

**LOWER SUSQUEHANNA RIVER
(CONOWINGO POOL)**

LANCASTER AND YORK COUNTIES

**WATER QUALITY STANDARDS REVIEW
AQUATIC LIFE USE ASSESSMENT REPORT**

**Segment: Mainstem
Stream Code: 06685
Drainage List: O**

**WATER QUALITY MONITORING SECTION
WATER QUALITY DIVISION
BUREAU OF CLEAN WATER
DEPARTMENT OF ENVIRONMENTAL PROTECTION**

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INTRODUCTION

In 2019 the Department of Environmental Protection (DEP) collected fish data for the purpose of assessing the Aquatic Life Use (ALU) of the Susquehanna River's Conowingo Pool. The results of the 2019 data collection and this assessment effort indicate that the entire Conowingo Pool of the Susquehanna River from the Holtwood Dam to the State line is not meeting ALU assessment thresholds and will be listed as impaired on Pennsylvania's list of impaired waters (Category 5) of the Pennsylvania Integrated Water Quality Monitoring and Assessment Report, developed pursuant to section 303(d) of the federal Clean Water Act (CWA). The cause of impairment will be listed as Thermal Modifications. The source of the impairment will be listed as Industrial Thermal Discharges.

GENERAL WATERBODY DESCRIPTION

The Conowingo Pool is the southernmost portion of the Susquehanna River within Pennsylvania before continuing into Maryland and entering the Chesapeake Bay (Figure 1). The Conowingo Pool is bounded upstream by the Holtwood Dam, downstream by the Conowingo Dam, and flows through portions of Lancaster and York Counties on the east and west, respectively. The entire pool is within the Piedmont physiographic province. The lower portion of the Susquehanna River is currently designated Warm Water Fishes, Migratory Fishes (WWF, MF). There are several facilities with National Pollutant Discharge Elimination (NPDES) permits that discharge to the Conowingo Pool including: Holtwood Electric Facility (permit PA0008435) located at the Holtwood Dam, Exelon's Muddy Run Pump Storage Facility (permit PA0009741), Exelon's Peach Bottom Atomic Power Station (PBAPS, permit PA0009733), and Wildcat Point Generation Facility (permit PA0265951). There are numerous tributaries to the Conowingo Pool. The largest of which include, Muddy Run (West) and Michael Run entering on the right descending bank (RDB) and Muddy Run (East), Fishing Creek and Peters Creek entering on the left descending bank (LDB).

WATER QUALITY

Sampling design, data collection, and the assessment were implemented according to DEP's *Water Quality Monitoring Protocols for Surface Waters* (Lookenbill and Arnold 2023) and *Assessment Methodology for Surface Waters* (the Assessment Book, Shull and Whiteash 2023). Discrete physicochemical and biological fish assemblage data were collected and used for this assessment effort.

Station locations were established to be representative of conditions found in the Conowingo Pool on both the RDB and LDB, pursuant to DEP's *Sampling Design and Planning* (Lookenbill et al. 2023). Data were collected at four locations throughout the Conowingo Pool (Figure 1 & Table 1). Sampling locations were established to avoid direct influence from local tributaries, to the extent possible. The order of locations sampled was determined based on known thermal influences downstream of PBAPS; sites downstream of known thermal influence were sampled during the coolest portion of the day to avoid temperature changes or differences (Δ) being influenced by air temperature. Locations bracketing PBAPS effluent were established to provide evidence of causal effects related to temperature following

DEP's *Cause and Effect Surveys* (Lookenbill and Wertz 2021). Two stations were established upstream of the PBAPS influence (1SRLDB and 2SRRDB); two stations were established downstream of the PBAPS influence (4SRRDB and 5SRRDB). A mid-channel station was also established as an ambient water temperature station representing conditions outside of the PBAPS influence.

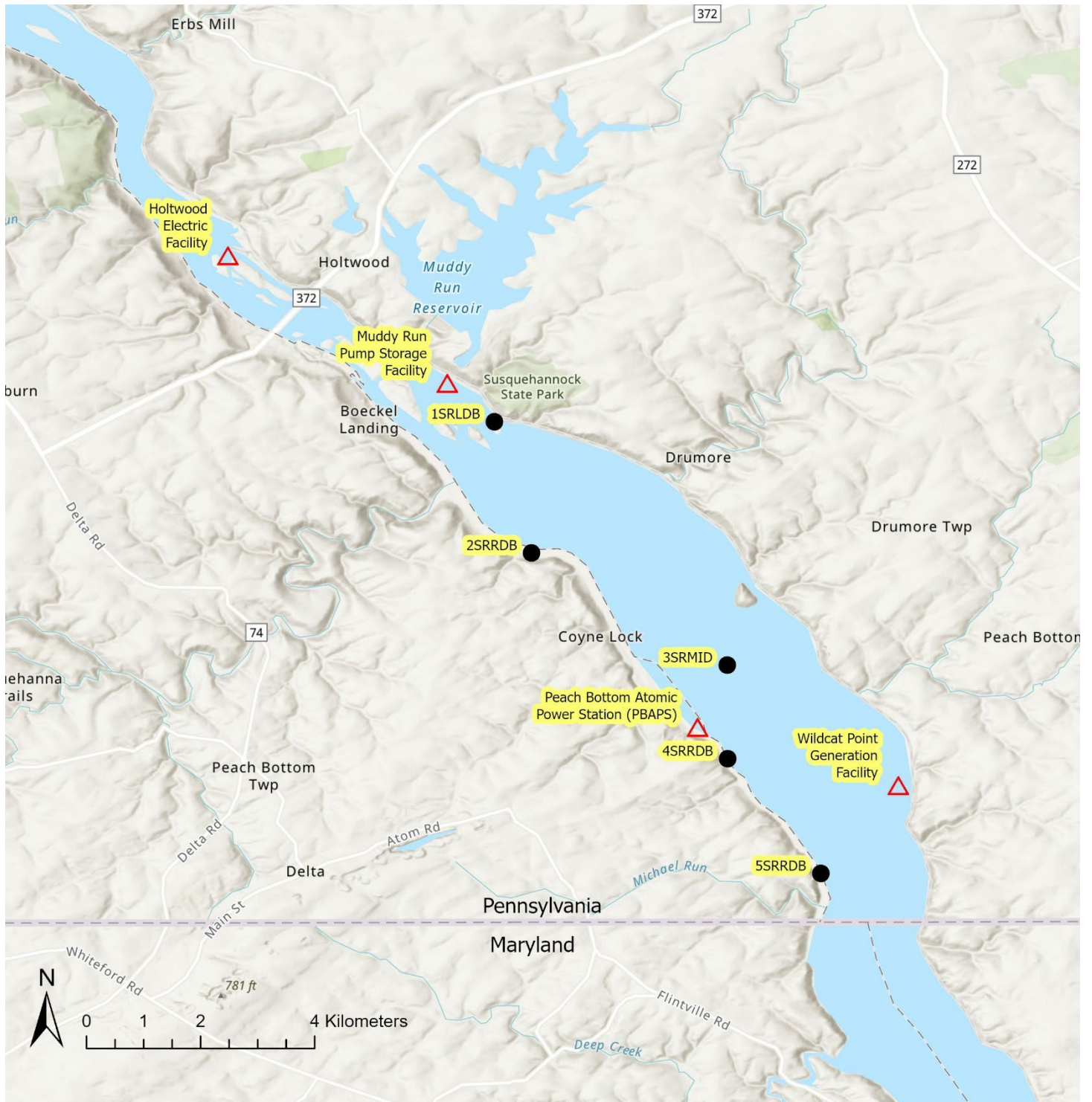


Figure 1. Map of the Conowingo Pool of the Susquehanna River with General Locations of Facility Discharge Points and Fish Samples Collected on August 14, 2019.

Table 1. Station Locations and Descriptions.

STATIONS	DESCRIPTION
1SRLDB	Susquehanna River upstream of PBAPS, LDB Fulton Township, Lancaster County Lat: 39.8002 Long: -76.2917
2SRRDB	Susquehanna River upstream of PBAPS, RDB Fulton Township, Lancaster County Lat: 39.7795 Long: -76.28586
3SRMID	Susquehanna River at PBAPS, MID Fulton Township, Lancaster County Lat: 39.76183 Long: -76.25504
4SRRDB	Susquehanna River downstream of PBAPS, RDB Fulton Township, Lancaster County Lat: 39.7471 Long: -76.25497
5SRRDB	Susquehanna River ~2.5km downstream of PBAPS, RDB Fulton Township, Lancaster County Lat: 39.729 Long: -76.24032

Discrete Physicochemical

A discrete surface water temperature measurement was collected at a mid-channel location, upstream of the PBAPS influence (3SRMID). Datum at 3SRMID was used to represent water temperature conditions outside of the PBAPS influence. Discrete water temperature readings were also collected at stations 4SRRDB and 5SRRDB; these data represent conditions downstream the PBAPS influence. Two readings were recorded at 4SRRDB and 5SRRDB to represent temperatures at the start of the sampling reach and at the end of the sampling reach. Sampling reaches are defined in the ‘Biological’ section below. Water temperature measurements were recorded immediately before fish sampling. Data were collected in accordance with DEP’s *In-Situ Field Meter, Transect, and Vertical Profile Data Collection Protocol* (Hoger and Arnold 2023).

Biological

Fishes

Fish sampling was conducted following DEP’s *Fish Data Collection Protocol* (Wertz and Arnold 2023). Fish assemblage data were collected at 1SRLDB, 2SRRDB, 4SRRDB, and 5SRRDB. Fish were not collected at station 3SRMID. Boat-mounted electrofishing techniques were implemented with average amperage and voltage outputs of 12 and 250, respectively. Sampled reaches were 500 meters in length with a minimum electrofishing time of 30 minutes. Fish were enumerated and identified to species.

PROTECTED USE ASSESSMENT

DEP evaluated fish data using the DEP *Stream Fish Assemblage Assessment Method* (Wertz 2021a). The assessment method utilizes a Thermal Fish Index (TFI; Wertz 2021b) to measure a waterbody’s ability to support defined ecological communities across six classifications of surface waters. The Assessment Method and the TFI recognize surface water classifications that include limestone and freestone classifications as well as longitudinal drainage area groups (DAGs). The Conowingo Pool locations fall within the freestone, greater than 6000 square kilometers classification with an

assessment threshold of 8.4. Scores above assessment thresholds indicate impairment. Surface water temperature data were evaluated for causal evidence. Additional source investigations were also conducted following guidance in *Causal Analysis/Diagnosis Decision Information System* (CADDIS; USEPA 2017).

Surface water temperature data from the downstream locations (3SRRDB and 4SRRDB) were compared to the upstream mid-channel water temperature in order to characterize Δ between locations. The upstream water temperature (27.5°C) was measured minutes prior to fish data collection. Water temperature measured at the start of the 4SRRDB reach was 35.5 °C ($\Delta = 8$ °C) and at the end of the reach was 34.5 °C ($\Delta = 7$ °C) (Table 1). The start of the 4SRRDB reach (35.5°C) was located immediately downstream of the PBAPS discharge; the end of the reach was 500 meters downstream of the start location. Temperature measured at the start of the 5SRRDB reach was 31 °C ($\Delta = 3.5$ °C) and at the end of the reach was 29.9 °C ($\Delta = 2.4$ °C). The start of the 5SRRDB reach was located upstream of Michael Run and the end of the reach was located downstream of Michael Run and approximately 2.5 km downstream of PBAPS thermal discharge (Table 1).

TFI scores for all four fish samples indicated ALU impairment (TFI > 8.4). The two upstream stations were specifically chosen to be representative of conditions in the Conowingo Pool, outside the direct influence of the PBAPS thermal discharge. The two locations downstream of the PBAPS influence were established to determine if the PBAPS discharge was causing a localized impact and/or causing and contributing to the ALU impairment of the Conowingo Pool. TFI scores at the upstream stations, 1SRLDB and 2SRRDB, were 9.6 and 9.4, respectively. The downstream TFI scores at stations 4SRRDB and 5SRRDB were higher than the upstream stations; respectively TFI scores at these two stations were 10 and 9.8 (Table 1).

Table 1. Temperature, TFI Scores and Assessment Determination.

STATIONS ¹	Δ TEMP ²		TFI SCORE	ASSESSMENT DECISION
	REACH START	REACH END		
1SRLDB	-	-	9.6	Impaired
2SRRDB	-	-	9.4	Impaired
4SRRDB	(+) 8 °C	(+) 7 °C	10	Impaired
5SRRDB	(+) 3.5 °C	(+) 2.4 °C	9.8	Impaired

¹ Refer to Figure 1 for station locations

² Documented change in temperature compared to upstream water temperature at 3SRMID (27.5 °C).

The fish assemblage data were further evaluated for representativeness. As part of the assessment method, consideration was given to the following conditions. First, data was evaluated to determine if > 50 individuals were present. All stations except station 2SRRDB had > 50 individuals; station 2SRRDB had 45 individuals. Upon evaluation of the data, this observation indicated the reason for having less than 50 individuals was due to reduced numbers of Gizzard Shad in the sample, which was the dominant species in the other three samples (Table 2). While the reason for this observation remains unknown, it may be attributed to indirect effects from nearby tributaries, in this case, Muddy Run (West) confluence was located approximately 1.5 kilometers upstream of the sample reach. The rest of the assemblage in the sample from 2SRRDB was considered comparable to 5SRRDB and

1SRLDB samples in structure and function; therefore, the 2SRRDB TFI score is considered representative of site conditions. Second, consideration was given to whether only one species was found in the samples. All samples had more than 1 species. Richness ranged from 6 taxa at station 4SRRDB and 12 taxa at 5SRRDB.

Table 2. Fish Data.

THERMAL PREFERENCE	TAXA		STATIONS ¹			
			1SRLDB	2SRRDB	4SRRDB	5SRRDB
Cool	White Sucker	<i>Catostomus commersonii</i>	-	-	-	2
Cool	Yellow Perch	<i>Perca flavescens</i>	-	1	-	-
Cool-Warm	Chesapeake Logperch	<i>Percina bimaculata</i>	-	1	-	1
Cool-Warm	Mimic Shiner	<i>Notropis volucellus</i>	25	-	-	-
Cool-Warm	Rock Bass	<i>Ambloplites rupestris</i>	2	-	-	-
Cool-Warm	Shorthead Redhorse	<i>Moxostoma macrolepidotum</i>	1	5	-	1
Cool-Warm	Smallmouth Bass	<i>Micropterus dolomieu</i>	6	5	-	3
Warm	Bluegill	<i>Lepomis macrochirus</i>	-	9	-	5
Warm	Channel Catfish	<i>Ictalurus punctatus</i>	2	-	-	2
Warm	Comely Shiner	<i>Notropis amoenus</i>	-	4	3	1
Warm	Common Carp	<i>Cyprinus carpio</i>	7	11	8	-
Warm	Flathead Catfish	<i>Pylodictis olivaris</i>	-	2	1	1
Warm	Gizzard Shad	<i>Dorosoma cepedianum</i>	98	1	75	41
Warm	Golden Shiner	<i>Notemigonus crysoleucas</i>	-	-	-	1
Warm	Green Sunfish	<i>Lepomis cyanellus</i>	-	1	2	-
Warm	Largemouth Bass	<i>Micropterus salmoides</i>	1	-	-	14
Warm	Spotfin Shiner	<i>Cyprinella spiloptera</i>	11	5	1	1
Taxa Richness			9	11	6	12
Total Individuals			153	45	90	73

¹ Refer to Figure 1 for station locations

“-“ indicate taxa was not identified at a particular station

Other indirect effects were observed and recorded for the sample collected from 4SRRDB, where most of the fish collected were in close proximity to the mouth of Michael Run. These effects were unavoidable as the goal was to sample a reach that was representative of the furthest downstream extent while remaining within Pennsylvania’s jurisdictional waters. While observational in nature, these indirect effects provide additional evidence of the important effects that proximal tributaries (with cooler temperatures) have on the current distribution of fishes in the Conowingo Pool.

In the Conowingo Pool, the biological response required by the assessment method to make an ALU impairment is satisfied by the two upstream station samples, 2SRRDB and 1SRLDB, exceeding the TFI impairment threshold of 8.4, at 9.4 and 9.6, respectively. The pollutant data required by the assessment method to describe causal factors, in this case Thermal Modifications, is satisfied by the temperature Δ between the upstream and the two downstream sites, 4SRRDB and 5SRRDB where end of reach temperature Δ was 7 °C and 3.4 °C respectively. The source of the Thermal Modifications cause, in this case Industrial Thermal Discharges, is supported by the cause and effect sampling design component of the study design bracketing the PBAPS thermal discharge.

Additional sources of Thermal Modifications were also investigated and ranked as Likely, Unlikely or Uncertain based on sources identified in Causal Analysis/Diagnosis Decision Information System (CADDIS) that contribute to Thermal Modifications causes (USEPA 2017). Ranking was determined based on weight of evidence and reasoning specific to the Conowingo Pool portion of the Susquehanna River. The results of this investigation support Industrial Thermal Discharges as the only Likely source (Table 3).

Table 3. CADDIS Sources Listed for Thermal Modifications with Ranking and Reason Descriptions.

Source	Ranking	Reason Description
Upstream Impoundment	Uncertain	Upstream impoundments exist. Upstream a surface water temperature of 27.5 °C may be influenced to some extent by upstream impoundments.
Downstream Impoundment	Uncertain	Downstream impoundments exist. Upstream surface water temperature of 27.5 °C may be influenced to some extent by lack of thermal buffering capacity from downstream impoundment.
Solar Radiation	Uncertain	Solar Radiation exists. Upstream temperature of 27.5 °C may be influenced to some extent by solar radiation but would only be exacerbated by impoundments and increased retention time.
Industrial Thermal Discharge	Likely	Industrial Thermal Discharges exist. Surface water temperature difference below PBAPS discharge ($\Delta = 8\text{ }^{\circ}\text{C}$) extending downstream ~2.5km on the RDB ($\Delta = 3.4\text{ }^{\circ}\text{C}$) provides evidence of pollutant and spatial impacts to support cause. Additional discharges identified within, and upstream of, Conowingo Pool.
Surface Water Withdrawal	Unlikely	Surface Water Withdrawals exist. Withdrawals are generally reserved for consumptive water use and could result in reduced thermal buffering capacity, but the ratio of withdraw to river size at this location is very small.
Groundwater Withdrawal	Unlikely	Groundwater Withdrawals unknown. Groundwater withdrawals wouldn't be of significant size to impact a large river.

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