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: AMETEK-Haveg
Facility Address: 900 Greenbank Road, Wilmington, Delaware
Facility EPA ID #: DED061805487

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.

This Environmental Indicator (EI) determination presents volatile organic compound (VOC), semi-volatile organic compound (SVOC), and metals data for groundwater samples collected from ten (10) on-site monitoring wells in April 2019, the most recent data available. These data are provided in Table 1, attached. Historical groundwater-quality monitoring data was also considered contextually, but historical data were not relied upon for this determination, other than evaluating trends.

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.

Rationale and Reference(s):

As stated in response to Question #1, above, Table 1 (attached) presents analytical data for the most recent groundwater quality monitoring, dated April 2019. To facilitate data evaluation, Table 1 also provides four (4) different sets of "appropriately protective 'levels'" consisting of:

- Groundwater Ingestion Screening Levels (SL)
- Ecological Fresh Surface Water SLs
- Residential Tap Water SLs
- Maximum Contaminant Levels (MCL)

The Groundwater Ingestion and Ecological Fresh Surface Water SLs were established by the Remediation Section of the Division of Waste and Hazardous Substances of the Department of Natural Resources and Environmental Control (DNREC) in Delaware under the authority of the Hazardous Substances Clean-Up Act (HSCA). This SL table was most recently updated in February 2020. The Residential Tap Water SLs are excerpted from the United States (U.S.) Environmental Protection Agency's (EPA) Regional SLs – Generic Tables, updated May 2020. The MCLs are established by the U.S. EPA under the Safe Drinking Water Act and were, likewise, excerpted from the previously referenced generic tables.

Exceedances of one (1) or more of these levels by April 2019 facility groundwater data are summarized in the table below.

<u>Summary of Exceedances</u>

Analyte	Ground Water (Ingestion)	Ecological Surface Water Fresh	Tap Water	MCL	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-9 (DUP)	MW-10
1,1,1-Trichloroethane	200	11	200	800				21		31000	250	1300	270	260	
1,1-Dichloroethane	2.8	47		2.8				30		4800	580	1200	160	160	
1,1-Dichloroethene	7	25	7	28						3700	360	600	82	71	
cis-1,2-Dichloroethene	3.6		70	3.6						24 J	9.3	5.1			
1,4-Dioxane	0.46			0.46				58		4000 J	610	690	140	160	
Trichloroethene	0.28	21	5	0.28						170	13	26	3.4	3.7	
1,2-Dichloroethane	0.17	100	5	0.17				1.2		160	16	27			
Vinyl chloride	0.019	930	2	0.019				1.4		65 J	37	31			
Benzene	0.46	370	5	0.46				2.3							
Tetrachloroethene	1	111	5	4.1						68 J					
Barium	380	4	2000	380	324	104	84.7	73.9	68.7	114	75.6	139	17.3	17.9	127
Iron	1400	300		1400	1020		4480	23300	566	8230	8400	16000			44400
Manganese	43	120			698		322	1360	831	2610	2380	2270			852
Zinc	600	120		600		304	121				1210		2110	2250	
Aluminum	2000	87		2000	619										
Arsenic	0.052	5	10	0.052	1.2 J		2.1	1.1 J	0.9 J	1 J	0.91 J	0.87 J			
Cobalt	0.6	23		0.6	3.5 J		3 J			2.9 J	3.6 J				1.7 J
Cadmium	0.92	0.25				0.9 J									

Exceedances were present for some metals and VOCs only. There were no exceedances indicated for SVOCs.

Evaluation of the April 2019 on-site groundwater data relative to the specified levels was performed to determine which, if any, non-detect results (reporting limits) exceed at least one (1) of the provided levels, as these represent data gaps. These are indicated in the attached Table 1 by italicized analyte names and reported concentrations. These "data gaps" are too numerous to list herein as there are approximately 65 analytes and many more individual results.

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.

Rationale and Reference(s):

The migration of contaminated groundwater appears to be stabilized such that contaminated groundwater is expected to remain within the existing area of contaminated groundwater, as defined herein.

Refer to the included map of interpreted contours of the water-table surface, constructed from measurements of water depth in each of the ten (10) monitoring wells on-site. Groundwater flow is interpreted as generally east to west, toward Red Clay Creek. The included map represents groundwater depth data from 2017 and was excerpted from the "Summary of Site Sampling Activities, Supplemental Remedial Facility Investigation," prepared by AMETEK and dated November 4, 2019.

The results of multiple groundwater quality monitoring events over numerous years indicate the groundwater contamination source area is located in the vicinity of AOCs 2 and 3. Groundwater has been shown to flow in a westerly through southwesterly direction from the source area, and monitoring wells MW-6, MW-7, MW-8, MW-9, and MW-10 appear to be located within the contaminant plume. In the 2019 groundwater dataset, these wells exhibit concentrations of select volatile organic compound (VOC) and metallic contaminants that exceed their corresponding groundwater HSCA SL.

Laterally, groundwater contamination appears to be bound by two (2) natural features and three (3) relatively non-impacted monitoring wells. Red Clay Creek to the west and the escarpment to the east act as topographic and/or hydraulic barriers that limit the migration of contaminated groundwater in these respective directions.

In the 2019 groundwater dataset, the samples collected from monitoring wells MW-2, MW-3, and MW-5 have been indicated to contain only non-detectable to low-level concentrations of VOC contaminants. No exceedances of the HSCA SLs are indicated for VOC contaminants in these wells. These three (3) wells were reported to have concentrations of select metallic contaminants greater than the corresponding HSCA SLs; however, concentrations of these same metals within the contaminant plume monitoring wells are as much as an order of magnitude greater. As such, MW-2 and MW-3 are indicative of bounding conditions to the north, and MW-5 represents the limiting conditions to the south of the contaminant plume.

Vertically, the site is underlain by crystalline bedrock.

- In late 2016, five (5) monitoring wells and seven (7) soil borings were installed utilizing a Geoprobe 7822DT. These are the most recent wells and borings. In eight (8) of the 12 borings, refusal was recorded between nine (9) and 15 feet below the ground surface.
- Saprolite was observed in ten (10) of the 12 borings at depths between four (4) and 14 feet below the ground surface.
- Further, minerals/rocks identified within the saprolite include quartz, schist, garnet, chlorite, muscovite, and serpentine.
- Northern Delaware, located with the piedmont physiographic province, is known to be regionally underlain by a number of igneous and metamorphic formations, commonly granite, gabbro, schist, and gneiss.
- In addition, evidence of significant fracturing of these bedrock units has not been encountered.

The migration of contaminated groundwater appears to be vertically limited by the underlying bedrock lithology and the proximity of Red Clay Creek.

The migration of contaminated groundwater appears to be stabilized such that contaminated groundwater is expected to remain within the existing area of contaminated groundwater bounded by MW-2 and MW-3 to the north (cross-gradient), a significant escarpment to the east (upgradient), MW-5 to the south (cross-gradient), Red Clay Creek to the west (downgradient), and crystalline bedrock vertically.

Footnotes:

[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.

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.

Rationale and Reference(s):

As indicated in Question #3, above, Red Clay Creek appears to be the downgradient potentially affected surface water body receiving contaminated groundwater from the AMETEK facility. During subsequent evaluation, monitoring wells MW-9 and MW-10 are considered representative of the groundwater quality discharged into Red Clay Creek. These wells are located downgradient of the presumed groundwater-contamination source area and are less than approximately 50 feet from the easterly extent of Red Clay Creek.

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)?

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☐ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting:
1) the maximum known or reasonably suspected concentration3 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 concentration 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.

Rationale and Reference(s):

No, the discharge of contaminated groundwater into surface water, namely Red Clay Creek, is not likely to be insignificant. Table 2, attached, presents an evaluation of the discharge-quality dataset, as described below, in accordance with the parameters established in Question #5, above. Table 2 provides the requested information for only those contaminants detected at concentrations exceeding any one (1) of the four (4) "levels," as previously presented in Table 1. For each of these contaminants, Table 2 indicates exceedances of ten times (10x) and 100 times (100x) the previously specified HSCA groundwater ingestion SLs. The table presents data for only monitoring wells MW-9 and MW-10, as these wells are most likely to be most representative of the quality of groundwater discharged to Red Clay Creek. It should be noted that during the 2019 groundwater sampling event, a quality control (QC) blind duplicate sample was collected from MW-9, thus Table 2 presents the maximum concentration for each listed contaminant selected from the MW-9 field or "parent" sample and the associated duplicate sample.

Table 2 indicates (by bolded text) that groundwater discharged to Red Clay Creek contains 1,1,1-trichloroethane; zinc; and cobalt in excess of the HSCA groundwater ingestion SL. Trichloroethene; 1,2-dichloroethane; 1,2-dichloroethene; iron; and manganese are indicated (by orange bolded text) to discharge into Red Clay Creek at concentrations in excess of ten times (10x) the HSCA groundwater ingestion SL. 1,4-Dioxane is discharged at concentrations greater than 100 times (100x) the HSCA groundwater ingestion SL, as indicated by red bolded text. Table 2 also indicates (by italicization) several analytes were reported as non-detect, but with reporting limits greater than the groundwater SL. Two (2) analytes are indicated to have reporting limits greater than ten times (10x) the groundwater SL, as indicated by yellow highlighting.

Examining groundwater quality data dating to 2017, the concentrations of 1,4-dioxane; 1,1,1-trichloroethane; and zinc in samples collected from MW-9 exhibit an overall increasing trend, as does 1,4-dioxane in samples from MW-10. 1,1,1-Trichloroethane and zinc exhibit a decreasing trend in MW-10. The trends of the concentrations of trichloroethene; 1,1-dichloroethane; 1,1-dichloroethene; iron; manganese; and cobalt are decreasing or relatively neutral in wells MW-9 and MW-10.

Based upon the evaluation of the discharge quality dataset, as provided in Table 2, 1,4-dioxane is the only detected contaminant in the discharge to Red Clay Creek that exceeds 100 times (100x) its corresponding HSCA groundwater ingestion SL. Based upon known groundwater flow rates and reported concentrations of 1,4-dioxane across the AMETEK site, approximately 23 kilograms (kg) of 1,4-dioxane are discharged annually from the AMETEK site into Red Clay Creek. The calculation of the flux is provided in Table 3, attached.

The concentration of 1,4-dioxane in MW-9 in July of 2017 was 43 micrograms per liter (µg/L), 53 µg/L in November 2018, and 160 µg/L in April 2019. 1,4-Dioxane in MW-10 has been consistently reported at non-detectable concentrations. Holding all other factors equal, as both hydraulic conductivity and discharge area is based on a single previous determination, and noting the increasing trend of 1,4-dioxane, the mass flux of 1,4-dioxane appears to be increasing.

In summary, data evaluation of the discharge quality dataset indicates the discharge of 1,4-dioxane; trichloroethene; 1,2-dichloroethane; 1,2-dichlorothene; iron; and manganese from the AMETEK facility to Red Clay Creek is significant, defined as greater than ten times (10x) the HSCA groundwater ingestion SL. In addition, approximately 23 kg of 1,4-dioxane is discharged into Red Clay Creek from the site annually.

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

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.

Rationale and Reference(s):

Yes, all of the “unlikely to be insignificant” contaminants detected in the groundwater discharged from the AMETEK facility to Red Clay Creek may be considered to be currently acceptable. Referring to Table 2, 1,4-dioxane; trichloroethene; 1,2-dichloroethane; 1,2-dichloroethene; iron; and manganese are the groundwater contaminants whose discharge to Red Clay Creek are considered significant.

Examining the concentration of each of these analytes with regard to the published state ecological fresh surface water SLs indicates that the discharge of 1,4-dioxane and trichloroethene may be considered acceptable. No ecological fresh surface water SL value for 1,4-dioxane has been published. Although the reported concentration of trichloroethene is more than ten times (10x) the HSCA groundwater ingestion SL, the reported concentration (3.7 µg/L) is only approximately one-sixth (⅙) that of its HSCA ecological fresh surface water SL (21 µg/L). Thus, the discharge of trichloroethene into Red Clay Creek does not exceed “levels” established to be protective of the environment, even absent consideration of dilution that occurs upon discharge.

The reported concentrations of the remaining contaminants (1,2-dichloroethane; 1,2-dichloroethene; iron; and manganese) exceed their corresponding HSCA ecological fresh surface water SL absent consideration of dilution upon discharge and during subsequent downstream transport. To address these “exceedances,” DNREC requested AMETEK to conduct an ecological evaluation of Red Clay Creek to determine whether the discharge of contaminants from the AMETEK facility is having a detrimental impact upon the ecology of the receiving fresh surface-water body. This evaluation was conducted by AMETEK’s consultant, ERM, with a DNREC representative on-site, observing the sampling of three (3) locations within the reach of Red Clay Creek adjacent to the facility, one (1) upstream of the facility, and one (1) downstream of the facility. ERM’s requested evaluation is provided as an attachment hereto and, succinctly, indicates that Red Clay Creek is no more impaired at and downstream of the AMETEK facility than it is upstream of the facility due to *legacy impacts from channel alterations*.

In summary, six (6) contaminants are identified whose discharge to Red Clay Creek may be unlikely to be insignificant. Two (2) of these six (6) contaminants’, 1,4-dioxane and trichloroethene, concentrations, exclusive of dilution considerations, do not exceed their respective HSCA ecological fresh surface water SL. The absence of impairment to Red Clay Creek attributable to the discharge of groundwater contaminants from the AMETEK facility, as demonstrated by the requested ecological evaluation, indicates that the discharged contamination may be considered to be currently acceptable until a final remedy decision can be made and implemented.

Footnotes:

[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.

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.

Rationale and Reference(s):

Groundwater monitoring efforts occur annually, at a minimum, and generally consist of relative groundwater depth measurements and collection of samples for laboratory analysis for VOCs, SVOCs, and metals from all on-site monitoring wells, MW-1 through MW-10. Future groundwater sampling efforts and frequency will likely be established during the future Corrective Measures Study.

In addition, a workplan to perform an ecological risk assessment, to include additional surface water and sediment sampling in Red Clay Creek, as well as collection of additional human health risk assessment data, has been submitted to DNREC for comment and approval. Review of the workplan is pending completion and response.

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 Ametek-Haveg facility, EPA ID # DED061805487, located at 900 Greenbank Road, Wilmington, Delaware. 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 9/23/2020
Lawrence D. Matson, P.G.
Hydrologist IV

Supervisor Christopher L Brown Date 9/23/2020
Christopher L. Brown, P.G.
Environmental Program Manager II
Delaware DNREC

Locations where References may be found:

Project files are maintained by Delaware Department of Natural Resources and Environmental Protection Remediation Section; 89 Kings Hwy; Dover, Delaware 19901

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Tables

Ametek EI-750 Determination
Data Evaluation Notes

Notes:

- Monitoring wells (MW) MW-1 through MW-5 were sampled on April 9, 2019. MW-6 thorugh MW-10 were sampled on April 11, 2019.
- All concentrations reported in micrograms per liter (µg/L), which approximates parts per billion (ppb).
- Concentrations of volatile organic compound (VOC) analytes determined by TestAmerica Laboratories in accordance with Environmental Protection Agency (EPA) Method SW-846
- Concentrations of semivolatile organic compound (SVOC) analytes determined by TestAmerica Laboratories in accordance with EPA Method SW-846 8270D.
- Concentrations of metalic analytes, excluding mercury (Hg), determined by TestAmerica Laboratories in accordance with EPA Method SW-846 6020B.
- Concentrations of Hg determined by TestAmerica Laboratories in accordance with EPA Method SW-846 7470A.
- Blank cells are intentional and indicate an absence of applicable data or results.
- The source of the Ecological Fresh Surface Water and the Groundwater (GW, Ingestion) Screening Levels (SL) is the Hazardous Substances Clean-Up Act (HSCA) SL Table, effective February 2020, prepared by The State of Delaware, Department of Natural Resources and Environmental Control (DNREC), Division of Waste and Hazardous Substances (WHS), Remediation Section (RS), available via http://www.dnrec.delaware.gov/dwhs/SIRB/Pages/SIRBRiskAssessmentCleanupStandards.asp
- The source of the Residential Tap Water Regional Screening Levels (RSL) and the Maximum Contaminant Levels (MCL) is the United States (U.S.) EPA RSL - Generic Table, effective November 2019 and available via https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

DUP = Blind duplicate (BD) of indicated sample submitted for analysis as a quality control measure of the laboratory's analytical precision.

J = Reported concentration is estimated less than the reporting limit (RL), but greater than the method detection limit (MDL).

L = The laboratory control sample (LCS) result and/or LCS duplicate (LCSD) result are/is outside of acceptable limits. For VOCs, the relative percent difference (RPD) of the LCS and LCSD exceeds the control limits.

D = Sample results are obtained from a dilution; the surrogate or matrix spike (MS, duplicate[MSD]) recoveries reported are calculated from diluted samples.

* = In all calculations, non-detect (ND) results are considered, utilized, or input at the value of the RL.

† = A concentration for "xylenes" as not provied by the analytical laboratory, results for "o-xylene" and "m-+p-xylenes" were. An SL has not been established for "m-+p-xylenes," but an SL has been established for "xylenes." As such, the reported results* for "o-xylene" and "m-+p-xylenes" were summed to facilitate comparison to an appropriate SL.

‡ = Screening levels have not been established for cis-1,3-dichloropropene, nor trans-1,3-dichloropropene. However, screening levels have been established for 1,3-dichloropropene, non-isomer-specific. As such, the reported concentrations of the individual isomers were summed to facilitate evaluation.

MAX = Presented concentration represents the greater of the reported results for the BD and associated parent sample.

Ametek EI-750 Determination
Data Evaluation Notes

Table 1:

(lightest grey shading)	A presented concentration exceeds at least one of the listed SLs.
(light grey shading)	A presented concentration and an RL exceeds at least one of the listed SLs.
(medium grey shading)	An RL exceedsat least one of the listed SLs.
(dark grey shading)	Neither a presented concentration nor an RL exceeds any of the listed SLs.

Table 2:

Bold	A presented concentration exceeds the corresponding GW SL.
Orange Bold	A presented concentration exceeds ten times (10 x) the corresponding GW SL.
Red Bold	A presented concentration exceeds one hundred timse (100 x) the corresponding GW SL.
Italicized	A presented RL exceeds the corresponding GW SL.
Italicized (yellow highlight)	A presented RL exceeds ten times (10 x) the corresponding GW SL.
Text (yellow highlight)	Please note that above formatting can be combined to indicate multiple condition

Table 3:

- Flux calculation based largely upon the flux calculation performed by ERM and documented via Appendix D their April 20, 2017 "Proposed Scope of Work for Supplemental RCRA Facility Investigation" and contained within their "REVISED Summary of Site Sampling Activities," dated November 4, 2019.

Table 1. Groundwater Quality Evaluation
Ametek EI-750 Determination

Analyte	Ground Water (Ingestion)	Ecological Surface Water Fresh	Tap Water	MCL	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-9 (DUP)	MW-10
1,1,1-Trichloroethane	200	11	200	800	< 0.24	0.79 J	< 0.24	**21**	< 0.24	**31000**	**250**	**1300**	**270**	**260**	< 0.24
1,1-Dichloroethane	2.8	47		2.8	< 0.26	< 0.26	< 0.26	**30**	< 0.26	**4800**	**580**	**1200**	**160**	**160**	0.53 J
1,1-Dichloroethene	7	25	7	28	< 0.12	< 0.12	< 0.12	2	< 0.12	**3700**	**360**	**600**	**82**	**71**	< 0.12
cis-1,2-Dichloroethene	3.6		70	3.6	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	**24 J**	**9.3**	**5.1**	0.37 J	0.44 J	< 0.22
1,4-Dioxane	0.46			0.46	*<28*	*<28*	*<28*	**58**	*<28*	**4000 J**	**610**	**690**	**140**	**160**	*<28*
Trichloroethene	0.28	21	5	0.28	*<0.31*	*<0.31*	*<0.31*	*<0.31*	*<0.31*	**170**	**13**	**26**	**3.4**	**3.7**	*<0.31*
1,2-Dichloroethane	0.17	100	5	0.17	*< 0.43 L*	*< 0.43 L*	*< 0.43 L*	**1.2**	*< 0.43 L*	**160**	**16**	**27**	*<0.43*	*<0.43*	*<0.43*
Vinyl chloride	0.019	930	2	0.019	*<0.17*	*<0.17*	*<0.17*	**1.4**	*<0.17*	**65 J**	**37**	**31**	*<0.17*	*<0.17*	*<0.17*
Benzene	0.46	370	5	0.46	< 0.43	< 0.43	< 0.43	**2.3**	< 0.43	*<43*	*<0.86*	*<2.1*	< 0.43	< 0.43	< 0.43
Tetrachloroethene	1	111	5	4.1	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	**68 J**	< 0.5	*<1.2*	0.8 J	0.89 J	< 0.25

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Analyte	Ground Water (Ingestion)	Ecological Surface Water Fresh	Tap Water	MCL	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-9 (DUP)	MW-10
1,1,2,2-Tetrachloroethane	0.076	610		0.076	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<37*	*<0.73*	*<1.8*	*<0.37*	*<0.37*	*<0.37*
1,1,2-Trichloroethane	0.041	1200	5	0.041	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<43*	*<0.87*	*<2.2*	*<0.43*	*<0.43*	*<0.43*
1,2-Dibromo-3-Chloropropane	0.00033		0.2	0.0003	*<0.38*	*<0.38*	*<0.38*	*<0.38*	*<0.38*	*<38*	*<0.75*	*<1.9*	*<0.38*	*<0.38*	*<0.38*
1,3-Dichloropropene ‡	0.47	0.055		0.47	*<0.95*	*<0.95*	*<0.95*	*<0.95*	*<0.95*	*<95*	*<1.88*	*<4.7*	*<0.95*	*<0.95*	*<0.95*
1,4-Dichlorobenzene	0.48	26	75	0.48	*<0.76*	*<0.76*	*<0.76*	*<0.76*	*<0.76*	*<76*	*<1.5*	*<3.8*	*<0.76*	*<0.76*	*<0.76*
Bromomethane	0.75			0.75	*<1*	*<1*	*<1*	*<1*	*<1*	*<100*	*<2*	*<5*	*<1*	*<1*	*<1*
Chloroform	0.22	1.8	80	0.22	*< 0.33 L*	*< 0.33 L*	*< 0.33 L*	*<0.33*	*< 0.33 L*	*<33*	*<0.65*	*<1.6*	*<0.33*	*<0.33*	*<0.33*
Dichlorobromomethane	0.13		80	0.13	*< 0.34 L*	*< 0.34 L*	*< 0.34 L*	*<0.34*	*< 0.34 L*	*<34*	*<0.69*	*<1.7*	*<0.34*	*<0.34*	*<0.34*
Ethylene Dibromide	0.0075		0.05	0.0075	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<50*	*<1*	*<2.5*	*<0.5*	*<0.5*	*<0.5*
1,2,3-Trichlorobenzene	0.7			0.7	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36	*<36*	*<0.71*	*<1.8*	< 0.36	< 0.36	< 0.36
1,2,4-Trichlorobenzene	0.4	24	70	0.4	< 0.37	< 0.37	< 0.37	< 0.37	< 0.37	*<37*	*<0.73*	*<1.8*	< 0.37	< 0.37	< 0.37
1,2-Dichlorobenzene	30	0.7	600	30	< 0.43	< 0.43	< 0.43	< 0.43	< 0.43	*<43*	*<0.86*	*<2.2*	< 0.43	< 0.43	< 0.43
2-Hexanone	3.8	99		3.8	< 2.9	< 2.9	< 2.9	< 2.9	< 2.9	*<290*	*<5.8*	*<15*	< 2.9	< 2.9	< 2.9
1,2-Dichloropropane	0.82		5	0.82	< 0.35	< 0.35	< 0.35	< 0.35	< 0.35	*<35*	< 0.71	*<1.8*	< 0.35	< 0.35	< 0.35
Carbon tetrachloride	0.46	13.3	5	0.46	< 0.21	< 0.21	< 0.21	< 0.21	< 0.21	*<21*	< 0.42	*<1*	< 0.21	< 0.21	< 0.21
Chlorobenzene	7.8	1.3	100	7.8	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	*<38*	< 0.75	*<1.9*	< 0.38	< 0.38	< 0.38
Chlorodibromomethane	0.87		80	0.87	< 0.28	< 0.28	< 0.28	< 0.28	< 0.28	*<28*	< 0.56	*<1.4*	< 0.28	< 0.28	< 0.28
4-Methyl-2-pentanone	630	170		630	< 2.7	< 2.7	< 2.7	< 2.7	< 2.7	*<270*	< 5.5	< 14	< 2.7	< 2.7	< 2.7
Bromoform	3.3	320	80	3.3	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	*<54*	< 1.1	< 2.7	< 0.54	< 0.54	< 0.54
Carbon disulfide	81	0.92		81	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	*<16*	< 0.31	< 0.78	< 0.16	< 0.16	< 0.16
Chlorobromomethane	8.3			8.3	< 0.41	< 0.41	< 0.41	< 0.41	< 0.41	*<41*	< 0.82	< 2.1	< 0.41	< 0.41	< 0.41
Ethylbenzene	1.5	90	700	1.5	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	*<30*	< 0.6	< 1.5	< 0.3	< 0.3	< 0.3

Table 1. Groundwater Quality Evaluation
Ametek EI-750 Determination

Analyte	Ground Water (Ingestion)	Ecological Surface Water Fresh	Tap Water	MCL	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-9 (DUP)	MW-10
Isopropylbenzene	45	2.6		45	< 0.34	< 0.34	< 0.34	1.6	< 0.34	<34	1.1 J	2.2 J	< 0.34	< 0.34	< 0.34
Methyl tert-butyl ether	10	11070		14	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	<47	< 0.93	< 2.3	< 0.47	< 0.47	< 0.47
Methylene Chloride	5	98.1	5	11	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	<32	< 0.63	< 1.6	< 0.32	< 0.32	< 0.32
o-Xylene	19	13	10000	19	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36	<36	< 0.72	< 1.8	< 0.36	< 0.36	< 0.36
Toluene	110	2	1000	110	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	<38	< 0.76	< 1.9	< 0.38	< 0.38	< 0.38
Xylenes †	19	13	10000	19	1.46	< 0.66	< 0.66	< 0.66	< 0.66	<66	< 1.31	< 3.3	< 0.66	< 0.66	< 0.66
1,1,2-Trichloro-1,2,2-trifluoroethane	1000			1000	< 0.31	< 0.31	< 0.31	< 0.31	< 0.31	< 31	< 0.62	< 1.6	< 0.31	< 0.31	< 0.31
1,3-Dichlorobenzene					< 0.34	< 0.34	< 0.34	< 0.34	< 0.34	< 34	< 0.68	< 1.7	< 0.34	< 0.34	< 0.34
2-Butanone	560	14000		560	< 1.9	< 1.9	< 1.9	< 1.9	< 1.9	< 190	< 3.7	< 9.3	< 1.9	< 1.9	< 1.9
Acetone	1400	1500		1400	7	5.4	5.7	7.5	5.7	< 500	< 10	< 25	6	5.5	8
Chloroethane	2100			2100	< 0.32	< 0.32	< 0.32	230 D	< 0.32	92 J	150	65	< 0.32	< 0.32	< 0.32
Chloromethane	19			19	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 14	< 0.29	< 0.72	< 0.14	< 0.14	< 0.14
cis-1,3-Dichloropropene					< 0.46	< 0.46	< 0.46	< 0.46	< 0.46	< 46	< 0.91	< 2.3	< 0.46	< 0.46	< 0.46
Cyclohexane	1300			1300	< 0.32	< 0.32	< 0.32	3.1	< 0.32	< 32	< 0.64	< 1.6	< 0.32	< 0.32	< 0.32
Dichlorodifluoromethane	20			20	< 0.12 L	< 0.12 L	< 0.12 L	< 0.12	< 0.12 L	< 12	< 0.24	< 0.61	< 0.12	< 0.12	< 0.12
Methyl acetate	2000			2000	< 0.31	< 0.31	< 0.31	< 0.31	< 0.31	< 31	< 0.63	< 1.6	< 0.31	< 0.31	< 0.31
Methylcyclohexane					< 0.26	< 0.26	< 0.26	4.2	< 0.26	< 26	< 0.52	< 1.3	< 0.26	< 0.26	< 0.26
m-Xylene & p-Xylene					1.1	< 0.3	< 0.3	< 0.3	< 0.3	< 30	< 0.59	< 1.5	< 0.3	< 0.3	< 0.3
Styrene	100	72	100	120	< 0.42	< 0.42	< 0.42	< 0.42	< 0.42	< 42	< 0.83	< 2.1	< 0.42	< 0.42	< 0.42
trans-1,2-Dichloroethene	36	970	100	36	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 24	< 0.47	< 1.2	< 0.24	< 0.24	< 0.24
trans-1,3-Dichloropropene					< 0.49	< 0.49	< 0.49	< 0.49	< 0.49	< 49	< 0.97	< 2.4	< 0.49	< 0.49	< 0.49
Trichlorofluoromethane	520			520	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 14	< 0.29	< 0.72	< 0.14	< 0.14	< 0.14

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1,1'-Biphenyl	0.083	14		0.083	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*
1,2,4,5-Tetrachlorobenzene	0.17	3		0.17	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*
2,4-Dinitrophenol	3.9			3.9	*<14*	*<14*	*<14*	*<14*	*<14*	*< 14 L*	*< 14 L*	*< 14 L*	*< 14 L*	*< 14 L*	*< 14 L*
2,4-Dinitrotoluene	0.24	44		0.24	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
2,6-Dinitrotoluene	0.049	81		0.049	*<0.39*	*<0.39*	*<0.39*	*<0.39*	*<0.39*	*<0.39*	*<0.39*	*<0.39*	*<0.39*	*<0.39*	*<0.39*
3,3'-Dichlorobenzidine	0.13	4.5		0.13	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*<1.4*
4,6-Dinitro-2-methylphenol	0.15			0.15	*<13*	*<13*	*<13*	*<13*	*<13*	*< 13 L*	*< 13 L*	*< 13 L*	*< 13 L*	*< 13 L*	*< 13 L*
4-Chloroaniline	0.37	232		0.37	*<1.9*	*<1.9*	*<1.9*	*<1.9*	*<1.9*	*<1.9*	*<1.9*	*<1.9*	*<1.9*	*<1.9*	*<1.9*
Anthracene	180	0.012		180	*<0.63*	*<0.63*	*<0.63*	*<0.63*	*<0.63*	*<0.63*	*<0.63*	*<0.63*	*<0.63*	*<0.63*	*<0.63*
Atrazine	0.3	1.8	3	0.3	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*<1.3*
Benzo[a]anthracene	0.03	0.018		0.03	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*
Benzo[a]pyrene	0.025	0.015	0.2	0.025	*<0.41*	*<0.41*	*<0.41*	*<0.41*	*<0.41*	*<0.41*	*<0.41*	*<0.41*	*<0.41*	*<0.41*	*<0.41*
Benzo[b]fluoranthene	0.25			0.25	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*
Bis(2-chloroethyl)ether	0.014			0.014	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*
Dibenz(a,h)anthracene	0.025			0.025	*<0.72*	*<0.72*	*<0.72*	*<0.72*	*<0.72*	*<0.72*	*<0.72*	*<0.72*	*<0.72*	*<0.72*	*<0.72*
Dibenzofuran	0.79	3.7		0.79	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*
Fluoranthene	80	0.04		80	*<0.84*	*<0.84*	*<0.84*	*<0.84*	*<0.84*	*<0.84*	*<0.84*	*<0.84*	*<0.84*	*<0.84*	*<0.84*
Hexachlorobenzene	0.0098	0.0003	1	0.0098	*<0.4*	*<0.4*	*<0.4*	*<0.4*	*<0.4*	*<0.4*	*<0.4*	*<0.4*	*<0.4*	*<0.4*	*<0.4*
Hexachlorobutadiene	0.14	1.3		0.14	*<0.78*	*<0.78*	*<0.78*	*<0.78*	*<0.78*	*<0.78*	*<0.78*	*<0.78*	*<0.78*	*<0.78*	*<0.78*
Hexachlorocyclopentadiene	0.041		50	0.041	*<1.7*	*<1.7*	*<1.7*	*<1.7*	*<1.7*	*<1.7*	*<1.7*	*<1.7*	*<1.7*	*<1.7*	*<1.7*
Hexachloroethane	0.33	12		0.33	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*	*<1.2*
Indeno[1,2,3-cd]pyrene	0.25			0.25	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*<1.3*	*< 1.3 L*	*< 1.3 L*	*< 1.3 L*	*< 1.3 L*	*< 1.3 L*	*< 1.3 L*
Naphthalene	0.17	1.1		0.12	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*	*<1.1*
Nitrobenzene	0.14			0.14	*<0.57*	*<0.57*	*<0.57*	*<0.57*	*<0.57*	*<0.57*	*<0.57*	*<0.57*	*<0.57*	*<0.57*	*<0.57*
N-Nitrosodi-n-propylamine	0.011			0.011	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<0.43*	*<0.43*
Pentachlorophenol	0.041	0.5	1	0.041	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*<1.4*	*< 1.4 L*	*< 1.4 L*	*< 1.4 L*	*< 1.4 L*	*< 1.4 L*	*< 1.4 L*
Phenanthrene	12	0.4			*<0.58*	*<0.58*	*<0.58*	*<0.58*	*<0.58*	*<0.58*	*<0.58*	*<0.58*	*<0.58*	*<0.58*	*<0.58*
Pyrene	12	0.025		12	*<1.6*	*<1.6*	*<1.6*	*<1.6*	*<1.6*	*<1.6*	*<1.6*	*<1.6*	*<1.6*	*<1.6*	*<1.6*

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2,2'-oxybis[1-chloropropane]	71			71	< 0.63	< 0.63	< 0.63	< 0.63	< 0.63	< 0.63	< 0.63	< 0.63	< 0.63	< 0.63	< 0.63
2,3,4,6-Tetrachlorophenol	24	1.2		24	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75
2,4,5-Trichlorophenol	120			120	< 0.28	< 0.28	< 0.28	< 0.28	< 0.28	< 0.28	< 0.28	< 0.28	< 0.28	< 0.28	< 0.28
2,4,6-Trichlorophenol	1.2	4.9		1.2	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2,4-Dichlorophenol	4.6	11		4.6	< 0.42	< 0.42	< 0.42	< 0.42	< 0.42	< 0.42	< 0.42	< 0.42	< 0.42	< 0.42	< 0.42
2,4-Dimethylphenol	36			36	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24
2-Chloronaphthalene	75			75	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
2-Chlorophenol	9.1	24		9.1	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
2-Methylnaphthalene	3.6	4.7		3.6	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1
2-Methylphenol	93	13		93	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26
2-Nitroaniline	19			19	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47
2-Nitrophenol					< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75
3-Nitroaniline					< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96
4-Bromophenyl phenyl ether					< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75
4-Chloro-3-methylphenol	140			140	< 0.58	< 0.58	< 0.58	< 0.58	< 0.58	< 0.58	< 0.58	< 0.58	< 0.58	< 0.58	< 0.58
4-Chlorophenyl phenyl ether					< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
4-Methylphenol	190	543		190	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24
4-Nitroaniline	3.8			3.8	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
4-Nitrophenol					< 0.69	< 0.69	< 0.69	< 0.69	< 0.69	< 0.69	< 0.69	< 0.69	< 0.69	< 0.69	< 0.69

Table 1. Groundwater Quality Evaluation
Ametek EI-750 Determination

Analyte	Ground Water (Ingestion)	Ecological Surface Water Fresh	Tap Water	MCL	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-9 (DUP)	MW-10
Acenaphthene	53	5.8		53	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1
Acenaphthylene					< 0.82	< 0.82	< 0.82	< 0.82	< 0.82	< 0.82	< 0.82	< 0.82	< 0.82	< 0.82	< 0.82
Acetophenone	190			190	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79
Benzaldehyde	19			19	< 0.59 L	< 0.59 L	< 0.59 L	< 0.59 L	< 0.59 L	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59
Benzo[g,h,i]perylene					< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4
Benzo[k]fluoranthene	2.5			2.5	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67
Bis(2-chloroethoxy)methane	5.9			5.9	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.24
Bis(2-ethylhexyl) phthalate	5.6	16	6	5.6	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7
Butyl benzyl phthalate	16	19		16	< 0.85	< 0.85	< 0.85	< 0.85	< 0.85	< 0.85	< 0.85	< 0.85	< 0.85	< 0.85	< 0.85
Caprolactam	990			990	< 0.68 L	< 0.68 L	< 0.68 L	< 0.68 L	< 0.68 L	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68
Carbazole					< 0.68	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68
Chrysene	25			25	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91
Diethyl phthalate	1500	210		1500	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98
Dimethyl phthalate					< 0.77	< 0.77	< 0.77	< 0.77	< 0.77	< 0.77	< 0.77	< 0.77	< 0.77	< 0.77	< 0.77
Di-n-butyl phthalate	90	19		90	< 0.84	< 0.84	< 0.84	< 0.84	< 0.84	< 0.84	< 0.84	< 0.84	< 0.84	< 0.84	< 0.84
Di-n-octyl phthalate	20	22		20	< 4.8	< 4.8	< 4.8	< 4.8	< 4.8	< 4.8	< 4.8	< 4.8	< 4.8	< 4.8	< 4.8
Fluorene	29	3		29	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91	< 0.91
Isophorone	78			78	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
N-Nitrosodiphenylamine	12	210		12	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89
Phenol	580	4		580	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29

Table 1. Groundwater Quality Evaluation
Ametek EI-750 Determination

Analyte	Ground Water (Ingestion)	Ecological Surface Water Fresh	Tap Water	MCL	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-9 (DUP)	MW-10
Barium	380	4	2000	380	**324**	**104**	**84.7**	**73.9**	**68.7**	**114**	**75.6**	**139**	**17.3**	**17.9**	**127**
Iron	1400	300		1400	**1020**	68.4 J	**4480**	**23300**	**566**	**8230**	**8400**	**16000**	77.3 J	113 J	**44400**
Manganese	43	120			**698**	16.9	**322**	**1360**	**831**	**2610**	**2380**	**2270**	37	41.3	**852**
Zinc	600	120		600	93.1	**304**	**121**	< 11.1	12.2 J	< 11.1	**1210**	< 11.1	**2110**	**2250**	11.3 J
Aluminum	2000	87		2000	**619**	48.4	< 18.8	20.3 J	22.7 J	< 18.8	< 18.8	< 18.8	22.9 J	< 18.8	< 18.8
Arsenic	0.052	5	10	0.052	**1.2 J**	*<0.73*	**2.1**	**1.1 J**	**0.9 J**	**1 J**	**0.91 J**	**0.87 J**	*<0.73*	*<0.73*	*<0.73*
Cobalt	0.6	23		0.6	**3.5 J**	*<1.6*	**3 J**	*<1.6*	*<1.6*	**2.9 J**	**3.6 J**	*<1.6*	*<1.6*	*<1.6*	**1.7 J**
Cadmium	0.92	0.25			*<0.81*	**0.9 J**	*<0.81*	*<0.81*	*<0.81*	*<0.81*	*<0.81*	*<0.81*	*<0.81*	*<0.81*	*<0.81*
Mercury	0.063	0.026	2	0.063	*<0.12*	*<0.12*	*<0.12*	*<0.12*	*<0.12*	*<0.12*	*<0.12*	*<0.12*	*<0.12*	*<0.12*	*<0.12*
Selenium	10	1	50	10	*<5.4*	*<5.4*	*<5.4*	*<5.4*	*<5.4*	*<5.4*	*<5.4*	*<5.4*	*<5.4*	*<5.4*	*<5.4*
Thallium	0.02	0.8	2	0.02	*<0.16*	*<0.16*	*<0.16*	*<0.16*	*<0.16*	*<0.16*	*<0.16*	*<0.16*	*<0.16*	*<0.16*	*<0.16*
Antimony	0.78	30	6	0.78	0.56 J	< 0.4	0.49 J	0.51 J	0.65 J	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Beryllium	2.5	0.66	4	2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Calcium					77900	55300	53800	19900	52800	44200	41500	40900	17800	17900	65500
Chromium	10	85	100		< 2.3	< 2.3	< 2.3	< 2.3	< 2.3	< 2.3	< 2.3	< 2.3	< 2.3	< 2.3	< 2.3
Copper	80	9	1300	80	< 2	< 2	< 2	< 2	3.5 J	< 2	< 2	< 2	< 2	< 2	< 2
Lead	15	2.5	15	15	1.2	< 0.55	< 0.55	< 0.55	< 0.55	< 0.55	< 0.55	< 0.55	0.65 J	0.58 J	< 0.55
Magnesium					27300	14800	12200	11300	16200	12300	13800	14000	4830	4860	11500
Nickel	39	52		39	5.2	< 2.4	6.8	< 2.4	3.9 J	< 2.4	< 2.4	< 2.4	4.7	4.6	< 2.4
Potassium					8460	3810	4610	2950	4340	5010	6830	4260	3280	3320	6980
Silver	9.4	3.2		9.4	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59	< 0.59
Sodium					478000	11800	12100	13000	27600	12400	14100	13800	16400	16400	7920
Vanadium	8.6	20		8.6	2.2 J	< 1.1	< 1.1	< 1.1	2.6 J	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1

Table 2. Groundwater Discharge Quality Evaluation
Ametek EI-750 Determination

Analyte	Ground Water (Ingestion)	Ecological Surface Water Fresh	MW-9 (Max.)	MW-10
1,4-Dioxane	0.46		**160**	< *28*
1,1-Dichloroethene	7	25	**82**	< 0.12
1,1-Dichloroethane	2.8	47	**160**	0.53 J
Trichloroethene	0.28	21	**3.7**	< *0.31*
1,1,1-Trichloroethane	200	11	**270**	< 0.24
1,2-Dichloroethane	0.17	100	< *0.43*	< *0.43*
Vinyl chloride	0.019	930	< *0.17*	< *0.17*
Benzene	0.46	370	< 0.43	< 0.43
Tetrachloroethene	1	111	0.89 J	< 0.25
cis-1,2-Dichloroethene	3.6		0.44 J	< 0.22
Iron	1400	300	113 J	**44400**
Manganese	43	120	41.3	**852**
Zinc	600	120	**2250**	11.3 J
Cobalt	0.6	23	< *1.6*	**1.7 J**
Arsenic	0.052	5	< *0.73*	< *0.73*
Aluminum	2000	87	22.9 J	< 18.8
Barium	380	4	17.9	127
Cadmium	0.92	0.25	< 0.81	< 0.81

Table 3. Groundwater Discharge Flux Calculation
Ametek EI-750 Determination

Zone	Well	Flow (L/day)	1,4-Dioxin (µg/L)	Flux (µg/day)	Flux (kg/day)	Flux (kg/yr)
1	--	--	--	--	--	--
2	MW-2	14.3	28*	400.4	0.000	0.000
3	MW-3	87601	28*	2452828	0.002	0.896
4	**See Below**	652609	**94**	61345246	0.061	22.406
5	MW-5	101	28*	2828	0.000	0.001
					Total Flux (kg/yr)	**23**

Zone 4	
Well	**1,4-Dioxin** (µg/L)
MW-9	140
MW-9 Dup	160
MW-9 (Max)	160
MW-10	< 28*
Avg. MW-9 & MW-10	**94◊**

◊ 1,4 – Dioxin Concentration in Zone 4

$$\frac{MW-9\ (Max) + MW-10}{2} =$$

$$\frac{160\ \mu g/l + 28\ \mu g/l\ *}{2} =$$

$$\frac{188\ \mu g/l}{2} =$$

$$94\ \mu g/l$$

Figure

FIGURE 11
GROUNDWATER ELEVATION CONTOUR MAP - PHASE II
AMETEK, INC.
HAVEG DIVISION - 900 GREENBANK ROAD
MARSHALLTON, DELAWARE
JULY 2017

LEGEND

- SHALLOW MONITORING WELL AND SOIL BORING LOCATION (DECEMBER 2016)
- MONITORING WELL
- SOIL BORING LOCATION (DECEMBER 2016)
- OUTFALL
- 37.37 GROUNDWATER ELEVATION (FEET AMSL)
- 34 GROUNDWATER ELEVATION CONTOUR (FEET AMSL)

NOTES:
1. ALL BUILDINGS EAST OF RED CLAY CREEK REMOVED – ONLY SLABS REMAIN
2. ALL ABOVE GROUND STORAGE TANK AND WASTEWATER TREATMENT EQUIPMENT HAVE BEEN REMOVED FROM THE SITE.
3. GROUNDWATER ELEVATIONS ARE INFERRED BASED ON THE PRESENCE OF SUBSURFACE FOUNDATIONS.

150 75 0 150

SCALE IN FEET

ERM

\\usphlsan01\Data\Team\DMMY\CAD\Drawings\Ametek-Marshallton\0074600\A312.dwg

MLB/EMF/12-12-17

Attachment

Ecological Evaluation

At the request of DNREC in May 2020, in June 2020 ERM performed a benthic macroinvertebrate survey of the Red Clay Creek utilizing an ERM Biologist with 20 years' experience. During the survey, ERM completed a Physical Habitat evaluation to assist completing the RCRA Corrective Action Environmental Indicator Checklist as a measure of ecological health at and near the site. ERM checked regionally appropriate tolerance values and calculated the Hilsenhoff Biotic Index at each location. ERM reviewed historical aerial photographs of the site, current hydrodynamics, and the physical and biological data present at each sampling location. Historical aerial photographs show there are visible differences in the channel alignment just downstream of B-1. There is a small ditch-like feature that is west of the stream now was obviously much bigger when the aerial photo was taken and may have in fact accommodated the bulk of the flow at one time judging by the large riffle that is apparent in the photo in what is now the main stream channel. There is a thin pale stripe [*sic*] that appears to have some relief along much of the eastern bank at the site, which is typically how rip-rap revetments appear on black and white aerial photos, and would be consistent with past channelization.

During the physical habitat survey, ERM observed heavy sedimentation wherein large boulders and cobbles were "cemented" in place. Sedimentation was perhaps the most obvious physical impairment, but it was not the only physical characteristic that is depressing benthic scores in the study reach. The study reach has obviously been channelized in the past as the stream is unnaturally straight. There are some areas where the bank opposite the site had been armored with some large stones which present as having the same effect as riprap. The impoundment upstream has fundamentally changed the local foodweb and the bridge abutments at either end of the reach, and concrete block on the stream bank near the middle of the site stabilize the bank in place. There is a lack of woody debris wherein there is almost no deadfalls, root wads, or other woody habitat in channel.

These observed features have real consequences to biological stream health. Sedimentation fills in the interstitial spaces between coarse substrate, eliminating living space for macroinvertebrates and exposing them to scour. Channelization alters flow velocity, exacerbating scouring effects. Bank stabilization eliminates the natural meanders and the undercut stream banks that naturally form as a stream moves within its channel and depressing biodiversity. Impoundment upstream disturbs food web by interrupting flow of fine particulate organic matter and increases exposure to sunlight, thereby increasing water temperature. There is a lack of riparian vegetation that exacerbates thermal effects, and acts as a source of fine sediment and the lack of woody debris eliminates an important vertical element of natural habitat.

The physical habitat evaluation is a visual assessment that ranks habitat conditions on the basis of 10 readily field-observable attributes. It was developed by the EPA as a comparative index and assesses actual conditions relative to a theoretical optimum condition. The field protocol involves scoring of each attribute in the field on a scale of 1 to 20, where 20 represents the optimum condition.

The Macrobenthos Assessment is an intrusive quantitative assessment that evaluates the biological community on the basis of the composition of the benthic community. The USEPA developed the field methodology, which has been widely adopted by most states, but left the analytical methodology up to individual states and regions to develop. Field methodology requires collection of macrobenthos across a 1-meter square plot on the stream bottom. Substrate is disturbed manually, and benthos is washed into a 500 micron net by stream current. In order for macrobenthos sample to be diagnostic, sample plot must be indicative of general field characteristics at the site as a whole, therefore replicate sampling is highly desirable. DNREC has adopted a four-parameter Index of Biotic Integrity for freshwater macrobenthos. Raw parameter values are then given a score of 1, 3, or 6 and added to produce a numerical score on a scale of 1-24. Similar to the physical habitat protocol, sites are then placed into four qualitative categories, expressed as a percentage of 24.

ERM reviewed and sampled five locations within the Red Clay Creek, including one upgradient of the site boundary (B-1), one downgradient of the site boundary (B-5) and three adjacent to the southwestern portion of the site (B-2, B-3, B-4). The physical habitat score was 97 (marginal) at B-1, 111 (suboptimal) at B-2, 108 (suboptimal/marginal) at B-3, 117 (suboptimal) at B-4 and 109 (suboptimal/marginal) at B-5. The macrobenthos data showed that locations B-1, B-3, and B-5 were "severely degraded" while B-2 and B-4 were "moderately degraded".

The biological and physical habitat scores were generally in the same (reflecting moderate to severe degradation), and do not differ significantly between onsite and offsite locations. With the exception of the offsite upgradient reference location (B-1), relative differences between the sites' physical habitat scores are reflected in trends in macrobenthos scores. This suggests not only that physical habitat condition is playing a significant role in microbenthic diversity in the sampled reach of the Red Clay Creek, but it also likely plays a role in localized differences in microbenthic diversity between sites (i.e., at the mesohabitat scale).

If impacted groundwater from the site was driving benthic diversity, benthic scores should be higher in the upper portion of the sample reach than in the lower portion, but that is not what the data show. In fact, the upstream-most site (B-1) is outside the area of influence of onsite impact, but had the lowest benthic score (although this is not strictly proof of a lack of chemical/toxicological impacts per se, it is indicative of influence from upstream and is consistent with a watershed that is physically degraded).

The DNREC Index of Biotic Integrity (IBI) places a high degree of importance on Ephemeropterans (two of the four metrics in the IBI include this order), which indicates that Ephemeropterans are highly diagnostic of stream health in Delaware. The most intolerant Ephemeropteran genera at the site (primarily Baetis and Tricorythodes) are known to be among the most tolerant of fine sediment accumulation in the order, so their presence (to the exclusion of other common mayfly genera) is consistent with physical degradation, especially in the form of excess sedimentation. Similar attributes are presented in the Trichopteran genera – many are net spinning taxa that do not rely on interstitial spaces for macrohabitat. There is a complete absence of Plecopterans in the samples, which are considered by some to be the most sensitive of all the EPT taxa to physical habitat perturbation.

There is no current evidence of toxicological impairment of the aquatic biological community in the study reach. However, there is ample evidence of legacy impacts from channel alterations that continue to impair physical habitat at the site. These impacts are evident in the aquatic biological community in the study reach. Comparison of physical habitat and microbenthic data from upstream and downstream reference locations indicate that the composition of the microbenthic community in the sampled reach is characteristic of general impairment of the heavily industrialized and urbanized Christiana Watershed, rather than indicative of site-specific impairment.

NORMANDEAU ASSOCIATES, INC.

17 July 2020

Mr. Jason L. Willey
Environmental Resource Management, Inc. (ERM)
75 Valley Stream Parkway, Suite 200
Malvern, Pennsylvania 19355

CASE NARRATIVE

SUBJECT: Benthic Macroinvertebrate Sample Analysis: Red Clay Creek Project (Normandeau Associates, Inc. Project Number 24487.000)

Dear Mr. Willey:

On 25 June 2020 Normandeau Associates, Inc. (Normandeau) received a set of five benthic macroinvertebrate samples collected with a Kick Net by ERM for the Red Clay Creek project. Normandeau analyzed the samples according to Delaware DNREC protocol (2005) and to our corporate Standard Operating Procedures (SOPs).

Normandeau SOPs applicable to this project are:

- EA 5 – *Sorting of Macroinvertebrates from Sample Residue.*
- EA 6 – *Identification and Enumeration of Macroinvertebrates.*

Methodology

In the lab the sample matrices were placed in a gridded pan partially filled with water. Invertebrate specimens were removed under magnification from randomly selected grids until a total of 200 (+/- 10 %) was obtained. The invertebrates were identified to the genus/species taxonomic end point, as their age and condition allowed, using dissecting and compound microscopes. A tolerance value was entered for each taxon, ranging from 0 to 10 where low values indicate sensitive taxa. According to DNREC protocol the 200-counts are rarified to a computer generated random count of 100, and a set of metrics are calculated from genus taxonomic endpoints. Results were entered into report-ready data tables in Excel and submitted for review.

The data are condensed to a set of four ecological metrics published by the DNREC that are in-turn given scores of 0, 3, or 6. The DNREC metrics are:

1. The number of taxa – the total number of unique genera.
2. The number of EPT taxa – those in the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies); known to be sensitive to water quality degradation.
3. The percentage of EPT individuals – percent composition of mayflies, stoneflies, and caddisflies.
4. The Hilsenhoff Biotic Index – a weighted average of the tolerance values, calculated from the number of specimens in each genus. Values range from 0.00 to 10.00, where low values indicate a community comprised of sensitive forms.

In addition, Shannon diversity (H') and evenness were calculated. Shannon diversity is a summary statistic that is a measure of the numerical distribution of the specimens within those taxa present. The equation is:

$H' = \Sigma P_i \times \log P_i$: where Pi is the proportion of specimens belonging to the ith taxon.

Evenness is calculated by dividing the diversity metric by the maximum diversity attainable by each data set, if all of the taxa were present in equal numbers. It is a measure of relative diversity that ranges from 0.00 to 1.00.

Total scores (indices of Biotic Integrity) were calculated for each site by adding the scores for the individual metrics (max. = 24). Biotic Integrity was reported as a percentage by dividing these site totals by 24; interpreted as follows:

Biotic Index (%)	Classification	Biotic Index (%)	Classification
100 %	Excellent	34 % - 66 %	Moderately Degraded
67 % - 99 %	Good Condition	< 34 %	Severely Degraded

Quality Assurance/Quality Control

Quality Assurance/Quality Control was applied to selected samples for both the processing and taxonomic identification phases of the analysis.

For processing, a randomly selected sample was independently re-sorted to determine the efficiency of both taxa and specimen removal. The results were considered acceptable if a standard of 90 percent was attained. Quality Control results are shown below:

Sample Processing (sorting):

Sample	Sample Date	Taxa	Specimens
Station P1	22 June 2020	100.0%	100.0%

For taxonomy, a sample was re-analyzed by a second Biologist to determine the accuracy of the identifications. The results were considered acceptable if 90 percent or more of the identifications were confirmed. Quality Control results are given below:

Sample Analysis (taxonomy):

Sample	Sample Date	Taxa	Gross Count
Station B4	22 June 2020	100.0%	98.1%

Normandeau taxonomists are certified by the Society for Freshwater Science.

Respectively Submitted,

George M. Christian
(Senior Scientist/Laboratory Manager)

cc. file
Rachel Davis

Benthic macroinvertebrates collected by Environmental Resource Managemant, Inc. for the Red Clay Creek project

Sample ID:	**Station B2**				
Sample Date:	**22 June 2020**				
Gear:	Kick Net: Delaware (DNREC) single habitat protocol - 200 specimen subsample				

Taxon	**Tol.**	**Common name**	**Original Count**	**Rarified Count**	**Percent Abundance**
Nemertea					
Prostoma graecense	6	proboscis worm	1	2	2.0%
Nematoda	5	round worm	2	1	1.0%
Tricladida					
Dugesia tigrina	7	flat worm	1	1	1.0%
Mollusca					
Ferrissia rivularis	7	limpet snail	1	1	1.0%
Menetus dilatatus	6	orb snail	1	1	1.0%
Amphipoda					
Gammarus fasciatus	6	side swimmer	78	39	39.0%
Hydrachnidea	8	water mite	8	4	4.0%
Ephemeroptera					
Baetis flavistriga	6	mayfly	5	4	4.0%
Baetis sp.	6	mayfly	6		
Tricorythodes sp.	4	mayfly	1	1	1.0%
Trichoptera					
Cheumatopsyche sp.	5	caddisfly	7	3	3.0%
Hydroptila sp.	6	caddisfly	3	1	1.0%
Neureclipsis sp.	7	caddisfly	1	1	1.0%
Psychomyia flavida	2	caddisfly	4	3	3.0%
Coleoptera					
Optioservus trivittatus	4	riffle beetle	1	2	2.0%
Stenelmis crenata gr.	5	riffle beetle	8	2	2.0%
Diptera - Chironomidae					
Cricotopus bicinctus gr.	7	midge	7	3	3.0%
Cricotopus trifasciata	7	midge	5		
Dicrotendipes fumidus	8	midge	7	4	4.0%
Orthocladius cplx.	6	midge	18	10	10.0%
Orthocladius sp.	6	midge	7	2	2.0%
Phaenopsectra obedians gr.	7	midge	1	1	1.0%
Rheocricotopus robacki	6	midge	2		
Tanytarsus sp.	6	midge	22	11	11.0%
Tvetenia discoloripes gr.	5	midge	2	3	3.0%
Other Diptera					
Antocha sp.	3	crane fly	1		
Total Individuals			200	100	100.0%

DNREC Metrics (from rarified 100-counts)	**Value**	**Score**
Richness (number of genera)	**22**	**6**
EPT Genera	**6**	**3**
Percent EPT Abundance	**13.0%**	**0**
Hilsenhoff Biotic Index (rating = "fair")	**5.96**	**0**
Total Score (max. = 24)	**9**	
Biotic Index	**37.5%**	
Classification	**Moderately Degraded**	

Additional Metrics (from 200-counts)	**Value**
Total Richness	**26**
Shannon Dirersity (base e)	**2.36**
Maximum Diversity	**3.26**
Evenness	**0.72**

Benthic macroinvertebrates collected by Environmental Resource Managemant, Inc. for the Red Clay Creek project

Sample ID:	**Station B3**	
Sample Date:	**22 June 2020**	
Gear:	Kick Net: Delaware (DNREC) single habitat protocol - 200 specimen subsample	

Taxon	Tol.	Common name	Original Count	Rarified Count	Percent Abundance
Nematoda	5	round worm	1		
Oligochaeta					
imm. tubificid without hair chaetae	10	tube worm	3	2	2.0%
Megadrili	8	earth worm	1	1	1.0%
Amphipoda					
Gammarus fasciatus	6	side swimmer	54	31	31.0%
Hydrachnidea	8	water mite	4	2	2.0%
Ephemeroptera					
Baetis sp.	6	mayfly	1		
Tricorythodes sp.	4	mayfly	3	3	3.0%
Hemiptera					
Microvelia sp.	6	water strider	1		
Trichoptera					
Ceratopsyche morosa gr.	2	caddisfly	2	1	1.0%
Cheumatopsyche sp.	5	caddisfly	1	1	1.0%
Mystacides sp.	4	caddisfly	2		
Coleoptera					
Ancyronyx variegatus	2	riffle beetle	2		
Optioservus trivittatus	4	riffle beetle	1	1	1.0%
Stenelmis crenata gr.	5	riffle beetle	7		
Diptera - Chironomidae					
Ablabesmyia mallochi	8	midge	2		
Cladotanytarsus sp.	7	midge	9	6	6.0%
Cricotopus bicinctus gr.	7	midge	3		
Dicrotendipes fumidus	8	midge	16	3	3.0%
Eukiefferiella devonica gr.	8	midge	1		
Orthocladius cplx.	6	midge	3	1	1.0%
Phaenopsectra obedians gr.	7	midge	21	10	10.0%
Procladius sp.	9	midge	1		
Tanytarsus sp.	6	midge	83	36	36.0%
Tvetenia discoloripes gr.	5	midge	2	1	1.0%
Other Diptera					
Hemerodromia sp.	6	dance fly	1	1	1.0%
Total Individuals			225	100	100.0%

DNREC Metrics (from rarified 100-counts)	**Value**	**Score**
Richness (number of genera)	**15**	**3**
EPT Genera	**3**	**0**
Percent EPT Abundance	**5.0%**	**0**
Hilsenhoff Biotic Index (rating = "fair")	**6.22**	**0**
Total Score (max. = 24)	**3**	
Biotic Index	**12.5%**	
Classification	**Severely Degraded**	

Additional Metrics (from 200-counts)	**Value**
Total Richness	**25**
Shannon Dirersity (base e)	**2.08**
Maximum Diversity	**3.22**
Evenness	**0.65**

Benthic macroinvertebrates collected by Environmental Resource Managemant, Inc. for the Red Clay Creek project

Sample ID:	**Station B4**				
Sample Date:	**22 June 2020**				
Gear:	Kick Net: Delaware (DNREC) single habitat protocol - 200 specimen subsample				

Taxon	**Tol.**	**Common name**	**Original Count**	**Rarified Count**	**Percent Abundance**
Nematoda	5	round worm	1		
Oligochaeta					
Megadrili	8	earth worm	1		
Mollusca					
Ferrissia rivularis	7	limpet snail	1	1	1.0%
Amphipoda					
Gammarus fasciatus	6	side swimmer	35	19	19.0%
Hydrachnidea	8	water mite	2		
Ephemeroptera					
Acentrella sp.	4	mayfly	1		
Baetis flavistriga	6	mayfly	27	11	11.0%
Baetis intercalaris	6	mayfly	2	1	1.0%
Baetis sp.	6	mayfly	1	2	2.0%
Tricorythodes sp.	4	mayfly	1		
Trichoptera					
Ceratopsyche bronta	2	caddisfly	2	4	4.0%
Ceratopsyche sparna	2	caddisfly	1		
Cheumatopsyche sp.	5	caddisfly	4	1	1.0%
Hydroptila sp.	6	caddisfly	2	2	2.0%
Lepidostoma sp.	1	caddisfly	1		
Neureclipsis sp.	7	caddisfly	1		
Oecetis sp.	8	caddisfly	3	3	3.0%
Psychomyia flavida	2	caddisfly	9	4	4.0%
Coleoptera					
Optioservus trivittatus	4	riffle beetle	1		
Stenelmis crenata gr.	5	riffle beetle	6	1	1.0%
Diptera - Chironomidae					
Cricotopus bicinctus gr.	7	midge	21	15	15.0%
Cricotopus trifasciata	7	midge	7	2	2.0%
Dicrotendipes fumidus	8	midge	5	3	3.0%
Dicrotendipes neomodestus	8	midge	2		
Eukiefferiella devonica gr.	8	midge	3	3	3.0%
Orthocladius cplx.	6	midge	17	5	5.0%
Orthocladius sp.	6	midge	14	6	6.0%
Sublettea coffmani	6	midge	4	2	2.0%
Tanytarsus sp.	6	midge	17	8	8.0%
Tvetenia discoloripes gr.	5	midge	11	4	4.0%
Other Diptera					
Antocha sp.	3	crane fly	7	3	3.0%
Hemerodromia sp.	6	dance fly	1		
Total Individuals			211	100	100.0%

DNREC Metrics (from rarified 100-counts)	**Value**	**Score**
Richness (number of genera)	**18**	**3**
EPT Genera	**7**	**3**
Percent EPT Abundance	**28.0%**	**3**
Hilsenhoff Biotic Index (rating = "fair")	**5.89**	**0**
Total Score (max. = 24)	**9**	
Biotic Index	**37.5%**	
Classification	**Moderately Degraded**	

Additional Metrics (from 200-counts)	**Value**
Total Richness	**32**
Shannon Dirersity (base e)	**2.85**
Maximum Diversity	**3.47**
Evenness	**0.82**

Benthic macroinvertebrates collected by Environmental Resource Managemant, Inc. for the Red Clay Creek project

Sample ID: **Station P1**
Sample Date: **22 June 2020**
Gear: Kick Net: Delaware (DNREC) single habitat protocol - 200 specimen subsample

Taxon	**Tol.**	**Common name**	**Original Count [1]**	**Rarified Count**	**Percent Abundance**
Nematoda	5	round worm	3	3	3.1%
Tricladida					
Dugesia tigrina	7	flat worm	1	1	1.0%
Hirudinida					
Erpobdella sp.	8	leech	1	1	1.0%
Oligochaeta					
Aulodrilus pleuriseta	8	tube worm	4	4	4.1%
Bothioneurum vejdovskyanum	10	earth worm	4	4	4.1%
Ilyodrilus templetoni	10	tube worm	4	4	4.1%
Limnodrilus sp.	10	tube worm	15	15	15.5%
Mollusca					
Corbicula fluminea	4	Asiatic clam	1	1	1.0%
Pisidium sp.	8	pill clam	5	5	5.2%
Physella sp.	8	pouch snail	1	1	1.0%
Amphipoda					
Gammarus fasciatus	6	side swimmer	39	39	40.2%
Coleoptera					
Macronychus glabratus	2	riffle beetle	1	1	1.0%
Optioservus trivittatus	4	riffle beetle	1	1	1.0%
Stenelmis crenata gr.	5	riffle beetle	2	2	2.1%
Diptera - Chironomidae					
Dicrotendipes fumidus	8	midge	1	1	1.0%
Paralaterborniella nigrohalteralis	8	midge	2	2	2.1%
Paratanytarsus sp.	6	midge	1	1	1.0%
Tanytarsus sp.	6	midge	11	11	11.3%
Total Individuals			97	97	100.0%

DNREC Metrics (from rarified 100-counts)	**Value**	**Score**
Richness (number of genera)	**18**	**3**
EPT Genera	**0**	**0**
Percent EPT Abundance	**0.0%**	**0**
Hilsenhoff Biotic Index (rating = "fairly poor")	**7.11**	**0**
Total Score (max. = 24)	**3**	
Biotic Index	**12.5%**	
Classification	**Severely Degraded**	

Additional Metrics (from 200-counts)	**Value**
Total Richness	**18**
Shannon Dirersity (base e)	**2.09**
Maximum Diversity	**2.89**
Evenness	**0.72**

(1) This sample matrix was processed in entirety but did not produce 200 specimens.

Benthic macroinvertebrates collected by Environmental Resource Managemant, Inc. for the Red Clay Creek project

Sample ID:	**Station P5**				
Sample Date:	**22 June 2020**				
Gear:	Kick Net: Delaware (DNREC) single habitat protocol - 200 specimen subsample				

Taxon	**Tol.**	**Common name**	**Original Count**	**Rarified Count**	**Percent Abundance**
Nemertea					
Prostoma graecense	6	proboscis worm	3	1	1.0%
Oligochaeta					
Limnodrilus sp.	10	tube worm	1		
Nais sp.	8	naiad worm	1		
Mollusca					
Corbicula fluminea	4	Asiatic clam	1	2	2.0%
Amphipoda					
Gammarus fasciatus	6	side swimmer	36	20	20.0%
Hydrachnidea	8	water mite	3	1	1.0%
Ephemeroptera					
Baetis sp.	6	mayfly	2		
Tricorythodes sp.	4	mayfly	1		
Trichoptera					
Ceratopsyche bronta	2	caddisfly	3	1	1.0%
Ceratopsyche sp.	2	caddisfly	1		
Cheumatopsyche sp.	5	caddisfly	1	1	1.0%
Hydroptila sp.	6	caddisfly	2	1	1.0%
Mystacides sp.	4	caddisfly	7	6	6.0%
Psychomyia flavida	2	caddisfly	3		
Coleoptera					
Macronychus glabratus	2	riffle beetle	1	1	1.0%
Optioservus trivittatus	4	riffle beetle	1		
Stenelmis crenata gr.	5	riffle beetle	10	3	3.0%
Diptera - Chironomidae					
Cladotanytarsus sp.	7	midge	6	5	5.0%
Dicrotendipes fumidus	8	midge	20	9	9.0%
Microtendipes pedillus gr.	6	midge	5	3	3.0%
Orthocladius cplx.	6	midge	5	4	4.0%
Orthocladius sp.	6	midge	5	3	3.0%
Paratanytarsus sp.	6	midge	12	5	5.0%
Phaenopsectra obedians gr.	7	midge	2	2	2.0%
Sublettea coffmani	6	midge	6	2	2.0%
Tanytarsus sp.	6	midge	54	27	27.0%
Tvetenia discoloripes gr.	5	midge	5	2	2.0%
Other Diptera					
Antocha sp.	3	crane fly	1	1	1.0%
Total Individuals			198	100	100.0%

DNREC Metrics (from rarified 100-counts)	**Value**	**Score**
Richness (number of genera)	21	6
EPT Genera	4	0
Percent EPT Abundance	9.0%	0
Hilsenhoff Biotic Index (rating = "fair")	5.94	0
Total Score (max. = 24)	6	
Biotic Index	25.0%	
Classification	Severerly Degraded	

Additional Metrics (from 200-counts)	**Value**
Total Richness	28
Shannon Dirersity (base e)	2.55
Maximum Diversity	3.33
Evenness	0.77