Stantec Consulting Services Inc.
1060 Andrew Drive, Suite 140, West Chester, PA 19380

January 31, 2017

Attention: Mr. C. David Brown, P.G.
Pennsylvania Department of Environmental Protection
Southeast Regional Office
2 East Main Street
Norristown, PA 19401-4915

Reference: Response to Report Comments
Remedial Investigation Report
Philadelphia Refining Complex AOI 1
3144 Passyunk Avenue, Philadelphia, PA 19145

Dear Mr. Brown,

On August 5, 2016, Stantec Consulting Services Inc. (Stantec), on behalf of Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC (Evergreen) submitted the *Remedial Investigation Report* (RIR) for Area of Interest (AOI) 1 at the Philadelphia Refining Complex (the complex). This letter presents a response to Report Comments, dated November 8, 2016, issued by the Pennsylvania Department of Environmental Protection (PADEP) regarding the AOI 1 RIR.

> ***Comment #1***: *"The groundwater characterization reporting did not include DSCP sampling data, in particular for wells on the CSX and Steen properties. Benzene is elevated in both areas (e.g., > 20,000 µg/L at Steen). MTBE also exceeds in this area, at shallow and deep levels, at < 100 µg/L. Recent (2016) data is available at DEP's office. Data in this area is particularly pertinent to the groundwater modeling. The DSCP petroleum is not known to contain MTBE, and the presence of MTBE east of 26th Street suggests migration from the refinery."*

Response to Comment #1: Evergreen is engaged in data sharing with the Defense Logistics Agency (DLA) regarding characterization and remediation activities at the former Defense Supply Center Philadelphia (DSCP) facility, and recently received results of the 2016 groundwater monitoring activities. Data sharing activities between Evergreen and DLA are planned to continue throughout the One Cleanup Program process. Relevant groundwater characterization results from the former DSCP facility will be presented in conjunction with data from the complex in future Act 2 submittals, including documentation of the groundwater numerical model.

Regarding the distribution of methyl tertiary butyl ether (MTBE) in groundwater proximal to the complex, Stantec, on behalf of Evergreen, intends to continue evaluating potential MTBE sources. Results of ongoing MTBE source evaluation will be included in future Act 2 submittals, as appropriate.

> ***Comment #2***: *"A December 2009 Aqui-Ver, Inc. "data summary report" for an investigation of the area around AOI 1 and DSCP included relevant data that was not described or referenced in the RIR."*

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Response to Comment #2: Stantec reviewed the December 2009 "Data Summary Report for Activities Performed in Accordance With: Work Plan for Data Collection in the Area of the Sunoco Point Breeze Refinery and the Former DSCP Facility, South Philadelphia, Pennsylvania" prepared by AQUI-VER, Inc. (AQUI-VER), as a part of historical file reviews during AOI 1 RIR preparation. Stantec's review of the AQUI-VER report primarily included evaluation of cone penetrometer test (CPT) boring logs for consideration of use in the AOI 1 geologic model (e.g., CPT-05 continuous core), depth profiles of laser-induced fluorescence measurements as a diagnostic tool to aid in the understanding of a "smear" zone beneath the No. 2 Tank Farm and offsite areas (limits of the AQUI-VER study), sediment grain size distributions for selected core samples, and 2009 dissolved benzene concentrations in groundwater. Groundwater sampling results were less applicable to the AOI 1 RIR, as samples collected during the study were limited to areas outside of AOI 1.

With regard to data usage in the AOI 1 RIR, Stantec evaluated the completeness and level of detail of available historical data for the period of record and chose to form opinions and draw conclusions primarily from the most detailed information available. The most robust groundwater analytical datasets for AOI 1 were available for the years 2004/2005 and 2014/2015. For the geologic model, Stantec found that the subsurface data indicated on well and auger boring logs installed within AOI 1 and vicinity typically included more detailed information than the CPT borings performed in the same areas. Although relevant data pertaining to residual light non-aqueous phase liquid (LNAPL) is presented in the AQUI-VER report, Stantec chose to utilize historical trends in LNAPL thickness and extent from well observations, total fluids recovery information from remedial system operational history, well pumping tests, and LNAPL transmissivity estimates from the monitoring and recovery well network as the primary means for delineating and understanding the current extent and potential for future migration of existing AOI 1 LNAPL plumes. Moving forward, Evergreen and Stantec anticipate considering and potentially utilizing data from the AQUI-VER report as a part of Cleanup Plan and groundwater numerical modeling activities.

> ***Comment #3***: *"Has there been a source investigation at the former Arco gas station property at 26th Street and Hartranft Street? Does Evergreen view groundwater contamination on that property as originating from the refinery or the UST system at the Arco facility? Who owns the Arco property, and who has the environmental liability for it? Should the groundwater plume be delineated southeast of the intersection of 26th and Hartranft Streets? Are monitoring wells to the southeast needed to calibrate the fate-and-transport model?"*

Response to Comment #3: The former ARCO property is owned by Sunoco, and Evergreen retains the liability. The former ARCO station was one of the numerous properties that were part of the 2009 AQUI-VER study. In addition, four monitoring wells were installed on the property in 2011. Soil samples collected from monitoring wells, summarized on Table 3-2 of the AOI 1 RIR, and field observations during drilling activities, included on boring logs in Appendix C of the AOI 1 RIR, do not indicate an onsite source for groundwater impacts. The wells are currently included in ongoing gauging and sampling efforts in conjunction with neighboring refinery characterization, and have generally been sampled on an annual basis since installation. Evaluation of the

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potential need for off-site calibration wells will be included in the groundwater numerical modeling.

> ***Comment #4***: *"In Figure 5-8 Stantec contoured the differential groundwater elevations using data from well pairs screened in the water table and deep aquifers. The figure indicates a large negative head differential, implying upward flow, along the 26th Street sewer around the Pollack Street sewer intersection. This appears to be almost entirely an artifact of the contouring, as there are no well pairs with such large head differentials (–2'). Also, the contours do not match some of the data (e.g., S-389D, S-390D). I suggest you remake the figure to show only the differential elevations at each location rather than contours."*

Response to Comment #4: A revised copy of Figure 5-8 is attached to this response letter. In the revised figure, two changes have been made: the colorized grid showing head potentials between the unconfined and lower aquifers has been removed, and at lower aquifer well locations S-389D and S-390D the paired wells S-205 and S-207 have been removed. Those wells should have been boxed in the figure to indicate that they were not utilized in contouring of the May 2015 dataset due to anomalous water-level elevations (i.e., interpreted to be influenced by perched groundwater within fill). In the attached version, alternative wells S-396 and S-403 have been included for the evaluation of head differentials between the aquifers defined in the RIR near those locations.

Although removed, it is noted that the grid originally presented in RIR Figure 5-8 did not represent an interpolation of differential groundwater elevations at well pairs but was the product of grid math (i.e., equidimensional grids were produced for both aquifers and the lower aquifer piezometric surface was subtracted from the water-table elevation surface at each grid cell). Stantec used this information on a conceptual level to evaluate the potential for vertical exchange of groundwater between the aquifers under current hydraulic conditions. Although the higher well density in the unconfined aquifer along 26th Street is largely responsible for the pattern shown (as opposed to higher heads in the lower aquifer), the potential for negative differentials of the magnitude estimated by the grids may exist. Evaluation of head potentials between aquifers in this area of the complex will continue and may be presented in future Act 2 submittals, as appropriate.

> ***Comment #5***: *"The low areas along 26th Street in Figure 5-8 appear to be a consequence of lower heads in the unconfined aquifer wells rather than higher potentials in deeper aquifer wells. So the apparent upward vertical gradient there may not reflect an influence of the 26th Street sewer line on the lower aquifer. (Compare Figures 5-6 and 5-7.)"*

Response to Comment #5: When viewed independently of the water table, the lower aquifer piezometric surfaces presented in RIR Figures 5-6 and 5-7 both show flow convergence or lower heads in proximity to 26th Street along the No. 2 Tank Farm when compared to the surrounding area. It is Stantec's opinion that the flow convergence in this area may be the manifestation of head losses in the lower aquifer due to leakage into the 26th Street Intercepting Sewer, either

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through direct losses to the sewer where the sewer construction could have removed the middle clay unit aquitard, or through vertical leakage from the lower aquifer to the unconfined aquifer through the middle clay unit where that aquitard is documented to be thin and relatively sandy. There also appears to be an upward vertical gradient within the lower aquifer near well S-42I (screened within the lower aquifer near the invert elevation of the sewer interceptor).

Monitoring of hydraulic head differentials between the water-table and lower aquifers at AOI 1 and vicinity, particularly in the area along 26th Street adjacent to the No. 2 Tank Farm, will continue. On behalf of Evergreen, Stantec has been continuously monitoring (through use of data loggers) water levels in selected wells to evaluate potential seasonal variability in aquifer water levels and associated head differentials. It is anticipated that some of the water-level monitoring data will be presented in the AOI 4 RIR.

> ***Comment #6***: *"A remedial investigation report must include a determination of "the present and future extent and fate of contaminants" [§250.408(a)]. DEP recognizes that Evergreen is preparing a site-wide fate-and-transport analysis that will satisfy this requirement with a future report."*

Response to Comment #6: A determination of the present and future extent and fate of contaminants beneath and adjacent to the complex will be estimated through use of a complex-wide groundwater numerical model, in accordance with PADEP requirements [§250.408(a)]. It is anticipated that the model will be presented to the PADEP in 2017 and that the final modeling results will be submitted to the PADEP following completion of the remaining AOI RIRs.

> ***Comment #7***: *"Stantec stated that the aquifer is not used in the vicinity of the refinery, but this was not documented in the report [§250.404(c)]. Previous reports may have included this information; if so, they should be cited. A future report should include a current survey for supply wells and an assessment of aquifer use."*

Response to Comment #7: A well search for water wells within a 1.0 mile radius of the complex using the Pennsylvania Groundwater Information System (PaGWIS) repository was performed on May 28, 2013. The results of that well search are presented in Appendix F of the *Final Report AOI 11*, dated June 21, 2013. The AOI 11 report concluded that there are no residential or agricultural water supply wells within the search radius (included review of a list of potable wells provided by the PADEP on May 28, 2013). Evergreen plans to update the 2013 well search and include findings in the Cleanup Plan and/or future Act 2 submittals, as appropriate.

> ***Comment #8***: *"As LNAPL is present near the property boundary southeast of Tank 121, benzene is substantially elevated in groundwater there, and there is significant offsite groundwater contamination to the east (Steen property), Evergreen should evaluate the need for resuming remedial actions in this area."*

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Response to Comment #8: A site-wide evaluation of active and inactive remediation systems will be performed as part of the Cleanup Plan. Evergreen continues to evaluate remediation along the eastern boundary of AOI 1, in addition to other areas of the complex. Any additional planned remedial action at the complex will be presented in future Act 2 submittals, as appropriate.

> ***Comment #9***: *"Testing and stability analyses of LNAPL indicated that it is mobile and may continue to migrate in most wells. This emphasizes the importance of continuing to monitor the well network, particularly at property boundaries and offsite, and to maintain (or establish) hydraulic control where appropriate."*

Response to Comment #9: The current monitoring program consists of quarterly liquid level gauging at select wells, annual liquid level gauging of available wells at the complex (included some offsite wells), and annual groundwater sampling of select perimeter monitoring wells. A complex-wide evaluation of the need for hydraulic control in specific areas where appropriate will be performed and presented in the Cleanup Plan.

> ***Comment #10***: *"From the description of the 26th Street North recovery system (Appendix F), it was unclear if the entire system is now winterized or only part of it. Please clarify."*

Response to Comment #10: The current configuration of the 26th Street Remediation System has components that may be susceptible to cold weather conditions.

In 2015, components of the 26th Street Remediation System were affected by winter conditions. The aboveground discharge piping includes a flow meter/totalizer and associated valves. The flow meter, which is used to measure system flow, was affected by the cold weather as the valves could not be actuated to record a current flow rate. Additionally, the receiver tank on the air compressor could not be drained because water in the tank froze while the system was turned off during routine maintenance and repairs to a manifold. However, neither of these components adversely affected the remediation system's ability to operate. During the winter of 2015-2016 (December 2015 to March 2016), the remediation system remained operational except for non-weather related occurrences, specifically routine maintenance to components.

> ***Comment #11***: *"Based on notations in past reports, there may have been a groundwater recovery system adjacent to the Pollack Street sewer (e.g., RW-110–112, S-46, S-162). Please explain if there was LNAPL/groundwater recovery from those wells with the history of operation. (If there were any other historic remedial systems in AOI 1, other than those described in Appendix F of the RIR, include information on them as well.)"*

Response to Comment #11: All recovery well systems within the comprehensive Pollock Street Sewer Total Fluids Remediation System typically have been reported with AOI 2. There was a LNAPL/groundwater recovery system that is physically located within AOI 1, which was previously referred to as the Pollock Street East End Vertical Well System, and included RW-110, RW-111, and RW-112. The current configuration of the Pollock Street Sewer Total Fluids Recovery System

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includes operation of horizontal recovery wells HW-1, HW-2, HW-3, as well as vertical wells in the Pollock Street West End System. The eastern termination of HW-3 is physically located in AOI 1. No other recovery system information was located regarding S-46, S-162, or any other historic remediation systems in AOI 1.

The Pollock Street East End Vertical Well System consisted of a network of 3 recovery wells installed in May 2003, which were originally named S-160, S-172, and S-173, but were re-named to RW-110, RW-111 and RW-112 respectively. Within each system recovery well, a QED Environmental Systems Model AP-4 AutoPump was installed to recover groundwater and LNAPL and the pneumatic pumps conveyed total fluids through a common discharge line to HW-3's discharge piping. Each well pump contained a liquid level control and would discharge independently in accordance with the recharge rate of the well. The combined discharge was pumped to a benzene National Emissions Standards for Hazardous Pollutants (NESHAP)-controlled sewer and processed through the facility's wastewater treatment plant. As such, the volume of LNAPL recovered by RW-110, RW-111, and RW-112 could not be quantified. Activities associated with the Pollock Street East End Vertical Well System were historically reported in AOI 2 submittals and recovery totals were included with the Pollock Street Sewer Total Fluids Recovery System. On May 26, 2010, the pumps were removed from the wells due to a lack of recoverable LNAPL.

> ***Comment #12***: *"The Sep 1993 GES report "Groundwater Assessment, Jackson Street Sewer, Pollack Street Sewer, and 26th Street Sewer" was not referenced in the RIR. Figure 6 in that document shows the base of the sewer at ~20' below grade, whereas the RIR indicated a ~15' depth. The circa 1919 plan in IST (1998, Appendix F) also shows a ~20' depth to the southwest of Tank 178."*

Response to Comment #12: The referenced 1993 Groundwater and Environmental Services, Inc. (GES) report was not reviewed by Stantec at the time of AOI 1 RIR preparation. Interpretation of the Pollack Street sewer construction was based solely on review of the circa 1919 plans obtained from the 1998 Integrated Science and Technology, Inc. (IST) report, as noted above. Based on those drawings, two ground surfaces are depicted in profile view. One appears to represent ground surface that existed along the sewer center line prior to construction, and the other appears to represent the anticipated post construction ground surface (solid line with crowned cross streets; a cut and fill surface). If the latter represents present day grade, then the Pollack Street Sewer invert depth may be nearer 15 feet. Evergreen and Stantec may evaluate the true invert depth of the Pollack Street Sewer beneath AOI 1 during Cleanup Plan activities, which would be needed for the qualitative fate and transport analysis in the groundwater numerical model (should that sewer be leaky).

> ***Comment #13***: *"Does groundwater infiltrate into the Pollack sewer within AOI 1? Explain how this is understood. If there is infiltration of contaminated groundwater, even if intermittent, then it must be accounted for in the assessment of impacts to the Schuylkill River [§250.406]."*

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Response to Comment #13: Stantec is not aware of any direct observations of groundwater infiltration into the Pollack Street Sewer beneath AOI 1. Groundwater losses to that sewer may be inferred at times through interpretation of water-table contours across the sewer, where they have been observed to slightly bend or "V" to indicate flow towards the 26th Street Intercepting Sewer by way of the intercepting chamber. A better understanding of the presence or absence of groundwater infiltration into the larger sewers beneath the complex is needed for the groundwater numerical model. An evaluation of the Pollack Street Sewer may be performed as a part of that process.

> ***Comment #14***: *"In the vapor intrusion evaluation portion of the report (Section 7) Stantec compares the indoor air sample results to DEP's forthcoming screening values. They justified using the nonresidential Statewide health standard screening values with the understanding that VI is the only potentially complete exposure pathway for the Inline Blender Building. This is not entirely consistent with DEP's VI guidance. As soil and groundwater will attain site-specific standards, site-specific standard VI screening values should be used. These may include either one-tenth of the Statewide health standard screening values or appropriately selected EPA RSL-based screening values (i.e., at a cancer risk of 10–5 and a hazard quotient of 0.1)."*

Response to Comment #14: Future Act 2 submittals will use the screening procedures established in the *Land Recycling Program Technical Guidance Manual for Vapor Intrusion into Buildings from Groundwater and Soil under Act 2* (VI Guidance) published November 19, 2016. Under the assumption that vapor intrusion is the only potentially complete pathway, indoor air sampling results will be screened to Environmental Protection Agency (EPA) regional screening level (RSL) screening values adjusted to a target cancer risk of 10^{-5} and a hazard quotient of 0.1, as suggested in Comment #14 and described in the newly finalized VI Guidance.

> ***Comment #15***: *"The maximum indoor air concentration of 1,2,4-TMB in the Inline Blender Building sampling was 6.6 µg/m3. This exceeds the site-specific standard VI screening value of 3.1 µg/m3. This result indicates that an inhalation risk assessment is required, with submittal of an Act 2 risk assessment report (which may be combined with the cleanup plan). Consider using EPA's VISL Calculator for this purpose. One alternative would be to utilize occupational criteria (OSHA PELs) with a covenant."*

Response to Comment #15: Concentrations of constituents of concern (COCs) in indoor air will be reevaluated against EPA RSL screening values at the time of the submittal of the Cleanup Plan. If COC concentration results exceed these screening values, the Cleanup Plan will present options to assess, eliminate, or control exposure to those COCs.

> ***Comment #16***: *"Potential vapor intrusion at the Steen and other offsite properties was not addressed in the report."*

Response to Comment #16: The potential vapor intrusion pathway for offsite receptors was not discussed in detail as Evergreen is not aware of any receptors or pathways located within

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proximity or separation distances, with the exception of the 26th Street and Packer Avenue sewers, as mentioned in Section 7.0 of the RIR. Evergreen currently maintains a mitigation system to address vapors within these sewers. Generally, direct volatilization of COCs could occur from soil, groundwater, or LNAPL. In soil, a horizontal proximity distance for petroleum hydrocarbons of 30 feet is established in the VI Guidance. Volatilization from a source in soil is not of concern offsite, and potential receptors are located greater than 30 feet from potential onsite sources in soil. The recently finalized VI Guidance establishes vertical proximity distances from a potential source to the foundation of an inhabited building of five feet for dissolved phase constituents. In areas adjacent to AOI 1, the depth to the water table from grade is significantly greater than five feet. The VI Guidance also establishes proximity distances for LNAPL of 30 feet in the horizontal direction and 15 feet in the vertical direction. As depicted in Figure 6-3 of the RIR, the extent of LNAPL is not observed within 30 feet of offsite buildings. Furthermore, during a gauging event performed in May 2016 and presented in the *Second Quarter 2016 Progress Report for the Former Defense Supply Center, Philadelphia Facility, Philadelphia, PA*, prepared by Arcadis, LNAPL was not detected in monitoring wells located on the Steen property and depth to water measurements, with one exception, were greater than 15 feet. In summary, Evergreen continues to mitigate vapors from the identified preferential pathways and direct volatilization from sources associated with AOI 1 to potential VI receptors is not of concern, based on proximity distances specified in the VI Guidance.

> ***Comment #17***: *"The cross section (Figure 5-1) indicates that a "muddy sand" might be correlative with the PRM Middle Clay (e.g., at S-388D and S-389D). Do Evergreen and Stantec believe the muddy sand unit was deposited at the same time as the Middle Clay, in a somewhat different environment? Or that it reflects a reworking of the PRM deposits by some later erosional event? Is the muddy sand likely to act as an aquitard, like the Middle Clay, or is it relatively permeable and able to exchange groundwater between the shallow and deep aquifers?"*

Response to Comment #17: Stratigraphic Profile A – A' (Figure 5-1 of the RIR) presents a straight line interpolation of available test boring log data using generalized lithologies that Stantec correlated with published geologic units in the area based on sequence and stratigraphic position. Greenman et al. (1961) presented an interpretation of the Raritan Formation depositional sequences, where the upper surface of the middle clay unit is described to have been eroded by younger streams following similar courses to those that incised the bedrock troughs identified in southern Philadelphia. Along 26th Street in the area of question, the bedrock surface dips steeply into the League Island Trough. The middle clay unit appears to be thin, which agrees with the published interpretation. As such, the muddy sand, which in places vertically homogenizes thinly-bedded deposits, more likely represents a reworking of the middle clay coupled with sediment transport of coarser-grained material (the upper sand unit) into the area.

The permeability of the muddy sand has not been directly measured in this area but can be inferred through evaluation of head potentials between the hydrostratigraphic units defined. Based on review of those data to date, Stantec's opinion is that the muddy sand in this area acts

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as an aquitard that may be subject to vertical leakage, resulting in semi-confined aquifer conditions in the lower aquifer. On behalf of Evergreen, Stantec will continue to evaluate aquifer hydraulic heads along the AOI 1 property boundary and may use that information to further refine the groundwater numerical model (e.g., model layer hydraulic properties).

Please let us know of any questions or additional comments you may have.

Regards,

STANTEC CONSULTING SERVICES INC.

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cc: Tiffani Doerr, Evergreen

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 and Defense Logistics Agency (DLA)
3. Labels denote groundwater elevation in feet. Depth to groundwater was measured in each well to the nearest one-hundredth of a foot using an interface probe.
4. Aerial: Image courtesy of USGS Earthstar Geographics SIO © 2017 Microsoft Corporation
5. Copyright© 2013 National Geographic Society, i-cubed Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation

Legend

- UNCONFINED AQUIFER WELL
- LOWER AQUIFER WELL
- APPROXIMATE LOCATION OF PHILADELPHIA WATER DEPARTMENT SEWER
- AREA OF INTEREST (AOI) 1
- BELMONT TERMINAL
- AREA OF INTEREST (AOI)
- FORMER DSCP PROPERTY

0 250 500 Feet

1:3,000 (At original document size of 24x36)

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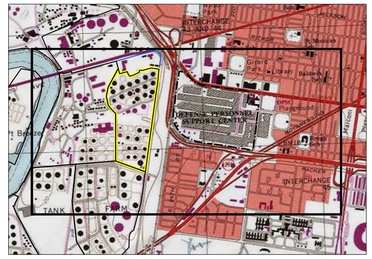

Project Location
Philadelphia Refining Complex
Philadelphia, Pennsylvania

213402434

Prepared by GWC on 1/9/2017
Technical Review by ADK on 1/9/2017
Independent Review by MN on 1/10/2017

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

Figure No.
5-8

Title
MAY 2015 HEAD POTENTIALS - UNCONFINED AND LOWER AQUIFERS