Philadelphia Energy Solutions (PES) Refining and Marketing LLC Complex

Remedial Investigation Reports Review

June 2020

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Acronym List/Glossary

AOI	Area of Interest; *subarea of the Site where individual environmental investigations have been completed.*
CAMU	Corrective Action Management Unit; *an area used for management of waste generated during remediation.*
COC	Contaminant of Concern; *chemical substances found in the environment that have harmful effects on people or the environment.*
EPA	United States Environmental Protection Agency; *a federal agency that oversees cleanup of contaminated sites, including this Site.*
IASHS	Indoor Air Statewide Health Standard; *PADEP indoor air standards.*
LNAPL	Light Non-Aqueous Phase Liquid; *a groundwater contaminant such as oil that floats on top of water and is present under the Site.*
MTBE	Methyl Tert Butyl Ether; *a volatile organic compound and contaminant found in groundwater under the Site.*
NIOSH	National Institute for Occupational Safety and Health; *a federal agency that works to prevent work-related injuries and illness.*
NIR	Notice of Intent to Remediate; *a notice submitted to PADEP that results in the facility entering into the Act 2 Program.*
OSHA	Occupational Safety and Health Administration; *a federal agency that sets and enforces standards and provides education to ensure safe and healthy working conditions.*

PADEP	Pennsylvania Department of Environmental Quality; *a state agency that is overseeing the remedial investigation and cleanup of the Site.*
PES	Philadelphia Energy Solutions; *the most recent operator at the Site.*
RIR	Remedial Investigation Report; *a report that describes all the data collected at a site to demonstrate that the environmental conditions at the property are known.*
SWMU	Solid Waste Management Unit; *a place where solid wastes have been placed or an area where solid wastes have been routinely released.*
VOC	Volatile Organic Compound; *compounds that easily become vapors or gases and represent a group of contaminants of concern (COCs) at the Site.*
SVOC	Semi-Volatile Organic Compound; *a subgroup of volatile organic compounds (VOCs) that are a group of COCs at the Site.*

Document Overview and Purpose

The former Sunoco Philadelphia Refinery, now known as the Philadelphia Energy Solutions Refining Marketing (PES) LLC Complex (Site) is located along the Schuylkill River in Philadelphia. EPA Region 3, the Pennsylvania Department of Environmental Protection (PADEP), and the city of Philadelphia have been working with Sunoco and Evergreen Resources Group, LLC (Evergreen) on remedial investigations of the areas of interest (AOIs) at the Site.

Sunoco has led groundwater cleanup at several areas of the Site since the 1990s. Evergreen has looked at soil and groundwater contamination on and next to the Site. Findings from these studies are in several remedial investigation reports (RIRs). Sunoco has also prepared two risk assessment reports. PADEP has approved completed RIRs for eight AOIs, including AOIs 1, 2, 3, 5, 6, 7, 8 and 10.

This report provides information on the Site and the RIR process. It covers contaminants of concern, future land use scenarios, and PADEP non-residential standards for soil and groundwater. It also shares key findings from the eight RIRs for AOIs 1, 2, 3, 5, 6, 7, 8 and 10. It also discusses common cleanup methods at refinery sites. The report's goal is to help nearby residents, businesses and organizations better understand contamination at the Site, how it could affect them, and what to expect for future site investigations and cleanup. [1]

[1] EPA's Technical Assistance Services for Communities (TASC) program provided this report under contract #EP-W-13-015 with contractor Skeo. EPA's TASC program funded the report. Its contents do not necessarily reflect the policies, actions or positions of EPA.

Site Background

Location and Current Status

The 1,400-acre Site is located along the east and west banks of the Schuylkill River in Philadelphia. Residential, commercial and other industrial properties surround the Site. The refinery made fuel and petrochemicals for the chemical industry. Its operations resulted in soil and groundwater contamination. In June 2019, after a production unit explosion, PES stopped operations and filed for bankruptcy.

During the refinery's operations, it was the largest single source of air pollution in Philadelphia, emitting 9% of the city's fine particle emissions, 20% of the city's greenhouse gas emissions and 470,000 pounds of air toxics each year. Since the refinery has stopped operating, the area's air quality is expected to improve significantly. It is possible that these air quality improvements will be long lasting. Recent news reports indicate that the developer expected to purchase the property has no plans to restart the refinery. Instead, Hilco Development Partners plans to redevelop it as a light industrial park reliant on its highway, rail, sea and pipeline connections. Site studies and cleanup preparations are ongoing.

Operational and Regulatory History

The Atlantic Refining Company started operating an oil distribution center on the property in the 1860s. The facility processed, transported and stored petroleum. In the 1900s, crude oil processing began. Full-scale gasoline production started during World War II. In addition to refining crude oil, the facility produced various chemicals such as acids and ammonia.

Sunoco purchased the facility in 1988. Environmental investigations took place at the Site during the 1980s and 1990s. In 2003, to better manage site investigations, the Site was divided into 11 AOIs. AOI 11 includes deep groundwater under the Site and surrounding areas. Figure 1 shows AOIs 1 through 10; AOI 11 is located under the Site.

Several remediation systems are in place throughout the Site to protect human health and the environment. These include recovery systems, which pump contaminated material and water out of the ground, barriers under the ground that get rid of vapors at the surface, systems that inject air into the ground to clean up groundwater, and venting systems that capture vapor and treat it. There are currently 10 remediation systems operating at the Site. Current remediation systems are detailed in Appendix A.

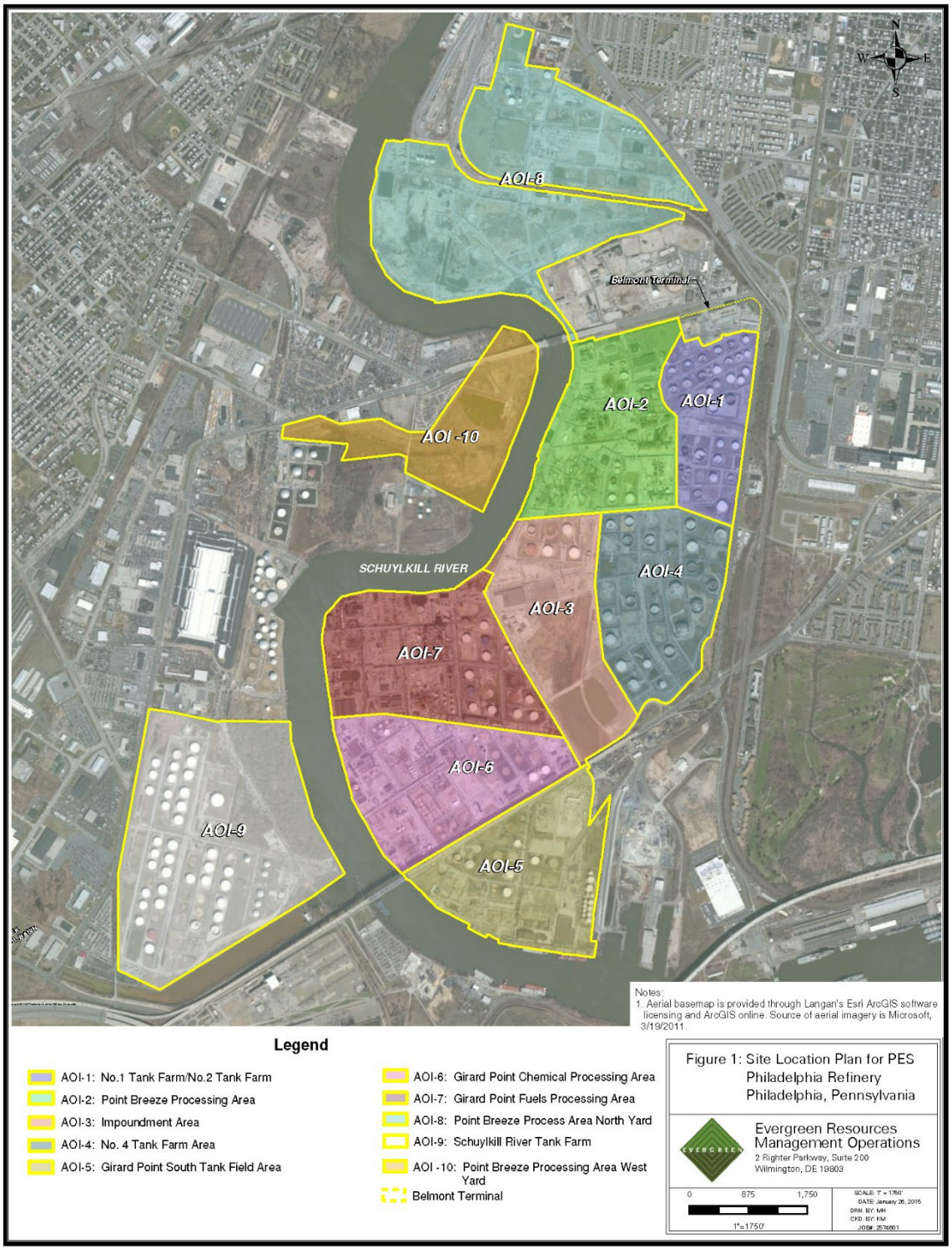

Figure 1. PES site map (Source: Evergreen)

Environmental investigations for each AOI took place through the PADEP Act 2 cleanup program. The Act 2 process starts with a Notice of Intent to Remediate (NIR). Sunoco submitted the NIR in 2006. In 2013, remediation liability transferred to Evergreen. Evergreen prepares the RIRs. This is the current stage of the Act 2 process at the Site. RIRs have been completed for AOIs 1, 2, 3, 5, 6, 7, 8 and 10.

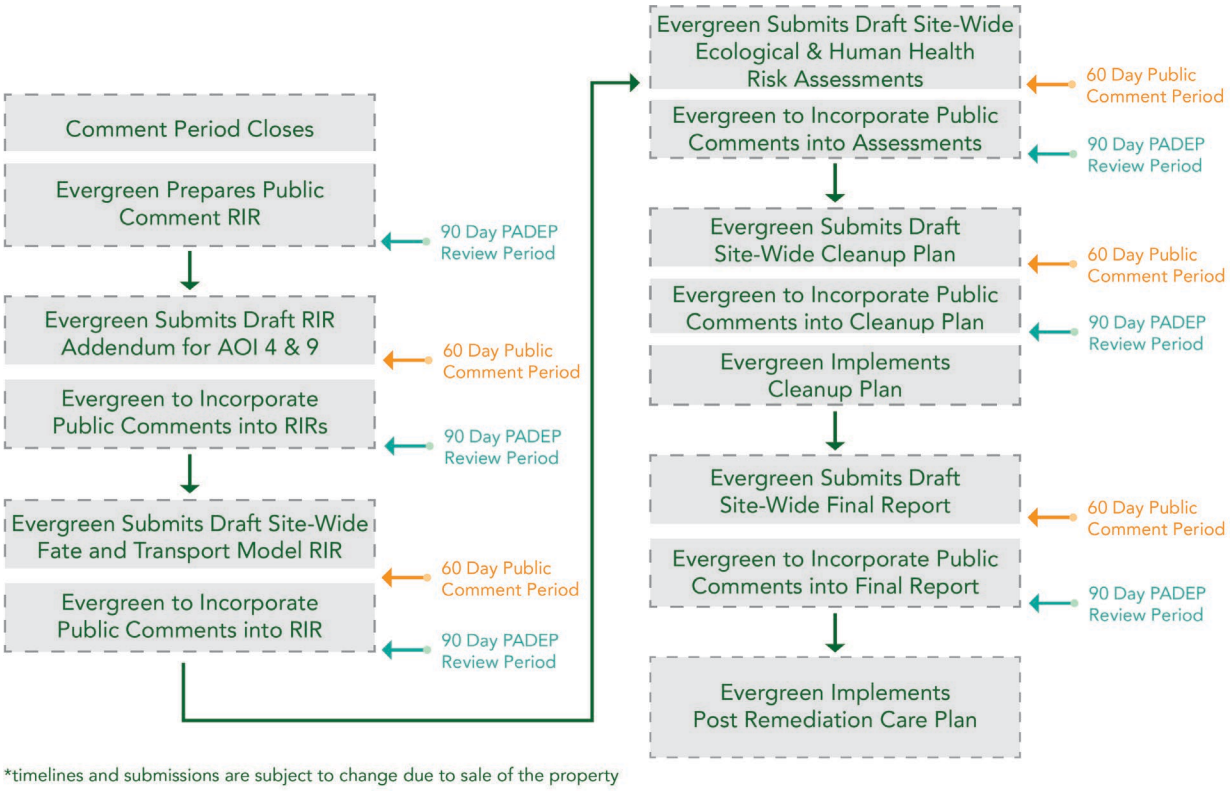

Figure 2. Act 2 Process at the Site

After completion of the remaining RIRs for AOIs 4 and 9, Evergreen will submit a draft study for the entire Site including AOI 11 (i.e., sitewide) that describes how chemicals move through the environment at the Site and what happens to the chemicals as they move. This is referred to as a fate and transport model. Some RIRs also included fate and transport modeling, and these results will be incorporated into the sitewide model. Evergreen will also submit a sitewide study to EPA and PADEP that describes the possible risks that chemicals found at the Site may have on human health and the environment. This is referred to as an ecological and human health risk assessment (Figure 2).

Potential Pathways and Active Threats

Researchers have found that people living near refineries face increased rates of respiratory illness. At the Site, while the area's air quality is expected to improve rapidly due to the refinery's

shutdown, the contamination left behind in the soil and groundwater will require long-term cleanup. Cleanup should protect future users of the site property and keep the contamination from moving into groundwater. The refinery's pollution may affect an area of underground water (i.e., an aquifer) used by the state of New Jersey for drinking water.

Cleanup activities can sometimes have negative effects on nearby residents. These effects may include truck traffic, noise and dust. *Community members may want to ask EPA and PADEP how the cleanup will minimize these effects.* For example, use of the refinery's seaport and rail connections for transporting equipment used for cleanup and to remove contaminated soil from the Site could provide a way to minimize truck traffic through the community. Assuming the refinery remains shut down permanently, the structures will need to be dismantled safely. Cleanup will need to include properly handling and disposing of building materials that contain asbestos. Monitoring of components will be needed to make sure flammable materials posing a risk to workers or surrounding communities through fire, explosion or off-gassing are not present.

RIR Process

An RIR is a report. It describes all information collected for an AOI documenting environmental conditions in the area. This process is called "characterization." Act 2 program requirements guide the remedial investigation process. After submittal, EPA and PADEP review each RIR. PADEP then responds with an approval or rejection letter. The letter specifies if the RIR meets Act 2 program requirements.

Fate, Transport and Conceptual Site Model

Fate: how chemicals break down in the environment.

Transport: how chemicals travel through the environment.

Conceptual Site Model: a model that provides an overall picture of what and where contamination is located, fate and transport, and how people and the environment are exposed to contamination.

Each RIR has the same basic structure. It includes an introduction and background section that summarizes operations, regulations, standards and chemicals of concern. The RIR then covers the AOI's environmental setting, characterization, fate and transport, and Conceptual Site Model. The RIR for each AOI differs due to differences in each AOI's physical and operational conditions. The next section of this report discusses common elements across the AOIs.

Sitewide Considerations for the RIRs

Environmental Setting

This part of each RIR describes general environment conditions across the AOIs, including below ground. Environmental media at the Site include soil, groundwater, surface water, sediment and air. Surface water includes on-site features such as ponds, as well as parts of the Schuylkill River that could be affected by contamination. Soils include surface soil (on the surface and generally less than 2 feet deep) and subsurface soil (from 2 feet down to the level of groundwater). Groundwater is water in the subsurface. This subsurface groundwater occurs in different units, often separated by layers of clay or silt.

The Site is located in a generally low-lying and fairly flat area. A layer of fill material is under the Site. Below the fill is peat and sand (close to the river) and some layers of gravel and mud (moving away from the river). Groundwater generally occurs in two units: the water table aquifer (shallow) and the lower aquifer (deep). In some places, an aquitard, a zone that prevents groundwater flow from one aquifer to another, separates these zones. However, in some areas of the Site, the aquitard is not present. In these areas, the water table and lower aquifer are hydraulically connected, meaning that groundwater can move between the zones (see Figure 3).

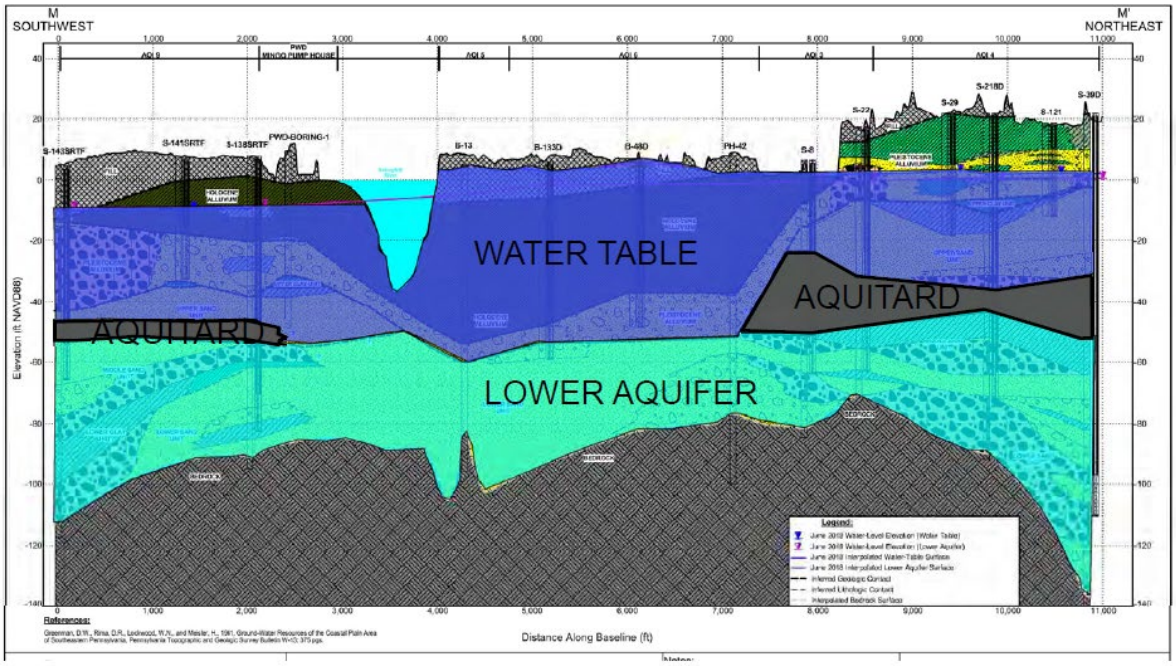

Figure 3. Hydrogeologic layers at the Site (Source: Evergreen)

Current and Future Use Scenarios and Assumptions

The Site is currently unoccupied. In the future, the Site will be used for industrial or commercial activities. The Site is not expected to ever be in residential use. For the purposes of characterization and cleanup planning, the Site's remedy will be protective for non-residential purposes (such as industrial and commercial uses) after cleanup. The Site's anticipated remedy will not be protective for residential use.

Standards

Act 2 standards are the concentrations of contaminants in soil or groundwater that are used in the development of a cleanup plan. They can be residential or non-residential, based on current or future use of the property. The standards for all areas of the Site are based on Act 2 non-residential statewide health standards for soil and groundwater. For the final cleanup, the remediator selects the standard to achieve at the Site. EPA and PADEP oversee the cleanup to ensure the standard is met appropriately.

There are three types of Act 2 standards:

Background: based on conditions in areas that are not affected by site contamination.

Statewide: established by PADEP.

Site-specific: calculated based on a risk assessment for the Site or based on pathway elimination.

In 2015, a human health risk assessment established a site-specific standard for lead in soils. If a sampling result is below the standard, more investigation is not required under the Act 2 regulation. If a sampling result is above the standard, more samples are collected until delineation is achieved (see description in the next section). Air sample results were compared to different standards, including PADEP Indoor Air Statewide Health Standards (IASHS) vapor intrusion screening levels, Occupational Safety and Health Administration (OSHA) screening levels, and National Institute for Occupational Safety and Health (NIOSH) standards, as well as EPA regional screening levels. EPA regional screening levels are generic values based on information about risk, exposure and toxicity for individual chemicals, to help determine if areas, contaminants, and conditions require further federal attention.

Site Characterization and Delineation Status

The RIRs discuss the investigation results in terms of whether contamination has been "delineated" and "characterized." The box to the right explains what these terms mean.

All contamination at the AOIs has been characterized. All soil contamination has been delineated. Areas of groundwater and LNAPL contamination have yet not been delineated. Additional investigations and modeling for groundwater and LNAPL contamination will be part of an upcoming Act 2 report.

Delineation versus Characterization

Delineated: a chemical was detected in a sample above the standard, additional samples were collected surrounding the initial sample, and the results around the initial sample were below the standard. Under these circumstances, the contaminated area has been "delineated."

Characterized: when environmental conditions are identified through sample collection and analysis.

Characterization and Contaminants of Concern (COCs)

To characterize, or investigate, the contamination in each AOI, four types of environmental samples were collected and analyzed. An overview of the sampled media is listed below. Figure 4 provides a visual representation of the sampling methods.

- *Light Non-Aqueous Phase Liquids (LNAPLs)* – oil refineries often leaked or spilled gasoline and other petroleum products onto the ground. This contamination is called free product. Certain types of free product are lighter than water, so they float on top of the groundwater. They are called LNAPLs. Groundwater and soil that comes into contact with free product becomes contaminated. Each RIR states if LNAPL is present in the AOI, its location and movement (if any), and the status of its removal or treatment.

- *Soil* – subsurface and surface samples were collected across the Site. The samples were compared to Act 2 standards or the site-specific standard for lead.

- *Groundwater* – samples were collected from wells and the results were compared to Act 2 standards (Figure 4).

- *Vapor Intrusion* – the movement of chemical vapors from contaminated soil and groundwater into nearby buildings. Indoor air samples (from occupied buildings), outdoor air samples (from above LNAPL areas) and ambient outside air samples (i.e., air samples determined to not be affected by site contamination) were collected from most AOIs.

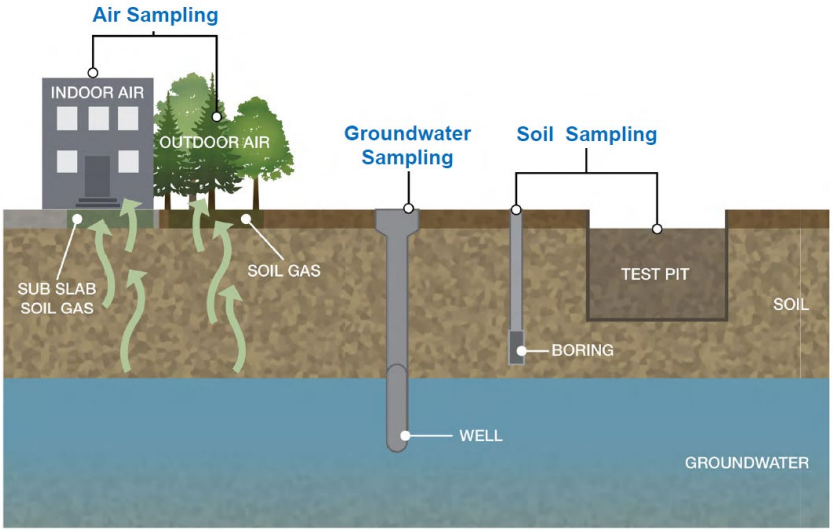

Figure 4. Methods of sampling (Source: Evergreen)

Site contaminants of concern (COCs) are mostly the same across the AOIs (Table 1). COCs are chemical substances found in soil, groundwater, surface water, sediments or air that have harmful effects on people or the environment.

The COCs include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and lead. AOI 10 has a larger list of COCs separated out by groundwater, soil, sediment and surface water.

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 tert 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

Table 1. AOI 1 COCs (Source: Evergreen)

Sitewide Characterization

This section summarizes the results of completed investigations at the Site. Table 2 below describes the environmental media (soil, groundwater, LNAPL) sampled for each AOI, whether the environmental media have been delineated and any related follow-up actions. For groundwater, only the water table aquifer results are shown in Table 2. The table also does not include air sampling results, as vapor intrusion (the movement of chemical vapors from contaminated soil and groundwater into nearby buildings) will be part of the upcoming human health risk assessment. While some areas have not been delineated, per Act 2 guidance, all areas have been characterized. Appendix A provides a more detailed summary of each AOI and the remedial investigation results.

Table 2. RIR Status Summary

AOI	Media	Delineation Yes/No/Not Needed*	Follow-up Actions
AOI 1	**Surface Soil**	Yes	Soil from locations above standards will need further evaluation or remediation.
	Subsurface Soil	Not needed	None specified
	Groundwater	No	Benzene and methyl tert butyl ether (MTBE) contamination extends off site. Further characterization is needed. It will be part of the upcoming fate and transport Act 2 report.
	LNAPL	No	LNAPL has been observed off site to the east and northeast and will continue to be monitored. Fluids recovery is ongoing in this area.
AOI 2	**Surface Soil**	Yes	None specified
	Subsurface Soil	Not needed	None specified
	Groundwater	No	Delineation is complete to the north, east and south, but not to the west. Fate and transport of groundwater in AOI 2 and an evaluation of surface water will be provided in a future Act 2 report.
	LNAPL	Yes	None specified

AOI	Media	Delineation Yes/No/Not Needed*	Follow-up Actions
AOI 3	Surface Soil	Yes	None specified
	Subsurface Soil	Not needed	None specified
	Groundwater	Yes	None specified
	LNAPL	Yes	None specified
AOI 5	Surface Soil	Yes	None specified
	Subsurface Soil	Yes	None specified
	Groundwater	Yes	None specified
	LNAPL	Yes	None specified
AOI 6	Surface Soil	Yes	None specified
	Subsurface Soil	No	Additional samples are planned for the area around sample number AOI 6-16-025.
	Groundwater	No	Delineation was not possible near the bulkhead along the Schuylkill River. Fate and transport of groundwater in AOI 6 will be provided in a future Act 2 report.
	LNAPL	No	Delineation was not possible near the bulkhead along the Schuylkill River. Fate and transport of groundwater in AOI 6 will be provided in a future Act 2 report.
AOI 7	Surface Soil	Yes	None specified
	Subsurface Soil	Not needed	None specified
	Groundwater	No	Additional sampling is planned and will be submitted in a future Act 2 report.
	LNAPL	Yes	LNAPL recovery is ongoing and will be part of the sitewide cleanup plan.
AOI 8	Surface Soil	No	Delineation is complete to the north and east, but delineation was not possible to the west as soil contamination extended right up to the Schuylkill River.
	Subsurface Soil	Not needed	None specified

AOI	Media	Delineation Yes/No/Not Needed*	Follow-up Actions
	Groundwater	No	Groundwater may be migrating from AOI 1 or other off-site sources and into sewers and the Schuylkill River. Fate and transport of groundwater in AOI 8 will be provided in a future Act 2 report.
	LNAPL	Yes	None specified
AOI 10	**Surface Soil**	No	Additional delineation for lead and benzo(a)pyrene are planned.
	Subsurface Soil	No	Samples were only collected around waste areas. Additional subsurface sampling will be conducted.
	Groundwater	No	Modeling results showed benzene in well W-33 could migrate to Lands Creek.
	LNAPL	Yes	None specified
Notes: * There were no concentrations above the standards, so delineation is not needed.			

Soil Investigation Results (All COCs Except Lead)

Sampling collected over 1,200 surface soil samples (0 to 2 feet deep) and just over 1,000 subsurface soil samples (2-15 feet deep) analyzed for all COCs except lead. Any samples above Act 2 standards were delineated (see red dots in Figure 5).

Soil Investigation Results (Lead Only)

Over 1,100 surface soil samples (0 to 2 feet deep) and just over 800 subsurface soil samples (2 to 15 feet deep) were collected across the Site and analyzed for lead. Any samples above the site-specific standard were delineated. No subsurface soils had COC concentrations above the site-specific standard. A summary of the sitewide results for surface and subsurface soil (not including lead) and surface soil (lead) are shown below (figures 5, 6 and 7, respectively).

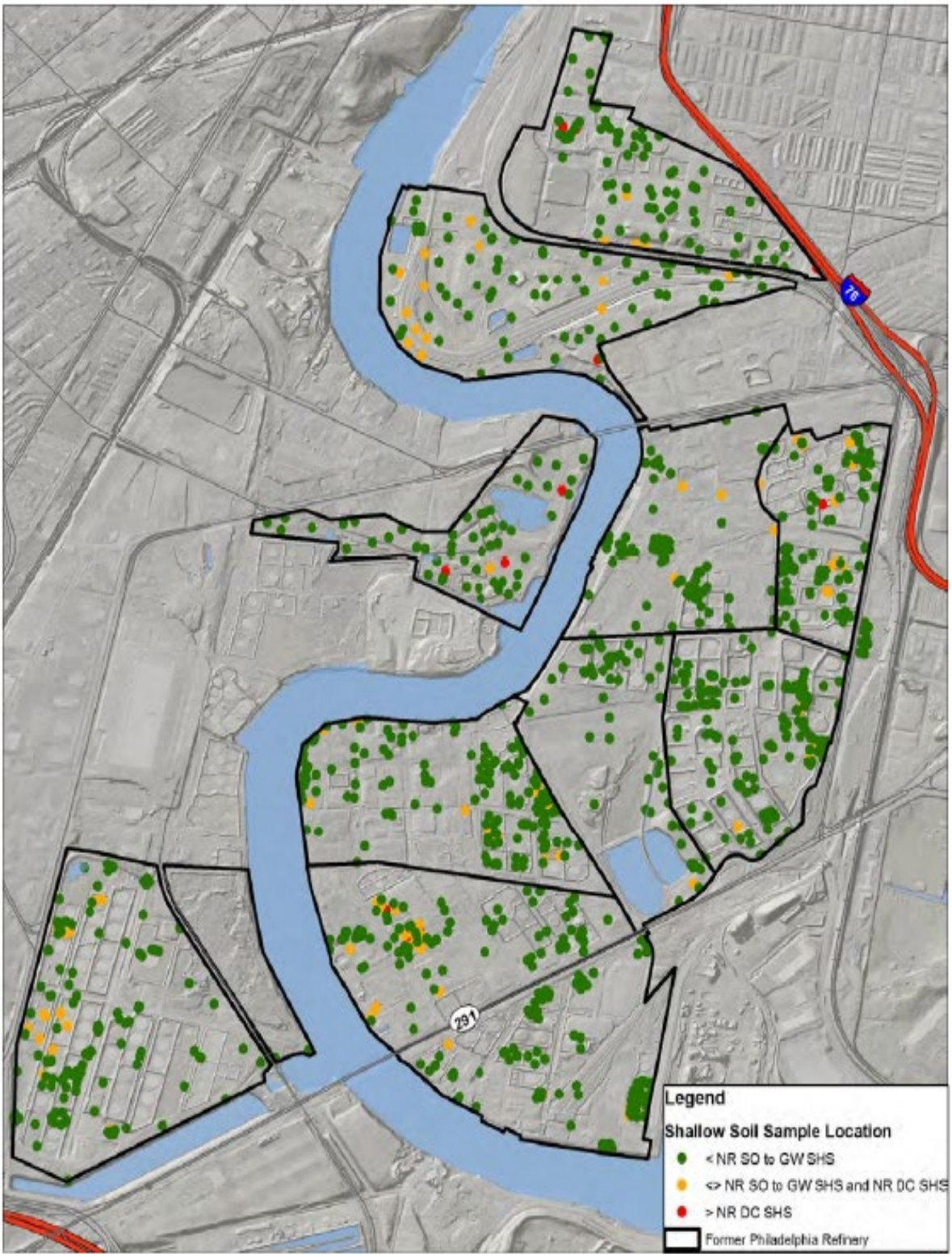

Figure 5. Surface soil investigation results (Source: Evergreen)

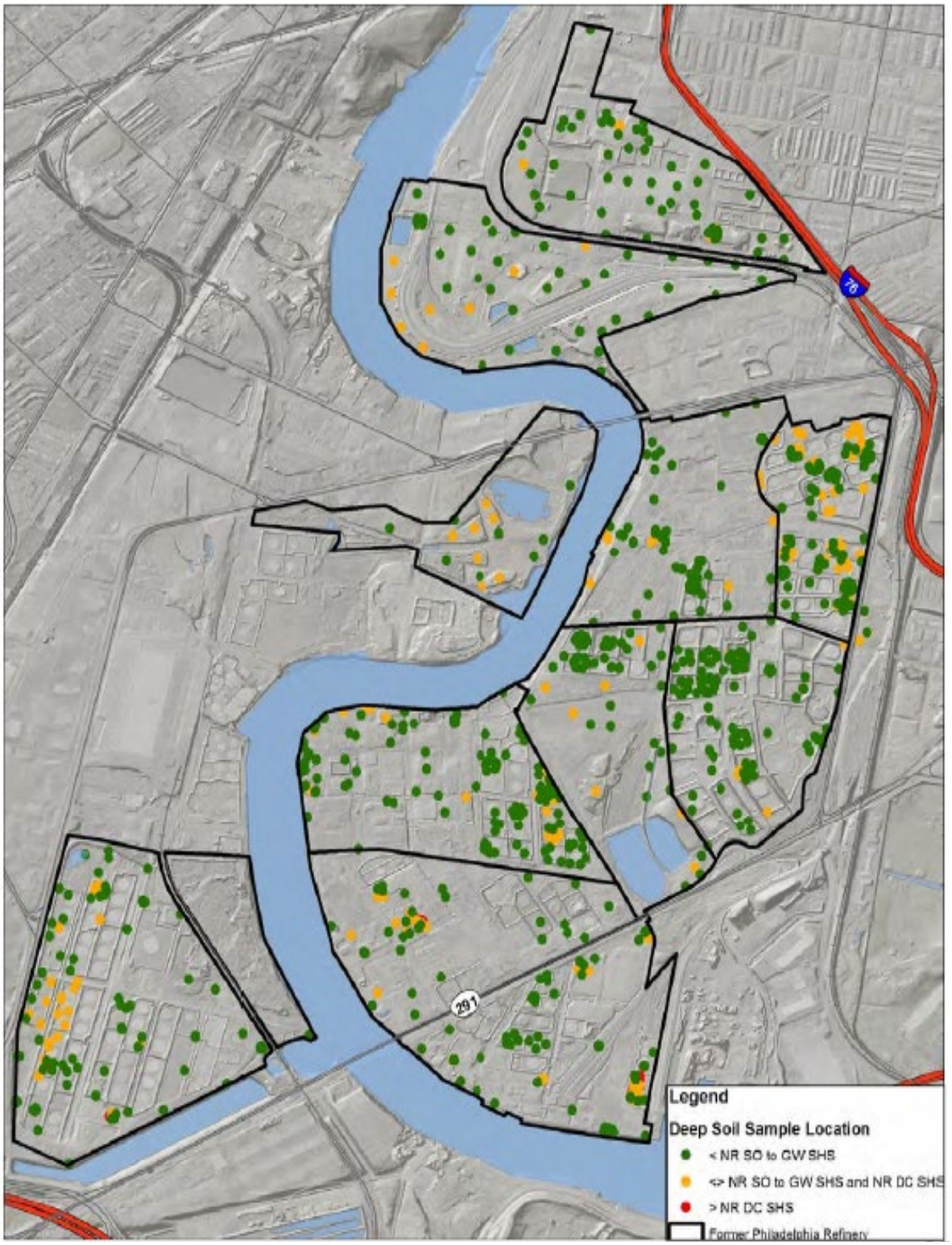

Figure 6. Subsurface soil investigation results (Source: Evergreen)

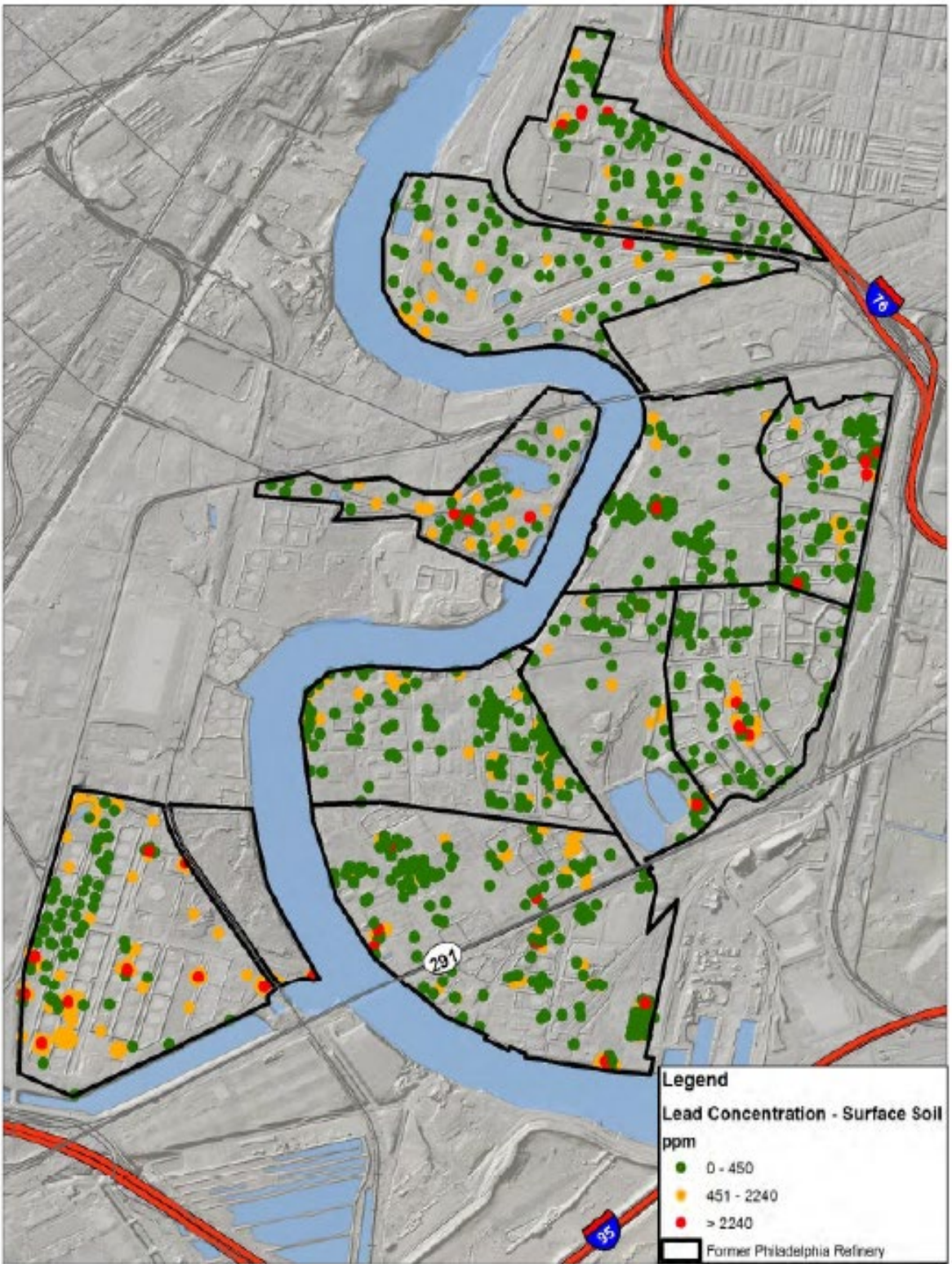

Figure 7. Lead surface soil investigation results (Source: Evergreen)

LNAPL Investigation Results

LNAPL is present under the Site above the groundwater surface in all AOIs, as shown in Figure 8. All LNAPL areas have been characterized. LNAPL in most areas is not spreading and does not appear to be contributing to groundwater contamination.

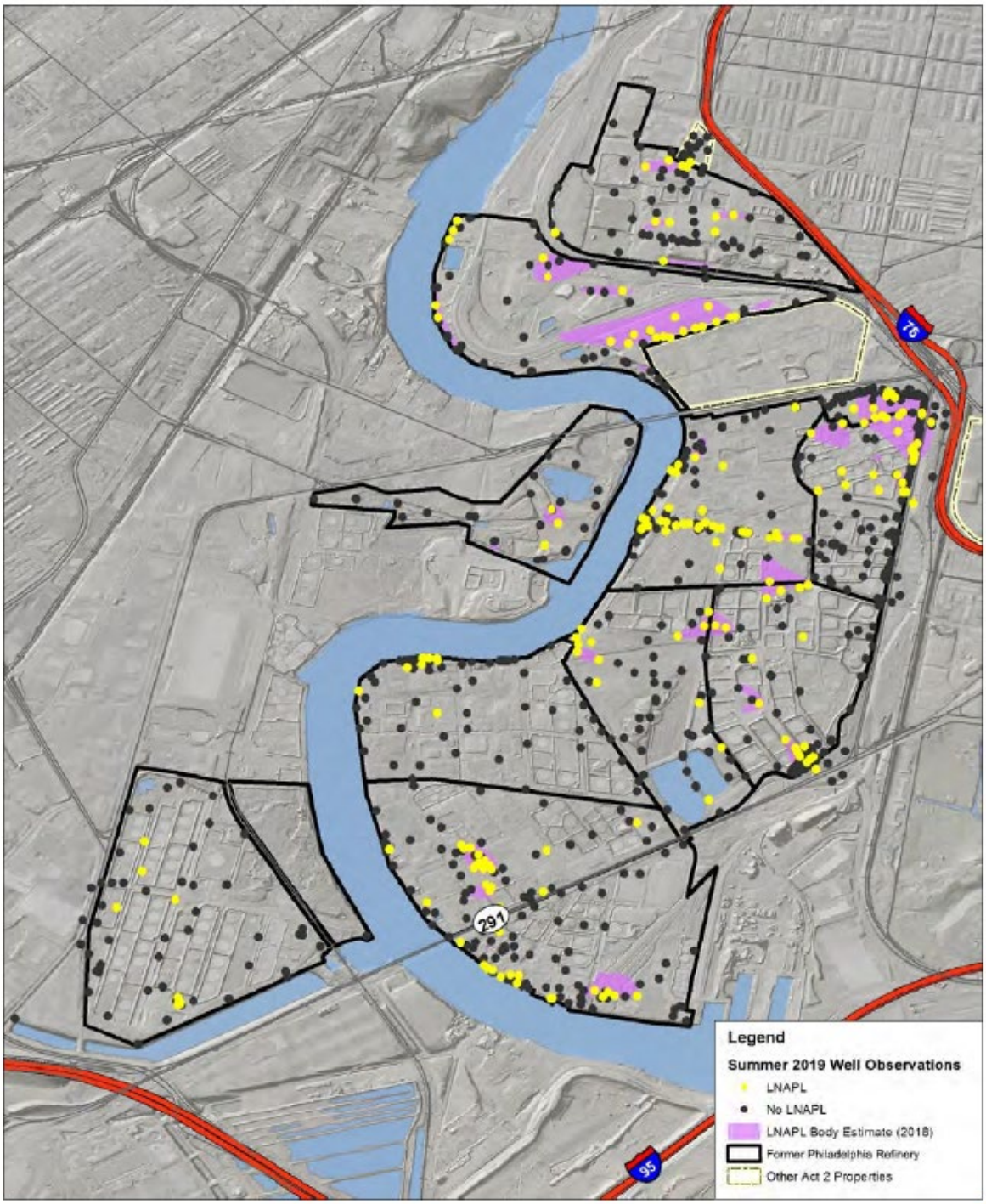

Figure 8. LNAPL Distribution 2018-2019 (Source: Evergreen)

Groundwater Investigation Results

Benzene, a VOC, is the primary groundwater contaminant at the Site. In the water table aquifer, benzene contamination extends off site and may have come from other facilities. Areas above the "statewide non-residential, used aquifer, statewide health" standards are shown in green. The darker areas correspond to higher concentrations (data were collected from 2014 to 2019). Groundwater fate and transport across the entire Site will be analyzed in a future Act 2 deliverable.

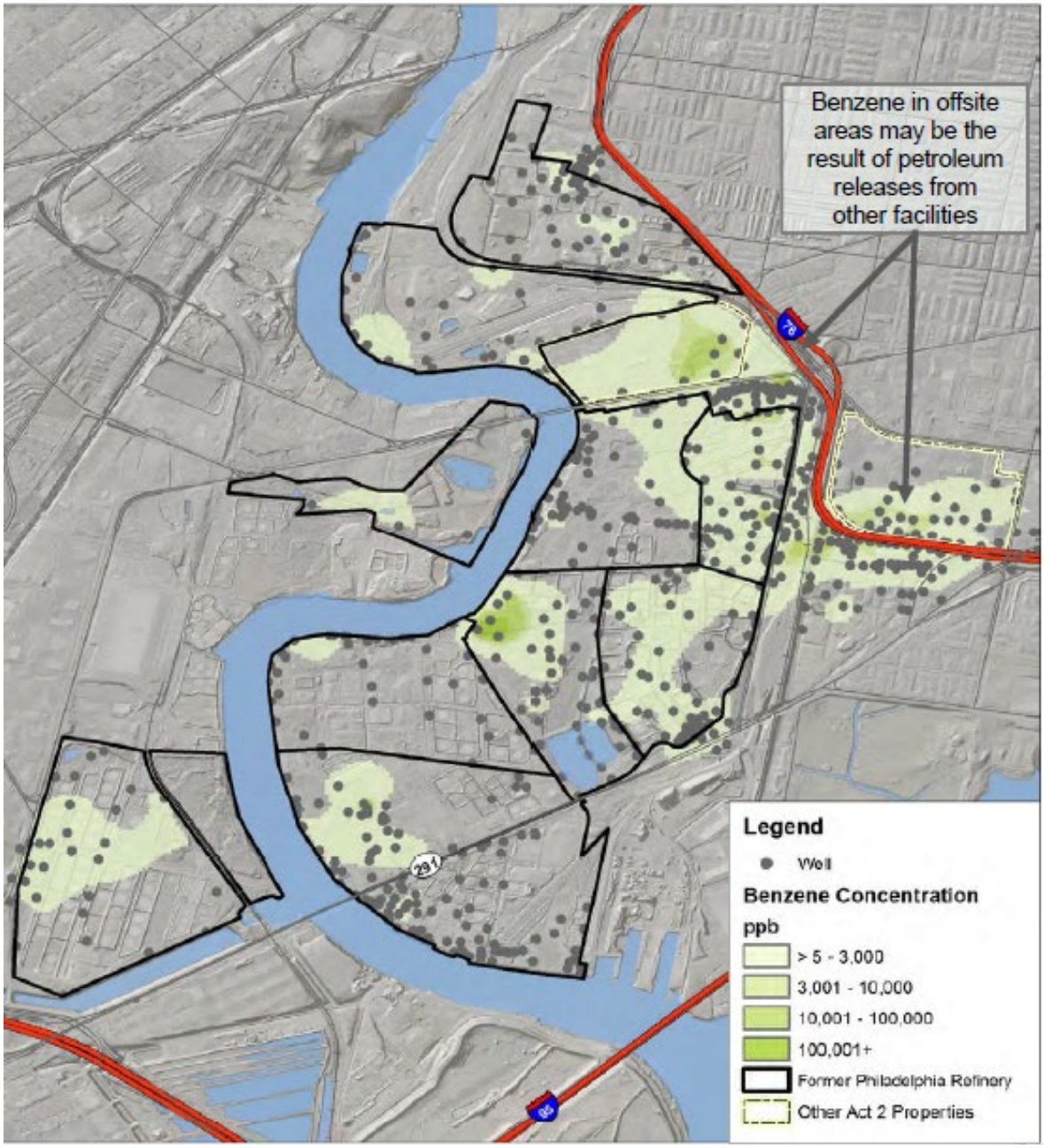

Figure 9. Benzene results in the water table aquifer, 2014 to 2019 (Source: Evergreen)

In the lower aquifer, fewer wells were installed, so areas of contamination cannot be shown as they are in the Figure 9 for the water table aquifer. Concentrations of benzene in the lower aquifer are much lower and there are fewer wells with concentrations above the standard.

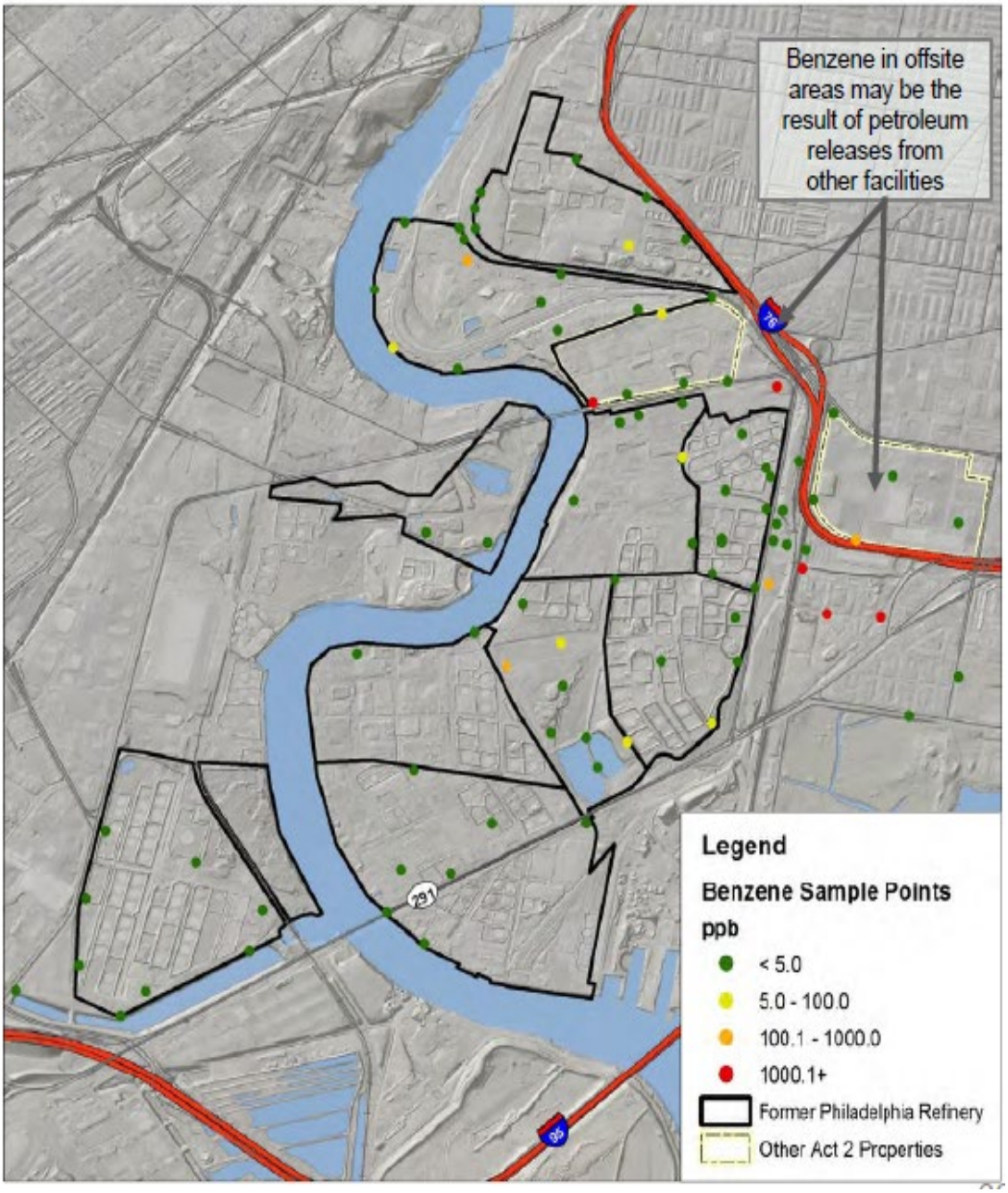

Figure 10. Benzene results in the lower aquifer (Source: Evergreen)

Air Investigation Results

Across the Site, over 200 air samples were collected. Most of the samples were indoor samples, taken in occupied buildings and buildings that could be occupied. Some of the samples were taken outside. Fewer than 10 of the samples came from the subsurface. Some samples were above standards or screening levels. They are discussed in more detail in the AOI sections below. Some buildings were occupied during the RIR process. There are currently no occupied buildings on site. Vapor intrusion is not currently a concern. However, it could be in the future, after site redevelopment. The sitewide human health risk assessment will evaluate this potential concern.

Cleanup Methods Used at Other Oil Refinery Sites

After the RIRs, sitewide fate and transport, human health and ecological risk assessments are submitted, approved by PADEP, and go through the public review period, Evergreen will submit a sitewide cleanup plan for PADEP approval and public review. This section describes common cleanup methods used at other oil refinery sites. All these methods may not be suitable for the Site.

A common way to clean up contaminated groundwater and LNAPL is **pumping and treatment**. Contaminated groundwater and LNAPL are pumped out of the ground using wells. The wells can collect LNAPL, groundwater or both (both is called dual-phase extraction). Collection trenches can help collect groundwater so it can be pumped out. The contaminated groundwater can then be treated at a wastewater treatment plant or in a treatment wetland. Recovered LNAPL can be disposed of or recycled. Injecting special additives into the ground that help flush out LNAPL and groundwater contamination can enhance the pump-and-treat process.

Other methods used to clean up groundwater at refinery sites include:

- **Air sparging**: pump air into the groundwater to collect contaminants and to stimulate microorganisms (bacteria) that break down contaminants. Air sparging is often combined with **soil vapor extraction**, in which the air with its collected contaminants is sucked out of the ground and treated.
- **Enhanced biodegradation**: inject nutrients and other additives into the ground to help microorganisms break down contaminants.
- **Monitored natural attenuation**: sample groundwater routinely to determine whether natural processes will reduce contamination to acceptable levels in a reasonable period.

Other methods used to clean up LNAPL at refinery sites include:

- **Sheet pile walls**: build an underground wall to stop LNAPL from spreading. These walls sometimes are made of metal sheets called sheet piles that are driven into the ground side by side. Underground barriers can also be used that absorb the LNAPL.
- **Soil washing**: flood an area with special liquids that enhance the removal of LNAPL.

Various cleanup methods have been used to clean up soil at refinery sites:

- **Excavation**: dig up contaminated soil and other materials. These materials can then be disposed of in a landfill or incinerated. The landfill can be on site or off site.

- **Capping**: cover contaminated areas with clean soil or other materials. The cover keeps people from being exposed to the contamination and keeps rainwater from soaking into the contamination.
- **Stabilization**: mix cement into the soil to prevent the contaminants from moving.
- **Bioremediation**: stimulate the growth of microorganisms that break down contaminants.
- **Phytoremediation**: plant trees or other plants that can help break down contaminants.
- **Soil vapor extraction:** pull contaminated air out of the ground and treat it.

Some sites are cleaned up to levels safe for industrial and commercial uses but not residential and other uses. At such sites, restrictions called "**institutional controls**" prevent the land or groundwater from being used in ways that would not be safe.

Discussion and Conclusions

Evergreen has completed eight of the RIRs following Act 2 program guidance. PADEP has approved them. These area-specific RIRs are generally focused on the soil and groundwater contamination within the boundary of each AOI. Vapor intrusion was characterized for occupied or potentially-occupied buildings and outdoor and ambient air in areas that are above groundwater or LNAPL contamination. Contamination was generally delineated on site. When this was not possible for groundwater, contamination was characterized as much as possible. Future Act 2 deliverables will assess groundwater fate and transport. LNAPL was also delineated when possible or characterized as immobile, which means that it is not moving.

Several upcoming Act 2 documents will evaluate conditions sitewide. Using computer simulations, a sitewide groundwater fate and transport model will show groundwater flow and chemical movement across the Site. After approval of all of the RIRs, Evergreen will also prepare and submit a human health risk assessment. It will consider people who could potentially be exposed to chemicals on site or off site, as well as the pathways these chemicals could take and the potential risk of exposure to these chemicals. Evergreen will also prepare an ecological risk assessment that applies to the entire Site and focuses on ecological receptors (such as birds, plants and fish). These documents, combined with the individual AOI RIRs, will inform the selection of the final cleanup plan for the Site.

Through the Act 2 process, the public has the right to participate and comment on Act 2 submittals and the cleanup plan. There are currently several ways for the public to provide comments, including through the website, via email and in person during public meetings. As the process continues, there will be additional opportunities for public involvement.

The community has expressed concerns about air quality near the Site. The review of the RIRs did not identify ambient air quality issues. However, emissions from the facility when it was active were not evaluated. The facility is currently inactive, so facility emissions that could affect local air quality no longer exist. There is a risk of vapor intrusion from shallow groundwater contamination that may extend off site. The upcoming groundwater fate and transport and human health risk assessment should evaluate any potential for vapor intrusion off site.

The characterization activities took place before the June 2019 explosion and facility shutdown. Due to the possible changed site conditions resulting from the explosion, the community may want to inquire if additional investigation activities are planned to evaluate possible changes to site conditions.

References

GHD. Remedial Investigation Report. AOI-7. Girard Point Refinery, Philadelphia Energy Solutions Complex. June 2017.

GHD. Remedial Investigation Report, AOI 6. Girard Point Refinery, Philadelphia Energy Solutions Complex. November 2017.

Langan Engineering & Environmental Services, Inc. (Langan). Site Characterization/Remedial Investigation Report, AOI 10. Prepared for Sunoco. June 2011.

Langan. Human Health Risk Assessment Report, Philadelphia Energy Solutions, Philadelphia Refinery. Prepared for Evergreen. February 2015.

Langan. Remedial Investigation Report, Area of Interest 5. Philadelphia Refinery Complex. Prepared for Evergreen. January 2017.

Langan. Remedial Investigation Report, Area of Interest 3. Philadelphia Refinery Complex. Prepared for Evergreen. March 2017.

Langan. Remedial Investigation Report, Area of Interest 2. Philadelphia Refinery Complex. Prepared for Evergreen. July 2017.

Evergreen. Philadelphia Refinery Legacy Remediation, Act 2 Program Public Meeting Presentation. November 2019.

Evergreen. Summary of Remedial Investigation Report – Area of Interest 1. Philadelphia Refining Complex. Draft. April 2020.

Evergreen. Overview of Former Sunoco Philadelphia Refinery Environmental Investigations. Draft. April 2020.

Stantec Consulting Services Inc. (Stantec). Remediation Investigation Report, Area of Interest 1. Philadelphia Refinery Complex. Prepared for Evergreen. August 2016.

Stantec. Remedial Investigation Report, Area of Interest 8. Philadelphia Refinery Complex. Prepared for Evergreen. December 2017.

Additional References

Abernathy, B. and Thiel, A. A Close Call and an Uncertain Future: An assessment of the past, present, and next steps for Philadelphia's largest refinery. November 2019.

EPA. Record of Decision, Operable Unit 2 – Soil and Sediments. Record of Decision Amendment, Operable Unit 1 – Light Non-Aqueous Phase Liquid Source Area. Diamond Head Oil Refinery Superfund Site, Kearny Township, Hudson County, New Jersey. September 2017.

EPA. Remediation System Evaluation for a Groundwater Pump and Treat System. BP Carson Refinery. December 2005.

GeoTrans, Inc. 14th Street (Upper Zone) Corrective Action Plan Completion Report. Exxon Mobil Corporation Baltimore Terminal. August 4, 2008.

GeoTrans, Inc. Lower Zone Corrective Action Plan. Exxon Mobil Baltimore Terminal. September 10, 2009.

Khaitan, S., Kalainesan, S., Erikson, L.E., Kulakow, P., Martin, S., Karthikeyan, R., Hutchinson, S.L.L., Davis, L.C., Illangasekare, T.H. and Ng'oma, C. Remediation of Sites Contaminated by Oil Refinery Operations. Wiley Interscience, DOI 10.1002, ep. 10083. April 13, 2005.

Mol, J.J.W. An analysis of the remediation of soil contaminated refinery sites. Environmental Management and Health; Bradford Vol. 10, Issue 1, 37-40. 1999.

Simeone, K. Beyond Bankruptcy, The Outlook for Philadelphia's Neighborhood Refinery. Kleinman Center for Energy Policy, University of Pennsylvania, School of Design. September 2018.

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Appendix A: RIR Review – AOIs 1, 2, 3, 5, 6, 7, 8 and 10

AOI 1 – No. 1 Tank Farm and No. 2 Tank Farm

Overview

AOI 1 covers about 67 acres on the eastern bank of the Schuylkill River along 26th Street (Figure A-1). In the 2016 RIR, the AOI consisted of 35 aboveground storage tanks, which had been used to store various petroleum products. Soil, groundwater and air samples were collected as part of the remedial investigation. PADEP and EPA reviewed the 2016 RIR for AOI 1. PADEP approved it in November 2016.

Two cleanup systems operate in AOI 1. The 26th Street North Remediation System pumps groundwater and LNAPL from 15 wells. The Packer Avenue and 26th Street Ventilation System and Biofilter System pulls and treats vapors from the sewers.

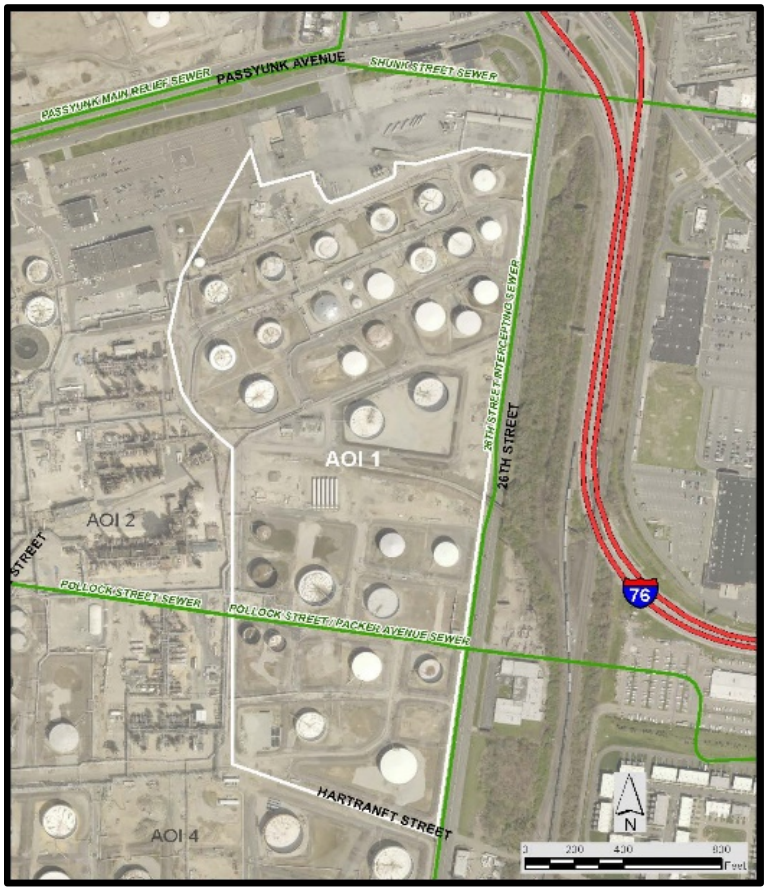

Figure A-1. AOI 1 (Source: Evergreen)

Findings

Overall findings of the AOI RIR for soil, groundwater, air and LNAPL are provided below.

Evergreen sampled AOI 1 soils in 2013 and 2015 for the RIR. The goal of sampling soil at AOI 1 was to characterize soil in potential source areas, including former tank areas and historic release areas. Soil samples were collected throughout AOI 1 at two depth ranges (surface from 0 to 2 feet deep, and subsurface from 2 to 15 feet deep). The RIR included the findings listed below:

- Lead and 1,2,4-trimethylbenzene were found above their standards in surface soil.
- All other COCs were below their standards including subsurface soil.
- Lead and 1,2,4-trimethylbenzene were delineated horizontally and vertically within AOI 1.
- Soil from locations that were above the lead and 1,2,4-trimethylbenzene standards will need further evaluation or remediation.

Groundwater occurs in two zones under AOI 1, the shallow water table aquifer and the lower aquifer. AOI 1 RIR findings for groundwater include:

- In the shallow water table aquifer, several contaminants were found above the Act 2 standards, including benzene, 1,2-dichoroethane, ethylbenzene, ethylene dibromide, MTBE, toluene, 1,2,4 trimethylbenzene, 1,3,5-trimethylbenzene, xylenes, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, naphthalene and lead.
- Groundwater in the shallow water table aquifer flows toward the 26th Street Intercepting Sewer and the Pollock Street/Packer Avenue Sewer.
- Benzene and MTBE, the most widespread and consistent shallow groundwater contaminants, extend east of AOI 1 to the 26th Street Intercepting Sewer.
- The intercepting sewer is likely receiving contaminated shallow groundwater. Evergreen considers the sewer the boundary for shallow groundwater contamination east of AOI 1.
- Benzene and MTBE were also found off site, east of the AOI, beyond the remediation system at 26th Street.
    - The RIR indicated several possible reasons, including LNAPL or groundwater migration or contamination from nearby facilities.
- A groundwater flow model is being developed to evaluate the fate and transport of contaminants in groundwater under AOI 1. Monitoring along the eastern boundary will continue.
- Benzene, MTBE and lead were found above standards in the lower aquifer under AOI 1. Groundwater contaminants, especially benzene and MTBE, could migrate off site and affect the water supply for New Jersey.

Indoor and outdoor air samples were collected near a previously-occupied building. Concentrations were below the PADEP IASHS screening levels. Benzene was found in ambient area and indoor air higher than the EPA regional screening level. 1,2,4-Trimethylbenzene was also found higher than the EPA regional screening level.

LNAPL was found under AOI 1 and subdivided into eight bodies or areas. The RIR found that most of the LNAPL appeared to be left over from historical petroleum hydrocarbon releases. Along the eastern boundary, a small area of LNAPL was found extending across 26th Street. This area will continue to be monitored for potential movement off site. The RIR also indicated a potential need for a vapor intrusion evaluation above the LNAPL areas at AOI 1.

AOI 2 – Point Breeze Processing Area

Overview

Area 2 covers about 111 acres on the east side of the Schuylkill River, west of AOI 1. At the time of the 2017 RIR, the area consisted of a pier along the western boundary, office buildings and paved parking areas. A sheet pile bulkhead separates AOI 2 from the river. Soil, groundwater and air samples were collected as part of the remedial investigation. The 2017 RIR includes results from sampling between 2010 and 2016. PADEP approved the RIR in October 2017.

Figure A-2. AOI 2 (Source: Evergreen)

Findings

From 2010 to 2016, over 70 surface soil samples were collected from AOI 2. Soil samples were collected from distinct areas of AOI 2, including areas around active and closed-in-place tanks. Between 2013 and 2016, about 60 subsurface soil samples were collected from between 2 feet deep and the water table.

Overall AOI 2 RIR conclusions for soil include:

- Benzo(a)pyrene and lead were above standards at four locations. Two of these locations were tank areas.
- No other contaminants were above standards in surface soil.
- No subsurface soil samples were above standards.

There are 107 wells to monitor the shallow water table aquifer and four wells to monitor the lower aquifer in AOI 2. Groundwater samples were collected in 2010, 2013 and 2016. The AOI 2 RIR presented the following conclusions for groundwater:

- Except for a few contaminants (1,2-dichloroethane, 1,3,5-trimethylbenzene, cumene, toluene, xylenes, fluorene and phenanthrene), all site contaminants were above standards in the shallow water table aquifer.
- No site contaminants were above standards in the lower aquifer during recent 2016 sampling events.

Based on several factors, including flow and concentration trends, the RIR indicates that groundwater contamination is delineated to the north, east and south. Groundwater contamination in the western part of AOI 2 is characterized but not delineated. It is possible that groundwater contamination is controlled by the active remedial systems. Release of contaminated groundwater to the river might also be prevented by a sheet pile wall, but details on the sheet pile wall were not available. The fate and transport of groundwater in AOI 2 and an evaluation of surface water will be provided in a future Act 2 report.

In 2012, 14 indoor air samples were collected from buildings in AOI 2. One outdoor air sample was collected near four buildings outside the Point Breeze Gate Area. In 2016, six indoor air samples and one outdoor air sample were collected. Outdoor work air sampling was also done to assess potential exposure for people working near LNAPL or dissolved groundwater contamination areas. Results were below standards. Some results were above the IASHS screening levels and EPA regional screening levels. All buildings are vacant because the facility is closed. Vapor intrusion into indoor air will be studied further as part of an upcoming sitewide human health risk assessment. Concentrations in outdoor air were below the screening levels for all contaminants.

There is LNAPL in AOI 2. Most of the LNAPL is near the remedial systems. It is being actively controlled and removed. Monitoring wells were installed between a vertical wall and the river. LNAPL was not found in these wells, indicating that LNAPL has not moved past the vertical wall. Based on the findings of the RIR, LNAPL does not appear to be moving off site or to be a source of groundwater contamination.

AOI 3 – Point Breeze North Yard

Overview

Area 3 covers about 107 acres on the east side of the Schuylkill River. The river is the northwestern border of AOI 3. Also known as the Impoundment Area, AOI 3 is within the historical Point Breeze South Yard. Historically, AOI 3 consisted of a tank farm (six aboveground storage tanks), an unlined stormwater pond, capped past disposal areas, and former ballfields used for waste disposal. Initial site characterization took place in 2010. The 2010 Site Characterization Report/RIR summarized the results. Based on the findings, additional characterization work took place from 2013 to 2016. The 2017 RIR includes the 2010, 2013 and 2016 investigation results. PADEP approved the RIR in June 2017. Soil, groundwater and air samples were collected and studied as part of the remedial investigation.

Figure A-3. AOI 3 (Source: Evergreen)

Findings

From 2010 to 2016, 53 surface soil samples were collected throughout AOI 3. From 2013 to 2015, 32 subsurface soil samples were collected. Overall RIR conclusions for soil include:

- Lead was found at concentrations greater than the site-specific standard in four surface soil locations.
- All four areas above the standard were delineated.
- In subsurface soil, no contaminants were above standards.

Groundwater monitoring took place in 2010, 2013, 2015 and 2016. Groundwater under AOI 3 occurs in a perched, isolated shallow zone above the shallow water table aquifer and the lower aquifer. Overall RIR conclusions for groundwater included:

- Sampling found contaminants above standards in the perched, water table and lower aquifers of AOI 3.
    - Perched Aquifer: 1,2-Dibromoethane, benzene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,hi,)perylene, chrysene, lead, MTBE and toluene.
    - Water Table Aquifer: 1,2,4-Trimethylbenzene, ethylene dibromide, benzene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,hi,)perylene, chrysene, lead, MTBE, naphthalene and toluene.

    - Lower Aquifer: Lead, benzene and MTBE
- Contaminants in AOI 3 groundwater are not expected to be above standards at the boundary. However, benzene appears to be increasing in the water table and lower aquifers, moving toward the middle of AOI 3, and further affecting the lower aquifer.
- A planned sitewide fate and transport Act 2 deliverable will evaluate the fate and transport of contaminated groundwater across the entire Site.

Nine indoor air samples and one outdoor air sample were collected in 2016. Outdoor air worker sampling was also done. During air sampling, no concentrations were found above PADEP IASHS screening levels. However, benzene and ethylbenzene were above other screening levels, including EPA's regional screening level. A human health risk assessment will evaluate indoor and outdoor air quality across the Site.

During groundwater monitoring, LNAPL was found in several wells; samples were collected where measurable (greater than 0.01 feet) LNAPL was found. AOI 3 LNAPL was delineated. The RIR found that LNAPL was likely not moving or affecting groundwater quality.

AOI 5 – Girard Point South Tank Field Area

Overview

Area 5 covers about 114 acres on the east bank of the Schuylkill River and is the southernmost area of the Site. AOI 5, commonly known as the Girard Point South Tank Field Area, has historically consisted of aboveground storage tanks holding various types of oil, packaging facilities, transfer facilities, a marine unloading/loading facility, and three solid waste management units (SWMUs). A sheet pile bulkhead extends along the river at the southern AOI 5 boundary.

An "SWMU" is a place where solid or hazardous wastes are placed at any time, or where wastes have been routinely and systematically released.

Initial site characterization activities took place in 2007. A site characterization report summarized them. Additional activities took place in 2009. A second report summarized them. Based on these two reports, additional studies took place in 2013 and 2016. They form the basis for the 2017 RIR. PADEP approved the RIR in May 2017. Soil, groundwater and air samples were collected as part of the remedial investigation.

Figure A-4. AOI 5 (Source: Evergreen)

Findings

Fifty-two surface soil samples were collected from 2007 to 2014. Between 2012 and 2014, 22 subsurface soil samples were collected to vertically delineate previously-identified contamination. Other surface and subsurface samples were collected during supplemental tank investigations. Overall conclusions for soil include:

- Outside of the SWMUs, surface and subsurface soil samples had contaminants above the standards. Most of these samples were in the eastern tank farm area.
- Lead and benzo(a)pyrene were above standards in surface soil.
- Benzene and cumene were above standards in subsurface soil.
- All soil areas were delineated.
- Lead was the only contaminant above the standard in the SWMUs. These areas were delineated.

Groundwater monitoring took place in 2007, 2011 and from 2014 to 2016. Lower aquifer wells were sampled in 2007. They were not sampled during the 2014-to-2016 sampling. Groundwater in AOI 5 flows south and southwest toward the river. 1,2,4-Trimethylbenzene, benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, lead and pyrene were above their standards. While some contaminants were above standards near the

river, the sheet pile wall stops contaminated groundwater from flowing into the river. Groundwater COCs are delineated within the boundary of the Site.

In 2012, one indoor and one outdoor air sample were collected. In 2016, six indoor air and one outdoor air sample were collected. Outdoor worker air sampling took place based on PADEP vapor intrusion guidance for areas near LNAPL or shallow groundwater contamination. As in other areas, no contaminants were found in indoor air above the PADEP IASHS screening levels. Benzene concentrations in indoor and outdoor air samples were above EPA regional screening levels. A human health risk assessment will evaluate indoor and outdoor air quality across the Site.

Groundwater monitoring found LNAPL in several wells. Samples were collected where there was measurable (greater than 0.01 feet) LNAPL. LNAPL was delineated in AOI 5. The RIR found that LNAPL was not likely moving or affecting groundwater quality. In addition, signs of LNAPL have not been seen on the river side of the sheet pile bulkhead.

AOI 6 – Girard Point Chemicals Processing Area

Overview

AOI 6, also known as the Girard Point Chemicals Processing Area, covers 100 acres on the east side of the Schuylkill River. A sheet pile wall runs along the western boundary of AOI 6. Historically, AOI 6 consisted of aboveground tanks holding chemicals such as benzene, toluene and other fuel stocks. AOI 6 also included processing and treating units. In 2017, AOI 6 included 16 routinely-occupied or potentially-occupied buildings.

There are two leaded-tank SWMUs in AOI 6. AOI 6 also has an LNAPL recovery system, the 27 Pump House Total Fluids Recovery System. This system started operating in 2001, changed from active to passive in 2010, and stopped operating in 2015. Initial AOI 6 studies took place for the 2006 and 2013 site characterization reports. Additional studies took place in 2016 and 2017 for the 2017 RIR. The RIR came out in 2017 and PADEP approved it in February 2018. Soil, groundwater and air samples were collected and evaluated for the remedial investigation.

Figure A-5. AOI 6 (Source: Evergreen)

Findings

Fifty-seven soil borings were taken from 2006 to 2012. Soil sampling in 2016 and 2017 focused on areas with contaminants above standards. Soil sampling in AOI 6 generally focused on areas with known releases or on tank areas. Surface soil samples had concentrations above the standard for benzo(a)pyrene, lead and benzene. Subsurface soil samples had concentrations above the benzene standard. Most areas have been delineated, but additional samples are planned in one area to further delineate benzene (subsurface sample number AOI 6-16-025). This sample is located in the center of AOI 6.

Soil boring is a way to collect soil samples from under the surface using a drill rig.

Groundwater monitoring was done in May and August 2016. Benzene, isopropyl benzene, 1,2-dibromoethane, toluene, 1,2,4-trimethylbenzene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)pyrene , benzo(b)fluoranthene, chrysene, naphthalene and lead were above their respective standards. However, these contaminants have generally been delineated. Benzene was the most widespread contaminant. Some areas near the sheet pile wall had groundwater above standards and had LNAPL, but delineation in this area is not possible because of the bulkhead. The areas near the bulkhead will be evaluated in the upcoming sitewide fate and transport report.

Indoor and outdoor air sampling was done in or near buildings that could have vapor intrusion. Except for benzene, there were no concentrations above PADEP IASHS screening levels. Additional sampling is planned. Vapor intrusion will be addressed in the sitewide human health risk assessment.

In 2016, two air samples were also collected over the LNAPL area in AOI 6. The results were similar to ambient air in this area.

Many monitoring wells across AOI 6 have measurable amounts of LNAPL. Based on the evaluation conducted in the RIR, LNAPL is not moving or affecting groundwater quality.

AOI 7 – Girard Point Fuels Processing Area

Overview

AOI 7, also known as the Girard Point Fuels Processing Area, covers about 130 acres on the east side of the Schuylkill River. A sheet pile wall runs along the western boundary of AOI 7. Historically, AOI 7 consisted of a fluid catalytic cracker unit, a carbon monoxide boiler, a sulfur plant, sludge basins, a hazardous waste incinerator and crude oil units. As of 2017, AOI 7 consisted of the historical units, aboveground storage tanks, gas tanks, a wastewater treatment plant and four closed hazardous waste aboveground storage tanks. There are five SWMUs in AOI 7.

Figure A-6. AOI 7 (Source: Evergreen)

In 2011, a sheen (shiny substance near the water surface) was seen on the Schuylkill River. The source of the sheen was a part of the sewer system. Repairs were completed and an extraction system with an oil/water separator recovered the LNAPL. Operation of this system is ongoing. Work has been done to characterize AOI 7 since at least 2010, when Evergreen submitted the first site characterization report. Evergreen submitted a second site characterization report in 2012. The 2017 RIR presents studies done since the 2012 report. PADEP approved the RIR in August 2017. Soil, groundwater and air samples were collected and evaluated as part of the remedial investigation.

Findings

Soil samples focused on tank areas, areas of known releases, and other potential source areas. Benzo(a)pyrene was the only contaminant above its standard in surface soil; it was only found in one surface soil sample. This sample was delineated. All other surface and subsurface soil samples were below standards.

A source area is a place where contaminants were released to the environment.

Groundwater sampling took place in May, July/August and August/September 2016. Benzene, isopropyl benzene, 1,2-dibromoethane, toluene, 1,2,4-trimethylbenzene, xylenes, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)pyrene, benzo(b)fluoranthene, chrysene, naphthalene and lead were above their standards in the AOI 7 water table aquifer. No contaminants were above standards in the lower aquifer. Groundwater will be further evaluated in a future Act 2 deliverable.

Indoor and outdoor air were sampled in the eight occupied buildings; no samples were above PADEP or EPA screening levels. In 2016, two air samples were collected over the LNAPL area in AOI 7. The results were compared to ambient air quality in the area as well as EPA's indoor air background concentrations for residential use. The results were similar to background levels for this area and below EPA's background indoor air concentrations for residential use.

Many monitoring wells across AOI 7 have measurable amounts of LNAPL. LNAPL was found near the river bulkhead. This LNAPL was delineated as much as possible. However, its location near the bulkhead made delineation hard. Sheening of the river has been seen there. Recovery of LNAPL in the northwest part of AOI 7 is ongoing.

AOI 8 – Point Breeze Refinery North Yard

Overview

AOI 8 covers about 250 acres on the northern end of the Site, on the east bank of the Schuylkill River. AOI 8 was home to the former Point Breeze Refinery. Historically, various industrial processing units associated with crude oil refining operated in AOI 8. During operations, this area had several aboveground storage tanks, processing areas, a land treatment unit, various plants and one SWMU. AOI 8 has hardened shoreline consisting of steel and wooden bulkheads. These bulkheads are probably from the late 1800s or early 1900s. AOI 8 also contains sewers, which cross the area and carry stormwater and sewage. Site characterization activities at AOI 8 have been done since 2008. Evergreen submitted a site characterization report in 2008 and 2012. Additional studies took place in 2016 and 2017 to support the RIR. The RIR came out in 2017 and PADEP approved it in March 2018. Soil, groundwater and air samples were collected and evaluated as part of the remedial investigation.

Figure A-7. AOI 8 (Source: Evergreen)

Findings

Based on sampling from 2008 to 2017, soil contamination is widespread in AOI 8. Lead, benzo(a)pyrene and benzo(b)fluoranthene were found in surface soils above standards. These areas have been delineated horizontally to the north and east, but delineation to the west was not possible because soil contamination extended right up to the Schuylkill River. Vertically, there no were contaminants above the standards below 2 feet.

There are 127 wells in the AOI 8 area. Almost all contaminants were above their standards in the water table and lower aquifer, but benzene was the most widespread. A fate and transport model was developed for AOI 8 as part of the RIR. The model showed three general areas of benzene contamination: the southern border, the northern portion and the western portion (near the bulkhead) of the AOI. The southern and northern benzene contamination areas may be migrating from AOI 1 or other off-site activities. The western contamination appears to be from AOI 8. Benzene and lead concentrations in the lower aquifer were above standards.

The RIR concluded that groundwater is moving into the Jackson Street and Mifflin Street sewers. Groundwater may also be able to move into the Rambo Creek Sewer.

Several contaminants were found above standards in the lower aquifer. Contamination in the lower aquifer is not completely delineated and some contaminants, such as benzene, could migrate off site. AOI 11 and the sitewide fate and transport report will further evaluate deep groundwater.

Vapor intrusion was studied in and near all buildings with people in them during the investigation activities. Indoor, outdoor and sub-slab air was not above EPA regional screening levels, except for one soil gas sample above the benzene screening level. Evergreen runs the Jackson Street Water Curtain to prevent vapor intrusion.

LNAPL is present under AOI 8 in 17 areas. The most notable LNAPL areas are in the benzene contamination areas described above. The RIR reported that LNAPL was delineated during the remedial investigation process and does not appear to be moving or affecting groundwater quality.

AOI 10 – Point Breeze West Yard

Overview

AOI 10, also known as the Point Breeze West Yard, covers about 80 acres on the west side of the Schuylkill River. Lands Creek crosses the southern part of AOI 10. There are four past disposal areas in AOI 10, including former lagoons and landfills. All four areas have been capped. Together, they are called the corrective action management unit or CAMU. Historically, AOI 10 also contained a tank area and two fuel docks. The facilities were all demolished in 2005.

Site characterization activities took place in 2011. The RIR came out in 2011 and PADEP approved it in January 2012. Soil, groundwater, surface water and sediment were collected and evaluated as part of the remedial investigation.

Figure A-8. AOI 10 (Source: Evergreen)

Findings

Forty-five soil samples were collected within AOI 10 but outside the CAMU areas. There were nine soil borings in CAMU areas; the borings were from 20 to 30 feet deep. Surface soil concentrations of benzene, benzo(a)pyrene, tetrachloroethene, arsenic, manganese and lead were above standards; lead and benzo(a)pyrene were not delineated as of the 2011 RIR. Subsurface soil samples were collected only around the perimeter of the CAMU areas. Several contaminants, including benzene, benzo(a)pyrene, naphthalene, arsenic, barium, cobalt, lead, manganese, mercury, nickel and thallium were above standards in the waste material and underlying soil in the CAMU. The RIR indicated that this contamination did not appear to be migrating to groundwater.

Groundwater sampling took place in April 2011. Groundwater contamination, including benzene, was found in eight AOI 10 wells. Modeling predicted that groundwater would not migrate past the boundary except for benzene in well W-33, which modeling found could reach Lands Creek.

Because there are no occupied buildings in AOI 10, soil sample results were used to evaluate the risk of vapor intrusion using PADEP guidance. Based on this evaluation, there were no concentrations above the EPA or OSHA screening values for non-residential use.

LNAPL was found in three AOI 10 wells. The remedial investigation concluded that LNAPL is not moving and is not affecting groundwater quality.

Surface water samples were collected from Lands Creek. Results were compared to PADEP screening criteria for fish and aquatic life. No concentrations were above the screening criteria. In a 2016 response, PADEP requested the use of human health criteria for fish consumption as a standard.

Sediment samples were also collected from Lands Creek. Results were compared to EPA Region 3 sediment and surface water benchmarks. Concentrations of volatiles and metals were found above the benchmarks. Lands Creek is fenced and within the limits of AOI 10, so there is no human contact with sediment.

Appendix B: Questions and TASC Responses from August 6, 2020 Community Meeting

On August 6, 2020, EPA convened a virtual community meeting with community members in Philadelphia to provide TASC the opportunity to present the RIR summary report and to respond to questions from community members. The following are questions asked during the meeting with TASC responses. EPA provided additional information to the responses below where appropriate.

1. What is the rationale for providing the breakout of the site characterization into the different areas of interest? For lay persons and the public at large, it seems to add unnecessary confusion and complexity.
    a. TASC response: Large, complicated hazardous waste sites are often divided into different areas or units to help organize environmental sampling and risk characterization. For the PES-Sunoco site, the areas of interest (AOIs) were determined based on past operation areas and were prioritized based on potential risk factors.

2. Benzene is known to cause cancer. It is prevalent in high concentrations throughout the site and it is suspected to be moving off of the site in some areas. There are also high concentrations in certain surrounding residential areas. What is being done to correct this situation?
    a. TASC response: The remedial investigation report (RIR) for AOI 1 states that concentration trends generally support that dissolved-phase benzene groundwater plumes have stabilized on site. It is expected that the upcoming fate and transport report and the human health risk assessment will discuss the potential migration of benzene on site and off site, as well as any potential exposure pathways to the surrounding residential areas. Currently, there are interim remedial systems in place at the site that are intended to contain benzene on site.

3. In a few of the AOIs, it is stated the contamination cannot be "delineated" beyond the bulkhead that acts as a barrier between the site and the Schuylkill River. If the contamination is right up against the barrier, and we can't see where it stops, how do we know the bulkhead is effective and the contamination is not going into the river?

a. TASC response: Contamination has been detected on site near the bulkhead, but full delineation has not been possible because it would disturb the structural integrity of the bulkhead. The areas near the bulkhead will be further evaluated in the upcoming sitewide fate and transport report.

4. I understand this presentation will not mention AOI 11 which is the entire underground aquifer of the site that has also been undefined.
    a. TASC response: AOI 11 is not part of the current TASC review. Additional information provided by EPA: TASC support centered on reviewing and providing the public with the information contained in the eight approved AOI RIRs. AOI 11 consists of the deep aquifer. Shallow groundwater is included in the respective individual AOI RIRs. Although deep groundwater data has been included in individual AOI RIRs since 2017, the fate and transport RIR for the deep groundwater will be submitted by December 2021 (per new PADEP Order). The RIR for the fate and transport model will be available for public review and will have its own comment period.

5. Now that the site has a new owner and they have a new vision for the site, shouldn't the cleanup be based on the vision of the future, rather than what has occurred historically?
    a. TASC response: The cleanup plan would be expected to include considerations of the future land use. The RIRs and human health risk assessment for lead assess the properties assuming a continued industrial or commercial land use.

6. Why wasn't the community given an opportunity to weigh in on site specific standards for lead? Who was at the table when this decision was made?
    a. TASC response: The February 2015 Human Health Risk Assessment Report used the standard EPA model for calculating lead cleanup goals for soils based on adult exposure and for non-residential use. PADEP approved the standard in 2015 under the Act 2 regulations.

7. Is there any consideration of long-term climate change leading to sea level rise leading to changes in groundwater levels, and transport of contaminants across and out of the site?
    a. TASC response: The RIRs do not consider impacts of long-term climate change. These potential impacts to the site may be factored into the fate and transport model or the assessment of cleanup options for the site.

8. Why wasn't the soil in AOI 10 delineated?
    a. TASC response: According to communication between Evergreen and PADEP, additional surface soil delineation for lead and benzo(a)pyrene are planned. Subsurface samples were only collected around waste areas. According to communication between Evergreen and PADEP, additional subsurface sampling will be conducted before a proposed cleanup.

9. How far did the contamination go under our homes?
    a. TASC response: The extent of off-site contamination should be further assessed in the upcoming fate and transport report. The RIRs indicate benzene may be present off site. Additional investigations will evaluate the source of off-site benzene.

10. When will the groundwater and LNAPL be fully delineated? What about heavy NAPL at the site?
    a. TASC response: Areas of groundwater and light non-aqueous phase liquid (LNAPL) contamination have yet not been delineated. Additional investigations and modeling for groundwater and LNAPL contamination will be part of an upcoming fate and transport report. Sampling at the site has identified the presence of LNAPL but has not identified the presence of dense non-aqueous phase liquid (DNAPL).

11. When will this investigation of air quality be extended to surrounding areas/neighborhoods? Their buildings were designed to prevent vaporization; our homes were not.
    a. TASC response: This question is beyond the scope of the TASC review. EPA has provided the following information: It is important to note the difference between ambient air quality and indoor air impacted by groundwater contamination beneath buildings. In relations to the neighborhood air quality, Philadelphia Air Management Services operates two ambient air monitoring stations in Philadelphia less than one mile from the PES refinery. The Ritner site is located northeast of the facility at 24th and Ritner Streets and has been in operation since 2004. The second site is the SWA site and is located southwest of the facility at 8200 Enterprise Avenue and has been in operation since 2009. Both locations sample for toxics including benzene once every six days for a 24-hour period. For the past three years, the average benzene data collected from these ambient air

monitoring locations has been below the 9 ug/m^3 annual average health benchmark for benzene. Philadelphia Air Management services has no plans on discontinuing either ambient air monitoring location. Vapor intrusion is the migration of volatile chemicals from contaminated groundwater and soils into the indoor air spaces of buildings through openings in the building foundation. The upcoming groundwater fate and transport and human health risk assessment should evaluate any potential for vapor intrusion.

12. Why hasn't indoor air monitoring been conducted at off-site buildings with underlying contaminant plumes?
    a. TASC response: The upcoming groundwater fate and transport and human health risk assessment should evaluate any potential for vapor intrusion off site.

13. Will EPA refinery fenceline air monitoring for benzene under method 325A/B continue on the site? The most recent data on the EPA website is from March 2020 but I understand that the data is uploaded quarterly.
    a. TASC response: This question is beyond the scope of the TASC review. EPA has provided the following information: Fence line air monitoring is currently continuing at the site. However, this monitoring was required under a federal regulation that applies to petroleum refineries. Once the site is no longer "a petroleum refinery," it will no longer be subject to the regulation and therefore not legally required to continue monitoring.

14. Has there been soil investigations for lead conducted outside the fenceline of the property?
    a. TASC response: The data presented in the RIRs are limited to the facility properties. Soil samples that exceeded the site-specific standard for lead were delineated on site, with the exception of AOI 10, which is located away from residential areas.

15. How does the Bulkhead Protection prevent transmission to the river under all conditions (seasonal, sea level rise, storm surge, flooding)?
    a. TASC response: The bulkheads are generally keyed into underlying clay layers and are expected to prevent or limit groundwater to surface water flow. The areas near the bulkhead and the effectiveness of the bulkheads should be further evaluated in the upcoming sitewide fate and transport report.

16. Why is Evergreen's site-specific lead standard (2,240 ppm) so much higher than the state standard (1,000 ppm)?
    a. TASC response: This question is beyond the scope of the TASC review.

17. How and where do the benzene pools interact?
    a. TASC response: The extent and delineation of benzene in groundwater is anticipated in the upcoming fate and transport report.

18. These graphics could be improved for better understanding:
    - The terms in the legend are not defined (NR SO to GW SHS, for example)
    - The dots are on top of each other in some areas.
    - The maps might benefit from being bigger, and shown with a higher resolution
    - Why are you just using shades of green to depict BENZENE in our water? Misleading

    a. TASC response: TASC's summary report and PowerPoint relied on Evergreen graphics from the RIRs and existing fact sheets.

19. Why are you just using shades of green to depict BENZENE in our water? Misleading.
    a. TASC response: TASC's summary report and PowerPoint relied on Evergreen graphics from the RIRs and existing fact sheets.

20. Will the cleanup be worse than the explosion with the chemical that you use for the cleanup?
    a. TASC response: The RIR reports do not present cleanup alternatives. Any use of potential chemical-based remediation would be considered in the proposed cleanup plan.

21. How can there be LNAPL on top of the shallow aquifer yet you say it's not contributing to groundwater contamination?
    a. TASC response: LNAPL can be a source of dissolved groundwater contamination. Sampling to date has included analyzing for dissolved concentrations in wells with LNAPL. This sampling occurs below the LNAPL. A comparison of dissolved concentrations in groundwater to the presence and amount of LNAPL present as well as the concentrations of contaminants in the LNAPL are used to determine if LNAPL is contributing to groundwater contamination. A more comprehensive,

sitewide evaluation of these data should be evaluated in the fate and transport report.

22. What is being done to prevent contaminated groundwater from entering the Pollock and 26th St Sewers?
    a. TASC response: Currently, there are interim remedial systems in place at the site that are intended to contain benzene on site and prevent contamination from moving off site and into receptors. While these systems are discussed in the RIRs for each AOI, their performance and effectiveness are not the focus of the RIRs. The Groundwater Remediation Status Reports may include more information about the groundwater remediation systems currently operating as part of the site. The August 2019 Groundwater Remediation Status Report is available on EPA's website: https://www.epa.gov/hwcorrectiveactionsites/documents-reports-and-photographs-sunoco-point-breeze-refinery-and-marketing

23. What is the quality of the water discharged from the Pollock St well system into the Schuylkill?
    a. TASC response: Currently, there are interim remedial systems in place at the site that are intended to contain benzene on site and prevent contamination from moving off site and into receptors. While these systems are discussed in the RIRs for each AOI, their performance and effectiveness are not the focus of the RIRs. The Groundwater Remediation Status Reports may include more information about the groundwater remediation systems currently operating as part of the site. The August 2019 Groundwater Remediation Status Report is available on EPA's website: https://www.epa.gov/hwcorrectiveactionsites/documents-reports-and-photographs-sunoco-point-breeze-refinery-and-marketing.

24. Heinz Nature preserve has a plant filtration system. Will there be any attempt to use natural systems to purify or clean the water and soil?
    a. TASC response: The RIR reports do not present cleanup alternatives. Any use of potential natural systems in the remedial approach would be considered in the proposed cleanup plan.

25. Please describe subsurface and airborne presence of benzene, their differences, prevalence, and connections.
    a. TASC response: The upcoming fate and transport report as well as the human health risk assessment will discuss the extent of benzene, the potential migration

of benzene off site, and any potential exposure pathways to the surrounding residential areas.

26. Why did it take 10+ years, and an almost-catastrophic explosion, for Evergreen to come back and engage the public?

    TASC response: This question is beyond the scope of the TASC review.

27. Will vapor intrusion studies be done in residents' homes to investigate the off-site benzene?
    a. TASC response: Ambient air and indoor air sampling conducted at AOI 8 in 2016 and 2017 indicated no exceedances of the EPA regional screening levels for industrial use. AOI 8 is located closest to the nearby residential neighborhood (Greys Ferry). The upcoming groundwater fate and transport and human health risk assessment should evaluate any potential for vapor intrusion off site.

28. What about the air quality after the cleanup? Can that be measured?
    a. TASC response: The RIR reports do not present cleanup alternatives. Any remedial technologies that would produce air emissions would be expected to comply with applicable air emission regulations and would be explained further in the cleanup plan.

29. Is pump-and-treat an appropriate technology for a site that is adjacent to the river? How can they ensure hydraulic containment when there is connection to the lower aquifer?
    a. TASC response: The RIR reports do not present cleanup alternatives. Pumping and treating of groundwater may be evaluated as a long-term cleanup component for the site. Assessment of pump-and-treat approaches would include considerations of aquifer connections and groundwater to surface water interactions.

30. What does "other ways" mean for bio and phyto-remediation?
    a. TASC response: The RIR reports do not present cleanup alternatives. Any specific approaches involving bioremediation or phytoremediation would be expected to be explained further in the cleanup plan.

31. Is capping an appropriate technology for an area that is prone to flooding? How could this impact stormwater management site, especially with climate change risks?

a. TASC response: The RIRs do not present cleanup alternatives. It is expected the cleanup plan will factor in the local flood risks when assessing remedial alternatives.

32. What was the impact of the recent hurricane on the ongoing remediation processes? Were any of the water treatment processes overwhelmed and were there any discharges into the River?
    a. TASC response: The RIRs do not include discussion of recent hurricane events or other weather events. The Groundwater Remediation Status reports may provide additional information: https://www.epa.gov/hwcorrectiveactionsites/documents-reports-and-photographs-sunoco-point-breeze-refinery-and-marketing.

33. Noting how LATE Evergreen's involvement has been.....how will Evergreen's/Sunoco's act 2 requirements change based on PES' heavy industrial classification into a light industrial classification?
    a. TASC response: The PADEP Act 2 standards applied in the RIRs assume non-residential land use (industrial or commercial). A zoning change from heavy to light industrial would not affect the Act 2 standards used in the RIRs.

34. LNAPL has been retrieved for years. What has been accomplished? What are conditions now as opposed to previously? Hilco plans to replace the water treatment systems. How? Why? What will the future hold?
    a. TASC response: The remediation systems operating in each AOI are described briefly in the RIRs, however these systems and their effectiveness are not the focus of the RIRs. The Groundwater Remediation Status reports may provide additional information: https://www.epa.gov/hwcorrectiveactionsites/documents-reports-and-photographs-sunoco-point-breeze-refinery-and-marketing.

35. How long will it take until cleanup starts?
    a. TASC response: TASC is not aware of an anticipated time for cleanup to begin.

36. We are still waiting on a city response to our request for a public hearing on Evergreen's existing remediation infrastructure, including vents that emit fumes coming from underground pollutants.
    a. TASC response: This question is beyond the scope of the TASC review.

37. The TASC Report (and RIRs) doesn't address issues related to PFAS. AFFF (Aqueous Film-Forming Firefighting Foam), which is used for Class B (liquid based, especially hydrocarbon fuel) fires contains PFAS ("forever" toxic contaminants). The PES Fire Brigade used AFFF to contain the fire at Point Breeze on 6/10/19 and Girard Point on 6/21/19. EPA and PADEP cannot ignore the PFAS problem at this site
    a. TASC response: This question is beyond the scope of the TASC review. EPA has provided the following information: EPA and PADEP are aware of this concern and are evaluating options with regard to PFAS.

38. Why wasn't a map/graphic of the benzene's mobility included in this presentation?
    a. TASC response: TASC's summary report and PowerPoint relied on Evergreen graphics from the RIRs and existing fact sheets.

39. There are still operation going at the site who are the operators filling tanks with order coming this way in south Philly
    a. TASC response: TASC is unaware of ongoing operations within the site area.

40. When will the fate and transport model be available?
    a. TASC response: TASC is unaware of the expected submittal date of the fate and transport report or when it will be available for public comment.

41. Will the cleanup affect the air and the water?
    a. TASC response: The RIRs do not present cleanup options for the site.

42. Can you describe the assumptions that were made during the risk assessment process (as referenced during conversation around lead)?
    a. TASC response: Both the PADEP standards and the calculated lead standard assume the property will not be used for residential purposes and will remain zoned for industrial or commercial use.

43. Of the various remediation methods, which ones are and are not options for this site? Which would expose the community the most? Which would primarily involve moving the problem to another community?
    a. TASC response: The RIRs do not present cleanup options for the site.

44. If the site were to be cleaned up to the most protective standard, what would need to be different in terms of cost or remediation methods used?

a. TASC response: The RIRs do not present cleanup options. In general, if more stringent standards are applied then the associated remedial costs would increase. In some cases, cleanup to the most protective standard is not possible due to physical limitations (infrastructure in the subsurface) or background contamination resulting from industrial activities outside of the site area. In addition, if cleanup goals were selected that differ from the Act 2 standards applied in the RIRs, then the extent of contamination would require reassessment.

45. The City's consultants recommend considering 6 feet of sea level rise by 2100 as an upper bound.
    a. TASC response: The RIRs do not consider impacts of long-term climate change. These potential impacts to the site may be factored into the assessment of cleanup options for the site.

46. Beyond the TASC Report and this Public Meeting, what is in the scope of work for Skeo technical assistance to the community? Will Skeo assistance extend beyond review/explanation of the Evergreen RIRs?
    a. TASC response: The purpose of TASC was to provide technical assistance in the form of a plain language summary of the RIR technical documents in order to provide the community at large with information needed to be better prepared for the meeting with Evergreen. That task has been completed, and the TASC project is now concluded.

47. Really, no anticipation of questions and concerns for the neighborhood? I look forward to response to today's questions.

    TASC response: The goals of the TASC assistance were to (1) enhance the community's understanding of the completed soil and groundwater investigations at the refinery and (2) provide the community the necessary knowledge to fully participate as the site progresses through the remaining investigations and remedy selection. Responses to questions within the scope of the assistance have been provided.

48. Can anything be built there after the cleanup?
    a. TASC response: Potential future development or reuse are not discussed in the RIRs.

49. Given Skeo's experience with remediation and advising communities through TASC, what deficiencies have you found with the RIRs? What contaminants or areas should community members focus on?
    a. TASC response: While not a deficiency of the RIRs, it is clear that full delineation of on-site and off-site contamination is not complete and there is no final conceptual site model that includes all pathways of concern. Going forward, the community members may choose to pursue clarity on the final delineation of all soil and groundwater contamination as well as potential exposures to migrating benzene contamination in off-site areas.

50. What questions has Skeo asked to Evergreen? Were the answers received satisfactory? What unanswered questions does Skeo have for Evergreen?
    a. TASC response: TASC has not engaged directly with Evergreen. The RIRs reviewed by TASC have been approved by PADEP.

51. What ways can we expect Skeo to engage with the community going forward? Will there be an opportunity for meaningful dialogue, as opposed to a 'managed' Q&A?
    a. TASC response: The purpose of TASC was to provide technical assistance in the form of a plain language summary of the RIR technical documents in order to provide the community at large with information needed to be better prepared for the meeting with Evergreen. That task has been completed, and the TASC project is now concluded.

52. Does bringing in EPA EJ trigger NEPA and the 'meaningful engagement' standard when doing EJ work? Why wasn't EPA EJ more present when Evergreen was absent (for so long) in the process?
    a. TASC response: This question is beyond the scope of the TASC review. EPA has provided the following information: Environmental justice (EJ) does not trigger NEPA. EPA is working to integrate EJ into all programs. EPA's EJ Program has not been previously involved in ACT 2 cleanups because the PADEP is the lead agency responsible for overseeing the cleanup and any public participation requirements. At the request of community members, EPA's EJ Program became involved and was able to secure TASC to address the community questions about the technical nature of the RIR documents.

53. Would a hurricane/storm surge/flooding bring LNAPL (and others?) to the surface, and leave them there once the flooding subsides?

a. TASC response: The RIRs do not present cleanup alternatives. It is expected the cleanup plan will factor in the local flood risks when assessing remedial alternatives.

54. Regarding legibility, Figure 3 on page 8 of the report is also not very readable.
    a. TASC response: TASC's summary report and PowerPoint relied on Evergreen graphics from the RIRs and existing fact sheets.

55. A lot of the cleanup options are not very benign, like stirring up dust and toxic chemicals if digging waste up, or soil vapor extraction (where chemicals are stripped into the air), or where incineration is used in any form (including "soil burner" plants like the one in SW Philly), or where plants used in phytoremediation are disposed of by burning.
    a. TASC response: The RIR reports do not present cleanup alternatives. The risks and associated regulations and best management practices of each remedial alternative would be considered in the cleanup plan.

56. The climate change issue here is not so much increased precipitation, but rather that the Schuylkill is tidal, and will rise along with sea levels worldwide. What impact might a 6-foot higher level of the Schuykill have?
    a. TASC response: The RIRs do not consider impacts of long-term climate change. These potential impacts to the site may be factored into the assessment of cleanup options for the site.

57. As a community member, it appears this presentation continues to give the community responses that don't fully answer community concerns to assure that areas around the refinery site are going to any better off by the clean-up efforts presently being used. In the upcoming feedback and comment sessions I would hope off-site community concerns will be addressed.
    a. TASC response: This presentation focused on the completed RIRs. The upcoming fate and transport, risk assessment, and proposed cleanup plan and associated outreach will continue to address the community's questions and concerns.

58. I'd like to see green infrastructure plans for the property.
    a. TASC response: The RIR reports do not present cleanup alternatives or reuse ideas. Any use of potential green infrastructure at the property would be considered in the proposed cleanup plan or separate reuse planning documents.

59. How can we copy the chat? Can this be made available?
    a. TASC response: This list of questions and responses reflects the extent of questions asked in the chat log.