2017	NM	NM	NM	NM	Top of pump at 33.8 ft btoc
RW-702	1/10/2018	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	2/7/2018	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	3/14/2018	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	6/18/2018	---	19.27	---	1.69	
RW-702	8/21/2018	---	1.41	---	19.55	
RW-702	9/24/2018	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	10/24/2018	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	11/27/2018	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	1/23/2019	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	2/11/2019	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	3/6/2019	---	33.80	---	-12.85	Water level is at top of pump intake level.
RW-702	4/3/2019	---	18.40	---	2.56	
RW-702	5/6/2019	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	6/6/2019	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	7/10/2019	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	8/6/2019	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	9/11/2019	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	10/10/2019	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	12/5/2019	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	2/5/2020	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	3/2/2020	---	21.90	---	-0.95	Water level is at top of pump intake level.
RW-702	4/28/2020	---	19.71	---	1.25	
RW-702	5/18/2020	---	19.71	---	1.25	
RW-702	6/4/2020	---	13.87	---	7.09	
RW-702	7/8/2020	---	20.52	---	0.44	
RW-702	8/5/2020	---	20.01	---	0.95	
RW-702	9/14/2020	---	19.80	---	1.16	
RW-702	10/27/2020	---	21.35	---	-0.40	
RW-702	11/17/2020	---	16.88	---	4.08	
RW-702	12/28/2020	---	17.34	---	3.62	
RW-702	12/30/2020	---	18.96	---	2.00	
RW-702	1/28/2021	---	19.43	---	1.53	
RW-702	4/16/2021	---	18.79	---	2.17	
RW-703	6/9/2016	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	7/6/2016	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	8/3/2016	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	8/12/2016	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	8/17/2016	---	31.34	---	-10.72	Water level is at top of pump intake level.
RW-703	10/3/2016	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	10/10/2016	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	11/15/2016	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	11/15/2016	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	1/10/2017	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	3/1/2017	---	29.00	---	-8.38	Water level is at top of pump intake level.
RW-703	4/5/2017	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	5/8/2017	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	6/6/2017	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	7/6/2017	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	8/2/2017	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	9/5/2017	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	10/2/2017	NM	NM	NM	NM	Top of pump at 29.7 ft btoc
RW-703	11/9/2017	NM	NM	NM	NM	Top of pump at 29.7 ft btoc
RW-703	8/6/2019	---	18.80	---	1.82	
RW-703	9/11/2019	---	18.80	---	1.82	
RW-703	10/10/2019	---	18.80	---	1.82	
RW-703	10/29/2019	---	18.61	---	2.01	
RW-703	12/5/2019	---	18.80	---	1.82	
RW-703	12/13/2019	---	22.16	---	-1.54	
RW-703	2/5/2020	---	18.80	---	1.82	
RW-703	3/2/2020	---	18.80	---	1.82	
RW-703	4/28/2020	---	17.79	---	2.83	
RW-703	5/18/2020	---	17.63	---	2.99	
RW-703	6/4/2020	19.81	19.83	0.02	0.80	
RW-703	7/8/2020	---	19.83	---	0.79	
RW-703	8/5/2020	---	19.71	---	0.91	
RW-703	9/3/2020	---	19.42	---	1.20	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-703	9/14/2020	---	18.80	---	1.82	
RW-703	10/27/2020	---	18.04	---	2.58	
RW-703	11/17/2020	---	17.79	---	2.83	
RW-703	12/28/2020	16.47	17.34	0.87	4.05	
RW-703	12/30/2020	16.74	17.34	0.60	3.81	
RW-703	1/28/2021	---	19.34	---	1.28	
RW-703	4/16/2021	---	18.02	---	2.60	
RW-703	5/10/2021	---	18.93	---	1.69	
RW-704	6/9/2016	---	21.70	---	-1.47	Water level is at top of pump intake level.
RW-704	7/6/2016	---	21.70	---	-1.47	Water level is at top of pump intake level.
RW-704	8/3/2016	---	21.90	---	-1.67	Water level is at top of pump intake level.
RW-704	8/12/2016	---	21.90	---	-1.67	Water level is at top of pump intake level.
RW-704	10/3/2016	---	21.90	---	-1.67	Water level is at top of pump intake level.
RW-704	10/10/2016	---	21.90	---	-1.67	Water level is at top of pump intake level.
RW-704	11/15/2016	---	21.90	---	-1.67	Water level is at top of pump intake level.
RW-704	11/15/2016	---	21.90	---	-1.67	Water level is at top of pump intake level.
RW-704	1/10/2017	---	21.90	---	-1.67	Water level is at top of pump intake level.
RW-704	3/1/2017	---	21.90	---	-1.67	Water level is at top of pump intake level.
RW-704	4/5/2017	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	5/8/2017	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	6/6/2017	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	7/6/2017	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	8/2/2017	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	9/5/2017	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	10/2/2017	NM	NM	NM	NM	Top of pump at 21.25 ft btoc
RW-704	11/9/2017	NM	NM	NM	NM	Top of pump at 21.25 ft btoc
RW-704	12/5/2017	NM	NM	NM	NM	Top of pump at 21.25 ft btoc
RW-704	1/10/2018	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	2/7/2018	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	3/14/2018	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	6/18/2018	---	19.01	---	1.22	
RW-704	8/21/2018	---	17.75	---	2.48	
RW-704	9/24/2018	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	10/24/2018	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	11/27/2018	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	1/23/2019	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	2/12/2019	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	3/6/2019	---	21.25	---	-1.02	Water level is at top of pump intake level.
RW-704	4/3/2019	---	18.70	---	1.53	
RW-704	4/15/2019	---	18.91	---	1.32	
RW-704	5/6/2019	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	6/6/2019	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	7/10/2019	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	8/6/2019	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	9/11/2019	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	10/10/2019	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	12/5/2019	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	2/5/2020	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	3/2/2020	---	21.75	---	-1.52	Water level is at top of pump intake level.
RW-704	4/28/2020	---	19.64	---	0.59	
RW-704	5/18/2020	---	19.65	---	0.58	
RW-704	6/4/2020	---	19.61	---	0.62	
RW-704	7/8/2020	---	18.79	---	1.44	
RW-704	8/5/2020	---	18.46	---	1.77	
RW-704	9/14/2020	---	19.65	---	0.58	
RW-704	10/27/2020	18.88	18.96	0.08	1.34	
RW-704	11/17/2020	---	17.39	---	2.84	
RW-704	12/30/2020	---	19.09	---	1.14	
RW-704	1/28/2021	---	18.93	---	1.30	
RW-704	4/16/2021	18.09	18.09	<0.01	2.15	
RW-705	6/9/2016	---	14.77	---	1.15	
RW-705	7/6/2016	---	15.32	---	0.60	
RW-705	2/7/2018	---	15.57	---	0.35	
RW-705	3/14/2018	---	14.11	---	1.81	
RW-705	6/18/2018	---	14.00	---	1.92	
RW-705	8/21/2018	---	14.55	---	1.37	
RW-705	9/24/2018	---	12.64	---	3.28	
RW-705	10/24/2018	---	14.40	---	1.52	
RW-705	11/27/2018	---	11.39	---	4.53	
RW-705	1/15/2019	---	13.12	---	2.80	
RW-705	1/23/2019	---	13.18	---	2.74	
RW-705	2/12/2019	---	12.53	---	3.39	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-705	3/6/2019	---	11.71	---	4.21	
RW-705	4/3/2019	---	13.60	---	2.32	
RW-705	4/15/2019	---	11.05	---	4.87	
RW-705	5/6/2019	---	11.93	---	3.99	
RW-705	6/5/2019	---	14.97	---	0.95	
RW-705	7/10/2019	---	12.90	---	3.02	
RW-705	8/6/2019	---	14.03	---	1.89	
RW-705	9/11/2019	---	14.63	---	1.29	
RW-705	10/10/2019	---	15.16	---	0.76	
RW-705	12/5/2019	---	15.27	---	0.65	
RW-705	2/5/2020	---	15.12	---	0.80	
RW-705	3/2/2020	---	14.78	---	1.14	
RW-705	6/4/2020	---	11.23	---	4.69	
RW-705	7/8/2020	---	15.15	---	0.77	
RW-705	8/5/2020	---	14.28	---	1.64	
RW-705	9/14/2020	---	14.00	---	1.92	
RW-705	10/27/2020	---	14.98	---	0.94	
RW-705	11/17/2020	---	13.68	---	2.24	
RW-705	12/30/2020	---	13.32	---	2.60	
RW-705	12/30/2020	---	13.32	---	2.60	
RW-705	1/28/2021	---	14.30	---	1.62	
RW-705	4/16/2021	---	13.25	---	2.67	
RW-706	6/9/2016	---	19.40	---	-3.51	
RW-706	7/6/2016	---	15.41	---	0.48	
RW-706	8/3/2016	---	19.20	---	-3.31	
RW-706	8/12/2016	---	19.20	---	-3.31	
RW-706	10/3/2016	---	16.05	---	-0.16	
RW-706	10/10/2016	---	16.05	---	-0.16	
RW-706	11/15/2016	---	16.01	---	-0.12	
RW-706	11/15/2016	---	16.01	---	-0.12	
RW-706	1/10/2017	---	16.04	---	-0.15	
RW-706	3/1/2017	---	15.66	---	0.23	
RW-706	4/5/2017	---	15.52	---	0.37	
RW-706	5/8/2017	---	15.24	---	0.65	
RW-706	6/6/2017	---	14.90	---	0.99	
RW-706	7/6/2017	---	15.16	---	0.73	
RW-706	8/2/2017	---	15.30	---	0.59	
RW-706	9/5/2017	---	15.03	---	0.86	
RW-706	10/2/2017	---	15.56	---	0.33	
RW-706	11/9/2017	---	15.62	---	0.27	
RW-706	12/5/2017	---	15.62	---	0.27	
RW-706	1/10/2018	---	16.26	---	-0.37	
RW-706	2/7/2018	---	15.99	---	-0.10	
RW-706	3/14/2018	---	14.38	---	1.51	
RW-706	6/18/2018	---	14.12	---	1.77	
RW-706	8/21/2018	---	14.92	---	0.97	
RW-706	9/24/2018	---	14.77	---	1.12	
RW-706	10/24/2018	---	14.51	---	1.38	
RW-706	11/27/2018	---	12.74	---	3.15	
RW-706	1/15/2019	---	13.25	---	2.64	
RW-706	1/23/2019	---	13.39	---	2.50	
RW-706	2/12/2019	---	13.69	---	2.20	
RW-706	3/6/2019	---	13.18	---	2.71	
RW-706	4/3/2019	---	13.67	---	2.22	
RW-706	4/15/2019	---	13.71	---	2.18	
RW-706	5/6/2019	---	14.17	---	1.72	
RW-706	6/5/2019	---	14.16	---	1.73	
RW-706	7/10/2019	---	13.73	---	2.16	
RW-706	8/6/2019	---	14.12	---	1.77	
RW-706	9/11/2019	---	14.70	---	1.19	
RW-706	10/10/2019	---	15.22	---	0.67	
RW-706	12/5/2019	---	15.51	---	0.38	
RW-706	2/5/2020	---	15.17	---	0.72	
RW-706	3/2/2020	---	14.76	---	1.13	
RW-706	6/4/2020	---	14.81	---	1.08	
RW-706	7/8/2020	---	15.12	---	0.77	
RW-706	8/5/2020	---	14.69	---	1.20	
RW-706	9/14/2020	---	14.94	---	0.95	
RW-706	10/27/2020	---	14.99	---	0.90	
RW-706	12/30/2020	---	13.84	---	2.05	
RW-706	1/28/2021	---	14.31	---	1.58	
RW-706	4/16/2021	---	13.74	---	2.15	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-707	6/9/2016	---	15.50	---	0.79	
RW-707	7/6/2016	---	15.83	---	0.46	
RW-707	8/3/2016	---	16.23	---	0.06	
RW-707	8/12/2016	---	16.23	---	0.06	
RW-707	9/13/2016	---	16.53	---	-0.24	
RW-707	10/3/2016	---	16.40	---	-0.11	
RW-707	10/10/2016	---	16.40	---	-0.11	
RW-707	11/15/2016	---	16.42	---	-0.13	
RW-707	11/15/2016	---	16.42	---	-0.13	
RW-707	1/10/2017	---	16.45	---	-0.16	
RW-707	3/1/2017	---	16.09	---	0.20	
RW-707	4/5/2017	---	15.95	---	0.34	
RW-707	5/8/2017	---	15.64	---	0.65	
RW-707	6/6/2017	---	15.35	---	0.94	
RW-707	7/6/2017	---	15.52	---	0.77	
RW-707	8/2/2017	---	15.65	---	0.64	
RW-707	9/5/2017	---	15.42	---	0.87	
RW-707	10/2/2017	---	15.90	---	0.39	
RW-707	11/9/2017	---	15.95	---	0.34	
RW-707	12/5/2017	---	15.95	---	0.34	
RW-707	1/10/2018	---	16.45	---	-0.16	
RW-707	2/7/2018	---	16.03	---	0.26	
RW-707	3/14/2018	---	14.80	---	1.49	
RW-707	6/18/2018	---	14.52	---	1.77	
RW-707	8/21/2018	---	15.28	---	1.01	
RW-707	9/24/2018	---	15.12	---	1.17	
RW-707	10/24/2018	---	14.83	---	1.46	
RW-707	11/27/2018	---	13.76	---	2.53	
RW-707	1/15/2019	---	13.62	---	2.67	
RW-707	1/23/2019	---	13.77	---	2.52	
RW-707	2/12/2019	---	13.38	---	2.91	
RW-707	3/6/2019	---	13.93	---	2.36	
RW-707	4/3/2019	---	13.98	---	2.31	
RW-707	4/15/2019	---	14.17	---	2.12	
RW-707	5/6/2019	---	14.49	---	1.80	
RW-707	6/5/2019	---	14.54	---	1.75	
RW-703	12/5/2017	NM	NM	NM	NM	Top of pump at 29.7 ft btoc
RW-703	1/10/2018	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	2/7/2018	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	3/14/2018	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	6/18/2018	---	19.43	---	1.19	
RW-703	8/21/2018	---	19.73	---	0.89	
RW-703	9/24/2018	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	10/24/2018	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	11/6/2018	---	18.63	---	1.99	
RW-703	11/12/2018	---	18.63	---	1.99	
RW-703	11/27/2018	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	1/23/2019	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	2/12/2019	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	3/6/2019	---	29.70	---	-9.08	Water level is at top of pump intake level.
RW-703	4/3/2019	---	18.20	---	2.42	
RW-703	4/15/2019	---	18.23	---	2.39	
RW-703	5/6/2019	---	18.83	---	1.79	
RW-703	6/6/2019	---	18.83	---	1.79	
RW-703	7/10/2019	---	18.83	---	1.79	
RW-705	8/3/2016	---	15.74	---	0.18	
RW-705	8/12/2016	---	15.74	---	0.18	
RW-705	8/16/2016	---	15.89	---	0.03	
RW-705	10/3/2016	---	15.98	---	-0.06	Water level is at top of pump intake level.
RW-705	10/10/2016	---	15.98	---	-0.06	Water level is at top of pump intake level.
RW-705	11/15/2016	---	15.97	---	-0.05	Water level is at top of pump intake level.
RW-705	11/15/2016	---	15.97	---	-0.05	Water level is at top of pump intake level.
RW-705	1/10/2017	---	16.00	---	-0.08	
RW-705	3/1/2017	---	15.65	---	0.27	
RW-705	4/5/2017	---	15.01	---	0.91	
RW-705	5/8/2017	---	14.90	---	1.02	
RW-705	6/6/2017	---	13.52	---	2.40	
RW-705	7/6/2017	---	15.11	---	0.81	
RW-705	8/2/2017	---	15.21	---	0.71	
RW-705	9/5/2017	---	12.25	---	3.67	
RW-705	10/2/2017	---	15.49	---	0.43	
RW-705	11/9/2017	---	14.97	---	0.95	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-705	12/5/2017	---	15.60	---	0.32	
RW-705	1/10/2018	---	15.77	---	0.15	
RW-710	4/3/2019	---	13.83	---	2.05	
RW-710	4/15/2019	---	13.92	---	1.96	
RW-710	5/6/2019	---	14.35	---	1.53	
RW-710	6/5/2019	---	14.31	---	1.57	
RW-710	7/10/2019	---	13.95	---	1.93	
RW-710	8/6/2019	---	14.28	---	1.60	
RW-710	9/11/2019	---	14.88	---	1.00	
RW-710	10/10/2019	---	15.45	---	0.43	
RW-710	12/5/2019	---	15.76	---	0.12	
RW-710	2/5/2020	---	15.35	---	0.53	
RW-710	3/2/2020	---	15.16	---	0.72	
RW-710	6/4/2020	---	15.02	---	0.86	
RW-710	7/8/2020	---	15.34	---	0.54	
RW-710	8/5/2020	---	15.92	---	-0.04	
RW-710	9/14/2020	---	14.29	---	1.59	
RW-710	10/27/2020	---	15.21	---	0.67	
RW-710	11/17/2020	---	14.93	---	0.95	
RW-710	12/30/2020	---	14.06	---	1.82	
RW-710	1/28/2021	---	14.51	---	1.37	
RW-710	4/16/2021	---	13.96	---	1.92	
RW-711	6/9/2016	---	14.54	---	0.95	
RW-711	7/6/2016	---	14.94	---	0.55	
RW-711	8/3/2016	---	15.30	---	0.19	
RW-711	8/12/2016	---	15.30	---	0.19	
RW-711	8/16/2016	---	15.40	---	0.09	
RW-711	10/3/2016	---	15.58	---	-0.09	Water level is at top of pump intake level.
RW-711	10/10/2016	---	15.58	---	-0.09	Water level is at top of pump intake level.
RW-711	11/15/2016	---	15.58	---	-0.09	Water level is at top of pump intake level.
RW-711	11/15/2016	---	15.58	---	-0.09	Water level is at top of pump intake level.
RW-711	1/10/2017	---	15.54	---	-0.05	
RW-711	3/1/2017	---	15.19	---	0.30	
RW-711	4/5/2017	---	15.06	---	0.43	
RW-711	5/8/2017	---	14.79	---	0.70	
RW-711	6/6/2017	---	14.53	---	0.96	
RW-711	7/6/2017	---	14.72	---	0.77	
RW-711	8/2/2017	---	14.50	---	0.99	
RW-711	9/5/2017	---	14.59	---	0.90	
RW-711	10/2/2017	---	15.07	---	0.42	
RW-711	11/9/2017	---	15.11	---	0.38	
RW-711	12/5/2017	---	15.05	---	0.44	
RW-715	6/18/2018	---	17.63	---	-2.26	
RW-715	6/28/2018	---	13.81	---	1.56	
RW-715	8/21/2018	---	14.35	---	1.02	
RW-715	9/24/2018	---	14.21	---	1.16	
RW-715	10/24/2018	---	13.91	---	1.46	
RW-715	11/27/2018	---	12.86	---	2.51	
RW-715	1/15/2019	---	12.61	---	2.76	
RW-715	1/23/2019	---	12.73	---	2.64	
RW-715	2/12/2019	---	13.07	---	2.30	
RW-715	3/6/2019	---	12.91	---	2.46	
RW-715	4/3/2019	---	13.03	---	2.34	
RW-715	4/15/2019	---	13.22	---	2.15	
RW-715	5/6/2019	---	13.54	---	1.83	
RW-715	6/5/2019	---	13.49	---	1.88	
RW-715	7/10/2019	---	13.11	---	2.26	
RW-715	8/6/2019	---	13.48	---	1.89	
RW-715	9/11/2019	---	14.07	---	1.30	
RW-715	9/20/2019	---	14.84	---	0.53	
RW-715	10/10/2019	---	14.65	---	0.72	
RW-715	12/5/2019	---	14.92	---	0.45	
S-96	6/18/2018	17.87	19.60	1.73	1.67	
S-96	6/5/2019	17.75	19.11	1.36	1.84	
S-96	10/10/2019	17.85	19.81	1.96	1.68	
S-96	6/3/2020	18.76	18.77	0.01	1.01	
S-96	4/28/2021	16.29	16.30	0.01	3.48	
S-97	8/17/2016	---	22.55	---	5.40	
S-97	10/7/2016	---	28.00	---	-0.05	
S-97	5/8/2017	NM	NM	NM	NM	Destroyed
S-102	10/6/2016	---	17.76	---	0.46	
S-102	11/15/2016	---	17.92	---	0.30	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-102	5/8/2017	---	15.54	---	2.68	
S-102	6/18/2018	---	16.52	---	1.70	
S-102	6/5/2019	---	16.46	---	1.76	
S-102	10/10/2019	---	7.21	---	11.01	
S-102	6/3/2020	---	17.28	---	0.94	
S-102	4/15/2021	---	16.61	---	1.61	
S-216	10/7/2016	---	15.32	---	0.44	
S-216	11/15/2016	---	15.35	---	0.41	
S-216	5/8/2017	---	15.12	---	0.64	
S-216	6/18/2018	---	18.94	---	-3.18	
S-216	6/5/2019	---	13.64	---	2.12	
S-216	10/10/2019	---	14.38	---	1.38	
S-216	6/3/2020	---	14.52	---	1.24	
S-216	4/16/2021	---	13.98	---	1.78	
S-217	5/8/2017	NM	NM	NM	NM	Destroyed
S-218	8/17/2016	---	20.80	---	4.94	
S-218	10/7/2016	---	25.72	---	0.02	
S-218	11/15/2016	---	25.37	---	0.37	
S-218	5/8/2017	NM	NM	NM	NM	Datalogger in well
S-218	6/18/2018	---	23.63	---	2.11	
S-218	6/5/2019	---	23.18	---	2.56	
S-218	10/10/2019	---	24.38	---	1.36	
S-218	6/3/2020	---	24.32	---	1.42	
S-218	12/29/2020	---	24.11	---	1.63	
S-218	4/16/2021	---	23.71	---	2.03	
S-218D	8/31/2016	---	25.15	---	-0.63	
S-223	4/23/2019	---	13.72	---	2.16	
S-223	6/5/2019	---	14.93	---	0.95	
S-223	10/10/2019	---	15.07	---	0.81	
S-223	12/4/2019	---	15.20	---	0.68	
S-223	6/4/2020	---	14.67	---	1.21	
S-223	9/1/2020	---	14.65	---	1.23	
S-223	12/28/2020	---	13.68	---	2.20	
S-223	4/16/2021	---	13.58	---	2.30	
S-223	5/4/2021	---	14.00	---	1.88	
S-224	8/16/2016	---	15.88	---	0.15	
S-224	10/10/2016	---	16.12	---	-0.09	
S-224	3/1/2017	---	15.69	---	0.34	
S-224	4/5/2017	---	15.50	---	0.53	
S-224	5/8/2017	---	15.28	---	0.75	
S-224	6/6/2017	---	14.92	---	1.11	
S-224	7/6/2017	---	15.19	---	0.84	
S-224	1/25/2018	---	16.14	---	-0.11	
S-224	4/2/2018	---	14.67	---	1.36	
S-224	6/18/2018	---	14.11	---	1.92	
S-224	11/6/2018	---	12.68	---	3.35	
RW-707	7/10/2019	---	14.13	---	2.16	
RW-707	8/6/2019	---	14.47	---	1.82	
RW-707	9/11/2019	---	15.06	---	1.23	
RW-707	10/10/2019	---	15.57	---	0.72	
RW-707	12/5/2019	---	15.87	---	0.42	
RW-707	2/5/2020	---	15.49	---	0.80	
RW-707	3/2/2020	---	15.31	---	0.98	
RW-707	6/4/2020	---	15.17	---	1.12	
RW-707	7/8/2020	---	15.49	---	0.80	
RW-707	8/5/2020	---	15.03	---	1.26	
RW-707	9/14/2020	---	15.28	---	1.01	
RW-707	10/27/2020	---	15.35	---	0.94	
RW-707	11/17/2020	---	15.03	---	1.26	
RW-707	12/30/2020	---	14.25	---	2.04	
RW-707	1/28/2021	---	14.72	---	1.57	
RW-707	4/16/2021	---	14.11	---	2.18	
RW-708	6/9/2016	---	17.45	---	-1.96	
RW-708	7/6/2016	---	17.45	---	-1.96	
RW-708	8/3/2016	18.60	18.60	<0.01	-3.10	
RW-708	8/12/2016	18.60	18.60	<0.01	-3.10	
RW-708	9/13/2016	15.51	16.38	0.87	-0.18	
RW-708	10/3/2016	---	16.30	---	-0.81	
RW-708	10/10/2016	---	16.30	---	-0.81	
RW-708	11/15/2016	---	16.30	---	-0.81	Water level is at top of pump intake level.
RW-708	11/15/2016	---	16.30	---	-0.81	Water level is at top of pump intake level.
RW-708	1/10/2017	---	16.30	---	-0.81	Water level is at top of pump intake level.

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-708	3/1/2017	---	16.30	---	-0.81	Water level is at top of pump intake level.
RW-708	4/5/2017	---	16.50	---	-1.01	
RW-708	5/8/2017	---	14.82	---	0.67	
RW-708	6/6/2017	---	14.53	---	0.96	
RW-708	7/6/2017	---	14.73	---	0.76	
RW-708	8/2/2017	---	14.87	---	0.62	
RW-708	9/5/2017	---	14.66	---	0.83	
RW-708	10/2/2017	---	15.11	---	0.38	
RW-708	11/9/2017	---	15.23	---	0.26	
RW-708	11/14/2017	---	15.21	---	0.28	
RW-708	12/5/2017	---	15.17	---	0.32	
RW-708	1/10/2018	---	16.93	---	-1.44	
RW-708	2/7/2018	---	16.77	---	-1.28	
RW-708	3/14/2018	---	14.23	---	1.26	
RW-708	6/18/2018	---	14.58	---	0.91	
RW-708	9/24/2018	14.30	14.39	0.09	1.17	
RW-708	10/24/2018	14.00	14.12	0.12	1.47	
RW-708	11/27/2018	---	12.98	---	2.51	
RW-708	1/15/2019	---	12.77	---	2.72	
RW-708	1/23/2019	---	12.97	---	2.52	
RW-708	2/12/2019	---	13.20	---	2.29	
RW-708	3/6/2019	---	13.15	---	2.34	
RW-708	4/3/2019	---	13.20	---	2.29	
RW-708	4/15/2019	---	13.33	---	2.16	
RW-708	5/6/2019	---	13.70	---	1.79	
RW-708	6/6/2019	---	13.72	---	1.77	
RW-708	7/10/2019	---	13.30	---	2.19	
RW-708	8/6/2019	---	13.62	---	1.87	
RW-708	9/11/2019	14.21	14.21	<0.01	1.29	
RW-708	9/28/2019	---	14.98	---	0.51	
RW-708	10/10/2019	---	14.78	---	0.71	
RW-708	12/5/2019	---	15.09	---	0.40	
RW-708	2/5/2020	---	14.71	---	0.78	
RW-708	3/2/2020	---	14.52	---	0.97	
RW-708	4/28/2020	---	14.05	---	1.44	
RW-708	5/18/2020	---	14.10	---	1.39	
RW-708	6/4/2020	---	14.38	---	1.11	
RW-708	7/8/2020	---	14.46	---	1.03	
RW-708	8/5/2020	---	14.58	---	0.91	
RW-708	9/14/2020	---	14.00	---	1.49	
RW-708	10/27/2020	---	14.46	---	1.03	
RW-708	11/17/2020	---	14.26	---	1.23	
RW-708	12/30/2020	---	13.38	---	2.11	
RW-708	12/30/2020	---	13.38	---	2.11	
RW-708	1/28/2021	---	13.84	---	1.65	
RW-708	4/16/2021	---	13.30	---	2.19	
RW-708	5/3/2021	---	13.69	---	1.80	
RW-709	6/9/2016	---	14.47	---	0.83	
RW-709	7/6/2016	---	14.82	---	0.48	
RW-709	8/3/2016	---	15.21	---	0.09	
RW-709	8/12/2016	---	15.21	---	0.09	
RW-709	9/13/2016	---	15.47	---	-0.17	
RW-709	10/3/2016	---	15.42	---	-0.12	
RW-709	10/10/2016	---	15.42	---	-0.12	
RW-709	11/15/2016	---	15.41	---	-0.11	
RW-709	11/15/2016	---	15.41	---	-0.11	
RW-709	1/10/2017	---	15.42	---	-0.12	
RW-709	3/1/2017	---	15.03	---	0.27	
RW-709	4/5/2017	---	14.87	---	0.43	
RW-709	5/8/2017	---	15.05	---	0.25	
RW-709	6/6/2017	---	14.30	---	1.00	
RW-709	7/6/2017	---	14.55	---	0.75	
RW-709	8/2/2017	---	14.63	---	0.67	
RW-709	9/5/2017	---	14.42	---	0.88	
RW-709	10/2/2017	---	14.93	---	0.37	
RW-709	11/9/2017	---	14.98	---	0.32	
RW-709	12/5/2017	---	14.97	---	0.33	
RW-709	1/10/2018	---	15.70	---	-0.40	
RW-709	2/7/2018	---	15.62	---	-0.32	
RW-709	3/14/2018	---	13.77	---	1.53	
RW-709	6/18/2018	---	14.16	---	1.14	
RW-709	8/21/2018	---	14.25	---	1.05	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-709	9/24/2018	---	14.30	---	1.00	
RW-709	10/24/2018	---	13.84	---	1.46	
RW-709	11/27/2018	---	12.80	---	2.50	
RW-709	1/15/2019	---	12.58	---	2.72	
RW-709	1/23/2019	---	12.73	---	2.57	
RW-709	2/12/2019	---	13.02	---	2.28	
RW-709	3/6/2019	---	12.92	---	2.38	
RW-709	4/3/2019	---	13.00	---	2.30	
RW-709	4/15/2019	---	13.16	---	2.14	
RW-709	5/6/2019	---	13.53	---	1.77	
RW-709	6/5/2019	---	13.45	---	1.85	
RW-709	7/10/2019	---	13.15	---	2.15	
RW-709	8/6/2019	---	13.45	---	1.85	
RW-709	9/11/2019	---	14.03	---	1.27	
RW-709	10/10/2019	---	14.58	---	0.72	
RW-709	12/5/2019	---	14.90	---	0.40	
RW-709	2/5/2020	---	14.50	---	0.80	
RW-709	3/2/2020	---	14.30	---	1.00	
RW-709	6/4/2020	---	14.18	---	1.12	
RW-709	7/8/2020	---	14.55	---	0.75	
RW-709	8/5/2020	---	14.06	---	1.24	
RW-709	9/14/2020	---	14.49	---	0.81	
RW-709	10/27/2020	---	14.35	---	0.95	
RW-709	11/17/2020	---	14.04	---	1.26	
RW-709	12/30/2020	---	15.17	---	0.13	
RW-709	1/28/2021	---	13.66	---	1.64	
RW-709	4/16/2021	---	13.11	---	2.19	
RW-710	6/9/2016	---	15.27	---	0.61	
RW-710	7/6/2016	---	15.61	---	0.27	
RW-710	8/3/2016	---	16.00	---	-0.12	
RW-710	8/12/2016	---	16.00	---	-0.12	
RW-710	10/3/2016	---	16.25	---	-0.37	
RW-710	10/10/2016	---	16.25	---	-0.37	
RW-710	11/15/2016	---	16.27	---	-0.39	
RW-710	11/15/2016	---	16.27	---	-0.39	
RW-710	1/10/2017	---	16.28	---	-0.40	
RW-710	3/1/2017	---	15.92	---	-0.04	
RW-710	4/5/2017	---	15.75	---	0.13	
RW-710	5/8/2017	---	15.52	---	0.36	
RW-710	6/6/2017	---	15.13	---	0.75	
RW-710	7/6/2017	---	15.40	---	0.48	
RW-710	8/2/2017	---	15.53	---	0.35	
RW-710	9/5/2017	---	15.18	---	0.70	
RW-710	10/2/2017	---	15.75	---	0.13	
RW-710	11/9/2017	---	15.80	---	0.08	
RW-710	12/5/2017	---	15.84	---	0.04	
RW-710	1/10/2018	NM	NM	NM	NM	Could not locate under snow
RW-710	2/7/2018	---	15.79	---	0.09	
RW-710	3/14/2018	---	14.62	---	1.26	
RW-710	6/18/2018	---	14.32	---	1.56	
RW-710	8/21/2018	---	15.12	---	0.76	
RW-710	9/24/2018	---	14.95	---	0.93	
RW-710	10/24/2018	---	14.67	---	1.21	
RW-710	11/27/2018	---	13.63	---	2.25	
RW-710	1/15/2019	---	13.42	---	2.46	
RW-710	1/23/2019	---	13.56	---	2.32	
RW-710	2/12/2019	---	11.83	---	4.05	
RW-710	3/6/2019	---	13.77	---	2.11	
RW-711	1/10/2018	---	15.86	---	-0.37	
RW-711	2/7/2018	---	15.81	---	-0.32	
RW-711	3/14/2018	---	13.90	---	1.59	
RW-711	6/18/2018	---	13.68	---	1.81	
RW-711	8/21/2018	---	14.45	---	1.04	
RW-711	9/24/2018	---	14.25	---	1.24	
RW-711	10/24/2018	---	13.96	---	1.53	
RW-711	11/27/2018	---	12.95	---	2.54	
RW-711	1/15/2019	---	12.72	---	2.77	
RW-711	1/23/2019	---	12.82	---	2.67	
RW-711	2/12/2019	---	13.17	---	2.32	
RW-711	3/6/2019	---	13.12	---	2.37	
RW-711	4/3/2019	---	13.12	---	2.37	
RW-711	4/15/2019	---	13.26	---	2.23	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-711	5/6/2019	---	13.67	---	1.82	
RW-711	6/5/2019	---	13.07	---	2.42	
RW-711	7/10/2019	---	13.28	---	2.21	
RW-711	8/6/2019	---	13.61	---	1.88	
RW-711	9/11/2019	---	14.19	---	1.30	
RW-711	10/10/2019	---	14.75	---	0.74	
RW-711	12/5/2019	---	15.07	---	0.42	
RW-711	2/5/2020	---	14.67	---	0.82	
RW-711	3/2/2020	---	14.50	---	0.99	
RW-711	6/4/2020	---	14.35	---	1.14	
RW-711	7/8/2020	---	14.63	---	0.86	
RW-711	8/5/2020	---	14.20	---	1.29	
RW-711	9/14/2020	---	14.49	---	1.00	
RW-711	10/27/2020	---	1.53	---	13.96	
RW-711	11/17/2020	---	14.25	---	1.24	
RW-711	12/30/2020	---	13.32	---	2.17	
RW-711	1/28/2021	---	13.83	---	1.66	
RW-711	4/16/2021	---	13.26	---	2.23	
RW-712	6/9/2016	---	14.69	---	0.87	
RW-712	7/6/2016	---	15.03	---	0.53	
RW-712	8/3/2016	---	15.43	---	0.13	
RW-712	8/12/2016	---	15.43	---	0.13	
RW-712	10/3/2016	---	15.71	---	-0.15	
RW-712	10/10/2016	---	15.71	---	-0.15	
RW-712	11/15/2016	---	15.70	---	-0.14	
RW-712	11/15/2016	---	15.70	---	-0.14	
RW-712	1/10/2017	---	15.65	---	-0.09	
RW-712	3/1/2017	---	15.34	---	0.22	
RW-712	4/5/2017	---	15.18	---	0.38	
RW-712	5/8/2017	---	14.90	---	0.66	
RW-712	6/6/2017	---	14.62	---	0.94	
RW-712	7/6/2017	---	14.82	---	0.74	
RW-712	8/2/2017	---	14.92	---	0.64	
RW-712	9/5/2017	---	14.72	---	0.84	
RW-712	10/2/2017	---	15.22	---	0.34	
RW-712	11/9/2017	---	15.26	---	0.30	
RW-712	12/5/2017	---	15.23	---	0.33	
RW-712	1/10/2018	---	15.95	---	-0.39	
RW-712	2/7/2018	---	15.69	---	-0.13	
RW-712	3/14/2018	---	14.07	---	1.49	
RW-712	6/18/2018	---	13.21	---	2.35	
RW-712	8/21/2018	---	14.75	---	0.81	
RW-712	9/24/2018	---	14.41	---	1.15	
RW-712	10/24/2018	---	14.14	---	1.42	
RW-712	11/27/2018	---	13.08	---	2.48	
RW-712	1/15/2019	---	12.88	---	2.68	
RW-712	1/23/2019	---	12.98	---	2.58	
RW-712	2/12/2019	---	13.21	---	2.35	
RW-712	3/6/2019	---	13.22	---	2.34	
RW-712	4/3/2019	---	13.31	---	2.25	
RW-712	4/15/2019	---	13.53	---	2.03	
RW-712	5/6/2019	---	13.81	---	1.75	
RW-712	6/5/2019	---	13.83	---	1.73	
RW-712	7/10/2019	---	13.26	---	2.30	
RW-712	8/6/2019	---	13.72	---	1.84	
RW-712	9/11/2019	---	14.33	---	1.23	
RW-712	10/10/2019	---	14.87	---	0.69	
RW-712	12/5/2019	---	15.19	---	0.37	
RW-712	2/5/2020	---	14.80	---	0.76	
RW-712	3/2/2020	---	14.61	---	0.95	
RW-712	6/4/2020	---	14.47	---	1.09	
RW-712	7/8/2020	---	14.78	---	0.78	
RW-712	8/5/2020	---	14.34	---	1.22	
RW-712	9/14/2020	---	14.59	---	0.97	
RW-712	10/27/2020	---	14.64	---	0.92	
RW-712	11/17/2020	---	14.39	---	1.17	
RW-712	12/30/2020	---	13.43	---	2.13	
RW-712	12/30/2020	---	13.43	---	2.13	
RW-712	1/28/2021	---	13.94	---	1.62	
RW-712	4/16/2021	---	13.41	---	2.15	
RW-713	6/9/2016	---	14.10	---	0.92	
RW-713	7/6/2016	---	14.45	---	0.57	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-713	8/3/2016	---	14.84	---	0.18	
RW-713	8/12/2016	---	14.84	---	0.18	
RW-713	9/13/2016	---	15.20	---	-0.18	
RW-713	10/3/2016	---	15.13	---	-0.11	
RW-713	10/10/2016	---	15.13	---	-0.11	
RW-713	11/15/2016	---	15.14	---	-0.12	
RW-713	11/15/2016	---	15.14	---	-0.12	
RW-713	1/10/2017	---	15.07	---	-0.05	
RW-713	3/1/2017	---	14.76	---	0.26	
RW-713	4/5/2017	---	14.57	---	0.45	
RW-713	5/8/2017	---	14.29	---	0.73	
RW-713	6/6/2017	---	13.99	---	1.03	
RW-713	7/6/2017	---	14.25	---	0.77	
RW-713	8/2/2017	---	14.37	---	0.65	
RW-713	9/5/2017	---	14.10	---	0.92	
RW-713	10/2/2017	---	14.63	---	0.39	
RW-713	11/9/2017	---	14.80	---	0.22	
RW-713	12/5/2017	---	14.67	---	0.35	
RW-713	1/10/2018	---	15.42	---	-0.40	
RW-713	2/7/2018	---	15.41	---	-0.39	
RW-713	3/14/2018	---	13.43	---	1.59	
RW-713	6/18/2018	---	13.19	---	1.83	
RW-713	8/21/2018	---	13.95	---	1.07	
RW-713	9/24/2018	---	13.72	---	1.30	
RW-713	10/24/2018	---	13.55	---	1.47	
RW-713	11/27/2018	---	12.51	---	2.51	
RW-713	1/15/2019	---	12.28	---	2.74	
RW-713	1/23/2019	---	12.40	---	2.62	
RW-713	2/12/2019	---	12.77	---	2.25	
RW-713	3/6/2019	---	12.61	---	2.41	
RW-713	4/3/2019	---	12.74	---	2.28	
RW-713	4/15/2019	---	12.97	---	2.05	
RW-713	5/6/2019	---	13.20	---	1.82	
RW-713	6/5/2019	---	13.18	---	1.84	
RW-713	7/10/2019	---	12.78	---	2.24	
RW-713	8/6/2019	---	13.16	---	1.86	
RW-713	9/11/2019	---	13.75	---	1.27	
RW-713	10/10/2019	---	14.29	---	0.73	
RW-713	12/5/2019	---	14.62	---	0.40	
RW-713	2/5/2020	---	14.22	---	0.80	
RW-713	3/2/2020	---	15.08	---	-0.06	
RW-713	6/4/2020	---	13.89	---	1.13	
RW-713	7/8/2020	---	14.19	---	0.83	
RW-713	8/5/2020	---	13.75	---	1.27	
RW-713	9/14/2020	---	14.01	---	1.01	
RW-713	10/27/2020	---	14.06	---	0.96	
RW-713	11/17/2020	---	13.81	---	1.21	
RW-713	12/30/2020	---	12.86	---	2.16	
RW-713	1/28/2021	---	13.39	---	1.63	
RW-713	4/16/2021	---	12.82	---	2.20	
RW-714	6/9/2016	---	14.28	---	0.93	
RW-714	7/6/2016	---	14.64	---	0.57	
RW-714	8/3/2016	15.01	15.01	<0.01	0.21	
RW-714	8/12/2016	15.01	15.01	<0.01	0.21	
RW-714	9/13/2016	15.35	15.42	0.07	-0.16	
RW-714	9/19/2016	15.43	15.51	0.08	-0.24	
RW-714	10/3/2016	---	15.60	---	-0.39	
RW-714	10/10/2016	---	15.60	---	-0.39	
RW-714	11/15/2016	---	16.00	---	-0.79	Water level is at top of pump intake level.
RW-714	11/15/2016	---	16.00	---	-0.79	Water level is at top of pump intake level.
RW-714	1/10/2017	---	16.00	---	-0.79	Water level is at top of pump intake level.
RW-714	3/1/2017	---	16.00	---	-0.79	Water level is at top of pump intake level.
RW-714	4/5/2017	---	16.05	---	-0.84	
RW-714	5/8/2017	---	14.51	---	0.70	
RW-714	6/6/2017	---	14.27	---	0.94	
RW-714	7/6/2017	---	14.43	---	0.78	
RW-714	8/2/2017	---	14.63	---	0.58	
RW-714	9/5/2017	---	14.31	---	0.90	
RW-714	10/2/2017	---	14.84	---	0.37	
RW-714	11/9/2017	---	14.85	---	0.36	
RW-714	11/14/2017	---	14.85	---	0.36	
RW-714	12/5/2017	---	14.90	---	0.31	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-714	1/10/2018	---	15.55	---	-0.34	
RW-714	2/7/2018	---	15.46	---	-0.25	
RW-714	3/14/2018	---	13.55	---	1.66	
RW-714	6/18/2018	---	14.02	---	1.19	
RW-714	8/21/2018	---	14.16	---	1.05	
RW-714	9/24/2018	---	14.00	---	1.21	
RW-714	10/24/2018	---	13.74	---	1.47	
RW-714	11/27/2018	---	12.67	---	2.54	
RW-714	1/15/2019	---	12.44	---	2.77	
RW-714	1/23/2019	---	12.57	---	2.64	
RW-714	2/12/2019	---	12.88	---	2.33	
RW-714	3/6/2019	---	12.82	---	2.39	
RW-714	4/3/2019	---	12.90	---	2.31	
RW-714	4/15/2019	---	13.04	---	2.17	
RW-714	5/6/2019	---	13.38	---	1.83	
RW-714	6/5/2019	---	13.33	---	1.88	
RW-714	7/10/2019	---	12.95	---	2.26	
RW-714	8/6/2019	---	13.31	---	1.90	
RW-714	9/11/2019	---	13.92	---	1.29	
RW-714	10/10/2019	---	14.46	---	0.75	
RW-714	12/5/2019	---	14.77	---	0.44	
RW-714	2/5/2020	---	14.38	---	0.83	
RW-714	3/2/2020	---	13.91	---	1.30	
RW-714	4/28/2020	---	13.73	---	1.48	
RW-714	5/18/2020	---	13.77	---	1.44	
RW-714	6/4/2020	---	14.06	---	1.15	
RW-714	7/8/2020	---	14.40	---	0.81	
RW-714	8/5/2020	---	14.26	---	0.95	
RW-714	9/14/2020	---	14.18	---	1.03	
RW-714	10/27/2020	---	14.24	---	0.97	
RW-714	11/17/2020	---	14.00	---	1.21	
RW-714	12/30/2020	---	13.01	---	2.20	
RW-714	1/28/2021	---	13.55	---	1.66	
RW-714	4/16/2021	---	12.97	---	2.24	
RW-715	6/9/2016	---	14.42	---	0.95	
RW-715	7/6/2016	---	14.79	---	0.58	
RW-715	8/3/2016	---	15.18	---	0.19	
RW-715	8/12/2016	---	15.18	---	0.19	
RW-715	8/16/2016	---	15.04	---	0.33	
RW-715	9/13/2016	---	15.56	---	-0.19	
RW-715	10/3/2016	---	15.48	---	-0.11	
RW-715	10/10/2016	---	15.48	---	-0.11	
RW-715	11/15/2016	---	15.47	---	-0.10	
RW-715	11/15/2016	---	15.47	---	-0.10	
RW-715	1/10/2017	---	15.43	---	-0.06	
RW-715	3/1/2017	---	15.10	---	0.27	
RW-715	4/5/2017	---	14.92	---	0.45	
RW-715	5/8/2017	---	14.63	---	0.74	
RW-715	6/6/2017	---	14.35	---	1.02	
RW-715	7/6/2017	---	14.60	---	0.77	
RW-715	8/2/2017	---	14.72	---	0.65	
RW-715	9/5/2017	---	14.46	---	0.91	
RW-715	10/2/2017	---	14.97	---	0.40	
RW-715	11/9/2017	---	15.02	---	0.35	
RW-715	12/5/2017	---	14.98	---	0.39	
RW-715	1/10/2018	---	15.74	---	-0.37	
RW-715	2/7/2018	---	15.68	---	-0.31	
RW-715	3/14/2018	---	13.82	---	1.55	
RW-715	2/5/2020	---	14.55	---	0.82	
RW-715	3/2/2020	---	14.27	---	1.10	
RW-715	6/4/2020	---	14.25	---	1.12	
RW-715	7/8/2020	---	14.54	---	0.83	
RW-715	8/5/2020	---	14.12	---	1.25	
RW-715	9/14/2020	---	14.37	---	1.00	
RW-715	10/27/2020	---	14.41	---	0.96	
RW-715	11/17/2020	---	14.16	---	1.21	
RW-715	12/30/2020	---	13.18	---	2.19	
RW-715	1/28/2021	---	13.70	---	1.67	
RW-715	4/16/2021	---	13.15	---	2.22	
RW-715	5/4/2021	---	13.56	---	1.81	
RW-716	6/9/2016	---	14.56	---	0.99	
RW-716	7/6/2016	---	14.93	---	0.62	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-716	8/3/2016	---	15.35	---	0.20	
RW-716	8/12/2016	---	15.05	---	0.50	
RW-716	10/3/2016	---	15.67	---	-0.13	
RW-716	10/10/2016	---	15.67	---	-0.13	
RW-716	11/15/2016	---	15.64	---	-0.10	
RW-716	11/15/2016	---	15.64	---	-0.10	
RW-716	1/10/2017	---	15.58	---	-0.04	
RW-716	3/1/2017	---	15.22	---	0.33	
RW-716	4/5/2017	---	15.03	---	0.52	
RW-716	5/8/2017	---	14.68	---	0.87	
RW-716	6/6/2017	---	14.51	---	1.04	
RW-716	7/6/2017	---	14.75	---	0.80	
RW-716	8/2/2017	---	14.88	---	0.67	
RW-716	9/5/2017	---	14.63	---	0.92	
RW-716	10/2/2017	---	15.16	---	0.39	
RW-716	11/9/2017	---	15.20	---	0.35	
RW-716	12/5/2017	---	15.18	---	0.37	
RW-716	1/10/2018	---	15.90	---	-0.36	
RW-716	2/7/2018	---	15.74	---	-0.20	
RW-716	3/14/2018	---	13.85	---	1.70	
RW-716	6/18/2018	---	13.72	---	1.83	
RW-716	8/21/2018	---	14.52	---	1.03	
RW-716	9/24/2018	---	14.35	---	1.20	
RW-716	10/24/2018	---	14.07	---	1.48	
RW-716	11/27/2018	---	12.98	---	2.57	
RW-716	1/15/2019	---	12.78	---	2.77	
RW-716	1/23/2019	---	12.84	---	2.71	
RW-716	2/12/2019	---	13.21	---	2.34	
RW-716	3/6/2019	---	13.04	---	2.51	
RW-716	4/3/2019	---	13.22	---	2.33	
RW-716	4/15/2019	---	13.35	---	2.20	
RW-716	5/6/2019	---	13.70	---	1.85	
RW-716	6/5/2019	---	13.62	---	1.93	
RW-716	7/10/2019	---	13.26	---	2.29	
RW-716	8/6/2019	---	13.63	---	1.92	
RW-716	9/11/2019	---	14.25	---	1.30	
RW-716	10/10/2019	---	14.79	---	0.76	
RW-716	12/5/2019	---	15.04	---	0.51	
RW-716	2/5/2020	---	14.63	---	0.92	
RW-716	3/2/2020	---	14.49	---	1.06	
RW-716	6/3/2020	---	14.23	---	1.32	
RW-716	7/8/2020	---	14.74	---	0.81	
RW-716	8/5/2020	---	14.27	---	1.28	
RW-716	9/14/2020	---	14.54	---	1.01	
RW-716	10/27/2020	---	14.59	---	0.96	
RW-716	11/17/2020	---	14.35	---	1.20	
RW-716	12/30/2020	---	13.32	---	2.23	
RW-716	1/28/2021	---	13.88	---	1.67	
RW-716	4/16/2021	---	13.28	---	2.27	
RW-717	6/9/2016	---	14.54	---	1.07	
RW-717	7/6/2016	---	14.95	---	0.66	
RW-717	8/3/2016	---	15.30	---	0.31	
RW-717	8/12/2016	---	15.30	---	0.31	
RW-717	8/17/2016	---	15.43	---	0.18	
RW-717	10/3/2016	---	15.69	---	-0.08	
RW-717	10/10/2016	---	15.69	---	-0.08	
RW-717	11/15/2016	---	15.68	---	-0.07	
RW-717	11/15/2016	---	15.68	---	-0.07	
RW-717	1/10/2017	---	15.60	---	0.01	
RW-717	3/1/2017	---	15.21	---	0.40	
RW-717	4/5/2017	---	15.01	---	0.60	
RW-717	5/8/2017	---	14.83	---	0.78	
RW-717	6/6/2017	---	14.52	---	1.09	
RW-717	7/6/2017	---	14.78	---	0.83	
RW-717	8/2/2017	---	14.93	---	0.68	
RW-717	9/5/2017	---	14.67	---	0.94	
RW-717	10/2/2017	---	15.18	---	0.43	
RW-717	11/9/2017	---	15.20	---	0.41	
RW-717	12/5/2017	---	15.20	---	0.41	
RW-717	1/10/2018	---	15.88	---	-0.27	
RW-717	2/7/2018	---	15.81	---	-0.20	
RW-717	3/14/2018	---	13.89	---	1.72	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
RW-717	6/18/2018	---	13.74	---	1.87	
RW-717	8/21/2018	---	14.53	---	1.08	
RW-717	9/24/2018	---	14.36	---	1.25	
RW-717	10/24/2018	---	14.10	---	1.51	
RW-717	11/27/2018	---	12.98	---	2.63	
RW-717	1/15/2019	---	12.79	---	2.82	
RW-717	1/23/2019	---	12.88	---	2.73	
RW-717	2/12/2019	---	13.23	---	2.38	
RW-717	3/6/2019	---	13.08	---	2.53	
RW-717	4/3/2019	---	13.24	---	2.37	
RW-717	4/15/2019	---	13.45	---	2.16	
RW-717	6/5/2019	---	13.31	---	2.30	
RW-717	7/10/2019	---	13.29	---	2.32	
RW-717	8/8/2019	---	13.67	---	1.94	
RW-717	9/11/2019	---	14.26	---	1.35	
RW-717	10/10/2019	---	14.83	---	0.78	
RW-717	12/5/2019	---	15.10	---	0.51	
RW-717	2/5/2020	---	14.66	---	0.95	
RW-717	3/2/2020	---	14.48	---	1.13	
RW-717	6/3/2020	---	14.19	---	1.42	
RW-717	7/8/2020	---	14.79	---	0.82	
RW-717	8/5/2020	---	14.28	---	1.33	
RW-717	9/14/2020	---	14.56	---	1.05	
RW-717	10/27/2020	---	14.61	---	1.00	
RW-717	11/17/2020	---	14.39	---	1.22	
RW-717	12/30/2020	---	13.33	---	2.28	
RW-717	1/28/2021	---	13.90	---	1.71	
RW-717	4/16/2021	---	13.31	---	2.30	
S-26	8/10/2016	---	18.56	---	2.20	
S-26	10/10/2016	---	20.81	---	-0.05	
S-26	5/8/2017	---	19.91	---	0.85	
S-26	6/18/2018	---	18.81	---	1.95	
S-26	11/6/2018	---	18.94	---	1.82	
S-26	1/15/2019	---	17.98	---	2.78	
S-26	6/5/2019	---	18.84	---	1.92	
S-26	10/10/2019	---	19.94	---	0.82	
S-26	4/28/2020	---	19.26	---	1.50	
S-26	5/18/2020	---	19.41	---	1.35	
S-26	6/3/2020	---	19.42	---	1.34	
S-26	7/8/2020	---	19.87	---	0.89	
S-26	8/5/2020	---	19.76	---	1.00	
S-26	9/14/2020	---	19.64	---	1.12	
S-26	10/27/2020	---	19.73	---	1.03	
S-26	11/17/2020	---	19.40	---	1.36	
S-26	12/29/2020	---	18.72	---	2.04	
S-26	12/30/2020	---	18.72	---	2.04	
S-26	4/16/2021	---	18.51	---	2.25	
S-27	10/6/2016	---	24.73	---	-0.12	
S-27	11/7/2016	---	2.75	---	21.86	Missing J-plug, casing damaged
S-27	5/8/2017	---	23.96	---	0.65	
S-27	6/18/2018	NM	NM	NM	NM	
S-27	6/5/2019	NM	NM	NM	NM	Unable to locate
S-27	10/10/2019	NM	NM	NM	NM	Unable to locate
S-27	6/3/2020	NM	NM	NM	NM	Unable to locate
S-27	4/16/2021	NM	NM	NM	NM	Unable to locate
S-28	8/17/2016	NM	NM	NM	NM	Dry
S-28	10/6/2016	NM	NM	NM	NM	Dry
S-28	5/8/2017	---	18.99	---	6.75	
S-28	6/18/2018	---	19.55	---	6.19	
S-28	6/5/2019	NM	NM	NM	NM	Dry at 19.65
S-28	10/10/2019	NM	NM	NM	NM	Dry at 19.56
S-28	10/21/2019	---	21.15	---	4.59	
S-28	6/3/2020	NM	NM	NM	NM	Dry at 19.60 ft btoc
S-28	4/16/2021	NM	NM	NM	NM	Dry at 19.60 ft btoc
S-29	8/12/2016	20.67	23.30	2.63	2.27	
S-29	10/6/2016	21.08	21.08	<0.01	2.23	
S-29	11/15/2016	21.08	23.27	2.19	1.92	
S-29	5/8/2017	21.03	23.00	1.97	2.00	
S-29	6/18/2018	19.85	22.85	3.00	3.04	
S-29	4/19/2019	19.65	23.16	3.51	3.18	
S-29	6/5/2019	22.65	22.68	0.03	0.65	
S-29	10/10/2019	20.41	22.54	2.13	2.60	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-29	6/3/2020	20.60	22.72	2.12	2.41	
S-29	12/29/2020	20.51	22.64	2.13	2.50	
S-29	4/16/2021	20.05	22.73	2.68	2.89	
S-30	8/12/2016	21.58	29.24	7.66	0.54	
S-30	8/19/2016	NM	NM	NM	NM	LNAPL present
S-30	10/6/2016	22.00	29.46	7.46	0.15	
S-30	11/15/2016	21.91	29.32	7.41	0.24	
S-30	3/1/2017	21.63	29.25	7.62	0.49	
S-30	5/8/2017	22.22	23.97	1.75	0.68	
S-30	8/2/2017	21.35	27.81	6.46	0.93	
S-30	11/9/2017	21.57	29.15	7.58	0.56	
S-30	2/13/2018	22.06	29.82	7.76	0.05	
S-30	6/18/2018	22.11	22.13	0.02	1.02	
S-30	8/21/2018	21.82	22.32	0.50	1.24	
S-30	9/24/2018	21.68	21.76	0.08	1.44	
S-30	10/1/2018	21.40	21.58	0.18	1.71	
S-30	10/10/2018	21.13	21.30	0.17	1.98	
S-30	10/24/2018	21.36	21.49	0.13	1.75	
S-30	11/28/2018	20.72	21.18	0.46	2.35	
S-30	12/18/2018	20.84	21.35	0.51	2.22	
S-30	2/12/2019	20.67	21.35	0.68	2.37	
S-30	2/21/2019	20.59	21.51	0.92	2.42	
S-30	3/13/2019	20.68	21.95	1.27	2.28	
S-30	3/19/2019	20.78	21.16	0.38	2.30	
S-30	3/26/2019	20.91	21.09	0.18	2.20	
S-30	4/2/2019	20.87	21.06	0.19	2.23	
S-30	4/15/2019	20.96	21.59	0.63	2.09	
S-30	6/5/2019	21.01	21.23	0.22	2.09	
S-30	10/10/2019	21.90	22.40	0.50	1.16	
S-30	10/10/2019	21.93	22.38	0.45	1.14	
S-30	12/3/2019	NM	NM	NM	NM	
S-30	2/5/2020	21.98	21.98	<0.01	1.16	
S-30	3/3/2020	21.94	22.70	0.76	1.09	
S-30	4/28/2020	21.98	22.02	0.04	1.14	
S-30	5/20/2020	22.07	22.12	0.05	1.05	
S-30	6/3/2020	21.90	22.35	0.45	1.17	
S-30	8/5/2020	21.98	22.03	0.05	1.14	
S-30	9/9/2020	22.05	22.10	0.05	1.07	
S-30	10/21/2020	22.03	22.12	0.09	1.09	
S-30	11/11/2020	21.96	21.99	0.03	1.17	
S-30	12/29/2020	22.03	22.12	0.09	1.09	
S-30	4/16/2021	21.01	21.45	0.44	2.06	
S-31	10/6/2016	NM	NM	NM	NM	Damaged surface to 12 ft bgs
S-31	5/8/2017	NM	NM	NM	NM	Damaged - blocked at 13.10 ft btoc
S-31	4/15/2019	13.09	13.11	0.02	8.20	
S-31	4/16/2021	NM	NM	NM	NM	Damaged - obstruction at 13.10 ft btoc
S-32	8/19/2016	NM	NM	NM	NM	LNAPL present
S-32	10/6/2016	23.75	23.85	0.10	0.44	
S-32	5/8/2017	---	23.58	---	0.62	
S-32	6/18/2018	---	19.42	---	4.78	
S-32	4/15/2019	20.49	20.49	<0.01	3.72	
S-32	6/5/2019	---	22.34	---	1.86	
S-32	10/10/2019	---	22.97	---	1.23	
S-32	6/3/2020	---	23.11	---	1.09	
S-32	12/29/2020	---	21.04	---	3.16	
S-32	4/16/2021	---	22.50	---	1.70	
S-33	5/8/2017	NM	NM	NM	NM	Destroyed
S-34	8/12/2016	---	17.44	---	3.45	
S-34	10/7/2016	---	20.75	---	0.14	
S-34	11/15/2016	---	20.85	---	0.04	
S-34	3/1/2017	---	11.13	---	9.76	
S-34	5/8/2017	---	19.40	---	1.49	
S-34	8/2/2017	---	19.85	---	1.04	
S-34	11/9/2017	---	8.60	---	12.29	
S-34	2/13/2018	---	18.10	---	2.79	
S-34	6/18/2018	---	19.40	---	1.49	
S-34	8/21/2018	---	16.55	---	4.34	
S-34	2/12/2019	---	14.53	---	6.36	
S-34	6/6/2019	---	10.90	---	9.99	
S-34	10/10/2019	---	19.96	---	0.93	
S-34	6/3/2020	---	20.04	---	0.85	
S-34	4/15/2021	---	17.55	---	3.34	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-35	8/12/2016	---	20.63	---	0.31	
S-35	8/18/2016	---	20.70	---	0.24	
S-35	10/7/2016	---	20.90	---	0.04	
S-35	11/15/2016	---	21.00	---	-0.06	
S-35	3/1/2017	---	21.09	---	-0.15	
S-35	5/8/2017	---	20.58	---	0.36	
S-35	8/2/2017	---	20.32	---	0.62	
S-35	11/9/2017	---	20.35	---	0.59	
S-35	2/13/2018	---	21.27	---	-0.33	
S-35	6/18/2018	---	17.06	---	3.88	
S-35	8/21/2018	---	19.89	---	1.05	
S-35	2/12/2019	---	19.20	---	1.74	
S-35	6/6/2019	---	18.83	---	2.11	
S-35	10/10/2019	---	19.98	---	0.96	
S-35	6/3/2020	---	20.17	---	0.77	
S-35	4/15/2021	---	19.40	---	1.54	
S-36	8/12/2016	---	23.75	---	0.48	
S-36	10/7/2016	---	24.04	---	0.19	
S-36	11/15/2016	---	24.13	---	0.10	
S-36	3/1/2017	---	24.15	---	0.08	
S-36	5/8/2017	---	23.79	---	0.44	
S-36	8/2/2017	23.47	23.47	<0.01	0.77	
S-36	11/9/2017	---	23.77	---	0.46	
S-36	2/13/2018	---	24.40	---	-0.17	
S-36	6/18/2018	22.60	22.62	0.02	1.63	
S-36	8/21/2018	23.07	23.07	<0.01	1.17	
S-36	2/12/2019	22.32	22.32	<0.01	1.92	
S-36	6/5/2019	22.41	22.42	0.01	1.82	
S-36	10/10/2019	---	23.15	---	1.08	
S-36	6/3/2020	---	22.92	---	1.31	
S-36	4/15/2021	22.61	22.61	<0.01	1.63	
S-37	5/8/2017	NM	NM	NM	NM	Destroyed
S-38	8/16/2016	---	18.76	---	0.19	
S-38	10/7/2016	---	19.05	---	-0.10	
S-38	11/15/2016	---	18.94	---	0.01	
S-38	5/8/2017	---	18.26	---	0.69	
S-38	6/18/2018	---	17.06	---	1.89	
S-38	6/28/2018	---	16.07	---	2.88	
S-38	11/6/2018	---	16.84	---	2.11	
S-38	1/15/2019	---	16.13	---	2.82	
S-38	6/5/2019	---	16.97	---	1.98	
S-38	9/20/2019	---	18.30	---	0.65	
S-38	10/10/2019	---	18.11	---	0.84	
S-38	10/21/2019	---	25.15	---	-6.20	
S-38	6/3/2020	---	17.62	---	1.33	
S-38	9/2/2020	---	17.65	---	1.30	
S-38	12/29/2020	---	17.03	---	1.92	
S-38	4/16/2021	---	16.74	---	2.21	
S-38	5/3/2021	---	17.03	---	1.92	
S-38D	8/18/2016	---	19.51	---	-1.81	
S-38D	10/7/2016	---	18.85	---	-1.15	
S-38D	5/8/2017	---	18.37	---	-0.67	
S-38D	6/18/2018	---	17.41	---	0.29	
S-38D	6/5/2019	---	17.36	---	0.34	
S-38D	10/10/2019	---	18.00	---	-0.30	
S-38D	6/3/2020	---	17.94	---	-0.24	
S-38D	12/29/2020	---	17.44	---	0.26	
S-38D	4/16/2021	---	17.17	---	0.53	
S-38D2	8/18/2016	---	19.34	---	-1.15	
S-38D2	10/7/2016	---	19.46	---	-1.27	
S-38D2	5/8/2017	---	19.06	---	-0.87	
S-38D2	6/18/2018	---	17.86	---	0.33	
S-38D2	6/5/2019	---	18.45	---	-0.26	
S-38D2	10/10/2019	---	18.53	---	-0.34	
S-38D2	10/28/2019	---	18.79	---	-0.60	
S-38D2	6/3/2020	---	18.56	---	-0.37	
S-38D2	12/29/2020	---	17.90	---	0.29	
S-38D2	4/16/2021	---	17.65	---	0.54	
S-39	8/10/2016	---	22.29	---	0.59	
S-39	10/7/2016	---	22.70	---	0.18	
S-39	11/15/2016	---	22.61	---	0.27	
S-39	5/8/2017	---	22.13	---	0.75	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-39	6/18/2018	---	20.81	---	2.07	
S-39	6/5/2019	---	20.60	---	2.28	
S-39	10/10/2019	---	21.69	---	1.19	
S-39	6/3/2020	---	21.49	---	1.39	
S-39	12/29/2020	---	21.10	---	1.78	
S-39	4/16/2021	---	20.70	---	2.18	
S-39D	8/31/2016	---	25.14	---	-0.63	
S-39D	10/7/2016	---	25.15	---	-0.64	
S-39D	12/1/2016	---	25.22	---	-0.71	
S-39D	5/8/2017	---	25.12	---	-0.61	
S-39D	6/18/2018	---	23.79	---	0.72	
S-39D	6/28/2018	---	23.81	---	0.70	
S-39D	6/5/2019	---	23.75	---	0.76	
S-39D	10/10/2019	---	24.34	---	0.17	
S-39D	10/29/2019	---	24.61	---	-0.10	
S-39D	6/3/2020	---	24.42	---	0.09	
S-39D	12/29/2020	---	23.90	---	0.61	
S-39D	4/16/2021	---	25.65	---	-1.14	
S-39D	5/7/2021	---	23.90	---	0.61	
S-40	10/6/2016	---	24.68	---	-0.22	
S-40	12/1/2016	---	24.72	---	-0.26	
S-40	5/8/2017	---	24.33	---	0.13	
S-40	6/18/2018	---	23.01	---	1.45	
S-40	6/5/2019	---	22.89	---	1.57	
S-40	10/10/2019	---	23.83	---	0.63	
S-40	6/3/2020	---	23.76	---	0.70	
S-40	4/29/2021	---	23.06	---	1.40	
S-55	5/8/2017	NM	NM	NM	NM	Destroyed
S-56	8/18/2016	NM	NM	NM	NM	Unable to locate
S-56	10/7/2016	NM	NM	NM	NM	Unable to locate
S-56	5/8/2017	NM	NM	NM	NM	Destroyed
S-56	6/3/2020	NM	NM	NM	NM	Unable to locate
S-56	4/16/2021	NM	NM	NM	NM	Unable to locate
S-57	8/16/2016	---	12.15	---	0.35	
S-57	10/6/2016	---	12.25	---	0.25	
S-57	5/8/2017	---	11.91	---	0.59	
S-57	6/18/2018	---	10.89	---	1.61	
S-57	6/5/2019	---	10.81	---	1.69	
S-57	10/10/2019	---	11.62	---	0.88	
S-57	6/3/2020	---	11.63	---	0.87	
S-57	4/16/2021	---	10.86	---	1.64	
S-58	6/4/2020	NM	NM	NM	NM	Unable to locate
S-58	4/16/2021	NM	NM	NM	NM	Unable to locate
S-58D2	6/18/2018	NM	NM	NM	NM	
S-59D	8/19/2016	---	16.85	---	0.28	
S-59D	10/6/2016	---	16.70	---	0.43	
S-59D	11/15/2016	---	16.73	---	0.40	
S-59D	5/17/2017	---	16.53	---	0.60	
S-59D	6/18/2018	---	15.68	---	1.45	
S-59D	6/5/2019	---	15.66	---	1.47	
S-59D	10/10/2019	---	5.93	---	11.20	
S-59D	6/3/2020	---	16.33	---	0.80	
S-59D	4/15/2021	---	15.42	---	1.71	
S-67	6/4/2020	NM	NM	NM	NM	Unable to locate
S-67	4/16/2021	NM	NM	NM	NM	Unable to locate
S-96	8/17/2016	---	13.25	---	6.52	
S-96	10/10/2016	---	19.72	---	0.05	
S-96	12/1/2016	---	19.71	---	0.06	
S-96	5/8/2017	---	19.36	---	0.41	
S-103	10/6/2016	---	25.33	---	0.78	
S-103	11/15/2016	---	25.48	---	0.63	
S-103	5/8/2017	---	25.19	---	0.92	
S-103	7/16/2019	23.70	23.98	0.28	2.35	
S-103	10/10/2019	24.67	25.01	0.34	1.37	
S-103	6/3/2020	---	24.83	---	1.28	
S-103	4/15/2021	---	24.13	---	1.98	
S-104	8/19/2016	NM	NM	NM	NM	LNAPL present
S-104	10/10/2016	16.78	18.26	1.48	1.60	
S-104	11/15/2016	17.17	18.56	1.39	1.22	
S-104	5/8/2017	16.45	18.08	1.63	1.91	
S-104	6/18/2018	16.22	16.48	0.26	2.31	
S-104	4/15/2019	14.28	20.40	6.12	3.54	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-104	4/16/2019	14.75	21.75	7.00	2.97	
S-104	4/22/2019	14.71	21.65	6.94	3.01	
S-104	6/5/2019	14.05	22.07	8.02	3.54	
S-104	10/10/2019	15.11	21.12	6.01	2.73	
S-104	6/3/2020	15.44	21.37	5.93	2.41	
S-104	4/16/2021	14.06	21.20	7.14	3.64	
S-111	5/8/2017	NM	NM	NM	NM	Unable to locate
S-111	6/21/2018	8.61	8.80	0.19		
S-111	6/3/2020	NM	NM	NM	NM	Destroyed
S-115	10/10/2019	NM	NM	NM	NM	
S-115	6/3/2020	NM	NM	NM	NM	Destroyed
S-119	8/12/2016	---	26.15	---	0.45	
S-119	10/6/2016	---	26.50	---	0.10	
S-119	11/15/2016	---	26.49	---	0.11	
S-119	5/8/2017	---	28.20	---	-1.60	
S-119	6/18/2018	---	25.03	---	1.57	
S-119	6/5/2019	---	24.78	---	1.82	
S-119	10/10/2019	---	25.55	---	1.05	
S-119	6/3/2020	---	25.68	---	0.92	
S-119	4/16/2021	---	25.15	---	1.45	
S-119D	8/19/2016	---	25.04	---	0.06	
S-119D	10/6/2016	---	25.26	---	-0.16	
S-119D	11/15/2016	---	25.30	---	-0.20	
S-119D	5/8/2017	---	25.02	---	0.08	
S-119D	6/18/2018	---	23.82	---	1.28	
S-119D	6/5/2019	---	23.69	---	1.41	
S-119D	10/10/2019	---	24.46	---	0.64	
S-119D	6/3/2020	---	24.52	---	0.58	
S-119D	4/16/2021	---	23.79	---	1.31	
S-120	8/12/2016	---	19.16	---	0.66	
S-120	10/6/2016	---	19.58	---	0.24	
S-120	12/1/2016	---	19.58	---	0.24	
S-120	5/8/2017	---	19.06	---	0.76	
S-120	6/18/2018	---	17.77	---	2.05	
S-120	6/5/2019	---	17.58	---	2.24	
S-120	10/10/2019	---	18.61	---	1.21	
S-120	6/3/2020	---	18.45	---	1.37	
S-120	4/16/2021	---	17.68	---	2.14	
S-121	8/15/2016	---	20.69	---	0.43	
S-121	10/7/2016	NM	NM	NM	NM	Damaged
S-121	12/1/2016	NM	NM	NM	NM	Damaged
S-121	5/8/2017	---	20.54	---	0.58	Damaged
S-121	6/18/2018	---	18.83	---	2.29	
S-121	6/3/2020	NM	NM	NM	NM	Damaged
S-121	4/16/2021	---	19.10	---	2.02	
S-122	8/9/2016	---	25.19	---	0.52	
S-122	10/7/2016	---	25.61	---	0.10	
S-122	11/15/2016	---	25.53	---	0.18	
S-122	5/8/2017	---	25.11	---	0.60	
S-122	6/18/2018	---	21.86	---	3.85	
S-122	7/16/2019	---	23.24	---	2.47	
S-122	10/10/2019	---	24.59	---	1.12	
S-122	6/3/2020	---	24.33	---	1.38	
S-122	12/29/2020	---	23.89	---	1.82	
S-122	4/16/2021	---	23.45	---	2.26	
S-123	8/18/2016	---	21.85	---	0.28	
S-123	10/7/2016	---	22.18	---	-0.05	
S-123	5/8/2017	---	21.52	---	0.61	
S-123	6/18/2018	---	20.14	---	1.99	
S-123	11/6/2018	---	20.32	---	1.81	
S-123	1/15/2019	---	19.30	---	2.83	
S-123	6/5/2019	---	20.06	---	2.07	
S-123	10/10/2019	---	21.19	---	0.94	
S-123	6/3/2020	---	20.83	---	1.30	
S-123	12/29/2020	---	20.34	---	1.79	
S-123	4/16/2021	---	19.96	---	2.17	
S-124	8/19/2016	---	19.75	---	3.45	
S-124	10/7/2016	23.04	23.34	0.30	0.11	
S-124	3/1/2017	22.81	23.52	0.71	0.26	
S-124	5/8/2017	22.47	22.57	0.10	0.71	
S-124	6/18/2018	---	21.36	---	1.84	
S-124	11/6/2018	---	21.45	---	1.75	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-124	1/15/2019	---	20.54	---	2.66	
S-124	6/5/2019	21.40	21.40	<0.01	1.81	
S-124	10/10/2019	---	22.49	---	0.71	
S-124	4/28/2020	---	21.77	---	1.43	
S-124	5/18/2020	---	21.91	---	1.29	
S-124	6/4/2020	---	22.08	---	1.12	
S-124	7/8/2020	22.39	22.39	<0.01	0.82	
S-124	8/5/2020	---	22.31	---	0.89	
S-124	9/14/2020	---	21.80	---	1.40	
S-124	10/27/2020	---	22.26	---	0.94	
S-124	11/17/2020	22.01	22.06	0.05	1.18	
S-124	12/28/2020	21.03	21.06	0.03	2.16	
S-124	12/30/2020	21.03	21.06	0.03	2.16	
S-124	4/16/2021	21.02	21.04	0.02	2.18	
S-216	8/16/2016	---	15.08	---	0.68	
S-218D	10/7/2016	---	25.25	---	-0.73	
S-218D	5/8/2017	NM	NM	NM	NM	
S-218D	6/18/2018	---	23.64	---	0.88	
S-218D	6/28/2018	---	23.73	---	0.79	
S-218D	6/5/2019	---	22.23	---	2.29	
S-218D	10/10/2019	---	24.18	---	0.34	
S-218D	10/29/2019	---	24.42	---	0.10	
S-218D	6/3/2020	---	24.22	---	0.30	
S-218D	12/29/2020	---	23.76	---	0.76	
S-218D	4/16/2021	---	23.53	---	0.99	
S-218D	4/30/2021	---	23.75	---	0.77	
S-219	8/15/2016	---	22.63	---	0.46	
S-219	10/7/2016	---	22.95	---	0.14	
S-219	11/15/2016	---	22.90	---	0.19	
S-219	5/8/2017	---	22.34	---	0.75	
S-219	6/18/2018	---	20.93	---	2.16	
S-219	6/5/2019	---	20.85	---	2.24	
S-219	10/10/2019	---	21.92	---	1.17	
S-219	6/3/2020	---	21.71	---	1.38	
S-219	12/29/2020	---	21.35	---	1.74	
S-219	4/16/2021	---	20.89	---	2.20	
S-220	8/18/2016	NM	NM	NM	NM	LNAPL present
S-220	10/6/2016	20.57	21.40	0.83	0.12	
S-220	11/15/2016	20.54	21.40	0.86	0.14	
S-220	5/8/2017	19.85	20.35	0.50	0.89	
S-220	6/18/2018	18.63	19.60	0.97	2.08	
S-220	11/6/2018	---	18.95	---	1.86	
S-220	1/15/2019	17.98	18.01	0.03	2.83	
S-220	4/15/2019	18.57	18.65	0.08	2.23	
S-220	6/5/2019	---	18.75	---	2.06	
S-220	10/10/2019	19.75	19.78	0.03	1.06	
S-220	6/3/2020	19.38	19.45	0.07	1.42	
S-220	12/29/2020	18.89	18.90	0.01	1.92	
S-220	4/28/2021	18.76	18.76	<0.01	2.06	
S-221	8/3/2016	22.53	24.61	2.08	0.10	
S-221	8/9/2016	22.57	24.59	2.02	0.07	
S-221	8/12/2016	22.53	24.61	2.08	0.10	
S-221	8/15/2016	22.55	24.66	2.11	0.08	
S-221	8/24/2016	22.64	24.81	2.17	-0.03	
S-221	8/31/2016	22.63	24.86	2.23	-0.03	
S-221	9/13/2016	22.79	25.11	2.32	-0.20	
S-221	9/19/2016	22.90	25.27	2.37	-0.32	
S-221	10/3/2016	22.77	24.98	2.21	-0.16	
S-221	10/7/2016	22.80	25.00	2.20	-0.19	
S-221	10/19/2016	22.74	24.87	2.13	-0.12	
S-221	10/25/2016	22.86	25.10	2.24	-0.26	
S-221	11/15/2016	22.77	24.94	2.17	-0.16	
S-221	1/10/2017	22.80	24.78	1.98	-0.15	
S-221	3/1/2017	22.50	24.05	1.55	0.22	
S-221	4/5/2017	22.50	23.69	1.19	0.29	
S-221	5/8/2017	22.19	23.01	0.82	0.66	
S-221	6/6/2017	21.94	22.78	0.84	0.91	
S-221	7/6/2017	22.08	23.12	1.04	0.74	
S-221	9/5/2017	22.00	22.97	0.97	0.83	
S-221	11/14/2017	22.41	24.13	1.72	0.28	
S-221	3/14/2018	---	25.95	---	-2.95	
S-221	6/18/2018	---	21.02	---	1.98	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-221	8/21/2018	21.81	22.39	0.58	1.12	
S-221	9/24/2018	---	25.00	---	-2.00	
S-221	11/6/2018	---	25.20	---	-2.20	
S-221	11/27/2018	---	25.00	---	-2.00	
S-221	1/23/2019	---	25.00	---	-2.00	
S-221	2/12/2019	---	25.00	---	-2.00	
S-221	3/6/2019	---	25.00	---	-2.00	
S-221	4/3/2019	---	20.55	---	2.45	
S-221	4/15/2019	20.69	21.36	0.67	2.23	
S-221	5/6/2019	21.66	21.66	<0.01	1.35	
S-221	6/6/2019	---	21.50	---	1.50	
S-221	7/10/2019	---	21.50	---	1.50	
S-221	8/6/2019	---	21.50	---	1.50	
S-221	9/11/2019	---	21.50	---	1.50	
S-221	10/10/2019	---	21.50	---	1.50	
S-221	12/5/2019	---	21.50	---	1.50	
S-221	2/5/2020	---	21.50	---	1.50	
S-221	3/2/2020	---	21.50	---	1.50	
S-221	4/28/2020	21.53	21.64	0.11	1.46	
S-221	5/18/2020	21.55	21.70	0.15	1.43	
S-221	6/4/2020	21.80	21.80	<0.01	1.21	
S-221	7/8/2020	22.07	22.63	0.56	0.86	
S-221	8/5/2020	22.02	22.24	0.22	0.95	
S-221	9/14/2020	21.53	21.64	0.11	1.46	
S-221	10/27/2020	---	21.94	---	1.06	
S-221	11/17/2020	21.65	21.66	0.01	1.35	
S-221	12/28/2020	18.73	19.18	0.45	4.21	
S-221	12/30/2020	18.73	19.18	0.45	4.21	
S-221	1/28/2021	21.23	21.26	0.03	1.77	
S-221	4/16/2021	20.77	20.85	0.08	2.22	
S-222	8/17/2016	---	15.98	---	0.31	
S-222	10/10/2016	---	16.30	---	-0.01	
S-222	3/1/2017	---	15.86	---	0.43	
S-222	4/5/2017	---	15.60	---	0.69	
S-222	5/8/2017	---	15.33	---	0.96	
S-222	6/6/2017	---	15.05	---	1.24	
S-222	7/6/2017	---	15.32	---	0.97	
S-222	6/18/2018	---	14.29	---	2.00	
S-222	11/6/2018	---	14.30	---	1.99	
S-222	1/15/2019	---	13.30	---	2.99	
S-222	6/5/2019	---	13.15	---	3.14	
S-222	10/10/2019	---	15.37	---	0.92	
S-222	6/3/2020	---	14.79	---	1.50	
S-222	12/28/2020	---	13.86	---	2.43	
S-222	4/16/2021	---	13.83	---	2.46	
S-223	8/17/2016	---	15.71	---	0.17	
S-223	10/10/2016	---	15.99	---	-0.11	
S-223	3/1/2017	---	15.53	---	0.35	
S-223	4/5/2017	---	15.32	---	0.56	
S-223	5/8/2017	---	15.16	---	0.72	
S-223	6/6/2017	---	14.75	---	1.13	
S-223	7/6/2017	---	14.96	---	0.92	
S-223	1/25/2018	---	16.03	---	-0.15	
S-223	4/2/2018	---	14.20	---	1.68	
S-223	6/18/2018	---	14.96	---	0.92	
S-223	6/28/2018	---	14.15	---	1.73	
S-223	11/6/2018	---	14.04	---	1.84	
S-223	11/12/2018	---	14.04	---	1.84	
S-223	11/28/2018	---	13.24	---	2.64	
S-223	1/15/2019	---	13.04	---	2.84	
S-223	1/18/2019	---	13.26	---	2.62	
S-224	11/28/2018	---	13.03	---	3.00	
S-224	1/15/2019	---	13.20	---	2.83	
S-224	1/18/2019	---	13.20	---	2.83	
S-224	4/23/2019	---	15.16	---	0.87	
S-224	6/5/2019	---	16.34	---	-0.31	
S-224	10/10/2019	---	15.18	---	0.85	
S-224	6/4/2020	---	14.77	---	1.26	
S-224	12/28/2020	---	13.87	---	2.16	
S-224	4/16/2021	---	13.74	---	2.29	
S-225	8/15/2016	---	16.57	---		
S-225	10/7/2016	---	16.60	---		

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-225	11/15/2016	---	16.75	---		
S-225	5/8/2017	---	9.45	---		
S-225	6/18/2018	---	17.48	---		
S-225	6/5/2019	---	15.58	---		
S-225	10/10/2019	---	16.40	---	-1.41	
S-225	6/3/2020	---	16.61	---		
S-225	4/28/2021	---	16.19	---		
S-229	5/8/2017	NM	NM	NM	NM	Destroyed
S-233	8/3/2016	21.02	21.95	0.93	3.16	
S-233	8/9/2016	21.04	22.00	0.96	3.14	
S-233	8/12/2016	21.02	21.95	0.93	3.16	
S-233	8/15/2016	21.10	22.13	1.03	3.07	
S-233	8/24/2016	21.15	22.21	1.06	3.01	
S-233	8/31/2016	21.14	22.22	1.08	3.02	
S-233	9/13/2016	21.37	22.35	0.98	2.81	
S-233	9/19/2016	21.44	22.49	1.05	2.72	
S-233	10/3/2016	21.28	22.40	1.12	2.87	
S-233	10/7/2016	21.30	21.70	0.40	2.98	
S-233	10/19/2016	21.13	22.88	1.75	2.91	
S-233	10/25/2016	21.30	23.05	1.75	2.74	
S-233	11/15/2016	21.17	23.03	1.86	2.85	
S-233	1/10/2017	21.21	23.13	1.92	2.80	
S-233	3/1/2017	20.82	22.75	1.93	3.19	
S-233	4/5/2017	20.71	22.58	1.87	3.31	
S-233	5/8/2017	20.44	21.90	1.46	3.65	
S-233	6/6/2017	20.12	21.53	1.41	3.98	
S-233	7/6/2017	20.40	21.65	1.25	3.73	
S-233	9/5/2017	20.20	21.47	1.27	3.92	
S-233	11/14/2017	20.82	22.16	1.34	3.29	
S-233	6/18/2018	---	20.68	---	3.67	
S-233	11/6/2018	---	19.30	---	5.05	
S-233	1/15/2019	18.42	19.12	0.70	5.85	
S-233	6/5/2019	19.72	19.88	0.16	4.61	
S-233	10/10/2019	19.98	20.13	0.15	4.35	
S-233	4/28/2020	19.51	19.73	0.22	4.82	
S-233	5/18/2020	19.65	20.03	0.38	4.66	
S-233	6/4/2020	19.86	20.15	0.29	4.46	
S-233	7/8/2020	20.23	20.54	0.31	4.09	
S-233	8/5/2020	---	19.88	---	4.47	
S-233	9/14/2020	19.50	19.75	0.25	4.82	
S-233	10/27/2020	19.42	19.49	0.07	4.92	
S-233	11/17/2020	19.82	20.03	0.21	4.51	
S-233	12/28/2020	18.94	19.16	0.22	5.39	
S-233	12/30/2020	18.94	19.16	0.22	5.39	
S-233	4/16/2021	---	18.95	---	5.40	
S-234	8/3/2016	---	21.28	---	-0.05	
S-234	8/12/2016	---	21.28	---	-0.05	
S-234	8/17/2016	---	21.34	---	-0.11	
S-234	10/3/2016	NM	NM	NM	NM	
S-234	10/10/2016	---	21.56	---	-0.33	
S-234	11/15/2016	NM	NM	NM	NM	
S-234	1/10/2017	NM	NM	NM	NM	
S-234	3/1/2017	---	21.30	---	-0.07	
S-234	4/5/2017	---	20.95	---	0.28	
S-234	5/8/2017	---	20.78	---	0.45	
S-234	6/6/2017	---	20.30	---	0.93	
S-234	7/6/2017	---	20.72	---	0.51	
S-234	11/14/2017	---	21.12	---	0.11	
S-234	6/18/2018	---	19.59	---	1.64	
S-234	11/6/2018	---	17.19	---	4.04	
S-234	1/15/2019	---	18.73	---	2.50	
S-234	6/5/2019	---	19.65	---	1.58	
S-234	10/10/2019	---	20.75	---	0.48	
S-234	6/4/2020	---	19.99	---	1.24	
S-234	12/28/2020	---	18.11	---	3.12	
S-234	4/16/2021	---	19.22	---	2.01	
S-235	8/12/2016	22.65	23.81	1.16	0.27	
S-235	8/18/2016	NM	NM	NM	NM	LNAPL present
S-235	10/7/2016	22.94	23.40	0.46	0.10	
S-235	1/10/2017	NM	NM	NM	NM	
S-235	3/1/2017	22.71	23.67	0.96	0.25	
S-235	4/5/2017	22.64	23.04	0.40	0.41	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-235	5/8/2017	22.40	22.57	0.17	0.70	
S-235	6/6/2017	22.07	22.24	0.17	1.03	
S-235	7/6/2017	22.26	22.74	0.48	0.78	
S-235	11/14/2017	22.55	23.61	1.06	0.39	
S-235	6/18/2018	20.96	21.32	0.36	2.10	
S-235	11/6/2018	21.28	21.30	0.02	1.84	
S-235	1/15/2019	20.35	20.38	0.03	2.77	
S-235	6/5/2019	21.33	21.35	0.02	1.79	
S-235	10/10/2019	22.37	22.47	0.10	0.74	
S-235	4/28/2020	21.69	21.75	0.06	1.43	
S-235	5/18/2020	19.65	21.88	2.23	3.08	
S-235	6/4/2020	21.95	21.95	<0.01	1.18	
S-235	7/8/2020	22.29	22.44	0.15	0.81	
S-235	8/5/2020	22.21	22.22	0.01	0.91	
S-235	9/14/2020	21.70	21.76	0.06	1.42	
S-235	10/27/2020	22.16	22.24	0.08	0.95	
S-235	11/17/2020	22.86	22.92	0.06	0.26	
S-235	12/28/2020	20.96	20.99	0.03	2.16	
S-235	12/30/2020	20.96	20.99	0.03	2.16	
S-235	4/16/2021	---	20.96	---	2.17	
S-236	8/3/2016	22.58	24.47	1.89	0.06	
S-236	8/9/2016	22.62	24.50	1.88	0.02	
S-236	8/12/2016	22.58	24.47	1.89	0.06	
S-236	8/15/2016	22.64	24.69	2.05	-0.03	
S-236	8/24/2016	22.72	24.67	1.95	-0.09	
S-236	8/31/2016	22.71	24.68	1.97	-0.09	
S-236	9/13/2016	22.90	24.96	2.06	-0.29	
S-236	9/19/2016	22.98	25.06	2.08	-0.38	
S-236	10/3/2016	22.87	24.66	1.79	-0.22	
S-236	10/7/2016	22.92	25.16	2.24	-0.35	
S-236	10/19/2016	22.84	24.71	1.87	-0.20	
S-236	10/25/2016	22.93	24.95	2.02	-0.32	
S-236	11/15/2016	22.86	24.77	1.91	-0.23	
S-236	1/10/2017	22.91	24.67	1.76	-0.25	
S-236	3/1/2017	22.61	24.03	1.42	0.11	
S-236	4/5/2017	22.55	23.75	1.20	0.21	
S-236	5/8/2017	22.28	23.21	0.93	0.53	
S-236	6/6/2017	22.00	22.87	0.87	0.82	
S-236	7/6/2017	22.13	23.04	0.91	0.68	
S-236	9/5/2017	22.05	22.94	0.89	0.76	
S-236	11/14/2017	22.48	24.15	1.67	0.20	
S-236	3/14/2018	---	25.85	---	-2.88	
S-236	6/18/2018	20.98	21.37	0.39	1.92	
S-236	9/24/2018	---	25.85	---	-2.88	
S-236	11/6/2018	---	25.70	---	-2.73	
S-236	11/27/2018	---	25.85	---	-2.88	
S-236	1/23/2019	---	25.85	---	-2.88	
S-236	2/12/2019	---	25.85	---	-2.88	
S-236	3/6/2019	---	25.85	---	-2.88	
S-236	4/3/2019	---	20.64	---	2.33	
S-236	4/15/2019	---	20.83	---	2.14	
S-236	5/6/2019	---	25.45	---	-2.48	
S-236	6/6/2019	---	25.45	---	-2.48	
S-236	7/10/2019	---	25.45	---	-2.48	
S-236	8/6/2019	---	25.45	---	-2.48	
S-236	9/11/2019	---	25.45	---	-2.48	
S-236	10/10/2019	---	25.45	---	-2.48	
S-236	12/5/2019	---	25.45	---	-2.48	
S-236	2/5/2020	---	25.45	---	-2.48	
S-236	3/2/2020	---	25.45	---	-2.48	
S-236	4/28/2020	21.58	21.59	0.01	1.39	
S-236	5/18/2020	21.70	21.74	0.04	1.27	
S-236	6/4/2020	21.87	21.88	0.01	1.10	
S-236	7/8/2020	22.17	22.21	0.04	0.80	
S-236	8/5/2020	22.11	22.12	0.01	0.86	
S-236	9/14/2020	21.58	21.59	0.01	1.39	
S-236	10/27/2020	---	21.24	---	1.73	
S-236	11/17/2020	21.74	21.74	<0.01	1.24	
S-236	12/30/2020	20.93	20.93	<0.01	2.05	
S-236	1/28/2021	21.27	21.27	<0.01	1.71	
S-236	4/16/2021	20.80	20.81	0.01	2.17	
S-237	8/3/2016	22.36	24.45	2.09	0.08	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-237	8/9/2016	22.40	24.58	2.18	0.03	
S-237	8/12/2016	22.36	24.45	2.09	0.08	
S-237	8/15/2016	22.43	24.70	2.27	-0.02	
S-237	8/24/2016	22.48	24.70	2.22	-0.06	
S-237	8/31/2016	22.49	24.75	2.26	-0.08	
S-237	9/13/2016	22.68	24.90	2.22	-0.26	
S-237	9/19/2016	22.73	25.02	2.29	-0.32	
S-237	10/3/2016	22.64	24.81	2.17	-0.21	
S-237	10/10/2016	22.64	24.81	2.17	-0.21	
S-237	10/19/2016	22.62	23.92	1.30	-0.04	
S-237	10/25/2016	22.71	23.65	0.94	-0.06	
S-237	11/15/2016	22.65	23.75	1.10	-0.03	
S-237	1/10/2017	22.72	23.95	1.23	-0.12	
S-237	3/1/2017	22.44	23.93	1.49	0.11	
S-237	4/5/2017	22.41	23.46	1.05	0.22	
S-237	5/8/2017	22.17	22.95	0.78	0.51	
S-237	6/6/2017	21.89	22.61	0.72	0.80	
S-237	7/6/2017	22.00	23.09	1.09	0.62	
S-237	9/5/2017	21.91	22.95	1.04	0.72	
S-237	11/14/2017	22.29	23.07	0.78	0.39	
S-237	3/14/2018	---	24.25	---	-1.44	
S-237	6/18/2018	---	21.03	---	1.79	
S-237	8/21/2018	21.64	22.40	0.76	1.04	
S-237	9/24/2018	---	26.05	---	-3.24	
S-237	11/6/2018	---	25.95	---	-3.14	
S-237	11/27/2018	---	26.05	---	-3.24	
S-237	1/23/2019	---	26.05	---	-3.24	
S-237	2/12/2019	---	26.05	---	-3.24	
S-237	3/6/2019	---	26.05	---	-3.24	
S-237	4/3/2019	---	20.40	---	2.42	
S-237	4/15/2019	20.63	20.63	<0.01	2.19	
S-237	5/6/2019	---	21.28	---	1.54	
S-237	6/6/2019	---	21.30	---	1.52	
S-237	7/10/2019	---	21.30	---	1.52	
S-237	8/6/2019	---	21.30	---	1.52	
S-237	9/11/2019	---	21.30	---	1.52	
S-237	10/10/2019	---	21.30	---	1.52	
S-237	12/5/2019	---	21.30	---	1.52	
S-237	2/5/2020	---	21.30	---	1.52	
S-237	3/2/2020	---	21.30	---	1.52	
S-237	4/28/2020	21.50	21.66	0.16	1.30	
S-237	5/18/2020	21.51	21.63	0.12	1.29	
S-237	6/4/2020	21.68	21.68	<0.01	1.14	
S-237	7/8/2020	22.06	22.27	0.21	0.73	
S-237	8/5/2020	---	21.92	---	0.90	
S-237	9/14/2020	21.51	21.66	0.15	1.29	
S-237	10/27/2020	22.03	22.09	0.06	0.78	
S-237	11/17/2020	21.50	21.62	0.12	1.30	
S-237	12/30/2020	NM	NM	NM	NM	
S-237	1/28/2021	21.09	21.14	0.05	1.72	
S-237	4/16/2021	20.65	20.73	0.08	2.16	
S-238	10/7/2016	22.98	23.22	0.24	-0.11	
S-238	3/1/2017	22.55	23.07	0.52	0.27	
S-238	5/8/2017	22.16	22.25	0.09	0.74	
S-238	6/18/2018	20.95	21.37	0.42	1.89	
S-238	11/6/2018	21.15	21.45	0.30	1.71	
S-238	1/15/2019	20.18	20.44	0.26	2.69	
S-238	6/5/2019	21.34	21.98	0.64	1.46	
S-238	10/10/2019	22.14	22.22	0.08	0.76	
S-238	4/28/2020	---	21.48	---	1.44	
S-238	5/18/2020	21.59	21.61	0.02	1.32	
S-238	6/4/2020	---	21.78	---	1.14	
S-238	7/8/2020	---	22.06	---	0.86	
S-238	8/5/2020	---	21.98	---	0.94	
S-238	9/14/2020	---	21.48	---	1.44	
S-238	10/27/2020	---	21.94	---	0.98	
S-238	11/17/2020	22.68	22.69	0.01	0.23	
S-238	12/28/2020	20.76	20.78	0.02	2.15	
S-238	12/30/2020	20.76	20.78	0.02	2.15	
S-238	4/16/2021	20.68	20.70	0.02	2.23	
S-239	8/17/2016	---	15.67	---	0.15	
S-239	10/10/2016	---	15.96	---	-0.14	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-239	3/1/2017	---	15.25	---	0.57	
S-239	4/5/2017	---	15.30	---	0.52	
S-239	5/8/2017	---	15.05	---	0.77	
S-239	6/6/2017	---	14.70	---	1.12	
S-239	7/6/2017	---	14.97	---	0.85	
S-239	1/25/2018	---	15.95	---	-0.13	
S-239	4/2/2018	---	13.30	---	2.52	
S-239	6/18/2018	---	19.65	---	-3.83	
S-239	11/7/2018	---	14.08	---	1.74	
S-239	11/28/2018	---	13.10	---	2.72	
S-239	1/15/2019	---	12.98	---	2.84	
S-239	1/18/2019	---	13.05	---	2.77	
S-239	4/23/2019	---	13.66	---	2.16	
S-239	6/5/2019	---	13.95	---	1.87	
S-239	10/10/2019	---	15.05	---	0.77	
S-239	6/4/2020	---	14.59	---	1.23	
S-239	12/28/2020	---	13.55	---	2.27	
S-239	4/16/2021	---	13.53	---	2.29	
S-240	8/3/2016	23.38	25.95	2.57	0.03	
S-240	8/9/2016	23.37	25.91	2.54	0.04	
S-240	8/12/2016	23.38	25.95	2.57	0.03	
S-240	8/15/2016	23.42	25.97	2.55	-0.01	
S-240	8/24/2016	23.50	26.02	2.52	-0.08	
S-240	8/31/2016	23.53	26.04	2.51	-0.11	
S-240	9/13/2016	23.72	26.23	2.51	-0.30	
S-240	9/19/2016	23.78	26.29	2.51	-0.36	
S-240	10/3/2016	23.67	26.18	2.51	-0.25	
S-240	10/10/2016	23.67	26.18	2.51	-0.25	
S-240	10/19/2016	23.62	26.10	2.48	-0.20	
S-240	10/25/2016	23.77	26.24	2.47	-0.34	
S-240	11/15/2016	23.69	26.14	2.45	-0.26	
S-240	1/10/2017	23.75	25.84	2.09	-0.26	
S-240	3/1/2017	23.57	24.64	1.07	0.10	
S-240	4/5/2017	23.48	24.11	0.63	0.27	
S-240	5/8/2017	23.09	24.45	1.36	0.53	
S-240	6/6/2017	22.86	23.55	0.69	0.88	
S-240	7/6/2017	22.96	24.38	1.42	0.65	
S-240	9/5/2017	22.84	23.92	1.08	0.83	
S-240	11/14/2017	23.28	25.43	2.15	0.20	
S-240	6/18/2018	---	19.34	---	4.52	
S-240	11/6/2018	NM	NM	NM	NM	Unable to acces - surrounded by water
S-240	11/7/2018	---	22.28	---	1.58	
S-240	1/15/2019	---	21.20	---	2.66	
S-240	7/16/2019	21.69	22.38	0.69	2.10	
S-240	12/13/2019	---	25.69	---	-1.83	
S-240	1/3/2020	22.86	24.25	1.39	0.85	
S-240	4/28/2020	22.50	22.93	0.43	1.32	
S-240	5/18/2020	22.58	23.09	0.51	1.23	
S-240	6/4/2020	22.65	23.53	0.88	1.12	
S-240	7/8/2020	22.85	24.77	1.92	0.81	
S-240	8/5/2020	22.82	23.15	0.33	1.01	
S-240	9/14/2020	22.50	22.93	0.43	1.32	
S-240	10/27/2020	22.81	24.31	1.50	0.89	
S-240	11/17/2020	22.60	23.31	0.71	1.19	
S-240	12/28/2020	21.87	22.29	0.42	1.95	
S-240	12/30/2020	21.87	22.29	0.42	1.95	
S-240	4/16/2021	21.74	22.15	0.41	2.08	
S-241	8/3/2016	25.57	28.28	2.71	0.22	
S-241	8/9/2016	25.60	28.41	2.81	0.18	
S-241	8/12/2016	25.57	28.28	2.71	0.22	
S-241	8/15/2016	25.62	28.61	2.99	0.14	
S-241	8/24/2016	25.69	28.80	3.11	0.06	
S-241	8/31/2016	25.65	28.90	3.25	0.08	
S-241	9/13/2016	25.84	29.25	3.41	-0.12	
S-241	9/19/2016	25.93	29.35	3.42	-0.22	
S-241	10/3/2016	25.83	29.32	3.49	-0.12	
S-241	10/10/2016	25.83	29.32	3.49	-0.12	
S-241	10/19/2016	25.79	29.11	3.32	-0.06	
S-241	10/25/2016	25.92	29.15	3.23	-0.18	
S-241	11/15/2016	25.82	29.07	3.25	-0.09	
S-241	1/10/2017	25.93	28.84	2.91	-0.16	
S-241	3/1/2017	25.59	28.32	2.73	0.20	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-241	4/5/2017	25.55	28.04	2.49	0.27	
S-241	5/8/2017	25.20	27.51	2.31	0.63	
S-241	6/6/2017	24.90	27.34	2.44	0.92	
S-241	7/6/2017	25.10	27.33	2.23	0.74	
S-241	9/5/2017	24.94	27.19	2.25	0.90	
S-241	11/14/2017	25.55	27.69	2.14	0.30	
S-241	6/18/2018	23.96	26.60	2.64	1.84	
S-241	11/6/2018	24.10	26.48	2.38	1.73	
S-241	1/15/2019	23.30	26.04	2.74	2.49	
S-241	4/15/2019	23.73	26.21	2.48	2.09	
S-241	6/5/2019	24.10	25.92	1.82	1.79	
S-241	10/10/2019	25.23	26.27	1.04	0.74	
S-241	4/28/2020	24.55	26.44	1.89	1.33	
S-241	5/18/2020	24.67	26.44	1.77	1.22	
S-241	6/4/2020	24.79	26.51	1.72	1.11	
S-241	7/8/2020	25.13	26.73	1.60	0.78	
S-241	8/5/2020	25.12	25.88	0.76	0.88	
S-241	9/14/2020	24.50	26.60	2.10	1.36	
S-241	10/27/2020	25.01	26.72	1.71	0.89	
S-241	11/17/2020	24.68	26.27	1.59	1.23	
S-241	12/28/2020	23.85	25.77	1.92	2.03	
S-241	12/30/2020	23.85	25.77	1.92	2.03	
S-241	4/16/2021	23.76	25.98	2.22	2.08	
S-242	8/12/2016	---	21.69	---	0.20	
S-242	8/18/2016	---	21.77	---	0.12	
S-242	10/7/2016	---	22.05	---	-0.16	
S-242	3/1/2017	---	21.60	---	0.29	
S-242	5/8/2017	---	21.22	---	0.67	
S-242	6/18/2018	---	20.01	---	1.88	
S-242	11/6/2018	---	20.10	---	1.79	
S-242	1/15/2019	---	19.13	---	2.76	
S-242	6/5/2019	---	20.06	---	1.83	
S-242	10/10/2019	---	21.20	---	0.69	
S-242	6/4/2020	---	20.69	---	1.20	
S-242	12/28/2020	---	18.70	---	3.19	
S-242	4/16/2021	---	19.60	---	2.29	
S-243	8/3/2016	---	15.32	---	0.42	
S-243	8/12/2016	---	15.32	---	0.42	
S-243	8/17/2016	---	15.38	---	0.36	
S-243	10/10/2016	---	15.71	---	0.03	
S-243	3/1/2017	NM	NM	NM	NM	Unable to access - area around well manhole is flooded
S-243	4/5/2017	---	14.88	---	0.86	
S-243	5/8/2017	---	14.76	---	0.98	
S-243	6/6/2017	---	14.41	---	1.33	
S-243	7/6/2017	---	14.67	---	1.07	
S-243	1/25/2018	---	15.77	---	-0.03	
S-243	4/2/2018	---	13.30	---	2.44	
S-243	6/18/2018	---	14.52	---	1.22	
S-243	11/6/2018	NM	NM	NM	NM	Unable to access - surrounded by water
S-243	11/7/2018	---	13.85	---	1.89	
S-243	11/28/2018	---	12.93	---	2.81	DTB = 22.03'
S-243	1/15/2019	---	12.75	---	2.99	
S-243	1/18/2019	---	12.82	---	2.92	
S-243	4/23/2019	---	13.79	---	1.95	
S-243	6/5/2019	---	13.43	---	2.31	
S-243	10/10/2019	---	14.81	---	0.93	
S-243	6/4/2020	---	14.37	---	1.37	
S-243	12/28/2020	---	13.41	---	2.33	
S-243	4/16/2021	---	13.30	---	2.44	
S-244	8/15/2016	---	21.74	---	0.20	
S-244	10/7/2016	---	21.98	---	-0.04	
S-244	3/1/2017	---	21.56	---	0.38	
S-244	5/8/2017	---	20.82	---	1.12	
S-244	6/18/2018	---	18.92	---	3.02	
S-244	6/5/2019	---	19.94	---	2.00	
S-244	10/10/2019	---	21.14	---	0.80	
S-244	4/28/2020	---	18.07	---	3.87	
S-244	5/18/2020	---	20.48	---	1.46	
S-244	6/4/2020	---	27.10	---	-5.16	
S-244	7/8/2020	---	21.06	---	0.88	
S-244	8/5/2020	---	20.47	---	1.47	
S-244	9/14/2020	---	18.07	---	3.87	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-244	10/27/2020	---	15.02	---	6.92	
S-244	11/17/2020	---	12.91	---	9.03	
S-244	12/30/2020	---	12.62	---	9.32	
S-244	4/16/2021	13.94	13.94	<0.01	8.01	
S-245	8/3/2016	---	21.87	---	0.34	
S-245	8/9/2016	---	21.90	---	0.31	
S-245	8/12/2016	---	21.87	---	0.34	
S-245	8/15/2016	---	21.94	---	0.27	
S-245	8/24/2016	---	22.05	---	0.16	
S-245	8/31/2016	---	22.10	---	0.11	
S-245	9/13/2016	---	22.19	---	0.02	
S-245	9/19/2016	---	22.27	---	-0.06	
S-245	10/3/2016	---	22.17	---	0.04	
S-245	10/7/2016	---	22.22	---	-0.01	
S-245	10/19/2016	---	22.11	---	0.10	
S-245	10/25/2016	---	22.24	---	-0.03	
S-245	11/15/2016	---	22.15	---	0.06	
S-245	1/10/2017	---	22.20	---	0.01	
S-245	3/1/2017	---	21.94	---	0.27	
S-245	4/5/2017	---	21.73	---	0.48	
S-245	5/8/2017	---	21.40	---	0.81	
S-245	6/6/2017	---	21.07	---	1.14	
S-245	7/6/2017	---	21.24	---	0.97	
S-245	9/5/2017	---	21.07	---	1.14	
S-245	11/14/2017	---	21.72	---	0.49	
S-245	6/18/2018	---	20.04	---	2.17	
S-245	11/6/2018	---	20.36	---	1.85	
S-245	1/15/2019	---	19.11	---	3.10	
S-245	6/5/2019	---	20.21	---	2.00	
S-245	10/10/2019	---	21.36	---	0.85	
S-245	6/4/2020	---	20.81	---	1.40	
S-245	12/28/2020	---	19.92	---	2.29	
S-245	4/16/2021	---	19.81	---	2.40	
S-246	8/3/2016	---	18.25	---	3.31	
S-246	8/9/2016	---	18.83	---	2.73	
S-246	8/12/2016	---	18.25	---	3.31	
S-246	8/15/2016	---	19.60	---	1.96	
S-246	8/16/2016	---	19.69	---	1.87	
S-246	8/24/2016	---	20.67	---	0.89	
S-246	8/31/2016	---	20.64	---	0.92	
S-246	9/13/2016	---	21.63	---	-0.07	
S-246	9/19/2016	---	21.23	---	0.33	
S-246	10/3/2016	---	20.53	---	1.03	
S-246	10/7/2016	---	20.85	---	0.71	
S-246	10/19/2016	---	20.80	---	0.76	
S-246	10/25/2016	---	21.27	---	0.29	
S-246	11/15/2016	---	21.53	---	0.03	
S-246	1/10/2017	---	21.56	---	0.00	
S-246	3/1/2017	---	20.87	---	0.69	
S-246	4/5/2017	---	20.23	---	1.33	
S-246	5/8/2017	---	19.72	---	1.84	
S-246	6/6/2017	---	19.51	---	2.05	
S-246	7/6/2017	---	19.80	---	1.76	
S-246	9/5/2017	---	19.89	---	1.67	
S-246	11/14/2017	---	21.07	---	0.49	
S-246	6/18/2018	---	19.17	---	2.39	
S-246	6/5/2019	---	19.01	---	2.55	
S-246	10/10/2019	---	20.76	---	0.80	
S-246	6/4/2020	---	19.67	---	1.89	
S-246	4/16/2021	---	18.78	---	2.78	
S-278	8/12/2016	20.59	21.00	0.41	0.37	
S-278	8/18/2016	20.70	21.15	0.45	0.25	
S-278	10/7/2016	20.92	22.20	1.28	-0.12	
S-278	3/1/2017	20.68	21.55	0.87	0.20	
S-278	5/8/2017	20.19	20.33	0.14	0.82	
S-278	6/18/2018	---	19.10	---	1.93	
S-278	11/6/2018	---	19.10	---	1.93	
S-278	1/15/2019	---	18.23	---	2.80	
S-278	6/5/2019	---	19.16	---	1.87	
S-278	10/10/2019	20.23	20.24	0.01	0.80	
S-278	4/28/2020	---	19.55	---	1.48	
S-278	5/18/2020	---	19.66	---	1.37	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-278	6/3/2020	---	19.71	---	1.32	
S-278	7/8/2020	---	20.13	---	0.90	
S-278	8/5/2020	---	20.87	---	0.16	
S-278	9/14/2020	---	19.95	---	1.08	
S-278	10/27/2020	---	20.01	---	1.02	
S-278	11/17/2020	---	19.64	---	1.39	
S-278	12/28/2020	---	18.79	---	2.24	
S-278	12/30/2020	---	18.79	---	2.24	
S-278	4/16/2021	---	18.81	---	2.22	
S-279	8/12/2016	23.25	23.25	<0.01	3.21	
S-279	8/18/2016	NM	NM	NM	NM	LNAPL present
S-279	10/10/2016	26.20	26.25	0.05	0.17	
S-279	3/1/2017	25.87	25.88	0.01	0.51	
S-279	5/8/2017	25.32	26.00	0.68	0.94	
S-279	6/18/2018	23.74	24.60	0.86	2.55	
S-279	11/6/2018	24.22	24.84	0.62	2.09	
S-279	1/15/2019	23.43	24.08	0.65	2.88	
S-279	6/5/2019	23.96	24.61	0.65	2.35	
S-279	10/10/2019	24.95	25.58	0.63	1.36	
S-279	12/13/2019	---	25.95	---	0.43	
S-279	4/28/2020	24.73	25.19	0.46	1.60	
S-279	5/18/2020	24.69	25.16	0.47	1.64	
S-279	6/4/2020	24.86	25.33	0.47	1.47	
S-279	7/8/2020	25.08	25.54	0.46	1.25	
S-279	8/5/2020	25.11	25.52	0.41	1.23	
S-279	9/14/2020	24.75	25.20	0.45	1.58	
S-279	10/27/2020	25.04	25.52	0.48	1.29	
S-279	11/17/2020	24.65	25.12	0.47	1.68	
S-279	12/28/2020	23.92	24.18	0.26	2.43	
S-279	12/30/2020	23.92	24.18	0.26	2.43	
S-279	4/16/2021	24.21	24.21	<0.01	2.18	
S-282	10/6/2016	20.50	24.00	3.50	-0.38	
S-282	5/8/2017	---	20.98	---	-0.19	
S-282	6/18/2018	19.95	20.04	0.09	0.82	
S-282	7/16/2019	18.94	19.73	0.79	1.70	
S-282	10/10/2019	20.23	20.44	0.21	0.52	
S-282	6/3/2020	20.02	20.58	0.56	0.66	
S-282	4/15/2021	19.31	19.68	0.37	1.41	
S-329	8/12/2016	---	20.85	---	0.07	
S-329	8/17/2016	---	20.96	---	-0.04	
S-329	10/10/2016	---	21.29	---	-0.37	
S-329	3/1/2017	---	20.79	---	0.13	
S-329	5/8/2017	---	20.31	---	0.61	
S-329	6/18/2018	---	19.02	---	1.90	
S-329	11/6/2018	---	19.32	---	1.60	
S-329	1/15/2019	---	18.33	---	2.59	
S-329	6/5/2019	---	19.77	---	1.15	
S-329	10/10/2019	---	20.37	---	0.55	
S-329	6/3/2020	---	19.82	---	1.10	
S-329	12/28/2020	18.87	18.87	<0.01	2.06	
S-329	4/15/2021	---	18.86	---	2.06	
S-364	8/16/2016	---	3.47	---	17.86	Well damaged. Blockage at 5 ft bgs
S-364	10/6/2016	NM	NM	NM	NM	Damaged - stickup broken off below grade
S-364	5/17/2017	---	3.71	---	17.55	Damaged riser
S-364	6/5/2019	NM	NM	NM	NM	Obstruction at 5 feet
S-364	10/10/2019	---	4.26	---	17.00	
S-364	10/17/2019	NM	NM	NM	NM	
S-364	6/3/2020	NM	NM	NM	NM	Blockage at 4.84 ft btoc
S-364	4/15/2021	---	2.82	---	18.44	
S-365	8/18/2016	NM	NM	NM	NM	LNAPL present
S-365	10/6/2016	24.80	24.90	0.10	-3.91	
S-365	11/15/2016	20.98	21.07	0.09	-0.09	
S-365	5/8/2017	20.54	20.56	0.02	0.37	
S-365	7/16/2019	19.17	19.43	0.26	1.69	
S-365	10/10/2019	19.05	20.65	1.60	1.57	
S-365	6/3/2020	20.20	20.38	0.18	0.68	
S-365	4/15/2021	19.40	19.54	0.14	1.48	
S-366	8/16/2016	---	21.75	---	0.51	
S-366	10/6/2016	---	21.84	---	0.42	
S-366	11/15/2016	---	21.96	---	0.30	
S-366	5/8/2017	---	21.63	---	0.63	
S-366	6/18/2018	---	17.29	---	4.97	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-366	4/25/2019	20.58	20.87	0.29	1.61	
S-366	4/26/2019	20.50	20.52	0.02	1.75	
S-366	7/16/2019	20.25	20.27	0.02	2.00	
S-366	10/10/2019	21.24	21.34	0.10	0.99	
S-366	6/3/2020	---	21.40	---	0.86	
S-366	4/15/2021	---	20.66	---	1.60	
S-367	10/6/2016	---	15.61	---	0.41	
S-367	5/8/2017	---	15.49	---	0.53	
S-367	6/18/2018	---	18.98	---	-2.96	
S-367	6/5/2019	---	14.06	---	1.96	
S-367	10/10/2019	---	14.87	---	1.15	
S-367	6/3/2020	---	14.96	---	1.06	
S-367	4/16/2021	---	14.35	---	1.67	
S-368	10/10/2016	17.74	19.28	1.54	0.11	
S-368	11/15/2016	17.15	19.40	2.25	0.61	
S-368	5/8/2017	---	18.18	---	-0.16	
S-368	6/18/2018	15.69	16.72	1.03	2.21	
S-368	7/16/2019	15.47	16.23	0.76	2.46	
S-368	10/10/2019	16.45	17.05	0.60	1.50	
S-368	6/3/2020	16.65	16.72	0.07	1.36	
S-368	4/16/2021	16.07	16.16	0.09	1.94	
S-368	5/9/2021	16.22	16.28	0.06	1.79	
S-369	8/16/2016	---	29.76	---	-0.34	
S-369	10/6/2016	---	29.92	---	-0.50	
S-369	11/15/2016	---	29.94	---	-0.52	
S-369	5/8/2017	---	28.97	---	0.45	
S-369	6/28/2018	---	28.70	---	0.72	
S-369	6/5/2019	---	28.41	---	1.01	
S-369	10/10/2019	---	29.13	---	0.29	
S-369	6/3/2020	---	29.29	---	0.13	
S-369	4/16/2021	---	28.81	---	0.61	
S-369	5/10/2021	---	29.03	---	0.39	
S-370	8/16/2016	---	11.88	---	0.18	
S-370	10/6/2016	---	12.20	---	-0.14	
S-370	11/15/2016	---	12.38	---	-0.32	
S-370	5/8/2017	---	11.80	---	0.26	
S-370	6/18/2018	---	10.53	---	1.53	
S-370	6/5/2019	---	10.39	---	1.67	
S-370	10/10/2019	---	11.27	---	0.79	
S-370	6/4/2020	---	11.35	---	0.71	
S-370	4/16/2021	---	10.45	---	1.61	
S-371	8/16/2016	---	20.20	---	1.85	
S-371	10/6/2016	---	21.54	---	0.51	
S-371	5/8/2017	20.59	20.59	<0.01	1.47	
S-371	6/18/2018	---	18.80	---	3.25	
S-371	6/5/2019	---	19.25	---	2.80	
S-371	10/10/2019	---	20.28	---	1.77	
S-371	6/3/2020	---	19.99	---	2.06	
S-371	12/29/2020	---	18.31	---	3.74	
S-371	4/16/2021	---	17.96	---	4.09	
S-373	8/15/2016	20.80	21.10	0.30	-0.08	
S-373	8/16/2016	20.85	20.90	0.05	-0.09	
S-373	8/24/2016	20.88	21.14	0.26	-0.16	
S-373	8/31/2016	20.90	21.13	0.23	-0.17	
S-373	9/13/2016	21.04	21.28	0.24	-0.31	
S-373	9/19/2016	21.12	21.35	0.23	-0.39	
S-373	10/3/2016	21.08	21.29	0.21	-0.35	
S-373	10/7/2016	21.10	21.30	0.20	-0.37	
S-373	10/19/2016	21.00	21.13	0.13	-0.25	
S-373	11/15/2016	21.05	21.12	0.07	-0.29	
S-373	1/10/2017	20.99	21.06	0.07	-0.23	
S-373	3/1/2017	20.74	20.77	0.03	0.02	
S-373	4/5/2017	20.65	20.70	0.05	0.11	
S-373	5/8/2017	---	20.48	---	0.29	
S-373	6/6/2017	20.01	20.06	0.05	0.75	
S-373	7/6/2017	20.19	20.22	0.03	0.57	
S-373	6/18/2018	19.08	19.13	0.05	1.68	
S-373	11/6/2018	19.24	19.26	0.02	1.53	
S-373	1/15/2019	18.25	18.31	0.06	2.51	
S-373	6/5/2019	19.29	19.31	0.02	1.48	
S-373	10/10/2019	20.25	20.27	0.02	0.52	
S-373	4/28/2020	19.55	19.59	0.04	1.22	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-373	5/18/2020	19.62	19.72	0.10	1.14	
S-373	6/3/2020	19.71	19.74	0.03	1.06	
S-373	7/8/2020	20.12	20.13	0.01	0.65	
S-373	8/5/2020	20.12	20.14	0.02	0.65	
S-373	9/14/2020	19.58	19.60	0.02	1.19	
S-373	10/27/2020	20.00	20.01	0.01	0.77	
S-373	11/17/2020	19.76	20.11	0.35	0.97	
S-373	12/28/2020	18.93	18.99	0.06	1.83	
S-373	12/30/2020	18.93	18.99	0.06	1.83	
S-373	4/16/2021	19.26	19.27	0.01	1.51	
S-374	11/7/2018	---	13.88	---	1.75	
S-374	11/8/2018	---	13.94	---	1.69	
S-374	1/16/2019	---	12.95	---	2.68	
S-374	1/16/2019	---	12.95	---	2.68	
S-374	6/5/2019	---	13.68	---	1.95	
S-374	10/17/2019	---	15.01	---	0.62	
S-374	12/9/2019	---	15.02	---	0.61	
S-374	6/4/2020	---	14.50	---	1.13	
S-374	9/1/2020	---	14.54	---	1.12	
S-374	11/20/2020	---	14.33	---	1.33	
S-374	12/29/2020	---	13.71	---	1.95	
S-374	4/16/2021	---	13.46	---	2.20	
S-374	5/4/2021	---	13.84	---	1.82	
S-375	11/7/2018	---	14.27	---	1.69	
S-375	11/8/2018	---	14.28	---	1.68	
S-375	1/16/2019	---	13.33	---	2.63	
S-375	1/16/2019	---	13.33	---	2.63	
S-375	6/6/2019	---	14.09	---	1.87	
S-375	10/17/2019	---	15.41	---	0.55	
S-375	12/9/2019	---	15.48	---	0.48	
S-375	6/4/2020	---	14.86	---	1.10	
S-375	9/2/2020	---	14.75	---	1.21	
S-375	11/20/2020	---	14.71	---	1.25	
S-375	12/29/2020	---	14.02	---	1.94	
S-375	4/16/2021	---	13.78	---	2.18	
S-375	5/4/2021	---	14.21	---	1.75	
S-376	11/7/2018	---	13.94	---	1.70	
S-376	11/8/2018	---	13.95	---	1.69	
S-376	1/16/2019	13.07	13.07	<0.01	2.58	
S-376	1/16/2019	---	13.07	---	2.57	
S-376	7/16/2019	13.34	13.72	0.38	2.25	
S-376	10/17/2019	---	15.35	---	0.29	
S-376	11/20/2019	16.40	16.42	0.02	-0.76	
S-376	12/12/2019	---	15.42	---	0.22	
S-376	4/28/2020	14.08	14.63	0.55	1.49	
S-376	5/18/2020	14.23	14.92	0.69	1.33	
S-376	6/4/2020	14.30	15.05	0.75	1.25	
S-376	7/8/2020	14.67	15.61	0.94	0.85	
S-376	8/5/2020	14.08	14.63	0.55	1.49	
S-376	9/3/2020	14.30	15.21	0.91	1.23	
S-376	9/14/2020	14.05	14.60	0.55	1.52	
S-376	10/27/2020	13.96	14.48	0.52	1.62	
S-376	11/17/2020	14.20	14.41	0.21	1.41	
S-376	11/20/2020	14.09	14.09	<0.01	1.56	
S-376	12/29/2020	13.54	13.72	0.18	2.05	
S-376	12/30/2020	13.54	13.72	0.18	2.08	
S-376	4/16/2021	13.41	13.59	0.18	2.18	
S-376	5/12/2021	13.96	14.52	0.56	1.54	
S-377	11/7/2018	---	13.03	---	1.66	
S-377	11/12/2018	---	12.80	---	1.89	
S-377	1/16/2019	---	12.28	---	2.41	
S-377	1/17/2019	---	12.20	---	2.49	
S-377	6/6/2019	---	12.87	---	1.82	
S-377	10/17/2019	---	14.18	---	0.51	
S-377	11/5/2019	---	11.61	---	NM	Broken Riser
S-377	6/4/2020	---	11.49	---	1.48	Resurveyed prior to this event, PVC casing damaged at top
S-377	9/3/2020	---	11.45	---	1.10	
S-377	11/20/2020	---	11.20	---	1.35	
S-377	12/29/2020	10.58	10.60	0.02	1.96	
S-377	4/16/2021	NM	NM	NM	NM	Unable to locate
S-378	11/7/2018	---	10.30	---	1.67	
S-378	11/12/2018	---	10.20	---	1.77	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-378	1/16/2019	---	9.57	---	2.40	
S-378	1/17/2019	---	9.40	---	2.57	
S-378	6/6/2019	---	10.09	---	1.88	
S-378	10/17/2019	---	11.41	---	0.56	
S-378	12/10/2019	---	11.34	---	0.63	
S-378	6/4/2020	---	10.86	---	1.13	
S-378	9/2/2020	---	10.78	---	1.21	
S-378	11/20/2020	---	10.62	---	1.37	
S-378	12/29/2020	NM	NM	NM	NM	Unable to locate
S-378	4/16/2021	---	9.77	---	2.22	
S-378	5/6/2021	---	10.25	---	1.74	
S-379	10/6/2016	NM	NM	NM	NM	Dry
S-379	5/8/2017	NM	NM	NM	NM	Dry
S-379	6/18/2018	---	24.30	---	1.35	
S-379	6/5/2019	---	24.02	---	1.63	
S-379	10/10/2019	---	24.87	---	0.78	
S-379	6/3/2020	---	24.80	---	0.85	
S-379	4/16/2021	---	24.25	---	1.40	
S-380	8/12/2016	---	20.78	---	0.54	
S-380	10/6/2016	---	21.18	---	0.14	
S-380	12/1/2016	---	21.20	---	0.12	
S-380	5/8/2017	---	20.69	---	0.63	
S-380	6/18/2018	---	19.42	---	1.90	
S-380	6/28/2018	---	19.58	---	1.74	
S-380	6/5/2019	---	19.15	---	2.17	
S-380	10/10/2019	---	20.19	---	1.13	
S-380	6/3/2020	---	20.14	---	1.18	
S-380	4/16/2021	---	19.30	---	2.02	
S-381	8/17/2016	---	25.75	---	0.11	
S-381	10/7/2016	---	26.08	---	-0.22	
S-381	5/8/2017	---	25.36	---	0.50	
S-381	6/18/2018	---	24.16	---	1.70	
S-381	7/16/2019	---	23.76	---	2.10	
S-381	10/10/2019	---	25.06	---	0.80	
S-381	6/3/2020	---	24.74	---	1.12	
S-381	12/29/2020	---	21.28	---	4.58	
S-381	4/16/2021	---	23.94	---	1.92	
S-408	10/6/2016	---	15.82	---	0.06	
S-408	5/8/2017	---	14.85	---	1.03	
S-408	6/18/2018	---	13.84	---	2.04	
S-408	11/6/2018	---	13.75	---	2.13	
S-408	1/15/2019	---	13.06	---	2.82	
S-408	6/5/2019	---	13.78	---	2.10	
S-408	10/10/2019	---	14.98	---	0.90	
S-408	6/3/2020	---	14.44	---	1.44	
S-408	12/29/2020	---	13.66	---	2.22	
S-408	4/16/2021	---	13.48	---	2.40	
S-415	10/6/2016	---	18.89	---	0.34	
S-415	5/8/2017	---	18.66	---	0.57	
S-415	6/18/2018	---	17.60	---	1.63	
S-415	6/5/2019	---	17.45	---	1.78	
S-415	10/10/2019	---	18.21	---	1.02	
S-415	6/3/2020	---	18.27	---	0.96	
S-415	4/16/2021	---	17.92	---	1.31	
S-416	10/6/2016	---	16.99	---	2.19	
S-416	12/1/2016	---	18.09	---	1.09	
S-416	5/8/2017	---	11.66	---	7.52	
S-416	6/18/2018	---	9.96	---	9.22	
S-416	6/5/2019	---	11.87	---	7.31	
S-416	10/10/2019	---	17.07	---	2.11	
S-416	6/3/2020	---	11.78	---	7.40	
S-416	4/16/2021	---	9.56	---	9.62	
S-421	6/3/2020	NM	NM	NM	NM	
S-440	8/31/2020	---	11.16	---	1.18	
S-440	11/20/2020	---	11.96	---	0.38	
S-440	12/29/2020	---	10.08	---	2.26	
S-440	4/16/2021	---	9.96	---	2.38	
S-440	5/12/2021	---	10.45	---	1.89	
S-440_CD	6/15/2020	---	21.84	---		CD-15-W-25, temporary well data - corrected water levels not calculated
S-440_CD	6/17/2020	---	36.00	---		CD-15-W-40, temporary well, 3.3' standpipe, temporary well data - corrected water levels not calculated
S-441	8/31/2020	---	14.93	---	1.07	

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-441	11/20/2020	---	14.68	---	1.32	
S-441	12/29/2020	---	13.94	---	2.06	
S-441	4/16/2021	---	13.77	---	2.23	
S-441	5/5/2021	---	14.14	---	1.86	
S-441_CD	7/22/2020	---	12.85	---		CD-6A-W-19, temporary well, 2.5' standpipe, temporary well data - corrected water levels not calculated
S-441_CD	7/23/2020	---	11.90	---		CD-6A-W-44, temporary well, 0.75' standpipe, temporary well data - corrected water levels not calculated
S-442	8/31/2020	---	14.43	---	1.08	
S-442	11/20/2020	---	14.18	---	1.33	
S-442	12/29/2020	---	13.53	---	1.98	
S-442	4/16/2021	---	13.29	---	2.22	
S-442	5/5/2021	---	13.69	---	1.82	
S-442_CD	7/14/2020	---	9.15	---		CD-5-W-20, temporary well, 2.2' standpipe, temporary well data - corrected water levels not calculated
S-442_CD	7/15/2020	---	35.00	---		CD-5-W-44, temporary well, 5.4' standpipe, temporary well data - corrected water levels not calculated
S-443	8/31/2020	---	15.10	---	1.10	
S-443	11/20/2020	---	14.90	---	1.30	
S-443	12/29/2020	---	14.23	---	1.97	
S-443	4/16/2021	---	14.01	---	2.19	
S-443	5/5/2021	---	13.65	---	2.55	
S-443_CD	7/20/2020	---	5.50	---		CD-6C-W-19, temporary well, 3.3' standpipe, temporary well data - corrected water levels not calculated
S-443_CD	7/21/2020	---	22.85	---		CD-6C-W-40, temporary well, 3.5' standpipe, temporary well data - corrected water levels not calculated
S-444	8/31/2020	---	14.96	---	0.96	
S-444	11/20/2020	---	14.60	---	1.32	
S-444	12/29/2020	---	13.99	---	1.93	
S-444	4/16/2021	---	13.71	---	2.21	
S-444	5/6/2021	---	14.26	---	1.66	
S-444_CD	7/9/2020	---	24.90	---		CD-13A-W-39, temporary well, 4.65' standpipe, temporary well data - corrected water levels not calculated
S-445	9/1/2020	---	15.57	---	1.17	
S-445	11/20/2020	---	15.46	---	1.28	
S-445	12/29/2020	---	14.83	---	1.91	
S-445	4/16/2021	---	14.54	---	2.20	
S-445	5/5/2021	---	14.82	---	1.92	
S-445_CD	7/7/2020	---	32.80	---		CD-13B-W-40, temporary well, 5.6' standpipe, temporary well data - corrected water levels not calculated
S-446	9/1/2020	---	18.30	---	1.24	
S-446	11/20/2020	---	18.20	---	1.34	
S-446	12/29/2020	---	17.68	---	1.86	
S-446	4/16/2021	---	17.33	---	2.21	
S-446	5/5/2021	---	17.61	---	1.93	
S-446_CD	6/18/2020	NM	NM	NM	NM	CD-12-W-25 , temporary well, 3.5' standpipe, well went dry
S-446_CD	6/19/2020	---	32.70	---		CD-12-W-45, temporary well, 3.5' standpipe, temporary well data - corrected water levels not calculated
S-447	9/1/2020	---	17.50	---	1.18	
S-447	11/20/2020	---	17.40	---	1.28	
S-447	12/29/2020	---	16.73	---	1.95	
S-447	4/16/2021	---	16.48	---	2.20	
S-447	5/3/2021	---	16.84	---	1.84	
S-447	5/4/2021	---	16.86	---	1.82	
S-447_CD	6/23/2020	---	13.00	---		CD-10-W-38, temporary well data - corrected water levels not calculated
S-447_CD	6/24/2020	---	6.65	---		CD-10-W-45, temporary well, 3.6' standpipe, temporary well data - corrected water levels not calculated

Table 2-3
Liquid Level Measurements (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Well ID	Date	Depth to LNAPL (feet btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
S-448	9/2/2020	---	14.16	---	1.18	
S-448	11/20/2020	---	13.94	---	1.40	
S-448	12/29/2020	---	13.28	---	2.06	
S-448	4/16/2021	---	12.93	---	2.41	
S-448	5/6/2021	---	13.45	---	1.89	
S-448_CD	8/11/2020	---	19.35	---		CD-14S-W-23, temporaryorary well, 5.2' standpipe, temporaryorary well data - corrected water levels not calculated
S-449	9/2/2020	---	15.80	---	-0.55	
S-449	11/20/2020	---	15.81	---	-0.56	
S-449	12/29/2020	---	15.30	---	-0.05	
S-449	4/16/2021	---	15.10	---	0.15	
S-449	5/6/2021	---	15.45	---	-0.20	

Notes:
ft = feet
ft btoc = feet below top of casing
ft NAVD88 = feet relative to the North American Vertical Datum of 1988
LNAPL = Light Non Aqueous Phase Liquid
btoc = below top of casing
EPA = Environmental Protection Agency
NM = not measured
Well IDs with trailing "CD" indicate depth to water measurements collecting from temporary discrete-depth well points installed during confirmation drilling activities.

Table 2-4
Liquid Level Measurements, Select Lower Aquifer Wells Outside of Area of Interest 4 (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

AOI	Well ID	Date	Depth to LNAPL (ft btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
AOI 1	ARCO-1D	18-Aug-16	---	27.10	---	-0.04	
AOI 1	ARCO-1D	10-Oct-16	---	27.37	---	-0.31	
AOI 1	ARCO-1D	29-Nov-16	---	27.42	---	-0.36	
AOI 1	ARCO-1D	08-May-17	---	27.11	---	-0.05	
AOI 1	ARCO-1D	18-Jun-18	---	25.90	---	1.16	
AOI 1	ARCO-1D	25-Jun-18	---	26.13	---	0.93	
AOI 1	ARCO-1D	03-Jun-19	---	25.80	---	1.26	
AOI 1	ARCO-1D	21-Oct-19	---	26.74	---	0.32	
AOI 1	ARCO-1D	01-Nov-19	---	26.74	---	0.32	
AOI 1	ARCO-1D	05-Dec-19	---	27.09	---	-0.03	
AOI 1	ARCO-1D	02-Jun-20	---	26.65	---	0.41	
AOI 1	ARCO-1D	21-Apr-21	---	25.77	---	1.29	
AOI 1	ARCO-1D	07-May-21	---	26.18	---	0.88	
AOI 1	S-264D	18-Jun-18	---	25.15	---	1.48	
AOI 1	S-264D	03-Jun-19	---	25.13	---	1.50	
AOI 1	S-264D	21-Oct-19	---	25.94	---	0.69	
AOI 1	S-264D	02-Jun-20	---	25.97	---	0.66	
AOI 1	S-264D	21-Apr-21	---	25.12	---	1.51	
AOI 1	S-392D	29-Nov-16	---	20.01	---	-0.04	
AOI 1	S-392D	08-May-17	---	19.63	---	0.34	
AOI 1	S-392D	18-Jun-18	---	18.51	---	1.46	
AOI 1	S-392D	03-Jun-19	---	18.47	---	1.50	
AOI 1	S-392D	21-Oct-19	---	19.21	---	0.76	
AOI 1	S-392D	02-Jun-20	---	19.31	---	0.66	
AOI 1	S-392D	21-Apr-21	---	18.42	---	1.55	
AOI 1	S-399	29-Nov-16	---	20.21	---	-0.05	
AOI 1	S-399	08-May-17	---	19.82	---	0.34	
AOI 1	S-399	18-Jun-18	---	18.63	---	1.53	
AOI 1	S-399	19-Jun-18	---	19.20	---	0.96	
AOI 1	S-399	03-Jun-19	---	18.65	---	1.51	
AOI 1	S-399	21-Oct-19	---	19.41	---	0.75	
AOI 1	S-399	28-Oct-19	---	19.53	---	0.63	
AOI 1	S-399	02-Jun-20	---	19.51	---	0.65	
AOI 1	S-399	21-Apr-21	---	18.63	---	1.53	
AOI 1	S-399	29-Apr-21	---	19.00	---	1.16	
AOI 3	BF-90D	10-May-17	---	10.25	---	-0.48	
AOI 3	BF-90D	18-Jun-18	---	9.27	---	0.50	
AOI 3	BF-90D	05-Jun-19	---	9.41	---	0.36	
AOI 3	BF-90D	14-Oct-19	---	10.03	---	-0.26	
AOI 3	BF-90D	05-Jun-20	---	9.96	---	-0.19	
AOI 3	BF-90D	16-Apr-21	---	9.07	---	0.70	
AOI 3	BF-108	10-May-17	---	11.37	---	-0.39	
AOI 3	BF-108	18-Jun-18	---	10.47	---	0.51	
AOI 3	BF-108	05-Jun-19	---	10.61	---	0.37	
AOI 3	BF-108	14-Oct-19	---	11.25	---	-0.27	
AOI 3	BF-108	05-Jun-20	---	11.25	---	-0.27	
AOI 3	BF-108	16-Apr-21	---	10.41	---	0.57	
AOI 3	S-8	10-May-17	---	7.57	---	-1.15	
AOI 3	S-8	18-Jun-18	---	6.61	---	-0.19	
AOI 3	S-8	05-Jun-19	---	6.97	---	-0.55	
AOI 3	S-8	14-Oct-19	---	7.51	---	-1.09	
AOI 3	S-8	05-Jun-20	---	7.46	---	-1.04	
AOI 3	S-8	29-Dec-20	---	6.78	---	-0.36	
AOI 3	S-8	16-Apr-21	---	6.60	---	-0.18	
AOI 3	S-13	10-May-17	---	7.74	---	-1.38	
AOI 3	S-13	18-Jun-18	---	6.80	---	-0.44	
AOI 3	S-13	25-Sep-18	---	6.85	---	-0.49	
AOI 3	S-13	31-Oct-18	---	6.93	---	-0.57	
AOI 3	S-13	05-Jun-19	---	6.92	---	-0.56	
AOI 3	S-13	11-Oct-19	---	7.05	---	-0.69	
AOI 3	S-13	28-Oct-19	---	7.64	---	-1.28	
AOI 3	S-13	05-Jun-20	---	7.39	---	-1.03	
AOI 3	S-13	29-Dec-20	---	6.61	---	-0.25	
AOI 3	S-13	16-Apr-21	---	6.53	---	-0.17	
AOI 3	S-13	26-Apr-21	---	6.71	---	-0.35	
AOI 3	S-22	06-Jan-17	---	20.50	---	-1.84	
AOI 3	S-22	10-May-17	---	19.87	---	-1.21	
AOI 3	S-22	19-Jun-18	---	18.83	---	-0.17	
AOI 3	S-22	05-Jun-19	---	18.95	---	-0.29	
AOI 3	S-22	14-Oct-19	---	19.60	---	-0.94	
AOI 3	S-22	05-Jun-20	---	19.54	---	-0.88	
AOI 3	S-22	29-Dec-20	---	18.82	---	-0.16	
AOI 3	S-22	28-Apr-21	---	18.84	---	-0.18	
AOI 3	S-284D	10-May-17	---	11.93	---	0.19	
AOI 3	S-284D	18-Jun-18	---	11.01	---	1.11	
AOI 3	S-284D	26-Feb-19	---	11.12	---	1.00	
AOI 3	S-284D	05-Jun-19	---	11.17	---	0.95	

Table 2-4
Liquid Level Measurements, Select Lower Aquifer Wells Outside of Area of Interest 4 (2016 - 2021)
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

AOI	Well ID	Date	Depth to LNAPL (ft btoc)	Depth to Water (feet btoc)	Apparent LNAPL Thickness (ft)	Corrected Water Level Elevation (ft NAVD88)	Notes
AOI 3	S-284D	11-Oct-19	---	11.56	---	0.56	
AOI 3	S-284D	28-Oct-19	---	11.92	---	0.20	
AOI 3	S-284D	05-Jun-20	---	11.92	---	0.10	
AOI 3	S-284D	01-Sep-20	---	11.47	---	0.55	
AOI 3	S-284D	16-Apr-21	---	10.98	---	1.04	
AOI 3	S-284D	23-Apr-21	---	11.24	---	0.78	
AOI 5	A-19D	11-May-17	---	12.98	---	-2.34	
AOI 5	A-19D	17-May-17	---	12.98	---	-2.34	
AOI 5	A-19D	22-Jun-18	---	12.47	---	-1.83	
AOI 5	A-19D	07-Jun-19	---	12.59	---	-1.95	
AOI 5	A-19D	11-Oct-19	---	4.88	---	5.76	
AOI 5	A-19D	30-Oct-19	---	12.77	---	-2.13	
AOI 5	A-19D	09-Jun-20	---	12.85	---	-2.21	
AOI 5	A-19D	29-Dec-20	---	12.02	---	-1.38	
AOI 5	A-19D	27-Apr-21	---	12.16	---	-1.52	
AOI 5	A-19D	29-Apr-21	---	12.15	---	-1.51	
AOI 6	B-48D	17-May-17	---	11.50	---	-2.08	
AOI 6	B-48D	20-Jun-18	---	10.69	---	-1.27	
AOI 6	B-48D	06-Jun-19	---	11.09	---	-1.67	
AOI 6	B-48D	09-Oct-19	---	11.32	---	-1.90	
AOI 6	B-48D	08-Jun-20	---	10.93	---	-1.51	
AOI 6	B-48D	21-Apr-21	---	10.35	---	-0.93	
DSCP	FDR-DW-15	08-May-17	---	14.86	---	-1.28	
DSCP	FDR-DW-15	18-Jun-18	---	13.68	---	-0.10	
DSCP	FDR-DW-15	10-Sep-18	---	13.82	---	-0.24	
DSCP	FDR-DW-15	04-Dec-18	---	13.13	---	0.45	
DSCP	FDR-DW-15	03-Jun-19	---	13.68	---	-0.10	
DSCP	FDR-DW-15	10-Sep-19	---	14.15	---	-0.57	
DSCP	FDR-DW-15	02-Dec-19	---	14.36	---	-0.78	
DSCP	FDR-DW-15	11-Jun-20	---	14.28	---	-0.70	
DSCP	NOVA-DW-14	08-May-17	---	16.32	---	-1.14	
DSCP	NOVA-DW-14	18-Jun-18	---	15.25	---	-0.08	
DSCP	NOVA-DW-14	10-Sep-18	---	15.28	---	-0.10	
DSCP	NOVA-DW-14	04-Dec-18	---	14.55	---	0.63	
DSCP	NOVA-DW-14	03-Jun-19	---	14.95	---	0.23	
DSCP	NOVA-DW-14	10-Sep-19	---	15.48	---	-0.30	
DSCP	NOVA-DW-14	02-Dec-19	---	15.93	---	-0.75	
DSCP	NOVA-DW-14	11-Jun-20	---	15.82	---	-0.65	
DSCP	PH-DW-2	08-May-17	---	16.72	---	-0.18	
DSCP	PH-DW-2	18-Jun-18	---	15.45	---	1.09	
DSCP	PH-DW-2	10-Sep-18	NM	NM	NM	NM	Well was not accessible
DSCP	PH-DW-2	04-Dec-18	---	15.06	---	1.48	
DSCP	PH-DW-2	03-Jun-19	---	15.45	---	1.09	
DSCP	PH-DW-2	10-Sep-19	---	15.86	---	0.68	
DSCP	PH-DW-2	04-Dec-19	---	16.51	---	0.03	
DSCP	PH-DW-2	11-Jun-20	---	16.03	---	0.47	
DSCP	PH-DW-3	08-May-17	---	12.56	---	-0.30	
DSCP	PH-DW-3	18-Jun-18	---	11.36	---	0.90	
DSCP	PH-DW-3	10-Sep-18	---	12.35	---	-0.09	
DSCP	PH-DW-3	04-Dec-18	---	10.84	---	1.42	
DSCP	PH-DW-3	03-Jun-19	---	10.12	---	2.14	
DSCP	PH-DW-3	10-Sep-19	---	11.71	---	0.55	
DSCP	PH-DW-3	02-Dec-19	---	12.22	---	0.04	
DSCP	PH-DW-3	11-Jun-20	---	12.03	---	0.23	

Notes:
ft = feet
ft btoc = feet below top of casing
ft NAVD88 = feet relative to the North American Vertical Datum of 1988
LNAPL = Light Non Aqueous Phase Liquid
btoc = below top of casing
AOI = area of interest
DSCP = Defense Supply Center Philadelphia
NM = not measured
--- = LNAPL not detected

Table 2-5
Groundwater Analytical Results – Discrete Groundwater Samples
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			AOI4-BH-20-01		AOI4-BH-20-02	AOI4-BH-20-03							
Sample Date			5-Aug-20	7-Aug-20	3-Aug-20	28-Jul-20	28-Jul-20	28-Jul-20	29-Jul-20	29-Jul-20	30-Jul-20	30-Jul-20	30-Jul-20
Sample ID			CD-01-W-18-20200805	CD-01-W-41.5-20200807	CD-02-25-20200803	CD-3-W-25.0-20200728	CD-3-W-25.0-20200728	CD-3-W-25.0-20200728	CD-3-W-46.0-20200729	CD-3-W-46.0-20200729	CD-3-W-82.0-20200730	CD-3-W-82.0-20200730	CD-3-W-82.0-20200730
Sample Depth			18 ft bgs	41.5 ft bgs	25 ft bgs	25 ft bgs	25 ft bgs	25 ft bgs	46 ft bgs	46 ft bgs	82 ft bgs	82 ft bgs	82 ft bgs
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-9875-1	410-10068-1	410-9564-1	410-8907-1	410-12128-1	410-14623-1	410-9021-1	410-14623-1	410-12128-1	410-14623-1	410-9160-1
Laboratory Sample ID	Units	MSC-PA	410-9875-1	410-10068-1	410-9564-1	410-8907-1	410-12128-1	410-14623-4	410-9021-1	410-14623-5	410-12128-2	410-14623-6	410-9160-1
Field Parameters													
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0	0	0	0	-	-	0	-	-	-	0
OXIDATION REDUCTION POTENTIAL, FIELI	mV	n/v	-213	-200	-136	-105	-	-	-477	-	-	-	-349
pH, FIELD MEASURED	S.U.	n/v	7.70	8.39	7.36	8.47	-	-	7.45	-	-	-	8.05
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.712	2.49	0.304	0.317	-	-	1.92	-	-	-	0.344
TEMPERATURE, FIELD MEASURED	deg c	n/v	17.23	14.35	25.6	22.7	-	-	20.69	-	-	-	20.15
TURBIDITY	NTU	n/v	1,000	281	1,000	145	-	-	815	-	-	-	1,000
Volatile Organic Compounds													
BENZENE	µg/L	5	0.22 J	***450***	***2,400***	***4,500***	-	-	***390***	-	-	-	***950***
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (1.0)	ND (5.0)	*ND (10)*	ND (5.0)	-	-	ND (5.0)	-	-	-	ND (5.0)
ETHYLBENZENE	µg/L	700	310	26	570	***760***	-	-	5.7	-	-	-	14
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	40	15 J	23 J	35	-	-	4.5 J	-	-	-	14 J
METHYL TERTIARY BUTYL ETHER	µg/L	20	0.80 J	11	ND (10)	1.2 J	-	-	14	-	-	-	***46***
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (50)	ND (250)	ND (500)	140 J	-	-	ND (250)	-	-	-	ND (250)
TOLUENE	µg/L	1,000	0.50 J	54	***4,200***	***3,800***	-	-	51	-	-	-	86
1,2,4-TRIMETHYLBENZENE	µg/L	62	***570***	***70***	***820***	***730***	-	-	***91***	-	-	-	ND (25)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	240	26	260	290	-	-	38	-	-	-	15 J
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	600	150	3,600	1,900	-	-	240	-	-	-	220
Volatile Organic Compounds (SW8011)													
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.029)	ND (0.029)	ND (0.029)	-	-	ND (0.030) H H3	-	ND (0.029) H H3	-	ND (0.035) H H3	-
Semi-Volatile Organic Compounds													
ANTHRACENE	µg/L	66	0.29 J	0.19 J	ND (0.50)	ND (0.51)	-	-	ND (0.51) H3	-	-	-	ND (0.51)
BENZO(A)ANTHRACENE	µg/L	4.9	0.43 J	0.54	ND (0.50)	ND (0.51)	-	-	ND (0.51)	-	-	-	ND (0.51)
BENZO(A)PYRENE	µg/L	0.2	***0.38 J***	*ND (0.51)*	*ND (0.50)*	*ND (0.51)*	-	-	*ND (0.51) H3*	-	-	-	*ND (0.51)*
BENZO(B)FLUORANTHENE	µg/L	1.2	0.39 J	ND (0.51)	ND (0.50)	ND (0.51)	-	-	ND (0.51) H3	-	-	-	ND (0.51)
BENZO(G,H,I)PERYLENE	µg/L	0.26	0.25 J	*ND (0.51)*	*ND (0.50)*	*ND (0.51)*	-	-	*ND (0.51) H3*	-	-	-	*ND (0.51)*
CHRYSENE	µg/L	1.9	0.56	ND (0.51)	ND (0.50)	ND (0.51)	-	-	ND (0.51)	-	-	-	ND (0.51)
FLUORENE	µg/L	1,900	ND (0.51)	0.20 J	ND (0.50)	ND (0.51)	-	-	ND (0.51) H3	-	-	-	ND (0.51)
NAPHTHALENE	µg/L	100	***130***	9.8	***240***	***280***	-	-	5.1	-	-	-	1.6
PHENANTHRENE	µg/L	1,100	0.89	0.64	ND (0.50)	0.12 J	-	-	ND (0.51) H3	-	-	-	ND (0.51)
PYRENE	µg/L	130	0.85	0.34 J	ND (0.50)	ND (0.51)	-	-	ND (0.51)	-	-	-	ND (0.51)
Metals													
LEAD, Dissolved	µg/L	5	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	-	-	ND (0.52)	-	-	-	ND (0.52)
Petroleum Hydrocarbons													
>C12-C22	µg/L	n/v	940	730	820	-	690 H H3	-	1,200	-	1,100 H H3	-	-
>C22-C44	µg/L	n/v	270	800	170	-	120 H H3	-	670	-	290 H H3	-	-
C5-C12 GRO	µg/L	n/v	21,000	6,500	-	-	-	-	-	-	-	-	-
C4-C12 GRO	µg/L	n/v	-	-	35,000	44,000	-	-	3,900	-	-	-	8,400
TOTAL PETROLEUM HYDROCARBON	µg/L	n/v	-	-	990	-	-	-	1,900	-	-	-	-

See notes on last page.

Table 2-5
Groundwater Analytical Results – Discrete Groundwater Samples
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			AOI4-BH-20-04		S-440_CD		S-441_CD		
Sample Date			30-Jun-20	30-Jun-20	16-Jun-20	17-Jun-20	22-Jul-20	22-Jul-20	23-Jul-20
Sample ID			CD-6B-W-45.0-20200630	CD-6B-W-45.0-20200630	CD-15-W-25.0-20200616	CD-15-W-40.0-20200617	CD-6A-W-19.0-20200722	CD-6A-W-19.0-20200722	CD-6A-W-44.0-20200723
Sample Depth			45 ft bgs	45 ft bgs	25 ft bgs	40 ft bgs	19 ft bgs	19 ft bgs	44 ft bgs
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-14623-1	410-6241-1	410-4783-1	410-4783-1	410-14623-1	410-8574-1	410-14623-1
Laboratory Sample ID	Units	MSC-PA	410-14623-1	410-6241-1	410-4783-3	410-4783-4	410-14623-2	410-8574-1	410-14623-3
Field Parameters									
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	-	0.2	0	2.67	-	0	-
OXIDATION REDUCTION POTENTIAL, FIELD	mV	n/v	-	-369	-35	-36	-	-136	-
pH, FIELD MEASURED	S.U.	n/v	-	8.01	7.23	7.54	-	7.36	-
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	-	0.35	0.397	0.61	-	0.582	-
TEMPERATURE, FIELD MEASURED	deg c	n/v	-	17.39	17.77	18.7	-	24.72	-
TURBIDITY	NTU	n/v	-	480	560	404	-	82	-
Volatile Organic Compounds									
BENZENE	µg/L	5	-	***270***	ND (1.0)	ND (1.0)	-	***5.3***	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	-	ND (5.0)	ND (1.0)	ND (1.0)	-	ND (5.0)	-
ETHYLBENZENE	µg/L	700	-	44	ND (1.0)	ND (1.0)	-	21	-
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	-	10 J	ND (5.0)	ND (5.0)	-	16 J	-
METHYL TERTIARY BUTYL ETHER	µg/L	20	-	9.3	6.4	***49***	-	ND (5.0)	-
NAPHTHALENE	µg/L	100	-	-	ND (5.0)	ND (5.0)	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (250)	ND (50)	1,200 E	-	ND (250)	-
TOLUENE	µg/L	1,000	-	69	ND (1.0)	ND (1.0)	-	18	-
1,2,4-TRIMETHYLBENZENE	µg/L	62	-	***150***	ND (5.0)	ND (5.0)	-	***270***	-
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	-	58	ND (5.0)	ND (5.0)	-	55	-
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	-	320	ND (6.0)	ND (6.0)	-	57	-
Volatile Organic Compounds (SW8011)									
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.029) H H3	-	ND (0.029)	0.036	ND (0.029) H H3	-	ND (0.029) H H3
Semi-Volatile Organic Compounds									
ANTHRACENE	µg/L	66	-	ND (0.52)	-	-	-	ND (0.50)	-
BENZO(A)ANTHRACENE	µg/L	4.9	-	ND (0.52)	-	-	-	ND (0.50)	-
BENZO(A)PYRENE	µg/L	0.2	-	*ND (0.52)*	-	-	-	*ND (0.50)*	-
BENZO(B)FLUORANTHENE	µg/L	1.2	-	ND (0.52)	-	-	-	ND (0.50)	-
BENZO(G,H,I)PERYLENE	µg/L	0.26	-	*ND (0.52)*	-	-	-	*ND (0.50)*	-
CHRYSENE	µg/L	1.9	-	ND (0.52)	-	-	-	ND (0.50)	-
FLUORENE	µg/L	1,900	-	ND (0.52)	-	-	-	ND (0.50)	-
NAPHTHALENE	µg/L	100	-	22	-	-	-	8.9	-
PHENANTHRENE	µg/L	1,100	-	ND (0.52)	-	-	-	ND (0.50)	-
PYRENE	µg/L	130	-	ND (0.52)	-	-	-	ND (0.50)	-
Metals									
LEAD, Dissolved	µg/L	5	-	***11***	ND (0.52)	ND (0.52)	-	ND (0.52)	-
Petroleum Hydrocarbons									
>C12-C22	µg/L	n/v	-	3,300	290	770	-	670	-
>C22-C44	µg/L	n/v	-	320	940	1,100	-	450	-
C5-C12 GRO	µg/L	n/v	-	-	46 J	200	-	-	-
C4-C12 GRO	µg/L	n/v	-	5,200	-	-	-	5,900	-
TOTAL PETROLEUM HYDROCARBON	µg/L	n/v	-	3,600	1,200	1,900	-	1,100	-

Sample Location			S-441_CD	S-442_CD		S-443_CD		S-444_CD	S-445_CD
Sample Date			23-Jul-20	14-Jul-20	15-Jul-20	20-Jul-20	21-Jul-20	9-Jul-20	7-Jul-20
Sample ID			CD-6A-W-44.0-20200723	CD-5-W-20.0-202007	CD-5-W-44.0-20200715	CD-6C-W-19.0-20200720	CD-6C-W-40.0-20200721	CD-13A-W-39.0-20200709	CD-13B-W-40.0-20200707
Sample Depth			44 ft bgs	20 ft bgs	44 ft bgs	19 ft bgs	40 ft bgs	39 ft bgs	40 ft bgs
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-8574-1	410-7802-1	410-7956-1	410-8309-1	410-8309-1	410-7163-1	410-6786-1
Laboratory Sample ID	Units	MSC-PA	410-8574-2	410-7802-1	410-7956-1	410-8309-1	410-8309-2	410-7163-2	410-6786-1
Field Parameters									
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0	0	0	0	0	0	0
OXIDATION REDUCTION POTENTIAL, FIELD	mV	n/v	-150	-121	-42	-170	-249	-139	-239
pH, FIELD MEASURED	S.U.	n/v	7.85	6.77	8.85	6.95	7.44	7.02	10.14
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	2.48	0.302	1.97	1.46	3	0.263	1.32
TEMPERATURE, FIELD MEASURED	deg c	n/v	19.07	26.42	20.09	19.29	18.11	16.84	20.73
TURBIDITY	NTU	n/v	104	106	310	81	172	608	1,000
Volatile Organic Compounds									
BENZENE	µg/L	5	***220***	***15***	***1,100***	***780***	***360***	3.5 J	***480***
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)
ETHYLBENZENE	µg/L	700	78	220	170	***1,000***	180	430	59
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	12 J	42	23 J	20 J	11 J	85	45
METHYL TERTIARY BUTYL ETHER	µg/L	20	ND (5.0)	ND (5.0)	8.1	4.2 J	11	ND (5.0)	ND (1.0)
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (50)
TOLUENE	µg/L	1,000	230	110	230	72	350	94	120
1,2,4-TRIMETHYLBENZENE	µg/L	62	***140***	***730***	***300***	***710***	***390***	24 J	33
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	48	230	110	280	130	26	19
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	460	970	940	2,400	1,000	310	130
Volatile Organic Compounds (SW8011)									
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029) H	ND (0.028)
Semi-Volatile Organic Compounds									
ANTHRACENE	µg/L	66	ND (0.51)	ND (0.50)	ND (0.50) B	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.51)
BENZO(A)ANTHRACENE	µg/L	4.9	ND (0.51) B	ND (0.50)	ND (0.50) B	ND (0.50)	ND (0.50)	ND (0.50)	0.14 J
BENZO(A)PYRENE	µg/L	0.2	*ND (0.51)*	*ND (0.50)*	*ND (0.50) B*	*ND (0.50)*	*ND (0.50)*	*ND (0.50)*	*ND (0.51)*
BENZO(B)FLUORANTHENE	µg/L	1.2	ND (0.51) B	ND (0.50)	ND (0.50) B	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.51)
BENZO(G,H,I)PERYLENE	µg/L	0.26	*ND (0.51)*	*ND (0.50)*	*ND (0.50)*	*ND (0.50)*	*ND (0.50)*	*ND (0.50)*	*ND (0.51)*
CHRYSENE	µg/L	1.9	ND (0.51) B	ND (0.50)	ND (0.50) B	ND (0.50)	ND (0.50)	ND (0.50)	0.36 J
FLUORENE	µg/L	1,900	ND (0.51)	0.56	ND (0.50) B	0.21 J	0.13 J	0.19 J	0.18 J
NAPHTHALENE	µg/L	100	19	83	50 B	***140***	39	47	19
PHENANTHRENE	µg/L	1,100	ND (0.51)	0.75	0.16 JB	0.27 J	0.11 J	0.14 J	0.23 J
PYRENE	µg/L	130	ND (0.51)	ND (0.50)	ND (0.50) B	ND (0.50)	ND (0.50)	ND (0.50)	0.19 J
Metals									
LEAD, Dissolved	µg/L	5	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)
Petroleum Hydrocarbons									
>C12-C22	µg/L	n/v	1,400	1,700 H	470 H	1,200 H	920	220	860
>C22-C44	µg/L	n/v	270	140 H	180 H	160 H	430	70 J	48 J
C5-C12 GRO	µg/L	n/v	-	-	-	-	-	-	-
C4-C12 GRO	µg/L	n/v	6,600	20,000	12,000	22,000	12,000	16,000	4,900
TOTAL PETROLEUM HYDROCARBON	µg/L	n/v	1,700	1,800	650	1,400	1,400	290	910

See notes on last page.

Table 2-5
Groundwater Analytical Results – Discrete Groundwater Samples
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-446_CD		S-447_CD		S-448_CD
Sample Date			18-Jun-20	19-Jun-20	23-Jun-20	24-Jun-20	11-Aug-20
Sample ID			CD-12-W-25.0-20200618	CD-12-W-45.0-20200619	CD-10-W-38.0-20200623	CD-10-W-45.0-20200624	CD-14-W-23.0-20200811
Sample Depth			25 ft bgs	45 ft bgs	38 ft bgs	45 ft bgs	23 ft bgs
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-4913-1	410-5078-1	410-5534-1	410-5704-1	410-10488-1
Laboratory Sample ID	Units	MSC-PA	410-4913-2	410-5078-1	410-5534-3	410-5704-1	410-10488-1
Field Parameters							
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0	0	0	0	0
OXIDATION REDUCTION POTENTIAL, FIELI	mV	n/v	-218	-177	-180	-176	-159
pH, FIELD MEASURED	S.U.	n/v	9.02	8.76	7.07	7.51	7.36
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.241	0.357	0.334	0.295	0.921
TEMPERATURE, FIELD MEASURED	deg c	n/v	15.89	16.88	18.09	17.11	17.16
TURBIDITY	NTU	n/v	121	59.5	1,000	147	352
Volatile Organic Compounds							
BENZENE	µg/L	5	ND (1.0)	ND (1.0)	***230 H***	***270 H***	***18 J***
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (1.0)	ND (1.0)	ND (5.0) H	ND (1.0) H	*ND (20)*
ETHYLBENZENE	µg/L	700	3.7	160	280 H	86 H	***1,400***
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	9.2	44	36 H	42 H	54 J
METHYL TERTIARY BUTYL ETHER	µg/L	20	ND (1.0)	ND (1.0)	ND (5.0) H	ND (1.0) H	ND (20)
NAPHTHALENE	µg/L	100	1.8 J	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (50)	ND (50)	ND (250) H	68 H	ND (1,000)
TOLUENE	µg/L	1,000	0.81 J	78	330 H	210 H	700
1,2,4-TRIMETHYLBENZENE	µg/L	62	ND (5.0)	6.7	***160 H***	57 H	***800***
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	0.53 J	9.0	59 H	22 H	320
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	ND (6.0)	160	1,400 H	400 H	3,000
Volatile Organic Compounds (SW8011)							
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.030)
Semi-Volatile Organic Compounds							
ANTHRACENE	µg/L	66	-	ND (0.50)	0.72	ND (0.51)	0.19 J
BENZO(A)ANTHRACENE	µg/L	4.9	-	ND (0.50)	ND (0.51)	ND (0.51)	0.26 J
BENZO(A)PYRENE	µg/L	0.2	-	*ND (0.50)*	*ND (0.51) TL*	*ND (0.51)*	0.20 J
BENZO(B)FLUORANTHENE	µg/L	1.2	-	ND (0.50)	ND (0.51) TL	ND (0.51)	0.20 J
BENZO(G,H,I)PERYLENE	µg/L	0.26	-	*ND (0.50)*	*ND (0.51) TL*	*ND (0.51)*	0.10 J
CHRYSENE	µg/L	1.9	-	ND (0.50)	ND (0.51)	ND (0.51)	0.30 J
FLUORENE	µg/L	1,900	-	0.19 J	2.5	0.31 J	0.28 J
NAPHTHALENE	µg/L	100	-	58	***260***	61	***380***
PHENANTHRENE	µg/L	1,100	-	ND (0.50)	4.2	ND (0.51)	1.0
PYRENE	µg/L	130	-	ND (0.50)	0.35 J	ND (0.51)	0.35 J
Metals							
LEAD, Dissolved	µg/L	5	ND (0.53)	ND (0.52) H	ND (0.52)	0.46 J	ND (0.52)
Petroleum Hydrocarbons							
>C12-C22	µg/L	n/v	-	460	19,000	1,900	1,600
>C22-C44	µg/L	n/v	-	120	6,300	210	540
C5-C12 GRO	µg/L	n/v	580	6,000 E	-	-	31,000
C4-C12 GRO	µg/L	n/v	-	-	14,000 H	8,700 H	-
TOTAL PETROLEUM HYDROCARBON	µg/L	n/v	-	580	25,000	2,100	-

See notes on last page.

Table 2-5
Groundwater Analytical Results – Discrete Groundwater Samples
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Notes:

MSC-PA	Pennsylvania Department of Environmental Protection
	Medium-Specific Concentrations (MSCs) for Organic/Inorganic Regulated Substances in Groundwater - Used Aquifer, Non Residential, TDS ≤ 2500
6.5	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
ND (0.50)	Laboratory reporting limit was greater than the applicable standard.
ND (0.03)	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value
-	Parameter not analyzed / not available
B	Indicates the analyte is detected in the associated blank as well as in the sample.
E	Indicates compounds whose concentrations exceed the calibration range of the instrument.
H	Sample was prepped or analyzed beyond the specified holding time.
H3	Sample was received and analyzed past holding time.
J	Indicates an estimated value
TL	Internal standard response or retention time outside acceptable limits.
µg/L	Micrograms per liter
mg/L	Milligrams per liter
mV	Millivolts
S.U.	Standard Units
mS/cm	Millisiemens per centimeter
deg c	Degrees Celcius
NTU	Nephelometric Turbidity Units
TAED	Eurofins TestAmerica

Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			RW-701						RW-703				
Sample Date			17-May-17	29-Jun-18	29-Jun-18	20-Jun-19	28-Oct-19	10-May-21	20-Jun-19	29-Oct-19	13-Dec-19	3-Sep-20	10-May-21
Sample ID			RW-701-20170517	RW-701_20180629	RW-701_HS_20180629	RW-701_20190620	RW-701_20191028	RW-701_20210510	RW-703_20190620	RW-703_20191029	RW-703_CSIA_20191213	RW-703_20200903	RW-703_20210510
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	ESC	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	PACE	LANCASTER	LANCASTER
Laboratory Work Order			1803720	L1006569	L1006569	2050556	2072152	410-39343-1	2050556	2072152	30341748	410-12999-1	410-39343-1
Laboratory Sample ID			9003660	L1006569-04	L1006569-05	1088312	1189892	410-39343-5	1088313	1189896	30341748001	410-12999-5	410-39343-4
Hydrostratigraphic Unit	Units	MSC-PA	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Field Parameters													
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	-	0	-	0.78	0.00	1.85	3.12	0.00	0.27	0.43	5.37
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-	-163	-	-83	-85	-60	-67	-179	-151	-134	-116
pH, FIELD MEASURED	S.U.	n/v	-	6.66	-	6.54	6.24	7.09	6.53	7.09	7.48	6.43	6.62
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	-	0.633	-	0.386	0.310	0.548	0.289	0.440	0.498	0.741	0.749
TEMPERATURE, FIELD MEASURED	deg c	n/v	-	17.32	-	21.27	18.52	14.7	21.89	17.37	9.41	18.12	16.57
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	-	-	-	0.138	0.201	-	0.185	0.286	0.324	-	-
TURBIDITY	NTU	n/v	-	71	-	0	196	0	188	429	100	501	0
Volatile Organic Compounds													
BENZENE	µg/L	5	16,000	4,570 SL	4,250 SL	1,500	3,100	26	1,600	18,000	25,300 E	6,500	3,800
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (10)	ND (200) SL	ND (200) SL	ND (10)	ND (10)	ND (1.0)	ND (10)	ND (40)	-	ND (20)	ND (5.0)
ETHYLBENZENE	µg/L	700	1,300	554 SL	489 SL	230	240	0.93 J	45	710	1,020	430	140
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	35 J	ND (200) SL	ND (200) SL	14 J	8 J	ND (5.0)	3 J	18 J	-	14 J	3.9 J
METHYL TERTIARY BUTYL ETHER	µg/L	20	5,100	ND (200) SL	ND (200) SL	180	27	0.44 J	ND (1)	140	-	ND (20)	ND (5.0)
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (1,000) HT SL	ND (1,000) HT SL	99 J	150	ND (50)	ND (50)	360 J	-	ND (1,000)	63 J
TOLUENE	µg/L	1,000	9,100	2,120 SL	1,380 SL	740	1,000	2.4	1,400	8,400	13,300	1,900	82
1,2,4-TRIMETHYLBENZENE	µg/L	62	870	615 SL	515 SL	380	280	6.3	350	490	-	670	410
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	250	201 SL	ND (200) SL	140	96	34	150	150	-	220	250
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	6,900	3,580 SL	3,160 SL	1,600	1,500	56	1,900	4,600	6,510	4,100	2,000
Volatile Organic Compounds (SW8011)													
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	0.64	ND (0.0100) SL	ND (0.0100) SL	ND (0.027)	0.16	ND (0.028)	ND (0.014)	ND (0.0094) XQ	-	ND (0.029)	ND (0.029)
Semi-Volatile Organic Compounds													
ANTHRACENE	µg/L	66	35	30.6 SL	ND (0.100) SL	6	10	ND (0.58)	6	ND (0.1)	-	30	2.0
BENZO(A)ANTHRACENE	µg/L	4.9	0.2 J	0.0935 SL	ND (0.100) SL	0.2 J	ND (0.1)	ND (0.58)	ND (0.1)	ND (0.1)	-	ND (0.50)	ND (0.55)
BENZO(A)PYRENE	µg/L	0.2	ND (0.1)	ND (0.0515) SL	ND (0.100) SL	0.1 J	ND (0.1)	ND (0.58)	ND (0.1)	ND (0.1)	-	ND (0.50)	ND (0.55)
BENZO(B)FLUORANTHENE	µg/L	1.2	ND (0.1)	ND (0.0515) SL	ND (0.100) SL	0.2 J	ND (0.1)	ND (0.58)	ND (0.1)	ND (0.1)	-	ND (0.50)	ND (0.55)
BENZO(G,H,I)PERYLENE	µg/L	0.26	ND (0.1)	ND (0.0515) SL	ND (0.100) SL	0.1 J	ND (0.1)	ND (0.58)	ND (0.1)	ND (0.1)	-	0.14 J	ND (0.55)
CHRYSENE	µg/L	1.9	0.5 J	0.149 SL	ND (0.100) SL	0.2 J	ND (0.1)	ND (0.58)	ND (0.1)	ND (0.1)	-	ND (0.50)	ND (0.55)
FLUORENE	µg/L	1,900	91	48.7 SL	0.372 SL	18	23	ND (0.58)	16	5	-	60	4.2
NAPHTHALENE	µg/L	100	470	271 SL	12.7 SL	10	ND (0.1)	ND (0.58)	41	120	-	230	34
PHENANTHRENE	µg/L	1,100	230	126 SL	0.560 SL	39	70	ND (0.58)	37	9	-	160	5.6
PYRENE	µg/L	130	11	6.99 SL	0.169 SL	2	4	ND (0.58)	2	ND (0.1)	-	10	0.81
Metals													
LEAD, Dissolved	µg/L	5	0.17 J	ND (2.00) SL	ND (2.00) SL	ND (1.1)	0.57	0.26 J	ND (1.1)	0.53	-	ND (0.52)	ND (0.52)
Petroleum Hydrocarbons													
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	-	-	-	-	28,000	-

See notes on last page.

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Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			RW-708			RW-715				S-38							S-222
Sample Date			20-Jun-19	28-Oct-19	3-May-21	26-Jun-18	20-Jun-19	28-Oct-19	4-May-21	17-May-17	26-Jun-18	28-Jun-19	28-Oct-19	2-Sep-20	3-May-21	3-May-21	17-May-17
Sample ID			RW-708_20190620	RW-708_20191028	RW-708_20210503	RW-715_20180626	RW-715_20190620	RW-715_20191028	RW-715_20210504	S-38-20170517	S-38_20180626	S-38_20190628	S-38_20191028	S-38_20200902	S-38_20210503	DUP-5_20210503	S-222-20170517
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			2050556	2072152	410-38315-1	L1005209	2050556	2072152	410-38512-1	1803720	L1005209	2051366	2072152	410-12999-1	410-38315-1	410-38315-1	1803720
Laboratory Sample ID			1088314	1189893	410-38315-7	L1005209-13	1088315	1189894	410-38512-1	9003659	L1005209-12	1091979	1189895	410-12999-3	410-38315-1	410-38315-2	9003663
Hydrostratigraphic Unit	Units	MSC-PA	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Field Parameters																	
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0	0.15	4	0.48	4.02	8.71	4.16	-	0	0	0.00	0.44	1.49	-	-
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-95	-6	-119	-137	-9	5	-125	-	7	-1	-39	-28	-19	-	-
pH, FIELD MEASURED	S.U.	n/v	6.58	6.50	6.82	6.36	6.45	6.20	5.53	-	6.28	6.62	6.16	6.39	6.3	-	-
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.688	0.063	0.786	0.508	0.39	0.513	0.786	-	0.377	0.25	0.305	0.41	0.999	-	-
TEMPERATURE, FIELD MEASURED	deg c	n/v	17.29	20.82	15.58	20.29	20.36	20.08	16.19	-	19.25	15.07	19.77	18.17	14.35	-	-
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	0.44	0.041	-	-	0.257	0.328	-	-	-	0.162	0.198	-	-	-	-
TURBIDITY	NTU	n/v	97	37.4	31.7	2.9	253	139	50.4	-	27.4	47.4	10.4	9.8	0	-	-
Volatile Organic Compounds																	
BENZENE	µg/L	5	***510***	0.6 J	***99***	***47.8***	0.8 J	0.6 J	***6.0***	ND (0.5)	***72.3***	***120***	***81***	***130***	***5.5***	***7.5***	3
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (2)	ND (2)	ND (1.0)	ND (1.00)	ND (2)	ND (2)	ND (1.0)	ND (0.5)	ND (1.00)	*ND (10)*	*ND (10)*	ND (5.0)	ND (1.0)	ND (1.0)	ND (0.5)
ETHYLBENZENE	µg/L	700	260	8	50	2.23	ND (0.2)	ND (0.2)	ND (1.0)	ND (0.5)	30.9	110	130	97	1.6	3.8	2
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	12	0.4 J	2.2 J	1.81	ND (0.3)	ND (0.3)	1.5 J	ND (0.5)	4.68	17 J	18 J	13 J	0.66 J	1.3 J	ND (0.5)
METHYL TERTIARY BUTYL ETHER	µg/L	20	ND (0.2)	ND (0.2)	ND (1.0)	1.58	1	0.9 J	0.35 J	ND (0.5)	ND (1.00)	ND (1)	ND (1)	ND (5.0)	ND (1.0)	ND (1.0)	ND (0.5)
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	12 J	ND (10)	37 J	-	ND (10)	11 J	12 J	-	-	92 J	59 J	ND (250)	ND (50)	ND (50)	-
TOLUENE	µg/L	1,000	90	2	9.4	3.06	0.3 J	ND (0.2)	2.4	ND (0.5)	45.4	230	230	170	2.5	5.0	2
1,2,4-TRIMETHYLBENZENE	µg/L	62	***560***	24	***160***	1.53	ND (0.3)	ND (0.3)	2.7 J	ND (0.5)	7.22	28	28	13 J	ND (5.0)	1.3 J	2 J
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	230	20	92	ND (1.00)	ND (0.3)	ND (0.3)	0.32 J	ND (0.5)	3.46	12 J	14 J	8.0 J	ND (5.0)	0.50 J	0.6 J
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	1,700	74	470	4.08	0.6 J	ND (0.8)	3.9 J	ND (0.5)	30.4	150	160	110	2.4 J	5.7 J	8
Volatile Organic Compounds (SW8011)																	
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.0095)	ND (0.0094) XQ	ND (0.029)	ND (0.0100)	ND (0.0094)	ND (0.0094) XQ	ND (0.029)	ND (0.0096)	ND (0.0101)	ND (0.0094)	ND (0.0093) XQ	ND (0.029)	ND (0.029)	ND (0.028)	ND (0.0096)
Semi-Volatile Organic Compounds																	
ANTHRACENE	µg/L	66	1	ND (0.1)	ND (0.51)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	0.1 J	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	ND (0.52)	ND (0.51)	ND (0.1)
BENZO(A)ANTHRACENE	µg/L	4.9	ND (0.1)	ND (0.1)	ND (0.51)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	ND (0.1)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	ND (0.52)	ND (0.51)	ND (0.1)
BENZO(A)PYRENE	µg/L	0.2	ND (0.1)	ND (0.1)	*ND (0.51)*	ND (0.0500)	ND (0.1)	ND (0.1)	*ND (0.50)*	ND (0.1)	ND (0.0500)	ND (0.1)	ND (0.1)	*ND (0.50)*	*ND (0.52)*	*ND (0.51)*	ND (0.1)
BENZO(B)FLUORANTHENE	µg/L	1.2	ND (0.1)	ND (0.1)	ND (0.51)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	ND (0.1)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	ND (0.52)	ND (0.51)	ND (0.1)
BENZO(G,H,I)PERYLENE	µg/L	0.26	ND (0.1)	ND (0.1)	*ND (0.51)*	ND (0.0500)	ND (0.1)	ND (0.1)	*ND (0.50)*	ND (0.1)	ND (0.0500)	ND (0.1)	ND (0.1)	*ND (0.50)*	*ND (0.52)*	*ND (0.51)*	ND (0.1)
CHRYSENE	µg/L	1.9	ND (0.1)	ND (0.1)	ND (0.51)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	ND (0.1)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	ND (0.52)	ND (0.51)	ND (0.1)
FLUORENE	µg/L	1,900	5	ND (0.1)	0.97	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	1	ND (0.0500)	0.1 J	ND (0.1)	ND (0.50)	ND (0.52)	ND (0.51)	ND (0.1)
NAPHTHALENE	µg/L	100	91	ND (0.1)	ND (0.51)	1.45	ND (0.1)	ND (0.1)	0.24 J	1	6.48	25	38	20	0.25 J	0.50 J	0.3 J
PHENANTHRENE	µg/L	1,100	8	ND (0.1)	0.48 J	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	0.3 J	ND (0.0500)	0.1 J	ND (0.1)	ND (0.50)	ND (0.52)	ND (0.51)	ND (0.1)
PYRENE	µg/L	130	0.8	0.3 J	0.19 J	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	0.1 J	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.50)	ND (0.52)	ND (0.51)	ND (0.1)
Metals																	
LEAD, Dissolved	µg/L	5	ND (1.1)	0.23 J	0.24 J	ND (2.00)	ND (1.1)	ND (0.071)	ND (0.52)	0.099 J	ND (2.00)	ND (1.1)	ND (0.071)	ND (0.52)	ND (0.52)	0.088 J	ND (0.090)
Petroleum Hydrocarbons																	
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	3,000	-	-	-

See notes on last page.

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Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-223												
Sample Date			17-May-17	25-Jan-18	2-Apr-18	27-Jun-18	27-Jun-18	28-Nov-18	18-Jan-19	23-Apr-19	28-Jun-19	23-Oct-19	4-Dec-19	1-Sep-20	4-May-21
Sample ID			S-223-20170517	S-223_20180125	S-223-20180402	S-223_20180627	S-223_DUP_20180627	S-223_20181128	S-223-20190118-WG	S-223_20190423	S-223_20190628	S-223_20191023	S-223-CSIA_20191204	S-223_20200901	S-223_20210504
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	ESC	ESC	LANCASTER	ESC	LANCASTER	LANCASTER	LANCASTER	PACE	LANCASTER	LANCASTER
Laboratory Work Order			1803720	1901865	1926973	L1005894	L1005894	2013545	L1063104	2040606	2051366	2071371	30340458	410-12761-1	410-38512-1
Laboratory Sample ID			9003662	9427610	9538679	L1005894-02	L1005894-03	9917746	L1063104-07	1042262	1091980	1185681	30340458001	410-12761-4	410-38512-3
Hydrostratigraphic Unit	Units	MSC-PA	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Field Parameters															
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	-	0	0	0.48	-	1.02	-0.03	2.19	0	1.54	0.11	0.34	0.78
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-	29	-53	-121	-	-51	-108.6	-141	-136	-103	-68	-99	-119
pH, FIELD MEASURED	S.U.	n/v	-	6.66	4.6	6.38	-	6.18	6.68	7.24	6.72	6.23	5.43	6.33	5.42
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	-	0.476	0.304	1.03	-	0.155	0.754	0.547	0.59	0.549	0.516	0.584	1.29
TEMPERATURE, FIELD MEASURED	deg c	n/v	-	15	13.92	16.28	-	14.45	14.27	14.92	13.88	19.36	14.85	17	14.94
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	-	0.303	0.198	-	-	0.101	-	-	0.377	-	0.330	-	-
TURBIDITY	NTU	n/v	-	3.5	5.6	17.9	-	0	5.50	0.0	42.5	14.0	0.2	36.8	4.5
Volatile Organic Compounds															
BENZENE	µg/L	5	***37***	***1,700***	***1,800***	***1,830***	***1,850***	***1,500***	***1,680***	***1,200***	***2,200***	***2,800***	***3,450***	***2,200***	***830***
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (0.5)	-	-	ND (1.00)	ND (1.00)	-	*ND (50.0)*	-	*ND (20)*	*ND (20)*	-	ND (5.0)	ND (5.0)
ETHYLBENZENE	µg/L	700	26	400	530	***739***	***764***	370	601	310	410	***710***	***822***	700	540
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	1 J	-	-	25.5	27.1	-	ND (50.0)	-	15 J	26 J	-	23 J	27
METHYL TERTIARY BUTYL ETHER	µg/L	20	ND (0.5)	-	-	ND (1.00)	ND (1.00)	-	*ND (50.0)*	ND (2)	ND (2)	ND (2)	-	ND (5.0)	ND (5.0)
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	***336***	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	-	-	-	-	-	ND (250)	ND (100)	170 J	ND (100)	-	ND (250)	ND (250)
TOLUENE	µg/L	1,000	9	190	150	136	145	220	221	92	310	120	268	160	51
1,2,4-TRIMETHYLBENZENE	µg/L	62	50	-	-	***822***	***807***	-	***664***	-	***600***	***890***	-	***780***	***470***
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	21	-	-	241	245	-	232	-	210	290	-	260	230
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	87	1,100	1,500	1,740	1,790	980	1,400	1,100	990	1,800	1,630	1,200	670
Volatile Organic Compounds (SW8011)															
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.0096)	-	-	ND (0.0100)	ND (0.0100)	-	ND (0.0100)	-	0.014 J	ND (0.0094)	-	ND (0.029)	ND (0.029)
Semi-Volatile Organic Compounds															
ANTHRACENE	µg/L	66	ND (0.1)	-	-	0.0826	0.0799	-	-	-	ND (0.1)	0.2 J	-	0.17 J	ND (0.52)
BENZO(A)ANTHRACENE	µg/L	4.9	ND (0.1)	-	-	ND (0.0500)	ND (0.0500)	-	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)
BENZO(A)PYRENE	µg/L	0.2	ND (0.1)	-	-	ND (0.0500)	ND (0.0500)	-	-	-	ND (0.1)	ND (0.1)	-	*ND (0.51)*	*ND (0.52)*
BENZO(B)FLUORANTHENE	µg/L	1.2	ND (0.1)	-	-	ND (0.0500)	ND (0.0500)	-	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)
BENZO(G,H,I)PERYLENE	µg/L	0.26	ND (0.1)	-	-	ND (0.0500)	ND (0.0500)	-	-	-	ND (0.1)	ND (0.1)	-	*ND (0.51)*	*ND (0.52)*
CHRYSENE	µg/L	1.9	ND (0.1)	-	-	ND (0.0500)	ND (0.0500)	-	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)
FLUORENE	µg/L	1,900	ND (0.1)	-	-	0.701	0.707	-	-	-	1	1	-	1.4	1.3
NAPHTHALENE	µg/L	100	0.1 J	-	-	56.6	78.1	-	-	-	99	***210***	-	***180***	***110***
PHENANTHRENE	µg/L	1,100	ND (0.1)	-	-	ND (0.0500)	0.0986	-	-	-	0.6	1	-	0.85	0.79
PYRENE	µg/L	130	ND (0.1)	-	-	ND (0.0500)	ND (0.0500)	-	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)
Metals															
LEAD, Dissolved	µg/L	5	0.40 J	-	-	ND (2.00)	ND (2.00)	-	-	-	ND (1.1)	0.10 J	-	ND (0.52)	0.074 J
Petroleum Hydrocarbons															
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	17,000	-

See notes on last page.

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Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-224					S-239					S-240	S-243				
Sample Date			25-Jan-18	2-Apr-18	28-Nov-18	18-Jan-19	23-Apr-19	25-Jan-18	2-Apr-18	28-Nov-18	18-Jan-19	23-Apr-19	13-Dec-19	25-Jan-18	2-Apr-18	28-Nov-18	18-Jan-19	23-Apr-19
Sample ID			S-224_20180125	S-224-20180402	S-224_20181128	S-224-20190118-WG	S-224_20190423	S-239_20180125	S-239-20180402	S-239_20181128	S-239-20190118-WG	S-239_20190423	S-240_CSIA_20191213	S-243_20180125	S-243-20180402	S-243_20181128	S-243-20190118-WG	S-243_20190423
Sampling Company			STANTEC	STANTEC	STANTEC	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	AQUATERRA	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER	ESC	LANCASTER	PACE	LANCASTER	LANCASTER	LANCASTER	ESC	LANCASTER
Laboratory Work Order			1901865	1926973	2013545	L1063104	2040606	1901865	1926973	2013545	L1063104	2040606	30341748	1901865	1926973	2013545	L1063104	2040606
Laboratory Sample ID			9427609	9538678	9917745	L1063104-06	1042261	9427607	9538676	9917743	L1063104-08	1042259	30341748002	9427608	9538677	9917744	L1063104-09	1042260
Hydrostratigraphic Unit	Units	MSC-PA	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Field Parameters																		
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0	0	1.12	0.13	0.75	0	0	1.79	1.60	0.60	0.56	0	0	2.59	1.97	0.78
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	77	-47	-71	-71.1	-107	216	132	137	14.50	80	-128	253	101	102	59.80	184
pH, FIELD MEASURED	S.U.	n/v	6.69	4.77	6.06	6.75	6.97	6.85	4.83	6.3	7.50	9.28	6.90	6.62	5.03	6.26	7.08	7.58
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.196	0.441	0.242	0.162	0.183	3.45	0.516	0.322	0.259	0.102	0.5878	0.540	0.258	0.284	0.212	0.136
TEMPERATURE, FIELD MEASURED	deg c	n/v	15.68	14.45	15.9	13.23	18.91	14.38	11.68	13.40	15.30	15.11	12.32	12.21	13.15	16.33	11.10	16.53
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	0.117	0.283	0.158	-	-	0	0.331	0.21	-	-	0.376	0.337	0.167	0.185	-	-
TURBIDITY	NTU	n/v	17.2	36.1	16.4	6.90	4.6	222	669	36.2	38.0	77.1	19.6	123	400	61.2	138.20	10.1
Volatile Organic Compounds																		
BENZENE	µg/L	5	***160***	***370***	***240***	***107***	***88***	ND (0.5)	ND (0.5)	ND (0.2)	***25.1***	ND (0.2)	***8,480***	0.6 J	ND (0.5)	ND (0.2)	***22.2***	ND (0.2)
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	-	-	-	ND (1.00)	-	-	-	-	ND (1.00)	-	-	-	-	-	ND (1.00)	-
ETHYLBENZENE	µg/L	700	170	410	170	104	7	ND (0.5)	ND (0.5)	ND (0.2)	67.3	ND (0.2)	511	10	3	0.4 J	75.5	1 J
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	-	-	-	8.25	-	-	-	-	3.72	-	-	-	-	-	4.67	-
METHYL TERTIARY BUTYL ETHER	µg/L	20	-	-	-	ND (1.00)	ND (1)	-	-	-	ND (1.00)	ND (0.2)	-	-	-	-	ND (1.00)	ND (0.2)
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	-	-	209	270	-	-	-	ND (5.00)	ND (10)	-	-	-	-	ND (5.00)	ND (10)
TOLUENE	µg/L	1,000	43	110	49	51.5	16	ND (0.5)	ND (0.5)	ND (0.2)	21.9	ND (0.2)	296	1	ND (0.5)	ND (0.2)	23.2	ND (0.2)
1,2,4-TRIMETHYLBENZENE	µg/L	62	-	-	-	***131***	-	-	-	-	***86.7***	-	-	-	-	-	***106***	-
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	-	-	-	37.3	-	-	-	-	28.8	-	-	-	-	-	35.3	-
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	260	330	220	317	120	ND (0.5)	ND (0.5)	ND (0.5)	196	ND (0.5)	1,830	14	4	ND (0.5)	214	2 J
Volatile Organic Compounds (SW8011)																		
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	ND (0.0100)	-	-	-	-	ND (0.0100)	-	-	-	-	-	ND (0.0100)	-
Semi-Volatile Organic Compounds																		
ANTHRACENE	µg/L	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BENZO(A)ANTHRACENE	µg/L	4.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BENZO(A)PYRENE	µg/L	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BENZO(B)FLUORANTHENE	µg/L	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BENZO(G,H,I)PERYLENE	µg/L	0.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHRYSENE	µg/L	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FLUORENE	µg/L	1,900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHENANTHRENE	µg/L	1,100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PYRENE	µg/L	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals																		
LEAD, Dissolved	µg/L	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum Hydrocarbons																		
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

See notes on last page.

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Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-279	S-368	S-369						S-374						
Sample Date			13-Dec-19	19-May-21	17-May-17	27-Jun-18	19-Jun-19	23-Oct-19	10-May-21	10-May-21	8-Nov-18	16-Jan-19	19-Jun-19	23-Oct-19	9-Dec-19	1-Sep-20	4-May-21
Sample ID			S-279_BASE_GRAB_20191213	S-368_SL_20210519	S-369-20170517	S-369_20180627	S-369_20190619	S-369_20191023	S-369_20210510	DUP-8_20210510	S-374-20181108-WG	S-374-20190116-WG	S-374_20190619	S-374_20191023	S-374_CSIA_20191209	S-374_20200901	S-374_20210504
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			PACE	LANCASTER	LANCASTER	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER	PACE	ESC	LANCASTER	LANCASTER	PACE	LANCASTER	LANCASTER
Laboratory Work Order			30341748	410-40660-1	1803720	L1005894	2050556	2071371	410-39343-1	410-39343-1	30271414	L1063104	2050556	2071371	30340757	410-12585-1	410-38512-1
Laboratory Sample ID			32478-4	410-40660-2	9003661	L1005894-01	1088320	1185680	410-39343-1	410-39343-2	30271414001	L1063104-01	1088310	1185677	30340757002	410-12585-10	410-38512-6
Hydrostratigraphic Unit	Units	MSC-PA	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Field Parameters																	
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0.56	0 SL	-	1.06	1.02	0.00	5.97	-	0.33	-0.14	0	0.00	0.00	0.31	3.97
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-136	-138 SL	-	-143	-94	-105	-120	-	-84.8	-129.4	-117	-137	-82	-114	-121
pH, FIELD MEASURED	S.U.	n/v	6.93	6.54 SL	-	6.56	6.24	6.31	6.8	-	6.84	6.71	6.58	6.38	5.99	6.31	5.29
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.531	0.464 SL	-	0.64	0.683	0.562	0.971	-	0.387	0.409	0.384	0.343	0.442	0.405	0.528
TEMPERATURE, FIELD MEASURED	deg c	n/v	13.31	19.45 SL	-	18.94	17.29	18.82	15.11	-	14.35	13.24	14.22	16.55	13.43	15.01	14.47
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	0.340	-	-	-	0.438	-	-	-	-	-	0.25	-	0.287	-	-
TURBIDITY	NTU	n/v	13.0	68.6 SL	-	31.1	23.7	58.2	0	-	-	39.7	76.2	20.4	7.5	175	7.7
Volatile Organic Compounds																	
BENZENE	µg/L	5	-	70 SL	1,900	1,460	740	1,100	360	370	177	312	200	120	123	190	230
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	-	ND (1.0) SL	ND (5)	ND (1.00)	ND (10)	ND (10)	ND (1.0)	3.3	ND (1.0)	ND (20.0)	ND (10)	ND (10)	-	ND (5.0)	ND (5.0)
ETHYLBENZENE	µg/L	700	-	2.6 SL	17	13.3	12	10	9.7	10	1,360	1,530	1,000	1,100	1,030	980	890
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	-	7.7 SL	71	72.8	68	61	91	100	93.4	102	100	120	-	97	92
METHYL TERTIARY BUTYL ETHER	µg/L	20	-	ND (1.0) SL	47	62.3	11	22	1.9	2.0	ND (1.0)	ND (20.0)	ND (1)	ND (1)	-	ND (5.0)	ND (5.0)
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-	-	328	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (50) SL	-	-	1,100	1,200	180	180	-	ND (100)	ND (50)	ND (50)	-	ND (250)	ND (250)
TOLUENE	µg/L	1,000	-	3.4 SL	62	54.5	40	47	37	41	1,820	903	240	290	255	790	310
1,2,4-TRIMETHYLBENZENE	µg/L	62	-	9.6 SL	ND (5)	ND (1.00)	ND (2)	ND (2)	12	13	1,040	1,110	1,000	950	-	770	650
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	-	14 SL	5 J	3.73	3 J	3 J	2.4 J	2.5 J	179	237	240	220	-	160	140
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	-	17 SL	42	33.2	24 J	31	25	26	4,170	4,060	2,100	2,100	1,860	2,100	1,900
Volatile Organic Compounds (SW8011)																	
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	ND (0.028) SL	ND (0.0097)	ND (0.0100)	ND (0.0095)	ND (0.0094)	ND (0.029)	ND (0.028)	0.053	ND (0.0100)	0.021 J	0.025 J	-	ND (0.029)	ND (0.029)
Semi-Volatile Organic Compounds																	
ANTHRACENE	µg/L	66	-	3.0 SL	0.6	0.236	ND (0.1)	ND (0.1)	0.11 J	0.12 J	-	-	ND (0.1)	ND (0.1)	-	ND (0.51) H	ND (0.51)
BENZO(A)ANTHRACENE	µg/L	4.9	-	0.52 SL	0.1 J	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51) H	ND (0.51)
BENZO(A)PYRENE	µg/L	0.2	-	ND (0.51) SL	ND (0.1)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51) H	ND (0.51)
BENZO(B)FLUORANTHENE	µg/L	1.2	-	ND (0.51) SL	ND (0.1)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51) H	ND (0.51)
BENZO(G,H,I)PERYLENE	µg/L	0.26	-	ND (0.51) SL	ND (0.1)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51) H	ND (0.51)
CHRYSENE	µg/L	1.9	-	0.57 SL	0.1 J	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51) H	ND (0.51)
FLUORENE	µg/L	1,900	-	6.9 SL	2	2.08	2	2	1.7	2.1	-	-	0.1 J	0.3 J	-	ND (0.51) H	0.18 J
NAPHTHALENE	µg/L	100	-	ND (0.51) SL	3	3.13	ND (0.1)	ND (0.1)	1.1	ND (0.50)	-	-	120	200	-	160 H	220
PHENANTHRENE	µg/L	1,100	-	15 SL	2	1.26	1	0.9	1.1	1.3	-	-	ND (0.1)	0.1 J	-	ND (0.51) H	ND (0.51)
PYRENE	µg/L	130	-	5.7 SL	0.4 J	0.0772	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51) H	ND (0.51)
Metals																	
LEAD, Dissolved	µg/L	5	-	0.076 J SL	0.67 J	ND (2.00)	ND (1.1)	0.64	0.79	0.76	-	-	ND (1.1)	0.36 J	-	0.32 J	0.34 J
Petroleum Hydrocarbons																	
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

See notes on last page.

Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-375								S-376						
Sample Date			8-Nov-18	16-Jan-19	19-Jun-19	23-Oct-19	23-Oct-19	9-Dec-19	2-Sep-20	4-May-21	8-Nov-18	16-Jan-19	9-Jul-19	20-Nov-19	12-Dec-19	3-Sep-20	12-May-21
Sample ID			S-375-20181108-WG	S-375-20190116-WG	S-375_20190619	S-375_20191023	DUP-1	S-375_CSIA_20191209	S-375_20200902	S-375_20210504	S-376-20181108-WG	S-376-20190116-WG	S-376_SL_20190709	S-376_SL_20191120	S-376_CSIA_20191212	S-376_SL_20200903	S-376_SL_20210512
Sampling Company			AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			PACE	ESC	LANCASTER	LANCASTER	LANCASTER	PACE	LANCASTER	LANCASTER	PACE	ESC	LANCASTER	LANCASTER	PACE	LANCASTER	LANCASTER
Laboratory Work Order			30271414	L1063104	2050556	2071371	2071371	30340757	410-12999-1	410-38512-1	30271414	L1063104	2052789	2075960	30340757	410-12999-1	410-39710-1
Laboratory Sample ID			30271414002	L1063104-02	1088311	1185679	1185682	30340757001	410-12999-2	410-38512-10	30271414003	L1063104-03	1097914	1208202	30340757005	410-12999-7	410-39710-4
Hydrostratigraphic Unit	Units	MSC-PA	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Field Parameters																	
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0.49	-0.12	0	4.50	-	0.00	0.28	8.25	0.24	-0.14	1.56 SL	0.00 SL	0.00	0.51 SL	0 SL
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-55.3	-141	-170	-171	-	-140	-159	-139	-16.4	-104	-102 SL	-155 SL	-39	-119 SL	-192 SL
pH, FIELD MEASURED	S.U.	n/v	6.73	6.88	6.82	6.65	-	6.13	6.78	5.39	6.93	6.80	6.56 SL	6.11 SL	7.21	6.52 SL	6.78 SL
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.490	0.492	0.438	0.432	-	0.688	0.89	0.602	1.262	1.061	0.612 SL	3.56 SL	2.20	1.29 SL	2.72 SL
TEMPERATURE, FIELD MEASURED	deg c	n/v	16.22	14.10	17.21	18.34	-	14.96	16.75	15.65	16.28	10.71	20.23 SL	15.94 SL	14.04	19.18 SL	13.81 SL
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	-	-	0.286	-	-	0.441	-	-	-	-	0.392 SL	2.37 SL	1.40	-	-
TURBIDITY	NTU	n/v	-	33	158	19.9	-	1.9	47.5	5.2	-	170.4	192 SL	90.2 SL	94	203 SL	96.4 SL
Volatile Organic Compounds																	
BENZENE	µg/L	5	***1,900***	***1,090***	***440***	***1,100***	***1,100***	***794***	***1,600***	***490***	***101***	***198***	***150 SL***	***160 SL***	***69.1***	***130 SL***	***630 SL***
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (1.0)	ND (1.00)	ND (2)	*ND (10)*	*ND (10)*	-	ND (5.0)	ND (5.0)	ND (1.0)	*ND (10.0)*	*ND (10) SL*	ND (5) SL	-	*ND (10) SL*	ND (5.0) SL
ETHYLBENZENE	µg/L	700	641	***1,190***	***990***	***960***	***1,100***	***811***	***840***	***890***	302	***1,160***	***970 SL***	***1,400 SL***	480	***930 SL***	490 SL
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	31.7	43.7	46	43	47	-	40	39	14.2	26.9	25 J SL	24 SL	-	18 J SL	13 J SL
METHYL TERTIARY BUTYL ETHER	µg/L	20	0.58 J	ND (1.00)	ND (0.2)	ND (1)	ND (1)	-	2.5 J	ND (5.0)	3.4	ND (10.0)	ND (1) SL	1 J SL	-	2.4 J SL	6.4 SL
NAPHTHALENE	µg/L	100	-	-	-	-	-	***270***	-	-	-	-	-	-	***372***	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (5.00)	60	160	150	-	100 J	93 J	-	ND (50.0)	69 J SL	ND (25) SL	-	ND (500) SL	ND (250) SL
TOLUENE	µg/L	1,000	***3,340***	***2,920***	1,000	***1,100***	***1,200***	799	420	390	***1,660***	***2,310***	***2,000 SL***	***3,800 SL***	***1,090***	***3,500 SL***	1,000 SL
1,2,4-TRIMETHYLBENZENE	µg/L	62	***743***	***823***	***760***	***720***	***790***	-	***630***	***630***	***759***	***1,210***	***1,300 SL***	***1,600 SL***	-	***1,100 SL***	***530 SL***
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	231	239	250	240	260	-	210	220	284	373	420 SL	360 SL	-	330 SL	160 SL
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	4,820	6,270	4,400	4,900	5,500	3,590	3,700	4,200	3,930	6,220	6,100 SL	8,600 SL	4,450	6,400 SL	2,800 SL
Volatile Organic Compounds (SW8011)																	
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	***0.075***	ND (0.0100)	ND (0.019)	ND (0.0094)	ND (0.0094)	-	ND (0.029)	ND (0.029)	***0.079***	ND (0.0100)	ND (0.0094) SL	ND (0.0095) SL	-	ND (0.029) SL	ND (0.029) SL
Semi-Volatile Organic Compounds																	
ANTHRACENE	µg/L	66	-	-	ND (0.1)	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.50)	-	-	ND (0.1) SL	ND (0.1) SL	-	ND (0.50) SL	ND (0.50) SL
BENZO(A)ANTHRACENE	µg/L	4.9	-	-	ND (0.1)	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.50)	-	-	ND (0.1) SL	ND (0.1) SL	-	ND (0.50) SL	ND (0.50) SL
BENZO(A)PYRENE	µg/L	0.2	-	-	ND (0.1)	ND (0.1)	ND (0.1)	-	*ND (0.51)*	*ND (0.50)*	-	-	ND (0.1) SL	ND (0.1) SL	-	*ND (0.50) SL*	*ND (0.50) SL*
BENZO(B)FLUORANTHENE	µg/L	1.2	-	-	ND (0.1)	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.50)	-	-	ND (0.1) SL	ND (0.1) SL	-	ND (0.50) SL	ND (0.50) SL
BENZO(G,H,I)PERYLENE	µg/L	0.26	-	-	ND (0.1)	ND (0.1)	ND (0.1)	-	*ND (0.51)*	*ND (0.50)*	-	-	ND (0.1) SL	ND (0.1) SL	-	*ND (0.50) SL*	*ND (0.50) SL*
CHRYSENE	µg/L	1.9	-	-	ND (0.1)	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.50)	-	-	ND (0.1) SL	ND (0.1) SL	-	ND (0.50) SL	ND (0.50) SL
FLUORENE	µg/L	1,900	-	-	0.3 J	0.2 J	0.2 J	-	0.23 J	0.18 J	-	-	0.2 J SL	ND (0.1) SL	-	ND (0.50) SL	ND (0.50) SL
NAPHTHALENE	µg/L	100	-	-	***230***	***230***	***200***	-	***160***	***190***	-	-	***250 SL***	***270 SL***	-	***300 SL***	***160 SL***
PHENANTHRENE	µg/L	1,100	-	-	0.2 J	0.2 J	ND (0.1)	-	0.12 J	0.15 J	-	-	0.3 J SL	ND (0.1) SL	-	ND (0.50) SL	ND (0.50) SL
PYRENE	µg/L	130	-	-	ND (0.1)	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.50)	-	-	0.3 J SL	ND (0.1) SL	-	ND (0.50) SL	ND (0.50) SL
Metals																	
LEAD, Dissolved	µg/L	5	-	-	ND (1.1)	ND (0.071)	ND (0.071)	-	ND (0.52)	0.12 J	-	-	ND (1.1) SL	0.43 J SL	-	ND (0.52) SL	ND (0.52) SL
Petroleum Hydrocarbons																	
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	-	26,000	-	-	-	-	-	-	32,000 SL	-

See notes on last page.

Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-377						S-378							S-380		S-440	
Sample Date			12-Nov-18	17-Jan-19	19-Jun-19	5-Nov-19	10-Dec-19	3-Sep-20	12-Nov-18	17-Jan-19	19-Jun-19	23-Oct-19	10-Dec-19	2-Sep-20	6-May-21	17-May-17	26-Jun-18	31-Aug-20	12-May-21
Sample ID			S-377-20181112-WG	S-377-20190117-WG	S-377_20190619	S-377_20191105	S-377_CSIA_20191210	S-377_20200903	S-378-20181112-WG	S-378-20190117-WG	S-378_20190619	S-378_20191023	S-378_CSIA_20191209	S-378_20200902	S-378_20210506	S-380-20170517	S-380_20180626	S-440_20200831	S-440_20210512
Sampling Company			AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			ESC	ESC	LANCASTER	LANCASTER	PACE	LANCASTER	ESC	ESC	LANCASTER	LANCASTER	PACE	LANCASTER	LANCASTER	LANCASTER	ESC	LANCASTER	LANCASTER
Laboratory Work Order			L1044397	L1063104	2050556	2073111	30340757	410-12999-1	L1044397	L1063104	2050556	2071371	30340757	410-12999-1	410-39001-1	1803720	L1005209	410-12585-1	410-39710-1
Laboratory Sample ID			L1044397-01	L1063104-04	1088308	1194612	30340757004	410-12999-6	L1044397-02	L1063104-05	1088309	1185678	30340757003	410-12999-1	410-39001-8	9003664	L1005209-11	410-12585-1	410-39710-1
Hydrostratigraphic Unit	Units	MSC-PA	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Field Parameters																			
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0.69	-0.11	0	4.35	-	0.49	2.52	-0.11	0	0.00	0.00	0.58	3.58	-	0.88	0.5	0
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-54.3	-106.3	-146	-75	-	-131	-67	-89.0	-114	-98	-65	-132	-121	-	51	-24	99
pH, FIELD MEASURED	S.U.	n/v	6.50	6.71	6.69	5.60	-	6.57	6.65	6.65	6.58	6.20	5.98	6.56	6.62	-	6.47	5.98	5.59
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	1,181	0.848	1.1	0.886	-	1.57	805	0.745	0.649	0.751	1.17	1.13	0.981	-	0.204	0.511	0.223
TEMPERATURE, FIELD MEASURED	deg c	n/v	11.16	13.79	16.56	15.54	-	17.33	12.20	13.12	15.92	19.81	15.19	17.09	15.32	-	18.07	15.53	9.55
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	-	-	0.702	0.567	-	-	-	-	0.415	-	0.746	-	-	-	-	-	-
TURBIDITY	NTU	n/v	114.6	57.0	95	7.0	-	1.9	81.4	4.3	61	18.5	0.0	66.4	19.9	-	138	186	108
Volatile Organic Compounds																			
BENZENE	µg/L	5	***966***	***109***	***860***	***77***	***1,560***	***1,000***	***1,890***	***1,390***	***3,000***	***2,600***	***1,660***	***3,100***	***1,500***	ND (0.5)	ND (1.00)	ND (1.0)	0.94 J
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	*ND (1.00)*	-	-	-	-	-	*ND (10.0)*	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (1.00)	ND (5.00)	*ND (10)*	ND (2)	-	ND (5.0)	*ND (10.0)*	ND (5.00)	*ND (10)*	*ND (20)*	-	*ND (10)*	ND (5.0)	ND (0.5)	ND (1.00)	ND (1.0)	ND (1.0)
ETHYLBENZENE	µg/L	700	290	221	110	74	53.0	100	***1,040***	***1,090***	***1,300***	***1,400***	***848***	***740***	***910***	ND (0.5)	ND (1.00)	ND (1.0)	ND (1.0)
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	41.8	37.8	28	12	-	36	57.0	55.0	48	50 J	-	48 J	43	ND (0.5)	ND (1.00)	ND (5.0)	ND (5.0)
METHYL TERTIARY BUTYL ETHER	µg/L	20	ND (1.00)	ND (5.00)	12	ND (0.2)	-	13	10.6	ND (5.00)	ND (1)	ND (2)	-	5.9 J	ND (5.0)	ND (0.5)	ND (1.00)	5.3	ND (1.0)
NAPHTHALENE	µg/L	100	-	-	-	-	90.3 J	-	-	-	-	-	***271***	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (25.0)	130	ND (10)	-	84 J	-	130	130	130 J	-	170 J	ND (2,500)	-	-	170	ND (50)
TOLUENE	µg/L	1,000	267	61.0	240	44	319	260	504	325	450	510	360	320	270	ND (0.5)	ND (1.00)	ND (1.0)	ND (1.0)
1,2,4-TRIMETHYLBENZENE	µg/L	62	***405***	***284***	***89***	***170***	-	***93***	***898***	***722***	***890***	***940***	-	***510***	***570***	ND (0.5)	ND (1.00)	ND (5.0)	ND (5.0)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	194	129	77	120	-	110	337	289	320	330	-	190	220	ND (0.5)	ND (1.00)	ND (5.0)	ND (5.0)
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	873	494	410	350	384	600	1,520	1,270	1,300	1,700	660	730	730	ND (0.5)	ND (3.00)	ND (6.0)	ND (6.0)
Volatile Organic Compounds (SW8011)																			
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	ND (0.0100)	ND (0.0095)	ND (0.0095)	-	ND (0.029)	-	ND (0.0100)	ND (0.0095)	ND (0.0094)	-	ND (0.029)	ND (0.029)	ND (0.0097)	ND (0.0100)	ND (0.029)	ND (0.028)
Semi-Volatile Organic Compounds																			
ANTHRACENE	µg/L	66	-	-	ND (0.1)	ND (0.1)	-	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)	ND (0.1)	ND (0.0500)	ND (0.51)	ND (0.50)
BENZO(A)ANTHRACENE	µg/L	4.9	-	-	ND (0.1)	ND (0.1)	-	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)	0.2 J	ND (0.0500)	ND (0.51)	ND (0.50)
BENZO(A)PYRENE	µg/L	0.2	-	-	ND (0.1)	ND (0.1)	-	*ND (0.50)*	-	-	ND (0.1)	ND (0.1)	-	*ND (0.51)*	*ND (0.52)*	0.2 J	ND (0.0500)	*ND (0.51)*	*ND (0.50)*
BENZO(B)FLUORANTHENE	µg/L	1.2	-	-	ND (0.1)	ND (0.1)	-	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)	0.3 J	ND (0.0500)	ND (0.51)	ND (0.50)
BENZO(G,H,I)PERYLENE	µg/L	0.26	-	-	ND (0.1)	ND (0.1)	-	*ND (0.50)*	-	-	ND (0.1)	ND (0.1)	-	*ND (0.51)*	*ND (0.52)*	0.2 J	ND (0.0500)	*ND (0.51)*	*ND (0.50)*
CHRYSENE	µg/L	1.9	-	-	ND (0.1)	ND (0.1)	-	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)	0.3 J	ND (0.0500)	ND (0.51)	ND (0.50)
FLUORENE	µg/L	1,900	-	-	ND (0.1)	ND (0.1)	-	ND (0.50)	-	-	0.1 J	ND (0.1)	-	ND (0.51)	0.13 J	ND (0.1)	ND (0.0500)	ND (0.51)	ND (0.50)
NAPHTHALENE	µg/L	100	-	-	33	34	-	44	-	-	***320***	***330***	-	***130***	***220***	ND (0.1)	ND (0.250)	ND (0.51)	ND (0.50)
PHENANTHRENE	µg/L	1,100	-	-	ND (0.1)	ND (0.1)	-	ND (0.50)	-	-	0.2 J	ND (0.1)	-	ND (0.51)	ND (0.52)	0.3 J	ND (0.0500)	ND (0.51)	ND (0.50)
PYRENE	µg/L	130	-	-	ND (0.1)	ND (0.1)	-	ND (0.50)	-	-	ND (0.1)	ND (0.1)	-	ND (0.51)	ND (0.52)	0.4 J	0.0625	ND (0.51)	ND (0.50)
Metals																			
LEAD, Dissolved	µg/L	5	-	-	ND (1.1)	0.073 J	-	ND (0.52)	-	-	ND (1.1)	ND (0.071)	-	ND (0.52)	ND (0.52)	0.16 J	ND (2.00)	0.29 J	ND (0.52)
Petroleum Hydrocarbons																			
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	11,000	-	-	-	-	-	21,000	-	-	-	-	-

See notes on last page.

Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location	Units	MSC-PA	S-441		S-442		S-443		S-444		S-445		S-446			S-447		S-448	
Sample Date			31-Aug-20	5-May-21	31-Aug-20	5-May-21	31-Aug-20	5-May-21	31-Aug-20	6-May-21	1-Sep-20	5-May-21	1-Sep-20	1-Sep-20	5-May-21	1-Sep-20	3-May-21	2-Sep-20	6-May-21
Sample ID			S-441_20200831	S-441_20210505	S-442_20200831	S-442_20210505	S-443_20200831	S-443_20210505	S-444_20200831	S-444_20210506	S-445_20200901	S-445_20210505	DUP-1	S-446_20200901	S-446_20210505	S-447_20200901	S-447_20210503	S-448_20200902	S-448_20210506
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-12585-1	410-38735-1	410-12585-1	410-38735-1	410-12585-1	410-38735-1	410-12585-1	410-39001-1	410-12585-1	410-38735-1	410-12585-1	410-12585-1	410-38735-1	410-12761-1	410-38315-1	410-12761-1	410-39001-1
Laboratory Sample ID			410-12585-3	410-38735-12	410-12585-4	410-38735-2	410-12585-5	410-38735-10	410-12585-6	410-39001-1	410-12585-7	410-38735-7	410-12585-9	410-12585-8	410-38735-4	410-12761-3	410-38315-4	410-12761-5	410-39001-6
Hydrostratigraphic Unit	Units	MSC-PA	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Field Parameters																			
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0.35	2.76	0.29	2.44	0.25	1.86	0.4	7.34	0.46	6.14	-	0.41	5.94	0.42	7.72	0.42	0.58
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-194	-200	-163	-161	-148	-170	-163	-164	-194	-284	-	-124	-153	-168	-182	-142	-134
pH, FIELD MEASURED	S.U.	n/v	7.34	7.44	7.3	7.2	6.93	7.24	7	7.23	9.66	8.82	-	6.65	7.26	7.18	7.18	6.99	7.04
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	5.55	5.16	3.43	3.76	3.04	3.51	0.422	0.414	1.85	1.14	-	0.485	0.468	0.917	0.762	1.51	1.52
TEMPERATURE, FIELD MEASURED	deg c	n/v	17.2	16.29	17.03	14.93	16.23	14.47	16.22	14.84	16.8	14.47	-	16.01	13.88	19.01	15.88	18.13	12.76
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TURBIDITY	NTU	n/v	9.2	0	28.4	0	41.2	0	17.2	0	594	14	-	24.9	0	318	8	29.1	1.6
Volatile Organic Compounds																			
BENZENE	µg/L	5	***420***	***360***	***1,100***	***1,100***	***450***	***130***	***6.9***	***5.6***	***500***	***410***	ND (5.0)	ND (5.0)	1.2 J	***100***	***220***	0.23 J	3.5
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (5.0)	2.0 J	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)
ETHYLBENZENE	µg/L	700	19	23	66	18	180	31	320	540	68	49	170	180	170	500	310	6.7	ND (1.0)
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	24 J	19 J	17 J	15 J	11 J	7.3 J	67	50	28	22 J	54	59	49	26	15 J	1.7 J	ND (5.0)
METHYL TERTIARY BUTYL ETHER	µg/L	20	6.9	6.0	14	13	11	11	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	3.0	2.9
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (50)	ND (50)
TOLUENE	µg/L	1,000	120	120	62	21	250	7.3	110	150	130	100	59	66	81	950	450	0.47 J	ND (1.0)
1,2,4-TRIMETHYLBENZENE	µg/L	62	41	22 J	***140***	34	***430***	***190***	28	24 J	20 J	14 J	5.3 J	5.8 J	ND (25)	***150***	***120***	1.7 J	ND (5.0)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	28	17 J	65	ND (25)	150	4.0 J	30	25	12 J	8.1 J	8.7 J	9.9 J	3.3 J	47	40	3.3 J	ND (5.0)
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	180	150	310	20 J	1,000	18 J	230	360	110	90	180	200	190	1,700	710	5.2 J	ND (6.0)
Volatile Organic Compounds (SW8011)																			
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.029)	ND (0.028)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.028)
Semi-Volatile Organic Compounds																			
ANTHRACENE	µg/L	66	ND (0.51)	ND (0.53)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.51)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.52)	ND (0.50)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.51)	0.14 J	ND (0.52)
BENZO(A)ANTHRACENE	µg/L	4.9	ND (0.51)	ND (0.53)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.51)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.52)	ND (0.50)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.52)
BENZO(A)PYRENE	µg/L	0.2	*ND (0.51)*	*ND (0.53)*	*ND (0.51)*	*ND (0.52)*	*ND (0.50)*	*ND (0.51)*	*ND (0.51)*	*ND (0.52)*	*ND (0.50)*	*ND (0.52)*	*ND (0.50)*	*ND (0.50)*	*ND (0.51)*	*ND (0.50)*	*ND (0.51)*	*ND (0.50)*	*ND (0.52)*
BENZO(B)FLUORANTHENE	µg/L	1.2	ND (0.51)	ND (0.53)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.51)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.52)	ND (0.50)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.52)
BENZO(G,H,I)PERYLENE	µg/L	0.26	*ND (0.51)*	*ND (0.53)*	*ND (0.51)*	*ND (0.52)*	*ND (0.50)*	*ND (0.51)*	*ND (0.51)*	*ND (0.52)*	*ND (0.50)*	*ND (0.52)*	*ND (0.50)*	*ND (0.50)*	*ND (0.51)*	*ND (0.50)*	*ND (0.51)*	*ND (0.50)*	*ND (0.52)*
CHRYSENE	µg/L	1.9	ND (0.51)	ND (0.53)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.51)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.52)	ND (0.50)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.52)
FLUORENE	µg/L	1,900	ND (0.51)	ND (0.53)	ND (0.51)	ND (0.52)	0.14 J	ND (0.51)	0.12 J	0.16 J	ND (0.50)	ND (0.52)	0.29 J	0.28 J	0.22 J	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.52)
NAPHTHALENE	µg/L	100	3.8	4.8	14	1.6	61	6.7	33	85	24	17	56	54	53	84	31	1.2	ND (0.52)
PHENANTHRENE	µg/L	1,100	ND (0.51)	ND (0.53)	0.12 J	ND (0.52)	0.14 J	ND (0.51)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.52)	ND (0.50)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.51)	0.26 J	ND (0.52)
PYRENE	µg/L	130	ND (0.51)	ND (0.53)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.51)	ND (0.51)	ND (0.52)	ND (0.50)	ND (0.52)	ND (0.50)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.51)	ND (0.50)	ND (0.52)
Metals																			
LEAD, Dissolved	µg/L	5	ND (0.52)	ND (0.52)	0.16 J	ND (0.52)	ND (0.52)	ND (0.52)	0.25 J	ND (0.52)	0.19 J	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	1.0	ND (0.52)	ND (0.50)	ND (0.52)
Petroleum Hydrocarbons																			
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-	11,000	-	3,000	-

See notes on last page.

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Table 2-6a
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Unconfined Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Notes:

MSC-PA	Pennsylvania Department of Environmental Protection Medium-Specific Concentrations (MSCs) for Organic/Inorganic Regulated Substances in Groundwater - Used Aquifer, Non Residential, TDS ≤ 2500
6.5	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
ND (0.50)	Laboratory reporting limit was greater than the applicable standard.
ND (0.03)	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value
-	Parameter not analyzed / not available
E	Indicates compounds whose concentrations exceed the calibration range of the instrument.
H	Sample was prepped or analyzed beyond the specified holding time.
HT	Sample(s) received past/too close to holding time expiration
J	Indicates an estimated value
SL	Sample was collected below LNAPL
XQ	Indeterminate qualifier, refer to source documents for further information.
mg/L	Milligrams per liter
mV	Millivolts
S.U.	Standard Units
mS/cm	Millisiemens per centimeter
deg c	Degrees Celcius
NTU	Nephelometric Turbidity Units
µg/L	Micrograms per liter

Table 2-6b
Groundwater Analytical Results Summary and Field Parameters Summary (2017 - 2021)
Lower Aquifer
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-38D2			S-39D						S-218D					S-449	
Sample Date			20-Jun-19	28-Oct-19	30-Apr-21	28-Jun-18	28-Jun-18	20-Jun-19	29-Oct-19	29-Oct-19	7-May-21	28-Jun-18	28-Jun-18	26-Jun-19	29-Oct-19	30-Apr-21	2-Sep-20	6-May-21
Sample ID			S-38D2_20190620	S-38D2_20191028	S-38D2_20210430	S-39D_20180628	S-39D-HS_20180628	S-39D_20190620	S-39D_20191029	DUP-2_20191029	S-39D_20210507	S-218D_20180628	S-218D-HS_20180628	S-218D_20190626	S-218D_20191029	S-218D_20210430	S-449_20200902	S-449_20210506
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	ESC	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER	ESC	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			2050556	2072152	410-38134-1	L1006118	L1006118	2050556	2072152	2072152	410-39177-1	L1006118	L1006118	2051366	2072152	410-38134-1	410-12761-1	410-39001-1
Laboratory Sample ID			1088323	1189910	410-38134-9	L1006118-07	L1006118-06	1088322	1189911	1189914	410-39177-10	L1006118-09	L1006118-08	1091964	1189912	410-38134-8	410-12761-6	410-39001-5
Hydrostratigraphic Unit	Units	MSC-PA	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer
Field Parameters																		
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0.55	0	5.25	0.3	-	0.57	0	-	0.46	0	-	0	0	1.51	0.6	6.15
OXIDATION REDUCTION POTENTIAL, FIELD MEASU	mV	n/v	9	-26	-37	-65	-	-44	25	-	-7	-34	-	9	15	-5	-152	-179
pH, FIELD MEASURED	S.U.	n/v	6.07	6.25	6.37	6.54	-	6.43	6.11	-	6.48	6.46	-	6.46	6.34	6.87	7.13	7.6
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.587	0.558	0.597	1.05	-	1.02	1.24	-	1.31	0.694	-	0.762	0.743	0.805	0.818	0.986
TEMPERATURE, FIELD MEASURED	deg c	n/v	17.8	17.79	15.51	19.34	-	17.81	16.00	-	16.41	18.62	-	14.94	16.23	15.46	16.86	14.03
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	0.376	0.357	-	-	-	0.671	0.794	-	-	-	-	0.459	0.476	-	-	-
TURBIDITY	NTU	n/v	0	284	290	62.3	-	0	0	-	0	50.2	-	5.5	0	0	490	50.1
Volatile Organic Compounds																		
BENZENE	µg/L	5	ND (0.2)	1	ND (1.0)	-	-	0.2 J	ND (0.2)	ND (0.2)	0.69 J	-	-	ND (0.2)	ND (0.2)	ND (1.0)	***3,400***	***3,700***
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (2)	ND (2)	1.3	-	-	ND (2)	ND (2)	ND (2)	ND (1.0)	-	-	ND (2)	ND (2)	ND (1.0)	*ND (10)*	ND (5.0)
ETHYLBENZENE	µg/L	700	ND (0.2)	ND (0.2)	ND (1.0)	-	-	ND (0.2)	ND (0.2)	ND (0.2)	ND (1.0)	-	-	ND (0.2)	ND (0.2)	ND (1.0)	43	30
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	ND (0.3)	ND (0.3)	ND (5.0)	-	-	ND (0.3)	ND (0.3)	ND (0.3)	ND (5.0)	-	-	ND (0.3)	ND (0.3)	ND (5.0)	32 J	37
METHYL TERTIARY BUTYL ETHER	µg/L	20	ND (0.2)	ND (0.2)	ND (1.0)	***55.1***	***28.2***	***91***	***31***	***33***	***24***	***48.6***	***50.6***	***41***	***37***	***36***	***650***	***550***
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (10)	20 J	ND (50)	ND (5.00) OE	ND (5.00) OE	ND (10)	ND (10)	ND (10)	ND (50)	ND (5.00) OE	ND (5.00) OE	ND (10)	ND (10)	ND (50)	330 J	240 J
TOLUENE	µg/L	1,000	ND (0.2)	0.2 J	ND (1.0)	-	-	ND (0.2)	ND (0.2)	ND (0.2)	ND (1.0)	-	-	ND (0.2)	ND (0.2)	ND (1.0)	180	200
1,2,4-TRIMETHYLBENZENE	µg/L	62	ND (0.3)	ND (0.3)	ND (5.0)	-	-	ND (0.3)	ND (0.3)	ND (0.3)	ND (5.0)	-	-	ND (0.3)	ND (0.3)	ND (5.0)	12 J	9.4 J
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (0.3)	ND (0.3)	ND (5.0)	-	-	ND (0.3)	ND (0.3)	ND (0.3)	ND (5.0)	-	-	ND (0.3)	ND (0.3)	ND (5.0)	11 J	11 J
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	ND (0.5)	ND (0.8)	ND (6.0)	-	-	ND (0.5)	ND (0.8)	ND (0.8)	ND (6.0)	-	-	ND (0.5)	ND (0.8)	ND (6.0)	130	130
Volatile Organic Compounds (SW8011)																		
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.0094)	ND (0.0094)	ND (0.029)	-	-	ND (0.0094)	ND (0.0094)	ND (0.0094)	ND (0.029)	-	-	ND (0.0095)	ND (0.0094)	ND (0.029)	ND (0.029)	ND (0.029)
Semi-Volatile Organic Compounds																		
ANTHRACENE	µg/L	66	ND (0.1)	ND (0.1)	ND (0.60)	-	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.55)	-	-	ND (0.1)	ND (0.1)	ND (0.54)	0.19 J	ND (0.52)
BENZO(A)ANTHRACENE	µg/L	4.9	ND (0.1)	ND (0.1)	ND (0.60)	-	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.55)	-	-	ND (0.1)	ND (0.1)	ND (0.54)	ND (0.51)	ND (0.52)
BENZO(A)PYRENE	µg/L	0.2	ND (0.1)	ND (0.1)	*ND (0.60)*	-	-	ND (0.1)	ND (0.1)	ND (0.1)	*ND (0.55)*	-	-	ND (0.1)	ND (0.1)	*ND (0.54)*	*ND (0.51)*	*ND (0.52)*
BENZO(B)FLUORANTHENE	µg/L	1.2	ND (0.1)	ND (0.1)	ND (0.60)	-	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.55)	-	-	ND (0.1)	ND (0.1)	ND (0.54)	ND (0.51)	ND (0.52)
BENZO(G,H,I)PERYLENE	µg/L	0.26	ND (0.1)	ND (0.1)	*ND (0.60)*	-	-	ND (0.1)	ND (0.1)	ND (0.1)	*ND (0.55)*	-	-	ND (0.1)	ND (0.1)	*ND (0.54)*	*ND (0.51)*	*ND (0.52)*
CHRYSENE	µg/L	1.9	ND (0.1)	ND (0.1)	ND (0.60)	-	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.55)	-	-	ND (0.1)	ND (0.1)	ND (0.54)	ND (0.51)	ND (0.52)
FLUORENE	µg/L	1,900	ND (0.1)	ND (0.1)	ND (0.60)	-	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.55)	-	-	ND (0.1)	ND (0.1)	ND (0.54)	ND (0.51)	ND (0.52)
NAPHTHALENE	µg/L	100	ND (0.1)	ND (0.1)	ND (0.60)	-	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.55)	-	-	ND (0.1)	ND (0.1)	ND (0.54)	4.6	2.5
PHENANTHRENE	µg/L	1,100	ND (0.1)	ND (0.1)	0.17 J	-	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.55)	-	-	ND (0.1)	ND (0.1)	ND (0.54)	0.49 J	ND (0.52)
PYRENE	µg/L	130	ND (0.1)	ND (0.1)	ND (0.60)	-	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.55)	-	-	ND (0.1)	ND (0.1)	ND (0.54)	0.31 J	0.15 J
Metals																		
LEAD, Dissolved	µg/L	5	ND (1.1)	0.081 J	0.18 J	-	-	ND (1.1)	ND (0.071)	ND (0.071)	ND (0.52)	-	-	ND (1.1)	ND (0.071)	ND (0.52)	ND (0.50)	ND (0.52)
Petroleum Hydrocarbons																		
>C12-C22	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,000	-
>C22-C44	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-	-	350	-
C4-C12 GRO	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13,000	-

Notes:

MSC-PA	Pennsylvania Department of Environmental Protection
	Medium-Specific Concentrations (MSCs) for Organic/Inorganic Regulated Substances in Groundwater - Used Aquifer, Non Residential, TDS ≤ 2500
6.5	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
ND (0.50)	Laboratory reporting limit was greater than the applicable standard.
ND (0.03)	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value
-	Parameter not analyzed / not available
J	Indicates an estimated value
OE	The associated batch QC was outside the established quality control range for precision/accuracy.
mg/L	Milligrams per liter
mV	Millivolts
S.U.	Standard Units
mS/cm	Millisiemens per centimeter
deg c	Degrees Celcius
NTU	Nephelometric Turbidity Units
µg/L	Micrograms per liter

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Table 2-6c - Groundwater Analytical Results Summary and Field Parameter Summary (2017 - 2021)
Select Lower Aquifer Wells Outside of Area of Interest 4
Former Philadelphia Refinery, a series of Evergreen Resources Group, LLC

Sample Location			A-19D			ARCO-1D							FDR-DW-15		
Sample Date			28-Jun-19	30-Oct-19	29-Apr-21	25-Jun-18	3-Jul-19	3-Jul-19	1-Nov-19	1-Nov-19	7-May-21	7-May-21	16-May-17	19-Jun-18	11-Dec-19
Sample ID			A-19D_20190628	A-19D_20191030	A-19D_20210429	ARCO_1D_20180625	ARCO-1D_20190703	DUP-6_20190703	ARCO-1D_20191101	DUP-3_20191101	ARCO-1D_20210507	DUP-7_20210507	FDR-DW-15_05-16-2017	FDR-DW-15	FDR-DW-15_20191211
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	ARCADIS U.S., INC	UNKNOWN	UNKNOWN
Laboratory			LANCASTER	LANCASTER	LANCASTER	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	UNKNOWN	UNKNOWN	UNKNOWN
Laboratory Work Order			2051366	2072376	410-37993-1	L1004864	2052178	2052178	2073111	2073111	410-39177-1	410-39177-1	20170731EZ	EZ_DSCP_2018_GWS	EZ_DSCP_2019Q4
Laboratory Sample ID			1091972	1190930	410-37993-7	L1004864-08	1095561	1095562	1194619	1194623	410-39177-2	410-39177-3	UNKNOWN	UNKNOWN	UNKNOWN
Hydrostratigraphic Unit	Units	MSC-PA	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer
Field Parameters															
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0	0	0	0	2.06	-	0.00	-	2.19	-	-	-	-
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-82	-94	-165	12	-17	-	-85	-	-42	-	-	-	-
pH, FIELD MEASURED	S.U.	n/v	6.01	6.45	6.98	6.41	5.89	-	6.15	-	6.61	-	-	-	-
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.465	0.469	0.474	0.855	1.12	-	0.980	-	1.13	-	-	-	-
TEMPERATURE, FIELD MEASURED	deg c	n/v	16.03	17.02	14.65	16.42	15.01	-	15.14	-	13.56	-	-	-	-
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	0.299	0.305	-	-	0.723	-	0.623	-	-	-	-	-	-
TURBIDITY	NTU	n/v	6.9	0	3.9	80.9	161	-	0.2	-	25.7	-	-	-	-
Volatile Organic Compounds															
BENZENE	µg/L	5	ND (0.2)	ND (0.2)	0.53 J	**276**	3	3	**200**	**190**	**150**	**170**	ND (0.25)	ND (0.25)	ND (0.45)
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	ND (0.0099)	ND (0.01)	ND (0.01)
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (2)	ND (2)	ND (1.0)	ND (1.00)	ND (2)	ND (2)	ND (2)	ND (2)	ND (1.0)	ND (1.0)	ND (0.5)	ND (0.5)	ND (0.75)
ETHYLBENZENE	µg/L	700	ND (0.2)	ND (0.2)	ND (1.0)	ND (1.00)	ND (0.2)	ND (0.2)	0.2 J	0.2 J	ND (1.0)	ND (1.0)	ND (0.5)	ND (0.5)	ND (0.75)
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	ND (0.3)	ND (0.3)	0.31 J	1.61	ND (0.3)	ND (0.3)	1 J	2 J	0.76 J	0.89 J	ND (0.5)	ND (0.5)	ND (0.75)
METHYL TERTIARY BUTYL ETHER	µg/L	20	20	**58**	**44**	**30.4**	**66**	**66**	**61**	**64**	**84**	**74**	0.72 J	2	2
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	ND (2)	ND (2)	ND (3)
TERT-BUTYL ALCOHOL	µg/L	n/v	330	560	590	-	ND (10)	ND (10)	13 J	12 J	ND (50)	ND (50)	ND (5)	ND (7.5)	ND (7.5)
TOLUENE	µg/L	1,000	ND (0.2)	ND (0.2)	ND (1.0)	1.22	ND (0.2)	ND (0.2)	0.7 J	0.7 J	0.62 J	0.74 J	12.1	ND (0.5)	ND (0.75)
1,2,4-TRIMETHYLBENZENE	µg/L	62	ND (0.3)	ND (0.3)	ND (5.0)	ND (1.00)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (5.0)	ND (5.0)	ND (1)	ND (1)	ND (1.5)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (0.3)	ND (0.3)	ND (5.0)	ND (1.00)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (5.0)	ND (5.0)	ND (0.5)	ND (0.5)	ND (1.5)
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	ND (0.5)	ND (0.8)	ND (6.0)	ND (3.00)	ND (0.5)	ND (0.5)	ND (0.8)	1 J	ND (6.0)	ND (6.0)	ND (0.5)	ND (0.5)	ND (0.75)
Volatile Organic Compounds (SW8011)															
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.0095)	ND (0.0095)	ND (0.030)	ND (0.0100)	ND (0.0094)	ND (0.0094)	ND (0.0095)	ND (0.0094)	ND (0.029)	ND (0.028)	-	-	-
Semi-Volatile Organic Compounds															
ANTHRACENE	µg/L	66	ND (0.09)	ND (0.1)	ND (0.50)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.51)	-	-	-
BENZO(A)ANTHRACENE	µg/L	4.9	ND (0.09)	ND (0.1)	ND (0.50)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.51)	-	-	-
BENZO(A)PYRENE	µg/L	0.2	ND (0.09)	ND (0.1)	*ND (0.50)*	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	*ND (0.53)*	*ND (0.51)*	-	-	-
BENZO(B)FLUORANTHENE	µg/L	1.2	ND (0.09)	ND (0.1)	ND (0.50)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.51)	-	-	-
BENZO(G,H,I)PERYLENE	µg/L	0.26	ND (0.09)	ND (0.1)	*ND (0.50)*	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	*ND (0.53)*	*ND (0.51)*	-	-	-
CHRYSENE	µg/L	1.9	ND (0.09)	ND (0.1)	ND (0.50)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.51)	-	-	-
FLUORENE	µg/L	1,900	ND (0.09)	ND (0.1)	ND (0.50)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.51)	-	-	-
NAPHTHALENE	µg/L	100	ND (0.09)	ND (0.1)	ND (0.50)	ND (0.250)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.51)	-	-	-
PHENANTHRENE	µg/L	1,100	ND (0.09)	ND (0.1)	ND (0.50)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.51)	-	-	-
PYRENE	µg/L	130	ND (0.09)	ND (0.1)	ND (0.50)	ND (0.0500)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.53)	ND (0.51)	-	-	-
Metals															
LEAD, Dissolved	µg/L	5	ND (1.1)	ND (0.071)	ND (0.52)	ND (2.00)	ND (1.1)	ND (1.1)	0.073 J	0.095 JB	ND (0.52)	ND (0.52)	ND (2)	ND (2)	ND (2)
LEAD, Total	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	268	179
Petroleum Hydrocarbons															
ETHANOL	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-	ND (75)	ND (50)

See notes on last page.

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Table 2-6c - Groundwater Analytical Results Summary and Field Parameter Summary (2017 - 2021)
Select Lower Aquifer Wells Outside of Area of Interest 4
Former Philadelphia Refinery, a series of Evergreen Resources Group, LLC

Sample Location			NOVA-DW-14			PH-DW-2		PH-DW-3			S-13					
Sample Date			16-May-17	19-Jun-18	11-Dec-19	11-May-17	4-Dec-19	10-May-17	19-Jun-18	4-Dec-19	25-Sep-18	31-Oct-18	19-Jun-19	28-Oct-19	26-Apr-21	26-Apr-21
Sample ID			NOVA-DW-14_05-16-2017	NOVA-DW-14	NOVA-DW-14_20191211	PH-DW-2_05-11-2017	PH-DW-2_20191204	PH-DW-3_05-10-2017	PH-DW-3	PH-DW-3_20191204	S-13_20180925	S-13_20181031	S-13_20190619	S-13_20191028	S-13_20210426	DUP-3_20210426
Sampling Company			ARCADIS U.S., INC	UNKNOWN	UNKNOWN	ARCADIS U.S., INC	UNKNOWN	ARCADIS U.S., INC	UNKNOWN	UNKNOWN	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			20170731EZ	EZ_DSCP_2018_GWS	EZ_DSCP_2019Q4	20170731EZ	EZ_DSCP_2019Q4	20170731EZ	EZ_DSCP_2018_GWS	EZ_DSCP_2019Q4	1991572	2004864	2050556	2072152	410-37461-1	410-37461-1
Laboratory Sample ID			UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	9822544	9879537	1088324	1189897	410-37461-1	410-37461-2
Hydrostratigraphic Unit	Units	MSC-PA	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer
Field Parameters																
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	-	-	-	-	-	-	-	-	0	1.19	0	1.97	0.54	-
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	-	-	-	-	-	-	-	-	247	161	109	129	94	-
pH, FIELD MEASURED	S.U.	n/v	-	-	-	-	-	-	-	-	5.26	5.23	5.41	5.48	5.6	-
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	-	-	-	-	-	-	-	-	0.402	0.501	0.433	0.488	0.509	-
TEMPERATURE, FIELD MEASURED	deg c	n/v	-	-	-	-	-	-	-	-	15.58	15.95	13.82	16.16	13.01	-
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	-	-	-	-	-	-	-	-	-	-	0.282	-	-	-
TURBIDITY	NTU	n/v	-	-	-	-	-	-	-	-	59.4	0	14	0	269	-
Volatile Organic Compounds																
BENZENE	µg/L	5	ND (0.25)	ND (0.25)	ND (0.45)	***311***	ND (0.45)	***8,370***	***6,990***	***2,580***	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	1.9	2.0
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.0098)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.0096)	ND (0.01)	ND (0.01)	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (0.5)	ND (0.5)	ND (0.75)	ND (0.5)	ND (0.75)	*ND (10)*	*ND (25)*	ND (0.75)	-	-	ND (2)	ND (2)	ND (1.0)	ND (1.0)
ETHYLBENZENE	µg/L	700	ND (0.5)	ND (0.5)	ND (0.75)	ND (0.5)	ND (0.75)	14.2 J	20 J	3.1	-	-	ND (0.2)	ND (0.2)	ND (1.0)	ND (1.0)
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	ND (0.5)	ND (0.5)	ND (0.75)	1.3	ND (0.75)	14 J	ND (25)	3.4	-	-	ND (0.3)	ND (0.3)	ND (5.0)	ND (5.0)
METHYL TERTIARY BUTYL ETHER	µg/L	20	0.7 J	1	0.65 J	13.5	ND (0.75)	***33.9***	***26.5 J***	14.4	***240***	***120***	***400***	***220***	***180***	***200***
NAPHTHALENE	µg/L	100	ND (2)	ND (2)	ND (3)	ND (2)	ND (3)	ND (40)	ND (100)	ND (3)	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (5)	ND (7.5)	ND (7.5)	27	ND (7.5)	637	ND (380)	97.7	1,500 E	1,100	1,200 E	990	1,200 E	1,300 E
TOLUENE	µg/L	1,000	3.4	ND (0.5)	ND (0.75)	1.5	ND (0.75)	44.4	43.7 J	9.4	-	-	ND (0.2)	ND (0.2)	ND (1.0)	0.22 J
1,2,4-TRIMETHYLBENZENE	µg/L	62	ND (1)	ND (1)	ND (1.5)	ND (1)	ND (1.5)	ND (20)	ND (50)	ND (1.5)	-	-	ND (0.3)	ND (0.3)	ND (5.0)	ND (5.0)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (0.5)	ND (0.5)	ND (1.5)	ND (0.5)	ND (1.5)	ND (10)	ND (25)	ND (1.5)	-	-	ND (0.3)	ND (0.3)	ND (5.0)	ND (5.0)
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	ND (0.5)	ND (0.5)	ND (0.75)	0.97 J	ND (0.75)	57.2	60.4	10.8	-	-	ND (0.5)	ND (0.8)	ND (6.0)	ND (6.0)
Volatile Organic Compounds (SW8011)																
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	-	-	-	-	-	-	-	-	ND (0.0094)	ND (0.0094) XQ	ND (0.030)	ND (0.029)
Semi-Volatile Organic Compounds																
ANTHRACENE	µg/L	66	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	ND (0.58)	ND (0.52)
BENZO(A)ANTHRACENE	µg/L	4.9	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	ND (0.58)	ND (0.52)
BENZO(A)PYRENE	µg/L	0.2	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	*ND (0.58)*	*ND (0.52)*
BENZO(B)FLUORANTHENE	µg/L	1.2	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	ND (0.58)	ND (0.52)
BENZO(G,H,I)PERYLENE	µg/L	0.26	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	*ND (0.58)*	*ND (0.52)*
CHRYSENE	µg/L	1.9	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	ND (0.58)	ND (0.52)
FLUORENE	µg/L	1,900	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	ND (0.58)	ND (0.52)
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	ND (0.58)	ND (0.52)
PHENANTHRENE	µg/L	1,100	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	ND (0.58)	ND (0.52)
PYRENE	µg/L	130	-	-	-	-	-	-	-	-	-	-	ND (0.1)	ND (0.1)	ND (0.58)	ND (0.52)
Metals																
LEAD, Dissolved	µg/L	5	ND (2)	ND (2)	ND (2)	ND	ND (2)	ND (2)	ND (2)	ND (2)	-	-	ND (1.1)	0.57	0.15 J	0.088 J
LEAD, Total	µg/L	n/v	-	0.67 J	0.64 J	-	-	-	1.1 J	-	-	-	-	-	-	-
Petroleum Hydrocarbons																
ETHANOL	µg/L	n/v	-	ND (75)	ND (50)	-	-	-	ND (75)	-	-	-	-	-	-	-

See notes on last page.

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Table 2-6c - Groundwater Analytical Results Summary and Field Parameter Summary (2017 - 2021)
Select Lower Aquifer Wells Outside of Area of Interest 4
Former Philadelphia Refinery, a series of Evergreen Resources Group, LLC

Sample Location			S-22		S-284D					S-399			
Sample Date			9-Jul-19	18-Nov-19	26-Feb-19	19-Jun-19	28-Oct-19	1-Sep-20	23-Apr-21	19-Jun-18	17-Jun-19	28-Oct-19	29-Apr-21
Sample ID			S-22_20190709	S-22_20191118	S-284D_20190226	S-284D_20190619	S-284D_20191028	S-284D_20200901	S-284D_20210423	S-399_20180619	S-399_20190617	S-399_20191028	S-399_20210429
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	ESC	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			2052789	2075960	2031387	2050556	2072152	410-12818-1	410-37313-1	L1003320	2049839	2072152	410-37993-1
Laboratory Sample ID			1097911	1208190	9995293	1088325	1189898	410-12818-2	410-37313-4	L1003320-04	1084927	1189909	410-37993-11
Hydrostratigraphic Unit	Units	MSC-PA	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer	lower aquifer
Field Parameters													
DISSOLVED OXYGEN, FIELD MEASURED	mg/L	n/v	0.71	0.00	2.26	0	2.30	0.87	0	0.16	0.69	0	2.24
OXIDATION REDUCTION POTENTIAL, FIELD MEASURED	mV	n/v	141	73	-45	13	-44	-	58	-55	-113	-37	-27
pH, FIELD MEASURED	S.U.	n/v	6.42	6.48	12.58	6.39	8.24	8.9	5.51	6.85	6.54	6.85	6.95
SPECIFIC CONDUCTANCE FIELD	mS/cm	n/v	0.245	0.332	2.41	1.16	1.32	0.735	1.16	0.462	0.598	0.612	0.612
TEMPERATURE, FIELD MEASURED	deg c	n/v	20.34	11.29	11.89	15.33	17.99	21.62	16.48	20.08	19.94	18.59	16.48
TOTAL DISSOLVED SOLIDS, FIELD MEASURED	mg/L	n/v	0.159	0.216	-	0.749	-	-	-	-	0.383	0.398	-
TURBIDITY	NTU	n/v	13.2	0.0	64.3	20.3	0	0	18.7	112	248	0	168
Volatile Organic Compounds													
BENZENE	µg/L	5	ND (0.2)	ND (0.2)	0.3 J	ND (0.2)	0.3 J	ND (1.0)	***10***	ND (1.00)	0.4 J	0.4 J	***6.4***
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	-	-	*ND (0.3)*	-	-	*ND (1.0)*	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	5	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (1.0)	ND (1.0)	ND (1.00)	ND (2)	ND (2)	ND (1.0)
ETHYLBENZENE	µg/L	700	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (1.0)	0.55 J	ND (1.00)	ND (0.2)	ND (0.2)	0.83 J
ISOPROPYLBENZENE (CUMENE)	µg/L	3,500	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (5.0)	ND (5.0)	ND (1.00)	0.6 J	0.9 J	0.23 J
METHYL TERTIARY BUTYL ETHER	µg/L	20	ND (0.2)	ND (0.2)	ND (0.2)	0.6 J	ND (0.2)	ND (1.0)	1.3	***22.9***	19	***22***	6.9
NAPHTHALENE	µg/L	100	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (10)	ND (10)	-	ND (10)	ND (10)	-	ND (50)	2,620	1,600	2,200 E	600
TOLUENE	µg/L	1,000	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (1.0)	4.2	ND (1.00)	0.2 J	0.3 J	3.4
1,2,4-TRIMETHYLBENZENE	µg/L	62	ND (0.3)	ND (0.3)	-	ND (0.3)	ND (0.3)	-	1.1 J	ND (1.00)	ND (0.3)	ND (0.3)	ND (5.0)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (0.3)	ND (0.3)	-	ND (0.3)	1 J	-	0.43 J	ND (1.00)	ND (0.3)	ND (0.3)	0.31 J
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	10,000	ND (0.5)	ND (0.8)	ND (0.5)	ND (0.5)	ND (0.8)	ND (6.0)	6.0	ND (3.00)	ND (0.5)	ND (0.8)	4.7 J
Volatile Organic Compounds (SW8011)													
1,2-DIBROMOETHANE (EDB)	µg/L	0.05	ND (0.0095)	ND (0.0094)	-	ND (0.0095)	ND (0.0094) XQ	-	ND (0.029)	ND (0.0100)	ND (0.0095)	ND (0.0094)	ND (0.029)
Semi-Volatile Organic Compounds													
ANTHRACENE	µg/L	66	ND (0.1)	ND (0.1)	-	ND (0.1)	ND (0.1)	-	ND (0.57)	0.0654	ND (0.09)	0.1 J	ND (0.52)
BENZO(A)ANTHRACENE	µg/L	4.9	ND (0.1)	ND (0.1)	-	ND (0.1)	ND (0.1)	-	ND (0.57)	ND (0.0500)	ND (0.09)	ND (0.1)	ND (0.52)
BENZO(A)PYRENE	µg/L	0.2	ND (0.1)	ND (0.1)	-	ND (0.1)	ND (0.1)	-	*ND (0.57)*	ND (0.0500)	ND (0.09)	ND (0.1)	*ND (0.52)*
BENZO(B)FLUORANTHENE	µg/L	1.2	ND (0.1)	ND (0.1)	-	ND (0.1)	ND (0.1)	-	ND (0.57)	ND (0.0500)	ND (0.09)	ND (0.1)	ND (0.52)
BENZO(G,H,I)PERYLENE	µg/L	0.26	ND (0.1)	ND (0.1)	-	ND (0.1)	ND (0.1)	-	*ND (0.57)*	ND (0.0500)	ND (0.09)	ND (0.1)	*ND (0.52)*
CHRYSENE	µg/L	1.9	ND (0.1)	ND (0.1)	-	ND (0.1)	ND (0.1)	-	ND (0.57)	ND (0.0500)	ND (0.09)	ND (0.1)	ND (0.52)
FLUORENE	µg/L	1,900	ND (0.1)	ND (0.1)	-	ND (0.1)	1	-	ND (0.57)	0.119	ND (0.09)	ND (0.1)	ND (0.52)
NAPHTHALENE	µg/L	100	ND (0.1)	ND (0.1)	-	ND (0.1)	2	-	0.22 J	ND (0.250)	ND (0.09)	ND (0.1)	0.60
PHENANTHRENE	µg/L	1,100	ND (0.1)	ND (0.1)	-	ND (0.1)	2	-	ND (0.57)	0.234	0.1 J	0.6	ND (0.52)
PYRENE	µg/L	130	ND (0.1)	ND (0.1)	-	ND (0.1)	ND (0.1)	-	ND (0.57)	ND (0.0500)	ND (0.09)	ND (0.1)	ND (0.52)
Metals													
LEAD, Dissolved	µg/L	5	ND (1.1)	0.28 J	-	ND (1.1)	ND (0.071)	-	ND (0.52)	ND (2.00)	ND (1.1)	ND (0.071)	ND (0.52)
LEAD, Total	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-
Petroleum Hydrocarbons													
ETHANOL	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-

See notes on last page.

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Table 2-6c - Groundwater Analytical Results Summary and Field Parameter Summary (2017 - 2021)
Select Lower Aquifer Wells Outside of Area of Interest 4
Former Philadelphia Refinery, a series of Evergreen Resources Group, LLC

Notes:

MSC-PA	Pennsylvania Department of Environmental Protection (PADEP)
	Medium-Specific Concentrations (MSCs) for Organic/Inorganic Regulated Substances in Groundwater - Used Aquifer, Non Residential, TDS ≤ 2500
6.5	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
ND (0.50)	Laboratory reporting limit was greater than the applicable standard.
ND (0.03)	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
E	Indicates compounds whose concentrations exceed the calibration range of the instrument.
J	Indicates an estimated value
JB	Indicates an estimated value and that analyte was found in associated method blank
XQ	Indeterminate qualifier, refer to source documents for further information.
mg/L	Milligrams per liter
mV	Millivolts
S.U.	Standard Units
mS/cm	Millisiemens per centimeter
deg c	Degrees Celcius
NTU	Nephelometric Turbidity Units
µg/L	Micrograms per liter

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Table 2-7
Groundwater Analytical Results Summary – General Chemistry
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a Series of Evergreen Resources Group, LLC

Sample Location		AOI4-BH-20-01		AOI4-BH-20-02	AOI4-BH-20-03						AOI4-BH-20-04	
Sample Date		5-Aug-20	7-Aug-20	3-Aug-20	28-Jul-20	28-Jul-20	29-Jul-20	29-Jul-20	30-Jul-20	30-Jul-20	30-Jun-20	30-Jun-20
Sample ID		CD-01-W-18-20200805	CD-01-W-41.5-20200807	CD-02-25-20200803	CD-3-W-25.0-20200728	CD-3-W-25.0-20200728	CD-3-W-46.0-20200729	CD-3-W-46.0-20200729	CD-3-W-82.0-20200730	CD-3-W-82.0-20200730	CD-6B-W-45.0-20200630	CD-6B-W-45.0-20200630
Sampling Company		STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory		LANCASTER	LANCASTER	LANCASTER	LANCASTER	TAED	LANCASTER	TAED	LANCASTER	TAED	LANCASTER	TAED
Laboratory Work Order		410-9875-1	410-10068-1	410-9564-1	410-8907-1	410-8907-1	410-9021-1	410-9021-1	410-9160-1	410-9160-1	410-6241-1	410-6241-1
Laboratory Sample ID	Units	410-9875-1	410-10068-1	410-9564-1	410-8907-1	410-8907-1	410-9021-1	410-9021-1	410-9160-1	410-9160-1	410-6241-1	410-6241-1
General Chemistry												
ALKALINITY TO pH 4.5	µg/L	640,000	280,000	94,000	100,000	-	300,000	-	190,000	-	240,000	-
CHLORIDE (AS CL)	µg/L	27,000	760,000	79,000	-	65,000	-	600,000	-	46,000	-	1,300,000
ETHANE	µg/L	ND (5.0)	2.7 J	1.9 J	2.0 J	-	2.9 J	-	2.5 J	-	1.1 J	-
ETHENE	µg/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	-	ND (5.0)	-	ND (5.0)	-	ND (5.0)	-
METHANE	µg/L	16,000	8,200	300	7,100	-	3,900	-	12,000	-	5,600	-
NITROGEN, AMMONIA (AS N)	µg/L	720 J	1,000 J	ND (1,900)	ND (1,100)	-	1,300 J	-	700 J	-	1,400	-
NITROGEN, NITRATE (AS N)	µg/L	ND (500)	ND (500)	ND (2,000) H	ND (500)	-	ND (500)	-	ND (500)	-	ND (500) H	-
SULFATE (AS SO4)	µg/L	2,300 J	7,800	41,000	-	44,000	-	13,000	-	31,000	-	9,300
SULFIDE	µg/L	ND (300)	ND (300)	ND (300)	ND (300)	-	ND (300)	-	ND (300)	-	ND (300)	-
TOTAL CARBON	µg/L	-	-	-	-	-	-	-	-	-	-	-
TOTAL INORGANIC CARBON	µg/L	-	-	-	-	-	-	-	-	-	-	-
TOTAL KJELDAHL NITROGEN	µg/L	-	-	-	-	-	-	-	-	-	-	-
TOTAL ORGANIC CARBON	µg/L	-	-	-	-	-	-	-	-	-	-	-

See notes on last page.

Table 2-7
Groundwater Analytical Results Summary – General Chemistry
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a Series of Evergreen Resources Group, LLC

Sample Location		RW-701	RW-703	RW-708	RW-715	S-38		S-38D2	S-39D	S-218D	S-223	S-368
Sample Date		10-May-21	10-May-21	3-May-21	4-May-21	3-May-21	3-May-21	30-Apr-21	7-May-21	30-Apr-21	4-May-21	19-May-21
Sample ID		RW-701_20210510	RW-703_20210510	RW-708_20210503	RW-715_20210504	S-38_20210503	DUP-5_20210503	S-38D2_20210430	S-39D_20210507	S-218D_20210430	S-223_20210504	S-368_SL_20210519
Sampling Company		STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory		LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		410-39343-1	410-39343-1	410-38315-1	410-38512-1	410-38315-1	410-38315-1	410-38134-1	410-39177-1	410-38134-1	410-38512-1	410-40660-1
Laboratory Sample ID	Units	410-39343-5	410-39343-4	410-38315-7	410-38512-1	410-38315-1	410-38315-2	410-38134-9	410-39177-10	410-38134-8	410-38512-3	410-40660-2
General Chemistry												
ALKALINITY TO pH 4.5	µg/L	210,000	270,000	190,000	250,000	130,000	140,000	240,000	310,000	300,000	310,000	190,000 SL
CHLORIDE (AS CL)	µg/L	-	-	-	-	-	-	-	-	-	-	-
ETHANE	µg/L	ND (5.0)	1.0 J	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0) SL
ETHENE	µg/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0) SL
METHANE	µg/L	3,900	15,000	8,000	3,200	670	850	220	38	27	17,000	15,000 SL
NITROGEN, AMMONIA (AS N)	µg/L	-	-	-	-	-	-	-	-	-	-	-
NITROGEN, NITRATE (AS N)	µg/L	-	-	-	-	-	-	-	-	-	-	-
SULFATE (AS SO4)	µg/L	ND (5,000)	ND (5,000)	ND (5,000)	12,000	17,000	17,000	32,000	290,000	22,000	ND (5,000)	1,500 J SL
SULFIDE	µg/L	-	-	-	-	-	-	-	-	-	-	-
TOTAL CARBON	µg/L	44,000	87,000	39,000	65,000	44,000	38,000	51,000	87,000	72,000	98,000	55,000 B SL
TOTAL INORGANIC CARBON	µg/L	40,000	64,000	35,000	63,000	42,000	36,000	49,000	75,000	67,000	91,000	50,000 SL
TOTAL KJELDAHL NITROGEN	µg/L	950 J	4,300	2,000	580 J	550 J	760 J	1,500	12,000	1,400	740 J	730 J SL
TOTAL ORGANIC CARBON	µg/L	3,900	23,000	4,500	1,900	1,700	1,600	1,800	12,000	5,100	6,800	5,400 SL

See notes on last page.

Table 2-7
Groundwater Analytical Results Summary – General Chemistry
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a Series of Evergreen Resources Group, LLC

Sample Location		S-369		S-374	S-375	S-376	S-378	S-440	S-440_CD		S-441
Sample Date		10-May-21	10-May-21	4-May-21	4-May-21	12-May-21	6-May-21	12-May-21	16-Jun-20	17-Jun-20	5-May-21
Sample ID		S-369_20210510	DUP-8_20210510	S-374_20210504	S-375_20210504	S-376_SL_20210512	S-378_20210506	S-440_20210512	CD-15-W-25.0-20200616	CD-15-W-40.0-20200617	S-441_20210505
Sampling Company		STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory		LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		410-39343-1	410-39343-1	410-38512-1	410-38512-1	410-39710-1	410-39001-1	410-39710-1	410-4783-1	410-4783-1	410-38735-1
Laboratory Sample ID	Units	410-39343-1	410-39343-2	410-38512-6	410-38512-10	410-39710-4	410-39001-8	410-39710-1	410-4783-3	410-4783-4	410-38735-12
General Chemistry											
ALKALINITY TO pH 4.5	µg/L	280,000	280,000	140,000	120,000	420,000 SL	390,000	47,000	84,000	130,000	270,000
CHLORIDE (AS CL)	µg/L	-	-	-	-	-	-	-	7,400	9,900	-
ETHANE	µg/L	ND (5.0)	ND (5.0)	3.4 J	2.0 J	1.8 J SL	1.3 J	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
ETHENE	µg/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0) SL	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
METHANE	µg/L	23,000	21,000	24,000	19,000	16,000 SL	24,000	5.4	6.5	47	16,000
NITROGEN, AMMONIA (AS N)	µg/L	-	-	-	-	-	-	-	830 J	870 J	-
NITROGEN, NITRATE (AS N)	µg/L	-	-	-	-	-	-	-	ND (500) H	ND (500)	-
SULFATE (AS SO4)	µg/L	ND (5,000)	ND (5,000)	2,000 J	ND (5,000)	16,000 SL	ND (5,000)	9,100	3,300 J	5,500	ND (5,000)
SULFIDE	µg/L	-	-	-	-	-	-	-	ND (300)	ND (300)	-
TOTAL CARBON	µg/L	91,000	83,000	61,000	55,000	110,000 SL	97,000	23,000	-	-	63,000
TOTAL INORGANIC CARBON	µg/L	78,000	70,000	55,000	46,000	100,000 SL	85,000	22,000	-	-	54,000
TOTAL KJELDAHL NITROGEN	µg/L	1,600	1,600	530 J	ND (1,000)	ND (1,000) SL	1,400	ND (1,000)	-	-	630 J
TOTAL ORGANIC CARBON	µg/L	13,000	13,000	6,000	9,200	10,000 SL	12,000	970 J	-	-	8,800

See notes on last page.

Table 2-7
Groundwater Analytical Results Summary – General Chemistry
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a Series of Evergreen Resources Group, LLC

Sample Location		**S-441_CD**				**S-442**	**S-442_CD**				**S-443**
Sample Date		**22-Jul-20**	**22-Jul-20**	**23-Jul-20**	**23-Jul-20**	**5-May-21**	**14-Jul-20**	**14-Jul-20**	**15-Jul-20**	**15-Jul-20**	**5-May-21**
Sample ID		**CD-6A-W-19.0-20200722**	**CD-6A-W-19.0-20200722**	**CD-6A-W-44.0-20200723**	**CD-6A-W-44.0-20200723**	**S-442_20210505**	**CD-5-W-20.0-202007**	**CD-5-W-20.0-202007**	**CD-5-W-44.0-20200715**	**CD-5-W-44.0-20200715**	**S-443_20210505**
Sampling Company		**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**
Laboratory		**LANCASTER**	**TAED**	**LANCASTER**	**TAED**	**LANCASTER**	**LANCASTER**	**TAED**	**LANCASTER**	**TAED**	**LANCASTER**
Laboratory Work Order		**410-8574-1**	**410-8574-1**	**410-8574-1**	**410-8574-1**	**410-38735-1**	**410-7802-1**	**410-7802-1**	**410-7956-1**	**410-7956-1**	**410-38735-1**
Laboratory Sample ID	**Units**	**410-8574-1**	**410-8574-1**	**410-8574-2**	**410-8574-2**	**410-38735-2**	**410-7802-1**	**410-7802-1**	**410-7956-1**	**410-7956-1**	**410-38735-10**
General Chemistry											
ALKALINITY TO pH 4.5	µg/L	410,000	-	170,000	-	640,000	95,000	-	480,000	-	430,000
CHLORIDE (AS CL)	µg/L	-	61,000	-	1,000,000	-	-	13,000	-	430,000	-
ETHANE	µg/L	1.9 J	-	ND (5.0)	-	2.0 J	1.8 J	-	1.3 J	-	1.3 J
ETHENE	µg/L	ND (5.0)	-	ND (5.0)	-	ND (5.0)	ND (5.0)	-	ND (5.0)	-	ND (5.0)
METHANE	µg/L	5,300	-	5,600	-	8,300	5,500	-	3,800	-	7,400
NITROGEN, AMMONIA (AS N)	µg/L	780 J	-	870 J	-	-	ND (1,500)	-	ND (1,500)	-	-
NITROGEN, NITRATE (AS N)	µg/L	510	-	56 J	-	-	510	-	640	-	-
SULFATE (AS SO4)	µg/L	-	75,000	-	26,000	4,400 J	-	74,000	-	88,000	3,500 J
SULFIDE	µg/L	ND (300)	-	ND (300)	-	-	ND (300)	-	ND (300)	-	-
TOTAL CARBON	µg/L	-	-	-	-	140,000	-	-	-	-	88,000
TOTAL INORGANIC CARBON	µg/L	-	-	-	-	130,000	-	-	-	-	79,000
TOTAL KJELDAHL NITROGEN	µg/L	-	-	-	-	590 J	-	-	-	-	590 J
TOTAL ORGANIC CARBON	µg/L	-	-	-	-	8,900	-	-	-	-	8,900

See notes on last page.

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Table 2-7
Groundwater Analytical Results Summary – General Chemistry
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a Series of Evergreen Resources Group, LLC

Sample Location		S-443_CD				S-444	S-444_CD		S-445	S-445_CD	S-446
Sample Date		20-Jul-20	20-Jul-20	21-Jul-20	21-Jul-20	6-May-21	9-Jul-20	9-Jul-20	5-May-21	7-Jul-20	5-May-21
Sample ID		CD-6C-W-19.0-20200720	CD-6C-W-19.0-20200720	CD-6C-W-40.0-20200721	CD-6C-W-40.0-20200721	S-444_20210506	CD-13A-W-39.0-20200709	CD-13A-W-39.0-20200709	S-445_20210505	CD-13B-W-40.0-20200707	S-446_20210505
Sampling Company		STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory		LANCASTER	TAED	LANCASTER	TAED	LANCASTER	LANCASTER	TAED	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		410-8309-1	410-8309-1	410-8309-1	410-8309-1	410-39001-1	410-7163-1	410-7163-1	410-38735-1	410-6786-1	410-38735-1
Laboratory Sample ID	Units	410-8309-1	410-8309-1	410-8309-2	410-8309-2	410-39001-1	410-7163-2	410-7163-2	410-38735-7	410-6786-1	410-38735-4
General Chemistry											
ALKALINITY TO pH 4.5	µg/L	310,000	-	390,000	-	170,000	150,000	-	460,000	880,000	200,000
CHLORIDE (AS CL)	µg/L	-	260,000	-	800,000	-	-	11,000	-	88,000	-
ETHANE	µg/L	1.0 J	-	2.0 J	-	2.0 J	1.3 J	-	1.9 J	1.6 J	2.4 J
ETHENE	µg/L	ND (5.0)	-	ND (5.0)	-	ND (5.0)	ND (5.0)	-	ND (5.0)	ND (5.0)	ND (5.0)
METHANE	µg/L	15,000	-	7,200	-	24,000	22,000	-	3,300	2,100 E	16,000
NITROGEN, AMMONIA (AS N)	µg/L	ND (1,500)	-	ND (1,500)	-	-	570 J	-	-	2,500	-
NITROGEN, NITRATE (AS N)	µg/L	270 J	-	ND (500)	-	-	-	170 H	-	ND (500)	-
SULFATE (AS SO4)	µg/L	-	32,000	-	23,000	ND (5,000)	-	30,000	3,500 J	44,000 J	3,100 J
SULFIDE	µg/L	ND (300)	-	ND (300)	-	-	ND (300)	-	-	ND (300)	-
TOTAL CARBON	µg/L	-	-	-	-	42,000	-	-	190,000	-	49,000
TOTAL INORGANIC CARBON	µg/L	-	-	-	-	40,000	-	-	180,000	-	47,000
TOTAL KJELDAHL NITROGEN	µg/L	-	-	-	-	580 J	-	-	15,000	-	ND (1,000)
TOTAL ORGANIC CARBON	µg/L	-	-	-	-	2,400	-	-	9,800	-	2,300

See notes on last page.

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Table 2-7
Groundwater Analytical Results Summary – General Chemistry
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a Series of Evergreen Resources Group, LLC

Sample Location		S-446_CD		S-447	S-447_CD			S-448	S-448_CD	S-449	
Sample Date		18-Jun-20	19-Jun-20	3-May-21	23-Jun-20	23-Jun-20	24-Jun-20	6-May-21	11-Aug-20	2-Sep-20	6-May-21
Sample ID		CD-12-W-25.0-20200618	CD-12-W-45.0-20200619	S-447_20210503	CD-10-W-38.0-20200623	CD-10-W-38.0-20200623	CD-10-W-45.0-20200624	S-448_20210506	CD-14-W-23.0-20200811	S-449_20200902	S-449_20210506
Sampling Company		STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory		LANCASTER	LANCASTER	LANCASTER	LANCASTER	TAED	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		410-4913-1	410-5078-1	410-38315-1	410-5534-1	410-5534-1	410-5704-1	410-39001-1	410-10488-1	410-12761-1	410-39001-1
Laboratory Sample ID	Units	410-4913-2	410-5078-1	410-38315-4	410-5534-3	410-5534-3	410-5704-1	410-39001-6	410-10488-1	410-12761-6	410-39001-5
General Chemistry											
ALKALINITY TO pH 4.5	µg/L	140,000	160,000	240,000	160,000	-	160,000	630,000	710,000	180,000	180,000
CHLORIDE (AS CL)	µg/L	7,300	17,000	-	-	19,000	32,000 E	-	54,000	140,000 J	-
ETHANE	µg/L	ND (5.0)	2.0 J	6.2	7.4	-	6.3	ND (5.0)	ND (5.0)	6.6	7.0
ETHENE	µg/L	ND (5.0)	ND (5.0)	1.3 J	ND (5.0)	-	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
METHANE	µg/L	1,500	11,000	15,000	7,300 H	-	19,000	250	19,000	24,000	21,000
NITROGEN, AMMONIA (AS N)	µg/L	ND (1,100)	ND (1,100)	-	950 J	-	780 J	-	1,600 J	690 J	-
NITROGEN, NITRATE (AS N)	µg/L	ND (500)	880 H	-	-	90 J H	ND (500) H	-	ND (500)	ND (500)	-
SULFATE (AS SO4)	µg/L	8,000	65,000	ND (5,000)	-	8,900	12,000	140,000	21,000	12,000	ND (5,000)
SULFIDE	µg/L	ND (30,000)	ND (300)	-	ND (300)	-	ND (300)	-	ND (300)	ND (300)	-
TOTAL CARBON	µg/L	-	-	78,000	-	-	-	120,000	-	-	47,000
TOTAL INORGANIC CARBON	µg/L	-	-	59,000	-	-	-	110,000	-	-	39,000
TOTAL KJELDAHL NITROGEN	µg/L	-	-	2,500	-	-	-	770 J	-	-	600 J
TOTAL ORGANIC CARBON	µg/L	-	-	19,000	-	-	-	10,000	-	-	7,900

See notes on last page.

Table 2-7
Groundwater Analytical Results Summary – General Chemistry
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a Series of Evergreen Resources Group, LLC

Notes:

ND (0.03)	Analyte was not detected at a concentration greater than the laboratory reporting limit.
-	Parameter not analyzed / not available
B	Indicates the analyte is detected in the associated blank as well as in the sample.
E	Indicates compounds whose concentrations exceed the calibration range of the instrument.
H	Sample was prepped or analyzed beyond the specified holding time.
J	Indicates an estimated value.
SL	Sample was collected below LNAPL.
µg/L	Micrograms per liter
TAED	Eurofins TestAmerica

Stantec

Table 2-8
Groundwater Analytical Results Summary – Sucralose
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location Sample Date Sample ID Sampling Company Laboratory Laboratory Work Order Laboratory Sample ID	Units	RW-703 10-May-21 RW-703_20210510 STANTEC EARL M2105C W19471	S-39D 7-May-21 S-39D_20210507 STANTEC EARL M2105C W19469	S-369 10-May-21 S-369_20210510 STANTEC EARL M2105C W19470	S-376 12-May-21 S-376_SL_20210512 STANTEC EARL M2105C W19478	S-378 6-May-21 S-378_20210506 STANTEC EARL M2105C W19460	S-440 12-May-21 S-440_20210512 STANTEC EARL M2105C W19475	S-441 5-May-21 S-441_20210505 STANTEC EARL M2105C W19455	S-442 5-May-21 S-442_20210505 STANTEC EARL M2105C W19449	S-444 6-May-21 S-444_20210506 STANTEC EARL M2105C W19456	S-445 5-May-21 S-445_20210505 STANTEC EARL M2105C W19452	S-446 5-May-21 S-446_20210505 STANTEC EARL M2105C W19450	S-449 6-May-21 S-449_20210506 STANTEC EARL M2105C W19459
SUCRALOSE	ng/L	1,389	ND (145)	ND (145)	59.4	ND (145)	ND (145)	55.4	363	29.3 J	218	103	ND (145)

Notes:
ND (0.03) Analyte was not detected at a concentration greater than the laboratory reporting limit.
J Indicates an estimated value
ng/L Nanograms per liter
EARL Environmental Analysis Research Laboratory

Table 2-9
Groundwater Analytical Results - Total Iron and Major Ions
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location		AOI4-BH-20-01		AOI4-BH-20-02		AOI4-BH-20-03		AOI4-BH-20-04
Sample Date		5-Aug-20	7-Aug-20	3-Aug-20	28-Jul-20	29-Jul-20	30-Jul-20	30-Jun-20
Sample ID		CD-01-W-18-20200805	CD-01-W-41.5-20200807	CD-02-25-20200803	CD-3-W-25.0-20200728	CD-3-W-46.0-20200729	CD-3-W-82.0-20200730	CD-6B-W-45.0-20200630
Sampling Company		STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory		LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		410-9875-1	410-10068-1	410-9564-1	410-8907-1	410-9021-1	410-9160-1	410-6241-1
Laboratory Sample ID	Units	410-9875-1	410-10068-1	410-9564-1	410-8907-1	410-9021-1	410-9160-1	410-6241-1
Metals								
CALCIUM	µg/L	160,000	100,000	33,000	27,000	98,000	29,000	70,000
IRON	µg/L	18,000	45,000	48,000	10,000	19,000	80,000	38,000
MAGNESIUM	µg/L	47,000	53,000	19,000	12,000	48,000	16,000	43,000
POTASSIUM	µg/L	15,000	19,000	13,000	4,800	9,200	7,700	9,900
SODIUM	µg/L	46,000	380,000	50,000	49,000	330,000	72,000	820,000

See notes on last page.

Table 2-9
Groundwater Analytical Results - Total Iron and Major Ions
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location		S-440_CD		S-441_CD		S-442_CD		S-443_CD	
Sample Date		16-Jun-20	17-Jun-20	22-Jul-20	23-Jul-20	14-Jul-20	15-Jul-20	20-Jul-20	21-Jul-20
Sample ID		CD-15-W-25.0-20200616	CD-15-W-40.0-20200617	CD-6A-W-19.0-20200722	CD-6A-W-44.0-20200723	CD-5-W-20.0-202007	CD-5-W-44.0-20200715	CD-6C-W-19.0-20200720	CD-6C-W-40.0-20200721
Sampling Company		STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory		LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		410-4783-1	410-4783-1	410-8574-1	410-8574-1	410-7802-1	410-7956-1	410-8309-1	410-8309-1
Laboratory Sample ID	Units	410-4783-3	410-4783-4	410-8574-1	410-8574-2	410-7802-1	410-7956-1	410-8309-1	410-8309-2
Metals									
CALCIUM	µg/L	42,000	41,000	63,000	53,000	10,000	25,000	43,000	84,000
IRON	µg/L	130,000	30,000	6,200	7,400	27,000	6,100	14,000	37,000
MAGNESIUM	µg/L	32,000	21,000	31,000	39,000	3,600	18,000	25,000	35,000
POTASSIUM	µg/L	7,600	5,000	5,900	10,000	4,600	6,300 B	7,800	8,400
SODIUM	µg/L	40,000	99,000	120,000	900,000	55,000	490,000	110,000	500,000

See notes on last page.

Table 2-9
Groundwater Analytical Results - Total Iron and Major Ions
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location		S-444_CD	S-445_CD	S-446_CD		S-447_CD		S-448_CD	S-449
Sample Date		9-Jul-20	7-Jul-20	18-Jun-20	19-Jun-20	23-Jun-20	24-Jun-20	11-Aug-20	2-Sep-20
Sample ID		CD-13A-W-39.0-20200709	CD-13B-W-40.0-20200707	CD-12-W-25.0-20200618	CD-12-W-45.0-20200619	CD-10-W-38.0-20200623	CD-10-W-45.0-20200624	CD-14-W-23.0-20200811	S-449_20200902
Sampling Company		STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory		LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		410-7163-1	410-6786-1	410-4913-1	410-5078-1	410-5534-1	410-5704-1	410-10488-1	410-12761-1
Laboratory Sample ID	Units	410-7163-2	410-6786-1	410-4913-2	410-5078-1	410-5534-3	410-5704-1	410-10488-1	410-12761-6
Metals									
CALCIUM	µg/L	20,000	14,000	46,000	25,000	42,000	26,000	190,000	32,000
IRON	µg/L	15,000	5,100	1,200,000	13,000	95,000	16,000	38,000	13,000
MAGNESIUM	µg/L	16,000	15,000	72,000	12,000	20,000	16,000	68,000	22,000
POTASSIUM	µg/L	2,600	8,200	18,000	3,100 B	4,200	2,800	15,000	5,000
SODIUM	µg/L	27,000 B	410,000	12,000	54,000	19,000	33,000	76,000	81,000

Notes:

µg/L Micrograms per liter

B Indicates the analyte is detected in the associated blank as well as in the sample.

Table 2-10
Groundwater Analytical Results - Pesticides
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-369	S-378	S-440	S-441	S-442	S-444	S-445	S-446	S-447	S-449
Sample Date			10-May-21	6-May-21	12-May-21	5-May-21	5-May-21	6-May-21	5-May-21	5-May-21	4-May-21	6-May-21
Sample ID			S-369_DDT_20210510	S-378_DDT_20210506	S-440_DDT_20210512	S-441_DDT_20210505	S-442_DDT_20210505	S-444_DDT_20210506	S-445_DDT_20210505	S-446_DDT_20210505	S-447_DDT_20210504	S-449_DDT_20210506
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-39674-1	410-39021-1	410-39674-1	410-38814-1	410-38814-1	410-39021-1	410-38814-1	410-38814-1	410-38814-1	410-39021-1
Laboratory Sample ID	Units	MSC-PA	410-39674-1	410-39021-4	410-39674-2	410-38814-8	410-38814-2	410-39021-1	410-38814-5	410-38814-3	410-38814-1	410-39021-3
Pesticides												
P,P'-DDD	µg/L	14	ND (0.031)	ND (0.15) B	ND (0.030)	0.0085 J	ND (0.031)	ND (0.032) B	ND (0.15)	ND (0.031)	ND (0.15)	ND (0.15) B
P,P'-DDE	µg/L	10	ND (0.031)	ND (0.15)	ND (0.030)	ND (0.033)	ND (0.031)	ND (0.032)	ND (0.15)	ND (0.031)	ND (0.15)	ND (0.15)
P,P'-DDT	µg/L	5.5	ND (0.031)	ND (0.15)	ND (0.030)	ND (0.033)	ND (0.031)	ND (0.032)	ND (0.15)	ND (0.031)	ND (0.15)	ND (0.15)

Notes:

MSC-PA Pennsylvania Department of Environmental Protection - 2016
Medium-Specific Concentrations (MSCs) for Organic/Inorganic Regulated Substances in Groundwater - Used Aquifer, Non Residential, TDS ≤ 2500
15.2 Measured concentration did not exceed the indicated standard.
ND (0.03) Analyte was not detected at a concentration greater than the laboratory reporting limit.
B Indicates the analyte is detected in the associated laboratory blank.
J Indicates an estimated value.
µg/L Micrograms per liter

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Table 2-11
Soil Sampling Analytical Results Summary
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location					AOI4-BH-21-01	AOI4-BH-20-01	S-440		S-441	S-442	S-443	S-444	
Sample Date					7-Apr-21	5-Aug-20	16-Jun-20	16-Jun-20	22-Jul-20	14-Jul-20	17-Jul-20	9-Jul-20	9-Jul-20
Sample ID					AOI4-BH-21-01-0-2-20210407	CD-01-S-10-20200805	CD-15-S-5.0-20200616	CD-15-S-25.0-20200616	CD-6A-S-11.0-20200722	CD-5-S-20.0-20200714	CD-6C-S-9.0-20200717	CD-13A-S-39.0-20200709	CD-13A-S-50.0-20200709
Sample Depth					0 - 2 ft	10 ft	5 ft	25 ft	11 ft	20 ft	9 ft	39 ft	50 ft
Sampling Company					STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory					LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		MSC-PA	MSC-PA	MSC-PA	410-35275-1	410-9875-1	410-4783-1	410-4783-1	410-8427-1	410-7618-1	410-8129-1	410-7163-1	410-7329-1
Laboratory Sample ID	Units	A	B	C	410-35275-11	410-9875-2	410-4783-1	410-4783-2	410-8427-1	410-7618-1	410-8129-1	410-7163-1	410-7329-1
Volatile Organic Compounds													
BENZENE	mg/kg	290	330	0.5	-	0.0027 J	ND (0.0069)	ND (0.0053)	ND (0.006)	*ND (0.65)*	ND (0.0076)	0.00061 J	ND (0.0052)
1,2-DIBROMOETHANE (EDB)	mg/kg	3.7	4.3	0.005	-	ND (0.0047)	*ND (0.0069)*	*ND (0.0053)*	*ND (0.006)*	*ND (0.65)*	*ND (0.0076)*	ND (0.0049)	*ND (0.0052)*
1,2-DICHLOROETHANE (EDC)	mg/kg	86	98	0.5	-	ND (0.0047)	ND (0.0069)	ND (0.0053)	ND (0.006)	*ND (0.65)*	ND (0.0076)	ND (0.0049)	ND (0.0052)
ETHYLBENZENE	mg/kg	890	1,000	70	-	ND (0.0047)	ND (0.0069)	ND (0.0053)	ND (0.006)	11	ND (0.0076)	0.067	0.0024 J
ISOPROPYLBENZENE (CUMENE)	mg/kg	10,000	10,000	2,500	-	ND (0.0047)	ND (0.0069)	ND (0.0053)	ND (0.006)	11	ND (0.0076)	0.011	0.0034 J
METHYL TERTIARY BUTYL ETHER	mg/kg	8,600	9,900	2	-	ND (0.0047)	ND (0.0069)	0.0013 J	ND (0.006)	ND (0.65)	ND (0.0076)	ND (0.0049)	ND (0.0052)
NAPHTHALENE	mg/kg	760	190,000	25	-	ND (0.0047)	ND (0.0069)	ND (0.0053)	ND (0.006)	-	ND (0.0076)	0.022	ND (0.0052)
TERT-BUTYL ALCOHOL	mg/kg	n/v	n/v	n/v	-	ND (0.093)	-	-	ND (0.120)	ND (13) H3	ND (0.15)	ND (0.099)	ND (0.100)
TOLUENE	mg/kg	10,000	10,000	100	-	0.0020 J	ND (0.0069)	ND (0.0053)	ND (0.006)	0.91	ND (0.0076)	0.017	0.0074
1,2,4-TRIMETHYLBENZENE	mg/kg	560	640	35	-	ND (0.0047)	ND (0.0069)	ND (0.0053)	ND (0.006)	**190**[C]	ND (0.0076)	0.0074	ND (0.0052)
1,3,5-TRIMETHYLBENZENE	mg/kg	10,000	10,000	210	-	ND (0.0047)	ND (0.0069)	ND (0.0053)	ND (0.006)	100	ND (0.0076)	0.0046 J	0.00097 J
XYLENES, TOTAL (DIMETHYLBENZENE)	mg/kg	8,000	9,100	1,000	-	ND (0.0093)	ND (0.014)	ND (0.011)	ND (0.012)	42	ND (0.015)	0.039	0.0053 J
Volatile Organic Compounds (SW8011)													
1,2-DIBROMOETHANE (EDB)	mg/kg	3.7	4.3	0.005	-	-	-	-	-	-	-	-	-
Semi-Volatile Organic Compounds													
ANTHRACENE	mg/kg	190,000	190,000	350	-	1.700	ND (0.020)	ND (0.020)	ND (0.022)	0.049 J	ND (0.020)	ND (0.019)	ND (0.018)
BENZO(A)ANTHRACENE	mg/kg	130	190,000	430	-	1.900	ND (0.020)	ND (0.020)	ND (0.022)	ND (0.10)	ND (0.020)	ND (0.019)	ND (0.018)
BENZO(A)PYRENE	mg/kg	12	190,000	46	-	1.600	ND (0.020)	ND (0.020)	ND (0.022)	ND (0.10)	ND (0.020)	ND (0.019)	ND (0.018)
BENZO(B)FLUORANTHENE	mg/kg	76	190,000	170	-	1.800	ND (0.020)	ND (0.020)	ND (0.022)	ND (0.10)	0.0042 J	ND (0.019)	ND (0.018)
BENZO(G,H,I)PERYLENE	mg/kg	190,000	190,000	180	-	0.850	ND (0.020)	ND (0.020)	ND (0.022)	ND (0.10)	ND (0.020)	ND (0.019)	ND (0.018)
CHRYSENE	mg/kg	760	190,000	230	-	1.700	ND (0.020)	ND (0.020)	ND (0.022)	0.020 J	0.0047 J	ND (0.019)	ND (0.018)
FLUORENE	mg/kg	130,000	190,000	3,800	-	1.200	ND (0.020)	ND (0.020)	ND (0.022)	0.19	ND (0.020)	ND (0.019)	ND (0.018)
NAPHTHALENE	mg/kg	760	190,000	25	-	0.060	ND (0.020)	0.011 J	ND (0.022)	6.6	ND (0.020)	0.075	ND (0.018)
PHENANTHRENE	mg/kg	190,000	190,000	10,000	-	6.100	0.0045 J	ND (0.020)	0.0079 J	0.28	0.0049 J	ND (0.019)	ND (0.018)
PYRENE	mg/kg	96,000	190,000	2,200	-	3.700	0.0070 J	ND (0.020)	0.0074 J	ND (0.10)	0.0079 J	ND (0.019)	ND (0.018)
Metals													
LEAD, Total	mg/kg	1,000	190,000	450	250	22	19	5.0	11	2.9	9.1	0.82 J	ND (1.3)
Petroleum Hydrocarbons													
>C12-C22	mg/kg	n/v	n/v	n/v	-	43	ND (14)	ND (15)	ND (15)	630	ND (14)	ND (14)	ND (13)
>C22-C44	mg/kg	n/v	n/v	n/v	-	110	ND (14)	ND (15)	ND (15)	24	ND (14)	11 J	ND (13)
C5-C12 GRO	mg/kg	n/v	n/v	n/v	-	-	-	-	-	-	-	-	-
C4-C12 GRO	mg/kg	n/v	n/v	n/v	-	0.560	ND (0.15)	0.099 J	0.810	7,000	ND (0.17)	4.1	0.89
TOTAL PETROLEUM HYDROCARBON	mg/kg	n/v	n/v	n/v	-	-	ND (14)	ND (15)	ND (0.25)	650	ND (0.24)	11	ND (0.22)

See notes on last page.

Table 2-11
Soil Sampling Analytical Results Summary
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location					S-445	S-446		S-447			
Sample Date					1-Jul-20	17-Jun-20	17-Jun-20	22-Jun-20	22-Jun-20	23-Jun-20	23-Jun-20
Sample ID					CD-13B-S-3.0-20200701	CD-12-S-25.0-20200617	CD-12-S-25.0-20200617	CD-10-S-3.0-20200622	CD-10-S-3.0-20200622	CD-10-S-38.0-20200623	CD-10-S-38.0-20200623
Sample Depth					3 ft	25 ft	25 ft	3 ft	3 ft	38 ft	38 ft
Sampling Company					STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory					LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order		MSC-PA	MSC-PA	MSC-PA	410-6389-1	410-14623-1	410-4913-1	410-14623-1	410-5534-1	410-14623-1	410-5534-1
Laboratory Sample ID	Units	A	B	C	410-6389-1	410-14623-7	410-4913-1	410-14623-8	410-5534-1	410-14623-9	410-5534-2
Volatile Organic Compounds											
BENZENE	mg/kg	290	330	0.5	ND (0.0064)	-	ND (0.0051)	-	*ND (0.910)*	-	0.140
1,2-DIBROMOETHANE (EDB)	mg/kg	3.7	4.3	0.005	*ND (0.0064)*	-	-	-	*ND (0.910)*	-	ND (0.0047)
1,2-DICHLOROETHANE (EDC)	mg/kg	86	98	0.5	ND (0.0064)	-	ND (0.0051)	-	*ND (0.910)*	-	ND (0.0047)
ETHYLBENZENE	mg/kg	890	1,000	70	ND (0.0064)	-	ND (0.0051)	-	ND (0.910)	-	0.120
ISOPROPYLBENZENE (CUMENE)	mg/kg	10,000	10,000	2,500	ND (0.0064)	-	ND (0.0051)	-	ND (0.910)	-	0.0098
METHYL TERTIARY BUTYL ETHER	mg/kg	8,600	9,900	2	ND (0.0064)	-	ND (0.0051)	-	ND (0.910)	-	ND (0.0047)
NAPHTHALENE	mg/kg	760	190,000	25	ND (0.0064)	-	ND (0.0051)	-	-	-	0.042
TERT-BUTYL ALCOHOL	mg/kg	n/v	n/v	n/v	ND (0.130)	-	ND (0.100)	-	ND (18.000)	-	ND (0.094)
TOLUENE	mg/kg	10,000	10,000	100	ND (0.0064)	-	ND (0.0051)	-	0.160 J	-	0.100
1,2,4-TRIMETHYLBENZENE	mg/kg	560	640	35	ND (0.0064)	-	ND (0.0051)	-	ND (0.910)	-	0.044
1,3,5-TRIMETHYLBENZENE	mg/kg	10,000	10,000	210	ND (0.0064)	-	ND (0.0051)	-	ND (0.910)	-	0.017
XYLENES, TOTAL (DIMETHYLBENZENE)	mg/kg	8,000	9,100	1,000	ND (0.013)	-	ND (0.010)	-	ND (1.800)	-	0.380
Volatile Organic Compounds (SW8011)											
1,2-DIBROMOETHANE (EDB)	mg/kg	3.7	4.3	0.005	-	-	ND (0.00056)	-	-	-	-
Semi-Volatile Organic Compounds											
ANTHRACENE	mg/kg	190,000	190,000	350	ND (0.020)	-	ND (0.019)	-	0.690	-	ND (0.019)
BENZO(A)ANTHRACENE	mg/kg	130	190,000	430	ND (0.020)	-	ND (0.019)	-	1.100	-	ND (0.019)
BENZO(A)PYRENE	mg/kg	12	190,000	46	ND (0.020)	-	ND (0.019)	-	1.900	-	ND (0.019)
BENZO(B)FLUORANTHENE	mg/kg	76	190,000	170	ND (0.020)	-	ND (0.019)	-	1.100	-	ND (0.019)
BENZO(G,H,I)PERYLENE	mg/kg	190,000	190,000	180	ND (0.020)	-	ND (0.019)	-	1.200	-	ND (0.019)
CHRYSENE	mg/kg	760	190,000	230	ND (0.020)	-	ND (0.019)	-	1.400	-	ND (0.019)
FLUORENE	mg/kg	130,000	190,000	3,800	ND (0.020)	-	ND (0.019)	-	0.300	-	ND (0.019)
NAPHTHALENE	mg/kg	760	190,000	25	ND (0.020)	-	ND (0.019)	-	2.500	-	ND (0.019)
PHENANTHRENE	mg/kg	190,000	190,000	10,000	ND (0.020)	-	ND (0.019)	-	1.800	-	ND (0.019)
PYRENE	mg/kg	96,000	190,000	2,200	ND (0.020)	-	ND (0.019)	-	1.100	-	ND (0.019)
Metals											
LEAD, Total	mg/kg	1,000	190,000	450	7.7	-	4.3	8.8	-	0.99 J	-
Petroleum Hydrocarbons											
>C12-C22	mg/kg	n/v	n/v	n/v	ND (14)	-	ND (14)	-	110	-	13 J
>C22-C44	mg/kg	n/v	n/v	n/v	21	-	ND (14)	-	78	-	ND (14)
C5-C12 GRO	mg/kg	n/v	n/v	n/v	-	3.0 H B H3	-	-	-	-	-
C4-C12 GRO	mg/kg	n/v	n/v	n/v	ND (0.14) B	-	0.120	-	17.000 J H	-	4.000 J H
TOTAL PETROLEUM HYDROCARBON	mg/kg	n/v	n/v	n/v	21	-	ND (14)	-	190	-	13

See notes on last page.

Table 2-11
Soil Sampling Analytical Results Summary
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Notes:

MSC-PA	Pennsylvania Department of Environmental Protection (PADEP) - Medium Specific Concentrations
A	MSC for Organic/Inorganic Regulated Substances in Soil - Direct Contact - Non-Residential Surface Soil (0-2 ft)
B	MSC for Organic/Inorganic Regulated Substances in Soil - Direct Contact - Non-Residential Subsurface Soil (2-15 ft)
C	MSC for Organic/Inorganic Regulated Substances in Soil - Soil to Groundwater, Higher of the 100x the Groundwater MSC and the Generic Value (Unsaturated) - Non-Residential
190^{A}	Concentration exceeds standard A.
190^{B}	Concentration exceeds standard B.
190^{C}	Concentration exceeds standard C.
15.2	Measured concentration did not exceed the indicated standard.
ND (0.50)	Laboratory reporting limit was greater than the applicable standard.
ND (0.03)	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value
-	Parameter not analyzed / not available
B	Indicates the analyte is detected in the associated blank as well as in the sample.
H	Sample was prepped or analyzed beyond the specified holding time.
H3	Sample was received and analyzed past holding time.
J	Indicates an estimated value.
mg/kg	milligrams per kilogram
ft	feet

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Table 2-12
Air Analytical Results Summary
Area of Interest 4, Former Philadelphia Refinery
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location Sample Date Sample ID Sampling Company Laboratory Laboratory Work Order Laboratory Sample ID	Units	A EPA-RSL	B SVIA-NR SHS	C SVIA-NR SSS	D USEPA-AIR	E PADEP	F OSHA PEL	G NIOSH REL	H ACGIH TLV	AOI4-AA-17-01 9-Mar-17 AOI4-AA-17-01 GHD PACE 10381907 10381907018	AOI4-AI-17-01 9-Mar-17 AOI4-AI-17-01 GHD PACE 10381907 10381907017
Volatile Organic Compounds											
BENZENE	µg/m3	13	16	1.6	29	2.59	3,190	319	1,600	***2.4*** [C]	***3.0*** [CE]
1,2-DIBROMOETHANE (EDB)	µg/m3	0.20	0.20	0.02	n/v	n/v	153,800	346	n/v	*ND (6.1)*	*ND (6.1)*
1,2-DICHLOROETHANE (EDC)	µg/m3	3.1	4.7	0.47	0.2	0.16	202,500	4,000	40,000	*ND (0.64)*	*ND (0.64)*
ETHYLBENZENE	µg/m3	49	49	4.9	17	0.68	435,000	435,000	87,000	*ND (3.4)*	***2.4 J*** [E]
ISOPROPYLBENZENE (CUMENE)	µg/m3	180	1,800	180	n/v	11.2	245,000	245,000	246,000	ND (3.9)	ND (3.9)
METHYL TERTIARY BUTYL ETHER	µg/m3	470	470	47	72	n/v	n/v	n/v	180,000	ND (5.7)	ND (5.7)
NAPHTHALENE	µg/m3	1.3	3.6	0.36	4.8*	n/v	50,000	50,000	52,000	***0.63 J*** [C]	***0.97 J*** [C]
TOLUENE	µg/m3	2,200	22,000	2,200	144	4.52	754,000	375,000	75,000	3.1	3.6
1,2,4-TRIMETHYLBENZENE	µg/m3	26	31	3.1	19	1.12	n/v	125,000	123,000	***2.7 J*** [E]	***3.5 J*** [CE]
1,3,5-TRIMETHYLBENZENE	µg/m3	26	31	3.1	6.5	0.38	n/v	125,000	123,000	*ND (3.9)*	*ND (3.9)*
M, P-XYLENES	µg/m3	44 S3	n/v	n/v	63.5	n/v	435,000	435,000	434,000	5.4 J	6.2 J
O-XYLENE (1,2-DIMETHYLBENZENE)	µg/m3	44	n/v	n/v	20	n/v	435,000	435,000	434,000	ND (3.4)	3.0 J
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/m3	44	440	44	63.5	3.14	n/v	n/v	434,000	***5.4*** [E]	***9.2*** [E]

Notes:

EPA-RSL	EPA-Region 3 Screening Levels
A	EPA-Region 3 RSL Composite Worker Air (May 2021) - Target Risk=1E-5, Target Hazard Quotient=0.1
SVIA-NR	PADEP Vapor Intrusion Indoor Air Screening Values, Non-Residential
B	Statewide Health Standard (SHS) Vapor Intrusion Screening Values
C	Site Specific Standard (SSS) Vapor Intrusion Screening Values
USEPA-AIR	United States Environmental Protection Agency
D	Background Residential Indoor Air, North American, 2011, 95th percentile
PADEP	Pennsylvania Department of Environmental Protection
E	Marcus Hook Air Toxics Monitor 2015, maximum value of PADEP accessed February 5, 2016
OSHA	Occupational Safety and Health Administration
F	Permissible Exposure Limits (PEL)
NIOSH	National Institute for Occupational Safety and Health
G	Recommended Exposure Limits
ACGIH TLV	American Conference of Governmental Industrial Hygienists
H	Threshold Limit Value
6.5 [A]	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
ND (0.50)	Laboratory reporting limit was greater than the applicable standard.
ND (0.03)	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value
*	95th percentile value not provided, value is 90th percentile
S3	m,p-Xylenes are compared to the action limits for individual compounds m-Xylene and p-Xylene. Standards shown are the stricter of the two if they differ.
J	Indicates an estimated value
µg/m3	Micrograms per cubic meter

Stantec

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			**AOI4-BH-20-01**		**AOI4-BH-20-03**						**AOI4-BH-20-04**	
Sample Date			**5-Aug-20**	**7-Aug-20**	**28-Jul-20**	**28-Jul-20**	**29-Jul-20**	**29-Jul-20**	**30-Jul-20**	**30-Jul-20**	**30-Jun-20**	**30-Jun-20**
Sample ID			**CD-01-W-18-20200805**	**CD-01-W-41.5-20200807**	**CD-3-W-25.0-20200728**	**CD-3-W-25.0-20200728**	**CD-3-W-46.0-20200729**	**CD-3-W-46.0-20200729**	**CD-3-W-82.0-20200730**	**CD-3-W-82.0-20200730**	**CD-6B-W-45.0-20200630**	**CD-6B-W-45.0-20200630**
Sampling Company			**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**
Laboratory			**LANCASTER**	**LANCASTER**	**LANCASTER**	**LANCASTER**	**LANCASTER**	**LANCASTER**	**LANCASTER**	**LANCASTER**	**LANCASTER**	**LANCASTER**
Laboratory Work Order			**410-9875-1**	**410-10068-1**	**410-8907-1**	**410-14623-1**	**410-9021-1**	**410-14623-1**	**410-14623-1**	**410-9160-1**	**410-14623-1**	**410-6241-1**
Laboratory Sample ID	**Units**	**SVGW-NR SHS**	**410-9875-1**	**410-10068-1**	**410-8907-1**	**410-14623-4**	**410-9021-1**	**410-14623-5**	**410-14623-6**	**410-9160-1**	**410-14623-1**	**410-6241-1**
Volatile Organic Compounds												
BENZENE	µg/L	350	0.22 J	***450***	***4,500***	-	***390***	-	-	***950***	-	270
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1.0)	ND (5.0)	ND (5.0)	-	ND (5.0)	-	-	ND (5.0)	-	ND (5.0)
ETHYLBENZENE	µg/L	860	310	26	760	-	5.7	-	-	14	-	44
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	40	15 J	35	-	4.5 J	-	-	14 J	-	10 J
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	0.80 J	11	1.2 J	-	14	-	-	46	-	9.3
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (50)	ND (250)	140 J	-	ND (250)	-	-	ND (250)	-	ND (250)
TOLUENE	µg/L	430,000	0.50 J	54	3,800	-	51	-	-	86	-	69
1,2,4-TRIMETHYLBENZENE	µg/L	750	570	70	730	-	91	-	-	ND (25)	-	150
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	240	26	290	-	38	-	-	15 J	-	58
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	600	150	1,900	-	240	-	-	220	-	320
Volatile Organic Compounds (SW8011)												
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.029)	ND (0.029)	-	ND (0.030) H H3	-	ND (0.029) H H3	ND (0.035) H H3	-	ND (0.029) H H3	-
Semi-Volatile Organic Compounds												
NAPHTHALENE	µg/L	1,300	130	9.8	280	-	5.1	-	-	1.6	-	22

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-39							S-40			
Sample Date			2-Apr-13	13-Jun-13	19-May-14	18-May-15	12-May-16	10-Aug-16	11-Oct-16	8-Apr-13	17-Jun-13	18-May-15	19-May-16
Sample ID			S-39_040213	S-39_06_13_2013	S-39	S-39_20150518	S-39-20160512	S-39-20160810-WG	S-39-20161011-WG	S-40_040813	S-40_06_17_2013	S-40_20150518	S-40-20160519
Sampling Company			STANTEC	LANGAN	STANTEC	STANTEC	STANTEC	AQUATERRA	AQUATERRA	STANTEC	LANGAN	STANTEC	STANTEC
Laboratory			ACCUTEST	ACCUTEST	ACCUTEST	LL	LL	ESC	ESC	ACCUTEST	ACCUTEST	LL	LL
Laboratory Work Order			JB33199	JB39760	JB67407	1562471	1660187	L853818	L865495	JB33644	JB40115	1562471	1664163
Laboratory Sample ID		SVGW-NR	JB33199-2	JB39760-3	JB67407-1	7894635	8378396	L853818-02	L865495-03	JB33644-5	JB40115-3	7894632	8392571
	Units	SHS											
Volatile Organic Compounds													
BENZENE	µg/L	350	ND (1.0)	ND (1)	ND (0.50)	ND (0.5)	ND (1)	ND (1.00)	ND (1.00)	ND (1)	0.58 J	10	18
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	ND (1.00)	ND (1.00)	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (1)	ND (1.00)	ND (1.00)	ND (1)	ND (1)	ND (0.5)	ND (0.5)
ETHYLBENZENE	µg/L	860	ND (1.0)	ND (1)	ND (0.50)	ND (0.5)	ND (1)	ND (1.00)	ND (1.00)	ND (1)	ND (1)	ND (0.5)	1
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	ND (2.0)	ND (2)	ND (1.0)	ND (0.5)	ND (2)	ND (1.00)	ND (1.00)	ND (2)	1.3 J	6	16
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (1)	ND (1.00)	ND (1.00)	ND (1)	ND (1)	ND (0.5)	ND (0.5)
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	-	-	-	-	-	-	-	-	-	-
TOLUENE	µg/L	430,000	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (1)	ND (5.00)	ND (5.00)	ND (1)	ND (1)	2	4
1,2,4-TRIMETHYLBENZENE	µg/L	750	ND (2.0)	ND (2)	ND (2.0)	ND (0.5)	ND (2)	ND (1.00)	ND (1.00)	ND (2)	ND (2)	ND (0.5)	ND (0.5)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (2.0)	ND (2)	ND (2.0)	ND (0.5)	ND (2)	ND (1.00)	ND (1.00)	ND (2)	ND (2)	ND (0.5)	ND (0.5)
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (1)	ND (3.00)	ND (3.00)	ND (1)	ND (1)	ND (0.5)	1
Volatile Organic Compounds (SW8011)													
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.020)	ND (0.02)	ND (0.020)	ND (0.0096)	ND (0.029)	ND (0.0100)	ND (0.0100)	ND (0.02)	ND (0.02)	ND (0.0096)	ND (0.0097)
Semi-Volatile Organic Compounds													
NAPHTHALENE	µg/L	1,300	ND (0.10)	ND (0.1)	ND (0.10)	ND (0.1)	ND (0.5)	ND (0.250)	ND (0.250)	ND (0.1)	ND (0.1)	0.6	ND (0.1)

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-120							
Sample Date			2-Apr-13	12-Jun-13	21-May-14	18-May-15	18-May-16	12-Aug-16	11-Oct-16	11-Oct-16
Sample ID			S-120_040213	S-120_06_12_2013	S-120	S-120_20150518	S-120-20160518	S-120-20160812-WG	S-120-20161011-WG	S-120-20161011-WG-DUP
Sampling Company			STANTEC	LANGAN	STANTEC	STANTEC	STANTEC	AQUATERRA	AQUATERRA	AQUATERRA
Laboratory			ACCUTEST	ACCUTEST	ACCUTEST	LL	LL	ESC	ESC	ESC
Laboratory Work Order			JB33199	JB39629	JB67626	1562471	1664163	L853817	L865495	L865495
Laboratory Sample ID		SVGW-NR	JB33199-1	JB39629-18	JB67626-8	7894633	8392568	L853817-02	L865495-01	L865495-02
	Units	SHS								
Volatile Organic Compounds										
BENZENE	µg/L	350	ND (1.0)	ND (1)	7.8	ND (0.5)	ND (0.5)	ND (1.00)	ND (1.00)	ND (1.00)
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	ND (1.00)	ND (1.00)	ND (1.00)
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (0.5)	ND (1.00)	ND (1.00)	ND (1.00)
ETHYLBENZENE	µg/L	860	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (0.5)	ND (1.00)	ND (1.00)	ND (1.00)
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	ND (2.0)	ND (2)	ND (1.0)	ND (0.5)	ND (0.5)	ND (1.00)	ND (1.00)	ND (1.00)
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (0.5)	ND (1.00)	ND (1.00)	ND (1.00)
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	-	-	-	-	-	-	-
TOLUENE	µg/L	430,000	ND (1.0)	ND (1)	1.1	ND (0.5)	ND (0.5)	ND (5.00)	ND (5.00)	ND (5.00)
1,2,4-TRIMETHYLBENZENE	µg/L	750	ND (2.0)	ND (2)	ND (2.0)	ND (0.5)	ND (0.5)	ND (1.00)	ND (1.00)	ND (1.00)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (2.0)	ND (2)	ND (2.0)	ND (0.5)	ND (0.5)	ND (1.00)	ND (1.00)	ND (1.00)
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (0.5)	ND (3.00)	ND (3.00)	ND (3.00)
Volatile Organic Compounds (SW8011)										
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.020)	ND (0.02)	ND (0.020)	ND (0.0096)	ND (0.0098)	ND (0.0100)	ND (0.0100)	ND (0.0100)
Semi-Volatile Organic Compounds										
NAPHTHALENE	µg/L	1,300	1.39	ND (0.1)	ND (0.10)	ND (0.1)	ND (0.1)	ND (0.250)	ND (0.250)	ND (0.250)

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-122							
Sample Date			2-Apr-13	13-Jun-13	19-May-14	18-May-15	12-May-16	9-Aug-16	13-Oct-16	13-Oct-16
Sample ID			S-122_040213	S-122_06_13_2013	S-122	S-122_20150518	S-122-20160512	S-122-20160809-WG	S-122-20161013-WG	S-122-20161013-WG-DUP
Sampling Company			STANTEC	LANGAN	STANTEC	STANTEC	STANTEC	AQUATERRA	AQUATERRA	AQUATERRA
Laboratory			ACCUTEST	ACCUTEST	ACCUTEST	LL	LL	ESC	ESC	ESC
Laboratory Work Order			JB33199	JB39760	JB67407	1562471	1660187	L853820	L866378	L866378
Laboratory Sample ID	Units	SVGW-NR SHS	JB33199-3	JB39760-4	JB67407-2	7894634	8378397	L853820-01	L866378-01	L866378-02
Volatile Organic Compounds										
BENZENE	µg/L	350	ND (1.0)	ND (1)	ND (0.50)	ND (0.5)	ND (1)	ND (1.00)	ND (1.00)	ND (1.00)
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	ND (1.00)	ND (1.00)	ND (1.00)
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (1)	ND (1.00)	ND (1.00)	ND (1.00)
ETHYLBENZENE	µg/L	860	ND (1.0)	ND (1)	ND (0.50)	ND (0.5)	ND (1)	ND (1.00)	ND (1.00)	ND (1.00)
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	ND (2.0)	ND (2)	ND (1.0)	ND (0.5)	ND (2)	ND (1.00)	ND (1.00)	ND (1.00)
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (1)	ND (1.00)	ND (1.00)	ND (1.00)
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	-	-	-	-	-	-	-
TOLUENE	µg/L	430,000	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (1)	ND (5.00)	ND (5.00)	ND (5.00)
1,2,4-TRIMETHYLBENZENE	µg/L	750	ND (2.0)	ND (2)	ND (2.0)	ND (0.5)	ND (2)	ND (1.00)	ND (1.00)	ND (1.00)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (2.0)	ND (2)	ND (2.0)	ND (0.5)	ND (2)	ND (1.00)	ND (1.00)	ND (1.00)
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	ND (1.0)	ND (1)	ND (1.0)	ND (0.5)	ND (1)	ND (3.00)	ND (3.00)	ND (3.00)
Volatile Organic Compounds (SW8011)										
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.020)	ND (0.02)	ND (0.020)	ND (0.0097)	ND (0.029)	ND (0.0100)	ND (0.0100)	ND (0.0100)
Semi-Volatile Organic Compounds										
NAPHTHALENE	µg/L	1,300	ND (0.10)	ND (0.1)	ND (0.10)	0.2 J	ND (0.5)	ND (0.250)	ND (0.250)	ND (0.250)

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-369							
Sample Date			**16-Aug-16**	**10-Oct-16**	**17-May-17**	**27-Jun-18**	**19-Jun-19**	**23-Oct-19**	**10-May-21**	**10-May-21**
Sample ID			**S-369-20160816-WG**	**S-369-20161010-WG**	**S-369-20170517**	**S-369_20180627**	**S-369_20190619**	**S-369_20191023**	**S-369_20210510**	**DUP-8_20210510**
Sampling Company			**AQUATERRA**	**AQUATERRA**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**	**STANTEC**
Laboratory			**ESC**	**ESC**	**LL**	**ESC**	**LL**	**LL**	**LL**	**LL**
Laboratory Work Order			**L854116**	**L865153**	**1803720**	**L1005894**	**2050556**	**2071371**	**410-39343-1**	**410-39343-1**
Laboratory Sample ID		**SVGW-NR**	**L854116-01**	**L865153-06**	**9003661**	**L1005894-01**	**1088320**	**1185680**	**410-39343-1**	**410-39343-2**
	Units	**SHS**								
Volatile Organic Compounds										
BENZENE	µg/L	350	**2,370[A]**	**1,870[A]**	**1,900[A]**	**1,460[A]**	**740[A]**	**1,100[A]**	**360[A]**	**370[A]**
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (25.0)	ND (20.0)	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (25.0)	ND (20.0)	ND (5)	ND (1.00)	ND (10)	ND (10)	ND (1.0)	3.3
ETHYLBENZENE	µg/L	860	ND (25.0)	ND (20.0)	17	13.3	12	10	9.7	10
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	71.7	62.4	71	72.8	68	61	91	100
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	ND (25.0)	ND (20.0)	47	62.3	11	22	1.9	2.0
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	-	-	-	1,100	1,200	180	180
TOLUENE	µg/L	430,000	ND (125)	ND (100)	62	54.5	40	47	37	41
1,2,4-TRIMETHYLBENZENE	µg/L	750	ND (25.0)	ND (20.0)	ND (5)	ND (1.00)	ND (2)	ND (2)	12	13
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (25.0)	ND (20.0)	5 J	3.73	3 J	3 J	2.4 J	2.5 J
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	ND (75.0)	ND (60.0)	42	33.2	24 J	31	25	26
Volatile Organic Compounds (SW8011)										
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.0100)	ND (0.0100)	ND (0.0097)	ND (0.0100)	ND (0.0095)	ND (0.0094)	ND (0.029)	ND (0.028)
Semi-Volatile Organic Compounds										
NAPHTHALENE	µg/L	1,300	11.9	10.4	3	3.13	ND (0.1)	ND (0.1)	1.1	ND (0.50)

See notes on last page.

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Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-374						
Sample Date			8-Nov-18	16-Jan-19	19-Jun-19	23-Oct-19	9-Dec-19	1-Sep-20	4-May-21
Sample ID			S-374-20181108-WG	S-374-20190116-WG	S-374_20190619	S-374_20191023	S-374_CSIA_20191209	S-374_20200901	S-374_20210504
Sampling Company			AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			PACE	ESC	LL	LL	PACE	LANCASTER	LANCASTER
Laboratory Work Order			30271414	L1063104	2050556	2071371	30340757	410-12585-1	410-38512-1
Laboratory Sample ID	Units	SVGW-NR SHS	30271414001	L1063104-01	1088310	1185677	30340757002	410-12585-10	410-38512-6
Volatile Organic Compounds									
BENZENE	µg/L	350	177	312	200	120	123	190	230
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1.0)	ND (20.0)	ND (10)	ND (10)	-	ND (5.0)	ND (5.0)
ETHYLBENZENE	µg/L	860	***1,360***	***1,530***	***1,000***	***1,100***	***1,030***	***980***	***890***
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	93.4	102	100	120	-	97	92
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	ND (1.0)	ND (20.0)	ND (1)	ND (1)	-	ND (5.0)	ND (5.0)
NAPHTHALENE	µg/L	1,300	-	-	-	-	328	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (100)	ND (50)	ND (50)	-	ND (250)	ND (250)
TOLUENE	µg/L	430,000	1,820	903	240	290	255	790	310
1,2,4-TRIMETHYLBENZENE	µg/L	750	***1,040***	***1,110***	***1,000***	***950***	-	***770***	650
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	179	237	240	220	-	160	140
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	4,170	4,060	2,100	2,100	1,860	2,100	1,900
Volatile Organic Compounds (SW8011)									
1,2-DIBROMOETHANE (EDB)	µg/L	44	0.053	ND (0.0100)	0.021 J	0.025 J	-	ND (0.029)	ND (0.029)
Semi-Volatile Organic Compounds									
NAPHTHALENE	µg/L	1,300	-	-	120	200	-	160 H	220

See notes on last page.

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Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-375							
Sample Date			8-Nov-18	16-Jan-19	19-Jun-19	23-Oct-19	23-Oct-19	9-Dec-19	2-Sep-20	4-May-21
Sample ID			S-375-20181108-WG	S-375-20190116-WG	S-375_20190619	S-375_20191023	DUP-1	S-375_CSIA_20191209	S-375_20200902	S-375_20210504
Sampling Company			AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			PACE	ESC	LL	LL	LL	PACE	LANCASTER	LANCASTER
Laboratory Work Order			30271414	L1063104	2050556	2071371	2071371	30340757	410-12999-1	410-38512-1
Laboratory Sample ID	Units	SVGW-NR SHS	30271414002	L1063104-02	1088311	1185679	1185682	30340757001	410-12999-2	410-38512-10
Volatile Organic Compounds										
BENZENE	µg/L	350	***1,900***	***1,090***	***440***	***1,100***	***1,100***	***794***	***1,600***	***490***
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1.0)	ND (1.00)	ND (2)	ND (10)	ND (10)	-	ND (5.0)	ND (5.0)
ETHYLBENZENE	µg/L	860	641	***1,190***	***990***	***960***	***1,100***	811	840	***890***
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	31.7	43.7	46	43	47	-	40	39
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	0.58 J	ND (1.00)	ND (0.2)	ND (1)	ND (1)	-	2.5 J	ND (5.0)
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	270	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (5.00)	60	160	150	-	100 J	93 J
TOLUENE	µg/L	430,000	3,340	2,920	1,000	1,100	1,200	799	420	390
1,2,4-TRIMETHYLBENZENE	µg/L	750	743	***823***	***760***	720	***790***	-	630	630
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	231	239	250	240	260	-	210	220
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	4,820	6,270	4,400	4,900	5,500	3,590	3,700	4,200
Volatile Organic Compounds (SW8011)										
1,2-DIBROMOETHANE (EDB)	µg/L	44	0.075	ND (0.0100)	ND (0.019)	ND (0.0094)	ND (0.0094)	-	ND (0.029)	ND (0.029)
Semi-Volatile Organic Compounds										
NAPHTHALENE	µg/L	1,300	-	-	230	230	200	-	160	190

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location						S-376			
Sample Date			8-Nov-18	16-Jan-19	9-Jul-19	20-Nov-19	12-Dec-19	3-Sep-20	12-May-21
Sample ID			S-376-20181108-WG	S-376-20190116-WG	S-376_SL_20190709	S-376_SL_20191120	S-376_CSIA_20191212	S-376_SL_20200903	S-376_SL_20210512
Sampling Company			AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			PACE	ESC	LL	LL	PACE	LANCASTER	LANCASTER
Laboratory Work Order			30271414	L1063104	2052789	2075960	30340757	410-12999-1	410-39710-1
Laboratory Sample ID		SVGW-NR	30271414003	L1063104-03	1097914	1208202	30340757005	410-12999-7	410-39710-4
	Units	SHS							
Volatile Organic Compounds									
BENZENE	µg/L	350	101	198	150 SL	160 SL	69.1	130 SL	***630 SL***
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1.0)	ND (10.0)	ND (10) SL	ND (5) SL	-	ND (10) SL	ND (5.0) SL
ETHYLBENZENE	µg/L	860	302	***1,160***	***970 SL***	***1,400 SL***	480	***930 SL***	490 SL
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	14.2	26.9	25 J SL	24 SL	-	18 J SL	13 J SL
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	3.4	ND (10.0)	ND (1) SL	1 J SL	-	2.4 J SL	6.4 SL
NAPHTHALENE	µg/L	1,300	-	-	-	-	372	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (50.0)	69 J SL	ND (25) SL	-	ND (500) SL	ND (250) SL
TOLUENE	µg/L	430,000	1,660	2,310	2,000 SL	3,800 SL	1,090	3,500 SL	1,000 SL
1,2,4-TRIMETHYLBENZENE	µg/L	750	***759***	***1,210***	***1,300 SL***	***1,600 SL***	-	***1,100 SL***	530 SL
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	284	373	420 SL	360 SL	-	330 SL	160 SL
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	3,930	6,220	6,100 SL	8,600 SL	4,450	6,400 SL	2,800 SL
Volatile Organic Compounds (SW8011)									
1,2-DIBROMOETHANE (EDB)	µg/L	44	0.079	ND (0.0100)	ND (0.0094) SL	ND (0.0095) SL	-	ND (0.029) SL	ND (0.029) SL
Semi-Volatile Organic Compounds									
NAPHTHALENE	µg/L	1,300	-	-	250 SL	270 SL	-	300 SL	160 SL

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-377					
Sample Date			12-Nov-18	17-Jan-19	19-Jun-19	5-Nov-19	10-Dec-19	3-Sep-20
Sample ID			S-377-20181112-WG	S-377-20190117-WG	S-377_20190619	S-377_20191105	S-377_CSIA_20191210	S-377_20200903
Sampling Company			AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			ESC	ESC	LL	LL	PACE	LANCASTER
Laboratory Work Order			L1044397	L1063104	2050556	2073111	30340757	410-12999-1
Laboratory Sample ID		SVGW-NR	L1044397-01	L1063104-04	1088308	1194612	30340757004	410-12999-6
	Units	SHS						
Volatile Organic Compounds								
BENZENE	µg/L	350	***966***	109	***860***	77	***1,560***	***1,000***
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (1.00)	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1.00)	ND (5.00)	ND (10)	ND (2)	-	ND (5.0)
ETHYLBENZENE	µg/L	860	290	221	110	74	53.0	100
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	41.8	37.8	28	12	-	36
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	ND (1.00)	ND (5.00)	12	ND (0.2)	-	13
NAPHTHALENE	µg/L	1,300	-	-	-	-	90.3 J	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	ND (25.0)	130	ND (10)	-	84 J
TOLUENE	µg/L	430,000	267	61.0	240	44	319	260
1,2,4-TRIMETHYLBENZENE	µg/L	750	405	284	89	170	-	93
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	194	129	77	120	-	110
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	873	494	410	350	384	600
Volatile Organic Compounds (SW8011)								
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	ND (0.0100)	ND (0.0095)	ND (0.0095)	-	ND (0.029)
Semi-Volatile Organic Compounds								
NAPHTHALENE	µg/L	1,300	-	-	33	34	-	44

See notes on last page.

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Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-378							S-379
Sample Date			12-Nov-18	17-Jan-19	19-Jun-19	23-Oct-19	10-Dec-19	2-Sep-20	6-May-21	12-Jun-13
Sample ID			S-378-20181112-WG	S-378-20190117-WG	S-378_20190619	S-378_20191023	S-378_CSIA_20191209	S-378_20200902	S-378_20210506	S-379_06_12_2013
Sampling Company			AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	LANGAN
Laboratory			ESC	ESC	LL	LL	PACE	LANCASTER	LANCASTER	ACCUTEST
Laboratory Work Order			L1044397	L1063104	2050556	2071371	30340757	410-12999-1	410-39001-1	JB39629
Laboratory Sample ID		SVGW-NR	L1044397-02	L1063104-05	1088309	1185678	30340757003	410-12999-1	410-39001-8	JB39629-16
	Units	SHS								
Volatile Organic Compounds										
BENZENE	µg/L	350	***1,890***	***1,390***	***3,000***	***2,600***	***1,660***	***3,100***	***1,500***	19.9
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (10.0)	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (10.0)	ND (5.00)	ND (10)	ND (20)	-	ND (10)	ND (5.0)	ND (1)
ETHYLBENZENE	µg/L	860	***1,040***	***1,090***	***1,300***	***1,400***	848	740	***910***	1.5
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	57.0	55.0	48	50 J	-	48 J	43	3.4
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	10.6	ND (5.00)	ND (1)	ND (2)	-	5.9 J	ND (5.0)	ND (1)
NAPHTHALENE	µg/L	1,300	-	-	-	-	271	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	-	130	130	130 J	-	170 J	ND (2,500)	-
TOLUENE	µg/L	430,000	504	325	450	510	360	320	270	0.54 J
1,2,4-TRIMETHYLBENZENE	µg/L	750	***898***	722	***890***	***940***	-	510	570	0.53 J
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	337	289	320	330	-	190	220	3.9
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	1,520	1,270	1,300	1,700	660	730	730	1.3
Volatile Organic Compounds (SW8011)										
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	ND (0.0100)	ND (0.0095)	ND (0.0094)	-	ND (0.029)	ND (0.029)	ND (0.02)
Semi-Volatile Organic Compounds										
NAPHTHALENE	µg/L	1,300	-	-	320	330	-	130	220	ND (0.1)

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-380						S-440		S-440_CD	
Sample Date			12-Jun-13	12-Aug-16	10-Oct-16	10-Oct-16	17-May-17	26-Jun-18	31-Aug-20	12-May-21	16-Jun-20	17-Jun-20
Sample ID			S-380_06_12_2013	S-380-20160812-WG	S-380-20161010-WG	S-380-20161010-WG-DUP	S-380-20170517	S-380_20180626	S-440_20200831	S-440_20210512	CD-15-W-25.0-20200616	CD-15-W-40.0-20200617
Sampling Company			LANGAN	AQUATERRA	AQUATERRA	AQUATERRA	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			ACCUTEST	ESC	ESC	ESC	LL	ESC	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			JB39629	L853817	L865153	L865153	1803720	L1005209	410-12585-1	410-39710-1	410-4783-1	410-4783-1
Laboratory Sample ID		SVGW-NR	JB39629-17	L853817-03	L865153-08	L865153-11	9003664	L1005209-11	410-12585-1	410-39710-1	410-4783-3	410-4783-4
	Units	SHS										
Volatile Organic Compounds												
BENZENE	µg/L	350	2.1	ND (1.00)	ND (1.00)	ND (1.00)	ND (0.5)	ND (1.00)	ND (1.0)	0.94 J	ND (1.0)	ND (1.0)
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	ND (1.00)	ND (1.00)	ND (1.00)	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (1)	ND (1.00)	ND (1.00)	ND (1.00)	ND (0.5)	ND (1.00)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
ETHYLBENZENE	µg/L	860	0.26 J	ND (1.00)	ND (1.00)	ND (1.00)	ND (0.5)	ND (1.00)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	ND (2)	ND (1.00)	ND (1.00)	ND (1.00)	ND (0.5)	ND (1.00)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	ND (1)	ND (1.00)	ND (1.00)	ND (1.00)	ND (0.5)	ND (1.00)	5.3	ND (1.0)	6.4	49
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	-	-	-	ND (5.0)	ND (5.0)
TERT-BUTYL ALCOHOL	µg/L	n/v	-	-	-	-	-	-	170	ND (50)	ND (50)	1,200 E
TOLUENE	µg/L	430,000	0.27 J	14.7	ND (5.00)	ND (5.00)	ND (0.5)	ND (1.00)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
1,2,4-TRIMETHYLBENZENE	µg/L	750	ND (2)	ND (1.00)	ND (1.00)	ND (1.00)	ND (0.5)	ND (1.00)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	ND (2)	ND (1.00)	ND (1.00)	ND (1.00)	ND (0.5)	ND (1.00)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	0.45 J	ND (3.00)	ND (3.00)	ND (3.00)	ND (0.5)	ND (3.00)	ND (6.0)	ND (6.0)	ND (6.0)	ND (6.0)
Volatile Organic Compounds (SW8011)												
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.02)	ND (0.0100)	ND (0.0100)	ND (0.0100)	ND (0.0097)	ND (0.0100)	ND (0.029)	ND (0.028)	ND (0.029)	0.036
Semi-Volatile Organic Compounds												
NAPHTHALENE	µg/L	1,300	ND (0.1)	ND (0.250)	ND (0.250)	ND (0.250)	ND (0.1)	ND (0.250)	ND (0.51)	ND (0.50)	-	-

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-441		S-441_CD				S-442		S-442_CD	
Sample Date			31-Aug-20	5-May-21	22-Jul-20	22-Jul-20	23-Jul-20	23-Jul-20	31-Aug-20	5-May-21	14-Jul-20	15-Jul-20
Sample ID			S-441_20200831	S-441_20210505	CD-6A-W-19.0-20200722	CD-6A-W-19.0-20200722	CD-6A-W-44.0-20200723	CD-6A-W-44.0-20200723	S-442_20200831	S-442_20210505	CD-5-W-20.0-202007	CD-5-W-44.0-20200715
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-12585-1	410-38735-1	410-14623-1	410-8574-1	410-14623-1	410-8574-1	410-12585-1	410-38735-1	410-7802-1	410-7956-1
Laboratory Sample ID	Units	SVGW-NR SHS	410-12585-3	410-38735-12	410-14623-2	410-8574-1	410-14623-3	410-8574-2	410-12585-4	410-38735-2	410-7802-1	410-7956-1
Volatile Organic Compounds												
BENZENE	µg/L	350	***420***	***360***	-	5.3	-	220	***1,100***	***1,100***	15	***1,100***
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (5.0)	2.0 J	-	ND (5.0)	-	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
ETHYLBENZENE	µg/L	860	19	23	-	21	-	78	66	18	220	170
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	24 J	19 J	-	16 J	-	12 J	17 J	15 J	42	23 J
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	6.9	6.0	-	ND (5.0)	-	ND (5.0)	14	13	ND (5.0)	8.1
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (250)	ND (250)	-	ND (250)	-	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)
TOLUENE	µg/L	430,000	120	120	-	18	-	230	62	21	110	230
1,2,4-TRIMETHYLBENZENE	µg/L	750	41	22 J	-	270	-	140	140	34	730	300
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	28	17 J	-	55	-	48	65	ND (25)	230	110
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	180	150	-	57	-	460	310	20 J	970	940
Volatile Organic Compounds (SW8011)												
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.029)	ND (0.028)	ND (0.029) H H3	-	ND (0.029) H H3	-	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)
Semi-Volatile Organic Compounds												
NAPHTHALENE	µg/L	1,300	3.8	4.8	-	8.9	-	19	14	1.6	83	50 B

See notes on last page.

Stantec

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-443		S-443_CD		S-444		S-444_CD	S-445		S-445_CD
Sample Date			31-Aug-20	5-May-21	20-Jul-20	21-Jul-20	31-Aug-20	6-May-21	9-Jul-20	1-Sep-20	5-May-21	7-Jul-20
Sample ID			S-443_20200831	S-443_20210505	CD-6C-W-19.0-20200720	CD-6C-W-40.0-20200721	S-444_20200831	S-444_20210506	CD-13A-W-39.0-20200709	S-445_20200901	S-445_20210505	CD-13B-W-40.0-20200707
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-12585-1	410-38735-1	410-8309-1	410-8309-1	410-12585-1	410-39001-1	410-7163-1	410-12585-1	410-38735-1	410-6786-1
Laboratory Sample ID	Units	SVGW-NR SHS	410-12585-5	410-38735-10	410-8309-1	410-8309-2	410-12585-6	410-39001-1	410-7163-2	410-12585-7	410-38735-7	410-6786-1
Volatile Organic Compounds												
BENZENE	µg/L	350	***450***	130	***780***	***360***	6.9	5.6	3.5 J	***500***	***410***	***480***
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)
ETHYLBENZENE	µg/L	860	180	31	***1,000***	180	320	540	430	68	49	59
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	11 J	7.3 J	20 J	11 J	67	50	85	28	22 J	45
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	11	11	4.2 J	11	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)
NAPHTHALENE	µg/L	1,300	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (250)	ND (50)
TOLUENE	µg/L	430,000	250	7.3	72	350	110	150	94	130	100	120
1,2,4-TRIMETHYLBENZENE	µg/L	750	430	190	710	390	28	24 J	24 J	20 J	14 J	33
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	150	4.0 J	280	130	30	25	26	12 J	8.1 J	19
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	1,000	18 J	2,400	1,000	230	360	310	110	90	130
Volatile Organic Compounds (SW8011)												
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029) H	ND (0.029)	ND (0.029)	ND (0.028)
Semi-Volatile Organic Compounds												
NAPHTHALENE	µg/L	1,300	61	6.7	140	39	33	85	47	24	17	19

See notes on last page.

Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Sample Location			S-446			S-446_CD		S-448		S-448_CD
Sample Date			1-Sep-20	1-Sep-20	5-May-21	18-Jun-20	19-Jun-20	2-Sep-20	6-May-21	11-Aug-20
Sample ID			DUP-1	S-446_20200901	S-446_20210505	CD-12-W-25.0-20200618	CD-12-W-45.0-20200619	S-448_20200902	S-448_20210506	CD-14-W-23.0-20200811
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER	LANCASTER
Laboratory Work Order			410-12585-1	410-12585-1	410-38735-1	410-4913-1	410-5078-1	410-12761-1	410-39001-1	410-10488-1
Laboratory Sample ID		SVGW-NR	410-12585-9	410-12585-8	410-38735-4	410-4913-2	410-5078-1	410-12761-5	410-39001-6	410-10488-1
	Units	SHS								
Volatile Organic Compounds										
BENZENE	µg/L	350	ND (5.0)	ND (5.0)	1.2 J	ND (1.0)	ND (1.0)	0.23 J	3.5	18 J
1,2-DIBROMOETHANE (EDB)	µg/L	44	-	-	-	-	-	-	-	-
1,2-DICHLOROETHANE (EDC)	µg/L	510	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (20)
ETHYLBENZENE	µg/L	860	170	180	170	3.7	160	6.7	ND (1.0)	***1,400***
ISOPROPYLBENZENE (CUMENE)	µg/L	24,000	54	59	49	9.2	44	1.7 J	ND (5.0)	54 J
METHYL TERTIARY BUTYL ETHER	µg/L	96,000	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	3.0	2.9	ND (20)
NAPHTHALENE	µg/L	1,300	-	-	-	1.8 J	-	-	-	-
TERT-BUTYL ALCOHOL	µg/L	n/v	ND (250)	ND (250)	ND (250)	ND (50)	ND (50)	ND (50)	ND (50)	ND (1,000)
TOLUENE	µg/L	430,000	59	66	81	0.81 J	78	0.47 J	ND (1.0)	700
1,2,4-TRIMETHYLBENZENE	µg/L	750	5.3 J	5.8 J	ND (25)	ND (5.0)	6.7	1.7 J	ND (5.0)	***800***
1,3,5-TRIMETHYLBENZENE	µg/L	1,200	8.7 J	9.9 J	3.3 J	0.53 J	9.0	3.3 J	ND (5.0)	320
XYLENES, TOTAL (DIMETHYLBENZENE)	µg/L	12,000	180	200	190	ND (6.0)	160	5.2 J	ND (6.0)	3,000
Volatile Organic Compounds (SW8011)										
1,2-DIBROMOETHANE (EDB)	µg/L	44	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.029)	ND (0.028)	ND (0.030)
Semi-Volatile Organic Compounds										
NAPHTHALENE	µg/L	1,300	56	54	53	-	58	1.2	ND (0.52)	380

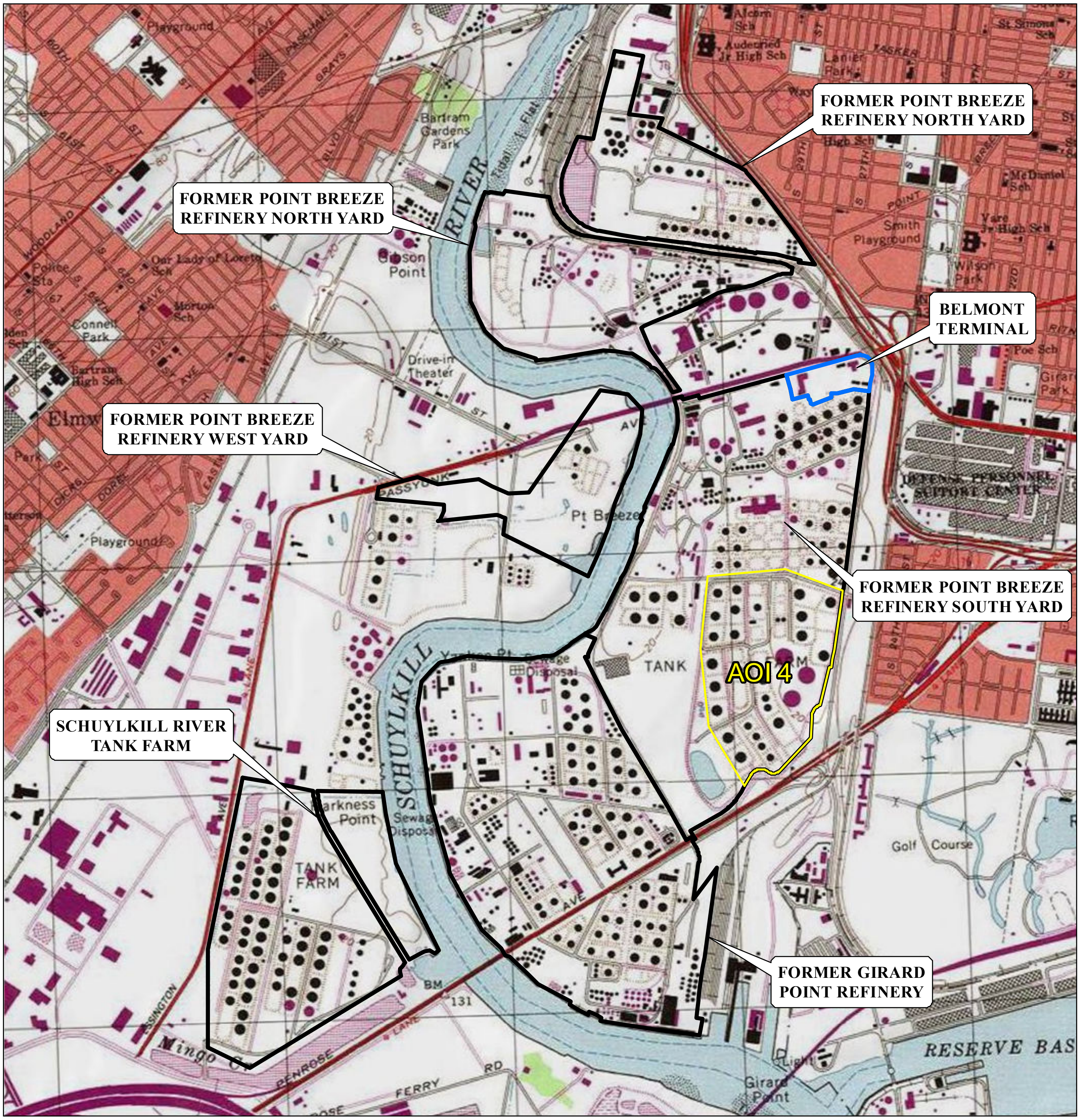
See notes on last page.

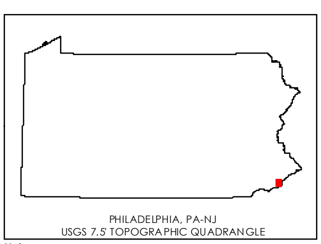
Table 3-1
Perimeter Area Groundwater to Indoor Air Screening – Statewide Health Standard
Area of Interest 4, Former Philadelphia Refining Complex
Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC

Notes:

SVGW-NR SHS	PADEP Vapor Intrusion Screening Values, Groundwater Statewide Health Standard, Non-Residential
6.5	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
ND (0.03)	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value
-	Parameter not analyzed / not available
B	Indicates the analyte is detected in the associated blank as well as in the sample.
E	Indicates compounds whose concentrations exceed the calibration range of the instrument.
H	Sample was prepped or analyzed beyond the specified holding time.
H3	Sample was received and analyzed past holding time.
J	Indicates an estimated value
SL	Sample was collected below LNAPL
µg/L	Micrograms per liter

FIGURES





LEGEND

- AREA OF INTEREST (AOI) 4 BOUNDARY
- BELMONT TERMINAL BOUNDARY
- FORMER PHILADELPHIA REFINERY

0 1,100 2,200 Feet

1:26,400 (at original document size of 8.5x11)

N

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Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
2. Source: Stantec
3. Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed

Project Location 213402602

City of Philadelphia, Philadelphia County, Pennsylvania

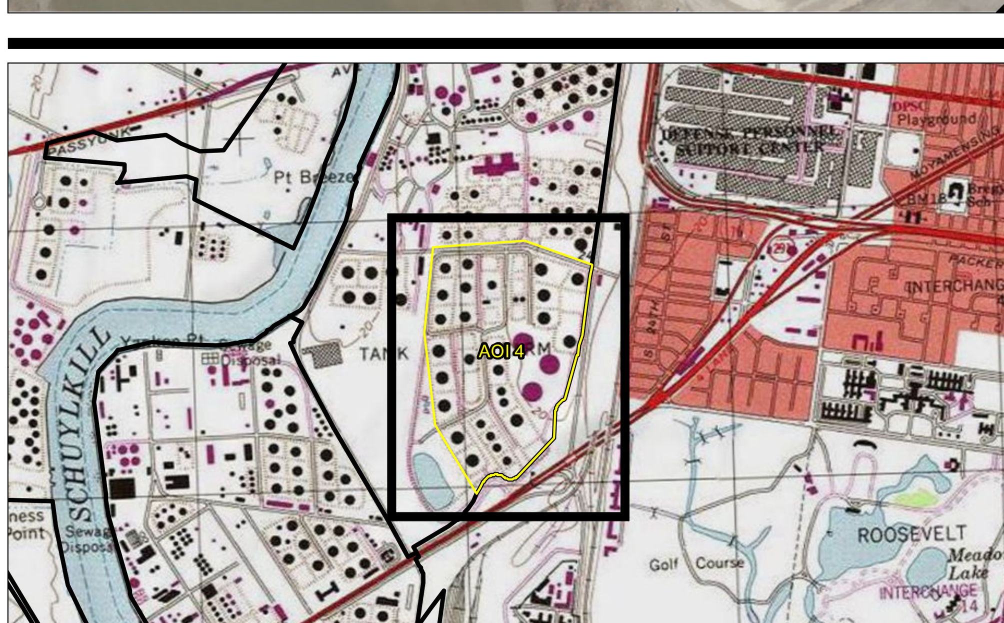
Prepared by GWC on 8/16/2021
Technical Review by JKK on 9/9/2021
Independent Review by JLM on 9/14/2021

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE
PHILADELPHIA, PA 19145

Figure No.
1-1

Title
SITE LOCATION MAP



LEGEND

- MONITORING WELL - UNCONFINED
- MONITORING WELL - LOWER AQUIFER
- DAMAGED MONITORING WELL
- DESTROYED MONITORING WELL
- REMEDIATION SYSTEM PIPING
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 30 TANK ID

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Figure No.

1-2

Title

SITE PLAN

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Project Location

213402602

City of Philadelphia,
Philadelphia County,
Pennsylvania

Prepared by GWC on 8/16/2021
Technical Review by JKK on 9/9/2021
Independent Review by JLM on 9/14/2021

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
2. Sources: Stantec
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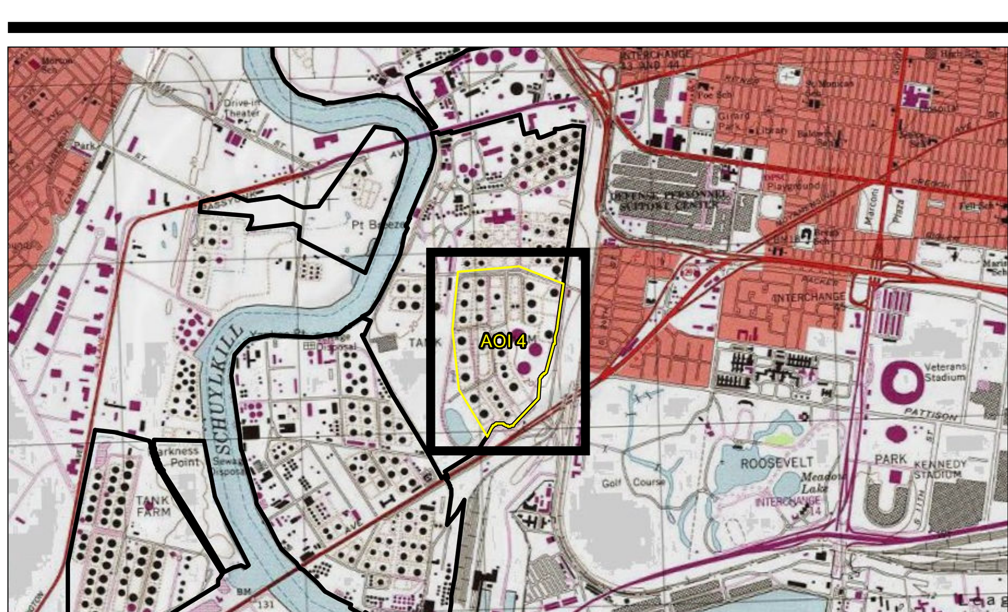

LEGEND

- AMBIENT AIR SAMPLE 2017
- INDOOR AIR SAMPLE 2017
- MONITORING WELL INSTALLED 2018
- MONITORING WELL INSTALLED 2018, DESTROYED 2020
- LNAPL SAMPLE COLLECTED 2017-2020
- LNAPL TRANSMISSIVITY TESTING 2018-2019
- MONITORING WELL INSTALLED 2020
- TEMPORARY WELL POINT INSTALLED 2020
- SHALLOW SOIL SAMPLE COLLECTED 2021
- SOIL BORING COMPLETED 2021
- FOSSIL FUEL TRAP DEPLOYED 2021
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- INTERIM REMEDIAL ACTION 2018
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 30 TANK ID

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
2. Sources: Stantec
3. LNAPL - Light Non-Aqueous Phase Liquid
4. Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

2-1

Title

ADDITIONAL CHARACTERIZATION ACTIVITIES: 2017-2021

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

213402602
Prepared by GWC on 8/16/2021
Technical Review by JKK on 9/9/2021
Independent Review by JLM on 9/14/2021

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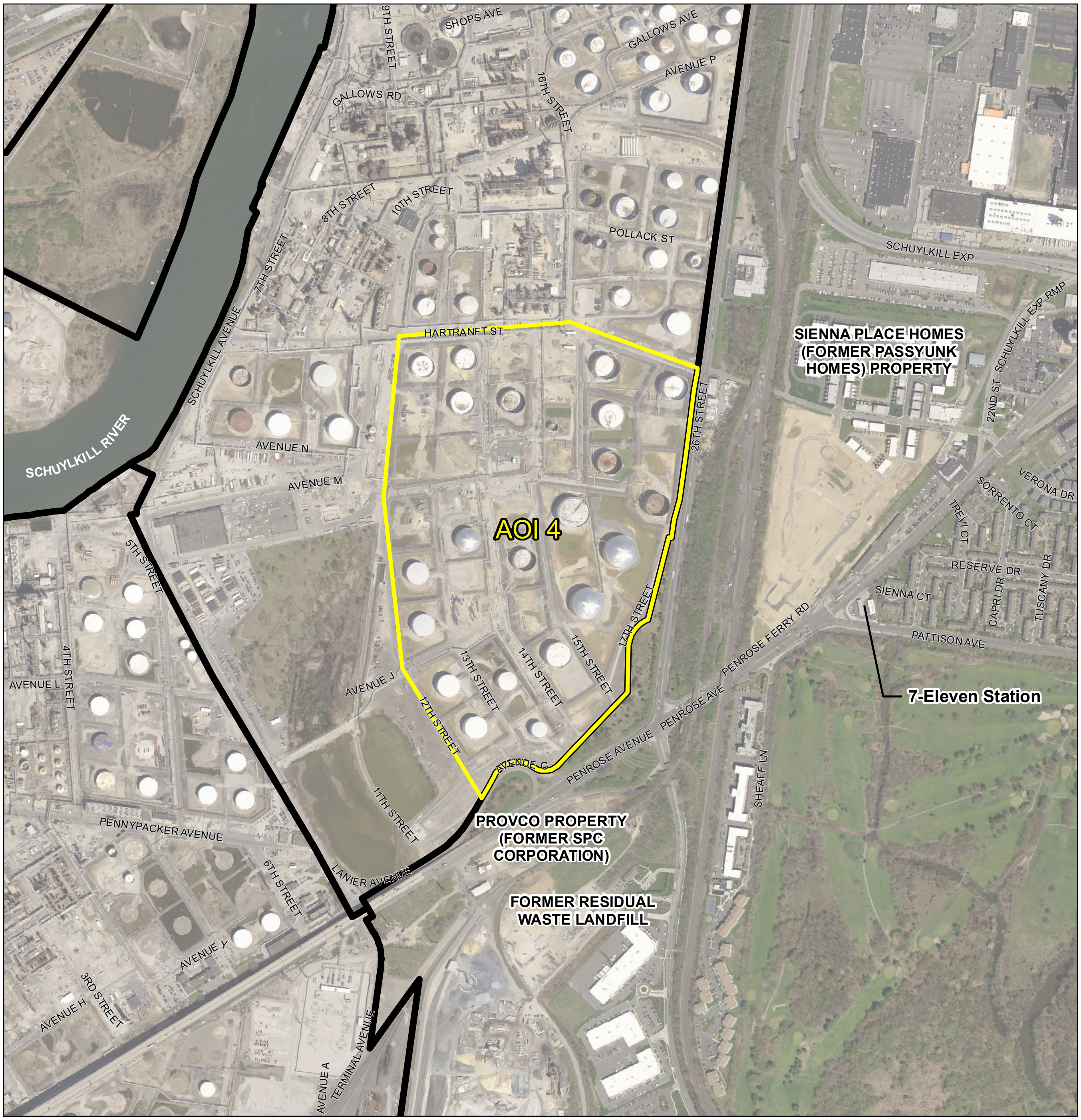

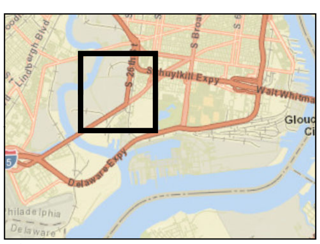

LEGEND

AREA OF INTEREST (AOI) 4 BOUNDARY

FORMER PHILADELPHIA REFINERY

0 500 1,000 Feet

1:12,000 (at original document size of 8.5x11)

N

Stantec

EVERGREEN

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
2. Source: Stantec
3. Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community PEMA Philadelphia County 2018 Aerial Imagery

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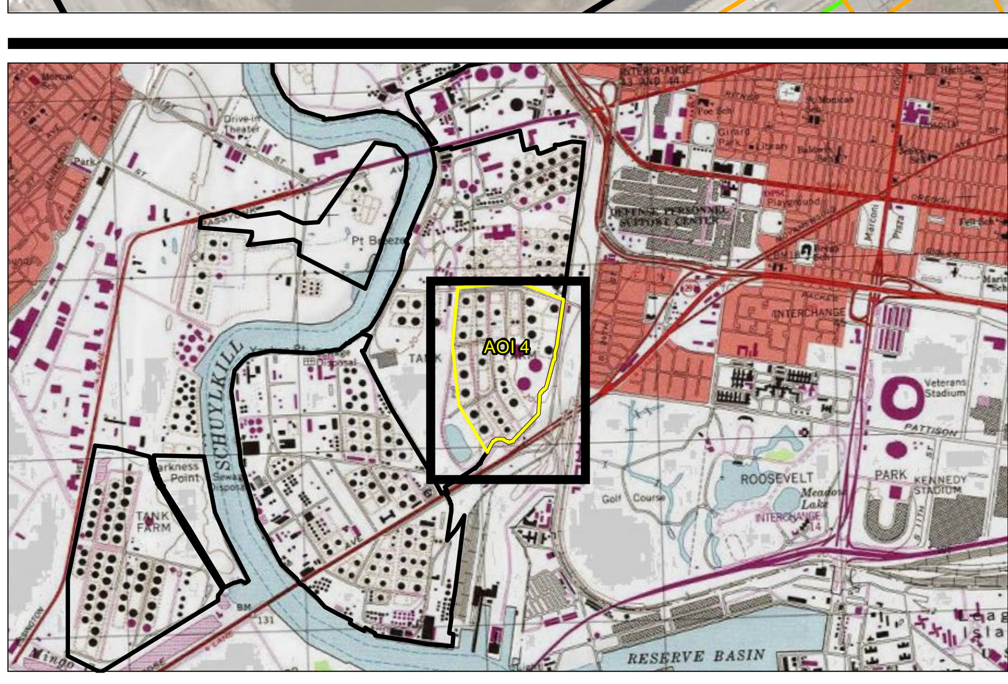
Project Location
City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by GWC on 9/2/2021
Technical Review by JKK on 9/7/2021
Independent Review by JLM on 9/14/2021

Client/Project
PHILADELPHIA REFINERY OPERATIONS, A SERIES OF
EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE
PHILADELPHIA, PA 19145

Figure No.
2-2

Title
FILE REVIEW:
PROPERTY LOCATIONS



LEGEND

- GROUNDWATER EXCEEDANCE OF THE PADEP GROUNDWATER STATEWIDE HEALTH STANDARD VAPOR INTRUSION SCREENING VALUES, NON-RESIDENTIAL (SVGW-NR), DETECTED DURING 2013 TO 2021 (UNCONFINED PROPERTY BOUNDARY AREA WELL)
- NO GROUNDWATER EXCEEDANCE OF THE SVGW-NR, DETECTED DURING 2013 TO 2021 (UNCONFINED PROPERTY BOUNDARY AREA WELL)
- MONITORING WELL LOCATION
- AMBIENT AIR SAMPLE (2017)
- INDOOR AIR SAMPLE (2017)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- APPROXIMATE STORM SEWER LINE
- APPROXIMATE SANITARY SEWER LINE
- APPROXIMATE PROCESS SEWER LINE
- PIPELINE LOCATIONS (APPROXIMATE)
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 30 TANK ID
- 3.61 APPARENT LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL) THICKNESS (FEET): MAXIMUM 2017-2021
- <0.01 LNAPL SHEEN
- ND LNAPL NOT DETECTED DURING 2017-2021

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
2. Sources: Stantec
3. For the temporary well locations, results from the shallowest sampling interval are shown.
4. For locations with multiple depth-discrete groundwater samples, the results for the shallowest samples are shown.
5. Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Figure No.

3-1

Title

VAPOR INTRUSION ASSESSMENT

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

213402602

Prepared by GWC on 9/17/2021
Technical Review by JKK on 9/21/2021
Independent Review by JLM on 9/23/2021

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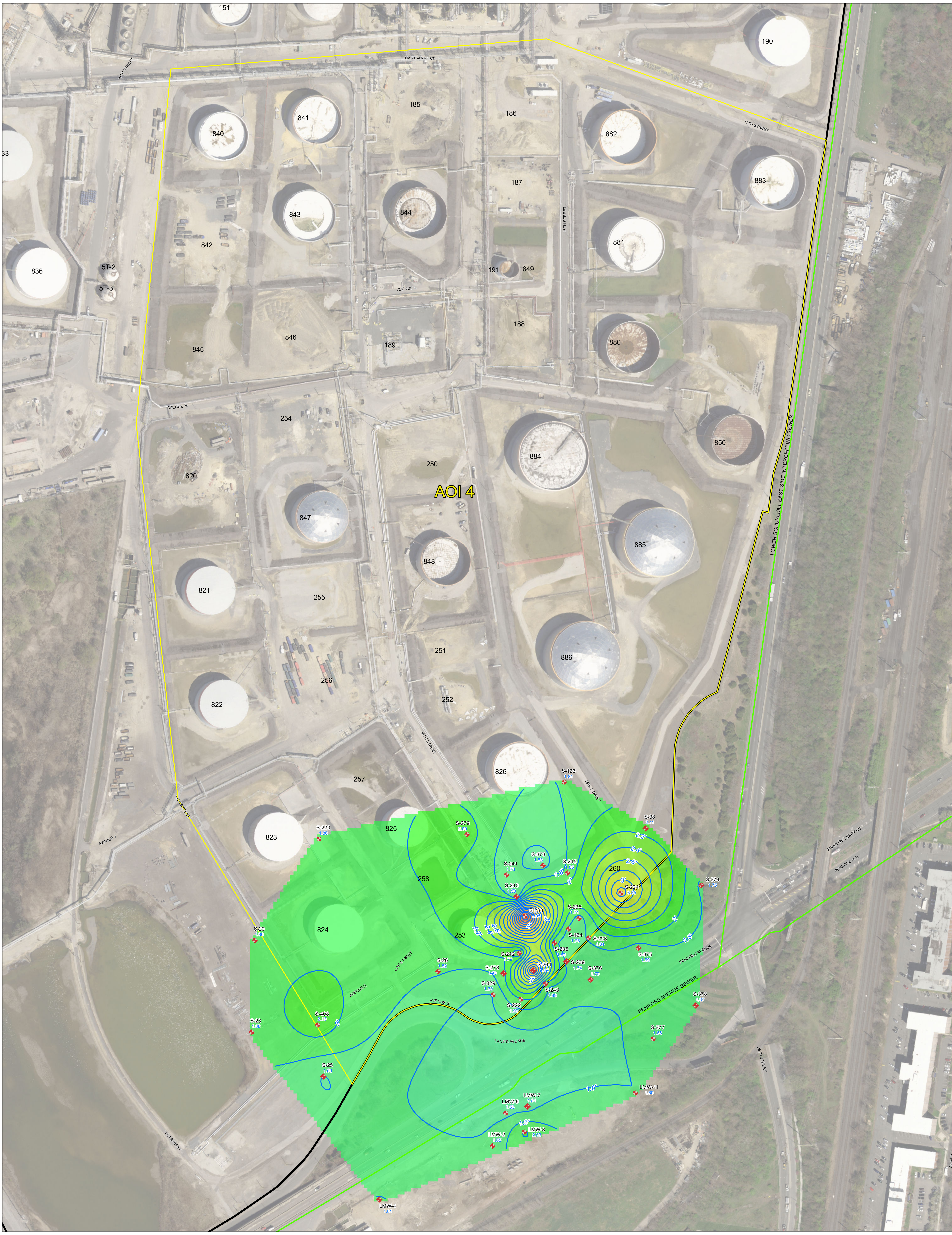

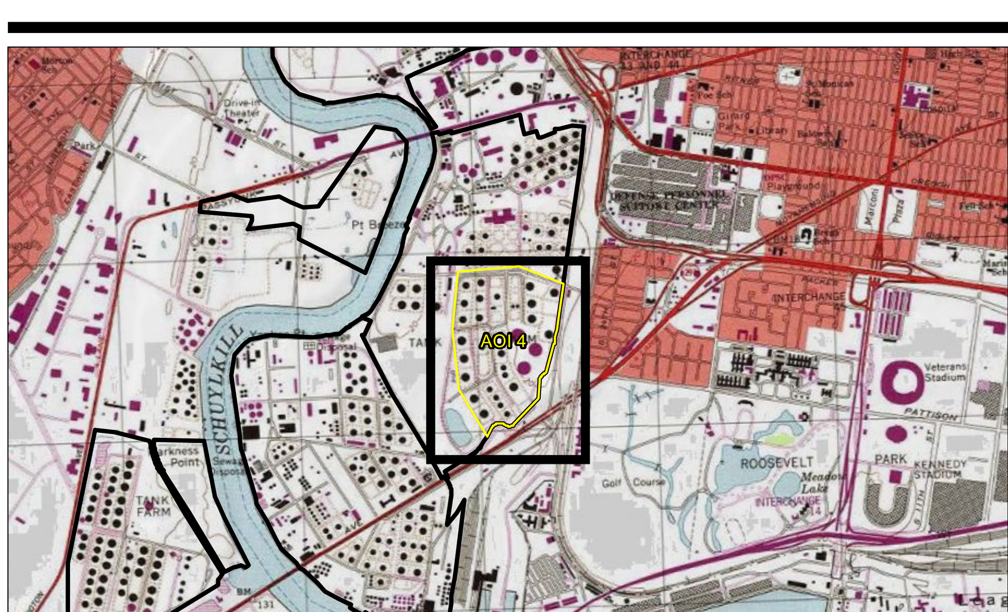

LEGEND

- MONITORING WELL SCREENED IN UNCONFINED AQUIFER, UTILIZED FOR NOVEMBER 2018 ELEVATION SURFACE
- WATER-TABLE ELEVATION CONTOUR (FEET NAVD 88)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 5.05 CORRECTED GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

NOVEMBER 2018 WATER-TABLE ELEVATION FT NAVD88

4.8 to 5.0	2.8 to 3.0
4.4 to 4.6	2.6 to 2.8
4.2 to 4.4	2.4 to 2.6
4.0 to 4.2	2.2 to 2.4
3.8 to 4.0	2.0 to 2.2
3.6 to 3.8	1.8 to 2.0
3.4 to 3.6	1.6 to 1.8
3.2 to 3.4	1.4 to 1.6
3.0 to 3.2	

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Figure No.

4-1a

Title

UNCONFINED AQUIFER ELEVATION, NOVEMBER 2018

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Project Location

213402602

City of Philadelphia,
Philadelphia County,
Pennsylvania

Prepared by GWC on 9/20/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 unconfined aquifer elevation within the limits of the available well data.
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Stantec

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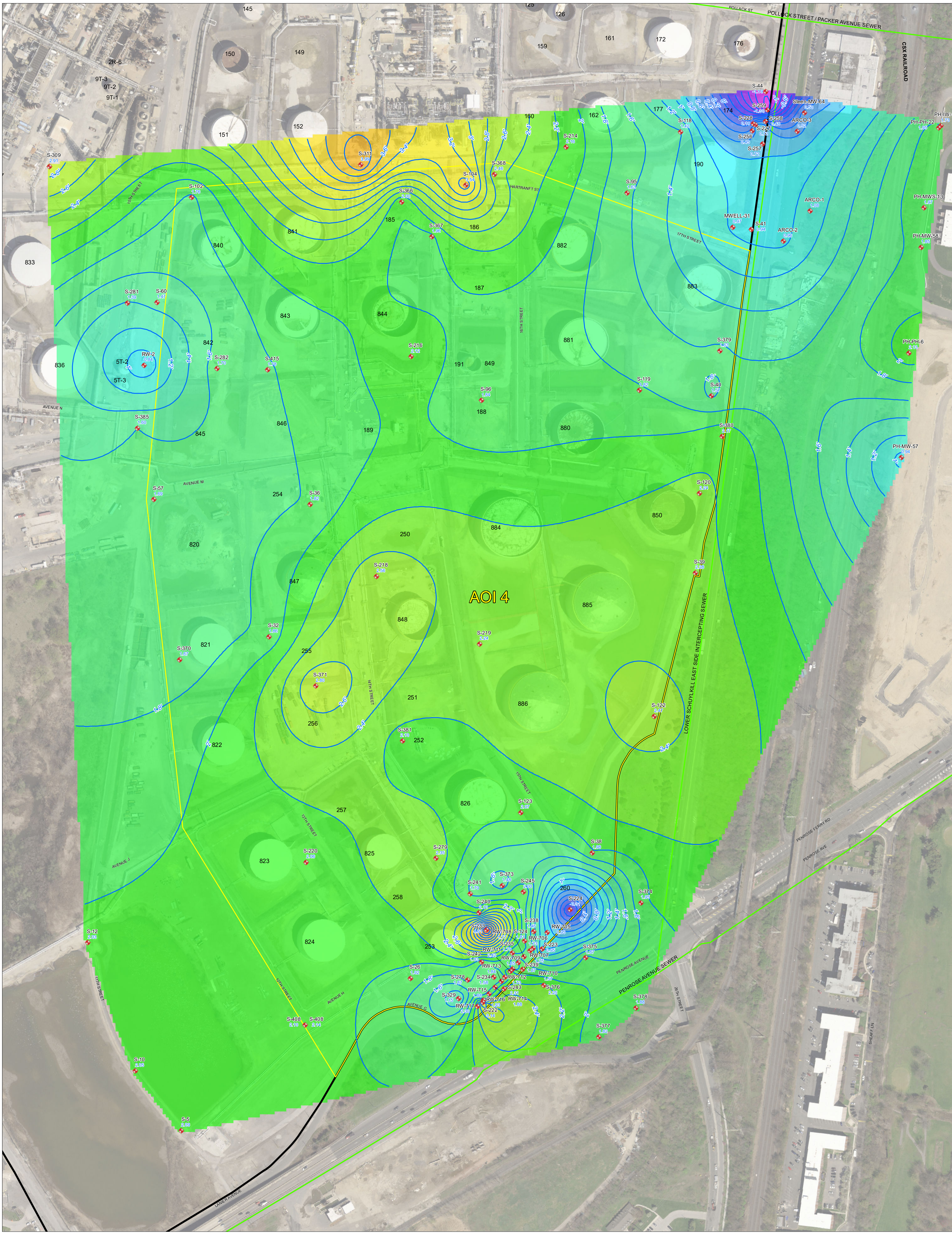
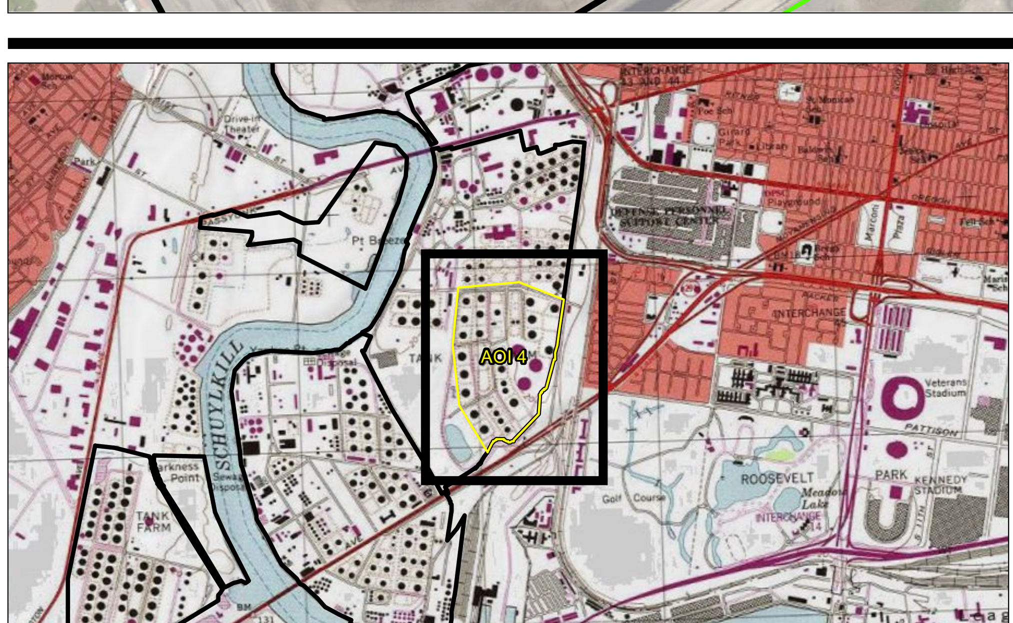




LEGEND

- MONITORING WELL SCREENED IN UNCONFINED AQUIFER, UTILIZED FOR JUNE 2019 ELEVATION SURFACE
- WATER-TABLE ELEVATION CONTOUR (FEET NAVD 88)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- -0.31 CORRECTED GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

JUNE 2019 WATER-TABLE ELEVATION FT NAVD88

4.4 to 4.6	1.4 to 1.6
4.2 to 4.4	1.2 to 1.4
4.0 to 4.2	1.0 to 1.2
3.8 to 4.0	0.8 to 1.0
3.6 to 3.8	0.6 to 0.8
3.4 to 3.6	0.4 to 0.6
3.2 to 3.4	0.2 to 0.4
3.0 to 3.2	0 to 0.2
2.8 to 3.0	-0.2 to 0
2.6 to 2.8	-0.4 to -0.2
2.4 to 2.6	-0.6 to -0.4
2.2 to 2.4	-0.8 to -0.6
2.0 to 2.2	-1.0 to -0.8
1.8 to 2.0	-1.2 to -1.0
1.6 to 1.8	-1.4 to -1.2

0 160 320 Feet

1:1,920 (At original document size of 22x34)

N

Figure No.

4-1b

Title

UNCONFINED AQUIFER ELEVATION, JUNE 2019

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF
EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

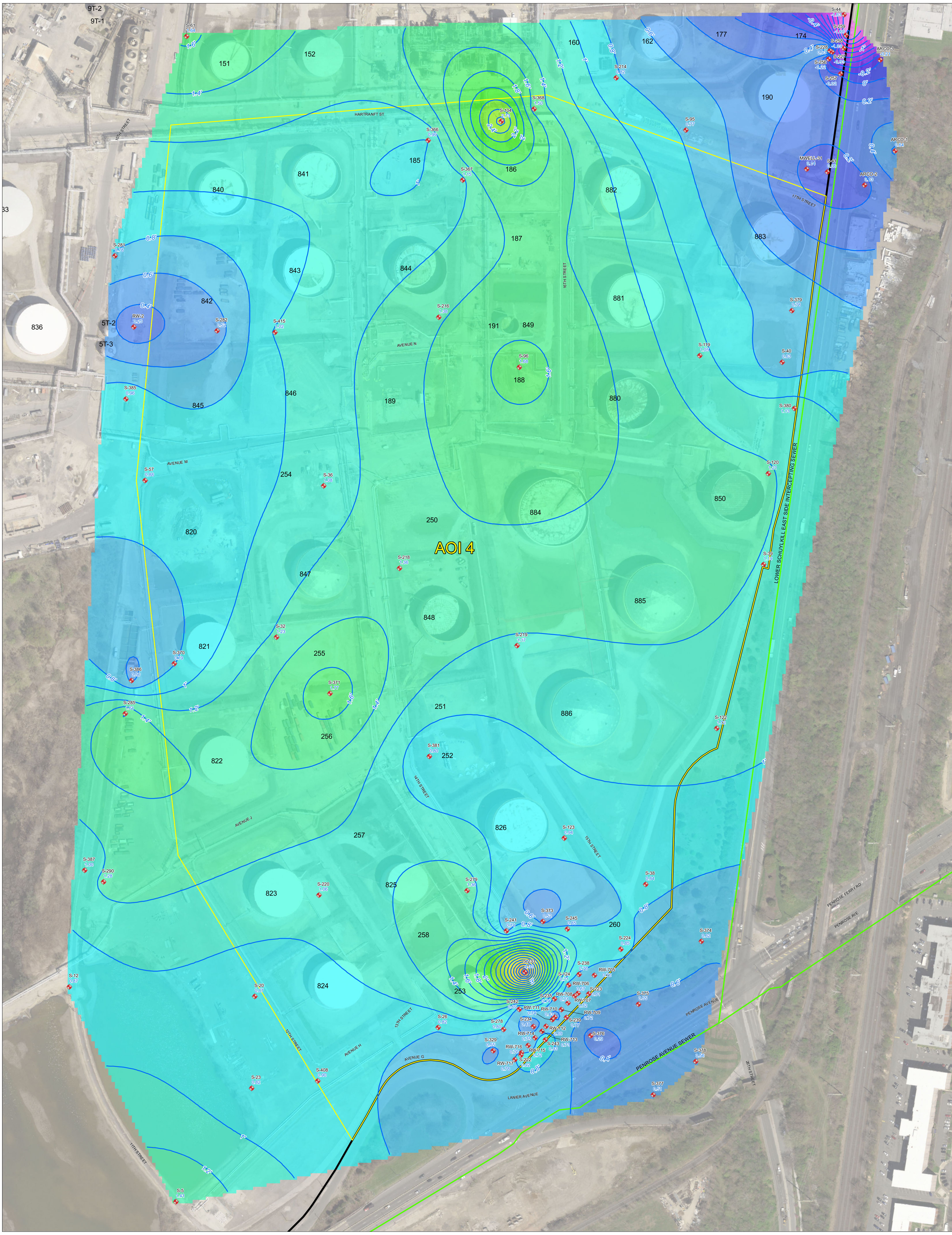
Project Location

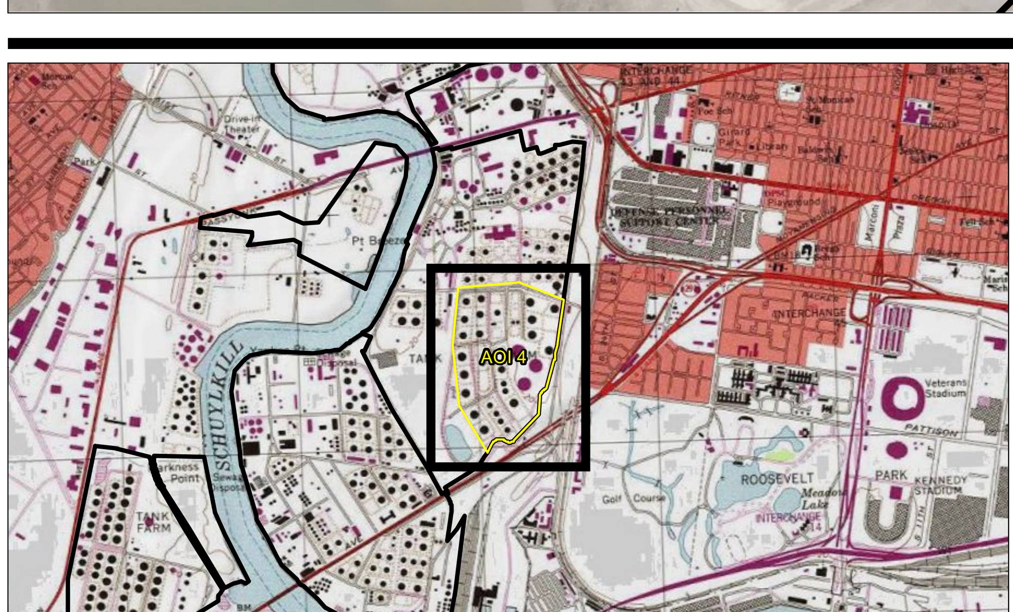
City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by GWC on 9/20/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 unconfined aquifer elevation within the limits of the available well data.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery





LEGEND

- MONITORING WELL SCREENED IN UNCONFINED AQUIFER, UTILIZED FOR OCTOBER 2019 ELEVATION SURFACE
- WATER-TABLE ELEVATION CONTOUR (FEET NAVD 88)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 2.73 CORRECTED GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

OCTOBER 2019 WATER-TABLE ELEVATION FT NAVD88

4.2 to 4.4	2.0 to 2.2	-0.2 to 0
4.0 to 4.2	1.8 to 2.0	-0.4 to -0.2
3.8 to 4.0	1.6 to 1.8	-0.6 to -0.4
3.6 to 3.8	1.4 to 1.6	-0.8 to -0.6
3.4 to 3.6	1.2 to 1.4	-1.0 to -0.8
3.2 to 3.4	1.0 to 1.2	-1.2 to -1.0
3.0 to 3.2	0.8 to 1.0	-1.4 to -1.2
2.8 to 3.0	0.6 to 0.8	-1.6 to -1.4
2.6 to 2.8	0.4 to 0.6	-1.8 to -1.6
2.4 to 2.6	0.2 to 0.4	-2.0 to -1.8
2.2 to 2.4	0 to 0.2	

0 140 280 Feet
1:1,680 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
   North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 unconfined aquifer elevation within the limits of the available well data.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed
   PEMA Philadelphia County 2018 Aerial Imagery

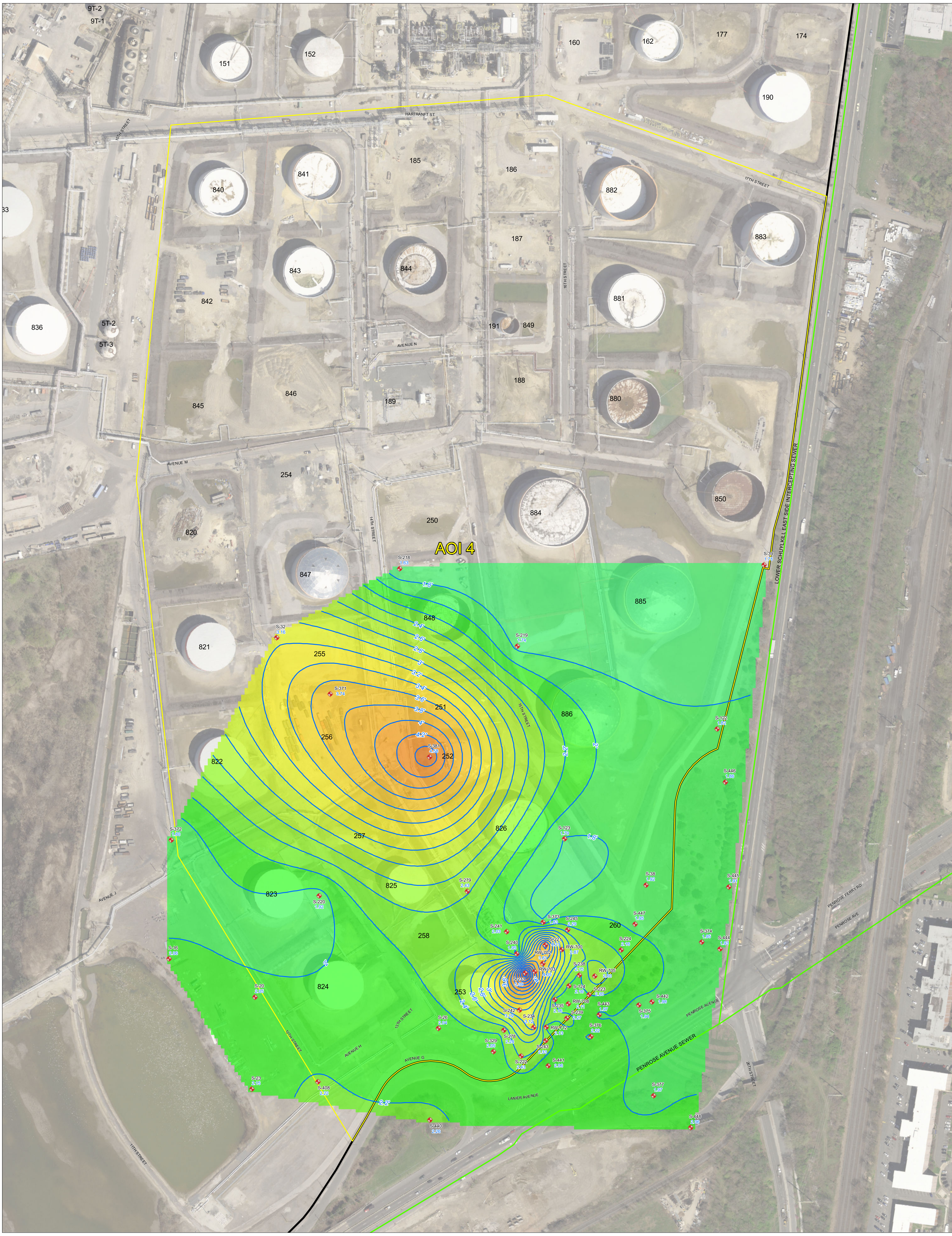
Figure No.
4-1c

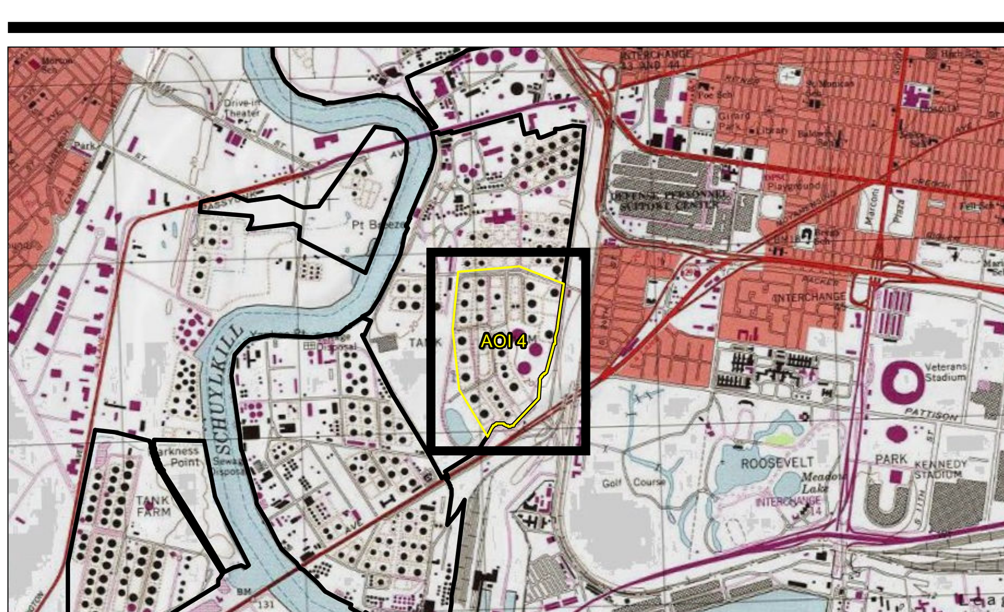
Title
UNCONFINED AQUIFER ELEVATION, OCTOBER 2019

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

213402602
Prepared by GWC on 9/20/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021





LEGEND

- MONITORING WELL SCREENED IN UNCONFINED AQUIFER, UTILIZED FOR DECEMBER 2020 ELEVATION SURFACE
- WATER-TABLE ELEVATION CONTOUR (FEET NAVD 88)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 2.43 CORRECTED GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

DECEMBER 2020 WATER-TABLE ELEVATION FT NAVD88

5.2 to 5.4	3.2 to 3.4
5.0 to 5.2	3.0 to 3.2
4.8 to 5.0	2.8 to 3.0
4.6 to 4.8	2.6 to 2.8
4.4 to 4.6	2.4 to 2.6
4.2 to 4.4	2.2 to 2.4
4.0 to 4.2	2.0 to 2.2
3.8 to 4.0	1.8 to 2.0
3.6 to 3.8	1.6 to 1.8
3.4 to 3.6	

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Figure No.

4-1d

Title

UNCONFINED AQUIFER ELEVATION, DECEMBER 2020

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

213402602

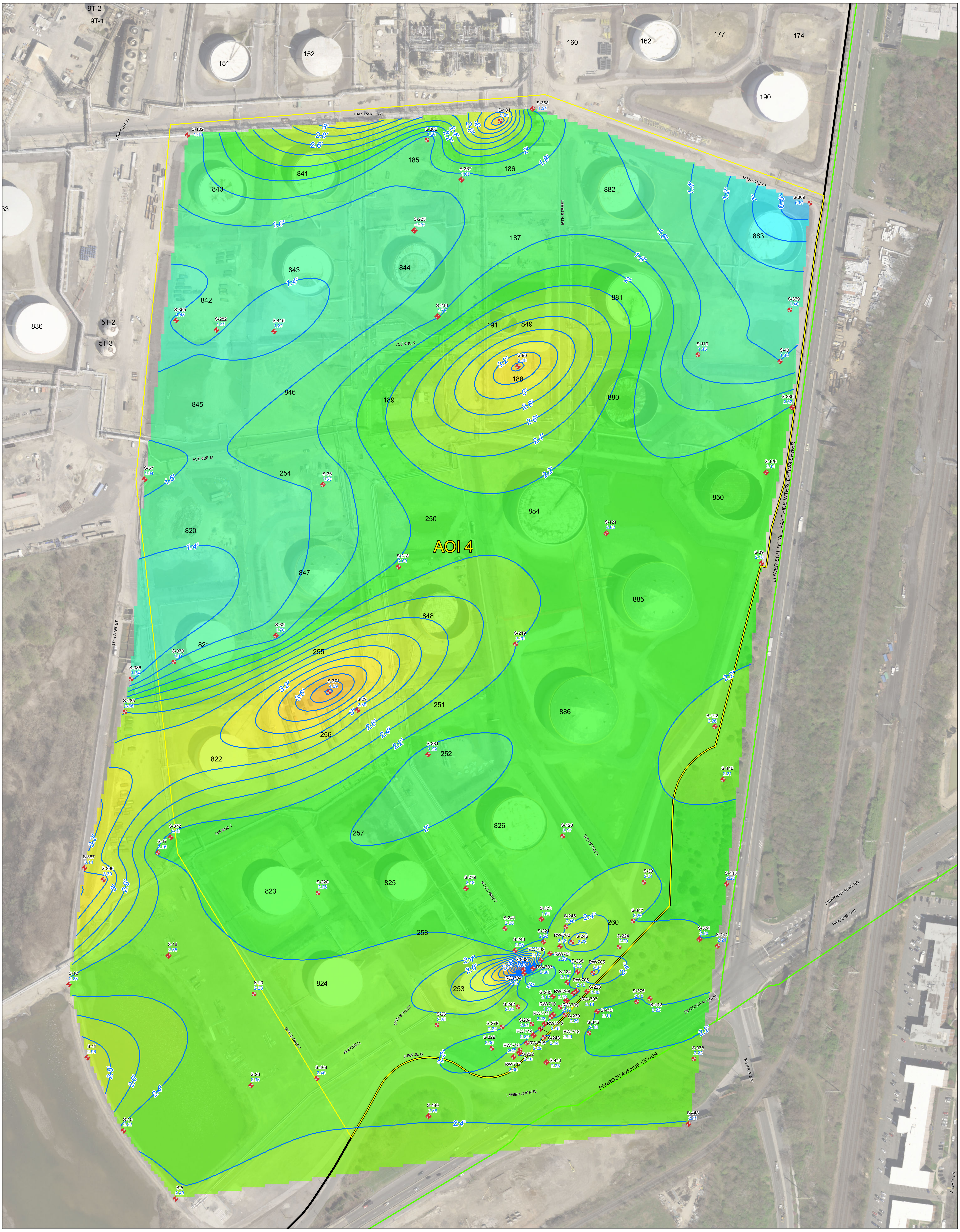
Prepared by GWC on 9/27/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

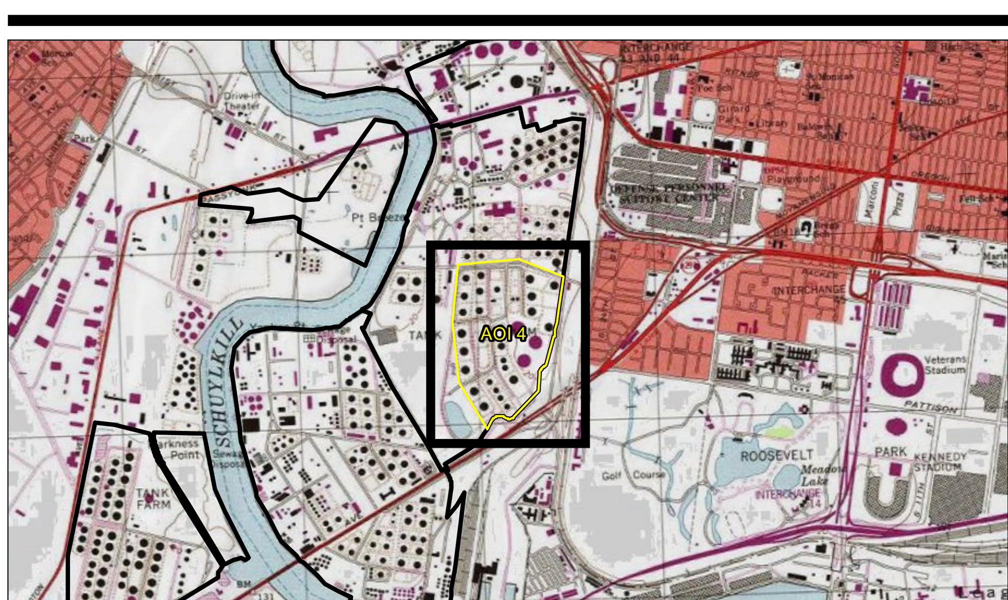
Stantec

EVERGREEN

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 unconfined aquifer elevation within the limits of the available well data.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery





LEGEND

- MONITORING WELL SCREENED IN UNCONFINED AQUIFER, UTILIZED FOR APRIL 2021 ELEVATION SURFACE
- WATER-TABLE ELEVATION CONTOUR (FEET NAVD 88)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 2.44 CORRECTED GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

APRIL 2021 WATER-TABLE ELEVATION FT NAVD88

4.8 to 5.0	3.2 to 3.4	1.6 to 1.8
4.6 to 4.8	3.0 to 3.2	1.4 to 1.6
4.4 to 4.6	2.8 to 3.0	1.2 to 1.4
4.2 to 4.4	2.6 to 2.8	1.0 to 1.2
4.0 to 4.2	2.4 to 2.6	0.8 to 1.0
3.8 to 4.0	2.2 to 2.4	0.6 to 0.8
3.6 to 3.8	2.0 to 2.2	
3.4 to 3.6	1.8 to 2.0	

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
   North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 unconfined aquifer elevation within the limits of the available well data.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed
   PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

4-1e

Title

UNCONFINED AQUIFER ELEVATION, APRIL 2021

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

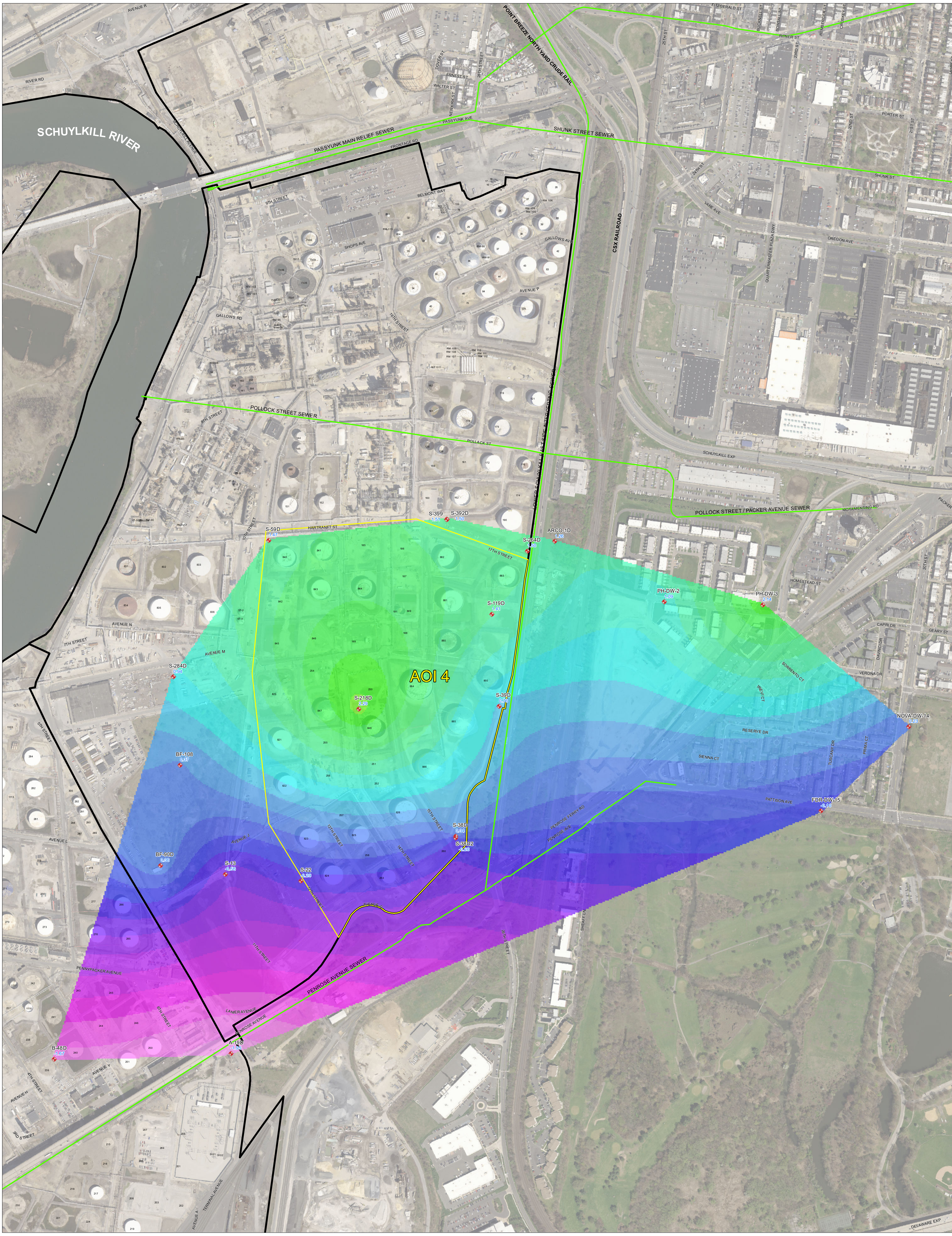
Project Location

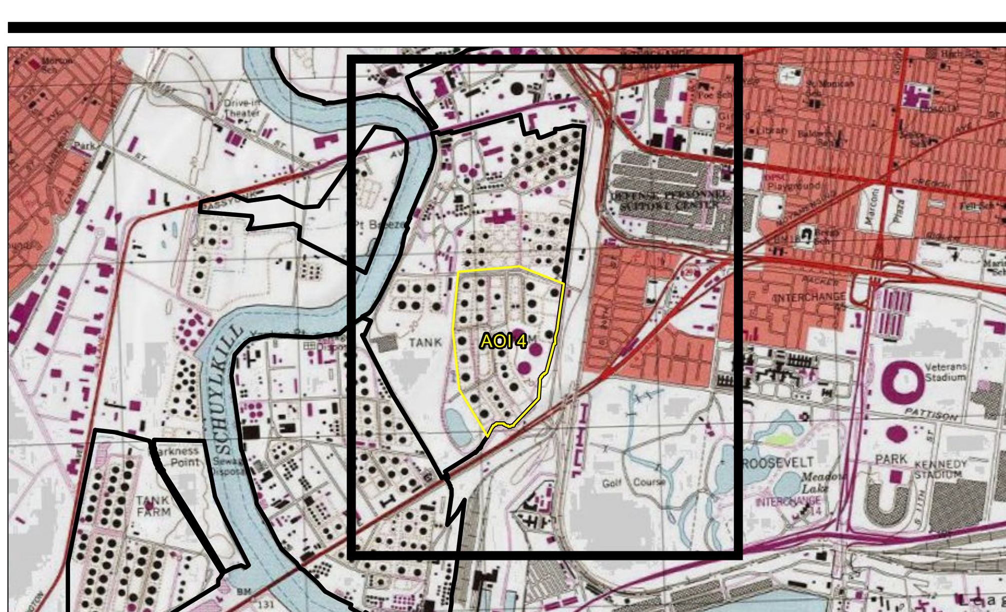
City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by GWC on 8/16/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

Stantec

EVERGREEN





LEGEND

- MONITORING WELL SCREENED IN LOWER AQUIFER, UTILIZED FOR JUNE 2019 ELEVATION SURFACE
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- -1.95 GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

JUNE 2019 LOWER AQUIFER ELEVATION FT NAVD88

2.2 to 2.4	-0.2 to 0
2.0 to 2.2	-0.4 to -0.2
1.8 to 2.0	-0.6 to -0.4
1.6 to 1.8	-0.8 to -0.6
1.4 to 1.6	-1.0 to -0.8
1.2 to 1.4	-1.2 to -1.0
1.0 to 1.2	-1.4 to -1.2
0.8 to 1.0	-1.6 to -1.4
0.6 to 0.8	-1.8 to -1.6
0.4 to 0.6	-2.0 to -1.8
0.2 to 0.4	
0 to 0.2	

0 350 700 Feet

1:4,200 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 lower aquifer elevation within the limits of the available well data.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

4-2a

Title

LOWER AQUIFER ELEVATION, JUNE 2019

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

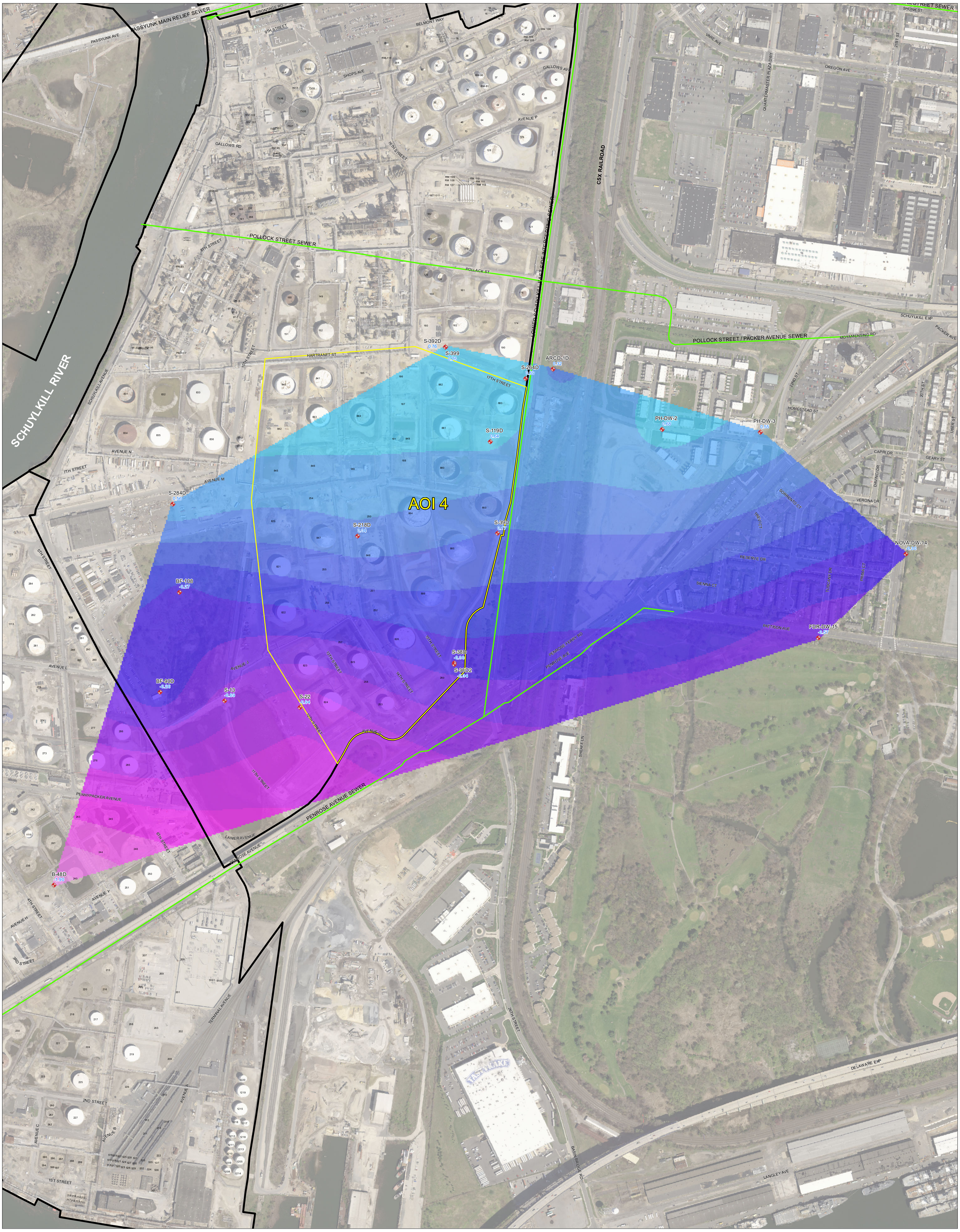
Project Location

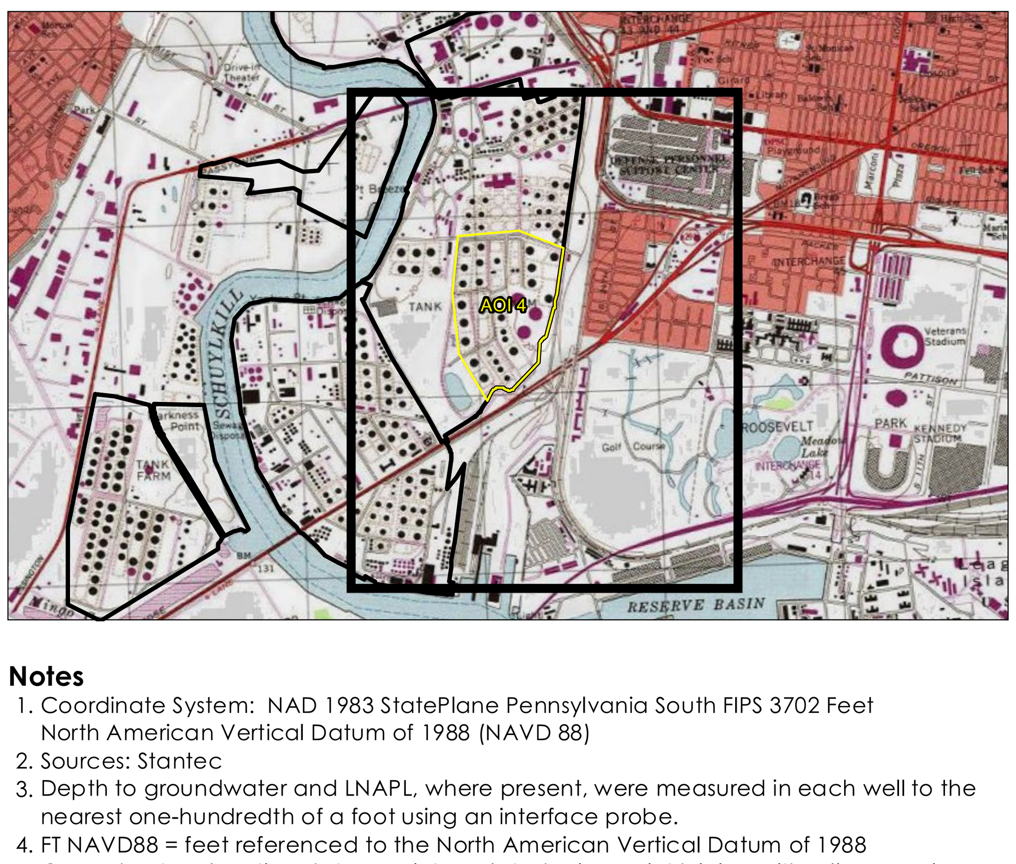
City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by GWC on 9/27/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

Stantec

EVERGREEN





LEGEND

- MONITORING WELL SCREENED IN LOWER AQUIFER, UTILIZED FOR OCTOBER 2019 ELEVATION SURFACE
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- - 1.90 GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

OCTOBER 2019 LOWER AQUIFER ELEVATION

FT NAVD88

- 0.6 to 0.8
- 0.4 to 0.6
- 0.2 to 0.4
- 0 to 0.2
- -0.2 to 0
- -0.4 to -0.2
- -0.6 to -0.4
- -0.8 to -0.6
- -1.0 to -0.8
- -1.2 to -1.0
- -1.4 to -1.2
- -1.6 to -1.4
- -1.8 to -1.6
- -2.0 to -1.8

0 350 700 Feet

1:4,200 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 lower aquifer elevation within the limits of the available well data.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

4-2b

Title

LOWER AQUIFER ELEVATION, OCTOBER 2019

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF
EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

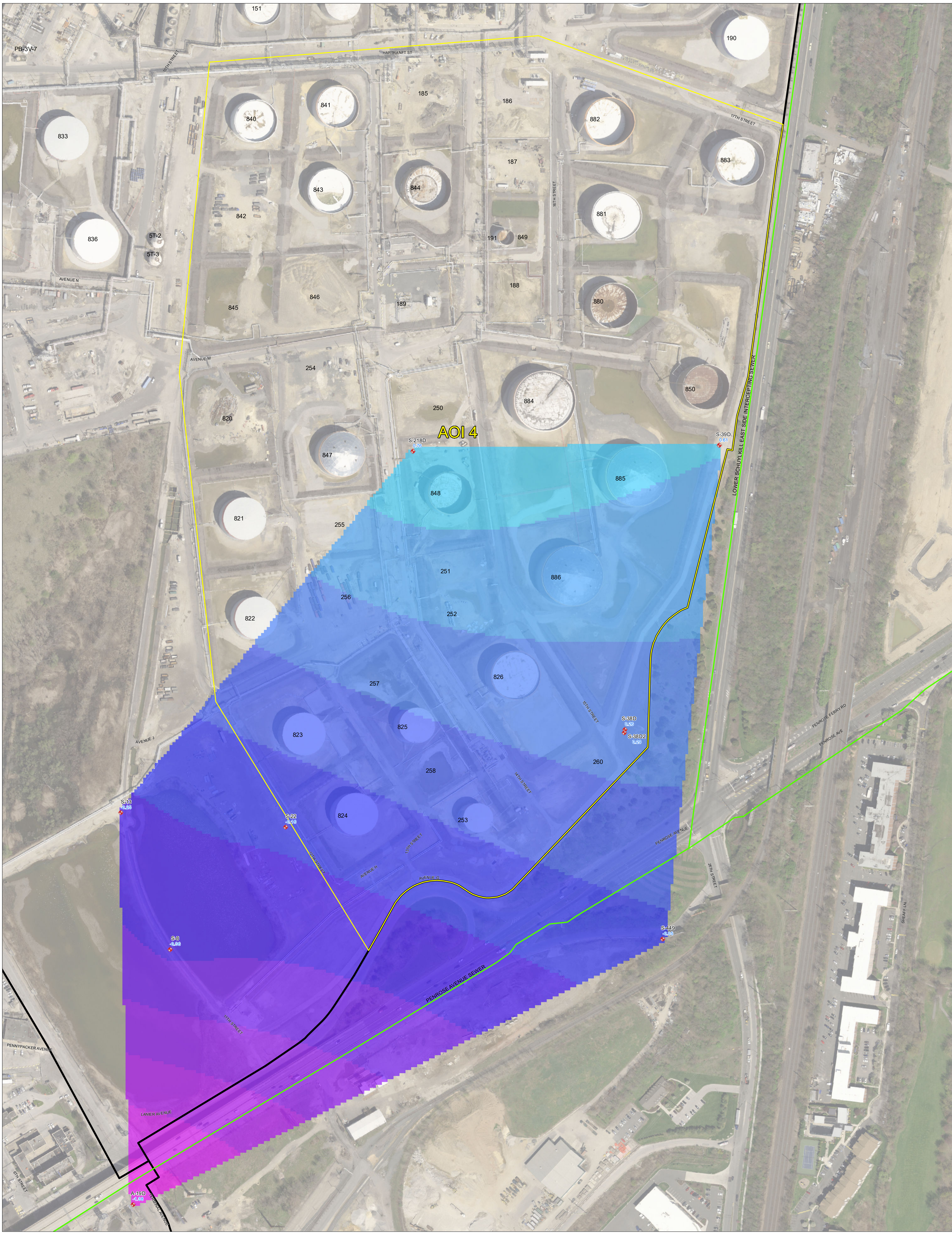
Project Location

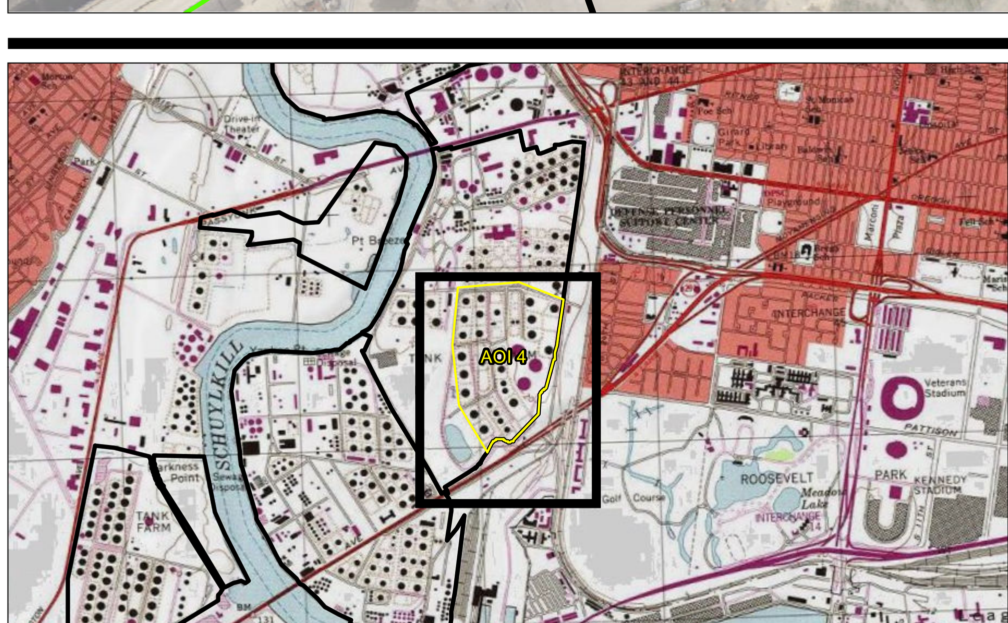
City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by GWC on 9/27/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

Stantec

EVERGREEN





LEGEND

- MONITORING WELL SCREENED IN LOWER AQUIFER, UTILIZED FOR DECEMBER 2020 ELEVATION SURFACE
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- -1.38 GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

DECEMBER 2020 LOWER AQUIFER ELEVATION FT NAVD88

- 0.6 to 0.8
- 0.4 to 0.6
- 0.2 to 0.4
- 0 to 0.2
- -0.2 to 0
- -0.4 to -0.2
- -0.6 to -0.4
- -0.8 to -0.6
- -1.0 to -0.8
- -1.2 to -1.0
- -1.4 to -1.2

0 160 320 Feet

1:1,920 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 lower aquifer elevation within the limits of the available well data.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

4-2c

Title

LOWER AQUIFER ELEVATION, DECEMBER 2020

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

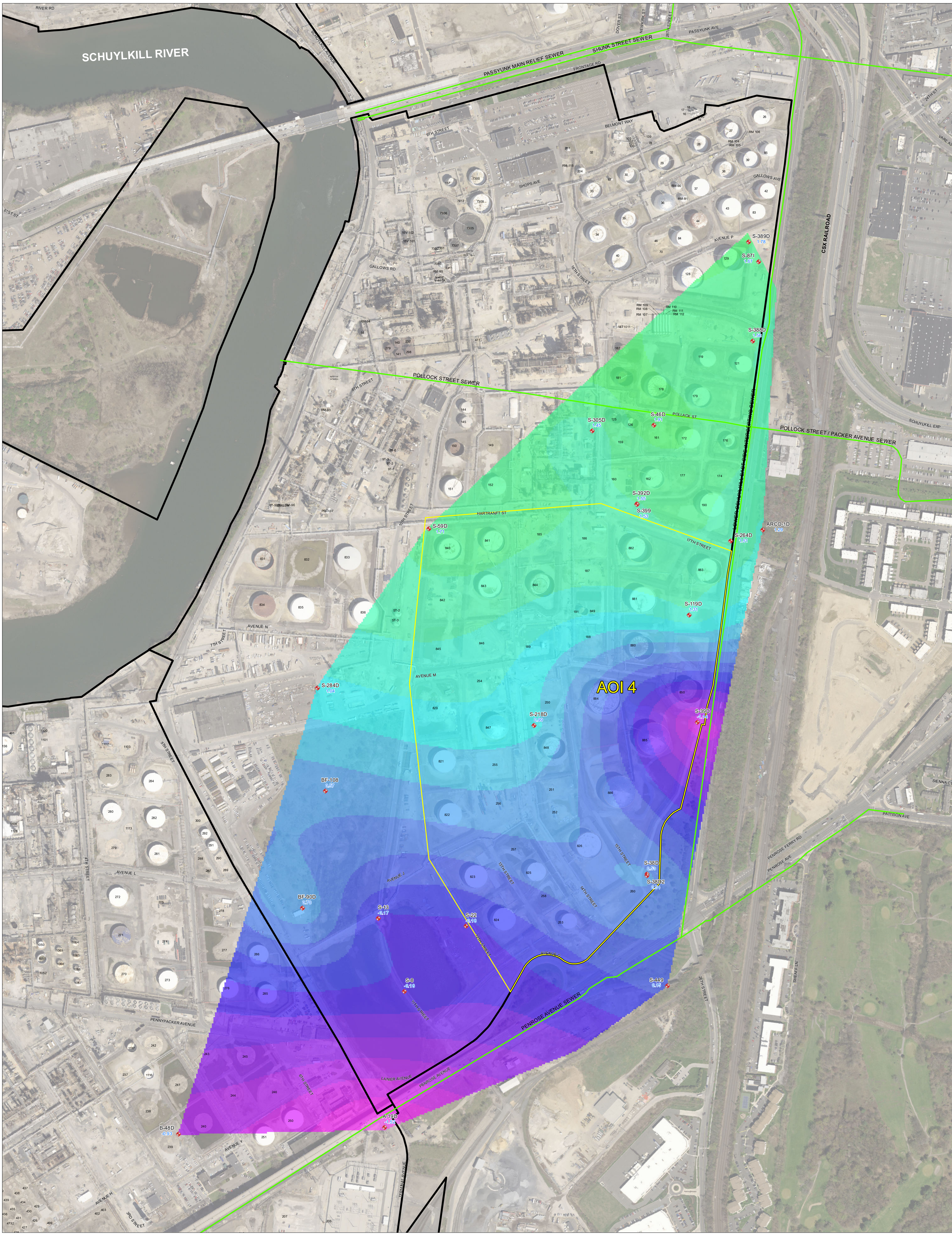
Project Location

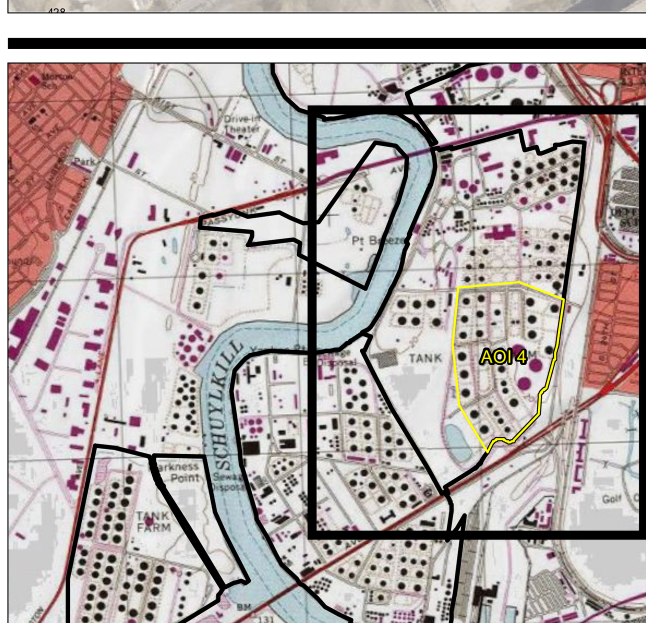
City of Philadelphia, Philadelphia County, Pennsylvania

213402602
Prepared by GWC on 9/27/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

Stantec

EVERGREEN





LEGEND

- MONITORING WELL SCREENED IN LOWER AQUIFER, UTILIZED FOR APRIL 2021 ELEVATION SURFACE
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- -1.14 GROUNDWATER ELEVATION (FT NAVD88)
- 30 TANK ID

APRIL 2021 LOWER AQUIFER ELEVATION FT NAVD88

1.6 to 1.8	-0.2 to 0
1.4 to 1.6	-0.4 to -0.2
1.2 to 1.4	-0.6 to -0.4
1.0 to 1.2	-0.8 to -0.6
0.8 to 1.0	-1.0 to -0.8
0.6 to 0.8	-1.2 to -1.0
0.4 to 0.6	-1.4 to -1.2
0.2 to 0.4	-1.6 to -1.4
0 to 0.2	

0 300 600 Feet

1:3,600 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
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 lower aquifer elevation within the limits of the available well data.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

4-2d

Title

LOWER AQUIFER ELEVATION, APRIL 2021

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

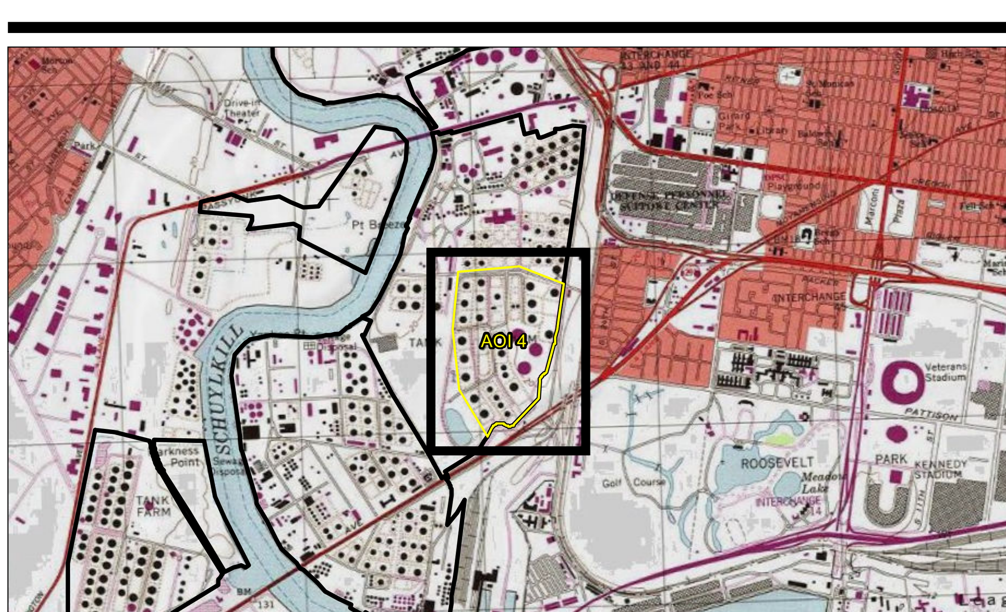
Project Location

City of Philadelphia, Philadelphia County, Pennsylvania

213402602
Prepared by GWC on 9/27/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

Stantec

EVERGREEN



LEGEND

MONITORING WELL WITH LNAPL OCCURRENCE, 2017-2021

- 0.01 to 0.10 ft
- 0.11 to 0.50 ft
- 0.51 to 1.00 ft
- 1.01 to 3.00 ft
- 3.01 to 6.00+ ft
- MONITORING WELL WITH NO LNAPL OCCURRENCE, 2017-2021
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 1.62 MAXIMUM LNAPL THICKNESS (FEET)
- 30 TANK ID

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
2. Sources: Stantec
3. LNAPL = Light Non-Aqueous Phase Liquid
4. Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

4-3

Title

MAXIMUM IN-WELL LNAPL THICKNESS (2017-2021)

Client/Project

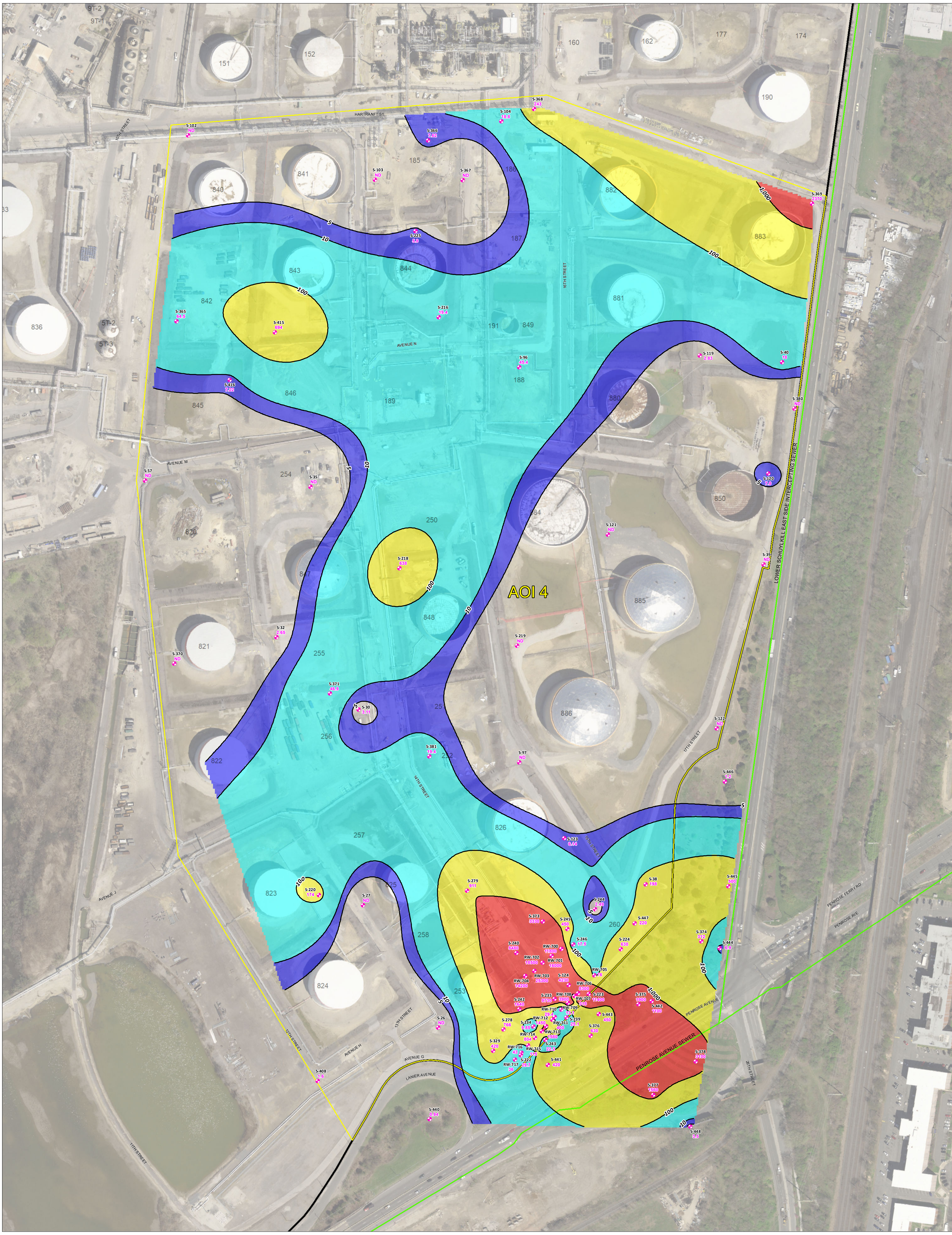
PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

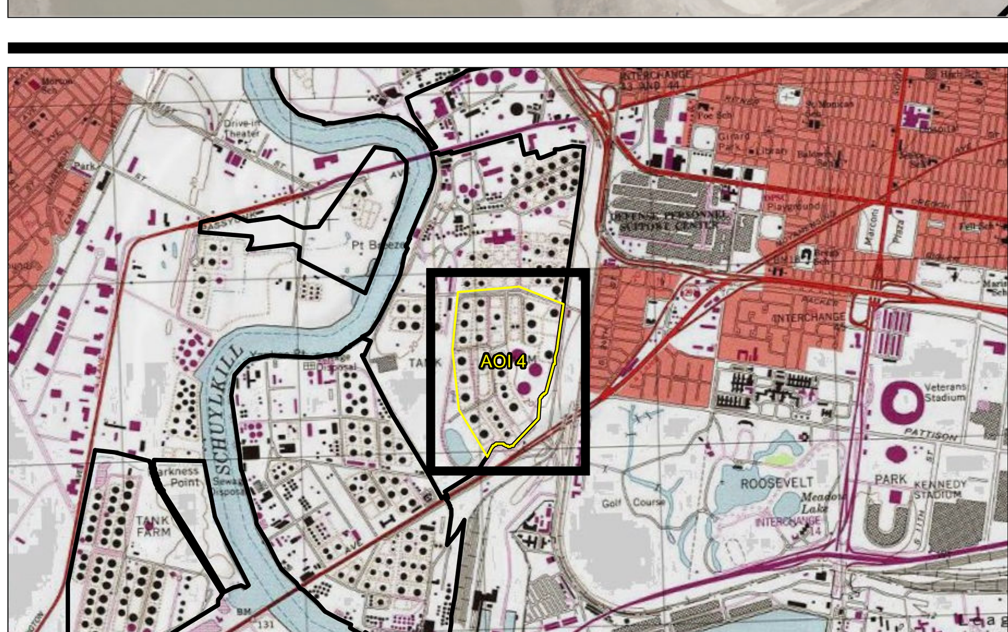
Project Location

City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by GWC on 8/16/2021
Technical Review by AJH on 8/25/2021
Independent Review by JKK on 9/9/2021

Stantec





LEGEND

- UNCONFINED MONITORING WELL UTILIZED IN CREATION OF ISOCONCENTRATION CONTOURS
- BENZENE MAXIMUM CONCENTRATION (ug/L)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 30 TANK ID
- 230 MAXIMUM CONCENTRATION OF BENZENE [ug/L]
- ND NOT DETECTED

BENZENE CONCENTRATION SCALE (ug/L)

- 1,000 to 10,000
- 100 to 1,000
- 10 to 100
- 5 to 10

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Figure No.

4-4

Title

MAXIMUM BENZENE CONCENTRATION, UNCONFINED AQUIFER, 2014-2021

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

213402602

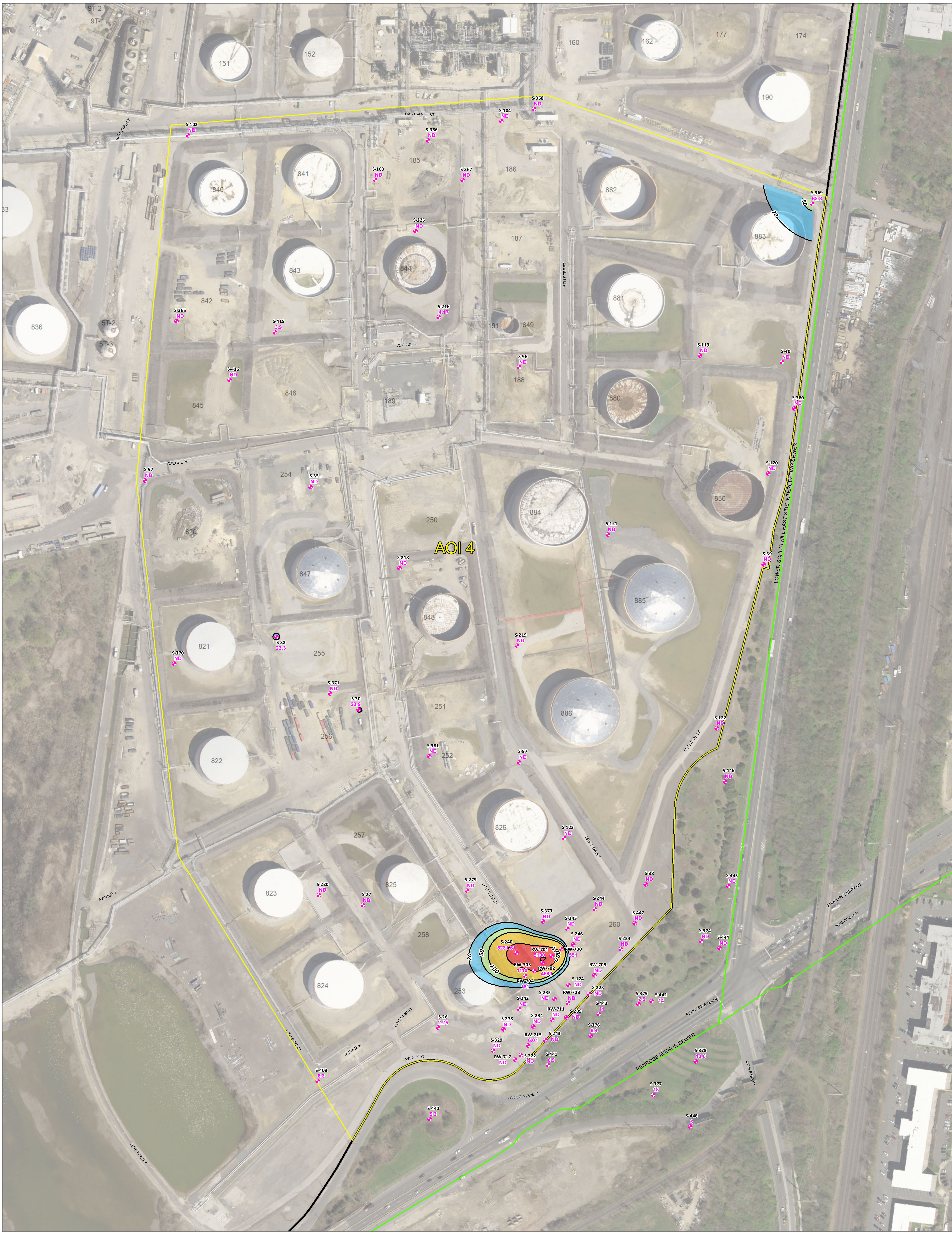
Prepared by GWC on 8/16/2021
Technical Review by AJH on 8/25/2021
Independent Review by JKK on 9/11/2021

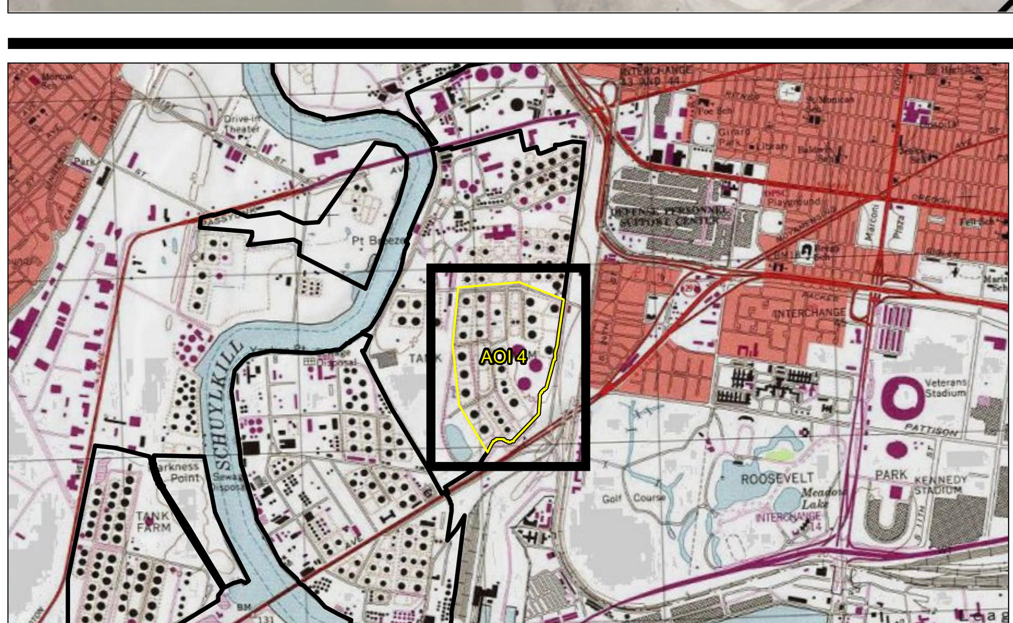
Stantec

EVERGREEN

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
   North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
3. Labels denote well identifier and benzene concentration in micrograms per liter (ug/L).
4. Analytical data was interpolated using the Kriging gridding method in Surfer.
5. Benzene concentrations depicted consider both forensic and routine chemistry results.
6. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed
   PEMA Philadelphia County 2018 Aerial Imagery





LEGEND

- UNCONFINED MONITORING WELL UTILIZED IN CREATION OF ISOCONCENTRATION CONTOURS
- MTBE MAXIMUM CONCENTRATION (ug/L)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 30 TANK ID
- 250 MAXIMUM CONCENTRATION OF MTBE [ug/L]
- ND NOT DETECTED
- MTBE METHYL TERTIARY BUTYL ETHER

MTBE CONCENTRATION SCALE (ug/L)

- 1,000 to 5,000
- 100 to 1,000
- 50 to 100
- 20 to 50

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Figure No.

4-5

Title

MAXIMUM MTBE CONCENTRATION, UNCONFINED AQUIFER, 2014-2021

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

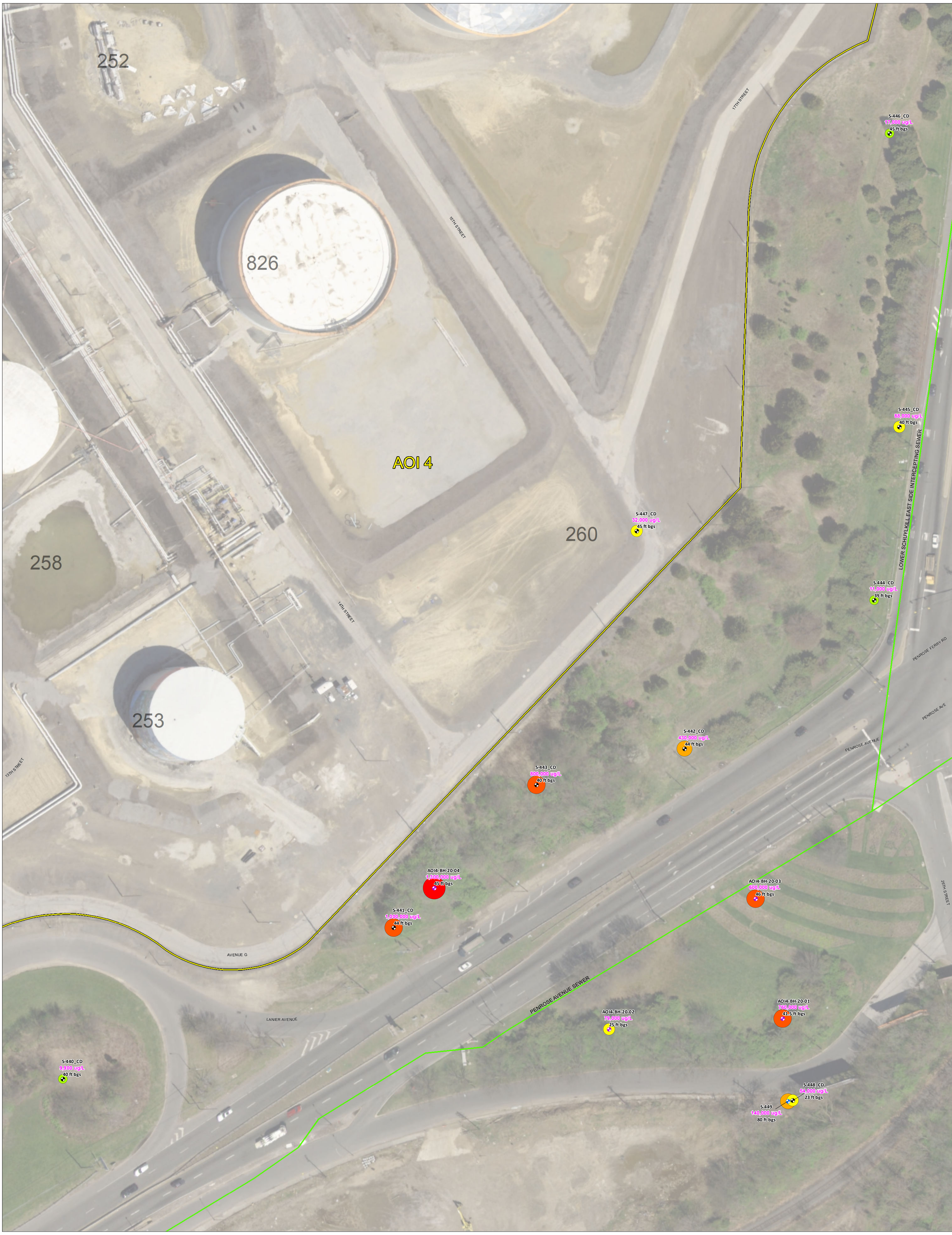
213402602
Prepared by GWC on 8/16/2021
Technical Review by AJH on 8/25/2021
Independent Review by JKK on 9/11/2021

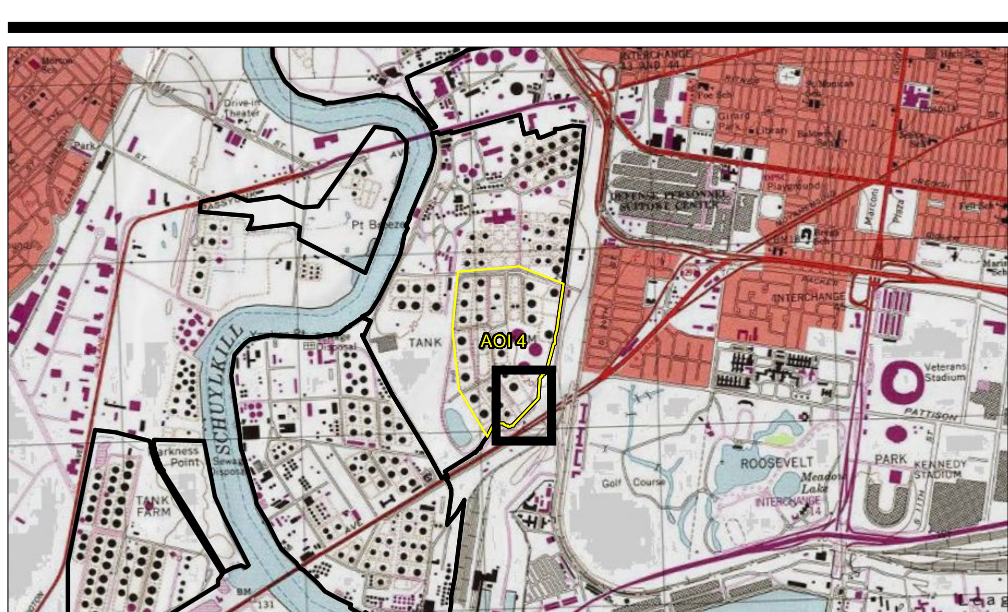
Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
   North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
3. Labels denote well identifier and MTBE concentration in micrograms per liter (ug/L).
4. Contour Interval = Logarithmic (3 levels per log cycle)
5. Analytical data was interpolated using the Kriging gridding method in Surfer.
6. MTBE concentrations depicted consider both forensic and routine chemistry results.
7. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed
   PEMA Philadelphia County 2018 Aerial Imagery

Stantec

EVERGREEN





LEGEND

- MONITORING WELL SCREENED IN LOWER AQUIFER
- TEMPORARY WELL POINT
- TEMPORARY WELL POINT - NOW PERMANENT
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 30 TANK ID
- 250 MAXIMUM CONCENTRATION OF CHLORIDE [ug/L]
- ug\L MICROGRAMS PER LITER
- ft bgs FEET BELOW GROUND SURFACE

CHLORIDE CONCENTRATION (ug/L)

- 9,900 to 20,000
- 20,000 to 100,000
- 100,000 to 500,000
- 500,000 to1,000,000
- > 1,000,000

0 50 100 Feet

1:600 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
3. Labels denote well identifier and chloride concentration in micrograms per liter (ug/L).
4. Analytical data was interpolated using the Kriging gridding method in Surfer.
5. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

4-6

Title

MAXIMUM CHLORIDE CONCENTRATION IN GROUNDWATER, 2020

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Project Location

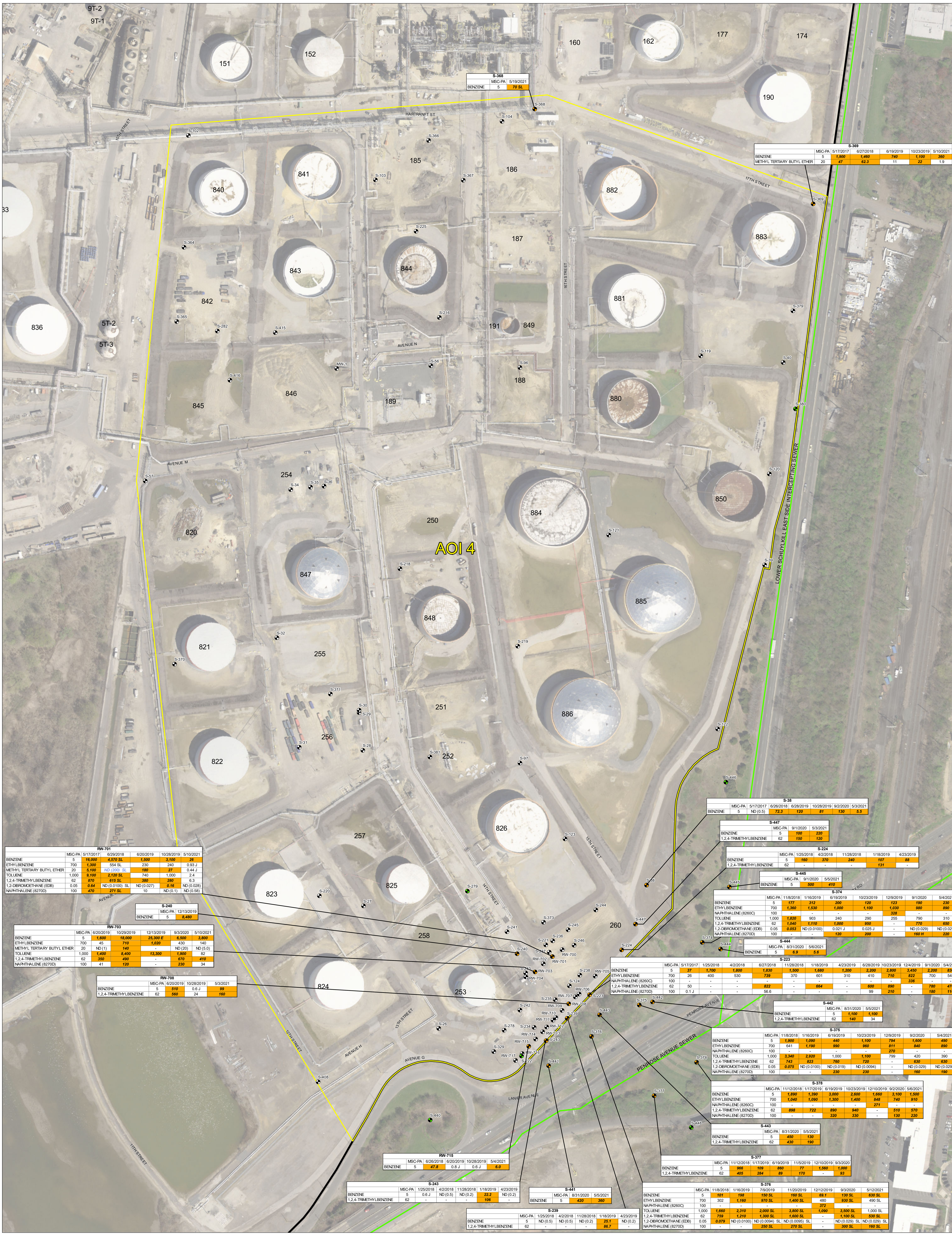
213402602

City of Philadelphia, Philadelphia County, Pennsylvania

Prepared by GWC on 8/16/2021
Technical Review by AJH on 8/25/2021
Independent Review by JKK on 9/11/2021

Stantec

EVERGREEN



RW-701	MSC-PA	5/17/2017	6/29/2018	6/20/2019	10/28/2019	5/10/2021
BENZENE	5	16,000	4,570 SL	1,500	3,100	26
ETHYLBENZENE	700	1,300	554 SL	230	240	0.93 J
METHYL TERTIARY BUTYL ETHER	20	5,100	ND (200) SL	180	27	0.44 J
TOLUENE	1,000	9,100	2,120 SL	740	1,000	2.4
1,2,4-TRIMETHYLBENZENE	62	870	615 SL	380	280	6.3
1,2-DIBROMOETHANE (EDB)	0.05	0.64	ND (0.0100) SL	ND (0.027)	0.16	ND (0.028)
NAPHTHALENE (8270D)	100	470	271 SL	10	ND (0.1)	ND (0.58)

S-240	MSC-PA	12/13/2019
BENZENE	5	8,480

RW-703	MSC-PA	6/20/2019	10/29/2019	12/13/2019	9/3/2020	5/10/2021
BENZENE	5	1,600	18,000	25,300 E	6,500	3,800
ETHYLBENZENE	700	45	710	1,020	430	140
METHYL TERTIARY BUTYL ETHER	20	ND (1)	140	-	ND (20)	ND (5.0)
TOLUENE	1,000	1,400	8,400	13,300	1,900	82
1,2,4-TRIMETHYLBENZENE	62	350	490	-	670	410
NAPHTHALENE (8270D)	100	41	120	-	230	34

RW-708	MSC-PA	6/20/2019	10/28/2019	5/3/2021
BENZENE	5	510	0.6 J	99
1,2,4-TRIMETHYLBENZENE	62	560	24	160

S-368	MSC-PA	5/19/2021
BENZENE	5	70 SL

S-369	MSC-PA	5/17/2017	6/27/2018	6/19/2019	10/23/2019	5/10/2021
BENZENE	5	1,900	1,460	740	1,100	360
METHYL TERTIARY BUTYL ETHER	20	47	62.3	11	22	1.9

S-38	MSC-PA	5/17/2017	6/26/2018	6/28/2019	10/28/2019	9/2/2020	5/3/2021
BENZENE	5	ND (0.5)	72.3	120	81	130	5.5

S-447	MSC-PA	9/1/2020	5/3/2021
BENZENE	5	100	220
1,2,4-TRIMETHYLBENZENE	62	150	120

S-224	MSC-PA	1/25/2018	4/2/2018	11/28/2018	1/18/2019	4/23/2019
BENZENE	5	160	370	240	107	88
1,2,4-TRIMETHYLBENZENE	62	-	-	-	131	-

S-445	MSC-PA	9/1/2020	5/5/2021
BENZENE	5	500	410

S-374	MSC-PA	11/8/2018	1/16/2019	6/19/2019	10/23/2019	12/9/2019	9/1/2020	5/4/2021
BENZENE	5	177	312	200	120	123	190	230
ETHYLBENZENE	700	1,360	1,530	1,000	1,100	1,030	980	890
NAPHTHALENE (8260C)	100	-	-	-	-	328	-	-
TOLUENE	1,000	1,820	903	240	290	255	790	310
1,2,4-TRIMETHYLBENZENE	62	1,040	1,110	1,000	950	-	770	650
1,2-DIBROMOETHANE (EDB)	0.05	0.053	ND (0.0100)	0.021 J	0.025 J	-	ND (0.029)	ND (0.029)
NAPHTHALENE (8270D)	100	-	-	120	200	-	160 H	220

S-444	MSC-PA	8/31/2020	5/6/2021
BENZENE	5	6.9	5.6

S-223	MSC-PA	5/17/2017	1/25/2018	4/2/2018	6/27/2018	11/28/2018	1/18/2019	4/23/2019	6/28/2019	10/23/2019	12/4/2019	9/1/2020	5/4/2021
BENZENE	5	37	1,700	1,800	1,830	1,500	1,680	1,200	2,200	2,800	3,450	2,200	830
ETHYLBENZENE	700	26	400	530	739	370	601	310	410	710	822	700	540
NAPHTHALENE (8260C)	100	-	-	-	-	-	-	-	-	-	336	-	-
1,2,4-TRIMETHYLBENZENE	62	50	-	-	822	-	664	-	600	890	-	780	470
NAPHTHALENE (8270D)	100	0.1 J	-	-	56.6	-	-	-	99	210	-	180	110

S-442	MSC-PA	8/31/2020	5/5/2021
BENZENE	5	1,100	1,100
1,2,4-TRIMETHYLBENZENE	62	140	34

S-375	MSC-PA	11/8/2018	1/16/2019	6/19/2019	10/23/2019	12/9/2019	9/2/2020	5/4/2021
BENZENE	5	1,900	1,090	440	1,100	794	1,600	490
ETHYLBENZENE	700	641	1,190	990	960	811	840	890
NAPHTHALENE (8260C)	100	-	-	-	-	270	-	-
TOLUENE	1,000	3,340	2,920	1,000	1,100	799	420	390
1,2,4-TRIMETHYLBENZENE	62	743	823	760	720	-	630	630
1,2-DIBROMOETHANE (EDB)	0.05	0.075	ND (0.0100)	ND (0.019)	ND (0.0094)	-	ND (0.029)	ND (0.029)
NAPHTHALENE (8270D)	100	-	-	230	230	-	160	190

S-378	MSC-PA	11/12/2018	1/17/2019	6/19/2019	10/23/2019	12/10/2019	9/2/2020	5/6/2021
BENZENE	5	1,890	1,390	3,000	2,600	1,660	3,100	1,500
ETHYLBENZENE	700	1,040	1,090	1,300	1,400	848	740	910
NAPHTHALENE (8260C)	100	-	-	-	-	271	-	-
1,2,4-TRIMETHYLBENZENE	62	898	722	890	940	-	510	570
NAPHTHALENE (8270D)	100	-	-	320	330	-	130	220

S-443	MSC-PA	8/31/2020	5/5/2021
BENZENE	5	450	130
1,2,4-TRIMETHYLBENZENE	62	430	190

S-377	MSC-PA	11/12/2018	1/17/2019	6/19/2019	11/5/2019	12/10/2019	9/3/2020
BENZENE	5	966	109	860	77	1,560	1,000
1,2,4-TRIMETHYLBENZENE	62	405	284	89	170	-	93

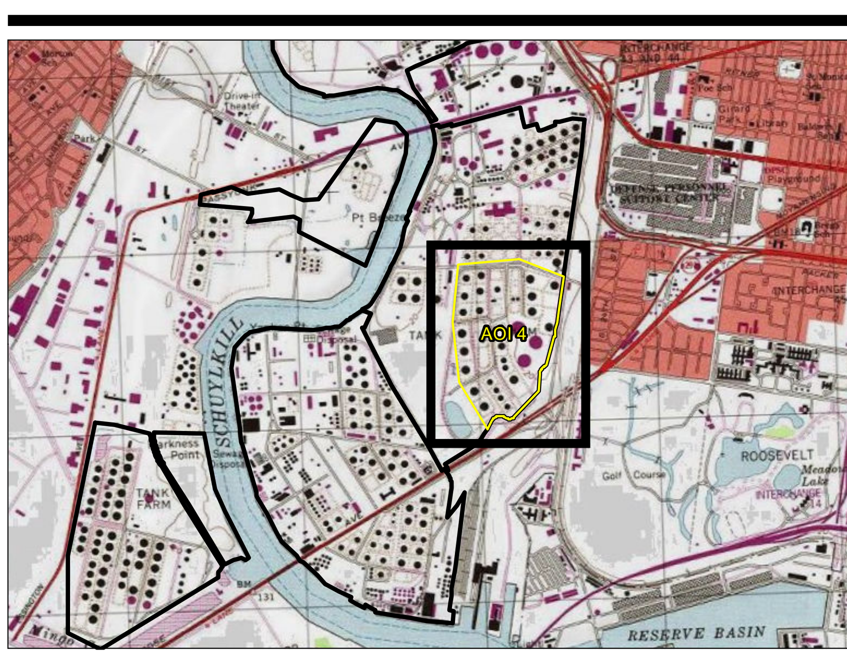
RW-715	MSC-PA	6/26/2018	6/20/2019	10/28/2019	5/4/2021
BENZENE	5	47.8	0.8 J	0.6 J	6.0

S-243	MSC-PA	1/25/2018	4/2/2018	11/28/2018	1/18/2019	4/23/2019
BENZENE	5	0.6 J	ND (0.5)	ND (0.2)	22.2	ND (0.2)
1,2,4-TRIMETHYLBENZENE	62	-	-	-	106	-

S-441	MSC-PA	8/31/2020	5/5/2021
BENZENE	5	420	360

S-239	MSC-PA	1/25/2018	4/2/2018	11/28/2018	1/18/2019	4/23/2019
BENZENE	5	ND (0.5)	ND (0.5)	ND (0.2)	25.1	ND (0.2)
1,2,4-TRIMETHYLBENZENE	62	-	-	-	86.7	-

S-376	MSC-PA	11/8/2018	1/16/2019	7/9/2019	11/20/2019	12/12/2019	9/3/2020	5/12/2021
BENZENE	5	101	198	150 SL	160 SL	69.1	130 SL	630 SL
ETHYLBENZENE	700	302	1,160	970 SL	1,400 SL	480	930 SL	490 SL
NAPHTHALENE (8260C)	100	-	-	-	-	372	-	-
TOLUENE	1,000	1,660	2,310	2,000 SL	3,800 SL	1,090	3,500 SL	1,000 SL
1,2,4-TRIMETHYLBENZENE	62	759	1,210	1,300 SL	1,600 SL	-	1,100 SL	530 SL
1,2-DIBROMOETHANE (EDB)	0.05	0.079	ND (0.0100)	ND (0.0094) SL	ND (0.0095) SL	-	ND (0.029) SL	ND (0.029) SL
NAPHTHALENE (8270D)	100	-	-	250 SL	270 SL	-	300 SL	160 SL



LEGEND

- GROUNDWATER EXCEEDANCE OF THE PADEP NON-RESIDENTIAL, USED AQUIFER STATEWIDE HEALTH STANDARDS (SHS) , 2017-2021
- NO GROUNDWATER EXCEEDANCE OF THE PADEP NON-RESIDENTIAL, USED AQUIFER SHS , 2017-2021
- MONITORING WELL SCREENED IN UNCONFINED AQUIFER
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 420 NON-RESIDENTIAL USED AQUIFER SHS EXCEEDANCE
- 30 TANK ID
- SL SAMPLE WAS COLLECTED BELOW LIGHT NON-AQUEOUS PHASE LIQUID
- J INDICATES ESTIMATED VALUE
- E INDICATES COMPOUND WHOSE CONCENTRATIONS EXCEED THE CALIBRATION RANGE OF THE INSTRUMENT
- ND(0.1) ANALYTE WAS NOT DETECTED AT A CONCENTRATION GREATER THAN THE LABORATORY REPORTING LIMIT SHOWN IN PARENTHESES
- ND(200) LABORATORY REPORTING LIMIT WAS GREATER THAN THE APPLICABALE STANDARD
- NAPHTHALENE (8270D) NAPHTHALENE RESULT IS FOR THE ANALYTICAL METHOD SHOWN IN PARENTHESES
- MSC-PA PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION (PADEP) MEDIUM-SPECIFIC CONCENTRATION (MSC) FOR ORGANIC/INORGANIC REGULATED SUBSTANCES IN GROUNDWATER - USED AQUIFER, NON RESIDENTIAL, TDS ≤ 2500

0 140 280 Feet
1:1,680 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
3. Results from forensics sampling not depicted.
4. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.
4-7a

Title
UNCONFINED AQUIFER EXCEEDANCES (2017-2021)

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

213402602
Prepared by GWC on 9/8/2021
Technical Review by JKK on 9/21/2021
Independent Review by JLM on 9/23/2021

Stantec

S-399	MSC-PA	6/19/2018	6/17/2019	10/28/2019	4/29/2021
BENZENE	5	ND (1.00)	0.4 J	0.4 J	***6.4***
METHYL TERTIARY BUTYL ETHER	20	***22.9***	19	***22***	6.9

ARCO-1D	MSC-PA	6/25/2018	7/3/2019	11/1/2019	12/5/2019	5/7/2021
BENZENE	5	***276***	3	***200***	-	***150***
METHYL TERTIARY BUTYL ETHER	20	***30.4***	***66***	***61***	-	***84***

PH-DW-2	MSC-PA	5/11/2017	12/4/2019
BENZENE	5	***311***	ND (0.45)
METHYL TERTIARY BUTYL ETHER	20	13.5	ND (0.75)

PH-DW-3	MSC-PA	5/10/2017	6/19/2018	12/4/2019
BENZENE	5	***8,370***	***6,990***	***2,580***
METHYL TERTIARY BUTYL ETHER	20	***33.9***	***26.5 J***	14.4

S-284D	MSC-PA	2/26/2019	6/19/2019	10/28/2019	9/1/2020	4/23/2021
BENZENE	5	0.3 J	ND (0.2)	0.3 J	ND (1.0)	***10***
METHYL TERTIARY BUTYL ETHER	20	ND (0.2)	0.6 J	ND (0.2)	ND (1.0)	1.3

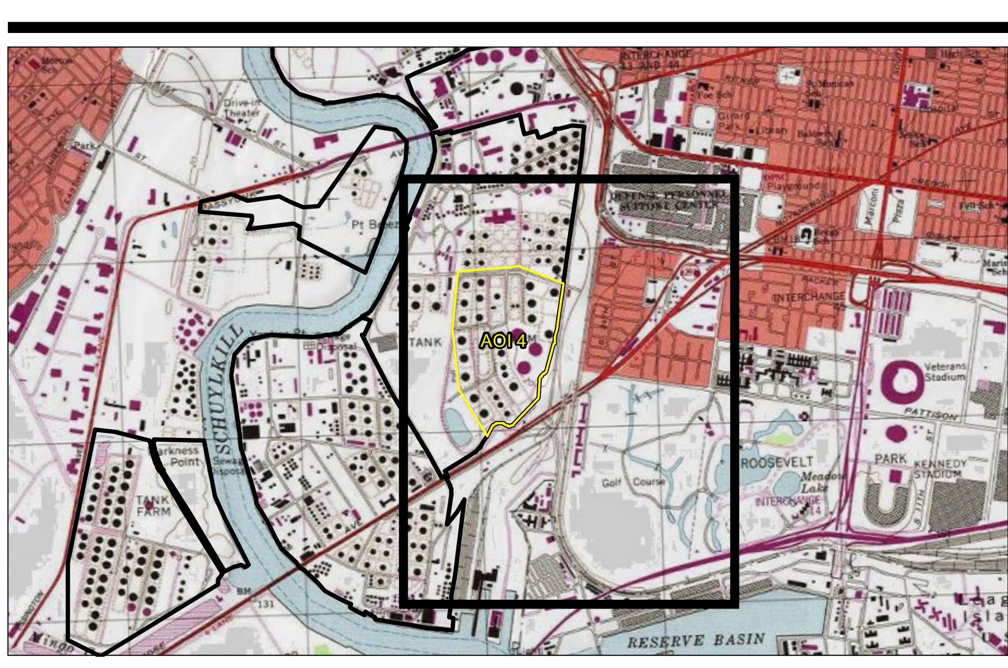
S-218D	MSC-PA	6/28/2018	6/26/2019	10/29/2019	4/30/2021
BENZENE	5	-	ND (0.2)	ND (0.2)	ND (1.0)
METHYL TERTIARY BUTYL ETHER	20	***48.6***	***41***	***37***	***36***

S-39D	MSC-PA	6/28/2018	6/20/2019	10/29/2019	5/7/2021
BENZENE	5	-	0.2 J	ND (0.2)	0.69 J
METHYL TERTIARY BUTYL ETHER	20	***55.1***	***91***	***31***	***24***

S-13	MSC-PA	9/25/2018	10/31/2018	6/19/2019	10/28/2019	4/26/2021
BENZENE	5	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	1.9
METHYL TERTIARY BUTYL ETHER	20	***240***	***120***	***400***	***220***	***180***

S-449	MSC-PA	9/2/2020	5/6/2021
BENZENE	5	***3,400***	***3,700***
METHYL TERTIARY BUTYL ETHER	20	***650***	***550***

A-19D	MSC-PA	6/28/2019	10/30/2019	4/29/2021
BENZENE	5	ND (0.2)	ND (0.2)	0.53 J
METHYL TERTIARY BUTYL ETHER	20	20	***58***	***44***



LEGEND

- GROUNDWATER EXCEEDANCE OF THE PADEP NON-RESIDENTIAL, USED AQUIFER STATEWIDE HEALTH STANDARDS (SHS) , 2017-2021 (LOW FLOW)
- NO GROUNDWATER EXCEEDANCE OF THE PADEP NON-RESIDENTIAL, USED AQUIFER SHS , 2017-2021 (LOW FLOW)
- MONITORING WELL SCREENED IN UNCONFINED AQUIFER
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- ***420*** NON-RESIDENTIAL USED AQUIFER SHS EXCEEDANCE
- 30 TANK ID
- J INDICATES ESTIMATED VALUE
- ND(0.1) ANALYTE WAS NOT DETECTED AT A CONCENTRATION GREATER THAN THE LABORATORY REPORTING LIMIT SHOWN IN PARENTHESES
- MSC-PA PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION (PADEP) MEDIUM-SPECIFIC CONCENTRATION (MSC) FOR ORGANIC/INORGANIC REGULATED SUBSTANCES IN GROUNDWATER - USED AQUIFER, NON RESIDENTIAL, TDS ≤ 2500

0 300 600 Feet
1:3,600 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
   North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
3. Results from forensics sampling not depicted.
4. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed
   PEMA Philadelphia County 2018 Aerial Imagery

Figure No.
4-7b

Title
LOWER AQUIFER EXCEEDANCES (2017-2021)

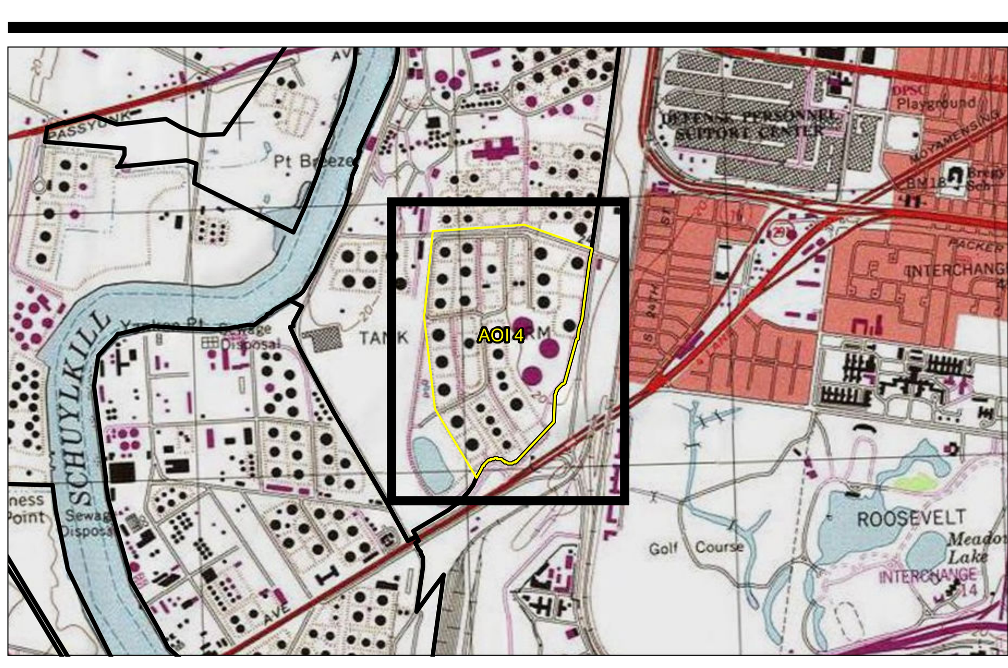
Client/Project
PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Project Location
City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by GWC on 9/8/2021
Technical Review by JKK on 9/21/2021
Independent Review by JLM on 9/23/2021

Stantec

EVERGREEN



LEGEND

- SHALLOW SOIL DOES NOT EXCEED THE PADEP SOIL TO GROUNDWATER VALUE, 450 MILLIGRAMS PER KILOGRAM (MG/KG)
- SHALLOW SOIL EXCEEDS THE PADEP SOIL TO GROUNDWATER VALUE, 450 MG/KG
- SHALLOW SOIL EXCEEDS THE PADEP NON-RESIDENTIAL DIRECT CONTACT STANDARD, 1,000 MG/KG
- SHALLOW SOIL EXCEEDS THE SITE SPECIFIC STANDARD, 2,240 MG/KG
- WELL LOCATION
- DESTROYED WELL LOCATION
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 250 — 2021 LEAD DELINEATION SAMPLE, CONCENTRATION DOES NOT EXCEED THE PADEP NON - RESIDENTIAL DIRECT CONTACT STANDARD FOR LEAD 0-2', 1,000 MG/KG

0 140 280 Feet

1:1,680 (At original document size of 22x34)

N

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
2. Sources: Stantec
3. Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

Figure No.

4-8

Title

LEAD IN SURFACE SOIL (0 - 2 FEET BGS)

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

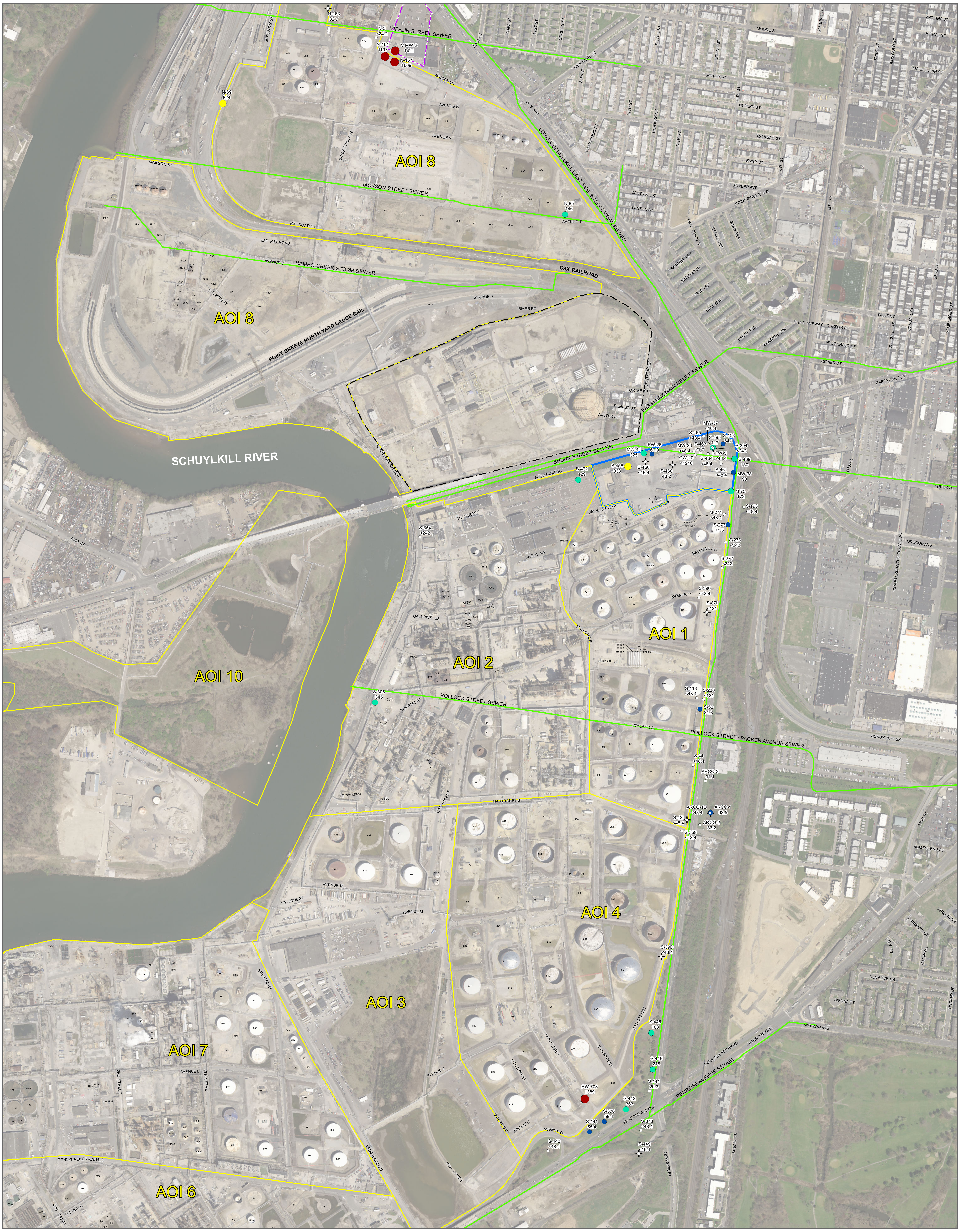
Project Location

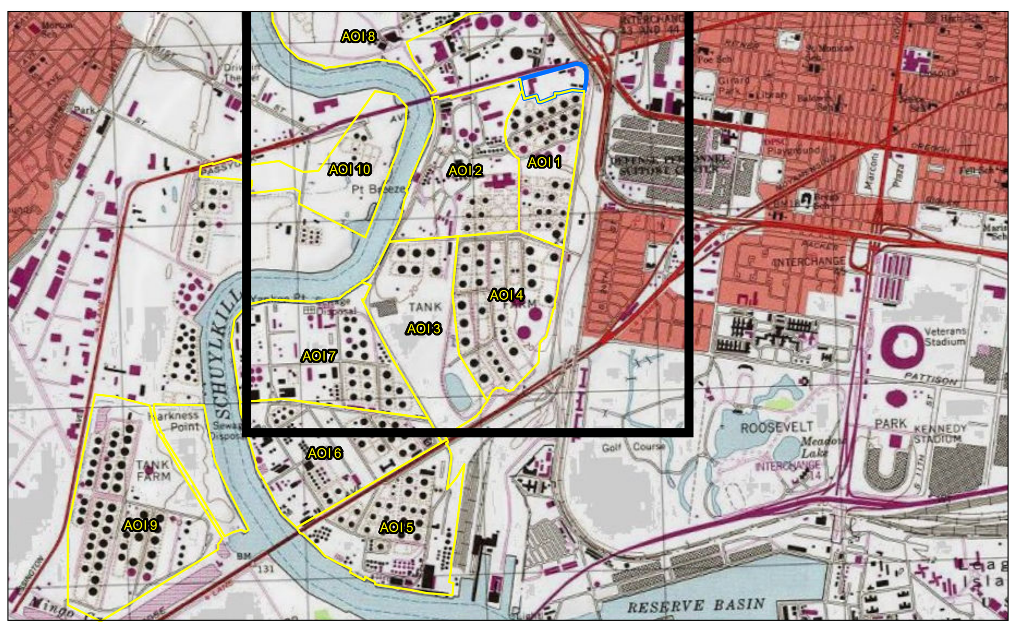
City of Philadelphia, Philadelphia County, Pennsylvania

213402602
Prepared by GWC on 9/17/2021
Technical Review by JKK on 9/24/2021
Independent Review by JLM on 9/27/2021

Stantec

EVERGREEN





LEGEND

MONITORING WELL WITH SUCRALOSE OCCURRENCE, 2021

- 0 to 50
- 50 to 100
- 100 to 500
- 500 to 1,000
- 1,000 to 1,668
- + DENOTES LOWER AQUIFER WELL LOCATION
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- PHILADELPHIA GAS WORKS (PGW) PASSYUNK FACILITY PROPERTY BOUNDARY
- VERIZON SOUTH DISTRICT WORK CENTER (SDWC) PROPERTY
- BELMONT TERMINAL
- AREA OF INTEREST (AOI) BOUNDARY
- 30 TANK ID
- ng/L NANOGRAMS PER LITER

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
2. Sources: Stantec
3. Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

0 400 800 Feet

1:4,800 (At original document size of 22x34)

N

Figure No.

4-9

Title

SUCRALOSE CONCENTRATIONS IN GROUNDWATER (2021)

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Project Location

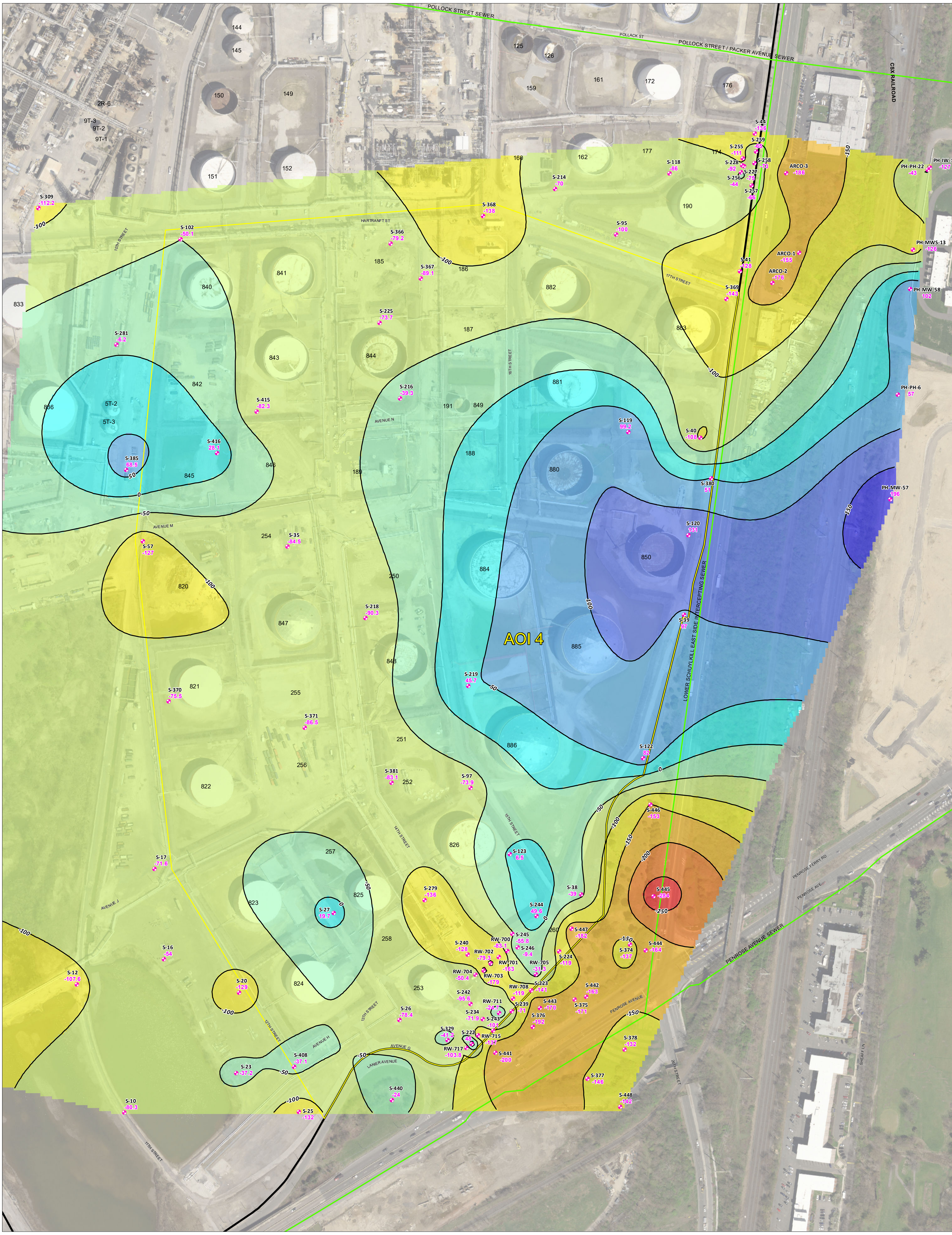
213402602

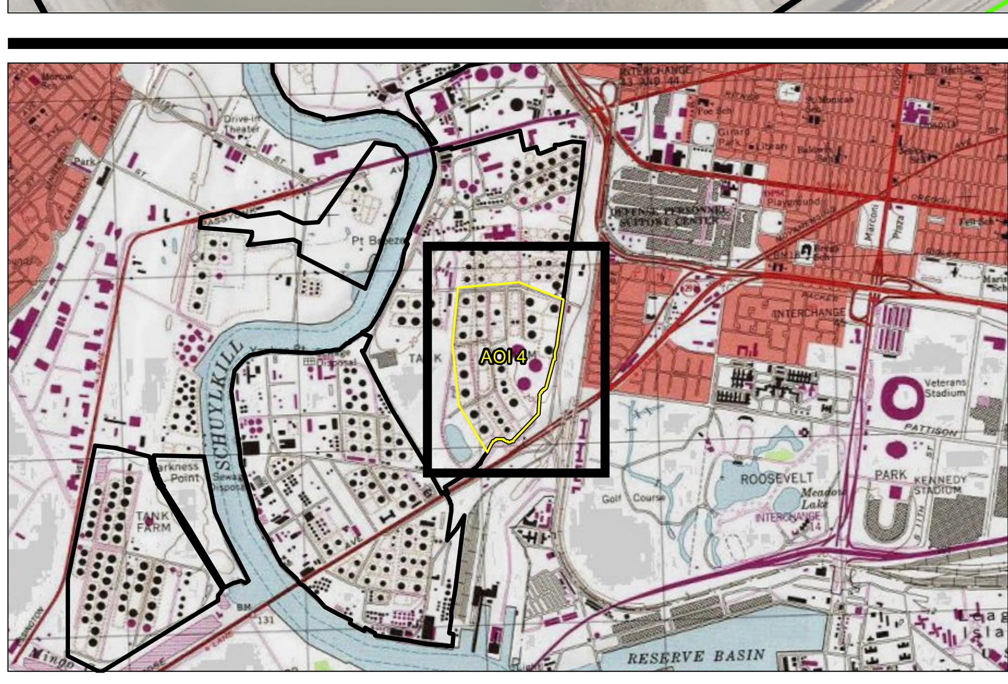
City of Philadelphia,
Philadelphia County,
Pennsylvania

Prepared by GWC on 9/24/2021
Technical Review by ADK on 9/24/2021
Independent Review by JKK on 9/28/2021

Stantec

EVERGREEN





LEGEND

- MONITORING WELL UTILIZED IN CREATION OF ISOCONCENTRATION CONTOURS
- ORP MINIMUM ISOCONCENTRATION CONTOUR, MILLIVOLTS (mV)
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY
- 30 TANK ID
- 102 MINIMUM ORP FIELD READING [mV]
- ORP OXIDATION REDUCTION POTENTIAL

ORP FIELD READING SCALE (mV)

- -250 to -280
- -200 to -250
- -150 to -200
- -100 to -150
- -50 to -100
- 0 to -50
- 50 to 0
- 100 to 50
- 150 to 100
- 200 to 150

Notes

1. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet North American Vertical Datum of 1988 (NAVD 88)
2. Sources: Stantec
3. Analytical data was interpolated using the Kriging gridding method in Surfer.
4. Aerial & Topo Copyright:© 2013 National Geographic Society, i-cubed PEMA Philadelphia County 2018 Aerial Imagery

0 160 320 Feet

1:1,920 (At original document size of 22x34)

N

Figure No.

4-10

Title

OXIDATION REDUCTION POTENTIAL FIELD READINGS, UNCONFINED AQUIFER, 2014-2021

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

213402602
Prepared by GWC on 9/27/2021
Technical Review by AJH on 9/28/2021
Independent Review by JKK on 9/28/2021

Stantec

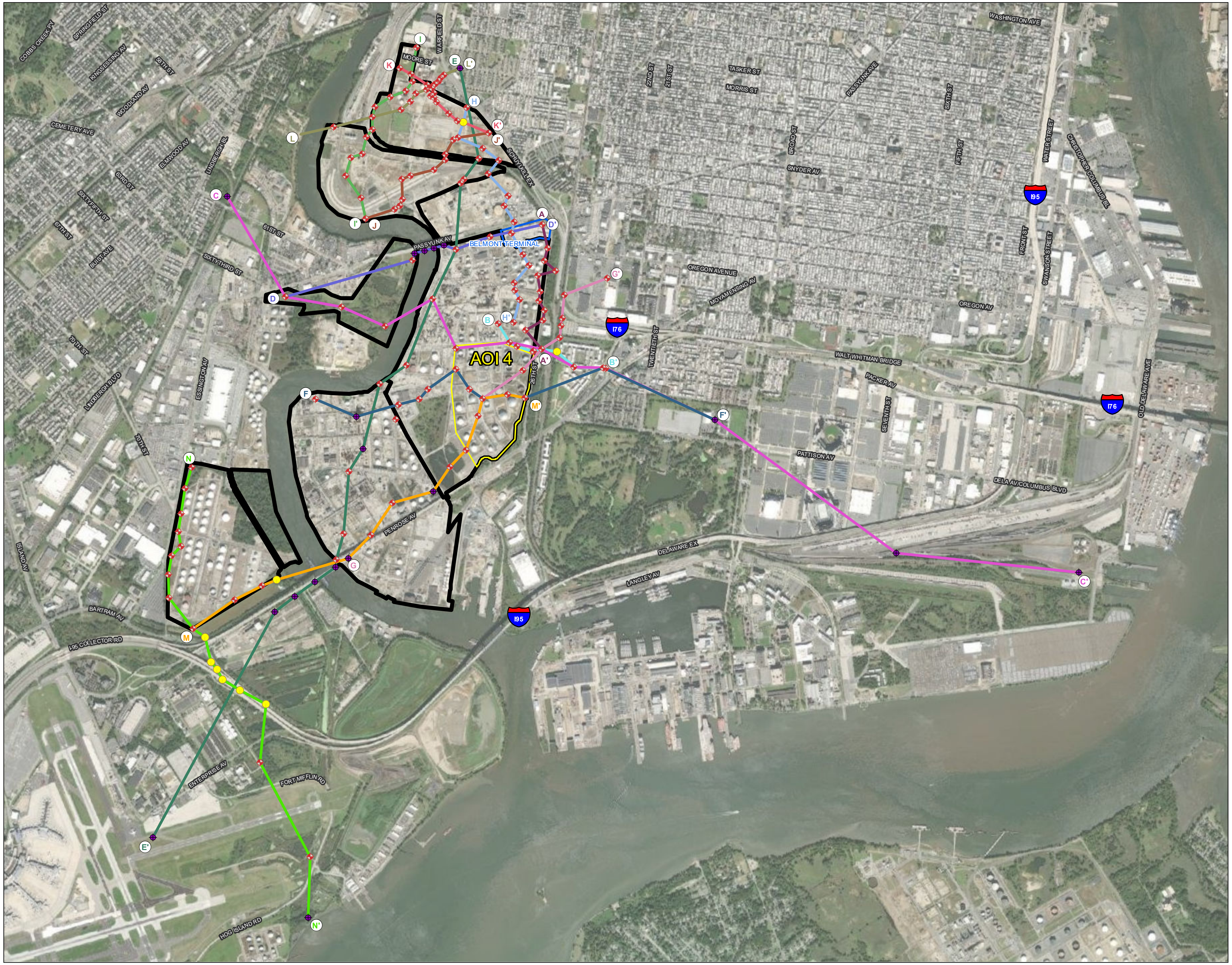


Figure No.

4-11

Title

STRATIGRAPHIC PROFILE LOCATION MAP

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

Project Location | 213402602
City of Philadelphia, Philadelphia County, Pennsylvania

Prepared by GWC on 8/3/2021
Technical Review by JKK on 8/3/2021
Independent Review by JLM on 8/18/2021

0 2,500 5,000 Feet

1:30,000 (At original document size of 11x17)

N

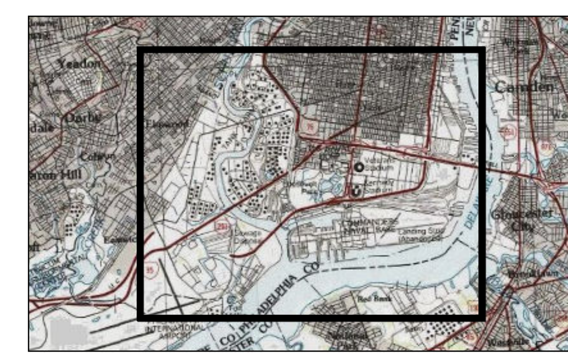
LEGEND

STRATIGRAPHIC 'PICK' LOCATION

- SOIL/TEST BORING RECORD
- WELL RECORD
- GREENMAN et al. (1961) HISTORIC RECORD
- BELMONT TERMINAL
- AREA OF INTEREST (AOI) 4 BOUNDARY
- FORMER PHILADELPHIA REFINERY

STRATIGRAPHIC PROFILE

- A - A'
- B - B'
- C - C'
- D - D'
- E - E'
- F - F'
- G - G'
- H- H'
- I - I'
- J - J'
- K - K'
- L - L'
- M - M'
- N - N'

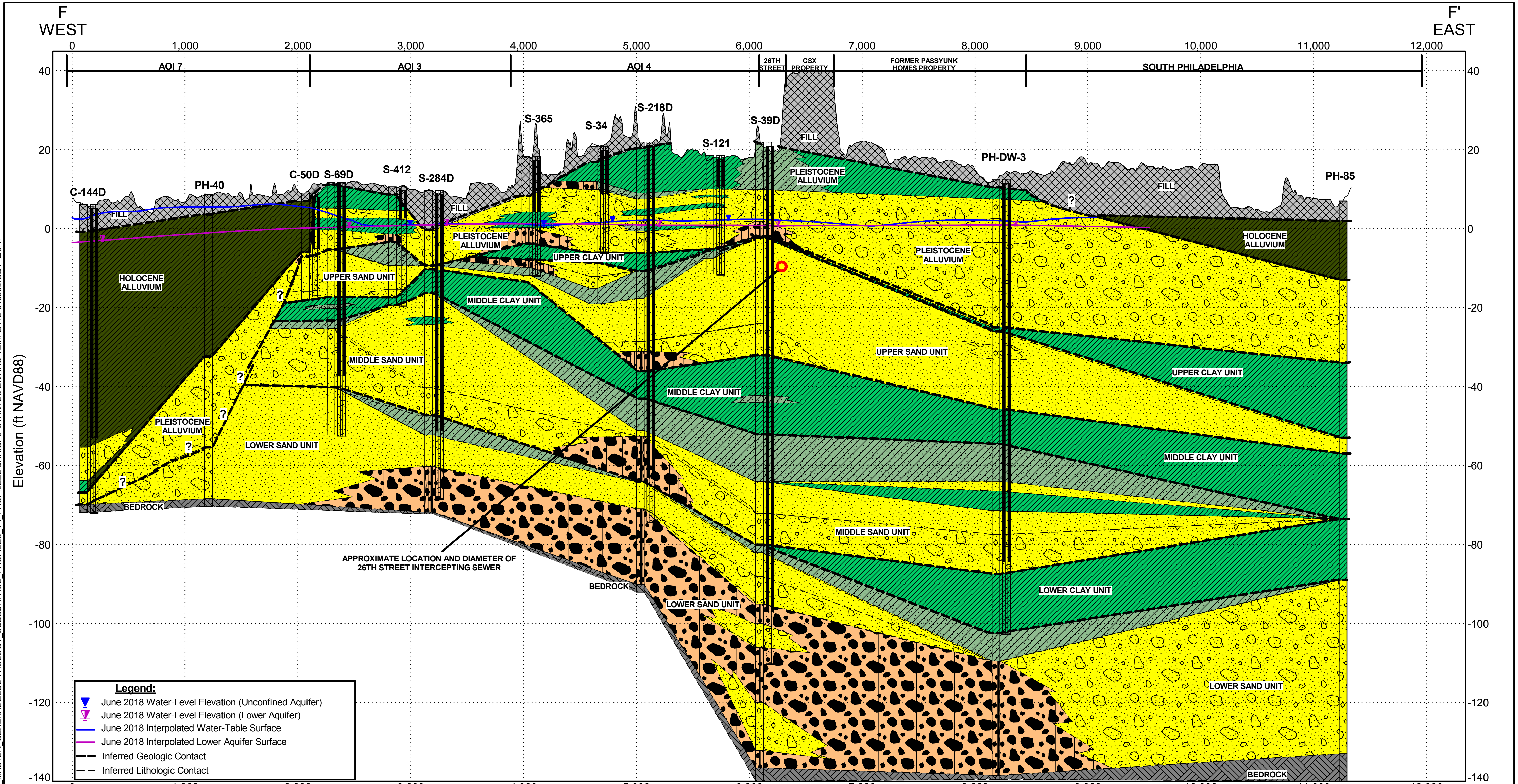


Notes

1. Vertical Datum: North American Vertical Datum of 1988 (NAVD 88)
2. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
3. Sources: Stantec, Greenman, D.W., Rima, D.R., Lockwood, W.N., and Meisler, H. (1961). Groundwater Resources of the Coastal Plain Area of Southeastern Pennsylvania, Pennsylvania Geological Survey Bulletin W13.
4. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Copyright:© 2013 National Geographic Society, i-cubed

Stantec

EVERGREEN



References:

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.

Tetra Tech (2005). Intermediate and Deep Well Installation and Sampling Report for the Former Defense Supply Center Philadelphia Facility, Philadelphia, Pennsylvania.

Stantec

STRATIGRAPHIC PROFILE INTERPRETED BY ANDREW D. KLINGBEIL, PENNSYLVANIA PROFESSIONAL GEOLOGIST PG005029

GENERALIZED LITHOLOGY GRAPHICS

- Apparent Fill
- Sandy Gravel
- Gravelly Sand
- Sand (incl. trace to little silt/clay/gravel)
- "Muddy" Sand
- Organic-Rich "Mud" (silt/clay, incl. some organic material)
- "Mud" (silt/clay, incl. trace to little sand/gravel)
- Bedrock (incl. saprolite where indicated)
- Peat

Notes:

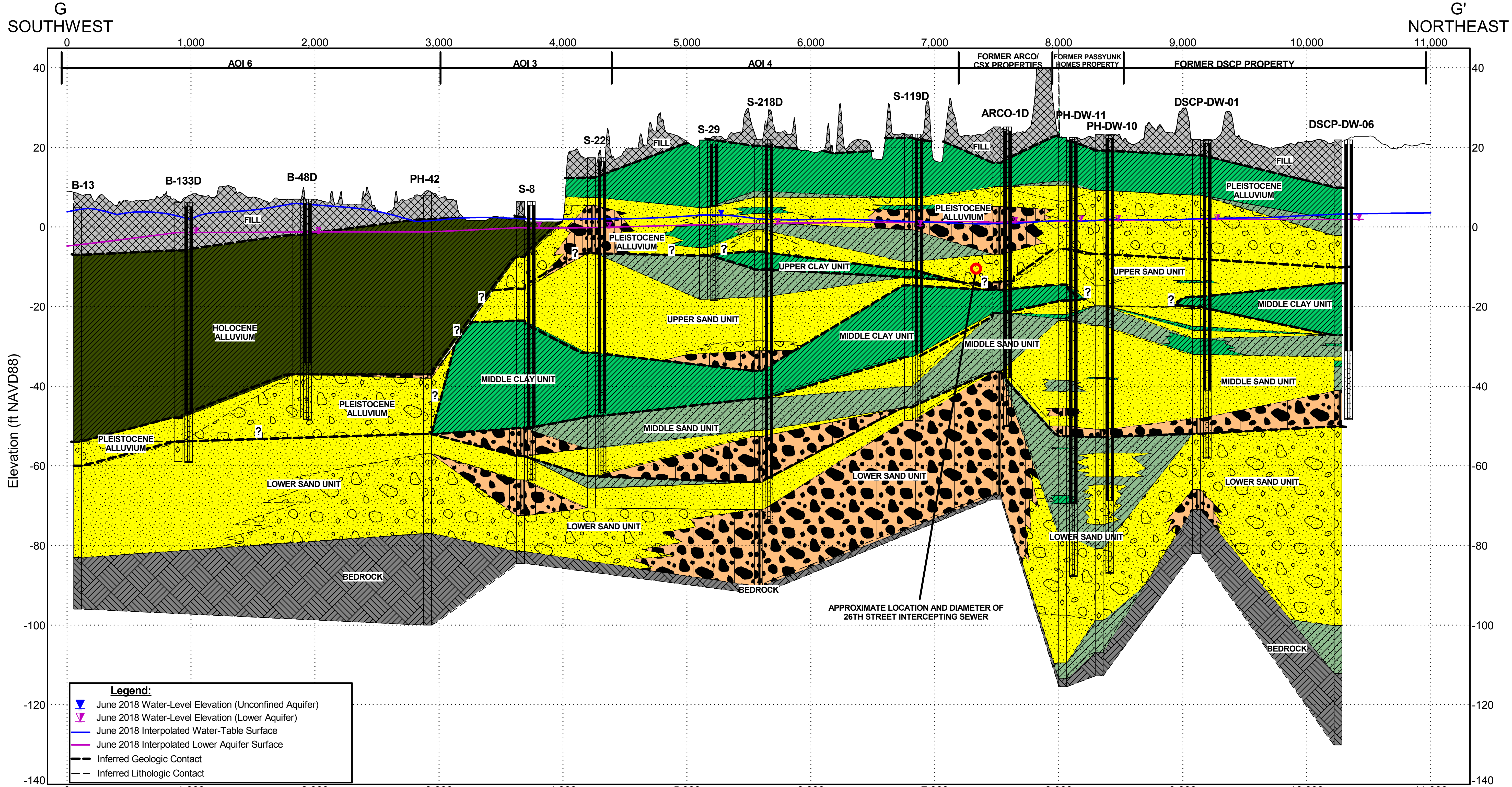
1. Land surface profile obtained from a 2010 Light Detection and Ranging (LiDAR) elevation model available from the United States Geological Survey (USGS).
2. Lithologic logs for borings PH-40 and PH-85 were obtained from Tables 13 and 14 of Greenman et al., 1961. Geographic locations for those borings were digitized on-screen by Stantec. Lithologic logs, well construction, and survey data for well PH-DW-03 was obtained from Tetra Tech (2005).
3. Water-table and lower aquifer surfaces were interpolated from selected June 2018 gauging data using point kriging.
4. Stantec generalized lithologic data from available borehole logs into 9 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. Holocene-age muds are colored a darker shade of green so they can be more easily distinguished from older units.
5. Correlation between lithologies and, where applicable, geologic units is based primarily on the straight-line method. Actual conditions between boreholes may vary from what is shown on this profile.
6. North American Vertical Datum of 1988 = NAVD 88
7. Vertical Exaggeration ~ 36 X

Figure 4-12. Stratigraphic Profile F - F'

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 2/9/17



References:

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.

Tetra Tech (2005). Intermediate and Deep Well Installation and Sampling Report for the Former Defense Supply Center Philadelphia Facility, Philadelphia, Pennsylvania.

Tetra Tech (2007). 2006-2007 Intermediate and Deep Well Installation and Sampling Report for the Former Defense Supply Center Philadelphia Facility, Philadelphia, Pennsylvania.

Stantec

STRATIGRAPHIC PROFILE INTERPRETED BY ANDREW D. KLINGBEIL, PENNSYLVANIA PROFESSIONAL GEOLOGIST PG005029

GENERALIZED LITHOLOGY GRAPHICS

- Apparent Fill
- Sandy Gravel
- Gravelly Sand
- Sand (incl. trace to little silt/clay/gravel)
- "Muddy" Sand
- Organic-Rich "Mud" (silt/clay, incl. some organic material)
- "Mud" (silt/clay, incl. trace to little sand/gravel)
- Bedrock (incl. saprolite where indicated)
- Peat

Notes:

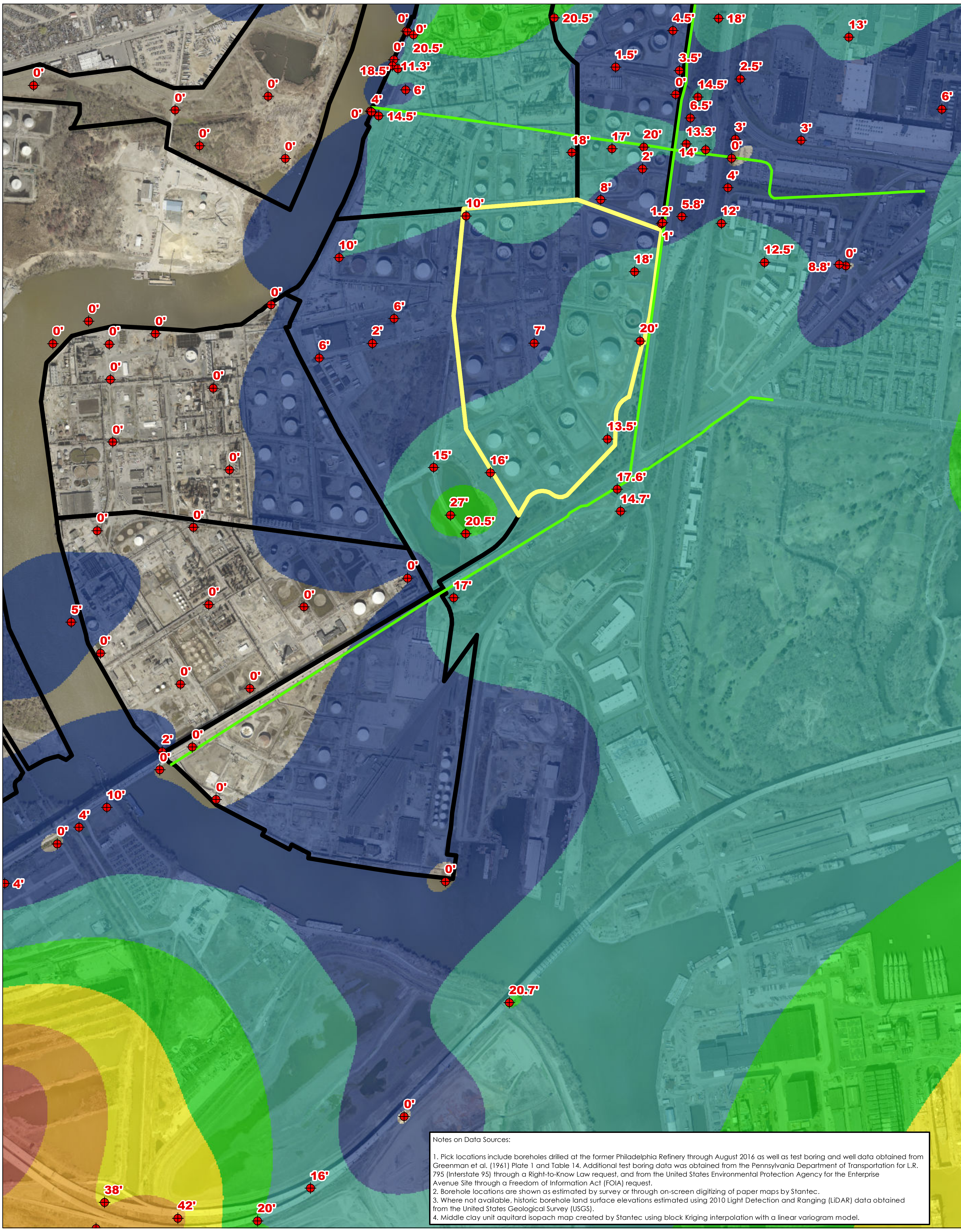
1. Land surface profile obtained from a 2010 Light Detection and Ranging (LiDAR) elevation model available from the United States Geological Survey (USGS).
2. Lithologic log for boring PH-42 was obtained from Tables 13 and 14 of Greenman et al. (1961). Geographic location for the boring was digitized on-screen by Stantec. Lithologic logs, well construction, and survey data for wells DSCP-DW-01, DSCP-DW-06, PH-DW-10, and PH-DW-11 were obtained from Tetra Tech (2005; 2007).
3. Water-table and lower aquifer surfaces were interpolated from selected June 2018 gauging data using point kriging.
4. Stantec generalized lithologic data from available borehole logs into 9 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. Holocene-age muds are colored a darker shade of green so they can be more easily distinguished from older units.
5. Correlation between lithologies and, where applicable, geologic units is based primarily on the straight-line method. Actual conditions between boreholes may vary from what is shown on this profile.
6. North American Vertical Datum of 1988 = NAVD 88
7. Vertical Exaggeration ~ 32 X

Figure 4-13. Stratigraphic Profile G - G'

Philadelphia Refinery Operations
a series of Evergreen Resources Group, LLC
3144 Passyunk Avenue
Philadelphia, PA 19145

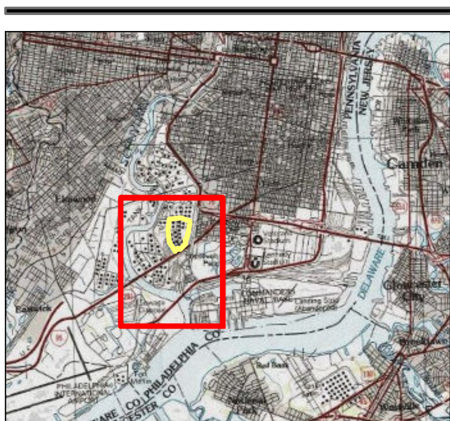
Project Number: 213402602

STRAT COLUMN WELL AND WAT LEVEL SM PRC_MASTER_GENERALIZEDLITHOLOGY_SUBSURFACE_PROFILES_V4_PROFILEELIDAR.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 2/13/17



Notes on Data Sources:

1. Pick locations include boreholes drilled at the former Philadelphia Refinery through August 2016 as well as test boring and well data obtained from Greenman et al. (1961) Plate 1 and Table 14. Additional test boring data was obtained from the Pennsylvania Department of Transportation for L.R. 795 (Interstate 95) through a Right-to-Know Law request, and from the United States Environmental Protection Agency for the Enterprise Avenue Site through a Freedom of Information Act (FOIA) request.
2. Borehole locations are shown as estimated by survey or through on-screen digitizing of paper maps by Stantec.
3. Where not available, historic borehole land surface elevations estimated using 2010 Light Detection and Ranging (LiDAR) data obtained from the United States Geological Survey (USGS).
4. Middle clay unit aquitard isopach map created by Stantec using block Kriging interpolation with a linear variogram model.



Notes

1. Vertical Datum: North American Vertical Datum of 1988 (NAVD 88)
2. Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
3. Source: Stantec
4. Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed
5. Contour Interval = 10 feet
6. 2020 aerial photograph obtained from Pennsylvania Spatial Data Access (PASDA).

LEGEND

- MIDDLE CLAY UNIT "PICK" LOCATION
- AREA OF INTEREST (AOI) 4
- FORMER PHILADELPHIA REFINERY
- STATE BOUNDARY
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER

THICKNESS OF MIDDLE CLAY UNIT AQUITARD

FEET

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 62

0 1,500 Feet

1:12,000 (At Original document size of 11x17)

N

Stantec

EVERGREEN

Project Location

City of Philadelphia,
Philadelphia County,
Pennsylvania

213402602
Prepared by ADK on 9/23/2021
Technical Review by JKK on 9/23/2021
Independent Review by JLM on 9/23/2021

Client/Project

PHILADELPHIA REFINERY OPERATIONS, A SERIES OF EVERGREEN RESOURCES GROUP, LLC
FORMER PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE, PHILADELPHIA, PA 19145

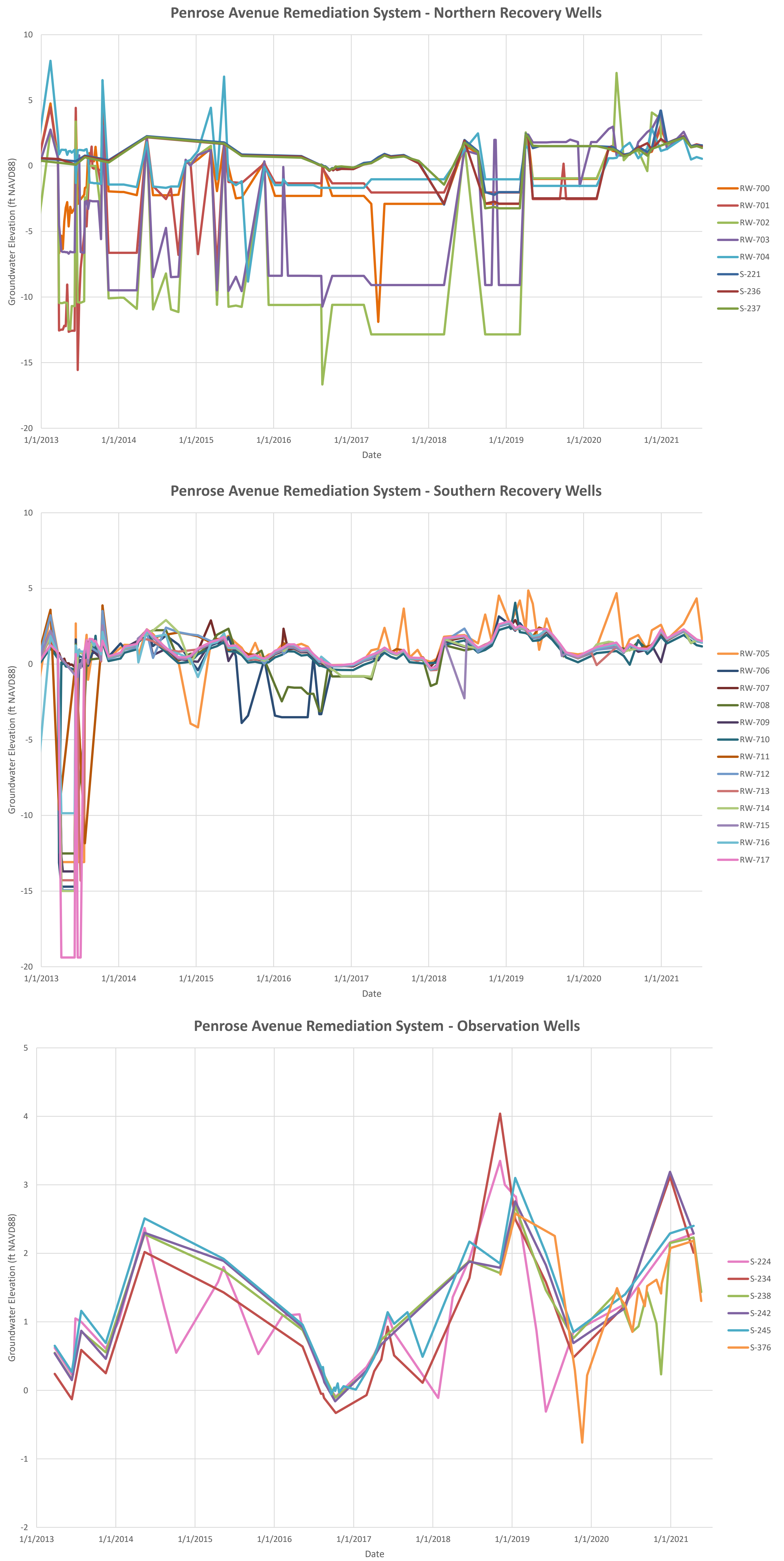
Figure No.

4-14

Title

ISOPACH MAP OF THE MIDDLE CLAY UNIT AQUITARD

Figure 4-15
Groundwater Elevation Hydrographs



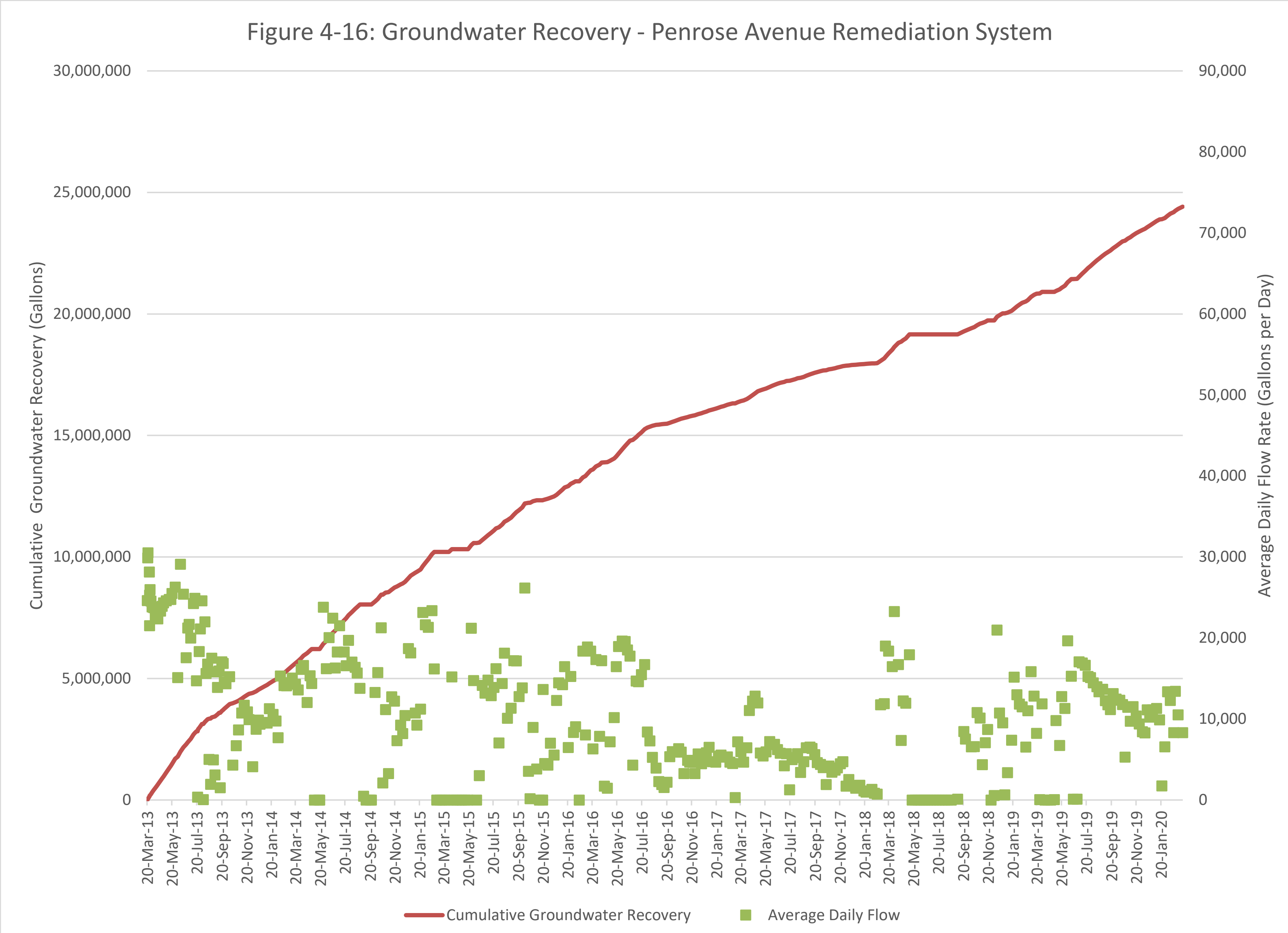


Figure 4-16: Groundwater Recovery - Penrose Avenue Remediation System
Cumulative Groundwater Recovery (Gallons)
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
Average Daily Flow Rate (Gallons per Day)
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
20-Mar-13
20-May-13
20-Jul-13
20-Sep-13
20-Nov-13
20-Jan-14
20-Mar-14
20-May-14
20-Jul-14
20-Sep-14
20-Nov-14
20-Jan-15
20-Mar-15
20-May-15
20-Jul-15
20-Sep-15
20-Nov-15
20-Jan-16
20-Mar-16
20-May-16
20-Jul-16
20-Sep-16
20-Nov-16
20-Jan-17
20-Mar-17
20-May-17
20-Jul-17
20-Sep-17
20-Nov-17
20-Jan-18
20-Mar-18
20-May-18
20-Jul-18
20-Sep-18
20-Nov-18
20-Jan-19
20-Mar-19
20-May-19
20-Jul-19
20-Sep-19
20-Nov-19
20-Jan-20
Cumulative Groundwater Recovery
Average Daily Flow

Stantec

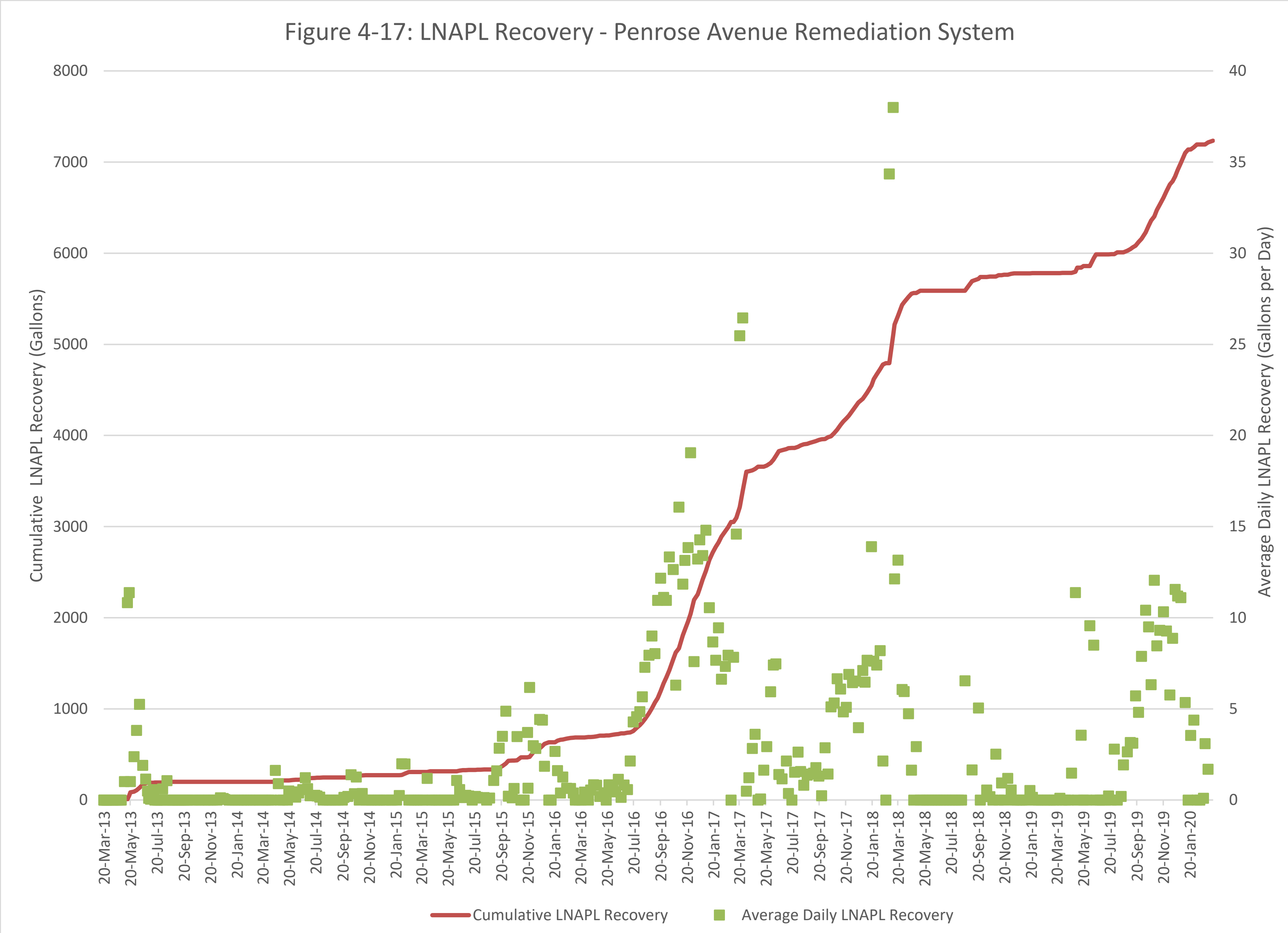


Figure 4-17: LNAPL Recovery - Penrose Avenue Remediation System
Cumulative LNAPL Recovery (Gallons)
Average Daily LNAPL Recovery (Gallons per Day)
0
1000
2000
3000
4000
5000
6000
7000
8000
0
5
10
15
20
25
30
35
40
20-Mar-13
20-May-13
20-Jul-13
20-Sep-13
20-Nov-13
20-Jan-14
20-Mar-14
20-May-14
20-Jul-14
20-Sep-14
20-Nov-14
20-Jan-15
20-Mar-15
20-May-15
20-Jul-15
20-Sep-15
20-Nov-15
20-Jan-16
20-Mar-16
20-May-16
20-Jul-16
20-Sep-16
20-Nov-16
20-Jan-17
20-Mar-17
20-May-17
20-Jul-17
20-Sep-17
20-Nov-17
20-Jan-18
20-Mar-18
20-May-18
20-Jul-18
20-Sep-18
20-Nov-18
20-Jan-19
20-Mar-19
20-May-19
20-Jul-19
20-Sep-19
20-Nov-19
20-Jan-20
Cumulative LNAPL Recovery
Average Daily LNAPL Recovery

Stantec

APPENDIX A

Report Notifications

Evergreen Resources Management
2 Righter Parkway, Suite 120
Wilmington, DE 19803

September 29, 2021

Leigh-Anne Rainford, Director
Environmental Health Services
Philadelphia Department of Public
Health321 University Avenue
Philadelphia, PA 19104

via electronic mail at LeighAnne.Rainford@Phila.gov

RE: Submission of Remedial Investigation Report Addendums
Former Philadelphia Refinery
PADEP Primary Facility ID # 780190 (Site-wide)
PADEP Facility ID # 770318 (AOI 4)
PADEP Facility ID # 778379 (AOI 9)
EPA PAD 002 28 9700
3144 Passyunk Ave, Philadelphia, PA, Philadelphia County, PA

Dear Ms. Rainford:

This letter is to provide notice that Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC (Evergreen) is submitting Remedial Investigation Report (RIR) Addendums to the Pennsylvania Department of Environmental Protection (PADEP) Southeast Regional Office for the former Philadelphia Refinery located at 3144 Passyunk Avenue in Philadelphia, Pennsylvania (Site) for Areas of Interest (AOI) 4 and 9. The RIR Addendums address deficiencies cited by the PADEP in previous RIRs that have been submitted for the Site under Pennsylvania's Land Recycling and Environmental Remediation Standards Act, the Act of May 19, 1995, P.L. #4, No. 2 (Act 2), as well as the joint PADEP and U.S. Environmental Protection Agency (US EPA) One Cleanup Program. The RIR Addendums are being submitted under Act 2 and the One Cleanup Program in accordance with the site-specific remediation standards. Evergreen is an affiliate of Sunoco (R&M), LLC, a former operator of the refinery, and both companies are indirect subsidiaries of Energy Transfer L.P. In November 2013, Evergreen was formed to manage Sunoco's legacy environmental cleanup at the Philadelphia Refinery.

Evergreen submitted a Notice of Intent to Remediate (NIR) to the PADEP in 2006, formally entering the Site into the Act 2 Program. At the request of the City of Philadelphia (City), Evergreen developed a Public Involvement Plan (PIP) in 2006 and updated it in 2019. The updated PIP outlines that each Act 2 report will have a 30-day public comment period at the time of their submittal. Following the submittal of the AOI 4 RIR Addendum and the AOI 9 Second RIR Addendum on September 30, 2021, the public will have 30 days to provide comments to Evergreen. Comments can be sent to Evergreen via the website https://phillyrefinerycleanup.info/comment-submission-form, via email at phillyrefinerycleanup@ghd.com, or via US Postal Service to PO Box 7275, Wilmington, DE 19803. Evergreen will address all comments and questions related to the AOI 4 RIR Addendum and the AOI 9 Second RIR Addendum submitted between September 30, 2021 and October 30, 2021 in correspondence to PADEP that will be incorporated into their review as they will not consider the report final until any comments/questions have been addressed.

Electronic copies of the AOI 4 RIR Addendum and the AOI 9 Second RIR Addendum will also be posted to the website (*https://phillyrefinerycleanup.info/act-2-documents/*) and provided to two local Free Library of Philadelphia branches: Thomas F. Donatucci, Sr. Library at 1935 Shunk St. and Eastwick Library at 2851 Island Avenue. A hard copy will be made available to you upon request. PADEP and US EPA will review the report and provide comment within 90 days.

We have appreciated the opportunity to work closely with the City in the implementation of our Public Involvement Plan, and we look forward to continuing to collaborate with the City and the community at the former Philadelphia Refinery.

Regards,
Evergreen Resources Management Operations

Tiffani L. Doerr, PG

Cc:

C. David Brown, PG, PADEP (via email)
Lisa Strobridge, PG, PADEP (via email)
Kevin Bilash, EPA (via email)
Patrick ONeill, City of Philadelphia (via email)

From:	Leigh-Anne Rainford
To:	DOERR, TIFFANI L
Cc:	Kachel, Jenny; Patrick ONeill; Strobridge, Lisa; Brown, C David; Bilash, Kevin
Subject:	Re: Municipality Notice for Act 2 Report Submittal
Date:	Thursday, September 30, 2021 8:35:02 AM
Attachments:	Outlook-hf1mmisw.png

Received.

Thank you,

Leigh Anne Rainford, MPH | Program Administrator - Food Protection and Environmental Engineering
Philadelphia Department of Public Health | Environmental Health Services
321 University Avenue – 2nd Floor | Philadelphia, PA 19104
Phone: (215) 685 – 7497 | Fax: (215) 382 – 1210
LeighAnne.Rainford@Phila.gov

Department of
Public Health
CITY OF PHILADELPHIA

From: DOERR, TIFFANI L <TLDOERR@evergreenresmgt.com>
Sent: Wednesday, September 29, 2021 12:36 PM
To: Leigh-Anne Rainford <LeighAnne.Rainford@phila.gov>
Cc: Kachel, Jenny <Jenny.Kachel@stantec.com>; Patrick ONeill <Patrick.ONeill@Phila.gov>; Strobridge, Lisa <lstrobridg@pa.gov>; Brown, C David <cdbrown@pa.gov>; Bilash, Kevin <Bilash.Kevin@epa.gov>
Subject: Municipality Notice for Act 2 Report Submittal

Hi Leigh-Anne,

As discussed, we're submitting an electronic copy of the notice letter for Evergreen's upcoming Act 2 Report submittals (Philly Refinery AOI-4 and AOI-9 RIR Addendums), as detailed in the attached correspondence. Please feel free to call if you have any questions or concerns.

Thank you,

Tiffani L. Doerr, PG
Evergreen Resources Management Operations
2 Righter Parkway, Suite 120
Wilmington, DE 19083

Office: 302-477-1305
Cell: 484-889-7347

EVERGREEN

DOERR, TIFFANI L

From: Constant Contact <noreply@constantcontact.com>
Sent: Thursday, September 30, 2021 1:55 PM
To: DOERR, TIFFANI L
Subject: [BULK EMAIL] Your campaign Philly Refinery - Act 2 Report Submittal Notification has been sent

Constant Contact

Dear Tiffani Doerr,

Your campaign **'Philly Refinery - Act 2 Report Submittal Notification'** was sent on 9/30/2021 around 1:54 PM EDT.

Below is a copy of the message your subscribers received. See how your campaign is doing by visiting Reports in your account to get real-time results and stats.

Subject: Philly Refinery - Act 2 Report Submittal Notification

EVERGREEN

Public Notice – Act 2 Report Submittal
Former Philadelphia Refinery
AOI 4 and AOI 9

Pursuant to the Land Recycling and Environmental Remediation Standards Act, the act of May 19, 1995, P.L. 4, No. 1995-2., notice is hereby given that Evergreen is submitting Remedial Investigation Report Addendums to the Pennsylvania Department of Environmental Protection for Area of Interest 4 and Area of Interest 9 at the former Philadelphia Refinery located at 3144 Passyunk Avenue, City of Philadelphia, Philadelphia County on September 30, 2021. The reports are being submitted in accordance with the site-specific remediation standards. The Act 2 public comment period associated with the reports will be 30 days in duration following the report submittal on September 30, 2021, extending through October 30, 2021. Comments can be sent to Evergreen via the website BLOCKEDphillyrefinerycleanup[.]info/comment-submission-formBLOCKED, via email at phillyrefinerycleanup@ghd.com, or via US Postal Service to PO Box 7275, Wilmington, DE 19803. All comments and questions pertinent to the reports being reviewed which are submitted within the 30-day review period, will be addressed by Evergreen and will be submitted by Evergreen to the PADEP as part of the official report submission. The reports will not be considered Final by PADEP until Evergreen has submitted public comments along with an appropriate response/action to be considered by PADEP in their review of the reports.

Reports can be accessed and downloaded from Evergreen's website BLOCKEDphillyrefinerycleanup[.]info/act-2-documents/BLOCKED and are also available at two local
Free Library of Philadelphia branches: Thomas F. Donatucci, Sr. Library at 1935 Shunk St. and Eastwick Library at 2851 Island Avenue.

The Philadelphia Inquirer

801 MARKET STREET, SUITE 300, PHILADELPHIA, PA 19107

Affidavit of Publication

On Behalf of:
STANTEC
1060 Andrew Drive, Ste #140
WEST CHESTER, PA 193805602

STATE OF PENNSYLVANIA COUNTY OF PHILADELPHIA:

Before the undersigned authority personally appeared the undersigned who, on oath represented a and say: that I am an employee of The Philadelphia Inquirer, LLC, and am authorized to make this affidavit of publication, and being duly sworn, I depose and say:

1. The Philadelphia Inquirer, LLC is the publisher of the Philadelphia Daily News, with its headquarters at 801 Market Street, Suite 300, Philadelphia, Pennsylvania 19107.
2. The Philadelphia Daily News is an edition of The Philadelphia Inquirer. The Philadelphia Daily News is continuously published and distributed Sunday-Friday in the City of Philadelphia, count and state aforesaid.
3. The printed notice or publication attached hereto set forth on attached hereto was published in all regular print editions of the Philadelphia Daily News on

Legal Notices

as published in **Daily News Legals** in the issue(s) of:

9/29/2021

4. Under oath, I state that the following is true and correct, and that neither I nor The Philadelphia Inquirer, LLC have any is interest in the subject matter of the aforesaid notice or advertisement.

Helene Sweeney

Kathy V. Harley
Notary Public

My Commission Expires:

Commonwealth of Pennsylvania - Notary Seal
KATHERINE V. HARLEY, Notary Public
Philadelphia County
My Commission Expires May 25, 2025
Commission Number 1312829

Ad No: 80307
Customer No: 106935

COPY OF ADVERTISEMENT

Evergreen - Former Philadelphia Refinery AOI 4 and AOI 9 Pursuant to the Land Recycling and Environmental Remediation Standards Act, the act of May 19, 1995, P.L. 4, No. 1995-2., notice is hereby given that Evergreen is submitting Remedial Investigation Report Addendums to the Pennsylvania Department of Environmental Protection for Area of Interest 4 and Area of Interest 9 at the former Philadelphia Refinery located at 3144 Passyunk Avenue, City of Philadelphia, Philadelphia County, Pennsylvania on September 30, 2021. The reports are being submitted in accordance with the site-specific remediation standards. The Act 2 public comment period associated with the reports will be 30 days in duration following the report submittal on September 30, 2021, extending through October 30, 2021. Comments can be sent to Evergreen via the website **https://phillyrefinerycleanup.info/comment-submission-form,** via email at **phillyrefinerycleanup@ghd.com,** or via US Postal Service to PO Box 7275, Wilmington, DE 19803. All comments and questions pertinent to the reports being reviewed which are submitted within the 30-day review period, will be addressed by Evergreen and will be submitted by Evergreen to the PADEP as part of the official report submission. The reports will not be considered Final by PADEP until Evergreen has submitted public comments along with an appropriate response/action to be considered by PADEP in their review of the reports.

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PROFESSIONAL SERVICES

Legal Notices

Court of Common Pleas for the County of Philadelphia, (AUGUST) Term, 2021, Docket No. (2286). Notice is hereby given that on (September 24, 2021), the petition of (TIFFANY JANINE HARRISON) was filed, praying for a decree to change (her) name to (NGA LAEILU EL). The Court has fixed (OCTOBER 22, 2021 at 10:00AM) in Room No. (691), City Hall, Phila., PA for hearing. All persons interested may appear and show cause if any they have, why the prayer of the said petitioner should not be granted.

PROFESSIONAL SERVICES

Legal Notices

Evergreen - Former Philadelphia Refinery AOI 4 and AOI 9

Pursuant to the Land Recycling and Environmental Remediation Standards Act, the act of May 19, 1995, P.L. 4, No. 1995-2., notice is hereby given that Evergreen is submitting Remedial Investigation Report Addendums to the Pennsylvania Department of Environmental Protection for Area of Interest 4 and Area of Interest 9 at the former Philadelphia Refinery located at 3144 Passyunk Avenue, City of Philadelphia, Philadelphia County, Pennsylvania on September 30, 2021. The reports are being submitted in accordance with the site-specific remediation standards. The Act 2 public comment period associated with the reports will be 30 days in duration following the report submittal on September 30, 2021, extending through October 30, 2021. Comments can be sent to Evergreen via the website https://phillyrefinerycleanup.info/comment-submission-form, via email at phillyrefinerycleanup@ghd.com., or via US Postal Service to PO Box 7275, Wilmington, DE 19803. All comments and questions pertinent to the reports being reviewed which are submitted within the 30-day review period, will be addressed by Evergreen and will be submitted by Evergreen to the PADEP as part of the official report submission. The reports will not be considered Final by PADEP until Evergreen has submitted public comments along with an appropriate response/action to be considered by PADEP in their review of the reports.

PERSONALS

Prayer Thank You

Prayer To The Blessed Virgin
(Never Known To Fail)
O most beautiful Flower of Mount Carmel, Fruitful Vine, Splendor of Heaven, Blessed Mother of the Son of God, Immaculate Virgin, assist me in my necessity. O Star of the Sea, help me and show me here you are my mother. O Holy Mary Mother of God, Queen of Heaven and Earth. I humbly beseech you from the bottom of my heart to succor me in my necessity (make request). There are none that can withstand your power. O Mary conceived without sin, pray for us who have recourse to thee (3 times). Holy Mary, I place this cause in your hands (3 times). Say this prayer for 3 consecutive days then you must publish and it will be granted to you. E.A.

Dear Jesus – Prayer for Favors
Dear Heart of Jesus: In the past, I have asked for many favors. This time, I ask you this very special one (mention favor). Take it dear Jesus and place it within your own bro-ken heart, where your father sees it. Then, in your merciful eyes, it will become your favor, not mine. Amen. Say this prayer for 3 days, promise publication and your favor will be granted. Never known to fail.
M.L.

APPENDIX B

Quality Assurance/Quality Control Plan and Field Procedures Manual

Quality Assurance/ Quality Control Plan and Field Procedures Manual

Sunoco Partners Marcus Hook Industrial Complex and Philadelphia Energy Solutions (PES) Philadelphia Refinery Complex

Evergreen Resources Management Operations
May 20, 2016

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Appendix

1.0 INTRODUCTION

This Quality Assurance/Quality Control Plan and Field Procedures Manual (QA/QC Plan) outlines the procedures developed to ensure the collection and analysis of quality data for investigations completed under the United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA), Pennsylvania Department of Environmental Protection (PADEP) Act 2, and Pennsylvania and Delaware's Tank programs at the Sunoco Partners Marketing and Terminals, LP (Sunoco Partners) Marcus Hook Industrial Complex (MHIC) and the Philadelphia Energy Solutions Refining and Marketing, LLC (PES) Philadelphia Refinery Complex (PRC) on behalf of Evergreen Resources Management Operations (Evergreen). This document shall be used in conjunction with the site-specific work plans developed for each site and Standard Operating Procedures (SOPs) for field work as incorporated as Appendix A of this QA/QC Plan.

The QA/QC Plan is a planning document that provides a "blueprint" for obtaining the type and quality of data needed to support environmental decision making. The QA/QC Plan integrates relevant technical and quality aspects of a project and documents quality assurance and quality control.

The selection criteria and evaluation specified in this document will be used for validating the data in accordance with the USEPA Guidance on Environmental Data Verification and Data Validation (USEPA 240-R-02-004), dated November 2002 (EPA QA/G-8), USEPA Contract Laboratory Program National Functional Guidelines (NFGs) for Superfund Organic Methods Data Review (USEPA 540-R-08-01), dated June 2008 (SOM02.2) and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (USEPA 540-R-10-011), dated January 2010 (ISM02.2). Qualifiers assigned to the data will be consistent with the data qualifiers specified in the NFGs and the USEPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (USEPA 540-R-08-01), collectively referred to herein as validation guidance.

2.0 QUALITY CONTROL REQUIREMENTS

The field and laboratory QC requirements for the characterization and remediation activities are discussed in the following subsections. Specific QC checks and acceptance criteria are provided in the referenced analytical methods.

2.1 Field Sampling Quality Control

The field QC requirements include analyzing reference standards for field instrument calibration and for routine calibration verifications. All initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions to ensure the equipment is functioning within the specified tolerances. The calibration and maintenance history of the project-specific field instrumentation will be maintained in an active field logbook.

Field QC samples for this project include field duplicate samples to assess the overall precision of the sampling and analysis event, equipment rinse blanks to ensure proper cleaning of non-dedicated equipment is conducted between samples to avoid potential cross contamination (also generally referred to as field blanks), and trip blank samples to monitor cross contamination of water samples by volatile organic compounds (VOCs) during sample transport.

The frequency of collection of equipment rinse blanks will be one per sampling event. Field duplicate samples will only be prepared for groundwater samples, not for soil sampling events, at a collection frequency of 1 in 20 samples. One trip blank will be included for every shipment of samples to an analytical laboratory, at a minimum frequency of one trip blank per sample shipment which contains samples for VOCs analyses.

2.2 Analytical Quality Control

The laboratory QC requirements for the analyses may include evaluating chemical/thermal preservation, holding times, handling requirements, method blanks, instrument performance checks, initial calibration standards, calibration verification standards, internal standards, surrogate compound spikes, interference check samples, serial dilution samples, matrix spike/matrix spike duplicate (MS/MSD) samples, and laboratory control samples (LCS). The acceptance criteria for the above identified requirements will be generated by the laboratory and included in the laboratory reports, along with the other laboratory QC requirements.

3.0 DATA VERIFICATION, VALIDATION, AND USABILITY

All field and laboratory data will be reviewed, verified, and/or validated. These terms are defined as follows:

- Data review is the in-house examination to ensure that the data have been recorded, transmitted, and processed correctly.
- Data verification is the process for evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, and/or contractual requirements.
- Data validation is an analyte-specific and sample-specific process that extends the evaluation of data beyond method, procedure, or contractual compliance (i.e., data verification) to determine the quality of a specific data set relative to the end use.

Field data and logbooks will be reviewed to ensure that the requirements of the sampling program, including the number of samples and locations, sampling, and sample handling procedures, were fulfilled.

Data verification, validation, and usability assessments performed on a percentage of lab packages to ensure that the data are scientifically defensible, properly documented, of known quality, and meet the project objectives, are described in the following sections. Data determined to be unusable may require corrective action be taken. Data use limitations will be identified in the data validation and usability assessment (VUA) report, which will be generated as required for characterization or final reporting to the agencies.

3.1 Data Review, Verification, and Validation Requirements

Data review, verification, and validation of the analytical data will be performed by each consultant completing the field activities. The exception to this scenario will be Aquaterra Technologies, Inc. (Aquaterra), in which case Aquaterra will review/verify the data and the consultant company working with Aquaterra will subsequently validate the samples.

Field information will be reviewed to ensure that all field measurements were conducted in accordance with the requirements of the site-specific work plan and this QA/QC Plan including applicable SOPs. Field measurements obtained using procedures inconsistent with the requirements of these documents will be evaluated and may require that additional samples are collected or the use of the data be restricted.

Stage 1 Verification and Validation Checks

One hundred percent of the sample results will go through a Stage 1 verification and validation. As part of the data management process, each consultant will complete verification and validation based on the validation guidance. Data verification and validation will consist of the following items based on the guidance stated.

Stage 1 verification and validation of the laboratory analytical data package consists of checks for the compliance of sample receipt conditions, sample characteristics (e.g., percent moisture), and analytical results (with associated information). It is recommended that the following minimum baseline checks (as relevant) be performed on the laboratory analytical data package received for a Stage 1 validation label:

1. Documentation identifies the laboratory receiving and conducting analyses, and includes documentation for all samples submitted by the project or requester for analyses.
2. Requested analytical methods were performed and the analysis dates are present.
3. Requested target analyte results are reported along with the original laboratory data qualifiers and data qualifier definitions for each reported result.
4. Requested target analyte result units are reported.
5. Requested reporting limits for all samples are present and results at and below the requested (required) reporting limits are clearly identified (including sample detection limits if required).
6. Sampling dates (including times if needed), date and time of laboratory receipt of samples, and sample conditions upon receipt at the laboratory (including preservation, pH and temperature) are documented.
7. Sample results are evaluated by comparing sample conditions upon receipt at the laboratory (e.g., preservation checks) and sample characteristics (e.g., percent moisture) to the validation guidance.

Stage 2 Verification and Validation Checks

A minimum of 10 percent of the samples will be flagged for VUA. When a laboratory work order is selected, the entire work order will undergo Stage 2 validation. Laboratory work orders or sample delivery groups (SDGs) that are selected for VUA will undergo validation based on the NFGs.

The selection of samples that will undergo VUA process is designed to meet the needs of the site investigation, characterization, remediation, and closure programs, such as tank closures. Sampling that falls outside these programs will not undergo the VUA process. This includes samples that are collected for permit compliance, such as RCRA and effluent wastewater, as well as product samples, onsite soil reuse samples, and waste characterization samples.

Ten percent of samples will be selected based on the following additional conditions:

1. Sample package selected will contain a field duplicate sample.
2. Sample package selected will contain an equipment rinse blank.
3. Sample package selected will be representative of the contracted analytical laboratories, sample media, parameters, time, and project goals.

QC samples that are collected in the field will provide the best information for completing the VUA reports. The conditions for selection of samples are designed to provide the most useful information regarding sample analysis. Therefore, field duplicate samples have been identified as a priority condition. However, field duplicate samples will only be prepared for groundwater samples, not for soil sampling events. This is due to the known, inherent heterogeneity of soil at the sites. For program efficiency, entire SDGs will be selected for submission in the VUA process. Individual samples should not be selected and processed unless there is an overriding reason to do so, such as a point of compliance sample result that when compared to the historic data set appears to be anomalous.

Stage 2 data validation includes a review of the following QC data deliverables:

1. Technical holding times
2. Method blanks
3. Surrogate spikes
4. MS/MSD results
5. LCS results
6. Field duplicates

7. Trip and equipment rinse blank samples

Stage 2B Verification and Validation Checks

Stage 2B verification and validation will be completed on inorganic analytical data and will contain the following (in addition to Stage 1 verification):

1. Requested methods (handling, preparation, cleanup, and analytical) are performed.
2. Method dates (including dates, times and duration of analysis for radiation counting measurements and other methods, if needed) for handling (e.g., Toxicity Characteristic Leaching Procedure), preparation, cleanup and analysis are present, as appropriate.
3. Sample-related QC data and QC acceptance criteria (e.g., method blanks, surrogate recoveries, deuterated monitoring compounds (DMC) recoveries, laboratory control sample (LCS) recoveries, duplicate analyses, matrix spike and matrix spike duplicate recoveries, serial dilutions, post digestion spikes, standard reference materials) are provided and linked to the reported field samples (including the field quality control samples such as trip and equipment blanks).
4. Requested spike analytes or compounds (e.g., surrogate, DMCs, LCS spikes, post digestion spikes) have been added, as appropriate.
5. Sample holding times (from sampling date to preparation and preparation to analysis) are evaluated.
6. Frequency of QC samples is checked for appropriateness (e.g., one LCS per twenty samples in a preparation batch).
7. Sample results are evaluated by comparing holding times and sample-related QC data to the requirements in the data validation guidance.
8. Initial calibration data (e.g., initial calibration standards, initial calibration verification [ICV] standards, initial calibration blanks [ICBs]) are provided for all requested analytes and linked to field samples reported. For each initial calibration, the calibration type used is present along with the initial calibration equation used including any weighting factor(s) applied and the associated correlation coefficients, as appropriate. Recalculations of the standard concentrations using the initial calibration curve are present, along with their associated percent recoveries, as appropriate (e.g., if required by the project, method, or contract). For the ICV standard, the associated percent recovery (or percent difference, as appropriate) is present.
9. Appropriate number and concentration of initial calibration standards are present.

10. Continuing calibration data (e.g., continuing calibration verification [CCV] standards and continuing calibration blanks [CCBs]) are provided for all requested analytes and linked to field samples reported, as appropriate. For the CCV standard(s), the associated percent recoveries (or percent differences, as appropriate) are present.
11. Reported samples are bracketed by CCV standards and CCBs standards as appropriate.
12. Method specific instrument performance checks are present as appropriate (e.g., tunes for mass spectrometry methods, DDT/Endrin breakdown checks for pesticides and aroclors, instrument blanks and interference checks for ICP methods).
13. Frequency of instrument QC samples is checked for appropriateness (e.g., gas chromatography-mass spectroscopy [GC-MS] tunes have been run every 12 hours).
14. Sample results are evaluated by comparing instrument-related QC data to the requirements in the data validation guidance.

Stage 3 Verification and Validation Checks

Stage 3 verification and validation will be completed on organic analytical data and will contain the following (in addition to Stage 2B):

1. Instrument response data (e.g., GC peak areas, ICP corrected intensities) are reported for requested analytes, surrogates, internal standards, and DMCs for all requested field samples, matrix spikes, matrix spike duplicates, LCS, and method blanks as well as calibration data and instrument QC checks (e.g., tunes, DDT/Endrin breakdowns, interelement correction factors, and Florisil cartridge checks).
2. Reported target analyte instrument responses are associated with appropriate internal standard analyte(s) for each (or selected) analyte(s) (for methods using internal standard for calibration).
3. Fit and appropriateness of the initial calibration curve used or required (e.g., mean calibration factor, regression analysis [linear or non-linear, with or without weighting factors, with or without forcing]) is checked with recalculation of the initial calibration curve for each (or selected) analyte(s) from the instrument response.
4. Comparison of instrument response to the minimum response requirements for each (or selected) analyte(s).
5. Recalculation of each (or selected) opening and closing CCV (and CCB) response from the peak data reported for each (or selected) analyte(s) from the instrument response, as appropriate.

6. Compliance check of recalculated opening and/or closing CCV (and CCB) response to recalculated initial calibration response for each (or selected) analyte(s).
7. Recalculation of percent ratios for each (or selected) tune from the instrument response, as appropriate.
8. Compliance check of recalculated percent ratio for each (or selected) tune from the instrument response.
9. Recalculation of each (or selected) instrument performance check (e.g., DDT/Endrin breakdown for pesticide analysis, instrument blanks, interference checks) from the instrument response.
10. Recalculation and compliance check of retention time windows (for chromatographic methods) for each (or selected) analyte(s) from the laboratory reported retention times.
11. Recalculation of reported results for each reported (or selected) target analyte(s) from the instrument response.
12. Recalculation of each (or selected) reported spike recovery (surrogate recoveries, DMC recoveries, LCS recoveries, duplicate analyses, matrix spike and matrix spike duplicate recoveries, serial dilutions, post digestion spikes, standard reference materials etc.) from the instrument response.
13. Each (or selected) sample result(s) and spike recovery(ies) are evaluated by comparing the recalculated numbers to the laboratory reported numbers according to the requirements in the data validation guidance.

Stage 4 Verification and Validation Checks

Additional data validation may be completed for selected sites and/or sampling events, up to EPA Level 4 data review, which will require a laboratory data package inclusive of raw data. Stage 4 verification and validation includes all of the elements of the previous stages of validation and the following:

1. Evaluation of instrument performance checks (GC/MS)
2. Initial and continuing calibration checks (organic and inorganic analyses)
3. Review of internal standards (GC/MS)
4. Instrument blanks (inorganics)
5. Interference check samples (metals)
6. Recalculations of sample results and reporting limits

3.2 Validation Codes

Consultant specific validation codes will be added to the database. This will allow quick identification of the consultant that has performed the verification and/or VUA. Stantec may append additional codes for data management purposes to the codes provided in dt_result table approval_code field. Valid codes are as follows:

Langan:

- LAN1 – Historical data collected by Langan Level 1 Validation (Verification)
- LAN-VER – Langan performed verification
- LAN-USB – Langan performed usability

GHD:

- GHD-VER – GHD performed verification
- GHD-USB – GHD performed usability

Stantec:

- STN-VER – Stantec performed verification
- STN-USB – Stantec performed usability

This methodology creates a means for consultants to perform verification and usability on data collected by another consultant.

3.3 Data Updates in the Electronic Data Deliverables

All consultants will request EQuIS 4 file format Electronic Data Deliverables (EDDs) for data management from the analytical laboratories. In order to facilitate the data updates in the database, the following methodology will be used.

1. The consultant chemist / chemist team will open the .RES file for the EDD that has been selected to be validated for usability. The file can be opened using Excel, Access, Notepad, or similar tool. Although, it is a best practice to open the file in a way to preserve the textual nature of the EDD, it is not necessary.
2. The chemist will use the result_comment field in the .RES file to enter the qualifiers associated with the record and add a semicolon as a delimiter (;) followed by the reason code for the qualification.

3. The .RES file is to be saved with a .USB extension at the end of the file. This file is to be separate from the original .RES file provided and should not be used to over write the original .RES file that was sent with the EDD. This will result in the laboratory work order undergoing VUA having five files instead of four for the EDD. For example:
   - 1234.SMP
   - 1234.TST
   - 1234.BCH
   - 1234.RES
   - 1234.RES.USB
4. Stantec will use the fifth file to update the database with the appropriate qualifiers and codes in validator_qualifiers and approval_a through approval_d fields in dt_result table in the database.
5. Stantec will also change the validated y/n field in dt_result table in the database for the particular EDD.

3.4 Validation Qualifiers

The following qualifiers should be used during the validation/usability process. These are based on the NFGs, validation guidance, and commonly used qualifiers.

Data Qualifiers and Definitions

U The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

J The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

J+ The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample, potentially biased high.

J- The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample, potentially biased low.

UJ The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

NJ The analyte has been "tentatively identified" or "presumptively identified" as present and the associated numerical value is the estimated concentration in the sample.

R The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

B The analyte was detected in the method, field, and/or trip blank. This qualifier is not pursuant to the NFGs.

If additional qualifiers are required, please forward the suggestions to the Stantec Data Management Team and they will be added to the list of approved codes.

Submitting Data and Validation Codes for Inclusion in the Database

EDDs will be submitted to the database using the SharePoint portal intake forms. The appropriate qualifiers and codes that have been added to the result_comment field in the .RES.USB file will be included in the submission.

Reason Codes

Following is a list of reason codes available for validation. If additional codes are required, please forward the suggestions to the Stantec Data Management Team and they will be added to the list of approved codes.

Reason Code	Reason Description
General Use	
EC	Result exceeds the calibration range.
HT	Holding time requirement was not met
MB	Method blank or preparation blank contamination
LCS	Laboratory control sample evaluation criteria not met
FB	Field blank contamination
RB	Rinsate blank contamination
SQL	The analysis meets all qualitative identification criteria, but the measured concentration is less than the reporting limit.
FD	Field duplicate evaluation criteria not met
TvP	Total to Partial criteria not met
RL	Reporting limit exceeds decision criteria (for non-detects)
Inorganic Methods	
ICV	Initial calibration verification evaluation criteria not met
CCV	Continuing calibration verification evaluation criteria not met
CCB	Continuing calibration blank contamination
PB	Preparation Blank
ICS	Interference check sample evaluation criteria not met
D	Laboratory duplicate or spike duplicate precision evaluation criteria not met
MS	Matrix spike recovery outside acceptance range
PDS	Post-digestion spike recovery outside acceptance range
MSA	Method of standard additions correction coefficient _0.995
DL	Serial dilution results did not meet evaluation criteria
Organic Methods	
TUNE	Instrument performance (tuning) criteria not met
ICAL	Initial calibration evaluation criteria not met
CCAL	Continuing calibration evaluation criteria not met
SUR	Surrogate recovery outside acceptance range
MS/SD	Matrix spike/matrix spike duplicate precision criteria not met
MS	Matrix spike recovery outside acceptance range
IS	Internal standard evaluation criteria not met
LM	The PFK lock mass SICPs indicate that ion suppression evident
ID	Target compound identification criteria not met
Results Reported for Analytes Analyzed Multiple Times	
NSR	Not selected for reporting because the result was qualified as unusable
NSDL	Not selected for reporting because diluted resulted was selected for reporting
NSQ	Not selected for reporting because result was lesser quality based on data validation
NSO	Not selected for reporting because of other reason
Bias Codes	
H	Bias in sample result likely to be high
L	Bias in sample result likely to be low
I	Bias in sample result is indeterminate

3.4 Verification and Validation Summary

Verification of sample collection procedures will consist of reviewing sample collection documentation for compliance with the requirements of the site-specific work plan and this QA/QC Plan. If alternate sampling procedures were used, the acceptability of the procedure will be evaluated to determine the effect on the usability of the data. Data usability will not be affected if the procedure used is determined to be an acceptable alternative that fulfills the measurement performance criteria in this QA/QC Plan.

The results of the data verification and validation procedure will identify data that do not meet the measurement performance criteria of this QA/QC Plan. Data verification and validation will determine whether the data are acceptable, of limited usability (qualified as estimated), or rejected. Data qualified as estimated will be reviewed and a discussion of the usability of estimated data will be included in the VUA report.

Data determined to be unusable may require corrective action to be taken. Potential types of corrective action may include resampling by the field team or reanalysis of samples by the laboratory. The corrective actions taken are dependent upon the ability to mobilize the field team and whether or not the data are critical for project data quality objectives to be achieved. Data use limitations will be identified in VUA report, which will be generated as required for characterization or final reporting to the agencies. Each consultant will be responsible for their own VUA reports.

Revision History

Revision	Description	Prepared By	Date
1.0	Initial creation of document as SOP for VUA	Stantec (Gus Sukkurwala/Jennifer Menges/Andrew Bradley)	5/31/2015
2.0	Incorporation into QA/QC Plan	GHD (Colleen Costello)	3/21/2016
3.0	Inclusion of Field Procedures. Edits from Langan (Emily Strake & Kevin McKeever)	Stantec (Jennifer Menges)	5/13/2016

APPENDIX A
EVERGREEN FIELD PROCEDURES MANUAL

Evergreen
Field Procedures Manual

Sunoco Partners Marcus Hook Industrial Complex and Philadelphia Energy Solutions (PES) Philadelphia Refinery Complex

Evergreen Resources Management Operations

May 20, 2016

Table of Contents

1.0 INTRODUCTION

This Field Procedures Manual outlines the standard operating procedures developed to ensure the collection and analysis of quality data for investigations completed under the United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) program, Pennsylvania Department of Environmental Protection (PADEP) Act 2 program and Pennsylvania and Delaware's Tank programs at the Sunoco Partners Marketing and Terminals, LP (Sunoco Partners) Marcus Hook Industrial Complex (MHIC) and the Philadelphia Energy Solutions Refining and Marketing, LLC (PES) Philadelphia Refinery Complex (PRC) on behalf of Evergreen Resources Management Operations (Evergreen). The MHIC and PRC are herein referred to as facility or site.

Evergreen's consultants collect data in pursuit of site characterization and remediation that will meet the expectations of the appropriate regulatory agencies. This document shall be used in conjunction with the site-specific work plans developed for each site and the QA/QC Plan of which this manual was incorporated as Appendix A.

1.1 Training Qualifications

All field personnel involved in field work at MHIC and the PRC shall have completed and where applicable, be current with OSHA 40-hour HAZWOPER training, annual OSHA 8-hour HAZWOPER refresher, Process Safety Management (PSM) training, site-specific safety module training for current facility badges (including fire watch and hole watch, if required), TWIC Card, annual drug screening, and annual respirator fit testing. All field personnel new to the facility should be provided with onsite health and safety (H&S) orientation by an experienced member of the project team. The onsite orientation should include review of the facility's emergency action plan and training on Evergreen and site-specific H&S requirements. Appropriately qualified personnel should perform field work, based on the work scope and experience level required by the task to be executed.

1.2 Health and Safety Requirements

All consultants performing work at the referenced sites on behalf of Evergreen shall comply with the *Evergreen Resources Management Operations Health and Safety Requirements* dated June 1, 2014. This includes contractors, sub-contractors, and third party companies performing work for Evergreen at MHIC and the PES PRC. Each consultant must also have their own site-specific health and safety plan (HASP) submitted to and approved by Evergreen prior to performing any work. A site-specific HASP must be reviewed and signed by all field personnel prior to commencement of field activities.

1.3 PPE Requirements

The minimum standard PPE at the facilities includes fire resistant clothing (FRC; coveralls may be Nomex or other FRC, 6 ounce minimum, orange in color) with the name of the company displayed on the back of the garment, hard hat, sturdy safety-toe boots, safety glasses, long-gauntlet leather gloves, and personal H_2S monitors. Nitrile gloves for chemical protection and hearing protection may also be required depending on the location and type of work. Workers are to be trained on these PPE requirements before being permitted onsite. An appropriate respirator may be required if site-specific air monitoring action levels are met, in accordance with the site-specific HASP. If a worker has a particular sensitivity or concern, a respirator may be worn regardless of OSHA action levels. During winter weather conditions, slip prevention footwear such as crampons or overshoes should be worn for traction. Task-specific PPE will be further identified in following sections.

1.4 Site Controls

Safety cones and/or caution tape should be used in high traffic areas. The "Buddy System" may also be employed in high traffic areas, in areas where other contractors are working, and in remote areas. Additional task-specific site controls will be detailed in following sections.

1.5 Equipment and Decontamination

Numerous practices are employed throughout the processes of site investigation and sampling to assure the integrity of the resulting data. The risk in use of non-dedicated equipment at multiple sampling locations lies in the potential for cross-contamination. While the threat of cross-contamination is always present, it can be minimized through the implementation of a consistent decontamination program during sensitive site measurement and data collection activities.

All site equipment to be used in multiple locations (non-dedicated) for sampling of soil, sediment, and/or groundwater will be decontaminated immediately prior to initial use and between uses at each location according to the following steps:

- Remove particulates with a sorbent pad or towel and/or initial rinse with clean potable tap water;
- Wash equipment with clean sponge, soft cloth, or scrub brush as necessary in a solution of tap water/laboratory grade detergent (Alconox®, Liquinox®, or equivalent);
- Rinse with tap water;
- Rinse with deionized or distilled water; and
- Air dry for as long as possible.

Rinse water generated during decontamination procedures will be treated onsite by passing the water through a bucket or tube filled with activated carbon prior to discharge to the ground surface. Additional decontamination procedures may be appropriate depending on the task, and will be identified in the following sections, as applicable.

1.6 Documentation

All site activities and conditions for characterization activities should be recorded by field personnel in a field computer (e.g., YUMA) using the EQuIS Data Gathering Engine (EDGE) application, or if necessary, a field book may be used. The entry shall include at a minimum, the date, time, weather conditions, location, personnel present onsite, field readings, sampling methodology, as well as additional comments or observations. Task specific observations which should also be recorded will be identified in the following applicable sections.

2.0 LIQUID LEVEL ACQUISITION (WELL GAUGING) PROCEDURES

2.1 Potential Hazards

Traffic, pinch points, chemical (airborne and physical contact), and biological are all likely hazards to be encountered as well as slip/trip/fall potential during onsite well gauging activities. Additional hazards may be mentioned in the site-specific HASP and/or the daily job safety analysis (JSA).

2.2 Materials and Equipment Necessary for Task Completion

Optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy, decontamination supplies (laboratory-grade detergent, deionized or distilled water, appropriate containers, scrub brush, and sorbent pads or paper towels), socket set, flathead screwdriver (or pry bar or manhole cover lifter), clear bailers with string for confirmation of light non-aqueous phase liquids (LNAPL), if necessary, and air monitoring instruments (optional, based on previous site visits).

2.3 Methodology

This task involves the deployment of an optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy into a well (in most cases), recording the measurement, and decontaminating the probe. The recorded field measurements may then be utilized for one of several applications including: well sampling, water table gradient mapping, LNAPL occurrence, LNAPL thickness, and/or gradient mapping, and various testing procedures. Wells should be gauged in order of least to most contaminated, based on existing sampling data or LNAPL occurrence, to minimize the potential for cross-contamination between wells. If LNAPL is detected in a well that does not typically have LNAPL, it should be confirmed with a clear bailer.

The proper procedure for liquid level acquisition is as follows:

1) Decontaminate the optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy prior to initial deployment, and again after each well measurement to prevent cross-contamination between wells.

2) If warranted, mark off a work area surrounding the well(s) to be gauged with safety cones and/or caution tape in order to protect personnel from auto traffic; the "Buddy System" may also be employed.

3) Where applicable, lift the manhole cover off of the well head (a screwdriver, pry bar, or manhole cover lifter may be used to lift the cover depending on the size of the manhole) or open protective well casing (stickup) and remove the well plug, if present.

4) Most wells should contain a mark or notch in the top edge of the casing from which normalized readings are to be measured (reference point elevation). Slowly lower the optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy into the well until the instrument signals contact with liquid. Note whether or not the instrument's tone is indicative of the presence of free-phase LNAPL (commonly a solid tone), or water (commonly an oscillating or beeping tone). If LNAPL is present, record the depth at which LNAPL was first indicated to the nearest hundredth of a foot, as measured from the top of well casing mark/notch. Slowly lower the probe through the LNAPL until the instrument's tone changes to indicate the presence of water. Record the depth at which water was first indicated to the nearest hundredth of a foot. A clear bailer may be used to verify the existence or approximate amount and appearance of LNAPL. If no LNAPL is apparent, record the depth to water.

5) Retract the probe from the well and secure the well appropriately.

6) Note the date and time of measurement for gauging and record all measurements and observations in the field computer or, if necessary, in a field book for subsequent electronic data entry.

7) Decontaminate the probe in accordance with the decontamination procedure outlined in Section 1.5.

8) Clean up the work area, remove gauging equipment, and remove any traffic control devices.

3.0 GROUNDWATER MONITORING PROCEDURES

3.1 Potential Hazards

Traffic, pinch points, chemical (airborne and physical contact), and biological are all likely hazards to be encountered as well as slip/trip/fall potential during onsite well gauging activities. Additional hazards may be mentioned in the site-specific HASP and/or the daily JSA.

3.2 Materials and Equipment Necessary for Task Completion

A list of equipment required to access, gauge, purge, and sample site monitoring wells is presented below. Also listed are materials necessary to store, label, preserve, and transport groundwater samples.

- Current site map detailing well locations;
- Field book and/or field computer for recording site data;
- Graduated, optical oil/water interface probe;
- Keys and tools to provide well access;
- Appropriate, laboratory prepared sample containers and labels;
- Appropriate well purging apparatus as determined by volume of groundwater to be purged and compounds to be analyzed;
- Water quality meter for monitoring indicator field parameters (DO, pH, specific conductance, redox potential, and turbidity if available);
- Dedicated polyethylene bottom-loading bailer or well pump and disposable tubing for groundwater sample collection;
- Clean nylon or polypropylene bailer cord;
- Disposable nitrile sampling gloves;
- Decontamination supplies;
- Calibrated five-gallon bucket and watch or stopwatch to determine discharge rate during purging;
- Blank chain-of-custody forms; and

- Cooler(s) and ice for sample preservation.

3.3 Methodology for Three Well Volume Sampling

Prior to site visitation for the groundwater sampling event, the following data will be reviewed to ensure proper preparation for field activities:

- Most recent liquid level data from all wells;
- Most recent analytical data from all wells to determine gauging and sampling sequence; and
- Well construction characteristics.

Each monitoring well to be sampled will be gauged to obtain liquid level data immediately prior to initiation of the sampling process (refer to well gauging procedures above). Liquid level data should be recorded in a field computer or if necessary, a field book. Should free-phase LNAPL be detected by the gauging process, routine groundwater sampling will not be conducted at that location. If groundwater sampling under LNAPL is warranted, refer to the sub-LNAPL sampling section and methodology in Section 3.6.

Groundwater sampling will be initiated by purging from the well a minimum of three well volumes, except in cases where the well is pumped dry, as referenced below. Well purging is performed to remove stagnant water and to draw representative water from the aquifer into the well for subsequent sampling and analysis. In extreme cases where a well is pumped dry and/or shows little recharge capacity, the well should be evacuated once prior to sampling. Wellbore storage volume should be estimated using as-built information stored in the field computer or as indicated on the well log, and the depth to water measurement obtained immediately prior to sampling.

Water quality should be monitored and readings recorded in the field computer or field book while purging, typically through use of a multi-parameter water quality meter with a flow through cell or cord for down-well measurements. Water quality readings should be recorded a minimum of three times (pre-purge, during purge, and post-purge/sample collection) or four times (pre-purge and following each well volume). The parameters to be monitored and recorded are dissolved oxygen, pH, specific conductance, redox potential, temperature, and turbidity if available.

Well purging can be performed with various equipment including: a dedicated bailer for hand bailing low volumes of water; a surface mounted electric centrifugal pump with dedicated polyethylene tubing; and/or submersible pump (particularly when the depth to water is greater than 20 feet) with dedicated polyethylene tubing. During pumping, the intake will be placed directly below the static water surface and slowly lowered during the purging process. This procedure may not be necessary in low-yielding wells but is important in high-yielding, permeable strata where an intake initially placed deep in a well may draw laterally and have little influence in exchanging water from shallower depths within the well bore.

Flow rate during well purging will be approximated by the bucket and stop watch method. The duration of pumping required to remove three well volumes will be calculated directly from this flow rate. All fluids removed during purging will be treated onsite with activated carbon or in accordance with an approved work plan.

The sequence of obtaining groundwater samples will be based upon available historical site data for existing wells and photoionization detector (PID) readings for newly installed wells. Monitoring wells will be sampled in order of those having the lowest to highest concentration of constituents of concern (or PID readings for new wells), based upon the most recent available set of laboratory analyses, to reduce the potential for cross-contamination. For general monitoring events, groundwater samples will not be obtained for analysis from any well containing measurable free product. If groundwater sampling under LNAPL is warranted, refer to the sub-LNAPL sampling section and methodology in Section 3.6.

The following sequence of procedures will be implemented for the collection of groundwater samples from monitoring wells.

1) Establish a clean work area where sampling equipment will not come in contact with the ground or any potentially contaminated surfaces.
2) Use a dedicated polyethylene sampling bailer for each well.
3) Use a clean pair of nitrile gloves.

4) Attach an appropriate length of unused, clean nylon or polypropylene cord to the designated sampling bailer.

5) Select appropriate laboratory-provided sample containers.

6) Slowly lower sampling bailer into well until water surface is encountered; continue to lower the sampling bailer into the standing water column to one foot below the water surface.

7) Retrieve bailer at a steady rate to avoid excess agitation.

8) Visually inspect bailed sample to ensure that no free product or organic detritus has been collected.

9) Uncap first designated sample vial and fill from bailer as rapidly as possible but minimizing agitation; secure septum and lid.

10) Inspect sealed sample for entrapped air; if air is present, remove the lid and gently top off sample in vial, seal and inspect. Repeat until no air is apparent.

11) Repeat Steps 9 and 10 for the remaining sample vials based on the laboratory and/or regulatory protocol.

12) Complete and attach labels to sample containers noting sample collector, date, time, and location of sample; record same data in field computer or field book.

13) Place samples in ice-filled cooler in such a manner as to avoid breakage. Samples will be maintained at a temperature of approximately 4°C.

14) Dispose of gloves, bailer, and bailer cord as solid waste and move to next sample location.

3.4 Methodology for Low-Flow Purging and Sampling

For wells that will be purged and sampled via low-flow methodology, the USEPA Region III Bulletin QAD023: *Procedure for Low-Flow Purging and Sampling of Groundwater Monitoring Wells* will be followed. The following data will be reviewed for each well in order to set the pump intake for the low-flow sampling:

- Soil boring lithologic log;
- Well construction log showing the screened interval;
- Identification of the most permeable zone screened by the well;
- Approximate depth to static water;

- Proposed pump intake setting; and
- Technical rationale for the pump intake setting, preferably across from the most impacted/contaminated subsurface interval.

Adjustable rate, submersible, bladder pumps in conjunction with polyethylene tubing for purging and sampling will be used. An alternate set up could include a stainless steel submersible pump, such as a Hurricane® pump or a Monsoon® pump with dedicated polyethylene tubing. The tubing diameter will be between 3/16-inch and ½-inch inner diameter and the length of the tubing extended outside of the well should be minimized. Flow-through cells will be used to monitor groundwater quality parameters during sampling. Monitoring well information, equipment specifications, water level measurements, parameter readings, and other pertinent information will be recorded during well purging and sampling.

The following sequence of procedures will be implemented for the collection of groundwater samples from monitoring wells by the low-flow methodology.

1) PID Screening of Well: A PID measurement may be collected at the rim of the well immediately after the well cap is removed and recorded in the field computer or field book, if historic data is not available.
2) Depth to Water Measurement: A depth to water measurement will be collected and recorded. To avoid disturbing accumulated sediment and to prevent the inadvertent mixing of stagnant water, measuring the total depth of the well should be done at the completion of sampling.
3) Low Stress Purging Startup: Water pumping will commence at a rate of 100 to 400 milliliters per minute (mL/min). This pumping should cause very little drawdown in the well (less than 0.2-0.3 feet) and the water level should stabilize. Water level measurements are made frequently, and flow rate will be recorded in mL/min on the sampling form or field computer.
4) Low Stress Purging and Sampling: The water level and pumping rate will be monitored and recorded every five minutes during purging, and any pumping rate adjustments will be recorded. During the early phase of purging, emphasis will be placed on minimizing and stabilizing pumping stress, and recording any necessary adjustments. Adjustments, when necessary, will be made in the first 15 minutes of purging. If necessary, pumping rates will

be reduced to the minimum capabilities of the pump to avoid well dewatering. If the minimal drawdown exceeds 0.3 feet, but the water level stabilizes above the pump intake setting, purging will continue until indicator field parameters stabilize, as detailed in Step 5 below. If the water level drops below the pump intake setting at the absolute minimum purge rate, the pump will remain in place and the water level will be allowed to recover repeatedly until there will be sufficient water volume in the well to permit the collection of samples.

5) Indicator Field Parameter Monitoring: During well purging, indicator field parameters (DO, pH, specific conductance, redox potential, and turbidity if available) will be monitored every five minutes (or less frequently, if appropriate). Purging will be considered complete and sampling can commence when all the indicator field parameters have stabilized. Stabilization will be achieved when three consecutive readings, taken at five minute intervals (or less frequently, if appropriate), are within the following limits:

    - DO (±10 percent);
    - turbidity (±10 percent);
    - specific conductance (±3 percent);
    - pH (± 0.1 unit); and
    - redox potential ([Eh] ±10 mv).

   Temperature and depth to water will be also monitored during purging. Should any of the parameter-specific components of the water quality meter fail during monitoring, the sampling team will attempt to locate a replacement multi-meter or individual criteria meter. If none are available, the sampling team will continue recording the parameters that are operational, and proceed with the sampling. Any other field observations relating to sample quality, such as odor, foaming, effervescence, and sheens, will also be recorded in the field computer or on the sampling form.

6) Collection of Ground Water Samples: Water samples for laboratory analyses will be collected prior to the flow-through cell by either using a bypass assembly or by temporarily disconnecting the flow-through cell. All sample containers will be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. During purging and sampling, the tubing should remain filled with water in order to minimize possible changes in water chemistry upon contact with the atmosphere. Methods employed to ensure that the outlet tubing will be filled include adjusting the tubing angle upward to

completely fill the tubing and restricting the diameter of the tubing near the outlet of the tubing.

The order in which samples will be collected is as follows:

- Volatile organics;
- Gas sensitive (e.g., Fe^{+2}, CH_4, H_2S/HS);
- Base neutrals or PAHs;
- Total petroleum hydrocarbons;
- Total metals;
- Dissolved metals;
- Cyanide;
- Sulfate and chloride;
- Nitrate and ammonia;
- Preserved inorganic;
- Non-preserved inorganic; and
- Bacteria.

After the appropriate laboratory-provided glassware is filled and labeled, the samples shall be placed in an ice-filled cooler and maintained at approximate 4°C for submittal to the laboratory. Upon completion of sampling at the well, decontaminate non-dedicated equipment in accordance with the decontamination procedure outlined in Section 1.5, and dispose of all dedicated equipment (gloves, tubing, etc.) as solid waste before moving to the next location.

3.5 Methodology for Passive (No-Purge) Sampling for Groundwater Collection

There are many passive groundwater sampling devices that allow for accurate sample collection without purging. Each device has specific uses and conditions for which they are more applicable. This methodology presents details for the use of HydraSleeve samplers.

The HydraSleeve is a disposable, single use device for the collection of representative groundwater samples for laboratory analysis of physical and chemical parameters.

HydraSleeves are placed within the screened interval (or other defined interval) of the well and activated after an equilibrium period. When used according to the manufacturer's instruction, the HydraSleeve will collect a groundwater sample without purging, thus causing no drawdown, agitation, or water column mixing. The HydraSleeve collects a sample from the screened interval only, and excludes water (or other fluids) from other parts of the well by use of check valve that seals when the sampler is full. The HydraSleeve takes advantage of the continuous natural movement of groundwater, which produces an equilibrium condition between the water in a well screen and the adjacent formation. HydraSleeves produce reliable data from low yield wells where other sample methods cannot due to well screen dewatering and associated alteration in water chemistry.

The HydraSleeve consists of the following components:

1) A long (usually 3 to 5 feet), flexible, lay-flat polyethylene sample sleeve, which is sealed at the bottom, and is equipped with a reed valve at the top allowing water to enter the HydraSleeve only during active sample retrieval.
2) A reusable, stainless steel weight attached with a clip to the bottom of the sleeve. The weight is used to carry the sample sleeve down the well to the specified depth (usually the bottom of the well screen). An optional top weight is also available to compress the sleeve in wells with short well screens.
3) A tether line attached to a spring clip at the top of the sample sleeve to deploy the device within the well and later retrieve it for sample collection.
4) A discharge tube is supplied with the device, which is used to puncture the wall of the sleeve after it is recovered to allow direct filling of sample bottles.

<u>Deployment</u>

Upon retrieval, the HydraSleeve is designed to effectively collect a "core" of water from within the well screen, which is equivalent in length and diameter to the sample sleeve. The upward motion opens the valve at the top, which then allows the device to fill with water. The Hydrasleeve should be installed with the top of the sample sleeve as close to the desired sample interval as possible. This will allow the sampler to fill and the check valve to close before the top of the device is pulled past the top of the sample interval.

To assemble and deploy the HydraSleeve:

1) Remove the Hydrasleeve from its package and hold it by the top, pinching the top at the holes.
2) Attach the spring clip and tether in the holes.
3) Slide the clip and bottom weight assembly into the holes at the bottom of the sleeve.
4) Lower the Hydrasleeve by the tether to the bottom or to the specified depth and secure the tether at the wellhead (Note: do not pull the HydraSleeve upward at any time during deployment, as this could cause the check valve to open and water to fill the sleeve inadvertently).

Sample Collection

Although the HydraSleeve only displaces approximately 100 milliliters (ml) of water during deployment, the well should be allowed to stabilize prior to sample collection so that natural flow conditions and contaminant distribution can return to equilibrium conditions. In certain jurisdictions, regulatory directives may prescribe a minimum equilibration period. When used for periodic monitoring programs, such as quarterly or semi-annual sampling, the HydraSleeve can be installed and remain in the well until the next sampling event, thus providing ample time for the well to equilibrate.

To collect a sample:

1) Be sure the tether is secured to the top of the well.
2) In one smooth motion, pull the tether upward at a rate of approximately 1 foot per second. The weight of the sampler will be felt when the valve closes. Continue pulling upward until the HydraSleeve is clear of the well.
3) Discard the water trapped at the top of the HydraSleeve above the reed valve.
4) Hold the HydraSleeve at the reed valve, and puncture the sleeve with the discharge tube just below the reed valve.
5) Decant the water into sample containers.
6) Discard the HydraSleeve as solid waste and process the excess water through activated carbon prior to discharge to the ground surface.

The weight and clips should be decontaminated prior to deploying a replacement HydraSleeve in the well. Tethers can be dedicated to individual wells or decontaminated and reused.

3.6 Methodology for Sub-LNAPL Sampling

The following section describes the methodology used for obtaining groundwater samples from the water column beneath LNAPL. Wells for sub-LNAPL sampling are not purged of three well volumes prior to sampling. This will prevent the potential of drawing LNAPL into the sample and to be representative of steady-state groundwater conditions beneath the LNAPL.

The following data will be reviewed for each well in order determine the appropriate equipment necessary:

- Well construction log showing diameter and total depth of the well;
- Approximate depth to LNAPL; and
- Approximate depth to static water.

A list of equipment for sub-LNAPL sampling is presented below:

- Field book or field computer for recording site data;
- Optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy;
- Keys and tools to provide well access;
- Peristaltic pump;
- Polyethylene tubing specifications of 0.25-inch outer diameter x 0.17-inch inner diameter is preferable as this small diameter assists in achieving lower flow rates;
- Silicone tubing of appropriate diameter to operate peristaltic pump;
- Polyvinyl chloride (PVC) drop tube (1.5-inch or other appropriate diameter);
- PVC rod (0.5-inch or other appropriate diameter);
- PVC end cap for drop tube;
- Tether for end cap;
- Clamps for securing drop tube to well casing;
- Appropriate sample containers and labels;

- Decontamination supplies;
- Blank chain-of-custody forms; and
- Cooler and ice for sample preservation.

The following sequence of procedures will be implemented for the collection of sub-LNAPL groundwater samples.

1) Determine LNAPL Thickness: Use an optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy to collect depth to LNAPL and depth to water measurements.
2) Installing Sampling Equipment: Deploy a 1.5-inch (or other appropriate diameter) PVC pipe (drop tube), with an attached end cap, through the LNAPL layer in the well. The end cap should be tethered to the drop tube so it is not lost in the well when removed and in a way that allows the drop tube to be sealed during installation. Lower the drop tube until the bottom of the tube is approximately two feet into the water column below the bottom of the LNAPL. Secure the drop tube to the well, and allow the system to equilibrate, approximately one half hour. The end cap is then removed by inserting a 0.5-inch (or other appropriate diameter) PVC rod into the drop tube and pushing on the cap until the lid is removed. The cap will be removed along with the tube upon completion of sampling.
3) Collection of Groundwater Samples: Lower polyethylene tubing through the 1.5-inch drop tube into the water column. Connect the polyethylene tubing to silicon tubing and engage the peristaltic pump for groundwater retrieval. Set the flow rate to the lowest pumping rate that can be sustained so that the LNAPL is not drawn into the tubing. Begin collecting groundwater in the sample container and continue until enough volume is obtained for all bottleware required by the laboratory for the requested analyses.

3.7 Decontamination Requirements

Of particular significance to the procedures of groundwater measurement and sampling is the limitation, whenever possible, of materials inserted into a well bore and, even more importantly, of materials transferred from well to well.

Many items can be discarded between well sampling and/or gauging locations without significantly impacting project costs. Dedicated sampling equipment which can be discarded between well sampling locations, will be used whenever possible to preclude decontamination requirements. Sampling equipment included in this category are polyethylene bailers, bailer cord, nitrile gloves, and sampling tubing. However, other monitoring and sampling equipment, such as oil/water interface probes and submersible sampling pumps, must be reused from well to well.

All site equipment to be used in multiple locations (non-dedicated) for gauging and/or sampling of groundwater will be decontaminated immediately prior to initial use and between uses at each location according to the following steps:

- Remove particulates with a sorbent pad or towel and/or initial rinse with clean potable tap water;
- Wash equipment with clean sponge, soft cloth, or scrub brush as necessary in a solution of tap water/laboratory grade detergent (Alconox®, Liquinox®, or equivalent);
- Rinse with tap water;
- Rinse with deionized or distilled water; and
- Air dry for as long as possible.

Rinse water generated during decontamination procedures will be treated onsite by passing the water through a bucket filled with activated carbon prior to disposal.

3.8 Documentation

All site activities and conditions at the time of purging and groundwater sampling should be recorded by field personnel in a field computer via the EDGE application or, if necessary, a field book may be used. The entry shall include the date, time, weather conditions, location (well name), personnel present onsite, PID readings, sampling methodology, purge rate, purge volume, and the aforementioned groundwater indicator parameters. A field qualifier “SL” shall be applied to each sub-LNAPL sample entry to denote sample collection as sub-LNAPL. Additional comments or observations (e.g., well damage, nearby pumping, LNAPL sheen) should also be recorded.

4.0 SOIL SAMPLING & WELL INSTALLATION PROCEDURES

4.1 Site Controls

Prior to hand augering, hydroexcavation, utilizing a backhoe, or deploying any drilling apparatus to the site, an underground utility line protection request must be made (i.e., Pennsylvania One Call) for mark-out of known subsurface utilities and associated laterals proximal to the drilling location. Site plans, if available, should be reviewed to document and avoid the location of onsite utilities.

After review of all known mapped and marked utilities, a site reconnaissance will be performed to document the location of utility meters and storm sewer drains. In addition, the location of overhead utilities must be documented. After completing the subsurface and overhead utility review, the area to drill may be considered clear of utilities, or the location may be adjusted to a nearby location, which must also be cleared.

Lastly, any drilling activities must be preceeded by clearing of the borehole, prior to advancement of augers or split spoons. To ensure the safety of workers, the borehole will be cleared by hand, hydroexcavator, or backhoe to a depth of approximately 8 feet below ground surface.

4.2 Potential Hazards

Traffic, pinch points, chemical (airborne and physical contact), and biological are all likely hazards to be encountered during soil sampling and well installation, as well as slip/trip/fall potential. Drilling is considered a high risk activity which requires facility approval prior to implementation. Additional hazards are identified in the site-specific HASP and/or the daily JSA.

4.3 Materials and Equipment Necessary for Task Completion

A list of equipment required to oversee test boring advancement and, where applicable, sample soil is presented below. Also listed are materials necessary to store, label, preserve, and transport soil samples.

- Current site map detailing well locations;
- Field computer and/or field book for recording site data;

- Appropriate, laboratory prepared sample containers and labels;
- PID;
- Single-use, disposable plastic scoops or stainless steel scoop for collecting soil samples;
- Single-use, disposable, laboratory-supplied syringes for soil sample collection (if applicable);
- Scale for weighing samples (e.g., methanol kits, if necessary);
- Disposable nitrile sampling gloves;
- Measuring tape (for measuring core recovery);
- Munsell soil color chart/book (recommended);
- Decontamination equipment (if applicable);
- Blank chain-of-custody forms; and
- Cooler(s) and ice for sample preservation.

4.4 Decontamination Requirements

All down-hole drilling equipment must be steam cleaned prior to drilling at each soil boring or well location. All soil sampling equipment must be cleaned with detergent and rinsed with deionized or distilled water prior to deployment into the borehole. All well construction materials (i.e. PVC well casing, PVC well screen, sand pack, bentonite) should be clean and dedicated to each borehole.

4.5 Methodology for Soil Boring Installation

4.5.1. Borehole Advancement

During test drilling activities, a borehole is advanced into the subsurface via a rotary or direct-push drilling technique. Various types of drilling methods could be deployed at these facilities to advance the borehole and gain access to the subsurface for characterization and sampling. A description of the most commonly utilized drilling methods is included below:

4.5.1.1 Hollow Stem Auger

A hollow, steel pipe (available diameters vary) with welded, exterior steel “flights” is used to convey subsurface material to the surface when rotated clockwise. A bit at the bottom of the lead auger cuts into the subsurface material, and the rotation conveys the loosened material (cuttings) up the flights, allowing the hole to be advanced (cuttings may not always return to the surface, such as when drilling in soft, saturated materials). The hollow center of the auger allows the driller to access the subsurface for soil sample collection and, where applicable, well installation during borehole advancement. During borehole advancement, a center stem of steel rods connected to an auger plug prevent soil cuttings from entering the drill column. Once a desired drilling depth is reached, the center plug and rods can be pulled out, leaving the auger stem in place to prevent borehole collapse. A split-spoon sampler can be threaded onto the rods in place of the plug and driven via a hammer to obtain a sample (Standard Penetration Test), or if terminal depth has been reached a monitoring well could be installed through the augers.

4.5.1.2 Air and Mud Rotary

Rotary drilling methods are similar to hollow stem auger drilling, however specialized drilling bits at the bottom of rods are used to cut into the subsurface material using compressed air, vibration, and/or pressurized drilling mud. Compressed air or mud is forced through the drilling rods via an air compressor or pump, and escapes through small holes in the drill bit. The circulation of drilling mud, or air combined with introduced water or formation water, conveys the soil cuttings to the surface (while also cooling the drilling bit and preventing borehole collapse).

4.5.1.3 Geoprobe®

A direct-push drilling method, Geoprobe® sampling utilizes a hydraulic hammer to drive steel rods into the subsurface for soil sampling. This method advances a core barrel lined with a plastic Macro-Core® sleeve into the soil column for continuous soil core collection.

4.5.1.4 Hand Auger

A stainless steel or aluminum hand auger is physically advanced to a desired soil sampling depth through rotation of the auger and head.

4.5.2 Soil Sampling

Soil samples will be obtained for lithologic logging and where appropriate, for laboratory analysis with one of three different sampling devices: Split barrel spoon sampler, hand auger, or Geoprobe® soil sampler. For either method, the sampling devices are lowered through the hollow-stem augers or open borehole to allow sampling of undisturbed sediments below the bit or drive shoe. Soil samples will be collected at regular intervals for subsurface characterization and selection of appropriate well screen interval(s). Soils which appear to be visually impacted or from intervals which exhibit the highest deflections on the screening device (PID or similar) will be sampled for laboratory analysis in accordance with an approved sampling plan.

4.5.2.1. Split barrel spoon sampler (split spoon)

The split spoon sampler will be driven into the soil column in accordance with ASTM Standard Method D1586 (Reference A6, Appendix E). Soil sampling by split spoon is characterized by drilling a borehole with a hollow-stem auger to the desired sampling depth (the standard calls for one sample per five foot depth interval). The split spoon sampler is attached to the drilling rods after removal of the auger plug. The drill operator will drive the sampler into the undisturbed soil by repeatedly striking the drilling rods with a 140 pound safety hammer over a 30 inch drop. Field personnel will record the number of blows required to drive the split spoon sampler for each successive six-inch interval. After the sampler has been filled, the driller will remove the rods and sampler from the borehole and should provide the intact sampler to field personnel for opening (the drive shoe and head can be loosened). Field personnel should split the spoon, scan with PID, measure sample recovery, thoroughly describe the soil lithology, note visual observations and odors, note degree of saturation, and where applicable collect soil sample(s) utilizing a stainless steel or disposable scoop. An approved, retractable knife may be used to trim the top and edges of the sample, and once prepared the sample should be containerized in appropriate sample containers.

4.5.2.2. Geoprobe®

The Geoprobe® operator will advance the drilling rods into the subsurface using a truck or track-mounted drill with a hydraulic hammer. A dedicated Geoprobe® Macro-Core® liner is inserted into the core barrel to collect continuous core samples, usually one per 4 foot interval. The Geoprobe® operator will remove the soil filled liner from the core barrel, cut the liner, and provide field personnel with the intact cores. After retrieval of the sample, the liner may be removed by field personnel and the soil core should be scanned with a PID and logged, including documentation of core recovery, soil lithology, visual observations and odors, and degree of saturation. Where applicable, field staff should remove the soil sample utilizing a stainless steel or disposable scoop and containerize in an appropriate sample container.

4.5.2.3. Hand Auger

The self-powered hand auger allows for soil from the desired interval to be collected directly through removal of the soil sample that is collected in the auger head for every six inches of advancement.

4.6 Methodology for Leaded Tank Bottoms Soil Sampling

Leaded tank bottom material is described as containing materials distinguished by distinctive rust/red to black, metallic, mostly oxidized scale materials, sometimes in a matrix of petroleum wax sludge. The approach for identifying leaded tank bottom materials is summarized below:

- If materials are encountered within the previously designated leaded tank bottom areas, matching the physical description given above for leaded tank bottoms, then samples should be collected for lead analysis.
- If total lead results are above the site-specific standard (SSS) for lead of 2,240 milligrams per kilogram (mg/kg) then samples should be analyzed for lead via Toxicity Characteristic Leaching Procedure (TCLP), EPA Test Method 1311.
- Delineated areas that exhibit soils that physically resemble leaded tank bottoms, exhibit lead concentrations greater than 2,240 mg/kg, and exceed 5 milligrams per liter (mg/l) for lead in the TCLP leachate (which is characteristically hazardous for lead) will retain the leaded tank bottom designation. If no soils are encountered that meet all three of these criteria, then the area will no longer be classified as a leaded tank bottom area.

4.7 Methodology for Monitoring Well or Recovery Well Installation

4.7.1 Well Construction

After drilling to a desired terminal depth via any of the drilling methods referenced above, permanent monitoring wells can be installed to allow access to groundwater for future monitoring and groundwater sampling. In general, monitoring wells are constructed of pipe with a slotted interval(s) (screen) through which groundwater can flow into the well from a desired water-bearing stratum. In most cases, PVC materials are utilized for monitoring well construction.

- For applications where LNAPL thickness measurement is necessary, the screened interval should extend above the presumed highest groundwater level.
- For applications where the shallowest groundwater interval is to be monitored (e.g., water-table aquifer), a single well casing is installed.
- For applications where multiple water bearing strata will be penetrated and where deep groundwater conditions are selected for monitoring, a double-cased well may be installed to prevent the vertical migration of contaminants to the deeper water bearing zone from shallower zone(s).

Each well construction type and considerations for field staff regarding how many casings are needed have been provided below.

4.7.1.1 Single Casing Construction

The most commonly installed monitoring well at the facilities have single casings and are constructed of PVC. To determine the length of screen used, seasonal groundwater table or tidal fluctuations should be considered to allow the water table to intercept the well screen throughout the year. Field personnel should advise the driller on the required well diameter, total well depth, screen interval, screen length, and slot size based on available subsurface information prior to drilling. Once the borehole is completed and the drilling crew has been advised on the desired construction, the drilling crew will thread the well screen onto an end cap at the wellhead and will lower the well into the borehole, adding lengths of casing until the terminal depth is reached.

While the well is held near the center of the borehole, the annular space between the well screen and formation is carefully backfilled with a sand filter pack, which consists of clean, sorted quartz sand sized to the formation grain size (typically #1 or #2 sand). The sand pack establishes continuity with the formation and acts as a filter to prevent soil from entering the well (the well screen slot size should be sized according to the formation median grain size to mitigate sediment intrusion, however is most commonly available from suppliers as 0.01 or 0.02-inch diameter slot size).

The sand pack should extend one to two feet above the top of well screen, and care must be taken by the driller to not bridge the sand or overshoot the top of sand target depth (particularly when installing wells through the auger stem). Above the sand pack, a seal (grout) is installed in the annular space between the well casing and the soil. The seal is comprised of hydrated bentonite, sometimes amended with pellets or a grout consisting of hydrated Portland cement, bentonite powder, or a blend of the two. A conventional grout blend is 95% Portland cement and 5% bentonite powder. The purpose of the seal is to prevent surface water from infiltrating the well screen. It is installed from the top of the sand to one to two feet below ground surface.

In circumstances where the top of well sand terminates below the water table (e.g., deeper groundwater or submerged screen), grout should be mixed into a slurry at the ground surface and pumped via tremmie pipe or hose to prevent bridging. Above the well seal, the annular space can be backfilled with granular bentonite or concrete. A cement cap or well pad is placed at the surface to further mitigate potential infiltration of surface water. A locking, steel protective casing (stand pipe) or a locking, flush-mounted curb box should be installed to protect the well.

4.7.1.2 Double Casing Construction

Construction of a double cased well is similar to that of a single case well; however, to prevent groundwater infiltration from shallower water bearing zones, a second casing is installed through a surface casing. This type of construction requires drilling two different diameter boreholes.

During drilling through the shallower groundwater bearing zone(s), a larger diameter borehole is drilled and should be sized according to the desired well and/or outer casing diameter. This may require reaming of the borehole depending on the conditions and drilling equipment. An outer (surface) casing is installed and the annulus is grouted. After the outer casing is installed and the grout has set, the borehole is advanced through the surface casing with a smaller diameter drill stem and bit. When the desired terminal depth is reached, a monitoring well is installed through the inner casing using the above-referenced single casing construction procedure (the annular space between the outer and inner casings above the well filter sand should be pressure grouted).

4.7.2 Handling of Soil Cuttings

Soil cuttings generated during drilling will be containerized or stockpiled on plastic until sampling and analytical data can be obtained. Soil cutting final placement (onsite soil reuse or offsite disposal) will be performed in accordance with Pennsylvania Department of Environmental Protection (PADEP) approved onsite soil reuse plans for each facility.

4.7.3 Well Development

After installation, monitoring wells will be developed to remove residual soil from within the well and filter media and to establish communication between the well and formation. Pump and surge methodology, either through use of a ditch pump or air compressor connected to black polyethylene pipe and surge block, should be utilized to successively agitate relatively clear groundwater from the well. Surging should begin from the bottom of the screened interval and continue iteratively to the top of the well screen in approximately 2 to 4-foot intervals (i.e., pump and surge each 2 to 4 foot interval of well screen several times until relatively clear discharge water is maintained, then move up to the next screen interval until all of the screen has been developed).

Alternately, a submersible pump may be used to pump water from the screened interval of shallow wells, with the screen of the well surged to evacuate silt that remains in the sand pack. The well should be alternately surged and purged until groundwater flowing from the well appears relatively free of sediments. A vacuum truck may be used for development for wells that contains product. Well development water should be managed/treated in accordance with the site-specific work plan.

4.8 Documentation

All site activities and conditions at the time of soil sampling, well installation, and well development should be recorded by field personnel in a field computer via the EDGE application or, if necessary, a field book may be used. The entry shall include the date, time, weather conditions, location (well or boring name), personnel present onsite, and the aforementioned lithologic data and well construction information. The entry shall include detailed data required to create representative soil boring lithologic logs and well as-built logs (if a well is constructed). This data should include but not be limited to soil type, soil texture (e.g., USCS), soil color, relative moisture content, depth of apparent water table, PID readings, blow counts (if split spoon samples are collected), sample recovery, total depth of borehole, length of well screen, length of well casing, sand pack interval, filter sand size, grout materials used, well seal interval, and all well construction materials. Notes should also include well development pumping rate, duration, and observations. Additional comments or observations should also be recorded, as appropriate.

5.0 LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL) SAMPLING PROCEDURES

5.1 Potential Hazards

Traffic, pinch points, chemical (airborne and physical contact), and biological are all likely hazards to be encountered during LNAPL sampling, as well as slip/trip/fall potential. Additional hazards may be mentioned in the site-specific HASP and/or the daily JSA. If significant amounts of LNAPL are being handled, a Tyvek suit should also be worn.

5.2 Materials and Equipment Necessary for Task Completion

A list of equipment required to sample LNAPL from a monitoring well is presented below:

- Current site map detailing well locations;
- Field book or field computer for recording site data;
- Optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy;
- Keys and tools to provide well access;
- Appropriate sample containers and labels. LNAPL samples will be collected in laboratory provided glassware with appropriate preservative, if applicable. A minimum of 10 ml is required for most laboratory analyses. In the case that sufficient volume is not obtained, a swabbing technique (described below) could be used;
- Sorbent pads (required for swabbing technique);
- Stainless steel or clear bottom-loading or top-loading bailer, depending on product thickness;
- Clean nylon or polypropylene bailer cord;
- Decontamination supplies;
- Blank chain-of-custody forms; and
- Cooler and ice for sample preservation.

5.3 Decontamination Requirements

During LNAPL sampling activities, dedicated sampling equipment (i.e., clear bailers, nitrile gloves, and bailer cord) may be utilized; thereby, minimizing decontamination requirements. However, a stainless steel bailer may be used and decontaminated between LNAPL sampling locations. The optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy used to record the presence or absence and approximate thickness of LNAPL prior to sampling also requires decontamination between sampling locations. Decontamination procedures are detailed in Section 1.5.

5.4 Sampling Procedure

Immediately prior to sampling, each monitoring well should be gauged to obtain liquid levels (i.e., depth to LNAPL and depth to water) for estimation of current LNAPL thickness. Refer to Section 3.0 for appropriate well gauging procedures. Liquid level data should be recorded in a field book or field computer through the EDGE application or, if necessary, a field book.

LNAPL sampling may be performed via two different methods, based upon the LNAPL thickness/availability at the time of sampling: direct sample or swabbing. As indicated above, a minimum LNAPL volume of 10 mL is typically required by the analytical laboratory for most LNAPL characterization.

The following sequence of procedures will be implemented for the collection of LNAPL samples from monitoring wells:

1) A clean work area will be established so that sampling equipment will not come in contact with the ground surface or any other potentially contaminated surfaces near the wellhead.
2) A pre-cleaned stainless steel bailer or dedicated disposable bailer will be used for each well.
3) A new pair of nitrile gloves will be worn during sampling and replaced for each well.
4) Based on the gauged depth to LNAPL, an appropriate length of dedicated nylon or polypropylene cord will be tied to the sampling bailer.
5) An appropriately sized (i.e., 40 ml glass vial with plastic cap fitted with Teflon® lined septum) laboratory-provided sample container will be used to containerize the LNAPL sample.

6) The sampling bailer will be slowly lowered into the well until the liquid level is encountered. Once encountered, the sampling bailer should be lowered into the standing liquid column to a depth of approximately 1 foot, or other appropriate depth based on product thickness.

7) The bailer should be retrieved at a steady rate to avoid excess agitation.

8) The bailed sample should be visually evaluated for the presence or absence of LNAPL. If sufficient LNAPL volume is present (>10 ml), a direct sample of the LNAPL will be collected into the laboratory vial. If less than 10 ml of LNAPL is apparent, a sorbent pad may be used to absorb the LNAPL from the surface of the groundwater sample and the swab placed in the laboratory vial. The site-specific work plan should dictate whether a swab sample should be analyzed, or if the well should be monitored at a later date for re-sampling.

9) Labels will be completed and attached to the sample vials, indicating the sample collector's name, date, time, and location of sample; record same data in field computer or field notebook.

10) Store samples in a secure location until possession is transferred to the laboratory.

11) Nitrile gloves, bailer, bailer cord, and any other trash will be disposed of as solid waste.

5.5 Documentation

All site activities and conditions at the time of sampling should be recorded by field personnel in a field computer via the EDGE application or, if necessary, a field book may be used. The entry shall include the date, time, weather conditions, location (well name), personnel present onsite, and the aforementioned well gauging parameters. Additional comments or observations (e.g., color or apparent viscosity of LNAPL) should be recorded.

6.0 INDOOR AND AMBIENT AIR SAMPLING PROCEDURES

In preparation for indoor and/or ambient air sampling, appropriate facility personnel should be notified of intended sampling prior to mobilization. The purpose of this would be to confirm that there are not any non-routine activities occurring in the building, such as painting of indoor walls, which would cause incidental contamination of the samples.

6.1 Materials and Equipment Necessary for Task Completion

A list of equipment required to collect indoor and/or ambient air samples is presented below:

- Field data book or field computer for recording site data;
- Laboratory certified Summa canisters (standard size is 6 liters);
- Flow controllers (standard duration is 8-hours) with integrated vacuum gauge;
- Equipment for elevating sample intake height (examples: extended sampling inlets, zip ties to attach units to fencing, tables, etc);
- Camera; and
- Blank chain-of-custody forms.

6.2 Precautions to Avoid Incidental Contamination

EPA Method TO-15 is the most common method used for analysis of air samples at these sites. This method is highly sensitive to trace concentrations of volatile organic compounds (VOCs). To avoid incidental contamination:

- Do not wear cologne or fragrance on day of sampling;
- Do not use hand sanitizers or lotions;
- Do not store canisters near containers of gasoline, or any fuel; and
- Make sure there are no sources of VOCs in the vehicle used to transport the canisters.

6.3 Sampling Procedure

1) Set Up Summa Canister. Inlets of the flow controllers are to be placed in the breathing zone, approximately 4 to 6 feet above the ground surface. Elevate Summa canisters using appropriate materials available onsite or use laboratory-provided extended inlets (approximately 3 ft long sampling canes). Indoor air samples should be representative of air

in the buildings and should be placed away from obvious ventilation to outdoor air or sources of VOCs. Securely attach flow controller and extended sampling inlet if applicable.

2) Start Air Sample Collection. Open the valve. Document the initial vacuum (should be between approximately -30 inHg and -26 inHg) and the start time of the test. If the vacuum is significantly outside of the range or has a high rate of change, consider using an alternate canister or flow controller as there may be leakage.
3) Monitoring Summa Condition During Sampling Period. Several times during the sampling period, verify that the Summa is in good condition and that the vacuum is decreasing at an appropriate rate several times during the sampling period. An example of a reasonable frequency would be every two hours during an 8-hour event. During these checks, record the time, remaining vacuum, and canister condition. If necessary, obtain a permit to operate a camera, and take a least one photo of each sampling location.
4) Completing Air Sample Collection. Near the end of the sampling period, monitor the gauge more frequently. The sample collection should be stopped when the gauge reads approximately -5 inHg. At this point, close the canister valve. Record the sample end time and sample end vacuum. Ensure that the canister is labeled with the sample ID. Remove all of the attached equipment from the canister. Pack the canisters, flow controller wrapped in bubble wrap, chain of custody (additional information in the following section), and any other laboratory provided equipment back into the original packaging.

6.4 Documentation

All site activities and conditions at the time of air sampling should be recorded by field personnel. The entry shall include the date, time, weather conditions (including wind direction and start/end barometric pressure), sample locations and IDs, and personnel present onsite. Any observation that could influence the level of VOCs in the samples should be noted.

7.0 SURFACE WATER SAMPLING PROCEDURES

7.1 Field Procedures for Surface Water Sampling

7.1.1 General

Surface water sampling is performed to obtain samples for surface water bodies that are representative of existing surface water conditions. Surface water sampling (or gauging) within 3 feet of a bulkhead at certain facilities will require field personnel to wear a life vest.

Surface water sampling locations for surface water quality and groundwater interaction studies are selected based on the following:

1) Study objectives
2) Location of point surface discharges
3) Non-point source discharges and tributaries
4) Presence of structures (e.g., bridge, dam)
5) Accessibility

During surface water sampling it is important to obtain samples that are not impacted by the re-suspension of sediment produced because of improper or poor surface water sampling techniques.

7.1.2 Surface Water Sample Location Selection

Prior to conducting surface water sampling activities, the first requirement is the consideration and development of surface water sampling locations. It is important that all surface water sampling locations be selected in accordance with the work plan.

Wading for surface water samples increases the chances of disturbance of sediments from the floor of the surface water body. When wading for surface water samples be aware of potential safety and health risks. A life vest and safety line must be worn at all times where footing is unstable or when sampling in fast moving or more than 3 feet (0.9 m) deep. A two-person team is required for most surface water sampling activities. If the site conditions require the use of the life vest and safety line, the two people involved in the sampling must be competent swimmers.

Surface water samples must be collected with no suspended sediments. Surface water samples are collected commencing with the furthest downstream location to avoid sediment interference with upstream locations.

7.1.2.1 Rivers, Streams, and Creeks

Surface water samples are generally collected in areas of surface water bodies that are representative of the surface water body conditions. Representative surface water samples will usually be collected in sections of surface water bodies that have a uniform cross section and flow rate. Mixing is influenced by turbulence and water velocity, therefore the selection of surface water sampling locations immediately downstream of a riffle area (i.e., fast flow zone) will ensure good vertical mixing. These locations are also likely areas for deposition of sediment since this occurs in areas of decreased flow velocity.

Surface water sampling locations should not be established in areas near point source discharges. Surface water sampling of these source discharge points can be performed to assess the impact of these source areas on overall surface water quality. Sample tributaries as close to the mouth as possible. It is important to select surface water sample locations considering the impact downstream, including tributary flow and sediment.

In all instances, properly document all surface water sampling locations. Documentation may include photographs and tie-ins to known structures.

7.1.2.2. Sampling Equipment and Techniques

When collecting surface water samples, direct dipping of the sample container into the stream or water is acceptable unless the sample container contains preservatives. If preserved, a pre-cleaned unpreserved sample container should be used to collect the surface water sample. The surface water sample is then transferred to the appropriate preserved sample container. When collecting surface water samples, submerse the inverted bottle to the desired sample depth and tilt the opening of the sample container upstream to fill. During surface water sample collection, wading or movement may cause sediment deposits to be re-suspended and can result in biased samples. Wading is acceptable if the stream has a noticeable current and the samples are collected directly in the sample container when faced upstream. If the stream is too deep to wade in or if addition samples must be collected at various depths, additional sampling equipment will be required. Surface water samples should be collected about 6 inches (15 cm) below the surface, with the sample bottles being completely submerged. Taking the surface water sample at this depth eliminates the collection of floating debris in the sample container.

Surface water sample collection where the flow depth is less than 1 inch (<2.5 cm) requires the use of special equipment to eliminate sediment disturbance. Surface water sampling may be conducted with a container then transferred to the appropriate sample container, or collection may be performed using a peristaltic pump. A small excavation in the stream bed to create a sump for sample collection can also be considered but should be prepared in advance to allow all the sediment to settle prior to surface water sampling activities.

Teflon™ bailers can be used for surface water sampling if it is not necessary to collect surface water samples at specific depths. A bottom loading bailer with a check ball is sufficient. When the bailer is lowered through the water, the water is continually displaced through the bailer until the desired depth is reached. The bailer is retrieved and the check ball prohibits the release of the collected surface water sample. Bailers are not suitable in surface water bodies with strong currents, or where depth-specific sampling is required. For discrete and specified depth surface water sampling, and the parameters to be monitored do not require a Teflon™ coated sampling device, a standard Kemmerer or Van Dorn sampler can be used. The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the sampler ends open while the sampler is being lowered. The sampler is lowered in a vertical position to allow water to pass through. The Van Dorn sampler is plastic and is lowered in a horizontal position. For both samplers, a messenger is sent down a rope when the sampler has reached the required depth. The messenger causes the stopper on the sampler to close. The sampler is then retrieved and the surface water sample can be collected through a valve. DO sample bottles can be filled by allowing overflow using a rubber tube attached to the valve. During depth-specific surface water sampling, take care not to disturb bottom sediments.

Glass beakers or stainless steel cups may also be used to collect surface water samples if

parameter interference does not occur. The beaker or cup must be rinsed at least three times with the surface water sample prior to sample collection.
All equipment must be thoroughly decontaminated.

7.1.2.3 Field Notes for Surface Water Sampling

Record daily surface sampling activities, describe surface water sampling locations, sampling techniques, and, if applicable, provide a description of photographs taken. Visual observations are important and provide valuable information when interpreting surface water quality results. Observations include:

1) Weather conditions
2) Stream flow directions
3) Stream physical conditions (width, depth, etc.)
4) Tributaries
5) Effluent discharges
6) Impoundments
7) Bridges
8) Railway trestles
9) Oil sheens
10) Odors
11) Buried debris
12) Vegetation
13) Algae
14) Fish and other aquatic life
15) Surrounding industrial areas

The following factors should be considered for surface water sampling:

1) Predominant Surrounding Land Use: Observe the prevalent land use type in the vicinity and note any other land uses in the area which, although not dominant, may potentially affect surface water quality.

2) Local Watershed Erosion: Note the existing or potential erosion of soil in the local watershed and its movement into the stream. Erosion can be rated through visual observation of watershed stream characteristics including increases or decreases in turbidity.

3) Local Watershed Non-Point Source Pollution: This refers to problems or potential problems other than erosion and sedimentation. Nonpoint source pollution can be diffuse agricultural and urban runoff. Other factors may include feed lots, wetlands, septic systems, dams, impoundments, and mine seepage.

4) Estimated Stream Width: The estimated distance from shore at a transect representative of the stream width in the area.

5) Estimated Stream Depth: Riffle (rocky area), run (steady flow area), and pool (still area). Estimate the vertical distance from the water surface to the bottom of the surface water body at a representative depth at three locations.

6) High Water Mark: Estimate the vertical distance from the bank of the surface water body to the peak overflow level, as indicated by debris hanging in bank or flood plain vegetation, and deposition of silt. In instances where bank flow is rare, high water marks may not be evident.

7) Velocity: Record or measure the stream velocity in a representative run area.

8) Dam Present: Indicate the presence or absence of a dam upstream or downstream of the surface water sampling location. If a dam is present, include specific information detailing the alteration of the surface water flow.

9) Channelized: Indicate if the area surrounding the surface water sampling location is channelized.

10) Canopy Cover: Note the general proportion of open to shaded areas which best describes the amount of cover at the surface water sampling location.

7.2 References

For additional information pertaining to surface water sampling, the user of this manual may reference the following:

ASTM D5358 Practice for Sampling with a Dipper or Pond Sampler

ASTM D4489 Practices for Sampling of Waterborne Oils

ASTM D3325 Practice for the Preservation of Waterborne Oil Samples

ASTM D4841 Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents

ASTM D4411 Guide for Sampling Fluvial Sediment in Motion

ASTM D4823 Guide for Core-Sampling Submerged, Unconsolidated Sediments

ASTM D3213 Practice for Handling, Storing, and Preparing Soft Undisturbed Marine Soil

ASTM D3976 Practice for Preparation of Sediment Samples for Chemical Analysis

ASTM E1391 Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing

ASTM D4581 Guide for Measurement of Morphologic Characteristics of Surface Water Bodies

ASTM D5906 Guide for Measuring Horizontal Positioning During Measurements of Surface Water Depths

ASTM D5073 Practice for Depth Measurement of surface water

8.0 SEDIMENT SAMPLING PROCEDURES

8.1. Introduction

Sediment sampling is conducted to obtain samples that are representative of existing chemical and/or physical conditions of sediment.

8.2 Equipment Decontamination

On environmental sites, sediment sampling equipment (e.g., split spoons, trowel, spoons, shovels, bowls, dredges, corers, scoops) are typically cleaned as follows:

1) Wash with clean potable water and laboratory detergent, using a brush as necessary to remove particulates.
2) Rinse with tap water.
3) Rinse with deionized water.
4) Air dry for as long as possible.

Additional or different decontamination procedures may be necessary if sampling for some parameters, including VOCs and metals.

8.3 Sample Site Selection

Before any sampling is conducted, the first requirement is to consider suitable sampling locations. Sampling locations should be selected in accordance with the work plan. Wading for sediment samples in lagoons, lakes, ponds, and slow-moving rivers and streams must be done with caution since bottom deposits are easily disturbed. Sampling must only be attempted where safe conditions exist and samples must be collected from undisturbed sediments. All sediment samples are to be collected commencing with the most downstream sample to avoid sediment interference with other downstream samples. A life vest and safety line should be worn in all cases where footing is unstable or where water is fast moving or over 3 feet (0.85 m) in depth. A second person may also be required for most of the sampling scenarios.

8.3.1. Rivers, Streams, and Creeks

Sediment samples may be collected along a cross-section of a river or stream in order to adequately characterize the bed material, or from specific sediment deposits as described in the work plan. A common procedure is to sample at quarter points along the cross-section of the sampling site selected. Samples may be composited as described in the work plan. Samples of dissimilar composition (e.g., grain size, organic content) should not be combined. Representative samples can usually be collected in portions of the surface water body that have a uniform cross-section and flow rate. Since mixing is influenced by turbulence and water velocity, the selection of a site immediately downstream of a riffle area (e.g., fast flow zone) are likely areas for deposition of sediment since the greatest deposition occurs where stream velocity slows.

A site that is clear of immediate point sources (e.g., tributaries and industrial and municipal effluents) is preferred for the collection of sediment samples unless the sampling is being performed to assess these sources.

8.4 Sampling Equipment and Techniques

8.4.1. General

Any equipment or sampling technique(s) [e.g., stainless steel, polyvinyl chloride (PVC)] used to collect a sample is acceptable so long as it provides a sample which is representative of the area being sampled and is consistent with the work plan.

8.4.2. Sediment Sampling Equipment and Techniques

A variety of methods may be used to collect sediment samples from a stream, river, or lake bed. Dredging (Peterson, Ponar, Van Veen), coring and scooping are acceptable sediment sample collection techniques. Precautions shall be taken to ensure that a representative sample of the targeted sediment is collected. Caution should be exercised when wading in shallow water so as not to disturb the area to be sampled. Samplers should be selected based on the interval to be sampled, type of sediment/sludge (silt, sand, gravel), and required sample volume. More than one sampler is often required to implement a sampling program at a site. The following describes some of these methods. Manufacturer's information should be consulted to determine the limitations of each type of sampling equipment.

8.4.3 Dredging

The Peterson dredge is best used for rocky bottoms, in very deep water, or when the stream velocity is rapid. The dredge should be lowered slowly as it approaches the bottom, so as to not disturb the lighter sediments.

The Ponar dredge is similar to the Peterson dredge in size and weight. The Ponar dredge is a "clam-shell" type unit that closes on contact with the river/lake bottom. Depending on the size of the unit, a winch is required for larger units, whereas smaller units are available for lowering by a hand line. Once retrieved, the unit is opened and the sample extracted using a sample scoop or spoon. The unit has been modified by the addition of side plates and a screen on top of the sample compartment. This permits water to pass through the sampler as it descends.

The Ponar grab sampler functions by the use of a spring-latch-messenger arrangement. The sampler is lowered to the bottom of the water body by means of a rope, then the messenger is sent down to trip the latch causing the sampler to close on the sediments. The sampler is then raised slowly to minimize the disturbance of the lighter sediments. Sediment is then placed into a stainless steel bowl, homogenized, and placed into the appropriate sample container (if collecting for VOC parameters, fill the VOC jars before homogenization).

8.4.4. Corers

Core samplers are used to obtain vertical columns of sediment. Many types of coring devices are available, depending on the depth of water from which the sample is to be collected, the type of bottom material, and the length of core to be obtained. They vary from hand-push tubes to weight or gravity-driven devices to vibrating penetration devices.

Coring devices are useful in contaminant monitoring due to the minimal disturbance created during descent. The sample is withdrawn intact, allowing the removal of only those layers of interest. Core liners consisting of plastic or Teflon may also be added, thereby reducing the potential for sample contamination and maintaining a stratified sample. The samples may be shipped to the lab in the tubes in which they were collected. The disadvantage of coring devices is that only a small sampling surface area and sample size is obtained, often necessitating repetitive sampling in order to collect the required amount of sediment for analysis. It is also often difficult to extract the sediment sample back out through the water column without losing the sample.

The core tube is pushed/driven into the sediment until only 4 inches (10 cm) or less of tube is above the sediment-water interface. When sampling hard or coarse sediments, a slight rotation of the tube while it is pushed will create greater penetration and reduce compaction. Cap the tube with a Teflon plug or a sheet of Teflon. The tube is then slowly withdrawn, keeping the sample in the tube. Before pulling the bottom part of the core above the water surface, it must be capped.

8.4.5 Scooping

The easiest way to collect a sediment sample is to scoop the sediment using a stainless steel spoon or scoop. This may be done by wading into the stream or pond and, while facing upstream (into the current), scooping the sample from along the bottom in an upstream direction. This method is only practical in very shallow water.

8.4.6 Mixing

Sediment samples collected for chemical analysis should be thoroughly mixed (except for VOCs) in a stainless steel bowl prior to placement in the appropriate sample container. Standard procedures exist for preparation of sediment samples (ASTM D3976). These should be followed or the laboratory informed of applicable procedures.

8.4.7 Air Monitoring

Prior to sediment/sludge sampling, measure the breathing space above the sample location with a PID, should the potential for volatiles be present, and use a hydrogen sulfide meter should hydrogen sulfide be present. Repeat these measurements during sampling. If either of these measurements exceed any of the air quality criteria established in the HASP, air purifying respirators (APRs) or supplied air systems will be required.

8.4.8 Sample Location Tie-In/Surveying

The recording of the sample locations and depth on the site plan is extremely important. This may be accomplished by manual measurement (i.e., swing ties), global positioning system (GPS) survey, or stadia methods. Manual measurements for each sample location should be tied into three permanent features (e.g., buildings, utility poles, hydrants). Diagrams with measurements should be included in the field book.

8.5 Field Notes

A bound field book is used to record daily activities, describe sampling locations and techniques, and describe photographs (if taken). Visual observations are important, as they may prove invaluable in interpreting water or sediment quality results. Observations shall include (as applicable) weather, stream flow conditions, stream physical conditions (width, depth, etc.), tributaries, effluent discharges, impoundments, bridges, railroad trestles, oil sheens, odors, buried debris, vegetation, algae, fish or other aquatic life, and surrounding industrial areas. The following observations should be considered:

- Predominant Surrounding Land Use: Observe the prevalent land use type in the vicinity (noting any other land uses in the area which, although not predominant, may potentially affect water quality).
- Local Watershed Erosion: The existing or potential erosion of soil within the local watershed (the portion of the watershed that drains directly into the stream) and its movement into a stream is noted. Erosion can be rated through visual observation of watershed and stream characteristics. (Note any turbidity observed during water quality assessment.)
- Local Watershed Non-point Source Pollution: This item refers to problems and potential problems other than siltation. Non-point source pollution is defined as diffuse agricultural and urban runoff (e.g., stormwater runoff). Other compromising factors in a watershed that may affect water quality are feedlots, wetlands, septic systems, dams and impoundments, and/or mine seepage.
- Estimated Stream Width: Estimate the distance from shore at a transect representative of the stream width in the area.

- Estimated Stream Depth: Riffle (rocky area), run (steady flow area), and pool (still area). Estimate the vertical distance from water surface to stream bottom at a representative depth at each of the three locations.
- High Water Mark: Estimate the vertical distance from the stream bank to the peak overflow level, as indicated by debris hanging in bank or floodplain vegetation, and deposition of silt or soil. In instances where bank overflow is rare, a high water mark may not be evident.
- Velocity: Record an estimate of stream velocity in a representative run area (see Section 12.0).
- Dam Present: Indicate the presence or absence of a dam upstream or downstream of the sampling station. If a dam is present, include specific information relating to alteration of flow.
- Channelized: Indicate whether the area around the sampling station is channelized.
- Canopy Cover: Note the general proportion of open to shaded area which best describes the amount of cover at the sampling station.
- Sediment Odors: Disturb sediment and note any odors described (or include any other odors not listed) which are associated with sediment in the area of the sampling station.
- Sediment Oils: Note the term which best describes the relative amount of any sediment oils observed in the sampling area.
- Sediment Characteristics: Note the grain size, color, consistency, layering, presence of biological organisms, man-made debris, etc. in accordance with standard ASTM soil description protocols.
- Sediment Deposits: Note those deposits described (or include any other deposits not listed) which are present in the sampling area. Also indicate whether the undersides of rocks not deeply embedded are black (which generally indicates low dissolved oxygen or anaerobic conditions).

8.6 References

For additional information pertaining to this topic, the user of this manual may reference the following:

ASTM D5358 Practice for Sampling with a Dipper or Pond Sampler
ASTM D4489 Practices for Sampling of Waterborne Oils
ASTM D3325 Practice for the Preservation of Waterborne Oil Samples

ASTM D4841 Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents

ASTM D4416 Guide for Sampling Fluvial Sediment in Motion

ASTM D4823 Guide for Core-Sampling Submerged, Unconsolidated Sediments

ASTM D3213 Practice for Handling, Storing, and Preparing Soft Undisturbed Marine Soil

ASTM D3976 Practice for Preparation of Sediment Samples for Chemical Analysis

ASTM E1391 Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing

ASTM D4581 Guide for Measurement of Morphologic Characteristics of Surface Water Bodies

ASTM D5906 Guide for Measuring Horizontal Positioning During Measurements of Surface Water Depths

ASTM D5073 Practice for Depth Measurement of Surface Water

ASTM D5413 Test Methods for Measurement of Water Levels in Open-Water Bodies

9.0 SLUG TEST PROCEDURES

9.1 Materials and Equipment Necessary for Task Completion

Water level (data) logger capable of recording pressure and/or depth at sub-second time intervals (preferably a vented logger capable of advanced logging modes); vented, direct-read cable of sufficient length (with dessicant); interface tape/probe or water level meter; solid (mechanical) slug, pneumatic slug, or packer system [the introduction or removal of water is not recommended (e.g., bailer or bucket)]; 5 gallon bucket, traffic cones and/or barricades, deionized or distilled water and Alconox®; decontamination bucket and brush; and laptop computer or rugged reader.

9.2 Decontamination Requirements

Equipment utilized during slug testing must be thoroughly decontaminated with Alconox® and deionized/distilled water prior to and between uses at each test well to prevent cross contamination between wells. Any groundwater removed from the well during testing must be containerized and either treated and discharged to ground surface, or disposed of in an approved manner, preferably in a properly installed, onsite holding tank. If LNAPL is encountered/recovered, it should be containerized and properly disposed onsite. However, the preferred test initiation methods (solid and/or pneumatic slug) do not generate any groundwater.

9.3 Methodology for Slug Testing

Slug tests are utilized to provide in-situ estimations of hydraulic conductivity (k) in saturated media, most often in geologic formations that exhibit aquifer properties (low k media can also be tested with special consideration). Slug tests involve rapidly displacing the static water level in a well, and analyzing the well's rate and pattern of recovery back to near-static conditions. Falling head or slug-in tests involve analysis of displacement due to the addition of volume, and rising head or slug-out tests involve the analysis of displacement due to the removal of volume. Displacement is initiated using either a solid or pneumatic slug. Water level response is monitored immediately following the initial displacement and for the ensuing time period until the water level has returned to near-static level (generally within 5% of static). Water level response should be recorded using a water level (data) logger capable of recording pressure and/or depth at sub-second time intervals (preferably a vented logger). Logarithmic logging modes are preferred to shorten the data file while still providing high resolution data just after test initiation.

9.4 Field Procedures

1) Test Well Construction and Configuration - Well construction details are needed to perform slug test calculations and are important considerations when selecting appropriate wells for testing. Important as-built details include: total well depth, well screened interval(s), depth to (static) water, casing diameter, screen diameter, filter pack diameter, filter pack size, and filter pack interval. While these details should be documented on the well log, static water level and total well depth should be field-confirmed before the test. Of particular importance to the testing procedure is the relationship between static water level and well screened interval, and the degree of well development. Test results for poorly or insufficiently-developed wells may be strongly affected by drilling debris/disturbance in the formation that can create skin effects, lowering the apparent formation k. Analysis of testing data for wells screened across the water-table should consider drainage of the filter pack media. In addition, a pneumatic slug assembly should not be utilized unless the test well is screened below the water table and the water level remains above the screen throughout the test.

2) Test Setup and Initiation - Upon arrival, the test well should be gauged for static depth to water and total well depth so that the total water column length can be estimated. Well gauging data should be recorded in a rugged reader using an EDGE file, if available, or field form or book.

   a. Solid Slug
   The displacement volume of the slug is needed. It is suggested that the slug be prefabricated and calibrated for displacement volume prior to site use. Calculate the expected initial well displacement, using the slug volume and well casing radius, and deploy the data logger/cable to a depth just below that level while considering the slug length (to avoid conflict and tangling of the slug and transducer). Also consider the submergence depth limit of the data logger (usually indicated on the logger body). Generally, placing the data logger a foot or two below the bottom of the slug is good practice. Once submerged, allow the

data logger temperature to equilibrate with groundwater prior to initiating the test (up to 30 minutes).

While the data logger temperature equilibrates, secure the slug to an adequate length of disposable string or rope and hang in the well to a depth just above the water surface. Mark the string/rope to accommodate the slug length and tie off. Using the rugged reader or field computer, set up a new test (logarithmic mode or sub-second recording interval) in the data logger supplied software and start the test. Indicate in the file name the type of test and test number (e.g., rising or falling head; test 1 or 2). Once logging is initiated, quickly and smoothly lower the slug (slug-in or falling head test) to the submerged depth and tie off the string/rope (displacement should be instantaneous). Monitor the data logger data until the water level has returned to near-static level. Stop the falling head test.

Without moving the slug or data logger, set up a new test in the data logger supplied software with the same settings and indicate in the file name the type of test being performed (rising head or slug out). Start the test and once the data logger is running, instantaneously lift the slug and tie off the string/rope to its pre-test position (just above static). Monitor the data being recorded by the data logger and stop the test when the water level has returned to near-static.

b. Pneumatic Slug

If a high formation k is anticipated, solid slug removal is found to be too slow to capture well recovery, or to minimize equipment decontamination for wells with submerged screens, a pneumatic slug assembly should be utilized.

Open air release valve, secure pneumatic slug assembly to well casing and tighten coupling to provide an air tight seal. Insert the data logger/cable and deploy to the target submergence depth [it is generally best to keep the data logger shallow (~1-2 feet below static water level) and use small initial displacements to avoid dynamic recovery effects in high k formations]. Close the air release valve and attach the air pump or compressor. Pressurize the well and use the pressure gauge to set initial displacement. Check for air leaks using a soapy water mixture and sprayer (assembly must be air tight). Allow the water level to return to static and remove the air pump. Using the rugged reader or field computer, set up a new test (logarithmic mode or sub-second recording interval) in the data logger supplied software and start the test. Indicate in the file name the type of test and test number (e.g., rising head; test number). Once logging is initiated, open the air release valve and monitor the test data. Stop the test when the water level has returned to near-static.

3) Test Monitoring and Guidelines - The following are general guidelines for slug testing performance as published by Midwest Geosciences Group in “Field Guide for Slug Testing and Data Analysis:”

- Conduct at least three or more tests per well and if possible conduct both rising and falling head test data.
- Use two or more initial displacement values (2 slug sizes or air pressures applied) that vary by an order of magnitude or more.
- Final slug test initial displacement should be nearly equivalent to the first test’s displacement.
- Allow tests to run until near-static conditions are achieved (+/- 5% of static)
- Digital slug test data files collected with the data loggers and/or EDGE files should be backed up to either a thumb drive, corporate email server, and/or corporate file server immediately after collection.

4) Test Data Reduction and Processing - Prior to slug test analyses, digital data logger files should be normalized so that multiple tests conducted on the same test well can be compared for the assessment of test validity and well conditions. Reducing the data as follows:

- From each raw data file, estimate the time of test initiation and the head (depth or pressure) under static conditions.

- In each slug test data file, subtract the time of test initiation from the elapsed time and save to a new field (normalized time or test time; start of test should be time zero).
- In each slug test data file, subtract the static pressure head from the test period pressure head values and save to a new field (deviation from static).
- To normalize the deviation from static values, divide that field by the displacement expected based upon the slug volume or air pressure head applied.
- Create a graphical plot of the normalized head data versus test time for each test performed on the test well. Review the data plots and confirm that the testing data for each repeat test roughly concur. Also confirm that the actual and expected initial displacements are nearly equal.
- If repeat testing data and/or expected versus actual initial displacements vary widely, review well completion details and testing methods prior to performing further analysis (step 5 below) as the results may not be valid (e.g., the well screen interval may be poorly developed or fouled, the data logger may have moved or placed too deep in the well, slug was removed too slowly). The well may need to be retested.

5) Test Data Analysis - For the purposes of this standard operating procedural document, it is assumed that slug test analysis software will be used to apply standard solution methods to the testing data. Various computer programs are available, such as AQTESOLV Professional. Choose an appropriate test solution method by considering the following well configurations (in AQTESOLV, use the Solution Expert):

   a. Submerged Screen and/or Confined Aquifer Well - If the well screen fully penetrates the intersecting aquifer, utilize the Cooper et al. Model or Hvorslev Model and analyze the curve match and/or best fit. If well is partially penetrating a confined formation, utilize the KGS Model or Hvorslev Model. If well screen is submerged in an unconfined formation, utilize the KGS Model or Bouwer and Rice Model.

b. Water-Table Intersects Well Screen - If the well screen is intersected by the water table, utilize the Bouwer and Rice Model (double straight line effect) or KGS Model.

c. Rapid Well Recovery in High k Formations - If well response to displacement is extremely rapid and normalized head plots display an oscillatory or concave-downward form, utilize the Butler and Zhan Model (most comprehensive solution available) or High-k Hvorslev Model for confined wells, or the High-k Bouwer and Rice Model.

9.5 Limitations

In general, results of slug test data analyses provide an initial estimate of formation k and have a small scale of relevance (particularly in high k settings). Slug tests can be strongly affected by the degree of well development and can be used diagnostically to assess the degree of well development. In most cases, slug testing should be performed on several wells in an area of interest to develop an understanding of the formation characteristics (e.g., heterogeneous or homogeneous formations).

10.0 PUMP TEST PROCEDURES

10.1 Materials and Equipment Necessary for Task Completion

Water-level (data) loggers (transducers) capable of recording pressure and/or depth at sub-second time intervals (preferably a vented logger capable of advanced logging modes for at least the pumping well); vented, direct-read cables of sufficient length (with dessicant packs); interface tape/probe or water-level meter; well pump (preferably a submersible pump), drop pipe and layflat or comparable discharge line of sufficient length, totalizing flow meter (recommended) and 5 gallon bucket, stop watch, rain gauge or nearby weather station; materials needed to monitor surface water bodies near the test site (e.g., staff gauge, weir, stakes, data logger, camera with permission from refinery personnel); traffic cones and/or barricades, deionized or distilled water and Alconox®; decontamination bucket and brush; laptop computer or rugged reader; portable generator or other power supply appropriate for the submersible pump; and containment (e.g., frac tank) or activated carbon filtration for the temporary staging or filtering of discharge water.

10.2 Decontamination Requirements

Equipment utilized during pumping tests must be thoroughly decontaminated with Alconox® and deionized/distilled water prior to and between uses at each test well to prevent cross contamination between wells. Any groundwater removed from the tested well must be containerized and either treated (filtered as appropriate) and discharged to ground surface, or disposed of in an approved manner, preferably in a properly installed, onsite holding tank. If LNAPL is encountered/recovered, it should be containerized and properly disposed of on or off-site.

10.3 Methodology for Pump Testing

10.3.1 Pre-test Considerations

In general, pumping tests are performed to estimate large-scale in-situ hydraulic properties of water-bearing strata in the subsurface (i.e., transmissivity and storativity) and average out local-scale heterogeneity that can limit the applicability of smaller-scale testing methods, such as slug tests. The geographical area influenced by a pumping test will be determined by the hydraulic properties of the strata being tested (including hydraulic properties of other strata supplying recharge to the pumped formation), boundary conditions, and on the duration of the test.

Pumping tests are also commonly performed to generate drawdown data from which hydraulic boundary conditions, hydraulic flow regime (e.g., anisotropy), and aquifer type (i.e., unconfined or confined, leaky confined) may be estimated. Smaller-scale pumping tests may also be utilized to address pumping efficiency and/or signal to noise ratio (pumping rate) at the pumping well, or to assist in remedial system design. However at this scale, the assumptions of some data analysis methods may not be applicable and should be considered prior to testing.

Appropriate design of a pumping test should include review of site-specific information regarding the geology and hydrogeology of the test area. Pumping test design should also consider the goal(s) of the test (i.e., scale of application of derived aquifer properties, identification of boundary influences, sources of recharge, well efficiency). This should include review of available lithologic well logs or test boring logs, geologic maps, cross sections, structure contour maps, isopach maps, and any other available information so that a conceptual model relating geologic units to hydrostratigraphic units or water-bearing strata can be developed. Additional pre-test considerations should include identification of any potential positive or negative hydraulic barriers, tidal effects, and/or influence from other wells that may be pumping in the test area. Without sufficient knowledge of factors influencing water-levels and hydrology of the test area, test results could be misinterpreted.

Often times, budget considerations and/or time limitations will necessitate the use of an existing monitoring well as the pumping well and/or existing wells as observation points. While this is generally acceptable, the wells must be screened appropriately with respect to the goals of the test and knowledge of well construction is critical to applying test solutions. Wells should also be redeveloped prior to testing if they are relatively old or if records of sufficient well development at the time of installation are not readily available.

Pumping tests can be divided into two general classifications: step-drawdown tests and constant rate tests. Step tests typically involve pumping a well at progressively higher rates or “steps” at intervals of one or two hours per step (typically up to 3 steps). They are often used to estimate the yield a well will sustain during a constant rate pumping test and to evaluate well efficiency (frictional head losses between the screen/gravel pack and the formation). Constant rate pumping tests are used primarily to evaluate hydraulic properties of water-bearing strata for design of groundwater treatment systems and/or water supply purposes (e.g., groundwater allocation). Where budgets permit, the best pumping test approach is to first perform a step-drawdown test on the pumping well to evaluate well efficiency and sustainable yield (and to gauge whether or not the pumping well needs additional development), allow recovery to near-static conditions, and then initiate a constant rate test.

The test duration is subject to goals of the test and to budget considerations. Optimally, a constant rate test should be run until all drawdowns have stabilized or boundary conditions are identified, and gravity drainage effects are curtailed; however, this is seldom practical due to time limitations. In most instances, an 8 hour constant rate test will be adequate, and a 24 hour test will be sufficient for higher sensitivity sites. Occasionally a 72 hour pumping test is warranted, though this is usually reserved for large scale water supply work. If there are any unexplained water level anomalies observed toward the scheduled end of a test, the test should be continued if at all possible.

The approximate test flow rate needs to be determined in advance for proper pump and discharge design selection, and sizing of discharge containment. If it is not appropriate to perform a step test, sustainable yield can be estimated from slug test data or a brief (<30 minutes) pumping episode the day before the actual test. Generally, it is best to pump the test well at a rate that maximizes the signal to noise ratio (a higher pumping rate does not influence test scale and should not be used as a means to shorten the test duration).

If testing must be performed in an area where contamination is known to be present, careful consideration of the impacts of the test scale should be considered prior to testing so that the spread of subsurface contamination is not increased. If floating product (LNAPL) is present at or near the pumping well, drawdown should be limited so as to not impact uncontaminated soils below the static water table (i.e., create a “smear” zone or allow for the significant migration of free-phase product). Discharge water must be either 1) treated prior to discharge or 2) containerized for on or off-site disposal. If it is to be discharged directly on-site and allowed to infiltrate, it must be routed sufficiently far enough from the test area as to avoid any artificial recharge effects. All appropriate withdrawal and discharge permits must be obtained and complied with. If discharge water is to be treated on-site, proper contaminant loading calculations for the test flow rate, approximate contaminant loading and test duration must be performed in advance to insure treatment is sufficient. Any on-site treatment should also include at least one discharge effluent sample analysis by an approved laboratory to document treatment effectiveness.

10.3.2 Pre-Test Water Level Monitoring

Water-level conditions in the test area should be monitored for at least one week prior to initiation of testing to identify background trends and factors influencing groundwater levels in the test area. Data loggers should be deployed in all wells to be utilized in the pumping test and set to record depth or pressure at a resolution that is high enough to identify any potential trends (generally a 15 minute recording interval is sufficient for background monitoring). A manual water level should be measured with a water-level meter or interface probe and referenced to the top of casing mark to calibrate the data logger data at the time of deployment and at sufficient intervals throughout the recording period to validate the data and provide backup data in the event that a data logger was to fail.

Ideally, groundwater levels should be static prior to starting a pumping test so that pumping influences alone can be readily evaluated. Any significant precipitation events within the previous several days (documented through use of a site rain gauge or nearby weather station) will usually result in noticeable water level changes. If there are any major water level changes observed that cannot be explained prior to testing, additional investigation into possible area influences (e.g., local well pumping or construction de-watering) should be conducted.

10.3.3 Pumping Test Set Up

Prior to starting the test, all well measuring points (i.e. top of casing) should be clearly marked and preferably surveyed to the nearest 0.01 feet in elevation. The horizontal distance between all wells utilized should be measured and illustrated on a base map. If there are any surface water bodies in the vicinity, a staff gauge (or similar measuring device) should be set up and surveyed to evaluate possible test influences on water levels or stream flow.

The preferred pump to be used for a pumping test is a submersible centrifugal pump powered by either existing site power or a portable generator. These pumps are not explosion proof, so a conductivity probe must be tied into the pump controls to alleviate any possibility of product coming into contact with the pump (if product is anticipated). If the test pump is designed to pump total fluids (e.g. air operated double diaphragm pump, jack pump, etc.) discharge must either be containerized, or treatment must include an oil/water separator to handle any floating product. The submersible pump should be set deep enough to maintain flow during the test period or at a maximum of just above the screened interval, using a handling line to support the pump's weight [**NOTE:** extreme care must be taken that the power cord is neither bearing any of the pumps weight, nor damaged during installation due to the potential for severe electric shock]. A check valve (or two check valves) should be installed above the pump in the discharge line to prevent backflow into the well after testing.

Discharge piping from the pump should include a flow meter (preferably with totalizer), followed by a flow adjustment valve. The flow meter should be installed in a straight section of hard piping of sufficient length to avoid meter distortion caused by turbulence (typically about 10 pipe diameters on either side of the meter). In low-flow pumping tests, flow rate can be calculated by measuring the exact time required to fill a known-sized container (bucket and stop watch) several times throughout the testing period. The bucket and stop watch method of estimating flow should also be used to back up and check the flow meter data.

Precise and frequent water-level measurements (to the nearest 0.01 feet) and time denotations before, during, and after pumping tests are critical to achieving accurate test results. In terms of prioritization, data loggers should be utilized in at least the pumping well and observation wells closest to the pumping well. Wells further from the pumping well may be manually monitored, due to the reduced likelihood that early-time drawdown will be critical at distal locations. Back-up manual measurements should be collected at least hourly during the first 8 hours of the test, and then at least every 3 hours, to verify data logger measurements. Readings from the transducers are not completely reliable until they have been submerged for at least 30 minutes (sensor equilibration period). All field personnel should have watches with a second hand, and they should all be calibrated to the same time. Liquid level measurements should be obtained using an optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy for those wells with floating product. For wells without product, a water-level meter may be sufficient. All non-dedicated probes must be properly decontaminated after each level reading to prevent any possibility of cross- contamination between wells.

Data loggers should be deployed in each selected well to a depth that will maintain submergence through the test period. Data loggers selected should be capable of being submerged to that anticipated depth (typically noted on the instrument body). The transducer cable should be secured at the wellhead (manufacturer supplied hangers, well caps, or electrical tape/cable ties) to minimize any movement of the sensor. Care must be taken that the transducer cable is not damaged from rough edges at the well head, and that no vehicles run over the cable. The data logger installed in the pumping well will need to be installed at a depth that will maintain submergence through the test, but also remain clear of the submersible pump (and pump noise if possible). In addition, wells with floating product may require an inner PVC stilling well surrounding the data logger cable to prevent damage from contact with the product. A stilling well may also eliminate the need for any water-level corrections for product thickness.

10.3.4 Running the Test

Once the data loggers have been deployed and secured, tests should be set up in each device and each device either started or “future” started to begin logging when the pump is turned on. The data logger in the pumping well should be set to logarithmic logging mode to capture sub-second data during the early portion of the test. If possible, the pump discharge control valve should be have been pre-set (based on the step test or mini pump test) to the desired flow rate prior to turning on the pump. However, depending on the test pumps performance curves, minor flow rate adjustments are generally needed during the first hour or two of the test to correct for the additional lift required by the pump due to increasing drawdown. In addition, movement of the discharge hose after the test has been started should be avoided, since any change in the elevation of the discharge will affect the pumping rate. All changes in flow rate should be recorded and time stamped.

A minimum of two field personnel are needed to run a pumping test, with additional personnel required for tests with multiple observations wells or additional complexity. One person should be designated to turn on the pump, monitor and adjust flow rate, maintain discharge and treatment, maintain the generator, etc. The second person should be responsible for data logger management and manual water-level measurements. As a rule of thumb regarding the frequency of manual well gauging, one measurement every half minute during the first 5 to 10 minutes, followed by one measurement every 3 to 5 minutes during the first hour, one measurement every 10 to 20 minutes for the second hour, and one hourly measurement thereafter is acceptable.

Throughout the test, data loggers should be downloaded in real time through use of direct-read, vented cables (or non-vented with a barometric logger for compensation) to monitor water-level conditions. It is essential that some data reduction be accomplished in the field, so that major water level trends are recognized during the test. At a minimum, drawdown trends from the pumping well and two of the nearest monitoring wells need to be semi-log plotted against time so that deviations indicative of boundary conditions can be discerned before pumping is ceased. This will allow decisions to be made about whether the test should run longer than planned.

Generally, water quality samples are collected during a pumping test for laboratory analysis of constituents of concern. These are generally collected after the first hour of pumping and just prior to pump shutdown. If the test is of more than 24 hours duration, it is advisable to collect additional samples during the testing period. All groundwater samples should be collected following Evergreen Field Procedures.

10.3.5 Post-test Recovery

At the conclusion of the test, water level recovery data should be collected until near-static conditions are re-established. This requires the installation of a check valve in the discharge line above the submersible pump to prevent backflow. The recovery data has the advantage in that there are no variations in the curve produced due to variations in pumping rate and is independent of test length. In water-table aquifers, however, the effects of formation de-watering can cause the recovery trends to be substantially different from drawdown trends. Consequently, recovery (residual drawdown) data should be used in conjunction with drawdown data where possible.

10.3.6 Data Analysis

The data collected during pumping tests are analyzed to estimate aquifer hydraulic properties, such as transmissivity, conductivity, and storage. Data collected by transducers must be downloaded and transformed (dimensionless drawdown or displacement from static) prior to analysis. Analysis typically involves curve matching of site data to type curves established in literature for particular flow regimes. Curve matching is commonly performed utilizing computer software, such as HydroSOLV's AQTESOLV program, along with diagnostic methods and derivative analysis to best estimate aquifer properties through identification of flow regimes and conditions.

It is noted that the mathematical solutions used in pumping test analysis include many assumptions that must be considered in the context of each test area (e.g., the formation is of uniform thickness and of infinite areal extent). In addition, some of the values incorporated into typical pumping test solutions are not actually measured, but are educated estimates (e.g., porosity based on lithology, etc.). Many problems associated with pumping test data evaluation are due to not recognizing, and/or correcting for, deviations from the theoretical solution employed. Some of the more common analytical errors occur due to: partial well penetration effects, formation de-watering effects, casing storage effects, poor pumping well efficiency and/or the application of incorrect equations or units. Consequently, a thorough understanding of the underlying assumptions inherent to the solution employed is required before the validity of the results can be trusted.

APPENDIX C

Soil Boring and Well Construction Logs

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 Remedial Investigation**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **S-374**
PAGE 1 OF 1

Aquaterra Technologies, Inc.

DRILLING: STARTED **10/8/18** COMPLETED: **10/15/18**
INSTALLATION: STARTED **10/15/18** COMPLETED: **10/15/18**
DRILLING COMPANY: **Total Quality Drilling**
DRILLING EQUIPMENT: **Truck-Mounted Mobile B-57**
DRILLING METHOD: **Hollow Stem Auger**
SAMPLING EQUIPMENT: **Split Spoon**

*NORTHING (ft): **219014** *EASTING (ft): **2685397.6**
*GROUND ELEV (ft): **13.2** *TOC ELEV (ft): **15.63**
INITIAL DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **36**
STATIC DTW (ft): **Not Measured** WELL DEPTH (ft): **35**
WELL CASING DIAMETER (in): **2"** BOREHOLE DIAMETER (in): **10"**
LOGGED BY: **Luke Mokrycki** CHECKED BY: **ADK**
*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0-1		APPARENT FILL [brown silty fine to coarse sand with roots and construction debris]	S-374@ 0-2' PID			0
1-8	CL	Yellow SILT/CLAY				
2-4			S-374@ 2-4' PID			0
4-6		SAME (brownish yellow to gray color)	S-374@ 4-6' PID			0
6-8		SAME (some gravel)	S-374@ 6-8' PID			0
8-10	SM	Yellowish brown to gray silty SAND, some medium to coarse gravel	S-374@ 8-10' PID	2	6 6 6 6	0
10-12		SAME (reddish yellow to gray color)	S-374@ 10-12' PID	2	6 7 6 6	0
12-14		SAME (reddish brown color; coarser than above, mostly coarse gravel)	S-374@ 12-14' PID	2	6 8 8 6	0
14-16		SAME (moist)	S-374@ 14-16' PID	2	4 10 10 8	0
16-18	SM	Reddish yellow to gray fine to medium silty SAND, trace to little fine to medium gravel (wet; saturated by 18' bgs)	S-374@ 16-18' PID	2	6 4 6 6	1
18-20			S-374@ 18-20' PID	2	8 10 12 8	1
20-22			S-374@ 20-22' PID	2	15 13 11 12	0.2
22-24	SW	Reddish yellow and brown fine to very coarse SAND, trace silt (saturated)	S-374@ 22-24' PID	2	10 8 8 12	1
24-26			S-374@ 24-26' PID	2	8 8 8 12	2
26-28			S-374@ 26-28' PID	2	8 10 12 14	35
28-30			S-374@ 28-30' PID	2	8 8 8 12	98
30-32	SW-GW	Whiteish gray to yellowish brown fine to very coarse SAND and GRAVEL, trace silt (saturated)	S-374@ 30-32' PID	2	8 10 12 14	32
32-34			S-374@ 32-34' PID	2	10 11 10 12	12
34-36			S-374@ 34-36' PID	2	12 8 8 10	3

Well Construction:
- Tremie Grout - Bentonite Amended Cement
- Sand Pack #2 Well Sand
- 2" Slotted PVC Casing (0.020in slot size)

GEO FORM 304 - AQUATERRA AOI9_TEMPLATE.GPJ AQUATERRA_LOGS.GDT 3/30/20

PROJECT: **PHRO - Corrective Measures Program**	WELL / PROBEHOLE / BOREHOLE NO:
LOCATION: **AOI 4 Remedial Investigation**	PAGE 1 OF 1 **S-375**
PROJECT NUMBER:	Aquaterra Technologies, Inc.

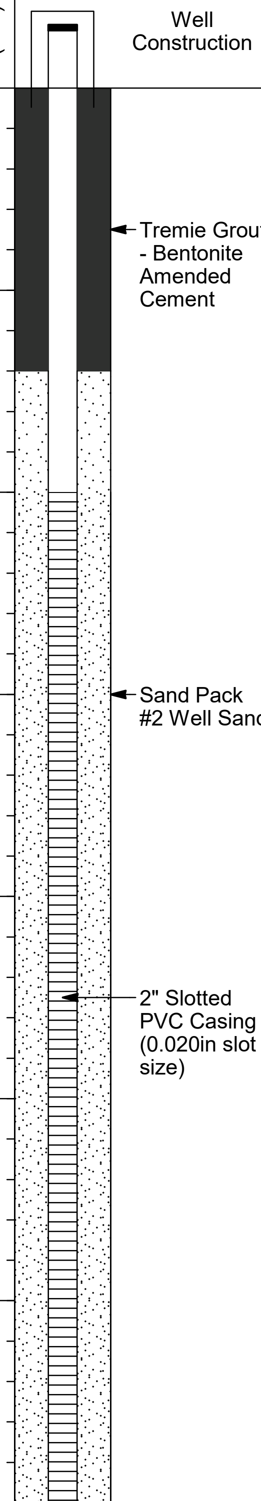
DRILLING: STARTED **10/8/18** COMPLETED: **10/22/18**	*NORTHING (ft): **218827.8**	*EASTING (ft): **2685210.5**
INSTALLATION: STARTED **10/22/18** COMPLETED: **10/22/18**	*GROUND ELEV (ft): **13.5**	*TOC ELEV (ft): **15.96**
DRILLING COMPANY: **Total Quality Drilling**	INITIAL DTW (ft): **Not Encountered**	BOREHOLE DEPTH (ft): **36**
DRILLING EQUIPMENT: **Truck-Mounted Mobile B-57**	STATIC DTW (ft): **Not Measured**	WELL DEPTH (ft): **35**
DRILLING METHOD: **Hollow Stem Auger**	WELL CASING DIAMETER (in): **2"**	BOREHOLE DIAMETER (in): **10"**
SAMPLING EQUIPMENT: **Split Spoon**	LOGGED BY: **Luke Mokrycki**	CHECKED BY: **ADK**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description
0–1		TOPSOIL [black silt/sand/roots]
1–8	CL	Yellowish brown CLAY/SILT, trace fine sand
3		SAME (some coarse, angular gravel)
5		SAME (less gravel; dark gray and yellowish brown color)
7		SAME (some coarse, angular gravel)
8–16	GW-GM	NO RECOVERY (rough drilling; driller reports boulders and cobbles)
16–20	SM	Reddish yellow and yellowish brown fine to coarse SAND, little to some silt, little medium to coarse gravel (moist to wet)
20–24	GW-GM	Reddish yellow and yellowish brown fine to coarse GRAVEL, some fine to coarse sand, trace silt
24–28	SM	Gray fine to medium SAND, some silt, little medium to coarse gravel (gravels subrounded)
28–32	GW-GM	Yellowish gray fine to coarse GRAVEL, some to and fine to coarse sand (gravels subangular)
32–36	SW	Grayish brown fine to coarse SAND, trace fine to medium gravel, trace silt (gravels rounded)

Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
S-375@ 0-2' PID			0
S-375@ 2-4' PID			0
S-375@ 4-6' PID			0
S-375@ 6-8' PID			0
S-375@ 8-10' PID	0	5 7 8 6	0
S-375@ 10-12' PID	0	8 9 8 8	30
S-375@ 12-14' PID	0	10 10 11 9	39
S-375@ 14-16' PID	0	9 10 8 10	53
S-375@ 16-18' PID	2	8 6 5 5	53
S-375@ 18-20' PID	2	2 3 4 2	70
S-375@ 20-22' PID	2	3 4 3 2	70
S-375@ 22-24' PID	2	3 4 4 3	108
S-375@ 24-26' PID	2	3 4 3 4	127
S-375@ 26-28' PID	2	3 3 3 2	130
S-375@ 28-30' PID	2	2 2 2 3	404
S-375@ 30-32' PID	2	3 2 3 4	577
S-375@ 32-34' PID	2	3 3 3 3	916
S-375@ 34-36' PID	2	2 3 2 3	999

Well Construction



GEO FORM 304 - AQUATERRA AOI9_TEMPLATE.GPJ AQUATERRA_LOGS.GDT 3/30/20

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 Remedial Investigation**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **S-376**
PAGE 1 OF 1

Aquaterra Technologies, Inc.

DRILLING: STARTED **10/9/18** COMPLETED: **10/18/18**
INSTALLATION: STARTED **10/18/18** COMPLETED: **10/18/18**
DRILLING COMPANY: **Total Quality Drilling**
DRILLING EQUIPMENT: **Truck-Mounted Mobile B-57**
DRILLING METHOD: **Hollow Stem Auger**
SAMPLING EQUIPMENT: **Split Spoon**

*NORTHING (ft): **218734.5** | *EASTING (ft): **2685068.6**
*GROUND ELEV (ft): **13.5** | *TOC ELEV (ft): **15.64**
INITIAL DTW (ft): **Not Encountered** | BOREHOLE DEPTH (ft): **36**
STATIC DTW (ft): **Not Measured** | WELL DEPTH (ft): **35**
WELL CASING DIAMETER (in): **2"** | BOREHOLE DIAMETER (in): **10"**
LOGGED BY: **Luke Mokrycki** | CHECKED BY: **ADK**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description
1–6	CL	Black to yellowish brown CLAY/SILT; SAME (little medium to coarse gravel); SAME (yellowish brown and gray color)
6–8	GW-GM	Gravel, Boulders, and Cobbles
8–12	CL	Gray CLAY/SILT, trace fine sand (very stiff consistency)
12–16	SM	Dark gray and dark reddish brown fine to medium SAND, some silt, little medium to coarse gravel (subrounded gravels) (moist; wet by 14' bgs)
16–18	SW-SC	Dark reddish brown and gray fine to coarse SAND, some to and gravel, little clay/silt (saturated)
18–22	SC	Dark gray and light reddish brown CLAY/SILT and SAND, some fine to medium gravel (benzene @ 66.75ppm)
22–24	SP	Dark gray fine to medium SAND, trace coarse sand, trace silt
24–26	SC	Grayish brown and brownish yellow fine to medium SAND, little clay
26–32	SP-SM	Gray fine SAND, little to some silt, trace to little fine to medium gravel
32–36	SW	Yellowish gray and brown fine SAND, trace to little fine to medium gravel (rounded), trace to no silt

Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
S-376@ 0-2' PID			0
S-376@ 2-4' PID			0
S-376@ 4-6' PID			0
S-376@ 6-8' PID			0
S-376@ 8-10' PID	0.2	2 3 4 20	0
S-376@ 10-12' PID	1.5	7 7 20 16	0.7
S-376@ 12-14' PID	2	8 6 7 8	120
S-376@ 14-16' PID	2	3 9 11 8	480
S-376@ 16-18' PID	2	20 10 16 18	980
S-376@ 18-20' PID	2	3 3 3 3	960
S-376@ 20-22' PID	2	2 4 5 25	999
S-376@ 22-24' PID	2	2 3 8 22	MAX
S-376@ 24-26' PID	2	3 2 3 3	MAX
S-376@ 26-28' PID	2	2 2 11 7	MAX
S-376@ 28-30' PID	2	6 6 6 7	MAX
S-376@ 30-32' PID	2	7 8 7 7	MAX
S-376@ 32-34' PID	2	35 17 15 14	999
S-376@ 34-36' PID	2	3 5 11 8	MAX

Well Construction:
- Tremie Grout - Bentonite Amended Cement
- Sand Pack #2 Well Sand
- 2" Slotted PVC Casing (0.020in slot size)

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 Remedial Investigation**
PROJECT NUMBER:

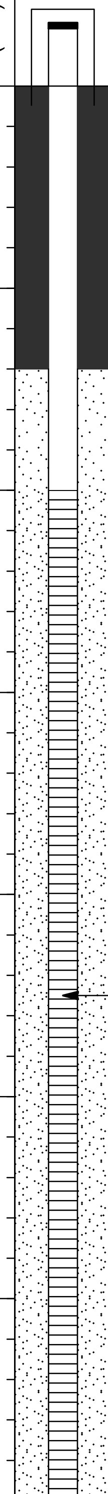
WELL / PROBEHOLE / BOREHOLE NO: **S-377**
PAGE 1 OF 1

DRILLING: STARTED **10/10/18** COMPLETED: **10/23/18**	*NORTHING (ft): **218559.2**
INSTALLATION: STARTED **10/23/18** COMPLETED: **10/23/18**	*EASTING (ft): **2685254.7**
DRILLING COMPANY: **Total Quality Drilling**	*GROUND ELEV (ft): **12.5**
DRILLING EQUIPMENT: **Truck-Mounted Mobile B-57**	*TOC ELEV (ft): **14.69**
DRILLING METHOD: **Hollow Stem Auger**	INITIAL DTW (ft): **Not Encountered**
SAMPLING EQUIPMENT: **Split Spoon**	BOREHOLE DEPTH (ft): **36**
	STATIC DTW (ft): **Not Measured**
	WELL DEPTH (ft): **35**
	WELL CASING DIAMETER (in): **2"**
	BOREHOLE DIAMETER (in): **10"**
	LOGGED BY: **Luke Mokrycki**
	CHECKED BY: **ADK**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0-2		TOPSOIL [black clay/silt with roots and organic material]	S-377@ 0-2' PID			0
2-8	CL	Black and brownish yellow CLAY/SILT, some fine to coarse gravel (gravel coarsens with depth), trace sand	S-377@ 2-4' PID			0
			S-377@ 4-6' PID			0
			S-377@ 6-8' PID			0
8-10	GW	White fine to very coarse GRAVEL	S-377@ 8-10' PID	0.2	9 14 29 14	0.5
10-16	SM	Dark red and dark gray fine to very coarse SAND, some silt, little to some coarse gravel	S-377@ 10-12' PID	2	13 13 17 21	0.5
			S-377@ 12-14' PID	0	13 20 17 12	278
			S-377@ 14-16' PID	1.75	12 10 9 14	617
16-20	SC	Dark brown and reddish yellow fine to very coarse SAND, some silt, little to some coarse gravel, little clay	S-377@ 16-18' PID	2	12 8 7 9	999
			S-377@ 18-20' PID	0.5	26 18 20 22	999
20-24	GW-GM	Dark gray and brown fine SAND and coarse GRAVEL, some cobbles, trace silt	S-377@ 20-22' PID	2	7 28 10 40	999
			S-377@ 22-24' PID	2	18 7 8 8	999
24-30	GW-GM	Brownish yellow and red to dark gray and black coarse to fine GRAVEL, some coarse sand, trace silt	S-377@ 24-26' PID	2	7 7 19 30	999
			S-377@ 26-28' PID	0.75	8 8 8 16	999
			S-377@ 28-30' PID	2	3 5 7 14	MAX
30-32	SC	Dark grayish brown and red SILT/CLAY, some to and fine sand	S-377@ 30-32' PID	2	4 10 10 23	MAX
32-34	GW-GM	Brownish yellow fine to coarse GRAVEL, some coarse sand, trace silt	S-377@ 32-34' PID	2	24 17 29 50	MAX
34-36	CL	Brown to light gray CLAY/SILT, some to and medium sand	S-377@ 34-36' PID	2	5 10 7 5	MAX

Well Construction



PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 Remedial Investigation**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **S-378**
PAGE 1 OF 1

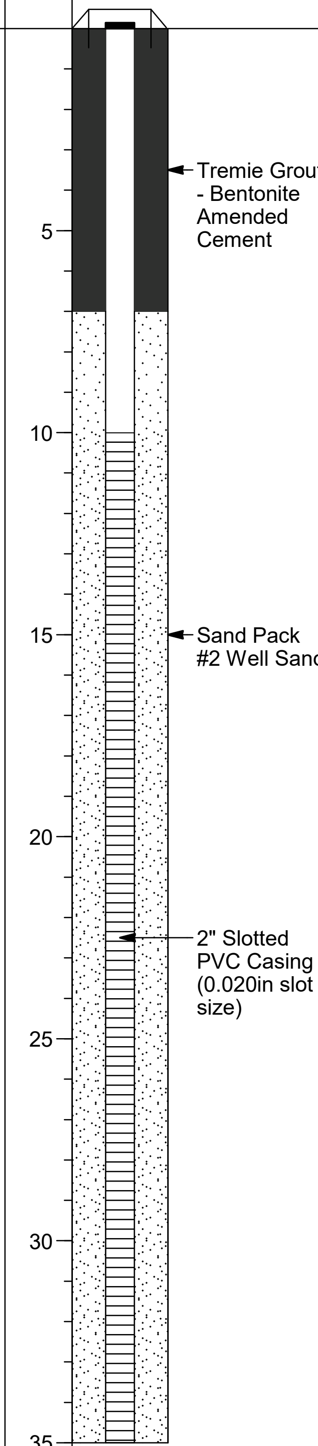
Aquaterra Technologies, Inc.

DRILLING: STARTED **10/10/18** COMPLETED: **10/22/18**	*NORTHING (ft): **218657.9**
INSTALLATION: STARTED **10/22/18** COMPLETED: **10/22/18**	*EASTING (ft): **2685380.7**
DRILLING COMPANY: **Total Quality Drilling**	*GROUND ELEV (ft): **12.1**
DRILLING EQUIPMENT: **Truck-Mounted Mobile B-57**	*TOC ELEV (ft): **11.97**
DRILLING METHOD: **Hollow Stem Auger**	INITIAL DTW (ft): **Not Encountered**
SAMPLING EQUIPMENT: **Split Spoon**	BOREHOLE DEPTH (ft): **36**
	STATIC DTW (ft): **Not Measured**
	WELL DEPTH (ft): **35**
	WELL CASING DIAMETER (in): **2"**
	BOREHOLE DIAMETER (in): **10"**
	LOGGED BY: **Luke Mokrycki**
	CHECKED BY: **ADK**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0-2		TOPSOIL [black clay/silt with roots and organic material]	S-378@ 0-2' PID			0
2-8	CL	Black and brownish yellow CLAY/SILT, some fine to coarse gravel (gravel coarsens with depth)	S-378@ 2-4' PID			0
			S-378@ 4-6' PID			0
			S-378@ 6-8' PID			0
8-10	GW	White fine to very coarse GRAVEL	S-378@ 8-10' PID	0.5	2 3 3 2	0
10-16	SM	Dark red and dark gray fine to very coarse SAND, some silt, little to some coarse gravel	S-378@ 10-12' PID	2	4 4 5 7	0
			S-378@ 12-14' PID	0	3 8 11 13	30
			S-378@ 14-16' PID	2	2 5 5 13	150
16-20	SC	Dark brown and reddish yellow fine to very coarse SAND, some silt, little to some coarse gravel, little clay	S-378@ 16-18' PID	2	2 3 5 5	338
			S-378@ 18-20' PID	2	3 3 5 7	701
20-24	GW-GM	Dark gray and brown fine SAND and coarse GRAVEL, some cobbles, trace silt	S-378@ 20-22' PID	1.5	3 3 9 13	853
			S-378@ 22-24' PID	2	3 5 14 17	999
24-30	GW-GM	Brownish yellow and red to dark gray and black coarse to fine GRAVEL, some coarse sand, trace silt	S-378@ 24-26' PID	2	3 3 5 8	999
			S-378@ 26-28' PID	2	3 3 4 6	999
			S-378@ 28-30' PID	2	4 4 5 3	MAX
30-32	SC	Dark grayish brown and red SILT/CLAY, some to and fine sand	S-378@ 30-32' PID	2	3 2 4 3	MAX
32-34	GW-GM	Brownish yellow fine to coarse GRAVEL, some coarse sand, trace silt	S-378@ 32-34' PID	2	2 2 2 4	MAX
34-36	CL	Brown to light gray CLAY/SILT, some to and medium sand	S-378@ 34-36' PID	2	3 2 2 5	MAX

Well Construction



GEO FORM 304 - AQUATERRA AOI9_TEMPLATE.GPJ AQUATERRA_LOGS.GDT 3/30/20

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO:
PAGE 1 OF 2 **CD-01/AOI4-BH-20-01**

Stantec

DRILLING: STARTED **8/5/20** COMPLETED: **8/7/20**	*NORTHING (ft): **218551.01**
INSTALLATION: STARTED -- COMPLETED: --	*EASTING (ft): **2685354.16**
DRILLING COMPANY: **Parratt Wolff**	*GROUND ELEV (ft): **--**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	*TOC ELEV (ft): **--**
DRILLING METHOD: **HSA; Mud Rotary**	INITIAL DTW (ft): **--**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	BOREHOLE DEPTH (ft): **48**
	STATIC DTW (ft): **Not Measured**
	WELL DEPTH (ft): --
	WELL CASING DIAMETER (in): **---**
	BOREHOLE DIAMETER (in): **8**
	LOGGED BY: **A Klingbeil/J Kachel**
	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)
0–2		APPARANT FILL (mostly black coal, cinders, stones debris, some clay/silt, moist to damp)	X		1.4	2 8 11 12	0	
2–4		SAME (some brick, gravel, damp)	X		1.0	10 8 7 8	0.1	
4–6		SAME (concrete debris, damp)	X		0.2	21 8 7 6	0.4	5
6–8		SAME (concrete debris, coal, cinders, dry)	X		0.1	8 4 2 6	0.2	
8–10		SAME (muddy bricks/fill, possible old lowland, wet)	X		0.1	13 7 4 2	0.8	
10–12	GP-GM	GP-GM; Grayish black, fine GRAVEL, little coarse gravel (red sandstone quartzite) little clay, some clayey silt, trace roots (recent alluvium) (saturated)	X	CD-01-S-10-20200805	0.6	8 7 18 10	5.7	10
12–14	GP-GM / CL	GP-GM; SAME (saturated) (recent alluvium) CL; Brownish gray, dark gray and black laminated CLAY AND SILT, few black mottles (slight marshy odor) (saturated) to organic matt	X		1.8	8 10 3 4	4.1	
14–16	CL / GM	CL; SAME (slight odor) (saturated) GM; Dark grayish brown-yellowish brown (with depth) coarse to fine GRAVEL some very coarse to fine sand, little clay/silt (saturated)	X		1.6	3 6 12 12	19	15
16–18	GM	GM; SAME (stained black) (strong odor) (saturated to wet) forensics soil sample at 17'	X		1.3	20 17 40 22	3017	
18–20	GM	GM; SAME (very coarse silty gravel, strong odor, sheen present, saturated to wet) Well screen set at 17-19.5' and sample through augers	X	CD-01-17-20200805 CD-01-W-18-20200805	1.7	14 14 16 19	2051	
20–22	GP-GC	GP-GC; Dark brown to dark gray GRAVEL (red mudstone), subrounded sand matrix, little silt (staining, strong odor, moist) quartzite	X		1.0	16 20 10 36	8200	20
22–24	GP-GC	GP-GC; SAME (fewer coarse gravels [red mudstone] odor, moist) Casing set at 24' switch from HSA to mud rotary	X		0.7	23 27 29 30	1500	
24–26	SP	SP; Brown grading to dark gray, moderately sorted, medium to fine SAND (strong odor) some mudstone clasts at 24'	X		0.7	8 7 6 10	1100	25
26–28	SP	SP; SAME (possible wash, wet, coarse mudstone gravel)	X		0.7	8 10 18 20	500	
28–30	SP	SP; Gray, slightly greenish, fine, soft SAND (wet) little clay, trace silt	X		0.5	13 12 11 13	800	

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO:
 CD-01/AOI4-BH-20-01

Stantec

DRILLING: STARTED **8/5/20**	COMPLETED: **8/7/20**	*NORTHING (ft): **218551.01**	*EASTING (ft): **2685354.16**
INSTALLATION: STARTED --	COMPLETED: --	*GROUND ELEV (ft): **--**	*TOC ELEV (ft): **--**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **48**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **Not Measured**	WELL DEPTH (ft): --
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **---**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **A Klingbeil/J Kachel**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
30–32	SP	SP; SAME (little fine gravel at 30' (rounded quartzite) very fine sand 31.5-32')		1.5	9 10 12 15	35
32–34	SP	SP; SAME (very fine sand to 32.2', 32.2-32.4' very coarse gravel (reddish, hard, very coarse, rounded) 32.5-34' medium sand, <5% fines, some laminations, wet		1.2	7 8 11 12	45
34–36	SP	SP; SAME to 35.5'. stiff, clean, fine SAND, no laminations, more uniform (very wet)		1.5	9 16 21 28	30
36–38	SP	SP; SAME (gray, clean, fine sand, medium sand lense at 37.5' bgs, few fine quartz gravels, mostly quartz sand) (wet)		1.0	10 12 10 14	35
38–40	SP	SP; SAME (brownish gray to 39', 39-40' yellowish brown, fine sand to 38.1', 38.1-40' medium sand, little fines, little coarse sand)		1.1	19 16 18 19	27
40–42	SP	SP; SAME (grayish brown, some fine gravel to 41', fine, 41-42' is medium sand, medium stiff, wet) Temporary well point set 41.5-44' and sampled	CD-01-W-41.5-20200807	0.9	8 9 11 13	40
42–44	SP	SP; SAME (medium sand, little fine gravel, wet)		1.1	11 10 7 11	45
44–46		No Recovery		0	11 10 7 11	
46–48	CL	CL; Yellowish tan and white to 47' banded bottom white with red banding, medium stiff, plastic CLAY		0.9	7 3 5 6	35

Note: Allowed hole to site at 9.9'. After 2 hours water in augers rose to 9'.

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO:
PAGE 1 OF 2 **CD-02/AOI4-BH-20-02**

Stantec

DRILLING: STARTED **8/3/20**	COMPLETED: **8/4/20**	*NORTHING (ft): **218539.4456**	*EASTING (ft): **2685170.105**
INSTALLATION: STARTED --	COMPLETED: --	*GROUND ELEV (ft): **--**	*TOC ELEV (ft): **--**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **43**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **Not Measured**	WELL DEPTH (ft): --
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **---**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **A Klingbeil**	CHECKED BY: **J Kachel**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)
1		APPARENT FILL brown SILT/CLAY/SAND mixed with stones and debris (coal, slag, trash, brick) (dry)		0.6	8 8 9 10	0	
2, 3		SAME (dry to damp)		1.5	6 9 6 5	0	
4, 5		SAME (few black layers possible coal/ash) (wet)		1.8	16 8 8 8	0	5
		APPARANT ALLUVIUM Yellowish brown SILT/CLAY/SAND				0	
6, 7	CL-ML	CL-ML; Light gray, reddish yellow and brownish yellow CLAY/SILT and very fine sand (laminated appearance) (few very fine mottles) (micaceous) (few roots) (root casts) (damp)		1.5	8 7 11 8	0.6	
8, 9	CL-ML	CL-ML; SAME (sand content increases with depth) (some laminations) (moist)		1.6	4 4 5 5	0.6	
10, 11	CL-ML	CL-ML; SAME (lenses of CLAY, one lens of SILTY SAND) (micaceous) (clay lenses have very fine prominent mottles) overall clay (trace red mudstone gravel) (moist to wet)		1.5	3 2 3 3	0.2	10
12, 13	CL-ML	CL-ML; SAME (moderate petroluem odor) (moist to wet)		1.4	2 6 6 9	678	
	GM	GM; Reddish brown, fine to very coarse gravel and coarse to fine sand, some silt (moderate odor) (wet)					
14	GC	GC; SAME (little clay) 9gravel are sandstone, conglomerate, gneiss with garnets) (saturated)		0.5	17 8 7 7	0.5	15
15, 16	SP	SP; Yellowish brown, fine to medium SAND, little coarse sand, trace very coarse sand, trace to no silt (saturated)					
17	GP-GM	GP-GM; Yellowish brown, fine to medium GRAVEL and some very coarse to fine sand, trace to no silt (saturated)		1.3	9 6 7 11	0.5	
18	GP-GM	GP-GM; SAME (black staining) (saturated)					
19	SP	SP; Grayish brown, very fine SAND, trace fine sand (trace mica) (saturated) to high mineral, trace to no silt, thin clay lens in shoe		0.5	15 8 8 8	9	
20	SP	SP; SAME (20.9-21 clay lens) (saturated) (rapid dilatancy) Set casing at 21'. Switch from HSA to mud rotary		1.4	12 7 11 13	42	20
21	SP	SP; Light gray and reddish gray, medium to fine SAND, some coarse, little very coarse sand, trace pebbles, trace to no silt (slight petroleum odor) (saturated)				933	
22, 23	SP	SP; SAME trace to no silt (appears less impacted than above) (saturated)		0.5	6 13 18 17	23	
24		Temporary well screen set at 24.25-26.75' and sampled	CD-02-25-20200803				
25, 26	SP	SP; Reddish gray, coarse to fine SAND, trace to no silt, little fine to medium gravel (SPG) in seams (saturated)		0.5	10 10 7 8	61	25
27, 28	SPG	SPG; SAME (more gravel than above) very coarse gravel (mudstone) (wet to saturated lenses)		1.1	6 7 9 9	51	
29	SPG	SPG; SAME (wet)			10 13		

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO:
 CD-02/AOI4-BH-20-02

Stantec

DRILLING: STARTED **8/3/20** COMPLETED: **8/4/20**
INSTALLATION: STARTED -- COMPLETED: --
DRILLING COMPANY: **Parratt Wolff**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**
DRILLING METHOD: **HSA; Mud Rotary**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**

*NORTHING (ft): **218539.4456** *EASTING (ft): **2685170.105**
*GROUND ELEV (ft): **--** *TOC ELEV (ft): **--**
INITIAL DTW (ft): **--** BOREHOLE DEPTH (ft): **43**
STATIC DTW (ft): **Not Measured** WELL DEPTH (ft): --
WELL CASING DIAMETER (in): **---** BOREHOLE DIAMETER (in): **8**
LOGGED BY: **A Klingbeil** CHECKED BY: **J Kachel**
*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)
30–31	SPG		0.3	17 13	58	
31–31.4	SPG	SPG; SAME (wet)	0.5	8 26 50/4"	67	
31.4–33	GM	GM; Brownish yellow and strong brown GRAVEL layer at 31.4' (saturated) Brownish yellow, fine to coarse GRAVEL, some coarse to fine sand, some little silt (micaceous) (wet to saturated)				
33–35	GM	GM; SAME	0.4	47 19 11 25	12	
35–37	GM	GM; SAME (mostly gray sandstone) (saturated) Rig rolling on gravel	0.3	18 23 15 18	62	35
37–37.5	GM	GM; SAME (saturated)	0.9	18 10 15 15	2.1 / 3	
37.5–39	CH	CH; White and reddish yellow laminated CLAY/SILT, fine gravel to very coarse sand (moist)				
39–39.5	CH	CH; SAME (few very coarse sand to fine gravel lenses) (moist) clay with gravel/sand iron rich coatings	1.5	8 7 10 18	--	40
39.5–41	CH	CH; White, red and yellow CLAY/SILT, trace very fine sand (damp)				
41–43		No Recovery. Clay on spoon	0	7 7 12 18	--	

GEO FORM 304 PHRO_AOI4_ADDENDUM_20210224.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/14/21

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO:
PAGE 1 OF 4 **CD-03/AOI4-BH-20-03**

Stantec

DRILLING:	STARTED **7/27/20**	COMPLETED: **7/30/20**	
INSTALLATION:	STARTED --	COMPLETED: --	

DRILLING COMPANY: **Parratt Wolff**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**
DRILLING METHOD: **HSA; Mud Rotary**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**

*NORTHING (ft): **218678.0098**	*EASTING (ft): **2685325.448**
*GROUND ELEV (ft): **--**	*TOC ELEV (ft): **--**
INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **100**
STATIC DTW (ft): **Not Measured**	WELL DEPTH (ft): --
WELL CASING DIAMETER (in): **---**	BOREHOLE DIAMETER (in): **8**
LOGGED BY: **D Hopkins/A Klingbeil**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	Graphic Log	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)
0–2			TOPSOIL APPARENT FILL([brownish yellow and reddish brown SILT and CLAY, little SAND, few stones (dry)			1.3	2 4 5 7	0 0	
2–4			SAME (trace asphalt) (dry to damp)			0.9	4 7 5 9	0	
4–6			SAME (trace wood) (few stones) (damp) First attempt at next spoon - refusal on concrete (50/3"0 offset boring			0.8	3 5 3 5	0	5
6–8			FILL moist CLAY and SILT with trace gravel, coal Attempt at next spoon - refusal on concrete (50/0") offset boring again			1.2		0	
8–10			FILL (same material, as above the sewer)			0.1	3 4 3 3	0	10
10–12			Dark gray CLAY and SILT in shoe			0.1	1 2 1 1	0	
12–14			FILL dark gray-brown CLAY and SILT with coal bits (wet)			0.1	1 3 5 3	0	
14–16		GM	FILL Varicolored CLAY and SILT with black staining (moist) FILL wood GM; Varicolored, fine to coarse GRAVEL, some fine coarse sand and trace silt (moist)			1.1	1 16 12 13	1.0	15
16–18		GM	GM; SAME (silty gravel with sand lens) (16-16.4' bgs reddish brown and reddish gray, fine to medium sand lens (saturated)			1.3	9 12 14 9	0.1	
18–20		SP-SC SP	SP-SC; Light gray and reddish gray interbedded, fine SAND and CLAY/SILT, 1" beds (clays are laminated) (saturated) SP; Reddish yellow, strong brown and gray, fine SAND trace to no silt, strong petroleum odors			0.9	10 9 10 11	2260	20
20–22		SP	SP; Light gray, fine to very fine SAND, trace to no silt, mica grains, sheen apparent (saturated) Forensics soil sample collected at 20.5'		CD-3-5-20.5-20200727	0.7	5 6 5 6	2011	
22–24		SP	SP; SAME (light gray-reddish gray, fine to very fine SAND, trace to no silt, 23.2' lens of coarse sand-medium gravel) (possible slight glaucunite, trace green sandst eon, fine gravel) (saturated)			1.3	11 10 11 8	2003	
24–26		SP	SP; Gray, fine SAND (one medium angular gravel) (strong petroleum odor, sheen, staining) (saturated) Trenporary well screen at 24-26.5' and sampled (includes DNA testing) casing set to 24' switch from HSA to mud rotary		CD-3-W-25.0-20200728	0.6	7 12 12 17	903	25
26–28		SW	SW; Gray SAND (well graded sand with some gravel; red claystone at 26.5' bgs) (strong petroleum odor, staining) (saturated)			0.7	5 6 7 5	1455	
28–30		SP	SP; Gray, fine to medium SAND with little rounded gravel (quartz) (organic degradation odor) (saturated)			0.5	13 12 8 14	0.1	

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-03/AOI4-BH-20-03**

Stantec

DRILLING: STARTED **7/27/20** COMPLETED: **7/30/20**	*NORTHING (ft): **218678.0098**
INSTALLATION: STARTED -- COMPLETED: --	*EASTING (ft): **2685325.448**
DRILLING COMPANY: **Parratt Wolff**	*GROUND ELEV (ft): **--**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	*TOC ELEV (ft): **--**
DRILLING METHOD: **HSA; Mud Rotary**	INITIAL DTW (ft): **--**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	BOREHOLE DEPTH (ft): **100**
	STATIC DTW (ft): **Not Measured**
	WELL DEPTH (ft): --
	WELL CASING DIAMETER (in): **---**
	BOREHOLE DIAMETER (in): **8**
	LOGGED BY: **D Hopkins/A Klingbeil**
	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)
30–32	SP	SP; SAME (coarsening downward to gray coarse sand) (organic odor) (saturated)		0.8	12 11 12 14	0.6	
32–34	SP	SP; SAME (gray coarse SAND fining downward; red claystone at 32.9' bgs) (no odor) (saturated) yellowish brown sand in shoe		1.0	14 9 13 12	0.7	
34–36		NO RECOVERY, yellowish brown sand in shoe		0	12 18 9 12	0	35
36–38	SP	SP; Yellowish brown, fine to medium SAND with little gravel (no odor) (saturated)		0.5	12 19 14 12	0	
38–40	SW	SW; Brown and gray SAND and GRAVEL (well graded) (no odor) (saturated)		0.8	13 8 6 5	0	
	SW	SW; Brownish yellow (oxidized) medium SAND 9no odor) (saturated) milky sand in shoe (looks like "Beaver dam" sand)					
40–42	SP	SP; Milky (white and light gray) medium to coarse SAND (no odor) (saturated) oxidation at 40.9' bgs; white, low plasticity clay at 40.5' bgs (moist)		0.9	8 6 5 4	0	40
42–44	SP	SP; SAME (fining downward) (no odor) (saturated)		0.7	6 10 10 11	0	
44–46	SP	SP; SAME very pale brown well graded caorse SAND (grains of pink and orange quartz becoming increasingly well graded with depth) (no odor) (saturated) white, low plasticity clay in drive shoe		0.9	13 16 15 12	0	45
46–48	SP	SP; White to yellow, fine SAND (degraded petroleum odor) (saturated)	CD-3-W-46.0-20200729	0.8	5 4 9 8	2.4	
	CH	CH; White and red mottled (high plasticity) CLAY (no odor) (dry)					
48–50	CH	CH; SAME (no odor) (dry) fat CLAY Casing advanced to 48'		1.1	5 13 19 17	0	
50–52	CH	CH; SAME (no odor) (dry)		1.8	6 10 11 12	0	50
52–54	CH	CH; SAME (no odor) (dry)		2.0	16 19 20 21	0.5	
54–56	CH	CH; SAME (no odor) (dry)		1.65	5 12 14 17	0.4	55
56–58	CH	CH; SAME (no odor) (dry) some dark red clay, friable white clay at 56.5' bgs		1.7	19 26 31 35	0	
58–60	CH	CH; SAME (introduction of yellow CLAY, dark red towards bottom (increasingly friable/and lyaered at bottom) (no odor) (dry)		1.8	10 18 27 29	0	

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO:
 CD-03/AOI4-BH-20-03

Stantec

DRILLING: STARTED **7/27/20** COMPLETED: **7/30/20**
INSTALLATION: STARTED -- COMPLETED: --
DRILLING COMPANY: **Parratt Wolff**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**
DRILLING METHOD: **HSA; Mud Rotary**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**

*NORTHING (ft): **218678.0098** *EASTING (ft): **2685325.448**
*GROUND ELEV (ft): **--** *TOC ELEV (ft): **--**
INITIAL DTW (ft): **--** BOREHOLE DEPTH (ft): **100**
STATIC DTW (ft): **Not Measured** WELL DEPTH (ft): --
WELL CASING DIAMETER (in): **---** BOREHOLE DIAMETER (in): **8**
LOGGED BY: **D Hopkins/A Klingbeil** CHECKED BY: **A Klingbeil**
*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
60-61	CL	CL; Red, low plasticity CLAY (no odor) (wet)	X		2.0	27 29 18 27	0.2
61-61.5	CH	CH; Red and light gray, high plasticity CLAY (no odor) (dry)					
61.5-62	CLS	CLS; Light gray, fine SANDY CLAY (increasing sand contents with depth) (no odor) (dry)					
62-64	CLS	CLS; Light gray and yellow mottled, fine SANDY CLAY to very fine CLAYEY SAND (tight/dense) (no odor) (dry) micaceous, powdery clay	X		0.5	50/6	0
64-66		NO RECOVERY (mud rotary through interval)					
66-68	CLS	CLS; SAME (no odor) (dry)	X		0.5	75/6	0
68-73		Mud rotary to 73' bgs due to continuous refusal					0.2
73-75	SP	SP; Red, yellowish brown and brownish yellow, fine to very fine SAND (no odor) (sturated)	X		1.0	46 50/6	
75-78		Mud rotary to 78' bgs due to continuous refusal					
78-80	SP	SP; Red and brownish yellow SAND, medium grained quartz and lignite (black) (no odor) (saturated)	X		1.0	78 50/4	0
80-80.5	SP	SP; SAME (no odor) (saturated)	X		1.3	50 75 50/3	0.4
80.5-82	SP	SP; Brownish yellow SAND, medium grained with white clayey sand rip up clasts and little rounded gravel (quartz and feldspar)					
82-84	SW	SW; Muddy brownish well graded SAND with clayey silt matrix (organic odor) (saturated) Temporary well screen set 81.5-84' and sampled.	X	CD-3-W-82.0-20200729	0.25	49 59 70 54	0.2
84-88		Mud rotary to 88' bgs					
88-90	SC	SC; Light yellowish brown, fine CLAYEY SAND (no odor) (wet) with light gray, fine sandy clay laminations (low plasticity) (moist) black lignite gravel (round), coarse quartz sand in shoe	X		0.3	38 46 50/4	0

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-03/AOI4-BH-20-03**

Stantec

DRILLING: STARTED **7/27/20** COMPLETED: **7/30/20**
INSTALLATION: STARTED -- COMPLETED: --
DRILLING COMPANY: **Parratt Wolff**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**
DRILLING METHOD: **HSA; Mud Rotary**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**

*NORTHING (ft): **218678.0098** *EASTING (ft): **2685325.448**
*GROUND ELEV (ft): **--** *TOC ELEV (ft): **--**
INITIAL DTW (ft): **--** BOREHOLE DEPTH (ft): **100**
STATIC DTW (ft): **Not Measured** WELL DEPTH (ft): --
WELL CASING DIAMETER (in): **---** BOREHOLE DIAMETER (in): **8**
LOGGED BY: **D Hopkins/A Klingbeil** CHECKED BY: **A Klingbeil**
*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	Graphic Log	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)
90–93			Mud rotary to 93' bgs						
93–95		SW	SW; Pale red well graded SAND with subangular quartz gravel; clayey fine sand matrix, light gray clayey, coarse sand clast (no odor) (saturated) very pale brown clean sand in shoe	X		0.5	56 57 37/3	0	95
95–98			Mud rotary to 98' bgs						
98–100			NO RECOVERY (all wash) (no recovery)	X		0	37 49 59 50/4	--	100

Depth scale: 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-05/S-442**

PAGE 1 OF 2

Stantec

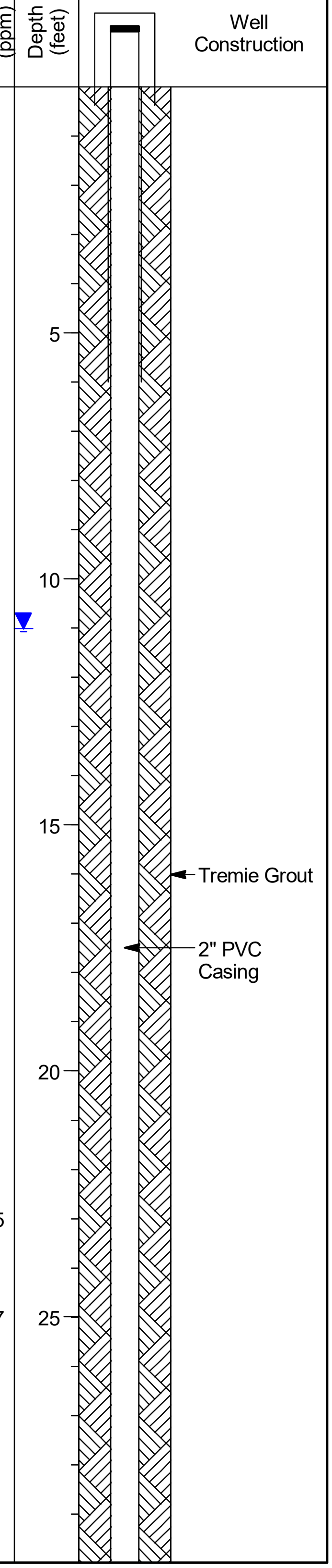
DRILLING: STARTED **7/13/20** COMPLETED: **7/16/20**	*NORTHING (ft): **218836.87**
INSTALLATION: STARTED **7/16/20** COMPLETED: **7/17/20**	*EASTING (ft): **2685250.41**
DRILLING COMPANY: **Parratt Wolff**	*GROUND ELEV (ft): **12.95**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	*TOC ELEV (ft): **15.51**
DRILLING METHOD: **HSA; Mud Rotary**	INITIAL DTW (ft): **--**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	BOREHOLE DEPTH (ft): **48**
	STATIC DTW (ft): **11**
	WELL DEPTH (ft): **46**
	WELL CASING DIAMETER (in): **2**
	BOREHOLE DIAMETER (in): **8**
	LOGGED BY: **D Hopkins**
	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0–2		APPARENT FILL, brown SAND WITH SILT with organic material at 0.1' bgs (dry) (no odor) APPARENT FILL, black asphalt fragments (dry) (asphalt odor)		1.0	11 9 5 4	0
2–4	CL-ML	CL-ML; Yellow SILTY CLAY (damp) (low plasticity) (no odor) (micaceous)		1.2	2 2 3 2	0
4–6	CL-ML	CL-ML; SAME, transition to CLAYEY SILT with depth (dry) (no odor)		1.0	2 2 2 4	0
6–8	CL-ML	CL-ML; SAME (yellowish brown and brown laminations) (dry) (no odor) (micaceous)		1.2	6 5 6 5	0
8–10	CL-ML	CL-ML; SAME (coarsening downward) (decreasing plasticity; brittle) (damp to dry) (no odor) trace to little fine sand at bottom Casing driven to 10'. Switch from HSA to mud rotary.		2.0	7 12 12 9	0
10–12	CL-ML	CL-ML; SAME (little fine SAND and GRAVEL) (gravel is subangular quartz) (moist to wet) (no odor)		0.8	6 7 9 7	0
12–14	CL-ML	CL-ML; SAME (saturated) clayey silty mud		0.1	4 4 3 3	0
14–16	GM	GM; MUDDY GRAVEL (yellowish brown, silty gravel) (angular) (saturated) (no odor) END OF DAY 7/13/2020		0.4	7 3 2 2	0
16–18	GM	GM; SAME (muddy gravel, subrounded quartz) (saturated) (no odor) coarse sandy gravel in drive shoe (saturated)		0.5	3 2 1 3	0
18–20		NO RECOVERY		0	7 3 2 2	0
20–22	SP-SM	SP-SM; Dark brown to black (stained) SAND WITH SILT (fine sand with little silt) (saturated) (strong petroleum odor, dark staining, visible sheen) soil sample collected including forensics	CD-5-S-20.0-20200714 CD-5-W-202007*	0.8	4 3 2 3	336
22–24	GW	GW; Dark brown and red well graded GRAVEL and SAND (saturated) (staining, strong petroluem odor, visible sheening)		0.5	7 9 12 14	1225
24–26	GW	GW; SAME (medium to large, angular to rounded) (heterogeneous) quartz and claystone gravels with well graded sand matrix (saturated) Dark and olive staining, strong, light ended hudrocarbon odor, slight chlorinated solvent odor (sweet) (sheen)		0.7	9 18 14 11	1887
26–28	GW / SW	GW; SAME SW; Dark brown and dark gray, fine to medium SAND with little gravel (round quartz) (saturated) (strong petroleum odor, dark staining, sheen)		0.9	12 16 16 15	55
28–30	SW	SW; SAME (brown to yellowish brown, fine to medium SAND, coarsening downward to well		0.7	10 10 10 10	4.3

Static water level symbol at 11 feet.

Well Construction



PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-05/S-442**

Stantec

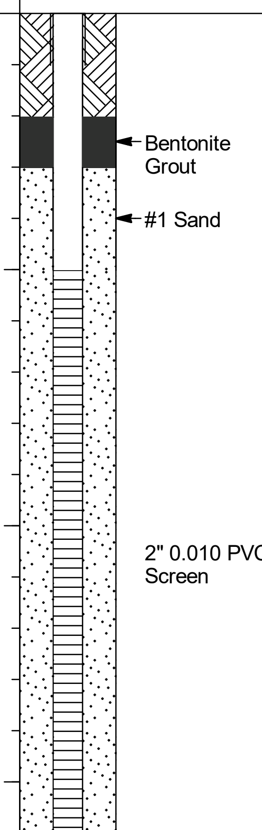
DRILLING: STARTED **7/13/20**	COMPLETED: **7/16/20**	*NORTHING (ft): **218836.87**	*EASTING (ft): **2685250.41**
INSTALLATION: STARTED **7/16/20**	COMPLETED: **7/17/20**	*GROUND ELEV (ft): **12.95**	*TOC ELEV (ft): **15.51**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **48**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **11**	WELL DEPTH (ft): **46**
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
30-32	SW	graded sand with little gravel (saturated) (slight olive staining, petroleum and organic odor)		1.0	10 10 16 16	14.5
		SW; SAME (yellow brown SAND, little gravel) (saturated) (slight olive stain, petroleum and organic odor) (possible sheening)				
32-34	SW	SW; SAME (gray brown and yellowish brown SAND with little gravel transitioning to fine to medium SAND with little to some gravel) (saturated) (very slight organic odor)		0.8	6 6 5 7	18.4
34-36	SW	SW; SAME (yellowish brown, fine and medium SAND with little gravel) (saturated) (slight organic odor)		0.6	4 5 6 4	5.6
36-38	GW	GW; Dark brown to dark red, well graded GRAVEL with sand) degraded dark red CLAYSTONE (resembles clay rip up clasts) (wet) (organic, possible degraded petroleum odor throughout)		0.4	10 14 10 50	4.0
38-40	SW	SW; Dark brown and red, well graded SAND with dark red CLAYSTONE (rip up clast) (wet)		0.8	40 12 14 10	2.2
	SP	SP; Light gray to white, fine SAND (saturated Beaverdam sand, milky) (no odor)				
40-42	SP	SP; SAME (very pale brown, light gray and white, fine SAND) (saturated) (no odor) Large gravel at 40.5'		0.6	4 12 14 13	--
42-44	SP	SP; White, light gray and gray sequences of fine, poorly graded SAND (saturated) and low plasticity CLAY laminations (wet) (no odor) milky well graded sand in drive shoe	CD-5-W-44.0-20200715	1.0	16 21 31 36	2.5
44-46	SW	SW; Pale brown to white, well graded SAND (saturated) trace to little CLAY (no odor)		0.4	7 11 15 16	0.5
46-48	SW	SW; SAME (gray well graded SAND with little CLAY) (saturated) (no odor)		1.3	10 16 21 22	0.2
	CH	CH; Red and white mottled CLAY (high plasticity) (dry) (no odor)				

*Note: Temporary well screens installed and sampled: 20-22.5' and 41.5-44'

Well Construction



PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-06A/S-441**

Stantec

DRILLING: STARTED **7/22/20** COMPLETED: **7/23/20**
INSTALLATION: STARTED **7/23/20** COMPLETED: **7/24/20**
DRILLING COMPANY: **Parratt Wolff**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**
DRILLING METHOD: **HSA; Mud Rotary**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**

*NORTHING (ft): **218647.16** *EASTING (ft): **2684941.91**
*GROUND ELEV (ft): **13.7** *TOC ELEV (ft): **16**
INITIAL DTW (ft): **--** BOREHOLE DEPTH (ft): **46**
STATIC DTW (ft): **12** WELL DEPTH (ft): **44**
WELL CASING DIAMETER (in): **2** BOREHOLE DIAMETER (in): **8**
LOGGED BY: **D Hopkins** CHECKED BY: **A Klingbeil**
*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description
0–1	MLS	MLS; APPARENT TOPSOIL Dark brown to brown, fine SANDY SILT with ORGANIC MATERIAL (dry) (no impacts)
1–2	SM	ASPHALT fragments (dry)
2–4	SM	SM; Brownish yellow and yellowish brown laminated SILT with little to trace fine SAND (dry) (no impacts) SM; SAME (dry) (no impacts)
4–6	SM	SM; SAME (micaceous) (dry) (no impacts)
6–8	SM	SM; SAME (fining downwards; little clay) (dry) (no impacts) (micaceous)
8–10	SM	SM; SAME (brownish yellow to yellowish brown laminated CLAYEY SILT) (dry) (no impacts) (micaceous)
10–12	SM	SM; SAME (yellowish brown, Clayey SILT) (dry 10-10.4' bgs; wet 10.4-11.2' bgs; moist 11.2-11.4' bgs) (no impacts) (micaceous) higher clay content where wet
12–14	SM	SM; SAME (wet to damp with depth; more clay content in shallower intervals) (micaceous) (no impacts)
14–16	SM / SP	SM; SAME (with some fine sand) (wet) (no impacts). Casing set at 14'. Switch from HSA to mud rotary. SP; Brown, silty, fine SAND with little to trace clay (saturated) (no impacts)
16–18	SP / CL / SC	SP; SAME (saturated) (no impacts) CL; Low plasticity SILTY CLAY (saturated) (no impacts) SC; Brown to dark gray, clayey, fine SAND (moist) (no impacts) little gravel (quartz)
18–20	SW	SW; White, red and gray SAND (well graded sand with heterogeneous gravel) (saturated) (petroleum odor, staining). Forensics sample collected at 19'.
20–22	SW	SW; SAME (saturated) (very slight petroleum odor, staining)
22–24	SW	SW; SAME (dark gray and white well graded SAND transitioning into dark gray, medium SAND) (red degraded claystone at 22.4' bgs) (saturated) (strong petroleum odor, dark staining) (olive at depth) (sheen at depth)
24–26	SW	SW; Dark gray, fine to medium SAND with some gravel (heterogeneous) (wet to saturated) (strong petroleum odor, dark staining, sheening where saturated)
26–28	SW	SW; SAME (gray/dark gray, white and red SAND) (well graded sand with quartz gravel) red claystone at 26.1' bgs (wet to saturated) (strong petroleum odor, sheen where saturated) (dark staining)
28–30	SP	SP; Dark gray to olive, fine SAND; little to trace gravel (saturated) (strong petroleum odor, staining (dark olive) (sheen)

Sample Interval (feet)	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0–2		1.4	3, 5, 12, 17	0
2–4		0.6	16, 13, 26, 22	0
4–6		1.4	3, 5, 5, 6	0.5
6–8		1.3	7, 8, 6, 10	0
8–10		1.0	4, 5, 6, 8	0.3
10–12	CD-6A-S-11.0-20200722	1.4	2, 4, 4, 3	0.3
12–14		1.7	3, 8, 4, 6	0
14–16		0.8	17, 16, 12, 11	0
16–18		1.3	6, 11, 12, 17	0.6
18–20	CD-6A-W-20200722	0.7	16, 12, 17, 11	928
20–22	CD-6A-S-19.0-20200722 (not anaylzed)	0.6	16, 11, 17, 11	1.9
22–24		0.8	13, 12, 16, 17	2223
24–26		0.8	16, 11, 13, 16	1434
26–28		0.9	11, 10, 15, 22	47.5
28–30		1.0	13, 17, 22, 20	26.2

Depth (feet)	Well Construction
0–30	Tremie Grout; 2" PVC Casing
12	Static water level ▼

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-06A/S-441**

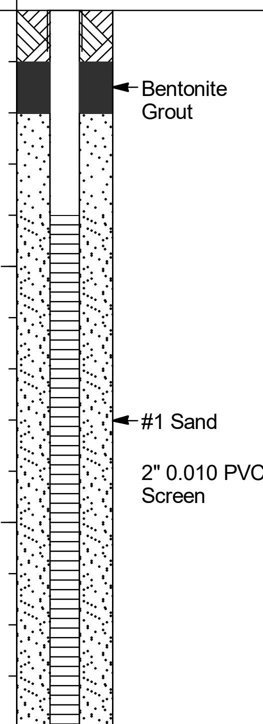
DRILLING: STARTED **7/22/20** COMPLETED: **7/23/20**
INSTALLATION: STARTED **7/23/20** COMPLETED: **7/24/20**
DRILLING COMPANY: **Parratt Wolff**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**
DRILLING METHOD: **HSA; Mud Rotary**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**

*NORTHING (ft): **218647.16** | *EASTING (ft): **2684941.91**
*GROUND ELEV (ft): **13.7** | *TOC ELEV (ft): **16**
INITIAL DTW (ft): **--** | BOREHOLE DEPTH (ft): **46**
STATIC DTW (ft): **12** | WELL DEPTH (ft): **44**
WELL CASING DIAMETER (in): **2** | BOREHOLE DIAMETER (in): **8**
LOGGED BY: **D Hopkins** | CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
30-32	SP	SP; SAME (olive, fine SAND coarsening downward to medium to coarse SAND) (saturated) (slight petroleum or organic odor)		1.0	9 8 10 9	2.4
32-34	SP	SP; SAME (olive to brown, medium to coarse SAND, little gravel (quartz) [saturated; oxidized (orange) with depth where most saturated] (slight petroleum odor)		1.3	11 12 14 17	1.2
34-36	SP	SP; SAME with little silt (saturated) (no odor)		1.0	12 15 12 16	0
36-38	SP	SP; SAME (fining downward into fine SAND with some gravel) [saturated; highest water content at bottom extent of silt (36.5' bgs)] (no odor)		1.6	12 15 11 15	0
38-40	SW	SW; Olive and gray SAND [gravelly (hererogeneous) well graded sand, red claystone at 38-38.1' bgs (saturated) (very slight degraded petroleum odor)]		0.7	22 12 11 13	0
40-42	GW	GW; Brown and dark brown GRAVEL (well graded gravel with sand; little red claystone) (wet) (very slight to no odor)		0.3	20 15 23 20	1.0
42-44	SW / SP	SW; Brown, gravelly, well graded SAND (saturated) (no odor) SP; White and light gray, medium SAND (saturated) little white, low plasticity, clay rip up clasts (moist) (no odor)	CD-6A-W-44.0-20200723	0.6	20 15 8 7	0.5
44-46	SC / CH	SC; Yellow, muddy, medium SAND (clayey sand) (saturated) (no odor) CH; Yellow to red and white mottled, high plasticity CLAY (dry) (no odor)		1.6	2 3 4 5	0.3

Note: Temporary well screens installed adn sampled: 18-20.5' and 41.5-44'.



PROJECT: **PHRO - Corrective Measures Program**	WELL / PROBEHOLE / BOREHOLE NO:
LOCATION: **AOI 4 - Former Philadelphia Refinery**	Stantec
PROJECT NUMBER: **213402602**	PAGE 1 OF 2 **CD-06B/AOI4-BH-20-04**
DRILLING: STARTED **6/25/20** COMPLETED: **6/30/20**	*NORTHING (ft): **218689.2** *EASTING (ft): **2684984.81**
INSTALLATION: STARTED **--** COMPLETED: **--**	*GROUND ELEV (ft): **--** *TOC ELEV (ft): **--**
DRILLING COMPANY: **Parratt Wolff**	INITIAL DTW (ft): **--** BOREHOLE DEPTH (ft): **48**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	STATIC DTW (ft): **Not Measured** WELL DEPTH (ft): **--**
DRILLING METHOD: **HSA; Mud Rotary**	WELL CASING DIAMETER (in): **6** BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	LOGGED BY: **D Hopkins/A Klingbeil** CHECKED BY: **A Klingbeil**
	*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0-1	SP-SM	SP-SM; Dark brown, fine SANDY SILT with trace clay and gravel (organic material - fine roots) (earthy odor) (damp)		1.0	1 3 3 3	0.3
1-2	SP-SM	SP-SM; Dark yellowish brown, fine, SANDY SILT wth trace clay and gravel (damp)				
2-4	SP-SM	SP-SM; Brownish yellow, silty, fine SAND, laminated present (dry) with reddish brown mottles		1.25	5 5 5 5	0
4-6	SP-SM	SP-SM; SAME (trace clay) (fining downward) (damp) (no odor)		0.9	11 4 4 5	1.1
6-8	SP-SM	SP-SM; SAME (damp) (no odor)		1.4	3 3 3 4	0
8-10	SP-SM	SP-SM; SAME (wet) (no odors) (brownish yellow silty, fine sand with little clay)		1.3	4 4 8 7	0
10-12	SC	SC; Yellowish brown, SANDY CLAY with little silt, yellowish brown mottles, laminated, slightly micaceous (moist) (no odor)		1.1	6 4 4 3	0
12-13	SC	SC; SAME (damp) (no odor)		1.5	5 5 4 7	0
13-14	SC	SC; SAME (light reddish brown) grading from clayey sand to silty sand in drive shoe				
14-15	SC	SC; SAME (mostly very fine to fine SAND and some silt and clay) (laminated) (moist)		1.1	10 10 15 16	0
15-16	SC	SC; SAME reddish brown interbedded, very fine to fine sand, some silt, few inch thick beds. Casing set at 15.5'. Switch from HSA to mud rotary.				0
16-18	CL	CL; Light yellowish brown, SILTY CLAY (low plasticity) (wet) (no odor) angular quartzite gravel in shoe		0.5	23 24 12 9	0
18	CL	CL; SAME (wet)		1.1	10 10 10 7	11.5
18-19	SP-SM	SP-SM; Reddish yellow, olive yellow and red gray, SILTY CLAY with gravel lenses (wet) (slight petroleum odor)				
19-20	SP-SM	SP-SM; SAND with SILT (yellow brown - stained brownish gray) (distinct petroleum odor) (saturated)				
20-22	GW-GM	GW-GM; Gray to gray brown GRAVEL with SILT (quartzite gravel) brown red degraded mudstone 20.2-20.4' (sheen) (LNAPL globules in mud tub) (very strong petroleum odor, gasoline-like) (saturated) wet,		0.9	13 17 12 12	336
22-24	GW-GM	GW-GM; SAME (interbedded with brownish gray, very fine to fine sand, some to trace silt/clay 22.2-23') (wet). Forensic sample collected at 22'-23'.	CD-6B-S-20200625	1.0	10 10 16 14	310
24-26		MISSED SAMPLE. Advance casing to 25'.				
26-27	CL-ML	CL-ML; Dark brown, SILTY CLAY with trace fine sand (strong petroleum odor and staining) (moist), fine sand lenses (laminated) reddish brown mudstone (27')		1.4	4 5 11 13	7.9
27-28	SW	SW; Gray GRAVELLY SAND (wet) (strong petrolum odor/dark staining) coarsening downward (well graded sand and gravel) quartzite gravel in shoe (angular)				
28-30	SW	SW; Fining downward well graded SAND (saturated) (less gravel) (dark staining/strong petroleum)		0.7	20 13 14 16	373

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO:

Stantec

 CD-06B/AOI4-BH-20-04

DRILLING: STARTED **6/25/20** COMPLETED: **6/30/20**	*NORTHING (ft): **218689.2**
INSTALLATION: STARTED **--** COMPLETED: **--**	*EASTING (ft): **2684984.81**
DRILLING COMPANY: **Parratt Wolff**	*GROUND ELEV (ft): **--**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	*TOC ELEV (ft): **--**
DRILLING METHOD: **HSA; Mud Rotary**	INITIAL DTW (ft): **--**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	BOREHOLE DEPTH (ft): **48**
	STATIC DTW (ft): **Not Measured**
	WELL DEPTH (ft): **--**
	WELL CASING DIAMETER (in): **6**
	BOREHOLE DIAMETER (in): **8**
	LOGGED BY: **D Hopkins/A Klingbeil**
	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
30–32	SW	SW; SAME gray brown well graded SAND with trace silt and gravel (quartzite) (saturated) (petroluem odor, dark staining)		0.8	7 8 9 10	0.7
32–34	SW	SW; SAME fining downward, trace silt and rounded gravel (quartz) (strong petroleum odor)		1.3	9 12 12 12	1.6
34–36	SM	SM; Very dark gray to dark brown SILTY SAND with trace gravel (moist) (dark staining, slight petroleum odor) fining downard		0.5	12 14 16 11	1.3
36–38	SW	SW; Dark brown to brown SAND coarsening downward to a SANDY GRAVEL (quartzite) reddish brown sandy gravel at 36.9' bgs (moist to saturated in gravels) (slight degraded odor, swampy)		0.9	16 12 13 9	1.5
38–40	SP GWS	SP; Dark brown gravelly, fine to medium SAND with little silt (rounded) (wet) trace clay (slight organic or peaty odor) GWS; Dark brown, fine to medium SANDY GRAVEL with little silt (coarsening downward, rounded, gravels) (saturated)		0.8	7 9 11 12	--
40–42	GWS	GWS; SAME (saturated)coarser gravels, trace fines (gravels rounded and well graded quartz) well graded gravel (organic odor)		0.5	7 7 23 12	--
42–44	SP	SP; Gray to light gray, clean SAND (milky, saturated) (slight petroleum odor) Beaverdam-like sand. Temporary well screen installed and sampled 43.5-46'.		0.7	38 22 20 21	0.5
44–46	SP SM	SP; SAME (fining downward, medium sand to fine sand) (saturated) (slight petroleum odor) SM; Light grayish brown to grayish brown, fine SAND with little silt (saturated to wet) (very slight to no odor) brown sand in shoe	CD-6B-W-45.0-20200630	1.2	11 17 28 28	--
46–48	CH CH	CH; Very pale brown GRAVELLY CLAY, trace silt (wet) (rounded gravelly matrix) (medium plasticity) CH; Red, whtie and very light gray high plasticity CLAY (banded, mottled) (dry) (no odor)		1.5	6 8 10 13	0.5

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-06C/S-443**

Stantec

DRILLING: STARTED **7/17/20** COMPLETED: **7/21/20**	*NORTHING (ft): **218798.56**
INSTALLATION: STARTED **7/21/20** COMPLETED: **7/21/20**	*EASTING (ft): **2685093.32**
DRILLING COMPANY: **Parratt Wolff**	*GROUND ELEV (ft): **14.24**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	*TOC ELEV (ft): **16.2**
DRILLING METHOD: **HSA; Mud Rotary**	INITIAL DTW (ft): **--**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	BOREHOLE DEPTH (ft): **50**
	STATIC DTW (ft): **14.4**
	WELL DEPTH (ft): **49**
	WELL CASING DIAMETER (in): **2**
	BOREHOLE DIAMETER (in): **8**
	LOGGED BY: **D Hopkins**
	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0–2	ML	TOPSOIL Dark brown SILT with little CLAY (organic rich, leaves, roots, wood) (dry) (earthy odor)		1.55	1 5 6 7	0.1
	ML	ML; Brownish yellow and yellow laminated SILT with little CLAY (earthy odor) (dry)				
2–4	ML	ML; SAME (earthy odor) breaks along laminations (dry)		1.4	7 7 7 8	0.1
4–6	ML	ML; SAME (little to trace fine sand) (earthy odor) (dry)		1.5	4 5 5 4	0
6–8	ML	ML; SAME (with SAND) (earthy odor) (damp)		1.4	6 7 9 7	0
8–10	ML	ML; SAME (earthy odor) (micaceous) (dry to damp)		1.6	1 3 5 2	0.1
	SM	SM; Yellow brown, silty, fine SAND (earthy odor) (dry)	CD-6C (9') CD-6C-S-9.0-02200717			
10–12	SM	SM; SAME (fining downward) transition into clayey SILT with some fine SAND (no odor) (damp) Casing driven to 12'. Switch from HSA to mud rotary		1.5	12 14 14 12	0.1
12–14	ML	ML; SAME (brown to dark brown, clayey SILT wtih some fine SAND and GRAVEL) (no odor) (moist)		1.0	20 20 17 7	0.1
14–16	ML	ML; SAME (brown) (no odor) (wet)		0.6	19 20 20 13	0
16–18	SM	SM; Brown to dark brown SILTY SAND with GRAVEL (petroleum odor, dark staining) (saturated)		0.9	10 8 10 6	37.9
18–20	SP	SP; Yellow brown to dark gray, fine SAND (petroleum stained) (strong peroleum odor) (sheen) (saturated)	CD-6C-W-19.0-20200720	1.0	9 12 13 20	1058
20–22	SP	SP; Dark gray, fine SAND (very strong petroleum odor, dark staining, sheen) little gravel and dark red clay stone (saturated)		0.6	6 8 12 11	1070
22–24	SP	SP; SAME (dark gray fine SAND) (very strong petrolum odor, dark staining, sheen) (saturated)		1.3	11 10 10 10	208
24–26	SP	SP; Gray to brown, fine to medium SAND (very strong petroluem odor, staining, sheen) (saturated)		0.8	8 7 8 9	1234
26–28	SP	SP; SAME (grayish brown, SAND) (strong petroluem odor) (staining) (saturated)		1.0	8 9 8 10	290
28–30	SP	SP; SAME (fining downward, olive gray fine SAND with little GRAVEL) (strong petroluem odor, slight olive staining) (saturated)		1.0	8 6 8 8	15.8

Well Construction:
- Tremie Grout to surface
- 2" PVC Casing

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-06C/S-443**

PAGE 2 OF 2

Stantec

DRILLING: STARTED **7/17/20** COMPLETED: **7/21/20**
INSTALLATION: STARTED **7/21/20** COMPLETED: **7/21/20**
DRILLING COMPANY: **Parratt Wolff**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**
DRILLING METHOD: **HSA; Mud Rotary**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**

*NORTHING (ft): **218798.56** *EASTING (ft): **2685093.32**
*GROUND ELEV (ft): **14.24** *TOC ELEV (ft): **16.2**
INITIAL DTW (ft): **--** BOREHOLE DEPTH (ft): **50**
STATIC DTW (ft): **14.4** WELL DEPTH (ft): **49**
WELL CASING DIAMETER (in): **2** BOREHOLE DIAMETER (in): **8**
LOGGED BY: **D Hopkins** CHECKED BY: **A Klingbeil**
*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
30-32	SP	SP; SAME (fine to medium SAND) degraded petroluem odor) (saturated)		0.8	6 7 6 8	16.3
32-34	SP	SP; SAME (fine to medium SAND, slightly micaceous) color transition olive to olive gray (degraded petroleum odor) (saturated)		1.7	7 6 8 10	1.8
34-36	SPG	SPG; Grayish brown, fine SAND with some GRAVEL (slight degraded petroleum odor) (saturated)		0.4	9 12 9 12	5.6
36-38	SW	SW; Grayish brown coarse SAND (quartz sand) (slight degraded petroleum odor) (saturated)		0.3	12 9 9 9	5.4
38-40	SW	SW; Grayish brown SAND (well graded micaceous gravelly sand) (degraded organic odor) (saturated); olive silty clay laminations throughout (wet); red degraded mudstone present at 38.2-38.3' bgs (moist)	CD-6C-W-40.0-20200721	0.7	9 10 11 10	4.8
40-42	SP	SP; "Milky" bluish gray, fine SAND (very sligth degraded organic odor) (saturated) slightly micaceous		0.9	6 9 12 13	0.9
42-44	SP	SP; SAME (bluish gray fine SAND coarsening to a medium sand) little GRAVEL (saturated) (no odor); white clay (low plasticity) laminations (wet)		0.9	10 12 12 13	4.2
44-46	SP	SP; SAME (some coarse sand, more poorly sorted with depth) (no odor) (quartz sand) (saturated)		0.9	9 10 8 12	0.9
46-48	SW	SW; White SAND (well graded quartz sand) (no odor) white clay laminations throughout (low plasticity) (saturated)		0.8	6 7 7 9	2.1
48-48.5	SW	SW; SAME (includes angular quartz gravels) (saturated) (no odor)		1.2	4 6 6 9	3.1
48.5-50	CL	CL; Yellow, red and white (high plasticity) CLAY (dry) (no odor)				

Note: Temporary well screens set and sampled at 17.5-20' and 39.5-42'.

Well Construction: Bentonite Chips; #1 Sand; 2" PVC 0.010-inch screen

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-10/S-447**

Stantec

DRILLING: STARTED **6/22/20** COMPLETED: **6/24/20**	*NORTHING (ft): **219067.58**
INSTALLATION: STARTED **6/24/20** COMPLETED: **6/24/20**	*EASTING (ft): **2685199.6**
DRILLING COMPANY: **Parratt Wolff**	*GROUND ELEV (ft): **16.18**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	*TOC ELEV (ft): **18.68**
DRILLING METHOD: **HSA; Mud Rotary**	INITIAL DTW (ft): **--**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	BOREHOLE DEPTH (ft): **52**
	STATIC DTW (ft): **14.9**
	WELL DEPTH (ft): **46**
	WELL CASING DIAMETER (in): **2**
	BOREHOLE DIAMETER (in): **8**
	LOGGED BY: **D Hopkins/A Klingbeil**
	CHECKED BY: **J Kachel**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0		APPARENT FILL (tank berm stones/cinders)				
0.5–2		APPRAENT FILL (brownish yellow and yellowish brown CLAY/SILT, stones in shoe)		1.1	11, 7, 23, 22	0
2–3.5		APPARENT FILL (cinders, moist) possible cinder road bed		1.5	15, 10, 9, 5	0
3.5–4.5	CL	APPARENT FILL Dark brownish gray CLAY/SILT, trace brick, trace stone/cinders (damp)				
4.5–6		CL; Brownish gray and black CLAY/SILT, many fine dark mottles (damp) (slight odor) trace fine sand (slightly micaceous)		0.8	5, 2, 1, 2	19
6–8	CL	CL; SAME (clay, some very fine sand)		1.3	4, 5, 5, 5	111
8–10	CL	CL; SAME (brownish gray laminated SILT/CLAY, some to trace very fine sand) (moist) (sheen at 8.5' continues down core) (moderate petroleum odor)		1.2	2, 2, 3, 2	130
10–11	CL	CL; SAME (moist)	CD-10-S-3.0-20200622 500	1.3	7, 6, 8, 6	220
11–12	SM	SM; Reddish brown, very fine to fine SAND, little silt (silt content decreases with depth) (slightly micaceous) (moist)				
12–14	SP	SP; Grayish brown, fine to medium SAND little coarse sand, trace silt, brownish yellow, trace fine gravel (gneiss) (damp)		--	10, 12, 13, 11	18, 0.9
14–16		Missed sample. Casing set to 14'. Switch from HSA to mud rotary		--		
16–17	SM	SM; SAME (dark brown, fine SAND, little silt) (saturated)		--	6, 8, 10, 18	47, 36, 78.8
17–18	SP	SP; Dark yellowish brown, fine SAND, little medium sand, trace coarse to fine gravel (saturated)				
18–19	SP-SM	SP-SM; Grayish brown, fine SAND, some gravel (saturated)		--	10, 10, 11, 10	14
19–20	SP-SM	SP-SM; SAME (gray-brown, fine to medium sand) (saturated)				
20–22	SP-SM	SP-SM; SAME (coarsening downward, medium to coarse to fine sand, trace to no silt) slight odor		--	7, 8, 8, 8	36.2
22–23	SP-SM	SP-SM; SAME (saturated, sheen) brownish gray, medium to fine SAND, trace to no silt, little coarse sand		1.1	10, 11, 15, 21	297
23–24	GW-GC	GW-GC; Very coarse reddish brown-grayish brown, coarse to fine GRAVEL, some to trace clay/silt (moist to wet) little coarse to fine sand, slightly micaceous				
24–25.5	GM	GM; SAME (wet to saturated)		0.6	13, 11, 13, 9	230
26–28	GM	GM; SAME (wet) (large heterogeneous gravels, weathered mudstone) (very strong peteolrum odors)		0.7	10, 10, 15, 9	120
28–28.5	GM	GM; SAME (wet)				
28.5–30	SP-SM	SP-SM; Bluish gray, yellowish brown and gray, fine to medium SAND, little coarse sand, little fine gravel to very coarse gravel (in lenses)		0.8	10, 16, 10, 10	300

Well Construction: Tremie Grout to surface; 2" PVC Casing

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-10/S-447**
PAGE 2 OF 2

Stantec

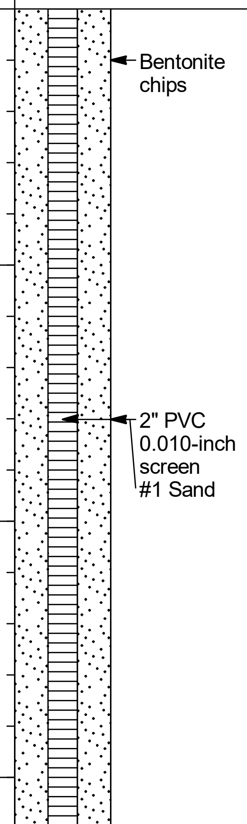
DRILLING: STARTED **6/22/20**	COMPLETED: **6/24/20**	*NORTHING (ft): **219067.58**	*EASTING (ft): **2685199.6**
INSTALLATION: STARTED **6/24/20**	COMPLETED: **6/24/20**	*GROUND ELEV (ft): **16.18**	*TOC ELEV (ft): **18.68**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **52**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **14.9**	WELL DEPTH (ft): **46**
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins/A Klingbeil**	CHECKED BY: **J Kachel**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
30-32	SP-SM	(stratified and stained) (saturated) trace to no silt in shoe (sheen)		1.4	8, 10, 12, 9	40
32-34	SP-SM; SP-SM; GP; SP	SP-SM; SAME (stratified layers, fine to medium, very coarse to coarse sand with pea gravel) (slightly micaceous) (very pale brown and yellow with depth) (saturated) (appears less impacted with depth) SP-SM; SAME (saturated) GP; Olive yellow GRAVEL layer		0.6	10, 15, 11, 13	21
34-36	SP	SP; White, fine SAND, some medium sand, trace coarse sand, little to no silt (saturated) yellow-pink grains ,trace heavy minerals		1.2	13, 10, 20, 24	99.9
36-38	SP	SP; SAME (34-34.1' white and brown clay stringer, slightly cemented) (moist, very pale brown and white, coarse to medium sand, trace to no silt, saturated)		1.0	14, 15, 14, 16	0
38-40	SP	SP; SAME (lenses of fine sand, trace to no silt (saturated) SP; SAME (yellow to brownish yellow, coarse to fine SAND, some very coarse to fine gravel) (pink, yellow and gray) (saturated) trace to no silt (slight odor)	CD-10-S-38.0-20200623 CD-10-W-38.0-20200623 37	1.3	15, 18, 23, 25	5
40-42	SP; SW	SP; SAME (slight petroleum odor) (saturated) SW; Brownish yellow-grayish brown, well graded SAND, little silt, gray silty clay rip up clasts and quartz gravel (slight petroleum odor) (saturated)		1.3	12, 13, 17, 20	1.9
42-44	SW; SW	SW; Brownish yellow and light brown, well graded, SAND with little silt (wet) (slight petroleum odor)		0.7	20, 21, 26, 35	0.4
44-46	SW	SW; SAME (gray silty clay, rip up clasts) (wet) (little to no odor) SW; SAME (brown yellow, well graded sand) coarsening downward (wet) (little to no odor)	CD-10-W-45.0-20200624	0.9	7, 9, 12, 14	0.7
46-48	SPG; SPG; CH	SPG; Light gray, coarse SAND and GRAVEL with some fine sand (saturated) some gray silty clay in shoe (milky)		0.5	11, 11, 11, 13	1.3
48-50	CH	SPG; SAME (light gray and gray, coarse sand and gravel) (quartz), some fine sand, light gray silty clay rip up clasts (saturated to wet) (no odor) CH; Light gray and red, high plasticity CLAY with trace silt (in shoe) (no odor) (dry)		1.1	2, 2, 4, 5	4.6
50-52		CH; SAME (light gray and red, high plasticity clay (damp to dry) (no odor)		1.8	5, 7, 11, 14	--

Note: Temporary well screens set and sampled at 36.5-39' and 43.5-46'

Well Construction



PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-12/S-446**
PAGE 1 OF 2

Stantec

DRILLING: STARTED **6/17/20**	COMPLETED: **6/19/20**	*NORTHING (ft): **219489.21**	*EASTING (ft): **2685467.61**
INSTALLATION: STARTED **6/19/20**	COMPLETED: **6/19/20**	*GROUND ELEV (ft): **16.88**	*TOC ELEV (ft): **19.54**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **46**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **15.54**	WELL DEPTH (ft): **46**
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins/A Klingbeil**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description
0		TOPSOIL
0.3	CL	CL; Brownish yellow SILT/CLAY (??? yellow mottles) trace very fine sand (dry to damp) little very fine sand (slightly micaceous)
2	CL	CL; SAME (damp))????, silt/clay and very fine sand) (laminated appearance)
4	CL-ML	CL-ML; SAME (moist) (laminated appearance) (silt and very fine sand, little clay, slightly micaceous)
6	CL-ML	CL-ML; Poor Recovery (same with little fine gravel mixed in) (moist)
8	CL-ML	CL-ML; SAME (moist)
8.5	SP-SM	SP-SM; Reddish yellow and strong brown, fine to medium SAND, little coarse to medium sand, trace very coarse to fine gravel, trace medium gravel, trace to no silt (damp)
10	SPG	SPG; SAME (lenses of medium to coarse fine gravel, heterogeneous gravel-red sandstone, quartzite) (damp)
12	SP	SP; Brown, very fine to fine SAND, trace medium sand, trace to no silt
13.2	SWG	SWG; Reddish yellow, fine to very coarse SAND, trace to no silt, some fine to medium gravel (red quartz, sub purple sandstone) (moist)
14.2	SWG	SWG; SAME (moist)
14.4	SM	SM; Reddish brown, very fine to fine SAND, little to some silt, slightly micaceous (wet, wet to saturated in shoe) trace clay
16	SM	SM; SAME (little fine to medium gravel, trace clay/silt clasts in shoe) (wet)
18	GM	GM; Strong brown, coarse to fine GRAVEL, some coarse to fine sand, trace to little silt (slightly micaceous) (saturated)
20	GM	GM; SAME (saturated)
20.5	SM	SM; Reddish brown to strong brown, very fine to fine SAND, trace medium sand, trace silt, trace fine gravel (saturated)
22	SM	SM; SAME (silty, clayey sand with depth) (saturated), rapid dilatancy
23	GM	GM; GRAVEL layer (wet)
23.3	SW	SW; Olive yellow, medium to coarse SAND, little very coarse sand, trace pebble trace silt (saturated) (slight petrolem odor)
24.5	GM	GM; GRAVEL
26	GM	GM; SAME (very coarse gravel) muddy matrix from weathered gravels (wet) (petroleum odor)
28		Note: soil sample was collected 25-26.5'. Missed sample. Switch from HSA to mud rotary. Casing driven to 30'.

Sample interval (feet)	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0-2		1.4	2, 5, 8, 5	0, 0
2-4		1.5	5, 6, 7, 7	0.1
4-6		1.4	1, 3, 3, 3	0
6-8		0.1	1, 6, 5, 6	0
8-10		0.8	2, 6, 8, 8	0, 0
10-12		1.1	4, 7, 8, 28	0.3
12-14		1.2	7, 7, 7, 5	0, 0
14-16		1.3	5, 5, 3, 5	0, 0
16-18		0.4	10, 18, 21, 12	0
18-20		1.0	9, 13, 14, 11	0
20-22		1.5	6, 4, 6, 4	0, 0
22-24		1.5	11, 36, 11, 8	0, 0, 0
24-26	CD-12-S-25.0-20200617 CD-12-W-25.0-20200618	0.6	8, 11, 11, 9	0, 0
26-28		1.3	10, 12, 14, 9	170

Well Construction: Tremie Grout to surface; 2" PVC Casing

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO:

CD-12/S-446

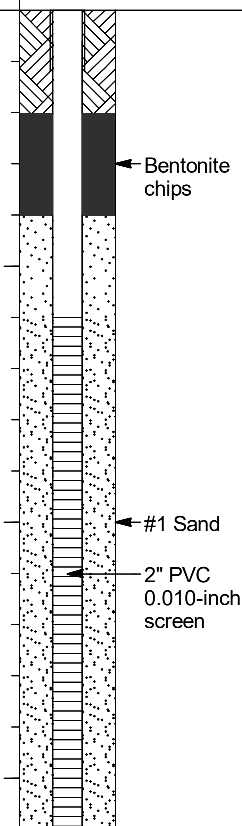
Stantec

DRILLING: STARTED **6/17/20** COMPLETED: **6/19/20**	*NORTHING (ft): **219489.21**
INSTALLATION: STARTED **6/19/20** COMPLETED: **6/19/20**	*EASTING (ft): **2685467.61**
DRILLING COMPANY: **Parratt Wolff**	*GROUND ELEV (ft): **16.88**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	*TOC ELEV (ft): **19.54**
DRILLING METHOD: **HSA; Mud Rotary**	INITIAL DTW (ft): **--**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	BOREHOLE DEPTH (ft): **46**
	STATIC DTW (ft): **15.54**
	WELL DEPTH (ft): **46**
	WELL CASING DIAMETER (in): **2**
	BOREHOLE DIAMETER (in): **8**
	LOGGED BY: **D Hopkins/A Klingbeil**
	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
30-30.7	GM	GM; SAME (very coarse, reddish brown, silty GRAVEL) (wet)		0.9	24, 16, 15, 17	29
30.7-32	SC	SC; Light gray and reddish yellow laminated CLAY/SILT and fine SAND, grades downward to clayey/silt and very fine sand, slightly micaceous (moist)				27
32-34	SC	SC; SAME (grades to clay, change to silty sand in shoe) (damp) (slight odor)		0.9	15, 12, 16, 21	21
34-35.1	CL	CL; SAME (white and reddish yellow laminated CLAY/SILT) (damp) (slight odor)		2.0	15, 27, 30, 36	0
35.1-36	SM	SM; Very pale brown, pale yellow and redddish yellow, very fine to fine SAND, little silt/clay grades to fine sand, trace to no silt (wet to saturated with depth)				0
36-38	SP	SP; SAME (pale yellow and white fine sand, little very fine sand, trace to no silt) (saturated)		1.4	-, 5, 9, 17	0
38-40	SP	SP; SAME (coarsens downward to medium to coarse sand) quartz gravels throughout (saturated) (slight odor) trace fine pea gravel to fine gravel		1.8	20, 25, 35, 36	0
40-42	SP	SP; SAME (saturated) (slight odor) (oxidation at 42')		1.0	4, 7, 1, 2	2.65
42-44	SP	SP; Fine to medium SAND poorly graded with depth (slight odor) trace silt (saturated)		1.7	18, 20, 24, 23	0
44-45	SP	SP; SAME (saturated) (slight odor) oxidation at 45'		1.9	18, 23, 25, 24	0
45-46	SP	SP; Pale gray and white, poorly sorted SAND	CD-12-W-45.0-20200619			
46		Note: Temporary well screens set and sampled at: 24.5-27' and 43.5-46'				

Depth scale: 31–59 feet



PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-13A/S-444**

Stantec

DRILLING:	STARTED **7/8/20**	COMPLETED: **7/9/20**	
INSTALLATION:	STARTED **7/9/20**	COMPLETED: **7/12/20**	
DRILLING COMPANY: **Parratt Wolff**			
DRILLING EQUIPMENT: **Truck-Mounted CME-55**			
DRILLING METHOD: **HSA; Mud Rotary**			
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**			

*NORTHING (ft): **218994.35**	*EASTING (ft): **2685451.31**
*GROUND ELEV (ft): **13.17**	*TOC ELEV (ft): **15.92**
INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **52**
STATIC DTW (ft): **11.85**	WELL DEPTH (ft): **48**
WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
LOGGED BY: **D Hopkins/A Klingbeil**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0–2		APPARENT FILL dark brown SILT with fine SAND organic material (roots,twigs) (dry) (no odor) FILL brownish yellow, fine SAND with SILT, micaceous, glass, brick fragments (dry) (no odor) layered horizontal breaks in core	1.6	8 12 10 6	0
2–4	SW-SM	SW-SM; Laminated SAND with SILT (dry) (no odor) brownish yellow to yellowish brown laminations	0.8	10 7 8 12	0.3
4–6	SW-SM SM	SW-SM; SAME (dry) (no odor) SM; Yellowish brown silty FINE SAND, little clay, fining downward, color change to brown and dark brown laminations at 4.6' bgs (dry) (no odor)	1.6	2 3 5 7	0
6–8	SM	SM; Dark gray, brown silty FINE SAND (trace to no clay) decreasing silt content with depth (dry) (organic odor, very slight petroluem odor)	1.3	7 5 7 10	2.1
8–10	SM	SM; SAME (dark grayish brown, fine SAND little clay and silt) (damp, moisture on ouside of spoon) (slight petroleium odor)	1.2	4 5 4 4	0
10–12	SM	SM; SAME (dark grayish brown, fine SAND little clay and silt) (lenses (0.1") dark brown sand) (well sorted, fine sand) (dry) (slight petroluem odor in sand, trace coarse to medium sand) round quartzite gravel in shoe	1.3	2 4 5 6	0
12–14	SM SPG SP SP	SM; SAME (dark grayish brown, fine SAND with little SILT) (dry, moistiure on outside of spoon) (very slight petroleum odor) SPG; Fine to medium quartz SAND and fractured round medium to coarse GRAVEL (quartzite and feldspar) (no odor) (moist) SP; Muddy fine SAND (saturated) fine to medium gravel with shale fragments in layer at bottom (no odor)	1.4	6 7 5 7	0
14–16	SP CL-ML SP	SP; Brown to grayish brown SAND (fine sand with little silt) (moist to saturated) (no odor) SP; SAME (saturated) (slight petroleum odor) CL-ML; Grayish brown to olive clay with trace silt (saturated) (low to medium plasticity) (petroleum odor) SP; Very dark graish brown SAND (fine to medium quartz sand with little to trace silt) (saturated) (strong petroleum odor, possible sheen)	1.7	6 7 8 7	74
16–20		NO RECOVERY Drive casing to 20': Switch from HSA to mud rotary.			
20–22	SP	SP; SAME [reddish brown and greenish gray, fine SAND, trace medium to coarse SAND, trace to no silt (saturated to wet)] (slighly micaceous) sand stratified with thin silty sand layers and coarse sand layers) (degraded petroleum odor)	1.1	7 12 12 9	161
22–24	SP	SP; SAME (slight glauconitic) (moistly fine sand) (in shoe, fractured green mudstone)	1.3	12 14 16 14	293 >500
24–	SP GP-	SP; SAME (saturated) GP-GM; Very coarse GRAVEL layer, fine pea		7 11	

Static water level marked at approx. 11.85 ft.

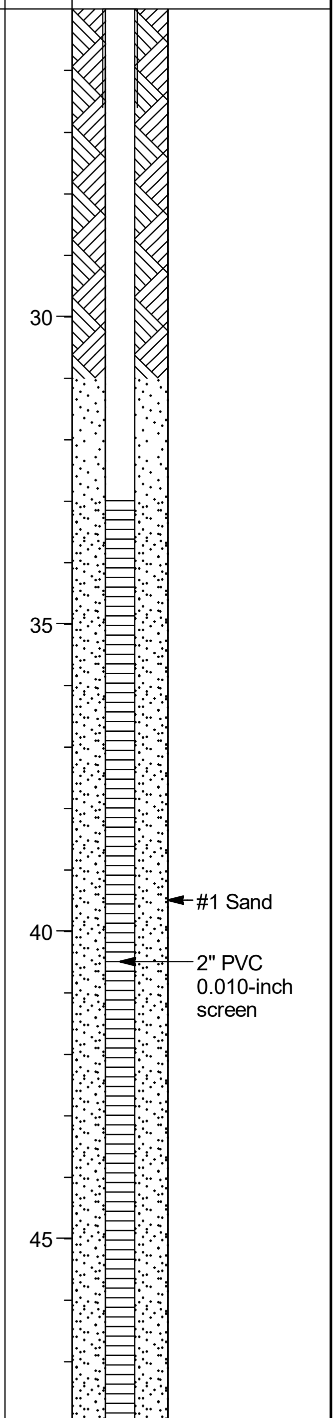
Well Construction: Tremie Grout to surface (from 10 ft); 2" PVC Casing

PROJECT: **PHRO - Corrective Measures Program**	WELL / PROBEHOLE / BOREHOLE NO:
LOCATION: **AOI 4 - Former Philadelphia Refinery**	PAGE 2 OF 3 **CD-13A/S-444**
PROJECT NUMBER: **213402602**	Stantec

DRILLING: STARTED **7/8/20** COMPLETED: **7/9/20**	*NORTHING (ft): **218994.35**	*EASTING (ft): **2685451.31**
INSTALLATION: STARTED **7/9/20** COMPLETED: **7/12/20**	*GROUND ELEV (ft): **13.17**	*TOC ELEV (ft): **15.92**
DRILLING COMPANY: **Parratt Wolff**	INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **52**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	STATIC DTW (ft): **11.85**	WELL DEPTH (ft): **48**
DRILLING METHOD: **HSA; Mud Rotary**	WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	LOGGED BY: **D Hopkins/A Klingbeil**	CHECKED BY: **A Klingbeil**
	*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88	

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
25–26	GM SP	gravel SP; Greenish gray, medium to fine SAND, some coarse, little very coarse and trace fine gravel (saturated, sheen present) (trace gray soft clay in shoe)	>7%	1.3	14 19	540
26–28	SPG SP	SPG; Greenish gray, very coarse to fine GRAVEL and coarse to fine SAND, trace silt (wet to saturated) (coarsening downward)		1.3	15 14 11 14	102
28–30	SP	SP; Light gray, white and yellow, fine SAND, trace to no silt, (saturated) SP; SAME (light gray and dark gray layers) (fine sand, trace to no silt) (saturated)		0.8	9 12 16 14	0.5
30–32	SP	SP; SAME (slightly micaceous) (transitions to reddish yellow) (saturated)		1.7	17 17 14 16	2.5
32–34	SP CL	SP; SAME (reddish yellow, fine SAND) (oxidized) (sturated) (little to no odor) CL; Yellow and light gray laminated CLAY, trace to no silt (folded laminations) (dry) (low plasticity) (no odor) saturated, white, fine sand in shoe		1.4	5 5 10 10	2.1
34–36	SP	SP; White to light gray, find SAND (saturated) (no odor) large quartz gravel plugged drive shoe preventing more recovery		0.35	20 26 16 27	0.8
36–38	SP	SP; SAME (light gray, fine SAND with dark gray bands) (saturated) yellow oxidation at 37.1' bgs (sligth degraded petroleum odor)		1.3	10 16 19 18	0.1
38–40	SP SW	SP; SAME (light gray and gray fine SAND) (saturated) coarsening downward and drcreasing sorting with depth (oxidation at depth) (very slight to no odor) SW; Reddish yellow (oxidized) well graded SAND (silica) (saturated) (very slight to no odor)	CD-13A-S-39.0-20200709 CD-13A-W-39.0-20200709	1.7	16 21 26 30	6.8
40–42	SW	(color change to dark gray at 39.5' bgs) light gray (low plasticity) sandy clay in drive shoe SW; SAME (reddish yellow well graded SAND) silica coarse sands (oxidation) (saturated) (slight bio/degraded odor)		0.7	12 15 17 16	6.5
42–44	SW CL SW-SC	SW; SAME (reddish brown well graded SAND) (saturated) (trace to no odor) white clay (low plasticity) lens (0.025') (damp) CL; Repeating layers of white low plasticity (damp) CLAY and reddish brown well graded SAND (saturated)		1.25	12 16 17 16	0.3
44–46	SW-SC SP	SW-SC; White to light gray SAND with CLAY (saturated) (trace to no odor) SW-SC; SAME [white to light gray SAND with CLAY (saturated)] decreasing clay content (red oxidation where clay is absent) (no odor)		1.1	9 12 16 19	3.3
46–48	SW-SC	SP; Sequences of light gray to gray, fine SAND (saturated) and light gray, low plasticity CLAY lenses (damp) (no odor)		1.8	17 19 26 31	1.6
48–50	CLS SW	SW-SC; Light gray SAND with CLAY (saturated) oxidation (reddish yellow and red) where clay is less present; light gray clay lenses (0-0.25') throughout (low plasticity) (damp) (no odor)		1.4	12 14 16 16	0.4

Well Construction



PROJECT: **PHRO - Corrective Measures Program**	WELL / PROBEHOLE / BOREHOLE NO:
LOCATION: **AOI 4 - Former Philadelphia Refinery**	PAGE 3 OF 3 **CD-13A/S-444**
PROJECT NUMBER: **213402602**	

DRILLING: STARTED **7/8/20** COMPLETED: **7/9/20**	*NORTHING (ft): **218994.35**	*EASTING (ft): **2685451.31**
INSTALLATION: STARTED **7/9/20** COMPLETED: **7/12/20**	*GROUND ELEV (ft): **13.17**	*TOC ELEV (ft): **15.92**
DRILLING COMPANY: **Parratt Wolff**	INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **52**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	STATIC DTW (ft): **11.85**	WELL DEPTH (ft): **48**
DRILLING METHOD: **HSA; Mud Rotary**	WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	LOGGED BY: **D Hopkins/A Klingbeil**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	Graphic Log	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)	Well Construction
		SW	CLS; Very pale brown, fine sandy CLAY (moist) (no odor)							
51		CH	SW; Reddish yellow, well graded SAND (oxidized) silica sand fining downard (slight bio/degraded odor), light gray, fine sandy clay lense		CD-13A-S-50.0-20200709 0.6	1.2	12 16 19 16	0		
52			SW; SAME [reddish yellow, well graded SAND (oxidized)] (saturated) (no odor)							
53			CH; White and red, high plasticity CLAY (dry) (no odor) red in shoe							
54			Note: Temporary well screen set and sample at 37.5-40'							
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PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-13B/S-445**

Stantec

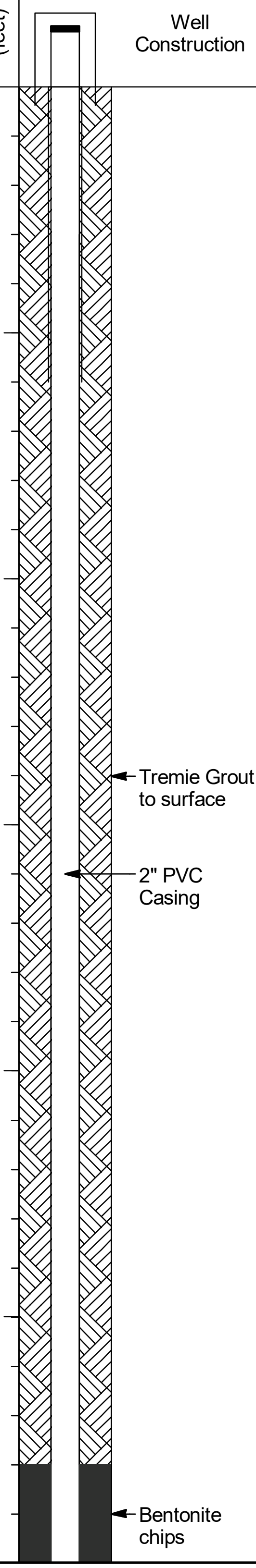
DRILLING: STARTED **7/1/20**	COMPLETED: **7/7/20**	*NORTHING (ft): **219178.04**	*EASTING (ft): **2685477.97**
INSTALLATION: STARTED **7/7/20**	COMPLETED: **7/7/20**	*GROUND ELEV (ft): **14.2**	*TOC ELEV (ft): **16.74**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **16.9**	BOREHOLE DEPTH (ft): **52**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **12.92**	WELL DEPTH (ft): **48**
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description
0–2	SM	SM; Light yellow brown to brown, silty, fine SAND (organic material, grass, roots) (dry) (no odor)
2–4	SP-SM	SP-SM; Light yellow brown, silty, fine SAND (dry) (no odor)
4–6	SP-SM	SP-SM; SAME (light yellow brown to brown laminations) (dry) (no odor)
6–8	SP-SM	SP-SM; SAME (trace clay) (dry) (no odor)
8–8.4	SP-SM	SP-SM; SAME (some quartz sand) more well sorted, little medium-coarse sand (slighly micaceous) (dry) (no odor)
8.4–10	ML	ML; Brown to yellow brown laminated silty CLAY, little fine sand (damp) (no odor) (medium plasticity)
10–12	SM	SM; Brown to dark brown, sitly CLAY with little fine SAND (dry) (no odor) fine sand lenses 10.3-10.6' (damp) dark brown clayey silt/gravel in shoe
12–14	SP	SP; Dark brown, clayey SILT with little fine SAND (moist) (no odor)
14–14.4	SP	SP; SAME (wet) fining into a silty CLAY (low plasticity) (no odor)
14.4–14.6	GP	GP; Dark brown to black GRAVEL (wet) (degraded organic odor) well graded gravel with sand (rounded to subangular)
14.6–16	SP	SP; Dark brown, fine to medium SAND (wet), well graded sand in show (quartz grains visible)
16–18	SW-SM	SW-SM; Dark grayish brown SAND with SILT, little gravels (rounded to subangular) (wet 16-16.6') (saturated 16.6-16.9') (no odor) coarsing downward to well graded gravel (quartzite) with sand Groundwater at 16.9'
18–20	GW	GW; SAME (dark grayish brown to dark gray, (well graded gravel with sand) (rounded to subrounded quartzite and subangular gneiss), gray clay rip up clasts in shoe
20–20.2	GW	GW; SAME (rounded quartzite) (saturated) (no odor)
20.2		Red and reddish brown CLAYSTONE (degraded) (damp) (no odor)
20.2–22	GW-GC	GW-GC; Light gray brown to dark brown GRAVEL with CLAY (sandy gravel with some silty clay matrix) (wet) (strange organic odor)
22–22.6	SW-SM	SW-SM; Brownish yellow SAND with SILT (well graded sand (fine to medium sand matrix, coarse sand to fine gravel) trace little silt (wet) (slight organic or degraded petroleum odor)
22.6–24	SP	SP; Grayish brown to brownish gray SAND (fine to medium sand) (wet) (organic or petroleum odor) little gravel (rounded medium)
24–26	SW	SW; Grayish brown well graded SAND (with gravel) (coarse, subangular to round, quartzite) (saturated) (strong petroleum odor)
26–26.6	SW	
26.6–28	CH	
28–28.5	CH	
28.5–28.8	SP-SC	
28.8–30	CH	

Sample Interval (feet)	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0–2		1.4	4, 6, 7, 4	0
2–4	CD-13B-S-3.0-20200701	1.4	2, 2, 5, 6	0
4–6		0.8	5, 4, 4, 9	0
6–8		0.1	4, 9, 13, 12	0
8–10		1.3	3, 4, 2, 4	0
10–12		0.6	6, 6, 6, 4	0
12–14		0.5	4, 21, 20, 4	0
14–16		0.9	6, 9, 9, 7	0
16–18		0.9	5, 5, 6, 9	0
18–20		0.4	8, 7, 5, 6	0
20–22		0.6	10, 5, 6, 7	0
22–24		0.9	7, 7, 7, 8	22.5
24–26		0.3	3, 7, 8, 11	572
26–28	CD-13B-S-26-20200706 (forensics) 3680	0.7	9, 11, 13, 11	130
28–30		1.2	6, 11, 10, 11	6.6

Well Construction



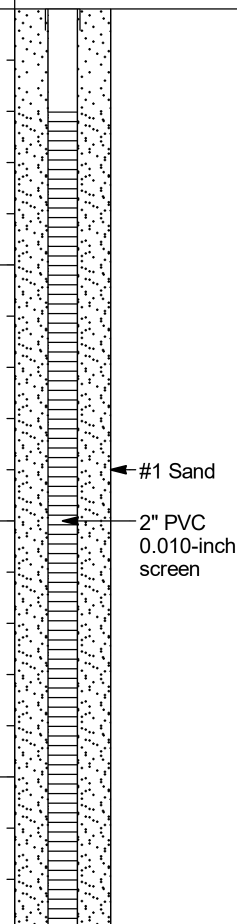
PROJECT: **PHRO - Corrective Measures Program**	WELL / PROBEHOLE / BOREHOLE NO:
LOCATION: **AOI 4 - Former Philadelphia Refinery**	PAGE 2 OF 2 **CD-13B/S-445**
PROJECT NUMBER: **213402602**	Stantec

DRILLING: STARTED **7/1/20**	COMPLETED: **7/7/20**	*NORTHING (ft): **219178.04**	*EASTING (ft): **2685477.97**
INSTALLATION: STARTED **7/7/20**	COMPLETED: **7/7/20**	*GROUND ELEV (ft): **14.2**	*TOC ELEV (ft): **16.74**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **16.9**	BOREHOLE DEPTH (ft): **52**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **12.92**	WELL DEPTH (ft): **48**
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins**	CHECKED BY: **A Klingbeil**
		*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88	

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
30-32	SP	SW; SAME (well graded sand with gravel) (saturated) (strong petroleum odor) (sheen) CH; Red and white, high plasticity CLAY (dry) (slight petroluem odor)		1.2	11 13 16 16	5
32-34	SP	CH; White and very pale brown laminated CLAY (medium to high plasticity) trace fine sand (dry) (very slight odor) SP-SC; White SAND with CLAY (poorly graded fine sand with little to some clay in matrix) (wet to saturated) (very slight petroleum odor)		NR	9 13 19 16	1.0
34-36	SP	CH; SAME as 28-28.5' (lower plasticity) (damp) (more white than very pale brown) (no petroleum odor) coarsening to clayey, fine sand		1.9	16 19 20 22	0.5
36-38	SP	SP; Light gray fine SAND with little CLAY (poorly graded) (wet to saturated with depth) (possible bio/degradation odor) (decreasing clay content with depth)		0.9	14 22 20 18	1.4
38-40	SP	SP; Pale brown to light gray fine SAND (wet to saturated with depth) (possible bio/degradation odor) very dark gray banding, trace rounded gravel, quartz sands		1.6	21 22 26 20	0
40-42	SP	SP; SAME (very pale brown and pale brown throughout) (wet to saturated with depth) (slight biodegradation odor) SP; SAME (saturated) (slight bio/degradation odor) "sugar sands" (fining downward)	CD-13B-W-40.0-20200707 3.0	0.8	17 24 26 32	0.3
42-44	SP	SP; SAME (saturated) (slight bio/degradation odor) (fining downard) pale brown to brown SP; SAME (saturated) (well sorted fine sand, light gray to white) (slight bio/degradation door)		0.9	49 41 50/ref	0
44-46	SP	SP; SAME (very pale brown to white, find sand) (saturated) (slight bio/degradation odor) SP; SAME (fine sand) (saturated) (slight bio/degradation odor)		0.8	7 9 16 24	0.1
46-48	SP	SP; SAME (fine sand) (very pale brown, light gray and white striations) (saturated) (slight bio/degradation odor) (micaceous)		1.4	25 34 48 58	0.2
48-50	SP CH	SP; SAME (dark brown, black, brownish yellow and very pale brown laminated sand, well sorted, fine sand) (satruated) (no odor) CH; Yellow and white mottled, high plasticity CLAY (dry) (no odor)		1.1	13 12 15 18	0.1
50-52	CH	CH; SAME (very pale brown and white to red mottled clay) (high plasticity) (dry) more red with depth		1.8	16 18 26 31	0

Note: Temporary well screen set and sampled at 37.5-40'. Water sample at 40' bgs included.

Well Construction

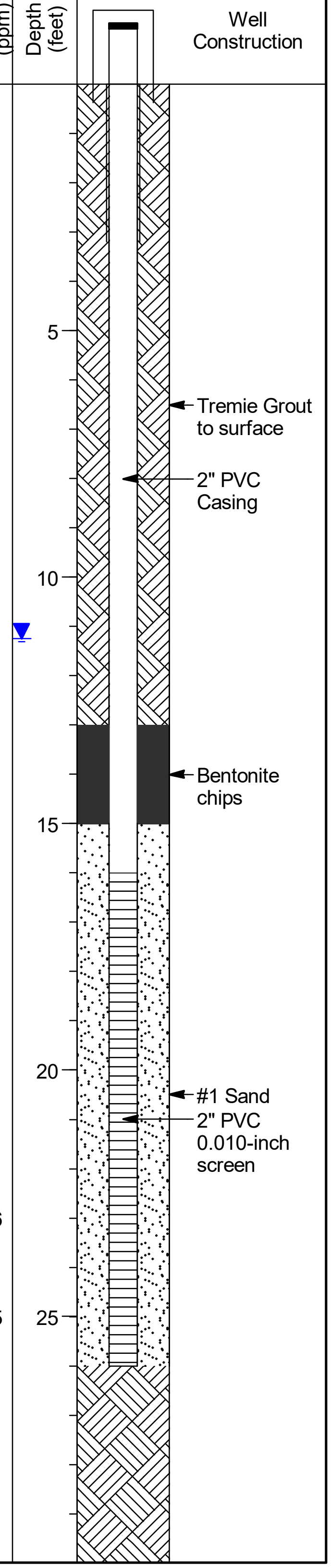


PROJECT: **PHRO - Corrective Measures Program**	WELL / PROBEHOLE / BOREHOLE NO:
LOCATION: **AOI 4 - Former Philadelphia Refinery**	PAGE 1 OF 2 **CD-14/S-448**
PROJECT NUMBER: **213402602**	Stantec

DRILLING: STARTED **8/11/20** COMPLETED: **8/12/20**	*NORTHING (ft): **218464.24** *EASTING (ft): **2685365.08**
INSTALLATION: STARTED **8/12/20** COMPLETED: **8/12/20**	*GROUND ELEV (ft): **12.65** *TOC ELEV (ft): **15.34**
DRILLING COMPANY: **Parratt Wolff**	INITIAL DTW (ft): **--** BOREHOLE DEPTH (ft): **46**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**	STATIC DTW (ft): **11.25** WELL DEPTH (ft): **26**
DRILLING METHOD: **HSA; Mud Rotary**	WELL CASING DIAMETER (in): **2** BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	LOGGED BY: **D Hopkins** CHECKED BY: **A Klingbeil**
	*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0–8		APPARENT FILL (gravelly silt with asphalt, brick, metal and concrete) (moist) (no impacts) Hydroex 0-8'				
8–10		FILL (brownish yellow silty clay with asphalt fragments and wood (saturated) (no odor)		0.4	2 2 4 3	0
10–12	SP	SP; Brown, silty, fine to medium SAND (saturated) (no odor)		0.3	2 2 1 1	
12–14	CLS	CLS; Very dark gray to grayish brown, fine SANDY CLAY with little silt (moist) (no odor)		1.0	1 1 3 3	0.1
14–16	CLS	CLS; SAME (saturated, no odor) Drive casing to 15': switch from HSA to mud rotary		1.4	5 5 4 3	0
16–18	CLS SW	CLS; SAME (wet) (strong petroleum odor, staining) SW; Dark gray, gravelly, well graded SAND with little to trace clay (moist) (strong petroluem odor, staining		0.7	15 20 30 20	150
18–20		No Recovery - very dark gray gravelly sand in drive shoe		0	14 13 10 16	85.6
20–22		No Recovery		0	21 17 18 20	0.2
22–24	SP	SP; Grayish brown, medium SAND (saturated) (very strong petroleum odor, staining) Groundwater sample at 23' included forensic analysis	CD-14-W-23.0-20200811	1.9		1576
24–26	SP	SP; SAME (fining downward) (saturated) (very strong petroleum odor, staining)		0.9	6 3 6 7	1075
26–28	SP	SP; SAME (fine SAND) (saturated) (strong petroleum odor, staining)		1.2	6 12 11 13	6.7
28–30	SP	SP; SAME (medium SAND) (saturated) (petroleum odor, staining)		0.5	6 5 8 7	1.7

Well Construction



PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-14/S-448**

Stantec

DRILLING: STARTED **8/11/20**	COMPLETED: **8/12/20**	*NORTHING (ft): **218464.24**	*EASTING (ft): **2685365.08**
INSTALLATION: STARTED **8/12/20**	COMPLETED: **8/12/20**	*GROUND ELEV (ft): **12.65**	*TOC ELEV (ft): **15.34**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **46**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **11.25**	WELL DEPTH (ft): **26**
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	Graphic Log	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)	Well Construction
31–32		SP	SP; SAME ; little subangular gravel, trace olive, silty clay (saturated) (petroleum odor, staining)			1.0	8, 10, 10, 12	5.7		Grout
32–34		SP	SP; SAME (brownish gray, olive tint, medium SAND (saturated) (petroleum odor, staining)			0.5	5, 9, 10, 10	4.9		Grout
34–36		SP	SP; SAME (brownish gray and olive brown, medium SAND, fining downward to dark gray fine SAND) (saturated) (slight petroleum odor, staining)			1.0	9, 12, 12, 16	0.4	35	Grout
36–38		SP	SP; SAME (dark grayish brown, fine SAND) (saturated) (slight petroleum odor, staining)			1.0	6, 9, 9, 12	2.6		Grout
38–40		SP	SP; SAME (saturated) (slight petroluem odor, staining)			1.0	13, 13, 14, 16	0.3	40	Grout
40–42		SP	SP; SAME olive gray (micaceouse, fine SAND) (saturated) (organic odor)			0.7	6, 16, 26, 32	2.0		Grout
42–44		SPG SC	SPG; Grayish brown and yellowish brown, well graded SAND and GRAVEL (subangular) (saturated) (no odor) SC; Brownish yellow to very pale brown, coarse CLAYEY SAND (wet) (no odor)			1.0	6, 6, 7, 10	2.3		Grout
44–46		CL CH	CL; Brownish yellow, gravelly CLAY (moist) (no odor) CH; Yellow, red and white mottled, high plasticity CLAY (dry) (no odor)			1.3	5, 5, 5, 8	3.3	45	Grout
46–47			Note: Temporary well screen set and sample 21.5-24'. Boring grouted 26-46'							
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49										
50									50	
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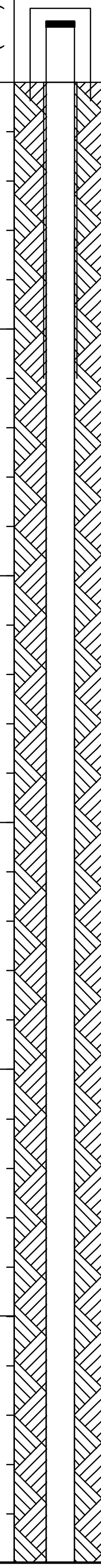
PROJECT: **PHRO - Corrective Measures Program**	ID:
LOCATION: **AOI 4 - Former Philadelphia Refinery**	PAGE 1 OF 3 **CD-14D/S-449**
PROJECT NUMBER: **213402602**	Stantec

DRILLING: STARTED **8/12/20**	COMPLETED: **8/13/20**	*NORTHING (ft): **218463.2**	*EASTING (ft): **2685360.11**
INSTALLATION: STARTED **--**	COMPLETED: --	*GROUND ELEV (ft): **12.28**	*TOC ELEV (ft): **15.25**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **87**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **12.84**	WELL DEPTH (ft): --
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins**	CHECKED BY: **A Klingbeil**
		*COORDINATE SYSTEM AND DATUMS: DE STATE PLANE SOUTH, NAD83; NAVD 88	

Depth (feet)	Graphic Log	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppb)	Depth (feet)	Well Construction
0–1			See log for CD-14/S-448 for lithology 0-46' bgs.							
1–2			Advance mud rotary to 44'. Casing driven to 45' bgs. Begin split spooning every 5' at 49' bgs.							
5									5	
10									10	
15									15	
20									20	
25									25	
29										



PROJECT: **PHRO - Corrective Measures Program**	ID:
LOCATION: **AOI 4 - Former Philadelphia Refinery**	PAGE 2 OF 3 **CD-14D/S-449**
PROJECT NUMBER: **213402602**	Stantec

DRILLING: STARTED **8/12/20** COMPLETED: **8/13/20**		*NORTHING (ft): **218463.2**	*EASTING (ft): **2685360.11**
INSTALLATION: STARTED -- COMPLETED: --		*GROUND ELEV (ft): **12.28**	*TOC ELEV (ft): **15.25**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **87**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **12.84**	WELL DEPTH (ft): --
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: DE STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	Graphic Log	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppb)	Depth (feet)	Well Construction
31–48									35, 40, 45	Tremie Grout to surface; 2" PVC Casing
49–51		CH	CH; White, red, yellow mottled, high plasticity CLAY (dry) (no odor)	X		1.8	5 5 13 15	1.0	50	
51–54										
54–56		CH	CH; SAME (dry) (no odor)	X		1.9	6 7 13 15	0.8	55	
56–59										
59		SP	SP; Yellow, very fine SAND with some clay in matrix (very compacted; moist; no odor)	X			49			
		SP								

GEO FORM 304 PHRO_AOI4_ADDENDUM_20210224.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/20/21

PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

ID: **CD-14D/S-449**

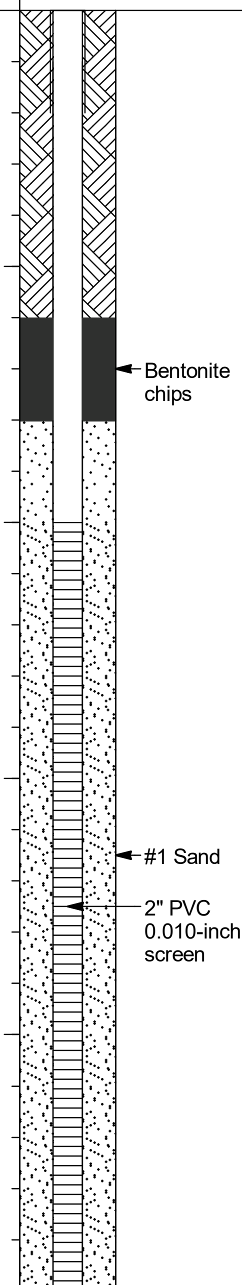
Stantec

DRILLING: STARTED **8/12/20**	COMPLETED: **8/13/20**	*NORTHING (ft): **218463.2**	*EASTING (ft): **2685360.11**
INSTALLATION: STARTED --	COMPLETED: --	*GROUND ELEV (ft): **12.28**	*TOC ELEV (ft): **15.25**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **87**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **12.84**	WELL DEPTH (ft): --
DRILLING METHOD: **HSA; Mud Rotary**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins**	CHECKED BY: **A Klingbeil**

*COORDINATE SYSTEM AND DATUMS: DE STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppb)	Depth (feet)
60–61	SP	SP; Light gray to white, very fine SAND with some powdery clay in matrix (very compact; moist; no odor)	6.2	0.7	50/1	0	
64–66	SP	SP; Light gray, white and yellow (oxidation), very fine SAND with little powdery, clay in matrix (wet; very compacted; no odor)		0.8	49 50/3	1.0	65
69–71	SP	SP; SAME (light gray and white powdery, very fine sand) (moist to wet; very compacted, no odor)		1.1	47 50/5	0	70
74–76	SP	SP; Red and light brownish gray, very fine SAND (very compacted; wet; no odor)		0.3	50/5	0	75
79–81	SP	SP; White, gray and yellow (oxidized) medium SAND (quartz) (saturated; very compacted; very slight organic odor)		1.0	45 45 50/5	0	80
85–87	SC	SC; Pale brown and light brownish gray, fine CLAYEY SAND with gravel (saturated; no odor)		0.5	50 70/5	0	85

Well Construction



PROJECT: **PHRO - Corrective Measures Program**
LOCATION: **AOI 4 - Former Philadelphia Refinery**
PROJECT NUMBER: **213402602**

WELL / PROBEHOLE / BOREHOLE NO: **CD-15/S-440**

Stantec

DRILLING: STARTED **6/16/20**	COMPLETED: **6/17/20**	*NORTHING (ft): **218486.8**	*EASTING (ft): **2684591.07**
INSTALLATION: STARTED **6/17/20**	COMPLETED: **6/17/20**	*GROUND ELEV (ft): **10.23**	*TOC ELEV (ft): **12.34**
DRILLING COMPANY: **Parratt Wolff**		INITIAL DTW (ft): **--**	BOREHOLE DEPTH (ft): **40.5**
DRILLING EQUIPMENT: **Truck-Mounted CME-55**		STATIC DTW (ft): **9.85**	WELL DEPTH (ft): **27**
DRILLING METHOD: **HSA**		WELL CASING DIAMETER (in): **2**	BOREHOLE DIAMETER (in): **8**
SAMPLING EQUIPMENT: **Split Spoon, Cuttings**		LOGGED BY: **D Hopkins/A Klingbeil**	CHECKED BY: **J Kachel**

*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description
0–1		APPARENT FILL (topsoil, brown silt, little clay, slightly micaceous (topsoil cap) (trace wood) damp
1–2	CL	CL; Brownish yellow SILT/CLAY, trace very fine sand, slightly micaceous (damp) (trace roots)
2–4	CL-ML	CL-ML; SAME brownish yellow SILT/fine SAND (damp) little clay (massive appearance coarsening downward reddish yellow to strong brown, very fine mottles)
4–6	CL-ML	CL-ML; SAME (poor recovery) (moist)
6–8		No Recovery. Trace concrete in spoon
8–8.5	CL-ML	CL-ML; SAME (moist)
8.5–10	SWG	SWG; Reddish yellow and strong brown, fine to coarse SAND and fine to coarse GRAVEL, trace little silt (wet at 8.5'), slightly micaceous gravels are mostly rounded quartz
10–10.5	SWG	SWG; SAME (saturated to wet)
10.5–12	SP	SP; Light brown, fine to medium SAND, little to some coarse sand, trace silt to no silt, gravel in shoe (saturated)
12–14	SP	SP; SAME (very pale brown to reddish yellow with depth), fining upward sequence, trace to no silt, mudstone gravel in drive shoe
14–14.2	SM	SM; Dark brown, fine to medium SILTY SAND with little clay
14.2–15	CLS	CLS; Dark brown, fine to medium, sandy CLAY with SILT
15–16	SP-SM	SP-SM; Fine to medium SAND with SILT and CLAY
16–17.5	SC	SC; SAME (saturated) CLAYEY SAND grading to CLAY
17.5–18	SP	SP; Gray/dark gray, coarse to fine SAND and GRAVEL (saturated) sharp break
18–20	SP	SP; Fine SAND (saturated), little medium sand, trace to no silt, coarsening downward
20–22	SPG	SPG; SAME (grayish brown, fine SAND, little coarse, (saturated) slightly micaceous (lenses of medium to coarse gravel)
22–24	SPG	SPG; SAME (gray) mostly medium to fine, trace coarse to pea gravel and fine gravel (trace to no silt) (<23'+/- strong brown cemented sand, slight petroleum odor), coarse gravel lenses
24–26	SP-SM	SP-SM; Light brown-reddish yellow, fine SAND, slightly micaceous, trace to little medium to coarse sand, trace to no silt, trace heavy minerals and glauconite (saturated) few very thin lenses with little to trace CLAY/SAND (laminated appearance)
26–27	SP-SM	SP-SM; SAME (reddish yellow and yellowish brown, fine SAND, little to some silt, trace clay (laminated appearance) (wet) gravel layer at contact
27–28	CL	
28–30	CL	CL; Dark gray and black CLAY/SILT, some lignite, trace fine to coarse sand, slightly micaceous (damp)

Sample interval (feet)	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Sample ID Method
0–2	1.7	1, 3, 4, 3	0	
2–4	1.5	2, 3, 6, 6	0	
4–6	0.5	6, 5, 14, 33	0.1	
6–8	0.0	6, 8, 11, 11	--	
8–10	0.9	10, 15, 9, 8	0	
10–12	0.8	13, 7, 7, 7	0, 0	
12–14	1.6	3, 4, 5, 6	0.1	
14–16	0.9	3, 3, 2, 2	0.1	CD-15-S-5.0-20200616
16–18	1.6	1, 2, 3, 4	0.1	
18–20	1.0	3, 2, 2, 3	0.1	
20–22	0.4	2, 6, 8, 6	0	
22–24	1.0	5, 3, 4, 5	0.1	
24–26	1.1	1, 2, 3, 4	0	CD-15-S-25.0-20200616 CD-15-W-25.0-20200616
26–28	1.3	9, 8, 7, 5	0	
28–30	1.4	5, 3, 3, 3	0	

Well Construction:
- Bentonite chips
- 2" PVC Casing
- #1 Sand
- 2" PVC 0.010-inch screen

PROJECT: **PHRO - Corrective Measures Program** LOCATION: **AOI 4 - Former Philadelphia Refinery** PROJECT NUMBER: **213402602**	WELL / PROBEHOLE / BOREHOLE NO: Stantec PAGE 2 OF 2 **CD-15/S-440**
DRILLING: STARTED **6/16/20** COMPLETED: **6/17/20** INSTALLATION: STARTED **6/17/20** COMPLETED: **6/17/20** DRILLING COMPANY: **Parratt Wolff** DRILLING EQUIPMENT: **Truck-Mounted CME-55** DRILLING METHOD: **HSA** SAMPLING EQUIPMENT: **Split Spoon, Cuttings**	*NORTHING (ft): **218486.8** *EASTING (ft): **2684591.07** *GROUND ELEV (ft): **10.23** *TOC ELEV (ft): **12.34** INITIAL DTW (ft): **--** BOREHOLE DEPTH (ft): **40.5** STATIC DTW (ft): **9.85** WELL DEPTH (ft): **27** WELL CASING DIAMETER (in): **2** BOREHOLE DIAMETER (in): **8** LOGGED BY: **D Hopkins/A Klingbeil** CHECKED BY: **J Kachel** *COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	Graphic Log	USCS	Description	Sample	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)	Depth (feet)	Well Construction
31		CL	CL; SAME (dark gray and brownish gray CLAY/SILT with lignite) (damp) CL; SAME (damp to dry)			1.3	2 4 6 8	0		
32–33		CL	CL; SAME (moist with wet lenses)			1.3	4 5 7 6	0		
34		CL	CL; SAME (wet)					0.1		
35		SM	SM; Light gray and white, medium to fine SAND, some coarse to very coarse sand, little pebbles to fine gravel, trace silt, slightly micaceous (wet)			0.4	10 3 5 4	0	35	
36–37		SWG	SWG; White, very pale brown and yellow (with depth) fine to coarse SAND, little very coarse sand, fine gravel, trace medium to coarse gravel, slightly micaceous (saturated) trace to no silt (few white clay/silt clasts)			1.1	2 3 4 7	0		Bentonite chips
38–40		SPG	SPG; SAME (white and reddish yellow with depth) (saturated) becomes coarse sand to very coarse sand (trace clay, little silt as grain coatings)		CD-15-W-40.0-20200617	0.5	6 10 8 6	0	40	
41			Note: Temporary well screens set adn sampled at 32.5 to 26' and 37.5 to 40.5'							
42–59									45, 50, 55	

PROJECT: **Belmont Terminal**
LOCATION: **Philadelphia, Pennsylvania**
PROJECT NUMBER: **213402797**

WELL / PROBEHOLE / BOREHOLE NO:
PAGE 1 OF 1 **ARCO-BH-21-01**

Stantec

DRILLING: STARTED **1/25/21** COMPLETED: **1/25/21**
INSTALLATION: STARTED COMPLETED:
DRILLING COMPANY: **Parratt Wolff**
DRILLING EQUIPMENT: **Geoprobe**
DRILLING METHOD: **Geoprobe**
SAMPLING EQUIPMENT: **4' Macrocore**

*NORTHING (ft): **221365.9** *EASTING (ft): **2685972.51**
*GROUND ELEV (ft): *TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **30**
STATIC DTW (ft): **Not Measured** WELL DEPTH (ft):
WELL CASING DIAMETER (in): **---** BOREHOLE DIAMETER (in):
LOGGED BY: **D. Hopkins** CHECKED BY: **J. Kachel**
*COORDINATE SYSTEM AND DATUMS: PA STATE PLANE SOUTH, NAD83; NAVD 88

Depth (feet)	USCS	Description	Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (ppm)
0	SM	SM; Dark brown, organic TOPSOIL, trace gravel (dry)				0
0.5	SM	SM; Yellowish brown to dark brown, organic TOPSOIL with little sandstone fragments (dry)				0
1.5	SM	SM; Yellowish brown, clayey SILT and fine SAND to yellowish brown, silty CLAY (fining downward) (dry)		3.3	N/A	0
4	CL	CL; Yellowish brown and pale brown CLAY with trace silt (laminated, mottled) (low plasticity) (moist to dry)		4	N/A	0
8	CL	CL; Yellowish brown, light gray and pale brown laminated CLAY with trace silt and fine sand (moist)		4	N/A	0
12	CL	CL; Pale brown CLAY with trace fine sand (low plasticity) (moist to dry)				2.5
13	SP	SP; Dark gray, fine SAND (dry, degraded petroleum odor) (stained)				35.7
13.3	SC	SC; Olive to dark gray clayey SAND and GRAVEL (pink and white sandstone fragments) (dry, very slight degraded petroleum odor)		3	N/A	2.5
16	SPG	SPG; Mulitcolored (yellowish brown, white, red, gray) fine to medium SAND and GRAVEL (quartz and claystone gravels) (dry)		4	N/A	2.6
20	SPG	SPG; SAME (red, pale gray and brown, white sand and gravel, trace fines) (dry, slight degraded petroleum odor)		1.5	N/A	17.6
24	SP	SP; Brown to yellowish brown, fine SAND with some gravel (saturated at 24.5' bgs) (oxidation)				0.6
25.2	SPG	SPG; Olive, gray, red, fine SAND and GRAVEL (increasing gravel content with depth) trace to little fines (saturated, degraded petroleum odor)		2.5	N/A	35.2
28	SW-SM	SW-SM; Brown to dark gray well graded SAND and GRAVEL, little silt Forensics soil sample 28-30'	ARCO-BH-21-01 (28-30')	2.0	N/A	1470