August 2019

**DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION**
Interim Final 2/5/99
**RCRA Corrective Action**
**Environmental Indicator (EI) RCRIS code (CA750)**
**Migration of Contaminated Groundwater Under Control**

**Facility Name: Rohm and Haas Bristol Plant**
**Facility Address: 200 Route 413, Bristol, PA**
**Facility EPA ID #: PAD 002 292 068**

1. Has **all** available relevant/significant information on known and reasonably suspected releases to the groundwater media, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

☒ If yes - check here and continue with #2 below.

☐ If no - re-evaluate existing data, or

☐ If data are not available, skip to #8 and enter "IN" (more information needed) status code.

## BACKGROUND

### Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

### Definition of "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

### Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, (GPRA). The "Migration of Contaminated Groundwater Under Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated ground water and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination and the need to restore, wherever practicable, contaminated groundwater to be suitable for its designated current and future uses.

### Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

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2. Is **groundwater** known or reasonably suspected to be **"contaminated"**[1] above appropriately protective "levels" (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

   ☒ If yes - continue after identifying key contaminants, citing appropriate "levels," and referencing supporting documentation.

   ☐ If no - skip to #8 and enter "YE" status code, after citing appropriate "levels," and referencing supporting documentation to demonstrate that groundwater is not "contaminated."

   ☐ If unknown - skip to #8 and enter "IN" status code.

Groundwater was investigated at six study areas within the Bristol Plant. They are outlined on the attached figure.

Drinking water screening levels referenced in this evaluation are the EPA Safe Drinking Water Act Maximum Contaminant Levels (MCLs), or the EPA Regional Screening Levels for tap water (RSLs) when no MCL is established.

Elevated manganese concentrations are found throughout the Bristol Plant. Manganese concentrations are naturally occuring, attributed to regional background condition. The assessment of background manganese concentrations is documented in Assessment of On-Site and Off-Site Manganese in Groundwater and Potential Influence Due to the Ammonium Sulfate Plume, Rohm and Haas Company, prepared by URS (February 2016); and approved by EPA and PADEP in April 2016.
**Therefore, manganese is not a "contaminant" related to the Bristol Plant.**

**North Parcel – Groundwater is not contaminated by releases at or from the facility.**

Only trichloroethylene (TCE) was detected above drinking water screening levels. During the Environmental Site Investigation, TCE was detected above the MCL of 5ug/l. TCE was detected in only one well, a background well, at 12 ug/l. The TCE contamination is attributed to the Croydon TCE Superfund Site contamination. Ongoing monitoring of the Superfund Site confirms that residual TCE contamination remains beneath part of the North Parcel. Maximum TCE concentrations in November 2017 were 7.9 ug/l in the shallow groundwater and 16.1 ug/l in the deep groundwater. PADEP is continuing remediation of the Croydon TCE Superfund Site groundwater contamination.
**Therefore, TCE is not a "contaminant" related to the North Parcel.**

**References:**

**Environmental Site Investigation Report, Parcel North of River Road, Rohm and Haas Company**, prepared by ST Environmental, April 2003

**Act 2 Final Closure Report for River Road North Parcel, Rohm and Haas Company**, prepared by URS, August 2012

**Fourth Five-Year Review Report for Croydon TCE Superfund Site, Bucks County, PA**, prepared by USEPA, Region 3, December 2, 2016.

**Croydon TCE NPL Site, Sampling and Operation & Maintenance Semi-Annual Report**, PADEP, prepared by Michael Baker/O'Brien & Gere, April 2018

**Bristol Landfill** - The landfill areas were closed with waste in place. Closure included the installation of a hydraulic barrier around the perimeter of the waste, and construction of a RCRA cap over the waste disposal areas. Post-closure care monitoring includes sampling at 22 groundwater wells outside of the barrier and at 4 stream locations. The most recent monitoring results are documented in the 2018 Post-Closure Monitoring Report (July 2019). The Report screens the detected constituents against the Media Protection Standards established in the December 1991 Record of Decision, and implemented through the August 1992 Administrative Order on Consent. The following evaluation screens the detected constituents against current drinking water screening levels.

Only one contaminant exceeded the drinking water screening levels. Bis(2-chloroethyl) ether (BCEE) exceeded the RSL of 0.014 ug/l at one location, LF-210, adjacent to the Delaware River. BCEE was detected in the Alluvial (shallow) well (7' to 13' below ground surface (bgs)) and in the Trenton Gravel (deep) well (38' to 48' bgs). The 2018 concentrations of BCEE were 1.0 ug/l in the shallow aquifer, and 14.3 ug/l in the deep aquifer. BCEE was not detected (<1.0 ug/l) at all other locations. BCEE was not detected in surface water samples.

**References**

**Bristol Landfill, 2018 Post-Closure Monitoring Report, Rohm and Haas Chemicals LLC**, prepared by Arcadis, July 2019

**Ammonium Sulfate Area** – Residual contamination from the disposal of ammonium sulfate waste exists in the groundwater. The total mass has decreased over time through natural attenuation. The 2014 Corrective Measures Study assessment identified a maximum ammonium sulfate concentration of 14,000 mg/l at the center of the plume. The maximum groundwater concentrations in the Point-of-Compliance wells adjacent to the Delaware River were:

| | Ammonia-Nitrogen, mg/l | Sulfate, mg/l |
|---|---|---|
| 2014 | 291 | 87 |
| 2018 | 155 | 35 |

There are no drinking water screening standards for ammonia or sulfate, although ammonia is extremely irritating to skin, eyes, and respiratory passages. PA Surface Water Quality Criteria (SWQC) for the Delaware River, where the plume might discharge, are:

- 1.34 mg/l ammonia-nitrogen, and
- 250 mg/l sulfate.

**References**

**Ammonium Sulfate Area RCRA Corrective Measures Study and Technical Impracticability Assessment, Rohm and Haas Company Bristol Plant**; URS Corp for Rohm and Haas Company, June 2016

**Initial Protectiveness Event, January 2017, Ammonium Sulfate Area Rohm and Haas Company Bristol Plant**; prepared by AECOM, March 31, 2017

**2018 Protectiveness Assessment, Ammonium Sulfate Area, Rohm and Haas Company, Bristol Plant**; prepared by Arcadis, February 2019

**Former Wastewater Treatment Area** – Organic contamination above drinking water screening levels existed primarily in an area adjacent to the Delaware River (Former Burning Area). The maximum concentrations of groundwater contamination corresponded to zones of highest soil contamination: the alluvial fill (shallow) zone, 2' to 10' below ground surface (bgs); and the upper saprolite (deep) zone, 40' to 50' bgs.

The following chemicals exceeded the drinking water screening levels:

| | Drinking Water Screening Level (ug/l) | Max concentration (ug/l) Shallow Groundwater 5' to 19' bgs | Max concentration (ug/l) Deep Groundwater 30' to 53' bgs |
|---|---|---|---|
| Bis(2-chloroethyl) ether (BCEE) | 0.014 | 20 | 25,000 |
| Bis(2-ethylhexyl) phthalate | 6 | - | 17 |
| benzene | 5 | 500 | 790 |
| chlorobenzene | 100 | 440 | 3,200 |
| 1,2-dichlorobenzene | 600 | 2,000 | 1,400 |
| 1,4-dichlorobenzene | 75 | 210 | 330 |
| 1,2-dichloroethane | 5 | 110 | 180 |
| 1,2-dichloropropane | 5 | 37 | 43 |
| 1,4-dioxane | 0.46 | - | 750 |
| Methylene chloride | 5 | - | 89 |
| tetrachloroethylene | 5 | - | 23 |
| trichloroethylene | 5 | 8 | 17 |
| Vinyl chloride | 2 | - | 13 |

**References**

**Former Burn Area, Act 2 Remedial Investigation Report, Rohm & Haas Company,** prepared by AECOM, June 2017

**Former Burning Area, Act 2 Clean-up Plan, Rohm & Haas Company Bristol Plant**, prepared by AECOM, August 2017

**Act 2 Final Report for Groundwater at the Former Wastewater Treatment Plant Area, Bristol Plant, Rohm and Haas Company**, prepared by AECOM, January 2018

**Manufacturing Area** – The current groundwater assessment was conducted from 2015 through 2018. It included 6 rounds of sampling from 69 wells.

Groundwater contaminants are limited in aerial extent and do not form contiguous plumes. Several constituents were detected at concentrations above screening levels in only one round of sampling, and are not considered contaminants of concern.

The following chemicals exceeded the drinking water screening levels:

| | Drinking Water Screening Level (ug/l) | Max concentration (ug/l) |
|---|---|---|
| Bis(2-chloroethyl) ether (BCEE) | 0.014 | 91 |
| Benzene | 5 | 18 |
| Benzo(a)Pyrene | 0.2 | 2.0 |
| Ethyl acrylate | 140 | 290,000 |
| Naphthalene | 0.17 | 3,300 |
| 1,4-dioxane | 0.46 | 300 |
| Arsenic | 10 | 144 |
| Cadmium | 5 | 46 |
| Cobalt | 6 | 53 |
| Nickle | 390 | 482 |
| Vanadium | 86 | 339 |
| Cyanide | 200 | 404 |

**References**

**Bristol Manufacturing Area, revised Act 2 Remedial Investigation Report/Focused Risk Assessment/Cleanup Plan for Soil, Rohm and Haas Company**, prepared by AECOM, July 2019

**Trailer Staging Area** – Contamination is highest within and immediately adjacent to the area of buried waste. Six rounds of groundwater samples were collected from 2016 through 2018. A seventh round of samples will be collected in 2019.

The primary contaminants of concern in 2016-2018 were:

| | Holocene (shallow) Aquifer | | Trenton Gravel (deep) Aquifer | | |
|---|---|---|---|---|---|
| | Maximum concentration ug/l | Perimeter well maximum concentration ug/l | Maximum concentration ug/l | Perimeter well Maximum concentration ug/l | Drinking Water Screening Level ug/l |
| 1,2-Dichloroethane | 40,000 | Up to 160 | 390 | Up to 390 | 5 |
| BCEE | 2,200 | Up to 17 | 17 | Up to 17 | 0.014 |
| Zinc | 6,516 | All below RSL | All below RSL | All below RSL | 6,000 |
| Arsenic | 1,423 | Up to 75 | 27 | Up to 19 | 10 |

Other contaminants within the buried waste area include benzene, 1,4-dioxane, and 1,2-dichlorobenzene. Tetrachloroethylene (PCE), trichloroethylene (TCE), and vinyl chloride (VC) were detected in the deep groundwater, the Trenton Gravel aquifer and deeper Raritan formation. The highest concentrations are off-site, in the upgradient wells located north of the Trailer Staging Area. These contaminants are likely migrating from an off-site source.

**References**

**Trailer Staging Area, Monitoring Well Rehabilitation and Groundwater Sampling Summary, Rohm and Haas Company**, prepared by URS, October 2016

**Trailer Staging Area, RI Groundwater Summary, Rohm and Haas Company**, prepared by AECOM, July 26, 2019

Footnotes:

[1]"Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

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3. Has the **migration** of contaminated groundwater **stabilized** (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater"[2] as defined by the monitoring locations designated at the time of this determination)?

☒ If yes - continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimensions of the "existing area of groundwater contamination"[2]).

☐ If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the "existing area of groundwater contamination"[2]) – skip to #8 and enter "NO" status code, after providing an explanation.

☐ If unknown - skip to #8 and enter "IN" status code.

## Bristol Landfill

BCEE is the only contaminant detected in groundwater. The concentrations exceed the screening level at only location, in wells LF-210S (shallow aquifer) and LF-210D (deep aquifer). Table 10 and Figure 10 of the 2018 Post-Closure Monitoring Report show BCEE concentrations from 2013 through 2018. Concentrations are stable or decreasing through that period. In addition, BCEE was not detected in the Delaware River surface water sample DR-400-PCA. That point-of-compliance sample location is directly in line with the LF-210 well location.

BCEE concentrations in ug/l - average of quarterly sampling results

| | LF-210S<br>Shallow Aquifer: 7' to 13' bgs | LF-210D<br>Deep Aquifer: 38' to 48' bgs |
|---|---|---|
| 2013 | 5.6 | 21.0 |
| 2014 | 3.0 | 20.7 |
| 2015 | 3.9 | 17.1 |
| 2016 | 4.4 | 28.5 |
| 2017 | 3.3 | 28.0 |
| 2018 | 1.0 | 14.3 |

**Reference: Bristol Landfill, 2018 Post-Closure Monitoring Report, Rohm and Haas Chemicals LLC**, prepared by Arcadis, July 2019

## Ammonium Sulfate Area

The Ammonium Sulfate plume is monitored at 11 wells along the perimeter of the Delaware River to determine whether plume migration into the Delaware River may impact aquatic life.

The 2018 Protectiveness Assessment shows that ammonia-nitrogen concentrations are declining. The maximum concentrations in the Point-of-Compliance wells along the Delaware River have decreased.

| | Ammonia-nitrogen<br>mg/l | Sulfate<br>mg/l |
|---|---|---|
| 2014 | 291 | 87 |
| 2018 | 155 | 35 |

**Reference:**

**Ammonium Sulfate Area RCRA Corrective Measures Study and Technical Impracticability Assessment, Rohm and Haas Company Bristol Plant**; URS Corp for Rohm and Haas Company, June 2016

**2018 Protectiveness Assessment, Ammonium Sulfate Area, Rohm and Haas Company, Bristol Plant**; prepared by Arcadis, February 2019

## Former Wastewater Treatment Area

Six contaminants exceeded the drinking water screening levels at the Point-of-Compliance wells along the perimeter of the Delaware River.

| | Drinking Water Screening Leve (ug/l) | Max concentration (ug/l) Shallow Groundwater 5' to 19' bgs | Max concentration (ug/l) Deep Groundwater 30' to 53' bgs |
|---|---|---|---|
| Bis(2-chloroethyl) ether (BCEE) | 0.014 | 16 | 730 |
| Benzene | 5 | 110 | 99 |
| Chlorobenzene | 100 | 440 | 1,800 |
| 1,4-dichlorobenzene | 75 | - | 150 |
| 1,2-dichloroethane | 5 | 27 | 7.2 |
| 1,4-dioxane | 0.46 | - | 130 |

A fate and transport assessment of groundwater contamination into the Delaware River identified one potential exceedance of the SWQC for the Delaware River. Migration of BCEE in the deep groundwater zone may result in surface water concentrations above the human health SWQC. The mass discharge calculation, using conservative assumptions, predicted a possible maximum in-stream concentration of 0.053 ug/l BCEE. This exceeds the human health criterion of 0.030 ug/l, but not the aquatic life criterion of 6,000 ug/l.

The contaminated soil in the upper saprolite, which was acting as source of continuing release to the deep groundwater zone, was treated by in-situ chemical oxidation to eliminate the bulk of the contamination. In November 2017, forty-two thousand (42,000) pounds of potassium permanganate was emplaced into multiple horizontal reactive zones within the upper saprolite. This should completely degrade the contamination in the deep groundwater zone. This prevents the migration of the contaminant plume beyond the bank of the Delaware River. Post-treatment groundwater monitoring will determine whether additional remediation is needed.

**References**

**Former Burn Area, Act 2 Remedial Investigation Report, Rohm & Haas Company,** prepared by AECOM, June 2017

**Former Burning Area, Act 2 Clean-up Plan, Rohm & Haas Company Bristol Plant**, prepared by AECOM, August 2017

**Act 2 Final Report for Groundwater at the Former Wastewater Treatment Plant Area, Bristol Plant, Rohm and Haas Company**, prepared by AECOM, January 2018

## Manufacturing Area

Although several constituents exceed the drinking water screening levels, the contamination area for any particular constituent is very localized. There are no contiguous plumes. Contamination is not migrating.

Constituents with significant exceedances, over 10 times the screening level, are evaluated below.

- BCEE: Highest concentrations were detected at well W-49-25. The highest concentration, 97 ug/l, was detected in 2015. Concentrations in 2018 were 27 ug/l and 17 ug/l. Hydropunch groundwater samples adjacent to W-49-25 were collected in 2017. BCEE concentrations in those samples were 3.6 ug/l and 0.77 ug/l.
- Ethyl Acrylate (EA): EA exceeded screening levels only in well W-111-20. The highest concentration, 290,000 ug/l, was found in October 2016. This location is immediately downgradient of the EA release area (May 2014). Remediation and natural attenuation reduced the concentrations of EA in groundwater. EA concentrations in 2018 were 43,000 ug/l in August, and 16 ug/l in November.
- Naphthalene: High concentrations are centered around Tank Farm 30A. The highest groundwater concentration was detected in April 2017, at 3,300 ug/l. Naphthalene concentrations declined to 120 ug/l in August 2018.
- 1,4-Dioxane: High concentrations are centered in two areas; well W-49-25 and Well W-14-35. Concentrations in 2018 were an order of magnitude below the highest concentrations detected during the assessment.
- Arsenic: High arsenic concentrations are found in proximity to areas where Holocene organic silt deposits are present. The highest concentrations, found in wells W-10-20, W-11-27, and W-77-23, are stable through the 2015-2018 assessment.

**References**

**Bristol Manufacturing Area, revised Act 2 Remedial Investigation Report/Focused Risk Assessment/Cleanup Plan for Soil, Rohm and Haas Company**, prepared by AECOM, July 2019

## Trailer Staging Area

Comparison of contaminant concentrations over the six rounds of sampling from, 2016 through 2018, show relatively stable concentrations. Comparison of the 2016-2018 data with the 2001 sampling data show a general reduced of organic chemical concentrations in the shallow aquifer. Other contamination remained stable.

**Perimeter well concentration comparison**

| | W-2-10: Holocene (shallow) well | | W-22-33: Trenton Gravel (deep) well | |
|---|---|---|---|---|
| | **2/2016** | **3/2018** | **2/2016** | **3/2018** |
| 1,2-Dichloroethane | 160 | 150 | 76 | 5.9 |
| BCEE | 13 | 10 | 1.6 | 0.7 |
| Arsenic | - | - | 17 | 19 |
| Zinc | 2,628 | 1,368 | - | - |

All concentrations are in ug/l

**References**

**Trailer Staging Area, Monitoring Well Rehabilitation and Groundwater Sampling Summary, Rohm and Haas Company**, prepared by URS, October 2016

**Trailer Staging Area, RI Groundwater Summary, Rohm and Haas Company**, prepared by AECOM, July 26, 2019

[2] "existing area of contaminated groundwater" is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of "contamination" that can and will be sampled/tested in the future to physically verify that all "contaminated" groundwater remains within this area, and that the further migration of "contaminated" groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

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4. Does "contaminated" groundwater **discharge** into **surface water** bodies?

☒ If yes - continue after identifying potentially affected surface water bodies.

☐ If no - skip to #7 (and enter a "YE" status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater "contamination" does not enter surface water bodies.

☐ If unknown - skip to #8 and enter "IN" status code.

**Bristol Landfill** – Contaminated groundwater discharges to the Delaware River.

**Ammonium Sulfate Area** - Contaminated groundwater discharges to the Delaware River.

**Former Wastewater Treatment Area** – Contaminated groundwater discharges to the Delaware River

**Manufacturing Area** – Contaminated water discharges to Otter Creek and Schmidt's Lake, a man-made basin.

**Trailer Staging Area** - Contaminated groundwater discharges to the Otter Creek.

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5. Is the **discharge** of "contaminated" groundwater into surface water likely to be **"insignificant"** (i.e., the maximum concentration[3] of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

☐ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting:
1) the maximum known or reasonably suspected concentrations of key contaminants discharged above their groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and
2) provide a statement of professional judgment/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or eco-system.

☒ If no - (the discharge of "contaminated" groundwater into surface water is potentially significant) - continue after documenting:
1) the maximum known or reasonably suspected concentrations of each contaminant discharged above its groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and
2) for any contaminants discharging into surface water in concentrations greater than 100 times their appropriate groundwater "levels," the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify **if there is evidence that the amount of discharging contaminants is increasing.**

☐ **If unknown - enter "IN" status code in #8.**

Groundwater at the Bristol Plant is not used for any consumptive purpose. Future groundwater use is or will be restricted by environmental covenants. All contaminated groundwater discharges to the Delaware River, Schmidt's Lake, or Otter Creek. Therefore, the PA Surface Water Quality Standards are used in this evaluation as the contaminant screening level (the "appropriate groundwater level").

## Bristol Landfill

BCEE is the only contaminant of concern. The Surface Water Quality Criteria (SWQC) for BCEE are:
0.03 ug/l, human health criterion, and
6,000 ug/l, aquatic life criterion.

The maximum detected concentrations in 2018 exceeded the human health SWQC:
Alluvial (shallow) aquifer, well LF-210S: 1.0 ug/l BCEE
Trenton Gravel (deep) aquifer, well LF-210D: 14.3 ug/l BCEE

Table 10 and Figure 10 of the Bristol Landfill, 2018 Post-Closure Monitoring Report, show BCEE concentrations from 2013 through 2018. Concentrations are stable or decreasing through that period.

**References**

**Bristol Landfill, 2018 Post-Closure Monitoring Report, Rohm and Haas Chemicals LLC**, prepared by Arcadis, July 2019

## Ammonium Sulfate Area

Sulfate concentrations at the Point-of Compliance wells along the Delaware River are below the SWQC of 250 mg/l. The maximum sulfate concentration detected in 2018 was 35 mg/l.

The maximum detected total ammonia-nitrogen concentration at a Point-of Compliance well is 155 mg/l, above the SWQC of 1.34 mg/l.

The 2018 Protectiveness Assessment shows that the plume is shrinking. The maximum concentrations in the Point-of-Compliance wells along the Delaware River have decreased.

| | Total Ammonia-Nitrogen, mg/l | Sulfate mg/l |
|---|---|---|
| 2014 | 291 | 87 |
| 2018 | 155 | 35 |

**Reference:**

**Ammonium Sulfate Area RCRA Corrective Measures Study and Technical Impracticability Assessment, Rohm and Haas Company Bristol Plant**; URS Corp for Rohm and Haas Company, June 2016

**2018 Protectiveness Assessment, Ammonium Sulfate Area, Rohm and Haas Company, Bristol Plant**; prepared by Arcadis, February 2019

**Former Wastewater Treatment Area – The discharge is likely to be insignificant.**

A fate and transport assessment of groundwater contamination into the Delaware River identified one potential exceedance of the SWQC for the Delaware River. Migration of BCEE in the deep groundwater zone may result in surface water concentrations above the human health SWQC. The mass discharge calculation, using conservative assumptions, predicted a possible maximum in-stream concentration of 0.053 ug/l BCEE. This exceeds the human health criterion of 0.030 ug/l, but not the aquatic life criterion of 6,000 ug/l.

The contaminated soil in the upper saprolite, which was acting as source of continuing release to the deep groundwater zone, was treated by in-situ chemical oxidation to eliminate the bulk of the contamination. In November 2017, forty-two thousand (42,000) pounds of potassium permanganate was emplaced into multiple horizontal reactive zones within the upper saprolite. This should completely degrade the contamination in the deep groundwater zone. This prevents the migration of the contaminant plume beyond the bank of the Delaware River. Post-treatment groundwater monitoring will determine whether additional remediation is needed.

**References**

**Former Burn Area, Act 2 Remedial Investigation Report, Rohm & Haas Company,** prepared by AECOM, June 2017

**Former Burning Area, Act 2 Clean-up Plan, Rohm & Haas Company Bristol Plant**, prepared by AECOM, August 2017

**Act 2 Final Report for Groundwater at the Former Wastewater Treatment Plant Area, Bristol Plant, Rohm and Haas Company**, prepared by AECOM, January 2018

**Manufacturing Area**

Contaminated groundwater discharges to Otter Creek to the north, the Trailer Staging Area to the northeast, and to Schmidt's Lake to the south. Groundwater migration to the east does not exceed screening levels.

Otter Creek - Contaminant concentrations along the bank of Otter Creek that exceed SWQC are:

| | SWQC Human Health, ug/l | SWQC Aquatic Life, ug/l | location | Maximum Concentration, ug/l |
|---|---|---|---|---|
| Zinc | NA | 120 | W-1-23<br>W-38-12 | 3,151<br>4,087 |
| Arsenic | 10 | 150 | W-115-18 | 29 |
| Cobalt | - | 19 | W-1-23 | 43 |

BCEE and 1,2-Dichloroethane concentrations exceed the screening levels at well W-2-10. That well is located at the Trailer Staging Area, downgradient of the Manufacturing Area. The contamination is evaluated as part of the Trailer Staging Area.

Schmidt's Lake – The basis does not have an outlet and is not used for recreation. Six rounds of groundwater samples (2015-2018) show no constituents above SWQC for aquatic life.

**References**

**Bristol Manufacturing Area, revised Act 2 Remedial Investigation Report/Focused Risk Assessment/Cleanup Plan for Soil, Rohm and Haas Company**, prepared by AECOM, July 2019

## Trailer Staging Area

Groundwater monitoring (2016-2018) identifies the following potential discharges to Otter Creek, based on contaminant concentration in wells adjacent to the Creek.

Holocene (shallow) groundwater

- BCEE, 1,2-DCA, and zinc along the north bank; and
- Arsenic along the northeast bank.

Trenton Gravel (deep) aquifer

- 1,2-DCA along the east bank; and
- BCEE along the north bank.

Maximum perimeter well contaminant concentrations compared to SWQC

| | SWQC Human Health | SWQC Aquatic Life | Shallow Aquifer Maximum Concentration | Deep Aquifer Maximum Concentration |
|---|---|---|---|---|
| 1,2-Dichloroethane | 0.38 | 3,100 | 160 | 390 |
| BCEE | 0.30 | 6,000 | 17 | 17 |
| Zinc | NA | 120 | 5,047 | All below RSL |
| Arsenic | 10 | 150 | 75 | 19 |

All concentrations are in ug/l

Comparison of contaminant concentrations over the six rounds of sampling from 2016 through 2018 show relatively stable concentrations. Comparison of the 2016-2018 data with the 2001 sampling data show a general reduced of organic chemical concentrations in the shallow aquifer. Other contamination remained stable.

**References**

**Trailer Staging Area, Monitoring Well Rehabilitation and Groundwater Sampling Summary, Rohm and Haas Company**, prepared by URS, October 2016

**Trailer Staging Area, RI Groundwater Summary, Rohm and Haas Company**, prepared by AECOM, July 26, 2019

[3] As measured in groundwater prior to entry to the groundwater-surface water/sediment interaction (e.g., hyporheic) zone.

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6. Can the **discharge** of "contaminated" groundwater into surface water be shown to be "**currently acceptable**" (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

☒ If yes - continue after either:
1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site's surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR
2) providing or referencing an interim-assessment[5], appropriate to the potential for impact that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialists, including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment "levels," as well as any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

☐ If no - (the discharge of "contaminated" groundwater can not be shown to be "**currently acceptable**") - skip to #8 and enter "NO" status code, after documenting the currently unacceptable impacts to the surface water body, sediments, and/or eco-systems.

☐ If unknown - skip to 8 and enter "IN" status code.

## Bristol Landfill

A fate and transport assessment of groundwater contamination into the Delaware River was performed as part of the Former Wastewater Treatment Area (Former Burning Area), immediately adjacent to the Bristol Landfill. The assessment shows that the groundwater concentrations are one to two orders of magnitude below concentrations needed to exceed the SWQC of 0.03 ug/l BCEE.

**References**

**Bristol Landfill, 2018 Post-Closure Monitoring Report, Rohm and Haas Chemicals LLC**, prepared by Arcadis, July 2019

**Former Burn Area, Act 2 Remedial Investigation Report, Rohm and Haas Company**, prepared by AECOM, June 2017- Section 4: Fate and Transport Analysis

## Ammonium Sulfate Area

The maximum detected ammonia-nitrogen concentration at a Point-of Compliance well is 155 mg/l, above the SWQC of 1.34 mg/l. A fate and transport assessment conducted as part of the Corrective Measures Study and Technical Impracticability Assessment, June 2016, shows that current discharges are not adversely impacting surface water quality.

The 2018 Protectiveness Assessment calculated the groundwater mass discharge to the Delaware River based on the 2018 groundwater concentrations. The groundwater discharge was calculated to contribute 0.196 mg/l of total ammonia-nitrogen to the River. The total River concentration, including the background concentration of 0.088 mg/l, is estimated to be 0.284 mg/l. That is well below the SWQC of 1.34 mg/l total ammonia-nitrogen.

**Reference:**

**Ammonium Sulfate Area RCRA Corrective Measures Study and Technical Impracticability Assessment, Rohm and Haas Company Bristol Plant**; URS Corp for Rohm and Haas Company, June 2016

**2018 Protectiveness Assessment, Ammonium Sulfate Area, Rohm and Haas Company, Bristol Plant**; prepared by Arcadis, February 2019

**Manufacturing Area**

A groundwater-to-surface water mass-flux evaluation was performed along the Otter Creek for the contaminants noted in question 5 (above). The estimated surface water concentrations were below the SWQC. The surface water concentration was estimated for each of the 6 groundwater sampling events. The estimated stream concentrations were:

- Zinc: 2.42 ug/l to 9.17 ug/l; below the SWQC of 120 ug/l
- Arsenic: 0 to 0.07 ug/l; below the SWQC of 10 ug/l
- Cobalt: 0 to 0.08 ug/l; below the SWQC of 19 ug/l

**References**

**Bristol Manufacturing Area, revised Act 2 Remedial Investigation Report/Focused Risk Assessment/Cleanup Plan for Soil, Rohm and Haas Company**, prepared by AECOM, July 2019
Appendix N: Tidal Study and Groundwater Discharge Evaluation

**Trailer Staging Area**

A preliminary evaluation of groundwater mass discharge to Otter Creek was conducted based on the 6 rounds of data from 2016 through 2018. The assessment makes the following estimates of in stream concentrations.

- 1,2-Dichloroethane approaches, but does not exceed the SWQC of 0.38 ug/l.
- BCEE exceeds the SWQC of 0.03 ug/l only with the October 2018 groundwater concentration. Average surface water concentrations over the assessment period are below the SWQC.
- Arsenic and zinc are well below the SWQC.

The groundwater will be sampled again in 2019. After the 2019 sampling data is available, the groundwater to surface water assessment will be reevaluated.

**References**

**Trailer Staging Area, Monitoring Well Rehabilitation and Groundwater Sampling Summary, Rohm and Haas Company**, prepared by URS, October 2016
**Trailer Staging Area, RI Groundwater Summary, Rohm and Haas Company**, prepared by AECOM, July 26, 2019

[4] Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.

[5] The understanding of the impacts of contaminated groundwater discharges into surface water bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediments or eco-systems.

**Migration of Contaminated Groundwater Under Control**
**Environmental Indicator (EI) RCRIS code (CA750)**

7. Will groundwater **monitoring** / measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the "existing area of contaminated groundwater?"

☒ If yes - continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations, which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the "existing area of groundwater contamination."

☐ If no - enter "NO" status code in #8.

☐ If unknown - enter "IN" status code in #8.

Monitoring locations are noted on the attached figure

**Bristol Landfill** - Post-closure care monitoring includes sampling at 22 groundwater wells outside of the landfill closure structures, and at 4 stream locations. This monitoring will continue through the post-closure period.

**Ammonium Sulfate Area** - On-going protectiveness assessments are required to determine the impact of contaminated groundwater discharges to the Delaware River. Groundwater sampling is required from 16 wells; 20 total samples at various depths. Eleven of the wells are Point-of Compliance wells along the bank of the Delaware River. Five wells are sentinel wells, to identify contaminant plume migration prior to impacting the River.

**Former Wastewater Treatment Area** - The treatment plan for the contaminated soil in the Former Burning Area requires monitoring at 9 groundwater wells to determine the effectiveness of the treatment.

**Manufacturing Area** - Soil remediation (removal) is proposed for an isolated area contaminated with lubrication oil and diesel fuel around well W-93. Two rounds of post-remediation groundwater sampling will be performed at a replacement well.

**Trailer Staging Area** - Assessment groundwater monitoring is continuing. Verification monitoring will be determined after the final assessment and remediation decision.

**Migration of Contaminated Groundwater Under Control**
**Environmental Indicator (EI) RCRIS code (CA750)**

8. Check the appropriate RCRIS status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

☒ YE - Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control" at the (insert facility and EPA ID #, located at (insert address). Specifically, this determination indicates that the migration of "contaminated" groundwater is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater" This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

☐ NO - Unacceptable migration of contaminated groundwater is observed or expected.

☐ IN - More information is needed to make a determination.

Completed by (signature) _____ Date 8-12-2019
(print) Maureen Essenthier
(title) Remedial Project Manager

Supervisor (signature) _____ Date 8-12-2019
(print) Paul Gotthold
(title) RCRA Corrective Action Branch Chief
(EPA Region or State) EPA Region 3

Locations where References may be found:

US EPA Region III
Land, Chemicals and Redevelopment Division
1650 Arch Street
Philadelphia, PA 19103

Contact telephone numbers and e-mail
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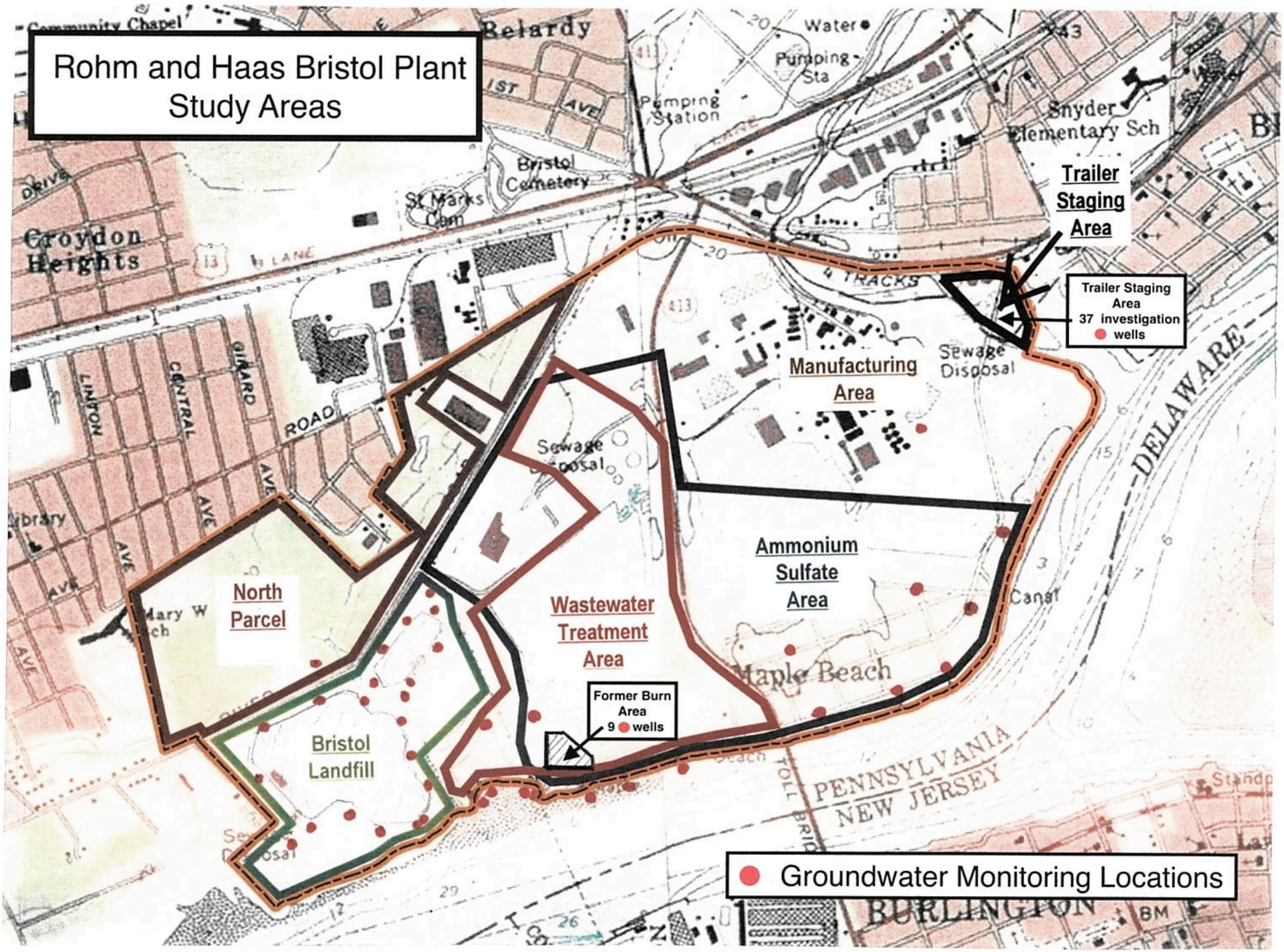
(phone #) 215-814-3416
(e-mail) Essenthier.maureen@epa.gov


Rohm and Haas Bristol Plant
Study Areas
Trailer
Staging
Area
Trailer Staging
Area
37 investigation
wells
Manufacturing
Area
Ammonium
Sulfate
Area
North
Parcel
Wastewater
Treatment
Area
Former Burn
Area
9 wells
Bristol
Landfill
Groundwater Monitoring Locations
Relardy
Croydon
Heights
Bristol
Cemetery
Snyder
Elementary Sch
Sewage
Disposal
Maple Beach
DELAWARE
PENNSYLVANIA
NEW JERSEY
BURLINGTON