

Muddy Run Pumped Storage Project American Eel Collection Facility in Octoraro Creek, 2023

FERC Project No. 2355



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Executive Summary

Constellation Energy Generation, LLC (Constellation) received a license from the Federal Energy Regulatory Commission (FERC) on December 22, 2015, for the Muddy Run Pumped Storage Project (Muddy Run Project; FERC Project No. 2355). An American Eel Passage Plan (Eel Plan) was developed by Constellation and included as a condition of the Pennsylvania Department of Environmental Protection (PA DEP) 401 Water Quality Certification (WQC; PA DEP File No. EA 36-033 dated December 10, 2014) for the Muddy Run Project that is a condition of the FERC license for the Muddy Run Project.

Pursuant to the FERC License and the PA DEP 401 WQC, Constellation began operation of a temporary eel trapping facility at Octoraro Creek in 2015. The temporary eel trapping facility at Octoraro Creek operated for three seasons: 2015, 2016, and 2017. An annual report was developed and filed with FERC and resource agencies after each year of operation. On March 1, 2018, FERC issued a letter indicating that the temporary eel trapping facility met the requirements of the PA DEP 401 WQC and United States Department of the Interior (DOI) fishway prescription for the Muddy Run Project. Subsequently, this eel facility location has been considered permanent since 2018. Constellation completed upgrades, including a larger submersible pump, water line, manifold, collection tank, and attraction flow lines, to the permanent Octoraro Creek Eel Facility (OCEF or facility) in support of eel passage prior to the 2019 season. The remaining work left to be completed addresses aesthetics, safety (stairs), and erosion, which has been ongoing since 2018.

In early 2020, Chester Water Authority (CWA), which owns the property where the OCEF is located, notified Constellation of the existence of a buried, abandoned tailrace structure below the existing OCEF. The upgrades to the eel collection structure and the erosion control concerned CWA, because the design drawing showed the footers to be placed on top of or through the underground buried structure. An underground survey needed to be completed prior to installing this structure. The survey was postponed until mid-May 2020 due to the COVID-19 pandemic. The 2020 season was also delayed due to the COVID-19 pandemic. Due to the results of the 2020 underground survey, which confirmed a void under the current location of the OCEF, it was constructed at the top of the hill with agreement from the EPAG and contained one longer ramp of Enkamat substrate in 2020. The OCEF in 2021 contained two longer ramps (12.3 meters compared to 7 meters), one with Enkamat substrate and one with Milieu substrate, both of which were used from 2015 through 2019.

The Conowingo Hydroelectric Project (Conowingo; FERC Project No. 405) license was issued by FERC on March 19, 2021, which is now vacated. Article 419 of this license required Constellation to prepare an American Eel Passage and Restoration Plan, which was developed in consultation with the U.S. Fish and Wildlife Service (USFWS), Maryland Department of Environment (MDE), and other members of the EPAG and was filed with FERC on September 16, 2021. The American Eel Passage and Restoration Plan discusses eel passage at Conowingo and on the east side of the Susquehanna River, which includes the OCEF.

A shoreline stabilization project for the permanent OCEF was completed in August 2022. This work included regarding the eroded shoreline to a suitable slope and placing articulate concrete blocks (ACBs) throughout an approximately 2,000-square-foot area. In addition, upgrades were made to the collection platform to move it upslope to a flat, easily accessible area and to provide a larger

working platform and a larger eel collection tank. In addition, Constellation is planning to enhance/replace the existing working platform with a wooden structure in the future. In 2023, the OCEF was set up identically to the 2022 facility.

Each year, American Eels *Anguilla rostrata* collected at the OCEF are transported to and held at the Conowingo West Eel Collection Facility (CWECF) and subsequently transported upriver and released at designated points in the Susquehanna River watershed.

This report provides details on the following objectives for the 2023 OCEF operational period:

- Install seasonal components of the OCEF immediately downstream of the CWA Pine Grove Low-Head Dam;
- Documentation of any modifications made to the OCEF during the season to improve functionality and eel attraction capability;
- Operate, maintain, and monitor the OCEF daily from May 1 through September 15, 2023;
- Collection of eel catch and length, water quality data, creek flow data, moon phase data, and rainfall during the entire operational period;
- Transport eels collected by the OCEF to the CWECF;
- Conduct weekly quality control checks and cleaning of the OCEF to maintain proper attraction water flow.

Seasonal components of the OCEF included juvenile eel ramps (14.8 meters), a one-horsepower submersible pump and water line, manifold, a collection tank (1,061-liters), and 25 mm attraction flow lines. The seasonal components were installed and placed in service on May 1, 2023. The OCEF operated a total of 138 days from May 1 until September 15, 2023.

A total of 62,113 juvenile eels were collected at the OCEF. The greatest number of juvenile eels was collected on July 11, 2023, with 17,082 eels or 27.5% of the total seasonal catch. Two large collection peaks occurred during the periods of July 4-5 and July 10-13, which accounted for 41,024 of the 62,113 (66.0%) juvenile eels collected at the OCEF. Two smaller collection peaks occurred from May 22-23 and May 25-26, which accounted for 6,551 of the 62,113 (10.5%) juvenile eels collected at the OCEF. Daily juvenile eel collections of less than 10 individuals were recorded on 51 of the 138 collection days (37.0%). Eel collections greater than 1,000 individuals occurred on 13 of the 138 collection days (9.4%). Volumetric estimation was used on fourteen days to quantify the number of eels collected during the 2023 season at the OCEF.

Length, weight, and injuries (i.e., condition factor) were recorded from biweekly subsamples on 596 juvenile eels. Length of juvenile eels ranged from 95-350 millimeters (mm) with an average length of 122.8 mm. The average weight of juvenile eels was 2.3 grams (g) and ranged from 0.7-62.0 g. Only three of the 596 (0.8%) eels showed any form of external injury such as hemorrhaging or abrasion.

A total of 62,095 of the 62,113 eels were transported within 24 hours of capture either to the CWECF where they were held before transport or directly to the mainstem Susquehanna River. Only 18 of the 62,113 (99.97%) juvenile American Eel collected at OCEF were removed from the collection tank dead, and no eels died during transport from OCEF during the 2023 season.

Cleaning and calibration of the OCEF was performed weekly. Cleaning of the screened barrel that housed the submersible pump, collection tank, screened drains, and spray bars occurred daily after

all eels were removed for transport. The pump, manifold, and attraction flow lines were also cleaned as needed during the season. CWA operated their small hydroelectric facility on 50 (36.2%) of the 138 collection days.

List of Abbreviations

Agencies/Groups

Constellation	Constellation Energy Generation, LLC			
CWA	Chester Water Authority			
CWECF	Conowingo West Eel Collection Facility			
DOI	United States Department of Interior			
EPAG	Eel Passage Advisory Group			
FERC	Federal Energy Regulatory Commission			
MDE	Maryland Department of Environment			
PA DEP	Pennsylvania Department of Environmental Protection			
USFWS	U.S. Fish and Wildlife Service			
USGS	U.S. Geological Survey			

Units of Measure

C	Celsius	
cfs	cubic feet per second	
DO	dissolved oxygen	
gpm	gallons per minute	
in	inches	
km	kilometer	
L	liter	
mg/L	milligrams per liter	
mm	millimeter	
Miscellaneous		
OCEF	Octoraro Creek Eel Facility	
WQC	Water Quality Certification	
YSI	YSI Incorporated	

1 Introduction

Constellation Energy Generation, LLC (Constellation), received a license from the Federal Energy Regulatory Commission (FERC) on December 22, 2015 for the Muddy Run Pumped Storage Project (Muddy Run Project; FERC Project No. 2355). An American Eel Passage Plan (Eel Plan) was developed by Constellation and included as a condition of the Pennsylvania Department of Environmental Protection (PA DEP) 401 Water Quality Certification (WQC; PA DEP File No. EA 36-033; dated 10 December 2014) for the Muddy Run Project and is a condition of the FERC license for the Muddy Run Project.

The Eel Plan required Constellation to investigate the feasibility of installing and operating a juvenile eel trapping facility on Octoraro Creek. The evaluation was conducted at a location identified on Octoraro Creek immediately downstream of the Chester Water Authority (CWA) Pine Grove Low-Head Dam. This site was approved by the PA DEP and other members of the Eel Passage Advisory Group (EPAG)¹.

The Conowingo Hydroelectric Project (Conowingo; FERC Project No. 405) license was issued by FERC on March 19, 2021. Article 419 of this license required Constellation to prepare an American Eel Passage and Restoration Plan, which was developed in consultation with the United States Fish and Wildlife Service (USFWS), Maryland Department of Environment (MDE), and other members of EPAG and was filed with FERC on September 16, 2021. The American Eel Passage and Restoration Plan discusses eel passage at Conowingo and on the east side of the Susquehanna River, which includes the Octoraro Creek Eel Facility (OCEF).

American Eel Anguilla rostrata collected at the OCEF were transported directly to and held at the Conowingo West Eel Collection Facility (CWECF) and subsequently transported and released at designated points in the Susquehanna River watershed.

The report provides details relative to the following objectives for the 2023 field investigation:

- Installation of seasonal components to the OCEF on Octoraro Creek immediately downstream of CWA Pine Grove Low-Head Dam;
- Documentation of any modifications made to the OCEF during the season to improve functionality and eel attraction capability;
- Operation, maintenance, and monitoring of the OCEF daily from May 1 through September 15, 2023;
- Collection of eel catch and length , water quality data, creek flow data, moon phase data, and rainfall during the entire operational period;
- Transportation of eels collected by the OCEF to the CWECF;
- Completion of weekly quality control checks and cleaning of the OCEF to maintain proper attraction water flow.

¹ EPAG members include the Pennsylvania Department of Environmental Protection, United States Fish and Wildlife Service, Pennsylvania Fish and Boat Commission, Maryland Department of Natural Resources, Susquehanna River Basin Commission, and Exelon. Maryland Department of Environment was added to the EPAG group on March 19, 2021.

Seasonal components of the OCEF included juvenile eel ramps (14.8 meters), a one-horsepower submersible pump and water line, manifold, a collection tank (1,061-liters), and 25 mm attraction flow lines. The seasonal components were installed and placed in service on May 1, 2023 and operated until September 15, 2023.

2 Background

Areas of lower Octoraro Creek from the confluence with the Susquehanna river to the area near CWA's Pine Grove Low-Head Dam were surveyed over a 13-week period from June 16 through September 10, 2014, using Fyke nets, red-light headlamps, and fine mesh dip nets (Figure 2.0-1 and Normandeau Associates and Gomez and Sullivan 2014). Based on the information gathered during the 2014 survey, eels were consistently found in the north corner of the spillway adjacent to the dam, whereas eels did not seem to be as abundant at the downstream sites during the same period. The report recommended that a site near the dam be considered for future juvenile eel trapping (Normandeau Associates and Gomez and Sullivan 2014). Constellation and EPAG discussed the possibility of utilizing this north corner of the spillway site for the temporary eel collection facility in 2015. However, due to concerns by the CWA relating to existing structures at the site, an alternative site along the south shore of the Pine Grove Low-Head Dam was selected and approved by the CWA and EPAG. The alternative site was located immediately downstream of the Octoraro Art Association building adjacent to the dam.

The temporary eel trapping facility adjacent to CWA's small hydroelectric site on Octoraro Creek was operated for three seasons: 2015, 2016, and 2017. An annual report was developed and filed with FERC and resource agencies after each year of operation. On March 1, 2018, FERC issued a letter indicating that the temporary eel trapping facility met the requirements of the PA DEP 401 WQC and U.S. Department of the Interior (DOI) fishway prescription for the Muddy Run Project². The OCEF location has been considered permanent since 2018.

Prior to the 2019 eel season, Constellation completed upgrades to the OCEF related to eel passage, including a larger submersible pump and water line, manifold, collection tank, and attraction flow lines. Work related to facility aesthetics and safety (e.g., stairs) and erosion remains to be completed. This remaining work requires a PA DEP Chapter 105 Wetland and Waterway Obstruction and Encroachment Permit and, therefore, a signed agreement from CWA (the landowner) was necessary so that Constellation could apply for this permit. Constellation received the CWA-signed agreement on December 2, 2019, and applied for the Chapter 105 permit on December 27, 2019. On January 16, 2020, the Chapter 105 Permit application package was deemed complete by PA DEP, and the permitting public comment period closed on March 2, 2020. Constellation received a permit on May 8, 2020. Meanwhile, in March 2020, CWA reviewed the OCEF project plans again and had concerns with the proposed upgraded eel structure plans along the left bank of Octoraro Creek due to an abandoned underground buried tailrace that runs below the proposed gazebo platform. The existing OCEF was revised, and improvement plans were reconsidered for safety and constructability. Constellation had an underground survey crew perform studies to identify the exact location of this structure and to determine if it created a void. In early May 2020, the underground survey was scheduled and completed, and the results of the survey were distributed to EPAG prior to a conference call on June 2, 2020. During this conference call, alternative options for the eel facility were discussed, and a decision was made and agreed to by all parties to construct a longer ramp with the collection tank and scaffolding placed at the top of the hill near the driveway. With

² On March 1, 2018, FERC issued a letter that stated, "Review of your filing indicates that it fulfils the pertinent WQC and fishway prescription requirements. Pursuant to the PADEP's WQC, because you have determined the Octoraro facility to be successful..." This approval was based on the OCEF being deemed successful and determining it as a permanent installation (Accession number: 20180301-3083; <u>FERC, 2018</u>)

the scaffolding at the top of the hill and the existing water line exiting at the mid hillside level near the old scaffolding, Constellation agreed to relocate the water line and have it exit at the top of the hill near the new scaffolding. This approach was used to decrease the head loss and increase the total attraction flow of the OCEF, and this work was completed on August 13, 2021.

Constellation conducted a topographic land survey on October 18, 2021, and developed a plan for the OCEF according to those results. The original shoreline protection design was changed from riprap to articulate concrete block (ACB) to reduce the depth of excavation and lessen the amount of weight placed over the buried tailrace. The shoreline stabilization project for the permanent OCEF was completed in August 2022 after the termination of an in-water work restriction due to the presence of threatened Chesapeake Logperch *Percina bimaculata* habitat at the site. This work included regrading the eroded shoreline to a suitable slope and placing ACBs throughout an approximately 2,000-square-foot area. In addition, upgrades were made to the collection platform to move it upslope to a flat, easily accessible area to provide a larger working platform. The site was seeded with a PA Piedmont Province shoreline-appropriate native grass mix. The shoreline stabilization was completed in late August 2022, and the OCEF began operations on September 5 and ceased on November 20, 2023; when the Octoraro Creek water temperature at CWA decreased below 10.0 °C for three consecutive days.

The OCEF began operations on May 1, 2023, and ceased on September 15, 2023. The OCEF in 2023 contained two longer ramps, one with Enkamat substrate and one with Milieu substrate, which were the substrates used from 2015-2022, except for 2020 when only a single Enkamat substrate ramp was used.

3 Methods

3.1 Design, Construction, and Installation of Facility

The size of the scaffolding platform was increased in 2022 to an eight foot by ten-foot platform to support the larger collection tank and oxygen supply system (Figure 3.1-1). A 1,061-liter collection tank replaced the former 310.4-liter tank, which increased the holding capacity of the tank from 3,104 eels to 10,610 eels. This larger tank was installed to minimize holding mortality of eels during periods of high capture rate. A stainless-steel frame was installed to support the collection tank. The manifold and submersible pump remained the same as the previous years (Normandeau Associates and Gomez and Sullivan 2020, 2021, and 2022). The rainfall gauge was reinstalled on the corner of the scaffolding to record daily rainfall events.

The longer juvenile eel ramps were constructed and installed with the entrance location near the locations of ramp installations from all previous years. The ramps consisted of two approximately 14.8 meter long by 305 millimeter (mm) wide cable trays positioned at a 28° angle, plus a continuous length of tray that was bent and shaped at a 90° angle over a 25 mm bend radius at the top of the ramp to convey juvenile eels into the collection tank. The entrances to the ramps were out of water when creek flows taken at the United States Geological Survey (USGS) Gage 01578475 on Octoraro Creek at Richardsmere, MD, located approximately 21 kilometers (km) downstream of CWA's Pine Grove Low-Head Dam were below 182 cubic feet per second (cfs), but smooth transitions from the ramp entrances and the ACBs were created by ensuring that the material of the ramps was flush to ACBs (gaps between the ramp entrances and the blocks were minimized). The entrances were near the shoreline riprap of the tailwater. A continuous piece of Enkamat extended beyond the ramp entrance and continued under the riprap below the ramp entrance, but nothing was placed under the area below the Milieu substrate entrance to prevent excluding eels from the rivulets of the water formed by the ACBs (Figure 3.1-2). The ramps were supported by seven Tshaped metal braces evenly spread across the length of the ramps, which were driven through the ACBs and into the ground beneath the ramps (Figure 3.1-3). On both sides of these braces, a hole was drilled into the flat bar and a strap was used to fasten the ramps to the braces. The ramps were directly and entirely covered with aluminum from the upper 90° bend down to approximately the median discharge elevation of Octoraro Creek to protect juvenile eels from predation and keep the ramps dark while ascending the ramps. A hinged cover was added to the ramps over the spray bar to decrease light inside the ramp at the top of the ramp, as eels are known to be photophobic.

A 51 mm diameter water line was attached to a 51 mm diameter manifold with seven 25 mm ball valves that supplied water to the spray bars and additional attraction flow lines.

The collection tank was 914 mm wide and 1,829 mm long. The depth of the water in the collection tank was approximately 762 mm, with a volume of approximately 1,061 liters (L). Like prior years of operation, the collection tank was filled by allowing some of the spray bar flow to enter the collection tank, but a 25 mm collection tank fill line was added in 2022 to supply additional freshwater to the larger collection tank. The collection tank contained two drains comprised of a 76 mm PVC pipe with holes drilled through it which were wrapped in one mm mesh to prevent juvenile eel escapement. The collection tank drain lines were directed to the highest points of the ramps that were possible via gravity feed, which provided eel scent from the eels in the collection tank to the

ramps to maximize eel attraction. The collection tank was custom fitted with a lid that was held down by clamps to prevent escapement.

The oxygen supply system, which was identical to the 2022 system, provided additional oxygen to the collection tank to minimize holding mortality. An oxygen regulator was attached to an oxygen bottle with a manifold that terminated at a micropore diffuser in the collection tank.

3.2 Data Collection

Daily recorded sample data included date, time of sample, weather, eel counts, water temperature, dissolved oxygen (DO), and rainfall. The data was verified, tabulated, and entered into an electronic format each week as part of a quality control and quality assurance protocol. Environmental conditions such as creek discharge and lunar fraction were also recorded, verified, and entered in an electronic format.

Eel length and weight measurements, along with condition factors were recorded biweekly from a subsample of a maximum of 25 individuals (when available). Eels were measured and weighed after being anesthetized.

Water temperature and DO were measured in the collection tank and in the head pond near the pump during each sampling event with a YSI water quality meter that was calibrated prior to each sampling event. An Onset HOBO dissolved oxygen and water temperature logger was added to the collection tank and continuously recorded data every fifteen minutes throughout the duration of the 2023 operational period.

3.3 Juvenile Eel Transport

All juvenile eels captured in the OCEF were either transported to the CWECF where they were held before subsequent transport and release upriver at designated locations in the Susquehanna River watershed or were transported and released directly to the designated locations daily. The determination for these two transportation options was dependent upon current water temperatures; eels were only transported and held at the CWECF during periods when water temperatures were less than 26° Celsius (C). This protocol was developed to minimize holding mortality.

When less than 150 eels were collected during a daily sampling event, the eels were transported in aerated 19 L buckets with lids that contained a maximum amount of water that would maintain escapement prevention, with less than or equal to 50 eels in each bucket. When daily collections of juvenile eels were greater than 150 but less than 2,500 individuals, a small, enclosed transport tank (250 L) was used. This transport tank was filled to a maximum level that would preclude escapement and was equipped with supplemental oxygen. When daily collections of juvenile eels were greater than 2,500 individuals, a large transport truck and tank (2,500 L) was used. This tank was filled completely to prevent sloshing and was equipped with supplemental oxygen to maintain DO levels in the tank.

4 Results

The OCEF commenced operation on May 1, and operation ceased on September 15, 2023. The OCEF was monitored daily during the 138-day season to ensure that it was attracting eels. A total of 62,113 juvenile eels were collected during the 2023 season (<u>Table 4.0-1</u>). Daily monitoring was conducted as a condition of the OCEF's permanent status.

4.1 Juvenile Eel Collection

A total of 62,113 juvenile American Eels were captured at the OCEF during the 2023 season (Table 4.0-1). The highest single-day collection of 17,083 juvenile eels occurred on July 11, which accounted for 27.5% of the total 2023 collection season (Table 4.0-1 and Figure 4.1-1). Volumetric estimations of collected eels, which are indicative of high collection rates, were required on fourteen days (10.1%, Table 4.0-1). Daily juvenile eel collections of less than 10 individuals were recorded on 51 of the 138 collection days (37.0%). Eel collections greater than 1,000 individuals occurred on 13 of the 138 collection days (9.4%), with eel collections greater than 5,000 individuals on two consecutive days in July (1.4%). The collection tank contained no eels on 16 of the 138 collection days (11.6%).

4.2 Juvenile Eel Biological Data

Biological data (length, weight, and condition factor) were recorded from biweekly subsamples. A total of 596 juvenile eels were collected from these biweekly subsamples (1.0% of total eels collected), during 34 of the 138 sample days (<u>Table 4.2-1</u>).

The average length of juvenile eels was 122.8 mm with a median size of 121.0 mm (<u>Table 4.2-1</u>). The length of juvenile eels ranged from 95-350 mm. During the 2023 season, only two eels measured greater than 175 mm (<u>Table 4.2-2</u>). Over 93% (557 individuals) of the 596 measured eels ranged between 100-144 mm.

The average weight of juvenile eels was 2.3 grams (g), with a median weight of 1.9 g (<u>Table 4.2-1</u>). The weight of juvenile eels ranged from 0.7-62.0 g (<u>Table 4.2-3</u>). During the 2023 season, three eels weighed more than 10.0 g (<u>Table 4.2-3</u>). Nearly 84% (500 individuals) of the 596 juvenile eels weighed between 1.0-2.9 g.

Eels from each biweekly subsample were examined for external injuries. Individual condition factors, date, and detailed biological data for these are shown on <u>Table 4.2-4</u>. External injuries were noted on 0.5% (3 of 596 individuals) of the examined eels. A small hemorrhage on the dorsal tail was noted on an eel on May 7 and May 29, 2023, while an abrasion to the head area was observed on July 3, 2023 (<u>Figure 4.2-1</u>).

4.3 Juvenile Eel Collection by Week

Many of the juvenile eels were collected during Week 11 (July 9-15) when the OCEF collected 56.97% (35,387 individuals) of the season total (<u>Table 4.3-1</u> and <u>Figure 4.3-1</u>). Eel collections during Week 10 comprised the second greatest weekly total of 15.25% (9,471 eels) of the season total. Week 4 was the only other week when greater than 10% of the season total was collected (12.08% or 7,503 individuals). Weeks 1, 6, 7, and 12-20 each collected less than 1.0% (less than 493 eels) of the season total (<u>Table 4.3-1</u> and <u>Figure 4.3-1</u>). Weeks 13 and 15-20 each collected less than 100 eels. Weekly catch data are also provided in <u>Appendix A</u>.

4.4 Peak Periods of Eel Collections

During the 2023 season, the OCEF had a single, large collection peak period and one less substantial peak period. The large peak period (July 10-13) yielded 33,898 of the 62,113 juvenile eels collected, or 54.6% of the total season catch (<u>Table 4.0-1</u> and <u>Figure 4.1-1</u>). The other peak occurred during the period of July 4-5. The two peak periods accounted for 41,024 of the 62,113 (66.0%) juvenile eels collected at the OCEF.

4.5 Juvenile Eel Catch in Relation to Environmental Factors

<u>Appendix B</u> contains averaged weekly environmental data from the 2015-2023 operational seasons coupled with the weekly proportions of eel collections at the OCEF and the weekly sum of eels collected at the CWECF, which are discussed further in this section.

Creek Flow

Creek flow and juvenile eel catch were not strongly correlated during the 2023 season. Daily average creek flow was taken from the USGS Gage 01578475 on Octoraro Creek at Richardsmere, MD, (<u>Table 4.5-1</u>). The highest daily average creek flow value when the OCEF was in operation occurred on May 1 (1,470 cfs, <u>Table 4.5-1</u>). Two days of increased daily average creek flow in July (July 4 and July 10) corresponded to increased eel collection at the OCEF over the days following these elevated flows. Similar events in the other four months (May, June, August, and September) did not show the increases in eel collection as observed in July.

During Week 1, the highest weekly average creek flow did not coincide with the highest weekly catch (Table 4.0-1 and 4.5-1 and Figure 4.5-1). Weeks 11 and 10 produced the first and second largest weeks of collection at the OCEF, but these two weeks had the fourth and sixth highest weekly average creek flows, respectively (Figure 4.5-1 and Appendix B). The second highest weekly average creek flow during Week 9 could have been a factor for the high catches during Weeks 10 and 11. Typical of most eel ladders, freshets in Octoraro Creek generally corresponded to greater numbers of eels collected during the 2023 operational period, but higher catch numbers during periods without an increase of flow may be a function of other environmental or behavioral variables.

Lunar Fraction

Juvenile eel catch did not appear to be correlated to lunar fraction during the 2023 season. The largest peak in eel capture (33,898 eels collected from July 10-13 [Week 11]) occurred in the week after the full moon in July (<u>Table 4.5-2</u>, <u>Figure 4.5-2</u> and <u>Appendix B</u>, <u>Time and Date Website</u>, 2022). Full moon is equal to 1.0 lunar fraction.

Based on average weekly lunar fraction, Weeks 16, 20, and 3 were the first, second, and third darkest weeks with a total of 226 eels (0.4%) of the 62,113 eels collected during these three weeks combined (Appendix B). Weeks 1, 18, and 14 were the first, second, and third brightest weeks, with a total of 610 (1.0%) of the 62,113 eels collected during these three weeks (Appendix B). Typically, the lower illuminance during lower lunar fraction periods (new moon) has been associated with increases in eel catch at eel traps (Welsh *et al.* 2015 and Schmidt *et al.* 2009).

Water Temperature

Water temperature and eel catch did appear to be correlated this season. Water temperatures ranged from 13.2° Celsius (C) soon after the season began on May 4 (Week 1) to 27.0° C on July 29, 2023 (Week 13, <u>Table 4.5-3</u> and <u>Figure 4.5-3</u>). The highest average weekly water temperature (26.1° C) occurred during Week 12, which occurred the week after the largest eel collection week of the season (<u>Appendix B</u>). The OCEF had sustained daily water temperatures above 20.0° C from June 16, 2023, until the facility was shut down on September 15, 2023.

Dissolved Oxygen

Eel collection numbers and DO did not appear to be related this season. DO was recorded as milligrams/Liter (mg/L). These data indicated that the DO readings were typically lower in the source water in the head pond above the dam than those observed in the collection tank for most of the season (Table 4.5-4 and Figure 4.5-4). The oxygen supply system was added to the collection tank in the 2022 season was used again in 2023 and operated daily. Daily DO readings are presented in Table 4.5-4 and displayed in Figure 4.5-4. DO levels in the head pond were lower than the collection tank when the oxygen supply system was operated properly (Figure 4.5-5 and Appendix B). Dissolved oxygen measurements were usually taken in the early morning when the lowest natural DO level was likely to be observed.

Rainfall

Juvenile eel collection and rainfall did not appear to be correlated during the 2023 season. Rainfall was recorded in inches (in) by a rain gauge affixed to the scaffolding platform. Only three rainfall events over 1.5 inches were recorded on September 9, July 4, and July 10 with 1.8, 1.6, and 1.5 inches recorded, respectively (Table 4.5-5 and Figure 4.5-6). Recorded rainfall amounts over 1.0 inch were observed on five days during the 2023 season: once in June, three times in July, and once in September. During 77.5% of the season (107 of the 138 days), the rain gauge recorded values of 0.0 inches.

4.6 Juvenile Eel Transport and Mortality

Table 4.6-1 has detailed information of transport and mortality data.

Transport

A total of 62,095 eels (99.97%) of the 62,113 eels collected at the OCEF were transported within 24 hours of capture to the CWECF where they were held before transport (<u>Table 4.6-1</u>). Transport time from the OCEF to the CWECF was approximately 30 minutes. No juvenile eel mortality occurred when transferring eels from the transport vehicle into the CWECF.

Mortality

Mortality at the OCEF was very low during the 2023 season. Eighteen eels perished at the OCEF, with fifteen of these eels removed during the largest collection day on July 11. (<u>Table 4.0-1</u> and <u>Table 4.6-1</u>). All juvenile eels captured at the OCEF were observed to be free of fungus.

4.7 Quality Control Activities

Cleaning and calibration activities were conducted weekly during the season. Scrubbing of the barrel housing the pump, along with the spray bars, was performed prior to performing any calibrations. The attraction flow lines, pump, barrel, and the manifold were cleaned as needed during the season.

Calibration of the ramp flow was executed each week after cleaning, using a 15-liter graduated bucket. Multiple locations of each ramp were checked for calibration purposes- the spray bar, the collection tank fill line, the scent line (collection tank drain), and the additional attraction flows at the entrance of the ramp. Detailed calibration records are listed in <u>Table 4.7-1</u>.

The amount of algal growth within the spray bars and collection tank fill were not an issue this season for they are cleaned daily. The flow through the hoses, screened barrel, and pump became a problem with meeting the suggested fishway design attraction flow for an eel facility as the season progressed. To increase the flow of attraction water to the ramps, the pump, the barrel, manifold, and all the attraction flow lines were scrubbed or cleaned with a drain snake weekly during the second half of the 2023 season when attraction flows were below expected volumes (Table 4.7-1). The same submersible pump was used all season.

Actual eel counts were compared to volumetric eel estimates to determine accuracy of the volumetric estimates. A quality control comparison of the volumetric estimate occurred once during the 2023 season: July 14. The detailed estimates for juvenile eels per 200 mL, displacement, total estimated, and actual counts are in <u>Table 4.7-2</u>. With only a small difference observed between estimates and actual counts (1.3%), no further changes to this method are warranted.

4.8 Other Species Caught

Four other aquatic species were caught in addition to American Eel and released to the tailrace of the field stone dam between the ramp entrance and the covered bridge. One hundred thirty crayfish (Cambaridae family) were found in the collection tank on 61 occasions during the season. Three common Musk Turtle *Sternotherus odoratus* were captured in the collection tank on August 9, August 29, and September 13, 2023, while a painted turtle *Chrysemys picta* was captured on July 16, 2023. A juvenile northern water snake *Nerodia sipedon* was observed at the apex of the ramp near the collection tank on August 6, 2023.

5 Discussion

The CWECF has one Enkamat ramp compared to the OCEF which contains one Enkamat and one Milieu ramp. Both ramps operated simultaneously from (May 1 to September 1). The CWECF continued to operate after the OCEF season was complete. Through September 1, 2023, the CWECF captured 204,018 eels compared to the OCEF which captured 62,113 juvenile eels during the 2023 season. When both ramps were operating simultaneously, the OCEF captured approximately 30.4% of the number of eels collected by the CWECF. During this time, the size range of the juvenile eels caught at the CWECF was 79-176 mm with an average length of 117.1 mm (Normandeau Associates, Inc. 2023 (draft)). The average size and range of the juvenile eels caught in the ramp at the OCEF were of a slightly larger size range of 95-350 mm and an average length of 122.8 mm. Overall, the eel ramp locations collected the larger size range, but the CWECF collected much smaller eels.

The collection tank was cleaned, hoses were inspected, and spray bars were examined and cleaned daily to ensure the facility was operating correctly. A routine (weekly) and as needed clean-out of the hoses and manifolds was performed to maintain consistent attraction flow. Minor decreases of attraction flow may be due to the build-up of biological growth in the system. The OCEF was not shaded during the 2023 season.

Water temperature and DO readings were taken daily in the head pond at the pump level and in the collection tank. These data indicated that the dissolved oxygen in the water above the dam was less than the dissolved oxygen observed in the collection tank for most of the season, likely due to the additional oxygen supply system added in 2022 and used again in 2023 (<u>Table 4.5-4</u> and <u>Figure 4.5-4</u>). The oxygen supply system was used when the ramp commenced and continued until the end of the season.

The average seasonal creek flow value per the USGS gage station during the 2023 season was compared to the previous years of operation (2015-2022). The average creek flow value during the operational period of May 1 through September 15, 2015-2023 was 203.6 cfs compared to the average creek flow value of 127.2 cfs in 2023 (Normandeau Associates and Gomez and Sullivan 2015, 2016, and 2018a and Normandeau Associates 2018, 2019, 2020, 2021, and 2022). During the 2023 season at OCEF, the daily average creek flow did not exceed 1,000 cfs, with the exception of May 1, 2023, the first day of the season, with a flow of 1,470 cfs. The daily average creek flow was below 100 cfs for sixty-nine days compared to 24, 65, 46, 4, 13, 18, 2, and 5 days in 2015, 2016, 2017, 2018, 2019, 2020, 2021, and 2022, respectively. CWA operated its hydropower facility on 50 of the 138 days (36.2%) this year, but no relationship was observed between eel catch and hydropower operation (Table 4.0-1). As in 2022, the entrance of the ramp was in close proximity to that of previous operational years but was above the tailwater elevation at creek flow less than 182 cfs, which was unlike the years prior to the shoreline stabilization project. The transition of the ramp entrance and the substrate became submerged when the creek flow was approximately 182 cfs, according to the USGS Gage 01578475 on Octoraro Creek at Richardsmere, MD (Figures 3.1-2 and 5.0-1). This daily average creek flow was observed to be greater than or equal to 182 cfs on 24 of the 138 operational days (17.4%), and the average creek flow for the 2023 eel season was 127.2 cfs (Tables 4.5-1 and 5.0-1). If the entrance of the ramp was to be located such that it was underwater at all creek flows, then the riprap would have to be moved causing structural concerns for the integrity of ACBs. If the ramp were to be located such that it would span over the rip-rap, the resulting location of the ramp entrance would be farther away from the shoreline to ensure the

bottom of the ramp was in contact with the creek bottom, which would increase the chances of damage to the ramp under high creek flows and create safety issues during set-up, tear-down, and weekly calibration of the facility. The Enkamat substrate extended below the entrance of the ramp and between the riprap and the ACBs into the tailrace at all creek flows in 2023 (Figures 3.1-2 and 5.0-1).

Since 2015, typically when the creek flow has increased, the catch of juvenile eels has also increased within a few days of the flow increase. This was evident during the higher creek flows in July, but not during the higher flows in the remainder of 2023. <u>Figure 5.0-2</u> shows a comparison of 2015 through 2023 weekly catch and average creek flow data.

The number of eels collected (62,113 individuals) in 2023 was the highest annual total since the commencement of this facility (Table 5.0-1). The prior season (2022) was the shortest season length and operated on a shifted schedule (September until mid-November) but did collect a fair number of eels (7,159 individuals) operating outside the normal eel migration season. The highest average seasonal collection of eels per day prior to this season was 364.8 eels/day in 2021 when 45,230 eels were collected over a 124-day season, but the OCEF collected an average of 450.1 eels/day in 2023 for the entire 138-day season. The OCEF collected more than the daily average (450.1 eels per day) on 17 of the 138 days (12.3% of the season, Tables 4.0-1 and 5.0-1). The average size of eels (122.8 mm) captured in 2023 was nearly identical to that observed in 2021 when the average size of eels was 123.5 and 123.9 mm, respectively (Table 5.0-1). From 2015 to 2018, juvenile eels were measured during every sample day (up to 25 eels if available), but only biweekly subsamples of lengths were collected in 2019-2023. The OCEF has caught juvenile eels less than or equal to 100 mm every year. The magnitude of the size range of eels collected and measured in 2023 was similar to all other years when both substrate ramps were used to collect eels, except for two large individuals that measured over 200 mm (Table 4.2-2).

The collection tank is 914 mm wide with a length of 1,829 mm. The depth of the water in the collection tank is approximately 762 mm with a volume of approximately 1,061 Liters. The capacity of American Eels in this new, larger collection tank is 10,061 eels under the USFWS guidelines. The capacity of the collection was exceeded once in 2023, with a very low mortality rate of 0.09%.

The improvements to the OCEF in 2022 helped minimize potential mortality events. The addition of a small oxygen bottle, regulator, and micro pore diffuser helped increase the oxygen levels in the collection tank. Oxygen levels were kept close to 100% saturation and not held at extreme levels. An oxygen bottle system was added to the OCEF which did not change its footprint. Oxygen was controlled and maintained manually and was increased daily when an increase in creek flows was forecasted or when higher eel collections were being recorded. Typically, at most eel ladders, increases of eel captures occur when river flows increase or shortly after these events.

Due to the installation of the larger collection tank, the footprint of the scaffolding needed to be increased to a platform of eight feet by ten feet. An additional length of the ramp was needed to reach the new location of the scaffolding and ensure the angle of the ramp did not change. These changes to the OCEF were agreed upon by EPAG and FERC was updated on these changes.

Multiple monitoring checks were performed during the evening after the large collection occurred on July 11 when the facility set a single daily collection record of 17,082 eels. The eel numbers in the

collection tank that evening were not high enough to anticipate that the holding capacity of the collection tank would be exceeded.

A loss of power event occurred on June 1, 2023, which may have been the reason the OCEF collected no eels that morning (<u>Table 4.0-1</u>).

Two inches of topsoil, seed, and coconut web mat was added along the hillside prior to the start of the season as part of the bank stabilization project.

6 References

- Federal Energy Regulatory Commission. Project No. 2355-026-Pennsylania Muddy Run Pumped Storage Project. Exelon Generation Company, LLC., March 1, 2018.
- Minkkinen, S., and I. Park. 2014. American eel sampling at Conowingo Dam, 2013. USFWS Technical Report, February 2014.
- Normandeau Associates, Inc. 2023 (draft). Muddy Run Pumped Storage Project. Conowingo West Eel Collection Facility Report, FERC Project No. 2355. Prepared for Constellation.
- Normandeau Associates, Inc. 2022. Muddy Run Pumped Storage Project. Conowingo West Eel Collection Facility Report, FERC Project No. 2355. Prepared for Constellation.
- Normandeau Associates, Inc. 2021. Muddy Run Pumped Storage Project. Conowingo West Eel Collection Facility Report, FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. 2020. Muddy Run Pumped Storage Project. Conowingo Eel Collection Facility Report, FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. 2019. Muddy Run Pumped Storage Project. Conowingo Eel Collection Facility Report, FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. 2018. Muddy Run Pumped Storage Project. Conowingo Eel Collection Facility Report, FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. 2022. Muddy Run Pumped Storage Project. American Eel Collection Facility in Octoraro Creek, FERC Project No. 2355. Prepared for Constellation
- Normandeau Associates, Inc. 2022. Muddy Run Pumped Storage Project. American Eel Collection Facility in Octoraro Creek, FERC Project No. 2355. Prepared for Constellation
- Normandeau Associates, Inc. 2021. Muddy Run Pumped Storage Project. American Eel Collection Facility in Octoraro Creek, FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. 2020. Muddy Run Pumped Storage Project. American Eel Collection Facility in Octoraro Creek, FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. 2019a. Muddy Run Pumped Storage Project. Evaluation of Temporary American Eel Collection Facility in Octoraro Creek, Year 5, FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. and Gomez and Sullivan. 2018a. Muddy Run Pumped Storage Project. Evaluation of Temporary American Eel Collection Facility in Octoraro Creek, Year 4, FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. and Gomez and Sullivan. 2018b. Muddy Run Pumped Storage Project. Conowingo Eel Collection Facility Report, FERC Project No. 2355. Prepared for Exelon.

- Normandeau Associates, Inc. and Gomez and Sullivan. 2017. Muddy Run Pumped Storage Project. Evaluation of Temporary Eel Collection Facility in Octoraro Creek, (Year 3). FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. and Gomez and Sullivan. 2016. Muddy Run Pumped Storage Project. Evaluation of Temporary Eel Collection Facility in Octoraro Creek, (Year 2). FERC Project No. 2355. Prepared for Exelon.
- Normandeau Associates, Inc. and Gomez and Sullivan. 2015. Evaluation of Temporary Eel Collection Facility in Octoraro Creek (Year 1). Prepared for Exelon.
- Normandeau Associates, Inc. and Gomez and Sullivan. 2014. Octoraro Creek Juvenile American Eel Trapping Evaluation. Prepared for Exelon.
- Schmidt, R.E., C.M. O'Reilly, D. Miller. 2009. Observations of American eels using an upland passage facility and effects of passage on the population structure. North American Journal of Fisheries Management, 29: 715-720.
- Time and Date website. 2022. Philadelphia, Pennsylvania, USA Moonrise, Moonset, and Moon Phases. https://www.timeanddate.com/moon/usa/philadelphia?month=5&year=2022
- Welsh S.A., J.L. Aldinger, M.A. Braham, J.L. Zimmerman. 2015. Synergistic and singular effects of river discharge and lunar illumination on dam passage of upstream migrant yellow-phase American eels. ICES Journal of Marine Science. Doi:10.1093/icesjms/fws052.

7 Tables and Figures

Date	Number of Fels						
5/1/2023	-	6/5/2023	72	7/10/2023	8521	*8/14/2023	3
5/2/2023	360	6/6/2023	93	7/11/2023	17082	*8/15/2023	4
5/3/2023	29	6/7/2023	80	7/12/2023	4551	8/16/2023	3
*5/4/2023	24	6/8/2023	27	7/13/2023	3744	8/17/2023	2
5/5/2023	30	*6/9/2023	8	7/14/2023	890	*8/18/2023	3
5/6/2023	50	6/10/2023	23	*7/15/2023	209	8/19/2023	14
5/7/2023	410	6/11/2023	29	7/16/2023	38	8/20/2023	0
5/8/2023	50	6/12/2023	43	*7/17/2023	32	8/21/2023	5
5/9/2023	1124	6/13/2023	38	7/18/2023	17	8/22/2023	4
5/10/2023	309	6/14/2023	147	7/19/2023	21	8/23/2023	1
5/11/2023	345	6/15/2023	82	7/20/2023	35	*8/24/2023	0
5/12/2023	550	6/16/2023	26	7/21/2023	9	*8/25/2023	4
*5/13/2023	24	6/17/2023	82	7/22/2023	32	*8/26/2023	1
5/14/2023	19	6/18/2023	196	*7/23/2023	31	*8/27/2023	0
5/15/2023	12	6/19/2023	135	7/24/2023	7	8/28/2023	0
*5/16/2023	2	6/20/2023	105	7/25/2023	4	*8/29/2023	0
5/17/2023	245	6/21/2023	323	*7/26/2023	4	8/30/2023	0
5/18/2023	227	6/22/2023	139	7/27/2023	3	8/31/2023	0
5/19/2023	259	*6/23/2023	205	7/28/2023	3	*9/1/2023	0
5/20/2023	1003	*6/24/2023	113	*7/29/2023	30	*9/2/2023	0
5/21/2023	563	*6/25/2023	191	7/30/2023	80	9/3/2023	1
5/22/2023	2592	*6/26/2023	331	7/31/2023	21	9/4/2023	2
5/23/2023	1639	*6/27/2023	239	*8/1/2023	7	9/5/2023	0
5/24/2023	263	*6/28/2023	226	*8/2/2023	5	9/6/2023	3
*5/25/2023	1230	*6/29/2023	142	*8/3/2023	1	9/7/2023	1
5/26/2023	1099	6/30/2023	85	8/4/2023	0	9/8/2023	0
5/27/2023	126	*7/1/2023	32	*8/5/2023	3	9/9/2023	2
*5/28/2023	297	*7/2/2023	12	8/6/2023	4	*9/10/2023	5
*5/29/2023	88	*7/3/2023	37	*8/7/2023	9	*9/11/2023	1
*5/30/2023	17	*7/4/2023	3078	*8/8/2023	11	*9/12/2023	1
5/31/2023	73	*7/5/2023	4048	8/9/2023	14	9/13/2023	0
6/1/2023	0	*7/6/2023	1290	*8/10/2023	5	9/14/2023	0
6/2/2023	114	7/7/2023	827	*8/11/2023	5	9/15/2023	0
*6/3/2023	255	7/8/2023	179	*8/12/2023	13		
6/4/2023	114	7/9/2023	390	*8/13/2023	6	Total	62,113

Table 4.0-1: Number of Juvenile Eels Caught Daily, Octoraro Creek Eel Facility, 2023

*Days the hydroelectric facility was operating (50 days)

Volumetric estimates are in italics (14)

Bolded numbers are peak days.

The peak periods are shown in boxes.

	Number of
	Eels in
Date	200 mL
5/9/2023	91
5/20/2023	118
5/22/2023	87
5/23/2023	78
5/25/2023	103
5/26/2023	109
7/4/2023	76
7/5/2023	92
7/6/2023	86
7/10/2023	59
7/11/2023	82
7/12/2023	82
7/13/2023	78
7/14/2023	89

Table 4.1-1: Known Eel Numbers in the 200 Milliliter Subsample during Days of Volumetric Estimates, Octoraro Creek Eel Facility, 2023

	Total
Number eels collected	62,113
Number measured	596
Data Collection Days	34
Length Range (mm)	95-350
Average length (mm)	122.8
Median length (mm)	121.0
Weight range (g)	0.7-62.0
Average weight (g)	2.3
Median weight (g)	1.9

Table 4.2-1: Number of Juvenile Eels Captured with Length and Weight Measurements, Octoraro Creek Eel Facility, 2023

TL (mm)	Number
95-99	4
100-104	34
105-109	61
110-114	75
115-119	95
120-124	91
125-129	80
130-134	46
135-139	47
140-144	28
145-149	10
150-154	9
155-159	6
160-164	5
165-169	2
170-174	1
200-204	1
350-354	1
Total	596

Table 4.2-2: Juvenile Eel Length Frequency, Octoraro Creek Eel Facility, 2023

Weight (g)	Number
0.5-0.9	16
1.0-1.4	110
1.5-1.9	203
2.0-2.4	120
2.5-2.9	67
3.0-3.4	35
3.5-3.9	15
4.0-4.4	14
4.5-4.9	6
5.0-5.4	2
5.5-5.9	3
7.5-7.9	1
8.5-8.9	1
41.5-41.9	1
42.0-42.4	1
62.0-62.4	1
Total	596

Table 4.2-3: Juvenile Eel Weight Frequency, Octoraro Creek Eel Facility, 2023

Table 4.2-4: Observed Injuries of Juvenile American Eels, Octoraro Creek Eel Facility, 2023

Date	Length (mm)	Weight (grams)	Condition Factor
05/07/2023	127	2.6	Slight Hemorrhage on Dorsal Tail
05/29/2023	136	2.6	Slight Hemorrhage on Dorsal Tail
07/03/2023	104	1.2	Abrasion on head

3 of 596 eels (0.5%) that were processed had an injury.

	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10
Total	493	2812	1767	7503	844	417	447	1216	1246	9471
Rank	9	4	5	3	8	11	10	7	5	2
Percent Catch (%)	0.79	4.53	2.84	12.08	1.36	0.67	0.72	1.96	2.01	15.25

	Wk 11	Wk 12	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	Wk 18	Wk 19	Wk 20
Total	35387	184	82	117	61	35	15	0	9	7
Rank	1	12	14	13	15	16	17	20	18	19
Percent Catch (%)	56.97	0.30	0.13	0.19	0.10	0.06	0.02	0.00	0.01	0.01

Top 3 ranked weeks are shown in boxes.

Wk 1: May 1 - May 6 Wk 2: May 7 - May 13 Wk 3: May 14 - May 20 Wk 4: May 21 - May 27 Wk 5: May 28 - June 3 Wk 6: June 4 - June 10 Wk 7: June 11 - June 17 Wk 8: June 18 - June 24 Wk 9: June 25 - July 1 Wk 10: July 2 - July 8 Wk 11: July 9 - July 15 Wk 12: July 16 - July 22 Wk 13: July 23 - July 29 Wk 14: July 30 - August 5 Wk 15: August 6 - August 12 Wk 16: August 13 - August 19 Wk 17: August 20 - August 26 Wk 18: August 27 - September 2 Wk 19: September 3 - September 9 Wk 20: September 10 - September 15

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Day	May	June	July	August	September
1	1470	63.1	147	86.7	104
2	475	60.5	113	79.7	159
3	314	57.6	148	76.2	89.1
4	266	59.7	290	75.1	47.8
5	230	60.7	123	76.7	45.6
6	196	61.7	109	77.2	43.9
7	183	59.5	63.7	111	44.3
8	183	59.2	61.2	198	45.0
9	173	58.3	222	151	101
10	159	59.1	314	82.5	136
11	146	56.2	179	214	156
12	159	60.0	128	207	88.8
13	159	95.7	107	167	49.2
14	147	101	97.3	109	46.0
15	194	90.5	91.5	103	73.3
16	208	117	92.7	55.3	
17	63.4	133	95.6	52.0	
18	67.1	103	91.8	47.8	
19	84.6	82.8	89.0	46.3	
20	92.2	73.2	129	48.1	
21	111	69.9	190	51.7	
22	112	73.1	185	64.2	
23	107	134	123	83.8	
24	103	189	101	81.2	
25	122	179	92.8	94.9	
26	131	200	90.6	50.7	
27	114	250	87.0	49.6	
28	113	313	94.0	49.9	
29	111	225	165	50.9	
30	111	184	133	50.3	
31	96.0		99.2	56.7	

Table 4.5-1: USGS 01578475 - Octoraro Creek at Richardsmere, MD Gage Flows Daily Average Creek Flows (cfs), 2023

Day	May	June	July	August	September
1	0.864	0.949	0.974	0.993	0.978
2	0.926	0.968	0.986	0.995	0.927
3	0.972	0.987	0.997	0.964	0.853
4	0.985	0.999	0.989	0.903	0.761
5	0.997	0.982	0.950	0.819	0.658
6	0.997	0.936	0.882	0.719	0.552
7	0.971	0.862	0.791	0.610	0.447
8	0.919	0.768	0.685	0.500	0.346
9	0.842	0.658	0.572	0.392	0.254
10	0.745	0.542	0.458	0.293	0.174
11	0.634	0.425	0.349	0.204	0.106
12	0.16	0.314	0.250	0.129	0.054
13	0.398	0.215	0.164	0.070	0.019
14	0.286	0.132	0.095	0.029	0.002
15	0.187	0.068	0.044	0.006	0.004
16	0.106	0.025	0.013	0.002	
17	0.046	0.004	0.002	0.018	
18	0.011	0.004	0.011	0.051	
19	0.000	0.026	0.038	0.103	
20	0.014	0.066	0.084	0.170	
21	0.048	0.123	0.145	0.252	
22	0.102	0.194	0.220	0.347	
23	0.171	0.277	0.306	0.451	
24	0.252	0.368	0.402	0.561	
25	0.341	0.465	0.505	0.672	
26	0.436	0.566	0.611	0.777	
27	0.534	0.667	0.715	0.870	
28	0.632	0.763	0.813	0.942	
29	0.726	0.851	0.896	0.964	
30	0.814	0.923	0.959	0.986	
31	0.890		0.976	0.999	

Table 4.5-2: Fraction of Moon Illumination, 2023 EST (1.0 Equals Full Moon)

Day	May	June	July	August	September
1	-	16.0	20.7	25.0	23.7
2	14.0	16.4	21.0	24.1	23.4
3	13.6	17.4	21.3	23.9	23.6
4	13.2	16.8	21.7	23.9	23.9
5	13.2	16.6	21.8	24.2	24.1
6	13.9	16.6	21.7	24.9	24.5
7	14.1	16.9	21.6	24.4	24.8
8	17.3	17.0	21.8	25.0	25.0
9	17.1	17.1	22.0	23.1	25.1
10	16.1	17.6	25.5	23.5	24.5
11	17.2	18.0	25.7	22.9	25.1
12	17.4	19.3	25.3	23.2	24.4
13	15.0	19.6	25.8	23.8	24.7
14	14.6	20.7	25.8	23.7	24.4
15	14.1	19.7	26.1	24.1	23.7
16	13.4	20.2	26.2	24.1	
17	14.7	21.6	26.0	23.8	
18	13.9	20.9	25.8	25.5	
19	15.9	21.2	26.0	24.6	
20	16.9	21.4	26.3	24.5	
21	17.6	21.1	26.0	24.8	
22	17.6	20.1	26.3	24.9	
23	18.4	20.4	25.4	24.5	
24	17.8	20.7	25.1	24.5	
25	19.0	21.0	25.0	24.7	
26	16.1	21.3	25.0	24.7	
27	14.9	20.5	25.4	24.5	
28	15.1	22.1	26.2	24.7	
29	15.7	20.8	27.0	24.6	
30	15.6	20.2	26.4	25.0	
31	15.2		25.6	24.2	

Table 4.5-3: Water Temperature (°C) from the Collection Tank, Octoraro Creek Eel Facility, 2023

		Collec	tion *	Head Pond		
Day	Time	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	
5/1/2023	-	-	-	-	-	
5/2/2023	830	14.0	10.45	14.1	9.50	
5/3/2023	5/3/2023 850		8.98	13.7	9.30	
5/4/2023	5/4/2023 845		9.30	13.3	9.58	
5/5/2023	910	13.2	9.61	13.3	9.74	
5/6/2023	820	13.9	9.7	13.9	9.66	
5/7/2023	755	14.1	9.16	14.1	9.31	
5/8/2023	1310	17.3	10.37	17.1	10.55	
5/9/2023	820	17.1	8.40	17.1	8.92	
5/10/2023	808	16.1	10.75	16.3	9.15	
5/11/2023	950	17.2	10.39	17.1	9.72	
5/12/2023	840	17.4	9.55	16.7	8.64	
5/13/2023	730	15.0	10.27	14.9	9.61	
5/14/2023	755	14.6	10.24	14.6	8.67	
5/15/2023	810	14.1	9.44	14.1	9.60	
5/16/2023	810	13.4	10.08	13.4	9.70	
5/17/2023	810	14.7	8.14	14.7	6.60	
5/18/2023	820	13.9	7.92	14.0	7.35	
5/19/2023	915	15.9	9.14	15.6	8.33	
5/20/2023	800	16.9	9.10	17.0	8.10	
5/21/2023	750	17.6	8.81	17.8	7.78	
5/22/2023	806	17.6	6.71	17.9	8.27	
5/23/2023	900	18.4	8.46	18.3	8.40	
5/24/2023	820	17.8	13.92	17.9	8.69	
5/25/2023	800	19.0	7.53	19.0	7.60	
5/26/2023	848	16.1	6.90	16.4	7.11	
5/27/2023	815	14.9	8.73	15.1	6.37	
5/28/2023	837	15.1	9.69	15.0	7.25	
5/29/2023	800	15.7	8.55	15.6	7.05	
5/30/2023	752	15.6	8.52	15.6	7.24	
5/31/2023	800	15.2	9.35	15.2	9.50	
6/1/2023	900	16.0	8.51	15.9	6.92	
6/2/2023	805	16.4	7.38	16.3	8.44	
6/3/2023	758	17.4	6.50	17.6	6.27	
6/4/2023	756	16.8	7.56	16.6	7.17	
6/5/2023	800	16.6	7.12	16.5	6.49	
6/6/2023	820	16.5	7.73	16.6	7.40	
6/7/2023	810	16.9	7.6	16.9	5.55	
6/8/2023	800	17.0	6.84	17.0	5.10	
6/9/2023	810	17.1	7.17	17.2	5.40	
6/10/2023	945	17.6	7.26	17.6	7.16	
6/11/2023	830	18.0	6.46	17.9	5.17	
6/12/2023	740	19.3	6.60	18.9	4.80	
6/13/2023	800	19.6	7.74	19.5	6.50	
6/14/2023	815	20.7	7.14	20.2	6.06	
6/15/2023	800	19.7	7.34	19.8	6.02	

Table 4.5-4: Water Quality Parameters at Associated Locations at Octoraro Creek Eel Facility, 2023

Table 4.5-4. (Continued)

		Colle	ction	Head Pond		
Day	Time	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	
6/16/2023	800	20.2	6.67	20.2	5.35	
6/17/2023	737	21.6	7.19	21.0	7.70	
6/18/2023	746	20.9	7.68	20.9	6.44	
6/19/2023	744	21.2	8.20	21.2	7.13	
6/20/2023	800	21.4	8.38	21.4	8.14	
6/21/2023	1000	21.1	7.50	21.0	7.27	
6/22/2023	800	20.1	7.28	20.2	6.98	
6/23/2023	755	20.4	7.54	20.4	7.10	
6/24/2023	740	20.7	7.44	20.7	7.12	
6/25/2023	802	21.0	7.28	21.0	6.95	
6/26/2023	750	21.3	5.48	21.2	5.47	
6/27/2023	737	20.5	5.15	20.4	4.07	
6/28/2023	750	22.1	6.84	22.1	6.58	
6/29/2023	757	20.8	5.74	20.8	4.51	
6/30/2023	747	20.2	8.22	20.2	4.14	
7/1/2023	753	20.7	7.98	20.7	4.15	
7/2/2023	800	21.0	8.16	21.0	4.31	
7/3/2023	750	21.3	8.4	21.3	4.1	
7/4/2023	737	21.7	6.12	21.6	4.72	
7/5/2023	815	21.8	5.78	21.7	3.91	
7/6/2023	815	21.7	6.91	21.6	4.18	
7/7/2023	750	21.6	7.31	21.6	4.14	
7/8/2023	730	21.8	7.05	N/A	N/A	
7/9/2023	730	22.0	7.0	N/A	N/A	
7/10/2023	800	25.5	4.73	25.5	6.50	
7/11/2023	1000	25.7	4.50	25.5	8.25	
7/12/2023	745	25.3	6.29	25.3	6.40	
7/13/2023	800	25.8	10.01	25.7	6.52	
7/14/2023	750	25.8	5.83	25.8	5.84	
7/15/2023	810	26.1	15.30	26.1	5.75	
7/16/2023	750	26.2	9.31	26.2	6.70	
7/17/2023	735	26.0	11.55	26.0	6.55	
7/18/2023	945	25.8	10.48	25.7	9.15	
7/19/2023	1015	26.0	6.82	25.9	6.60	
7/20/2023	800	26.3	7.12	26.3	6.11	
7/21/2023	905	26.0	8.05	26.0	7.55	
7/22/2023	920	26.3	8.27	26.2	7.36	
7/23/2023	752	25.4	7.07	25.5	5.95	
7/24/2023	800	25.1	10.16	25.2	5.63	
7/25/2023	750	25.0	6.95	25.1	6.15	
7/26/2023	744	25.0	7.21	25.0	6.18	
7/27/2023	747	25.4	6.04	25.4	6.31	
7/28/2023	800	26.2	6.98	26.1	5.73	
7/29/2023	730	27.0	7.55	27.0	6.46	
7/30/2023	804	26.4	7.12	26.5	5.96	
7/31/2023	757	25.6	7.61	25.6	5.84	
Table 4.5-4. (Continued)

		Colle	ction	Head	d Pond			
Day	Time	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)			
8/1/2023	810	25.0	6.81	25.0	5.70			
8/2/2023	751	24.1	7.07	24.2	6.65			
8/3/2023	730	23.9	6.34	24.0	7.45			
8/4/2023	810	23.9	7.01	23.9	6.06			
8/5/2023	730	24.2	6.08	24.1	6.96			
8/6/2023	745	24.9	6.09	24.8	5.72			
8/7/2023	740	24.4	6.56	N/A	N/A			
8/8/2023	850	25.0	7.87	25.0	7.60			
8/9/2023	755	23.1	6.60	23.1	5.25			
8/10/2023	730	23.5	5.58	23.5	4.45			
8/11/2023	730	22.9	7.19	22.9	4.84			
8/12/2023	727	23.2	5.39	23.2	4.15			
8/13/2023	800	23.8	6.01	23.8	4.55			
8/14/2023	750	23.7	5.05	23.7	3.68			
8/15/2023	737	24.1	5.45	24.0	4.09			
8/16/2023	810	24.1	5.35	24.0	4.61			
8/17/2023	750	23.8	5.4	23.8	4.35			
8/18/2023	744	25.5	5.47	25.5	4.12			
8/19/2023	750	24.6	5.15	24.7	3.62			
8/20/2023	735	24.5	6.00	24.6	3.82			
8/21/2023	748	24.8	6.40	24.8	4.58			
8/22/2023	756	24.9	5.25	25.0	3.61			
8/23/2023	750	24.5	5.53	24.6	3.63			
8/24/2023	740	24.5	5.12	24.6	3.20			
8/25/2023	750	24.7	5.50	24.7	3.15			
8/26/2023	750	24.7	5.50	24.7	2.91			
8/27/2023	748	24.5	5.73	24.5	3.50			
8/28/2023	733	24.7	5.71	24.7	3.27			
8/29/2023	740	24.6	5.45	24.6	5.11			
8/30/2023	800	25.0	4.46	24.9	3.60			
8/31/2023	745	24.2	5.72	24.4	4.13			
9/1/2023	735	23.7	5.80	23.9	4.08			
9/2/2023	740	23.4	5.03	23.6	3.03			
9/3/2023	745	23.6	4.97	23.8	3.89			
9/4/2023	735	23.9	3.96	23.9	3.15			
9/5/2023	751	24.1	4.57	24.1	2.64			
9/6/2023	725	24.5	4.60	24.4	2.64			
9/7/2023	750	24.8	4.42	24.7	2.88			
9/8/2023	806	25.0	5.34	25.0	4.52			
9/9/2023	800	25.1	5.45	25.1	3.23			
9/10/2023	745	24.5	6.65	24.5	5.47			
9/11/2023	746	25.1	7.19	25.1	6.01			
9/12/2023	807	24.4	6.18	24.4	3.70			
9/13/2023	745	24.7	5.73	24.8	2.85			
9/14/2023	750	24.4	4.40	24.4	3.55			
9/15/2023	750	23.7	5.02	23.8	4.44			

Day	May	June	July	August	September
1	-	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.1	0.0	0.0	0.0	0.0
4	0.0	0.0	1.6	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.5	0.0
8	0.0	0.0	0.0	0.8	0.2
9	0.0	0.0	0.9	0.0	1.8
10	0.0	0.2	1.5	0.0	0.4
11	0.0	0.0	0.0	0.6	0.1
12	0.0	0.0	0.0	0.0	0.1
13	0.0	1.0	0.0	0.0	0.2
14	0.1	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.5	0.0
16	0.0	0.0	0.0	0.0	
17	0.0	1.3	0.1	0.0	
18	0.0	0.0	0.0	0.0	
19	0.0	0.0	0.0	0.0	
20	0.0	0.0	1.2	0.0	
21	0.1	0.0	0.0	0.0	
22	0.0	0.2	0.0	0.0	
23	0.0	0.4	0.0	0.0	
24	0.0	0.8	0.0	0.0	
25	0.0	0.4	0.0	0.0	
26	0.0	0.0	0.0	0.0	
27	0.0	0.3	0.0	0.0	
28	0.0	0.6	0.0	0.0	
29	0.0	0.0	1.0	0.0	
30	0.0	0.0	0.1	0.2	
31	0.0		0.0	0.0	

Table 4.5-5: Rainfall (inches) Readings Taken at the Octoraro Creek Eel Facility, 2023

Bolded values represent rainfall amounts greater than or equal to 1.0 inches.

Table 4.6-1: Eel Transport/Stocking Data, 2023

		No.	eels died (morta	ality)	Domourad	Domovo hu	Number
Location of stocking	Number of Eels	Collection Tank	Holding Tank	Transport	for analysis	SRBC	stocked
Octoraro Creek Collection Tanks	62,113	18 (0.00%)					
Transported to Conowingo West Eel Collection Facility				0 (0.00%)			
Conowingo Collection Tank	204,018	41 (0.02%)	107 (0.05%)		100	300	203,470
Total Transported from Octoraro Creek and Conowingo West Eel Collection Facility	265,565			21 (0.01%)			265,544

Numbers displayed are from May 1 – September 15, 2023

Bolded value is assumed all dead eels were from the CWECF.

					DA	TE				
	5/10	5/17*	5/24	6/1	6/7*	6/14	6/21*	6/28	7/5*	7/12
Enkamat Ramp										
Spray bar	5.2	5.7	5.4	6.2	6.2	6.0	7.0	6.0	6.6	7.4
Scent line	3.3	3.8	4.8	4.8	4.5	5.3	4.2	3.7	3.6	4.4
Bottom Attraction flow	24.0	24.5	23.0	22.0	26.5	22.0	23.0	22.0	22.5	23.0
Milieu Ramp										
Spray bar	5.1	4.8	5.4	6.0	5.9	5.9	6.5	6.2	6.4	6.0
Scent line	3.8	3.5	4.5	5.7	4.8	3.9	4.0	3.5	3.9	4.5
Bottom Attraction flow	25.5	25.5	25.5	25.0	22.0	19.5	20.0	24.5	25.5	22.0
Collection Tank Fill	5.3	5.2	6.9	7.2	6.0	6.3	7.5	4.5	5.5	5.4
Overall Attraction Flows	65.1	65.7	66.2	66.4	66.6	59.7	64.0	63.2	66.5	63.8

Table 4.7-1: Checking Flows (Gallons per Minute) in the Octoraro Creek Eel Facility, 2023

* Cleaned pump, manifold, and hoses to increase flow

					DATE				
	7/19*	7/26*	8/2*	8/9*	8/16*	8/23*	8/30*	9/6*	9/13*
Enkamat Ramp									
Spray bar	7.2	6.3	5.8	5.8	6.0	5.5	6.0	6.0	6.2
Scent line	4.2	5.1	5.4	4.3	5.3	5.1	5.0	5.2	4.4
Bottom Attraction flow	19.5	19.2	19.8	20.5	20.0	18.0	21.5	16.5	16.5
Milieu Ramp									
Spray bar	7.5	6.8	6.2	6.6	5.5	5.5	6.0	5.1	6.4
Scent line	5.0	4.0	4.6	4.7	5.1	4.9	5.0	5.4	3.7
Bottom Attraction flow	19.2	19.5	21.0	20.0	19.5	18.0	19.0	19.2	18.0
Collection Tank Fill	6.3	5.5	6.0	7.4	7.4	7.8	6.8	7.5	5.6
Overall Attraction Flows	59.7	57.3	58.8	60.3	58.4	54.8	59.3	54.3	52.7

* Cleaned pump, manifold, and hoses to increase flow

Table 4.7-2: Quality Control Checks on Coun	ts, Octoraro Creel Eel Facility, 2023
---------------------------------------------	---------------------------------------

	Number	of eels in:	Displacement	Volumetric	Actual	
Date	200 mL	1 L	of Water	Estimate	Counts	Difference
7/14/2023	89	445	1.8	902	890	12
Total				902	890	12
						1.3%

All estimated eel counts contain extra eels that were anesthetized and counted.

Table 5.0-1: Comparison of Octoraro Creek Eel Facility, 2015-2023

Watershed area 540 km² Approximate Distance from Mouth of Chesapeake Bay to OCEF 341 km

	2015	2016	2017	2018	2021	2020	2021	2022 *	2023	Average
Eels Collected	7,197	21,094	11,347	4,203	14,170	3,597	45,230	7,159	62,113	19,567.8
Average Size (mm)	129.4	130.9	135.4	141.6	129.9	125.8	123.5	123.9	122.8	129.2
Eel length range (mm)	95-232	99-202	99-245	100-259	93-252	91-170	90-190	100-219	95-350	
Days of Operation	89	138	138	135	138	95	124	73	138	118.7
Average eels per day	80.9	152.9	82.2	31.1	102.7	37.9	364.8	99.4	450.1	164.9
Average creek flow (cfs)	180.9	121.3	138.0	411.0	240.0	224.0	203.0	187.0	127.2	203.6
Flow range (cfs)	60-1,490	43-512	51-557	88-2,370	63-1,610	64-3,920	93-1,070	57-687	44-1,470	

*Started operation on September 5, 2022, after the bank stabilization project was completed and continued operation until November 20, 2022.

Figure 2.0-1: Lower Octoraro Creek from Pine Grove Dam to the Mouth at the Susquehanna River, Octoraro Creek (Stone Masonry Dam Also Known as Pine Grove Low-Head Dam)



Figure 3.1-1: Overview of the Collection Tank with Support Frame and Scaffolding at top of the hill, Octoraro Creek Eel Facility, 2023









Figure 3.1-3: T-bar supports driven through ACBs, Octoraro Creek Eel Facility, 2023



Figure 4.1-1: Daily Eel Catch, Octoraro Creek Eel Facility, 2023

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Normandeau Associates, Inc.



MUDDY RUN PUMPED STORAGE PROJECT - FERC PROJECT NUMBER 2355

Figure 4.2-1: Image of Hemorrhage on Dorsal Tail (above) and Abrasion on Head (below), Octoraro Creek Eel Facility, 2023







Figure 4.5-1: Daily Eel Catch and Daily Average Creek Flow (cfs, top graph) and Weekly Eel Catch and Weekly Average Creek Flow (cfs, bottom graph), Octoraro Creek Eel Facility, 2023



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Figure 4.5-3: Eel Catch to Water Temperature (Daily above, Weekly Average below), Octoraro Creek Eel Facility, 2023

Figure 4.5-4: Comparison of Dissolved Oxygen Readings in Collection Tank and Head Pond, Octoraro Creek Eel Facility, 2023

Figure 5.0-1: Ramp Entrance at ACBs (42.7 cfs), Octoraro Creek Eel Facility, 2023

Figure 5.0-2: Weekly Catch and Average Creek Flow, Octoraro Creek Eel Facility, 2015-2023

Appendix A: Weekly Biological Data and Environmental Conditions for Octoraro Creek, 2023

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Octoraro Eels	493	2812	1767	7503	844	417	447	1216	1246	9471	35387	184	82	117	61	35	15	0	9	7
Creek flow (cfs, weekly avg.)	491.8	166.0	122.3	114.3	87.5	59.7	93.3	103.6	214.0	129.7	162.7	124.7	107.6	89.5	148.7	82.9	67.8	74.3	59.5	91.6
Lunar Fraction, (weekly avg.)	0.957	0.725	0.093	0.269	0.852	0.821	0.169	0.151	0.744	0.897	0.276	0.073	0.607	0.944	0.407	0.040	0.461	0.952	0.553	0.060
Water temp (°C, weekly avg.)	13.6	16.3	14.8	17.3	15.9	16.9	19.9	20.8	20.9	21.6	25.2	26.1	25.6	24.7	23.9	24.2	24.7	24.3	24.4	24.5
Dissolved Oxygen (mg/L, weekly avg.)	9.61	9.84	9.15	8.72	8.36	7.33	7.02	7.72	6.67	7.10	7.67	8.80	7.42	6.86	6.47	5.41	5.61	5.41	4.76	5.86
Rainfall (in, weekly total)	0.1	0.0	0.1	0.1	0.0	0.2	2.3	1.4	1.3	1.6	2.4	1.3	1.0	0.1	1.9	0.5	0.0	0.2	2.0	0.8
Percent of Catch	0.79	4.53	2.84	12.08	1.36	0.67	0.72	1.96	2.01	15.25	56.97	0.30	0.13	0.19	0.10	0.06	0.02	0.00	0.01	0.01
Conowingo Eels	33	2441	24747	6310	3119	3493	879	928	4499	37844	69566	20518	5805	1110	395	142	4047	11624	2907	3611

Wk 11: July 9 - July 15 Wk 12: July 16 - July 22 Wk 13: July 23 - July 29 Wk 14: July 30 - August 5 Wk 15: August 6 - August 12 Wk 16: August 13 - August 19 Wk 17: August 20 - August 26 Wk 18: August 27 - September 2 Wk 19: September 3 - September 9 Wk 20: September 10 - September 15

Wk 1: May 1 - May 6 Wk 2: May 7 - May 13 Wk 3: May 14 - May 20 Wk 4: May 21 - May 27 Wk 5: May 28 - June 3 Wk 6: June 4 - June 10 Wk 7: June 11 - June 17 Wk 8: June 18 - June 24 Wk 9: June 25 - July 1 Wk 10: July 2 - July 8

Appendix B: Weekly Data for 2015-2023

Weekly Eel Catch Data (2015-2022)

2015 Week							7	8	9	10	11	12	13	14	15	16	17	18	19	20
2015 Octoraro Eels							183	1458	1524	1819	765	240	273	271	258	50	42	13	194	107
2015 Creek flow (cfs)							222.8	225.9	564	228.6	179.7	131	141.9	108.1	111.1	130.4	91.9	70.6	130.6	221.7
2015 Lunar Fraction							0.05	0.48	0.94	0.57	0.05	0.33	0.89	0.69	0.09	0.2	0.8	0.8	0.18	0.01
2015 Water temp (°C)							25.1	23.3	22.7	24.4	24.5	25.3	25.7	25	24.3	24.3	22.8	24.9	23.3	19
Dissolved Oxygen (mg/L)							6.7	7	8.8	7.3	5.1	4.5	4.1	3.3	3.1	5.1	4.3	3.5	5.4	6.8
Percent of Catch							2.5	20.3	21.2	25.3	10.6	3.3	3.8	3.8	3.6	0.7	0.6	0.2	2.7	1.5
Conowingo Eels							2439	8200	5400	3166	4930	1794	284	190	128	327	469	267	59	
2016 Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2016 Octoraro Eels	23	13	58	585	4124	4243	431	516	323	183	97	90	121	9540	443	28	247	25	2	2
2016 Creek flow (cfs)	271.7	211.9	145.9	153	158.7	164.7	120.4	112.3	111.4	97.6	76	73.7	106.1	226.3	98.1	61.6	62.7	61.4	59.7	46.6
2016 Lunar Fraction	0.1	0.27	0.85	0.86	0.24	0.15	0.74	0.93	0.35	0.08	0.6	0.95	0.48	0.05	0.45	0.94	0.6	0.06	0.31	0.83
2016 Water temp (°C)	14.5	14.9	15.8	19.3	23.9	22.7	22.8	24.3	24.5	25.7	26.2	27.2	27.7	25.4	26.7	26.7	24.3	24.8	24.8	23.4
Dissolved Oxygen (mg/L)	9.8	10	9.1	7.8	5.3	5.4	6.9	6.3	5.6	5.9	5.6	5	4.7	3	3.9	3.7	3.8	4.4	4	3.8
Percent of Catch	0.1	0.1	0.3	2.8	19.6	20.1	2.0	2.4	1.5	0.9	0.5	0.4	0.6	45.2	2.1	0.1	1.2	0.1	0.0	0.0
Conowingo Eels				5	95	100	113	353	252	247	1061	280	26	25	53	14	31	20	6	3
2017 Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2017 Week 2017 Octoraro Eels	1 17	2 9	3 9	4 39	5 21	6 7	7 2	8 61	9 1565	10 19	11 13	12 7067	13 419	14 48	15 16	16 68	17 1793	18 12	19 149	20 12
2017 Week 2017 Octoraro Eels 2017 Creek flow (cfs)	1 17 142.8	2 9 144	3 9 178.1	4 39 167.4	5 21 119.9	6 7 84.3	7 2 57.6	8 61 123.3	9 1565 121.6	10 19 106.3	11 13 195.4	12 7067 133.7	13 419 150.3	14 48 117.7	15 16 140.7	16 68 225.4	17 1793 140.7	18 12 122.9	19 149 190.3	20 12 110.2
2017 Week 2017 Octoraro Eels 2017 Creek flow (cfs) 2017 Lunar Fraction	1 17 142.8 0.56	2 9 144 0.96	3 9 178.1 0.66	4 39 167.4 0.09	5 21 119.9 0.37	6 7 84.3 0.92	7 2 57.6 0.78	8 61 123.3 0.16	9 1565 121.6 0.24	10 19 106.3 0.84	11 13 195.4 0.88	12 7067 133.7 0.26	13 419 150.3 0.14	14 48 117.7 0.72	15 16 140.7 0.94	16 68 225.4 0.38	17 1793 140.7 0.07	18 12 122.9 0.58	19 149 190.3 0.96	20 12 110.2 0.56
2017 Week2017 Octoraro Eels2017 Creek flow (cfs)2017 Lunar Fraction2017 Water temp (°C)	17 142.8 0.56 17.4	2 9 144 0.96 14.2	3 9 178.1 0.66 18.8	4 39 167.4 0.09 18.2	5 21 119.9 0.37 18.9	6 7 84.3 0.92 20.2	7 2 57.6 0.78 21.6	8 61 123.3 0.16 24.4	9 1565 121.6 0.24 24.9	10 19 106.3 0.84 25.7	11 13 195.4 0.88 25.6	12 7067 133.7 0.26 26.9	13 419 150.3 0.14 26.2	14 48 117.7 0.72 25.2	15 16 140.7 0.94 24.1	16 68 225.4 0.38 24	17 1793 140.7 0.07 23.3	18 12 122.9 0.58 20.2	19 149 190.3 0.96 20.5	20 12 110.2 0.56 20.4
2017 Week 2017 Octoraro Eels 2017 Creek flow (cfs) 2017 Lunar Fraction 2017 Water temp (°C) Dissolved Oxygen (mg/L)	1 17 142.8 0.56 17.4 9.5	2 9 144 0.96 14.2 8.3	3 9 178.1 0.66 18.8 7.5	4 39 167.4 0.09 18.2 7.5	5 21 119.9 0.37 18.9 6.4	6 7 84.3 0.92 20.2 5.7	7 2 57.6 0.78 21.6 4.4	8 61 123.3 0.16 24.4 4.9	9 1565 121.6 0.24 24.9 5.1	10 19 106.3 0.84 25.7 4.5	11 13 195.4 0.88 25.6 2.3	12 7067 133.7 0.26 26.9 5.1	13 419 150.3 0.14 26.2 5	14 48 117.7 0.72 25.2 4	15 16 140.7 0.94 24.1 4.5	16 68 225.4 0.38 24 5	17 1793 140.7 0.07 23.3 3	18 12 122.9 0.58 20.2 4	19 149 190.3 0.96 20.5 6.3	20 12 110.2 0.56 20.4 5.5
2017 Week2017 Octoraro Eels2017 Creek flow (cfs)2017 Lunar Fraction2017 Water temp (°C)Dissolved Oxygen (mg/L)Percent of Catch	1 17 142.8 0.56 17.4 9.5 0.2	2 9 144 0.96 14.2 8.3 0.1	3 9 178.1 0.66 18.8 7.5 0.1	4 39 167.4 0.09 18.2 7.5 0.3	5 21 119.9 0.37 18.9 6.4 0.2	6 7 84.3 0.92 20.2 5.7 0.1	7 2 57.6 0.78 21.6 4.4 0.0	8 61 123.3 0.16 24.4 4.9 0.5	9 1565 121.6 0.24 24.9 5.1 13.8	10 19 106.3 0.84 25.7 4.5 0.2	11 13 195.4 0.88 25.6 2.3 0.1	12 7067 133.7 0.26 26.9 5.1 62.3	13 419 150.3 0.14 26.2 5 3.7	14 48 117.7 0.72 25.2 4 0.4	15 16 140.7 0.94 24.1 4.5 0.1	16 68 225.4 0.38 24 5 0.6	17 1793 140.7 0.07 23.3 3 15.8	18 12 122.9 0.58 20.2 4 0.1	19 149 190.3 0.96 20.5 6.3 1.3	20 12 110.2 0.56 20.4 5.5 0.1
2017 Week 2017 Octoraro Eels 2017 Creek flow (cfs) 2017 Lunar Fraction 2017 Water temp (°C) Dissolved Oxygen (mg/L) Percent of Catch Conowingo Eels	1 17 142.8 0.56 17.4 9.5 0.2 4387	2 9 144 0.96 14.2 8.3 0.1 151	3 9 178.1 0.66 18.8 7.5 0.1 1224	4 39 167.4 0.09 18.2 7.5 0.3 5384	5 21 119.9 0.37 18.9 6.4 0.2 2196	6 7 84.3 0.92 20.2 5.7 0.1 1761	7 2 57.6 0.78 21.6 4.4 0.0 5199	8 61 123.3 0.16 24.4 4.9 0.5 23318	9 1565 121.6 0.24 24.9 5.1 13.8 8090	10 19 106.3 0.84 25.7 4.5 0.2 799	11 13 195.4 0.88 25.6 2.3 0.1 1503	12 7067 133.7 0.26 26.9 5.1 62.3 1432	13 419 150.3 0.14 26.2 5 3.7 15435	14 48 117.7 0.72 25.2 4 0.4 32524	15 16 140.7 0.94 24.1 4.5 0.1 13130	16 68 225.4 0.38 24 5 0.6 2654	1793 140.7 0.07 23.3 3 15.8 2931	18 12 122.9 0.58 20.2 4 0.1 88	19 149 190.3 0.96 20.5 6.3 1.3 51	20 12 110.2 0.56 20.4 5.5 0.1 43
2017 Week 2017 Octoraro Eels 2017 Creek flow (cfs) 2017 Lunar Fraction 2017 Water temp (°C) Dissolved Oxygen (mg/L) Percent of Catch Conowingo Eels 2018 Week	1 17 142.8 0.56 17.4 9.5 0.2 4387 1	2 9 144 0.96 14.2 8.3 0.1 151 2	3 9 178.1 0.66 18.8 7.5 0.1 1224 3	4 39 167.4 0.09 18.2 7.5 0.3 5384 4	5 21 119.9 0.37 18.9 6.4 0.2 2196 5	6 7 84.3 0.92 20.2 5.7 0.1 1761 6	7 2 57.6 0.78 21.6 4.4 0.0 5199 7	8 61 123.3 0.16 24.4 4.9 0.5 23318 8	9 1565 121.6 0.24 24.9 5.1 13.8 8090 9	10 19 106.3 0.84 25.7 4.5 0.2 799 10	11 13 195.4 0.88 25.6 2.3 0.1 1503 11	12 7067 133.7 0.26 26.9 5.1 62.3 1432 12	13 419 150.3 0.14 26.2 5 3.7 15435 13	14 48 117.7 0.72 25.2 4 0.4 32524 14	15 16 140.7 0.94 24.1 4.5 0.1 13130 15	16 68 225.4 0.38 24 5 0.6 2654 16	17 1793 140.7 23.3 3 15.8 2931 17	18 12 122.9 0.58 20.2 4 0.1 88 18	19 149 190.3 0.96 20.5 6.3 1.3 51 19	20 12 110.2 0.56 20.4 5.5 0.1 43 20
2017 Week2017 Octoraro Eels2017 Creek flow (cfs)2017 Lunar Fraction2017 Water temp (°C)Dissolved Oxygen (mg/L)Percent of CatchConowingo Eels2018 Week2018 Octoraro Eels	1 17 142.8 0.56 17.4 9.5 0.2 4387 4387 1 5	2 9 144 0.96 14.2 8.3 0.1 151 2 31	3 9 178.1 0.66 18.8 7.5 0.1 1224 3 2072	4 39 167.4 0.09 18.2 7.5 0.3 5384 4 101	5 21 119.9 0.37 18.9 6.4 0.2 2196 5 115	6 7 84.3 0.92 20.2 5.7 0.1 1761 6 407	7 2 57.6 0.78 21.6 4.4 0.0 5199 7 55	8 61 123.3 0.16 24.4 4.9 0.5 23318 8 8 3	9 1565 121.6 0.24 24.9 5.1 13.8 8090 9 4	10 19 106.3 0.84 25.7 4.5 0.2 799 10 0	11 13 195.4 0.88 25.6 2.3 0.1 1503 11 1	12 7067 133.7 0.26 26.9 5.1 62.3 1432 12 11	13 419 150.3 0.14 26.2 5 3.7 15435 13 464	14 48 117.7 0.72 25.2 4 0.4 32524 14 29	15 16 140.7 0.94 24.1 4.5 0.1 13130 15 393	16 68 225.4 0.38 24 5 0.6 2654 16 343	17 1793 140.7 0.007 23.3 3 15.8 2931 17 73	18 12 122.9 0.58 20.2 4 0.1 88 18 5	19 149 190.3 0.96 20.5 6.3 1.3 51 19 69	20 12 110.2 0.56 20.4 5.5 0.1 43 20 22
2017 Week 2017 Octoraro Eels 2017 Creek flow (cfs) 2017 Lunar Fraction 2017 Water temp (°C) Dissolved Oxygen (mg/L) Percent of Catch Conowingo Eels 2018 Week 2018 Octoraro Eels 2018 Creek flow (cfs)	1 17 142.8 0.56 17.4 9.5 0.2 4387 4387 1 5 185	2 9 144 0.96 14.2 8.3 0.1 151 151 2 31 143	3 9 178.1 0.66 18.8 7.5 0.1 1224 3 2072 822.6	4 39 167.4 0.09 18.2 7.5 0.3 5384 4 101 484.1	5 21 119.9 0.37 18.9 6.4 0.2 2196 5 115 327.9	6 7 84.3 0.92 20.2 5.7 0.1 1761 6 407 519	7 2 57.6 0.78 21.6 4.4 0.0 5199 7 55 345.1	8 61 123.3 0.16 24.4 4.9 0.5 23318 8 3 3 231.3	9 1565 121.6 0.24 24.9 5.1 13.8 8090 9 4 195.7	10 19 106.3 0.84 25.7 4.5 0.2 799 10 0 10 0 150.9	11 13 195.4 0.88 25.6 2.3 0.1 1503 11 123.3	12 7067 133.7 0.26 26.9 5.1 62.3 1432 12 11 143.9	13 419 150.3 0.14 26.2 5 3.7 15435 13 464 655.6	14 48 117.7 0.72 25.2 4 0.4 32524 14 29 254.3	15 16 140.7 0.94 24.1 4.5 0.1 13130 15 393 315.7	16 68 225.4 0.38 24 5 0.6 2654 16 343 661.9	17 1793 140.7 0.07 23.3 3 15.8 2931 17 73 634	18 12 122.9 0.58 20.2 4 0.1 88 18 5 492.1	19 149 190.3 0.96 20.5 6.3 1.3 51 19 69 520.4	20 12 110.2 0.56 20.4 5.5 0.1 43 20 22 943
2017 Week2017 Octoraro Eels2017 Creek flow (cfs)2017 Lunar Fraction2017 Water temp (°C)Dissolved Oxygen (mg/L)Percent of CatchConowingo Eels2018 Octoraro Eels2018 Creek flow (cfs)2018 Lunar Fraction	1 17 142.8 0.56 17.4 9.5 0.2 4387 1 5 185 0.89	2 9 144 0.96 14.2 8.3 0.1 151 2 31 143 0.4	3 9 178.1 0.66 18.8 7.5 0.1 1224 3 2072 822.6 0.06	4 39 167.4 0.09 18.2 7.5 0.3 5384 4 101 484.1 0.6	5 21 119.9 0.37 18.9 6.4 0.2 2196 5 115 327.9 0.96	6 7 84.3 0.92 20.2 5.7 0.1 1761 6 407 519 0.55	7 2 57.6 0.78 21.6 4.4 0.0 5199 7 55 345.1 0.06	8 61 123.3 0.16 24.4 4.9 0.5 23318 8 3 231.3 0.47	9 1565 121.6 24.9 5.1 13.8 8090 9 4 195.7 0.95	10 19 106.3 0.84 25.7 4.5 0.2 799 10 0 150.9 0.69	11 13 195.4 0.88 25.6 2.3 0.1 1503 11 123.3 0.1	12 7067 133.7 0.26 26.9 5.1 62.3 1432 12 11 143.9 0.34	13 419 150.3 0.14 26.2 5 3.7 15435 13 464 655.6 0.91	14 48 117.7 0.72 25.2 4 0.4 32524 14 29 254.3 0.8	15 16 140.7 0.94 24.1 4.5 0.1 13130 15 393 315.7 0.18	16 68 225.4 0.38 24 5 0.6 2654 16 343 661.9 0.22	17 1793 140.7 23.3 3 15.8 2931 17 73 634 0.82	18 12 122.9 0.58 20.2 4 0.1 88 18 5 492.1 0.89	19 149 190.3 0.96 20.5 6.3 1.3 51 19 69 520.4 0.29	20 12 110.2 0.56 20.4 5.5 0.1 43 20 22 943 0.12
2017 Week2017 Octoraro Eels2017 Creek flow (cfs)2017 Lunar Fraction2017 Water temp (°C)Dissolved Oxygen (mg/L)Percent of CatchConowingo Eels2018 Octoraro Eels2018 Creek flow (cfs)2018 Lunar Fraction2018 Water temp (°C)	1 17 142.8 0.56 17.4 9.5 0.2 4387 1 5 185 0.89 15.3	2 9 144 0.96 14.2 8.3 0.1 151 2 31 143 0.4 15.9	3 9 178.1 0.66 18.8 7.5 0.1 1224 3 2072 822.6 0.06 18.4	4 39 167.4 0.09 18.2 7.5 0.3 5384 4 101 484.1 0.6 19.4	5 21 119.9 0.37 18.9 6.4 0.2 2196 5 115 327.9 0.96 21.4	6 7 84.3 0.92 20.2 5.7 0.1 1761 6 407 519 0.55 20.5	7 2 57.6 0.78 21.6 4.4 0.0 5199 7 55 345.1 0.06 20.8	8 61 123.3 0.16 24.4 4.9 0.5 23318 8 3 231.3 0.47 22.6	9 1565 121.6 0.24 24.9 5.1 13.8 8090 9 4 195.7 0.95 22.5	10 19 106.3 0.84 25.7 4.5 0.2 799 10 0 150.9 0.69 25.6	11 13 195.4 0.88 25.6 2.3 0.1 1503 11 123.3 0.1 25.5	12 7067 133.7 0.26 26.9 5.1 62.3 1432 12 11 143.9 0.34 25.3	13 419 150.3 0.14 26.2 5 3.7 15435 13 464 655.6 0.91 24.6	14 48 117.7 0.72 25.2 4 0.4 32524 14 29 254.3 0.8 24.9	15 16 140.7 0.94 24.1 4.5 0.1 13130 15 393 315.7 0.18 25.9	16 68 225.4 0.38 24 5 0.6 2654 16 343 661.9 0.22 25.2	17 1793 140.7 0.07 23.3 3 15.8 2931 17 73 634 0.82 23.2	18 12 122.9 0.58 20.2 4 0.1 88 18 5 492.1 0.89 25.3	19 149 190.3 0.96 20.5 6.3 1.3 51 19 69 520.4 0.29 24.6	20 12 110.2 0.56 20.4 5.5 0.1 43 20 22 943 0.12 18.2
2017 Week2017 Octoraro Eels2017 Creek flow (cfs)2017 Lunar Fraction2017 Water temp (°C)Dissolved Oxygen (mg/L)Percent of CatchConowingo Eels2018 Octoraro Eels2018 Creek flow (cfs)2018 Lunar Fraction2018 Water temp (°C)Dissolved Oxygen (mg/L)	1 17 142.8 0.56 17.4 9.5 0.2 4387 1 5 185 0.89 15.3 8.8	2 9 144 0.96 14.2 8.3 0.1 151 2 31 143 0.4 15.9 7.7	3 9 178.1 0.66 18.8 7.5 0.1 1224 3 2072 822.6 0.06 18.4 7.5	4 39 167.4 0.09 18.2 7.5 0.3 5384 4 101 484.1 0.6 19.4 9.4	5 21 119.9 0.37 18.9 6.4 0.2 2196 5 115 327.9 0.96 21.4 7.9	6 7 84.3 0.92 20.2 5.7 0.1 1761 6 407 519 0.55 20.5 8.1	7 2 57.6 0.78 21.6 4.4 0.0 5199 7 55 345.1 0.06 20.8 7.4	8 61 123.3 0.16 24.4 4.9 0.5 23318 8 3 231.3 0.47 22.6 6.8	9 1565 121.6 0.24 24.9 5.1 13.8 8090 9 4 195.7 0.95 22.5 7	10 19 106.3 0.84 25.7 4.5 0.2 799 10 0 150.9 0.69 25.6 6.6	11 13 195.4 0.88 25.6 2.3 0.1 1503 11 123.3 0.1 25.5 6.5	12 7067 133.7 0.26 26.9 5.1 62.3 1432 12 11 143.9 0.34 25.3 7.1	13 419 150.3 0.14 26.2 5 3.7 15435 13 464 655.6 0.91 24.6 7.5	14 48 117.7 0.72 25.2 4 0.4 32524 14 29 254.3 0.8 24.9 6.5	15 16 140.7 0.94 24.1 4.5 0.1 13130 15 393 315.7 0.18 25.9 6.2	16 68 225.4 0.38 24 5 0.6 2654 16 343 661.9 0.22 25.2 6.5	17 1793 140.7 0.07 23.3 3 15.8 2931 17 634 0.82 23.2 5.8	18 12 122.9 0.58 20.2 4 0.1 88 18 5 492.1 0.89 25.3 6.4	19 149 190.3 0.96 20.5 6.3 1.3 51 19 69 520.4 0.29 24.6 6.1	20 12 110.2 0.56 20.4 5.5 0.1 43 20 22 943 0.12 18.2 10.2
2017 Week2017 Octoraro Eels2017 Creek flow (cfs)2017 Lunar Fraction2017 Water temp (°C)Dissolved Oxygen (mg/L)Percent of CatchConowingo Eels2018 Octoraro Eels2018 Creek flow (cfs)2018 Lunar Fraction2018 Water temp (°C)Dissolved Oxygen (mg/L)Percent of Catch	1 17 142.8 0.56 17.4 9.5 0.2 4387 1 5 185 0.89 15.3 8.8 0.1	2 9 144 0.96 14.2 8.3 0.1 151 2 31 143 0.4 15.9 7.7 0.7	3 9 178.1 0.66 18.8 7.5 0.1 1224 3 2072 822.6 0.06 18.4 7.5 49.3	4 39 167.4 0.09 18.2 7.5 0.3 5384 4 101 484.1 0.6 19.4 9.4 2.7	5 21 119.9 0.37 18.9 6.4 0.2 2196 5 115 327.9 0.96 21.4 7.9 2.7	6 7 84.3 0.92 20.2 5.7 0.1 1761 6 407 519 0.55 20.5 8.1 9.7	7 2 57.6 0.78 21.6 4.4 0.0 5199 7 55 345.1 0.06 20.8 7.4 1.3	8 61 123.3 0.16 24.4 4.9 0.5 23318 8 3 231.3 0.47 22.6 6.8 0.7	9 1565 121.6 24.9 5.1 13.8 8090 9 4 195.7 0.95 22.5 7 0.1	10 19 106.3 0.84 25.7 4.5 0.2 799 10 0 150.9 0.69 25.6 6.6 0.0	11 13 195.4 0.88 25.6 2.3 0.1 1503 11 123.3 0.1 25.5 6.5 0.0	12 7067 133.7 0.26 26.9 5.1 62.3 1432 12 11 143.9 0.34 25.3 7.1 0.3	13 419 150.3 0.14 26.2 5 3.7 15435 13 464 655.6 0.91 24.6 7.5 11.0	14 48 117.7 0.72 25.2 4 0.4 32524 14 29 254.3 0.8 24.9 6.5 0.7	15 16 140.7 0.94 24.1 4.5 0.1 13130 15 393 315.7 0.18 25.9 6.2 9.4	16 68 225.4 0.38 24 5 0.6 2654 16 343 661.9 0.22 25.2 6.5 8.2	17 1793 140.7 0.007 23.3 3 15.8 2931 17 73 634 0.82 23.2 5.8 1.7	18 12 122.9 0.58 20.2 4 0.1 88 18 5 492.1 0.89 25.3 6.4 0.1	19 149 190.3 0.96 20.5 6.3 1.3 51 19 69 520.4 0.29 24.6 6.1 1.6	20 12 110.2 0.56 20.4 5.5 0.1 43 20 22 943 0.12 18.2 10.2 0.5

(continued)

(Continued)

2019 Week			1	2	3		4	5	6	7	8	9	9	10	11		12	13	14	15	16	17	18	19	20	21
2019 Octoraro Eels			1	9		5	3	9	20	144	1	12	36	73	224	14	8266	2874	391	42	5	19	12	2	4	1 0
2019 Creek flow (cfs)			279	400	53	0	277	240	189	319	17	74 2	203	208	44	4	197	435	186	172	142	122	126	6 10	0 9	2 88
2019 Lunar Fraction			0.07	0.16	0.	.80	0.85	0.29	0.09	0.69	9 0).93	0.43	0.06	0.	57	0.96	0.58	0.07	0.44	0.95	0.71	L 0.:	12 0	.31 0	.89 0.99
2019 Water temp (°C)			15.50	16.10	14.	60	15.70	17.90	19.90	20.00) 20	0.50 2	1.60	23.00	23.	10	23.40	23.70	23.70	23.90	23.90	24.00	23.	10 22	.90 22	.40 22.50
Dissolved Oxygen (mg/L)			9.73	9.36	10.	18	10.05	9.26	8.75	8.29	9 8	3.52	7.14	6.32	6.	13	5.72	6.17	6.29	5.89	5.41	5.87	7 4.0	69 5	.13 4	.93 4.63
Percent of Catch			0.01	0.06	0.	.04	0.02	0.06	0.14	1.02	2 0	0.08	0.25	0.52	15.	84	58.33	20.28	2.76	0.30	0.04	0.13	3 0.0	0 80	.03 0	.01 0.00
Conowingo Eels			6	4616	223	37 :	1774	9359	2097	1706	21	.87 2	056	39685	307	76	3141	5210	3213	1158	38115	3160	313	5 19	2 4	0 18
2020 Week	1	2	3	4	5	6	7		8 0	a .	10	11	12	1	3	14	1	5	16	17	18	19	20	21	22	23
2020 Octoraro Eels	-	-		•						0	15	64	4	4	40	20	-	71	1992	1005	306	22	5	5	2	6
2020 Creek flow (cfs)									1	46 1	128.1	244.1	119	9.3 1	24.2	90.2	2 10	018.5	250.9	195.5	235.4	165.4	118	150	117.4	187.9
2020 Lunar Fraction									(0.35	0.76	0.88	0.	.32	0.07	0.6	5	0.94	0.47	0.05	0.52	0.96	0.62	0.08	0.39	0.93
2020 Water temp (°C)									2	0.7	21.4	22.7	23	.8	24.8	25.5	5	22.5	22.8	23.6	23.5	23.4	21.7	18.6	18.6	18.8
Dissolved Oxygen (mg/L)										7.23	6.04	6.00	5.	.45	5.90	5.2	7	6.04	6.87	6.52	7.16	7.60	6.99	6.96	9.02	7.58
Rainfall (inch)									(0.01	0.01	0.49	0.	.00	0.13	0.0	4	0.62	0.00	0.11	0.25	0.11	0.07	0.00	0.09	0.30
Percent of Catch									(0.00	0.42	1.78	1.	.22	1.11	0.5	6	1.97	55.38	27.94	8.51	0.61	0.14	0.14	0.06	0.17
Conowingo Eels				2290	20801	369	93 108	42 37	73 18	395	4008	15127	750	09 3	6742	1769	3 2	9622	31905	24947	6993	2570	223	608	9	101
			-			-				_	_			_												
2021 Week			1	2	_	3	4	5	ť	> 	/	8	, C	9	10	11	10	12	13	14	15		16	1/	18	19
2021 Octoraro Eels			0		5	9	13	2	9	//	1050	1201		21	238	5	19	14925	154	483	5 4	52	112	2920	1/350	1319
2021 Creek flow (cfs)			230	24	0.6	181.3	154.6	1/8	.6 2	/9.4	292.1	1/2.9) 15	9.7	141./	14	5.7	190.7	114.3	330.	0 13	32.4	141.4	190.4	430.2	133.7
2021 Lunar Fraction			0.7	6 0).35	0.05	0.52	0.	96	0.49	0.04	0.3	9 (0.94	0.64	(0.09	0.26	0.89	0.7	7	0.18	0.16	0.81	0.88	0.44
2021 Water temp (°C)			14.4	15	5.84	15.04	16.46	18.	57 1	.8.61	22.10	21.0	7 21	1.69	23.10	23	3.89	25.89	25.27	24.3	3 2	3.83	24.44	25.66	24.96	25.00
Dissolved Oxygen (mg/L)			9.9	0 9	9.18	9.40	9.63	8	55	7.28	7.11	7.10	0 6	5.81	6.52	6	5.35	4.48	6.03	5.3	8	6.30	6.50	6.46	4.25	6.02
Rainfall (Weekly avg.)			0.0		0.31	0.03	0.00	0.	28	0.38	0.20	0.1	5 (0.40	0.13	(0.00	0.19	0.74	0.2	.8 (0.33	0.48	0.04	0.48	0.18
Percent of Catch			0.0		0.01	0.02	0.03	0.	06	0.17	2.32	2.6	6 (0.05	0.53	1	1.15	33.00	0.34	10.6	9	1.00	0.25	6.46	38.36	2.92
Conowingo Eels			5	46	640	15851	17528	428	48 29	9424	23335	18176	6 27	711	5659	75	609	63442	59128	5098	2 26	007	12628	3747	19265	58774

2022 Week	1 - 18	19	20	21	22	23	24	25	26	27	28	29	30
2022 Octoraro Eels	0	4240	46	91	272	1526	175	646	78	26	49	10	0
2022 Creek flow (cfs)		254	146	103	115	425	195	187	190	128	126	199	137
2022 Lunar Fraction		0.87	0.80	0.20	0.14	0.79	0.90	0.34	0.07	0.67	0.96	0.51	0.14
2022 Water temp (°C)		23.75	22.30	21.97	18.84	15.64	13.74	13.29	13.13	12.80	13.51	10.53	8.10
Dissolved Oxygen (mg/L)		7.67	7.15	7.56	7.62	9.41	9.41	9.12	9.84	9.43	10.61	12.05	12.50
Rainfall (inch)		0.63	0.02	0.03	0.29	0.54	0.14	0.07	0.16	0.03	0.14	0.16	0.00
Percent of Catch		59.23	0.64	1.27	3.80	21.32	2.44	9.02	1.09	0.36	0.68	0.14	0.00
Conowingo Eels	112209	747	11478	7353	3631	1035	665	2514	73	69	23	1	0

2023 Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2023 Octoraro Eels	493	2812	1767	7503	844	417	447	1216	1246	9471	35387	184	82	117	61	35	15	0	9	7
2023 Creek flow (cfs)	491.8	166.0	122.3	114.3	87.5	59.7	93.3	103.6	214.0	129.7	162.7	124.7	107.6	89.5	148.7	82.9	67.8	74.3	59.5	91.6
2023 Lunar Fraction	0.957	0.725	0.093	0.269	0.852	0.821	0.169	0.151	0.744	0.897	0.276	0.073	0.607	0.944	0.407	0.040	0.461	0.952	0.553	0.060
2023 Water temp (°C)	13.6	16.3	14.8	17.3	15.9	16.9	19.9	20.8	20.9	21.6	25.2	26.1	25.6	24.7	23.9	24.2	24.7	24.3	24.4	24.5
Dissolved Oxygen (mg/L)	9.61	9.84	9.15	8.72	8.36	7.33	7.02	7.72	6.67	7.10	7.67	8.80	7.42	6.86	6.47	5.41	5.61	5.41	4.76	5.86
Rainfall (inch)	0.1	0.0	0.1	0.1	0.0	0.2	2.3	1.4	1.3	1.6	2.4	1.3	1.0	0.1	1.9	0.5	0.0	0.2	2.0	0.80
Percent of Catch	0.79	4.53	2.84	12.08	1.36	0.67	0.72	1.96	2.01	15.25	56.97	0.30	0.13	0.19	0.10	0.06	0.02	0.00	0.01	0.01
Conowingo Eels	33	2441	24747	6310	3119	3493	879	928	4499	37844	69566	20518	5805	1110	395	142	4047	11624	2907	3611

Eel Catch (Collection) to Creek Flow (2015-2023)

B-6

Appendix C: Agency Comments on Draft 2023 American Eel Collection Facility in Octoraro Creek

2023 Octoraro Creek Eel Facility Report (May 1 - September 15) Comments Received by Resource Agency and Date								
Resource Agency	Date of Receipt by Constellation							
Susquehanna River Basin Commission	December 15, 2023							
Pennsylvania Fish and Boat Commission	No Comments Received							
United States Fish and Wildlife Service	December 14, 2023							
Maryland Department of the Environment								
Maryland Department of Natural Resources	December 15, 2023							
Pennsylvania Department of Environmental Protection	December 14, 2023							

Responses to Resource Agency Comments for the Octoraro Creek Eel Facility Report, 2023

SRBC

• The attraction flow at this ramp was consistently delivered below the suggested 70 gpm. Please continue to explore ways to provide the recommended flow through the ramp via additional or larger pumps capable of providing this volume. Constellation response: The cleaning of the attraction flow lines, pump, barrel, and spray bars at the facility are maintained weekly to supply the maximum volume of attraction flow to the eel facility from the existing power supply and total head pressure.

Researching other submersible pumps has been completed and will continue to ensure the best flow rated pump is being used for the power source supplied.

• Dissolved oxygen levels in the collection tank in the late summer time period often approached critical aquatic life thresholds. The Commission recommends exploring remote water quality monitoring options for this facility to allow for passive monitoring of the oxygen levels in the tank.

Constellation response: Monitoring at this facility is very difficult with minimal and unreliable cellular service for a remote water quality unit. The water quality data provided (DO and temperature) is taken first thing in the morning when a DO sag occurs. Constellation will evaluate options including adding additional supplemental oxygen for periods when low DO water is being pumped into collection tank to increase these collection tank DO valves. Note, DO concentrations in the collection tank were consistently higher than the source water due to the addition of supplemental oxygen to the collection tank.

 Understanding this facility has undergone recent bank stabilization measures and can be subject to routine high or low flows it is suggested that the collection ramp terminus be extended to a lower elevation to maintain connectivity to the creek via rope, mop or extension of the existing ramp substrates.
 Constellation response: The attraction flow lines that run along the top of the ramp are designed to help eels find the entrance area with the crashing/splashing creek sounds. Each ramp is designed to have the top attraction (spray bar-backside of ramp)

plus the scent line which is the overflow drain of the collection tank to the highest gravity feed, to form the ramp entrance attraction. This ramp flow was measured using the above formula to be about 9-11 gpm, thus providing flow downstream of the entrance of the ramp to provide connectively with Octoraro Creek. Since the bank stabilization project was completed in August 2022, the ramp was installed with entrance (transition from the metal ramp to ACB) equal to the tailrace level when creek flows are approximately 182 cfs at the Richardsmere gage, 10 miles downstream of the OCEF site. The OCEF ramp entrance was above the tailrace elevation 82.6% of the operational days (114 of the 138 days) but captured 77.2% (47,851 of 62,013 eels) of the eels during the 2023 season. There is still a connectivity of attraction water from the ramp to the tailrace. Adding Milieu substrate downstream of the entrance area would allow the ramp flow to exit closer to Octoraro Creek but the ramp flow from the Enkamat substrate would exit at the original entrance creating rivulets of water under the Milieu substrate. The Milieu substrate has a solid base and solid sides, thus only allowing eels to enter at its terminus. If another type of substrate such as oyster spat rope or Enkamat was added below the Milieu substrate it may attract eels of smaller sizes that could get confused

when they reached the Milieu substrate.
Constellation suggests performance of another redlight nighttime survey during the 2024 season when eels are present and the ramp entrance is out of water could help determine if eels are able to enter the Milieu ramp entrance without adding additional substrate. This is consistent with a request from other agencies.

USFWS

• The stated capacity of the holding tank is 10,610 eels and that capacity was exceeded on one day with record catch (July 11, 2023). It appears the larger collection tank installed in 2022 combined with supplemental oxygen likely contributed to the low mortality when the holding capacity was exceeded on this date. Although the Service recommends no changes to the components or operation of the facility at this time, if future catches continue to exceed the stated capacity of the holding tank, structural or operational modifications may be needed to ensure safe collection and holding of eels at the Octoraro eel collection facility.

Constellation response: The collection tank eel collections number will be recorded daily and if an increase in eel collection is expected to be close to capacity, then the supplemental dissolved oxygen will be increase and multiple collection tank checks. These operational changes are easier to institute than installing a larger collection tank for the limited amount of times when the tank capacity is exceeded due to space limitations. Constellation will continue to monitor this in the 2024 season.

• Although the redlight survey suggests that eels are found in the vicinity of the ramp and that the count in the collection tank reflects the abundance of eels in the creek, the survey is not a definitive measure of ramp effectiveness. The Service has continued concerns about the lack of connectivity of the ramp to Octoraro Creek under lower flow conditions. The Service recommends that Constellation consider adding mussel spat rope or some alternative substrate downstream of the Milieu portion of the ramp that extends into the creek, similar to the Enkamat substrate that is downstream of the Enkamat portion of the ramp. Installing a temporary partition in the collection tank could help evaluate the improvements to eel collection with the addition of a substrate compared to current conditions.

Constellation response: The design of the redlight nighttime survey was to look for congregation area of eels in the vicinity of the entrance to the eel ramp.

The attraction flow lines that run along the top of the ramp are designed to help eels find the entrance area with the crashing/splashing creek sounds. Each ramp is designed to have the top attraction (spray bar-backside of ramp) plus the scent line which is the overflow drain of the collection tank to the highest gravity feed, to form the ramp entrance attraction. This ramp flow was measured using the above formula to be about 9-11 gpm, thus providing flow downstream of the entrance of the ramp to provide connectively with Octoraro Creek.

Since the bank stabilization project was completed in August 2022, the ramp was installed with entrance (transition from the metal ramp to ACB) equal to the tailrace level when creek flows are approximately 182 cfs at the Richardsmere gage, 10 miles downstream of the OCEF site. The OCEF ramp entrance was above the tailrace elevation 82.6% of the operational days (114 of the 138 days) but captured 77.2% (47,851 of 62,013 eels) of the eels during the 2023 season. There is still a connectivity of attraction water from the ramp to the tailrace.

Adding Milieu substrate downstream of the entrance area would allow the ramp flow to exit closer to Octoraro Creek but the ramp flow from the Enkamat substrate would exit at the original entrance creating rivulets of water under the Milieu substrate. The Milieu substrate has a solid base and solid sides, thus only allowing eels to enter at its terminus. If another type of substrate such as oyster spat rope or Enkamat was added below the Milieu substrate it may attract eels of smaller sizes that could get confused when they reached the Milieu substrate.

Constellation is in agreement with performing another redlight nighttime survey when eels are present and the ramp entrance is out of water could help determine if eels are able to enter the Milieu ramp entrance without adding additional substrate.

Adding a divider would be difficult to allow water to pass through both sides of the tank and prevent eels from moving between both compartments. Material would need to be installed on walls and floor of collection tank to ensure no eels would get through the divider. Material installed in the tank would decrease the efficiency of removing eels daily and impact the daily tank cleaning process.

If the divider is not porous, an additional drain would need to be installed on the Milieu collection side to drain the water during daily checks. An additional collection tank fill line, a second oxygen line, manifold, and micropore diffuser would also need to be installed.

Between 2015 and 2018, the Octoraro eel facility contained a separate collection tank for each of the ramps (Enkamat vs. Milieu). During these years, eel collection numbers and individual lengths were recorded per sample event on 25 individuals per substrate. A greater percentage of eels were collected using the Enkamat substrate for each of these three years and total percentage of 59.2% (23,458 of the 39,638 eels). The size of the eels caught in the Enkamat substrate were similar in each of the three years with a range of 95-176 mm with an average size of 123.1, 125.9, 130.0 mm in 2015, 2016, and 2017, respectively. The Milieu substrate collected a total percentage of 40.8% (16,180 of the 39,638 eel) during the period of time that each ramp had its own collection tank. A larger size range of collected eels was observed with the Milieu substrate (106-245 mm), with an average size of 137.4, 138.1, and 141.4 mm for 2015, 2016, and 2017, respectively.

• The Service notes that the recommended attraction flow of 70 gpm is not being achieved at this facility. We recommend options be evaluated for providing additional attraction flow to the facility to be discussed at future EPAG meeting. Constellation response: The cleaning of the attraction flow lines, pump, barrel, and spray bars at the facility are maintained weekly to supply the maximum volume of attraction flow to the eel facility from the existing power supply and total head pressure.

Researching other submersible pumps has been completed and will continue to ensure the best flow rated pump is being used for the power source supplied.

PFBC

• No Comments received

MDE

• Please consider all reasonable methods to increase attraction flow. The current design and configuration has not consistently met the design parameter of 70 gpm. We suggest that an additional pump be deployed to provide the required attraction flow and provide redundancy to avoid complete loss of attraction flow if a pump goes offline.

Constellation response: The cleaning of the attraction flow lines, pump, barrel, and spray bars at the facility are maintained weekly to supply the maximum volume of attraction flow to the eel facility from the existing power supply and total head pressure.

Researching other submersible pumps has been completed and will continue to ensure the best flow rated pump is being used for the power source supplied.

• Please consider adding security monitoring devices

Constellation response: CWA has a security monitoring device at their hydro facility across Octoraro Creek. While this system does not monitor the eel facility, vandalism including theft has not been observed at this facility since it was established in 2015.

• Please consider dissolved oxygen remote monitoring. DO levels in the collection tank have approached critical aquatic life thresholds in 2023. Constellation response: Monitoring at this facility is very difficult with minimal and unreliable cellular service for a remote water quality unit. The water quality data provided (DO and temperature) is taken first thing in the morning when a DO sag occurs. Constellation will evaluate options including adding additional supplemental oxygen for periods when low DO water is being pumped into collection tank to increase these collection tank DO valves. Note, DO concentrations in the collection

tank were consistently higher than the source water due to the addition of supplemental oxygen to the collection tank.

• Please consider all reasonable methods to ensure ramp connectivity with the river/creek under all reasonable flow conditions.

Constellation response: The attraction flow lines that run along the top of the ramp are designed to help eels find the entrance area with the crashing/splashing creek sounds. Each ramp is designed to have the top attraction (spray bar-backside of ramp) plus the scent line which is the overflow drain of the collection tank to the highest gravity feed, to form the ramp entrance attraction. This ramp flow was measured using the above formula to be about 9-11 gpm, thus providing flow downstream of the entrance of the ramp to provide connectively with Octoraro Creek. Since the bank stabilization project was completed in August 2022, the ramp was installed with entrance (transition from the metal ramp to ACB) equal to the tailrace level when creek flows are approximately 182 cfs at the Richardsmere gage, 10 miles downstream of the OCEF site. The OCEF ramp entrance was above the tailrace elevation 82.6% of the operational days (114 of the 138 days) but captured 77.2% (47,851 of 62,013 eels) of the eels during the 2023 season. There is still a connectivity of attraction water from the ramp to the tailrace.

Adding Milieu substrate downstream of the entrance area would allow the ramp flow to exit closer to Octoraro Creek but the ramp flow from the Enkamat substrate would exit at the original entrance creating rivulets of water under the Milieu substrate. The Milieu substrate has a solid base and solid sides, thus only allowing eels to enter at its terminus. If another type of substrate such as oyster spat rope or Enkamat was added below the Milieu substrate it may attract eels of smaller sizes that could get confused when they reached the Milieu substrate.

Constellation suggests performance of another redlight nighttime survey during the 2024 season when eels are present and the ramp entrance is out of water could help determine if eels are able to enter the Milieu ramp entrance without adding additional substrate. This is consistent with a request from other agencies.

• Please consider alternative designs that would increase tank capacity and/or alternative operating procedures. Tank capacity was exceeded in 2023. Constellation response: The collection tank eel collections number will be recorded daily and if an increase in eel collection is expected to be close to capacity, then the supplemental dissolved oxygen will be increase and multiple collection tank checks. These operational changes are easier to institute than installing a larger collection tank for the limited amount of times when the tank capacity is exceeded. If a large collection in the future would need to be installed at this site, the gazebo footer may need to be increased.

PA DEP

• Appendix B, Weekly Eel Catch (2015-2022), page B-2: The 2017 Octoraro Eels row is missing from the 2017 Week chart. Constellation response: The Octoraro Creek eel collection numbers were added to the Appendix B table in the final report.
- Appendix B, Weekly Eel Catch (2015-2022), page B-3: The Rainfall (inch) row is missing from the 2021 Week chart. Constellation response: The Octoraro Creek rainfall weekly total valves were added to the Appendix B table in the final report.
- Octoraro Creek Eel Ramp attraction flow did not meet the recommended 70 gallon per minute (gpm). PADEP will continue to monitor the attraction flow during future eel collection seasons.
 Constellation response: The cleaning of the attraction flow lines, pump, barrel, and spray bars at the facility are maintained weekly to supply the maximum volume of attraction flow to the eel facility from the existing power supply and total head pressure.
 Researching other submersible pumps has been completed and will continue to ensure the best flow rated pump is being used for the power source supplied.
- The 1,061 liter collection tank exceeded eel capacity once during the 2023 season with 15 mortalities. PADEP will continue to monitor the collection tank and supplemental dissolved oxygen system during future eel collection seasons. Constellation response: The collection tank eel collections number will be recorded daily and if an increase in eel collection is expected to be close to capacity, then the supplemental dissolved oxygen will be increase and multiple collection tank checks. These operational changes are easier to institute than installing a larger collection tank for the limited amount of times when the tank capacity is exceeded. If a large collection in the future would need to be installed at this site, the gazebo footer may need to be increased.

From:	Mike Martinek		
Sent:	Friday, December 15, 2023 12:07 PM		
To:	Mike Martinek		
Subject:	FW: Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review		

From: Henning, Aaron <ahenning@srbc.gov> Sent: Friday, December 15, 2023 10:07 AM Subject: RE: Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

Andrea,

The Susquehanna River Basin Commission appreciates the opportunity to provide comments on the Octoraro Creek Eel Collection Facility Report and the Red-light Nighttime Survey. We offer the following comments:

Octoraro Creek Eel Collection Facility

- The attraction flow at this ramp was consistently delivered below the suggested 70 gpm. Please continue to
 explore ways to provide the recommended flow through the ramp via additional or larger pumps capable of
 providing this volume.
- Dissolved oxygen levels in the collection tank in the late summer time period often approached critical aquatic life thresholds. The Commission recommends exploring remote water quality monitoring options for this facility to allow for passive monitoring of the oxygen levels in the tank
- Understanding this facility has undergone recent bank stabilization measures and can be subject to routine high
 or low flows it is suggested that the collection ramp terminus be extended to a lower elevation to maintain
 connectivity to the creek via rope, mop or extension of the existing ramp substrates

Thank you.

Aaron

Aaron Henning

Fisheries Biologist Susquehanna River Basin Commission 4423 North Front St. Harrisburg, PA 17110 Office: (717) 238-0423 ext.1184 Mobile: (717) 884-5937 ahenning@srbc.gov https://www.srbc.gov/our-work/american-eels/

From:	Mike Martinek		
Sent:	Friday, December 15, 2023 7:44 AM		
То:	Mike Martinek		
Subject:	FW: [EXTERNAL] Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review		

From: Eyler, Sheila <sheila_eyler@fws.gov> Sent: Thursday, December 14, 2023 2:27 PM Subject: Re: [EXTERNAL] Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

Mike et al.

Thank you for the opportunity to review the Octoraro Red-Light Nighttime Survey and the Octoraro Creek Eel Collection Facility draft reports.

The Service provides the following comments:

- 1. Octoraro Creek Eel Collection Facility
- The stated capacity of the holding tank is 10,610 eels and that capacity was exceeded on one day with record catch (July 11, 2023). It appears the larger collection tank installed in 2022 combined with supplemental oxygen likely contributed to the low mortality when the holding capacity was exceeded on this date. Although the Service recommends no changes to the components or operation of the facility at this time, if future catches continue to exceed the stated capacity of the holding tank, structural or operational modifications may be needed to ensure safe collection and holding of eels at the Octoraro eel collection facility.
- Although the redlight survey suggests that eels are found in the vicinity of the ramp and that the count
 in the collection tank reflects the abundance of eels in the creek, the survey is not a definitive measure
 of ramp effectiveness. The Service has continued concerns about the lack of connectivity of the ramp
 to Octoraro Creek under lower flow conditions. The Service recommends that Constellation consider
 adding mussel spat rope or some alternative substrate downstream of the Milleu portion of the ramp
 that extends into the creek, similar to the Enkamat substrate that is downstream of the Enkamat
 portion of the ramp. Installing a temporary partition in the collection tank could help evaluate the
 improvements to eel collection with the addition of a substrate compared to current conditions.
- The Service notes that the recommended attraction flow of 70 gpm is not being achieved at this facility. We recommend options be evaluated for providing additional attraction flow to the facility to be discussed at future EPAG meetings.

Sheila Eyler U.S. Fish and Wildlife Service

C-9

From:	Mike Martinek	
Sent:	Monday, December 18, 2023 8:26 AM	
To:	Mike Martinek	
Subject:	FW: Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft	
	reports for review	

From: David Seaborn -MDE- <david.seaborn@maryland.gov> Sent: Friday, December 15, 2023 2:02 PM To: Mike Martinek <mmartinek@normandeau.com> Subject: Re: Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

Mike,

Maryland (MDE working together with MDNR) has the following comments:

• Please consider all reasonable methods to increase attraction flow. The current design and configuration has not consistently met the design parameter of 70 gpm. We suggest that an additional pump be deployed to provide the required attraction flow and provide redundancy to avoid complete loss of attraction flow if a pump goes offline.

• Please consider adding security monitoring devices.

• Please consider dissolved oxygen remote monitoring. DO levels in the collection tank have approached critical aquatic life thresholds in 2023.

• Please consider all reasonable methods to ensure ramp connectivity with the river / creek under all reasonable flow conditions.

• Please consider alternative designs that would increase tank capacity and/or alternative operating procedures. Tank capacity was exceeded in 2023.

• Please consider additional red-light surveys on alternative dates and at alternative river flows and lunar phases.

<u>Click here</u> to complete a three question customer experience survey.

From:	Mike Martinek	
Sent:	Thursday, December 14, 2023 12:14 PM	
То:	Mike Martinek	
Subject:	FW: [External] Red-light nighttime survey and the Octoraro Creek Eel Collection Faci draft reports for review	
Attachments:	2023_Octoraro Creek_redlightsurvey_finaldraft.pdf; 2023	
	_Octoraro_Creek_Eel_Ramp_Collection_Report_finaldraft.pdf	

From: Eberts, Ron <<u>reberts@pa.gov</u>> Sent: Thursday, December 14, 2023 10:57 AM Subject: RE: [External] Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

Andrea,

PADEP has reviewed the attached 2023 Octoraro Creek Red-light Survey DRAFT Report and the 2023 Octoraro Creek Eel Ramp Collection DRAFT Report received on November 17, 2023. We offer the following comments:

2023 Octoraro Creek Eel Ramp Collection

1. Appendix B, Weekly Eel Catch (2015-2022), page B-2: The 2017 Octoraro Eels row is missing from the 2017 Week chart.

2. Appendix B, Weekly Eel Catch (2015-2022), page B-3: The Rainfall (inch) row is missing from the 2021 Week chart.

3. Octoraro Creek Eel Ramp attraction flow did not meet the recommended 70 gallons per minute (gpm). PADEP will continue to monitor the attraction flow during future eel collection seasons.

4. The 1,061 liter collection tank exceeded eel capacity once during the 2023 season with 15 mortalities. PADEP will continue to monitor the collection tank and supplemental dissolved oxygen system during future eel collection seasons.

Thank you for the opportunity to comment.

Ronald C. Eberts, Jr. | Environmental Protection Compliance Specialist Department of Environmental Protection Southcentral Regional Office Waterways & Wetlands Program 909 Elmerton Avenue | Harrisburg, PA 17110 Phone: 717.705.4819| Fax: 717.705.4760

THE SOUTHCENTRAL REGIONAL OFFICE AFTER HOURS REPORTING & 24 HOUR EMERGENCY RESPONSE NUMBER: 1-800-541-2050.

Appendix D: Summary of Red-light Nighttime Survey at the Octoraro Creek Eel Collection Facility Ramp Entrance for American Eel, 2023 Report



Summary of Red-light Nighttime Survey at the Octoraro Creek Eel Collection Facility Ramp Entrance for American Eel, 2023

FERC Project No. 2355

Prepared For: Constellation Energy Corporation, LLC 2569 Shures Landing Road Darlington, Maryland 21034-1503

> Submitted On: January 9, 2024

Prepared By: Normandeau Associates, Inc. 1854 Lancaster Pike Peach Bottom, Pennsylvania 17563

www.normandeau.com

Background

Constellation Energy Generation, LLC (Constellation), received a license from the Federal Energy Regulatory Commission (FERC) on December 22, 2015 for the Muddy Run Pumped Storage Project (Muddy Run Project; FERC Project No. 2355). An American Eel Passage Plan (Eel Plan) was developed by Constellation and included as a condition of the Pennsylvania Department of Environmental Protection (PA DEP) 401 Water Quality Certification (WQC; PA DEP File No. EA 36-033; dated 10 December 2014) for the Muddy Run Project and is a condition of the FERC license for the Muddy Run Project.

The Eel Plan required Constellation to investigate the feasibility of installing and operating a juvenile American Eel (eel or eels) trapping facility on Octoraro Creek. The evaluation was conducted at a location identified on Octoraro Creek immediately downstream of the Chester Water Authority (CWA), Pine Grove Low-Head Dam. This site was approved by the PA DEP and other members of the Eel Passage Advisory Group (EPAG)¹.

The temporary eel trapping facility adjacent to CWA's small hydroelectric site on Octoraro Creek was operated for three seasons: 2015, 2016, and 2017. An annual report was developed and filed with FERC and resource agencies after each year of operation. On March 1, 2018, FERC issued a letter indicating that the temporary eel trapping facility met the requirements of the PA DEP 401 WQC and U.S. Department of the Interior (DOI) fishway prescription for the Muddy Run Project². The Octoraro Creek Eel facility (OCEF) location has been considered permanent since 2018.

Prior to the 2019 eel season, Constellation completed upgrades to the OCEF related to eel passage, including a larger submersible pump and water line, manifold, collection tank, and attraction flow lines. Additional work related to facility aesthetics and safety (e.g., stairs) and erosion was completed. This work required a PA DEP Chapter 105 Wetland and Waterway Obstruction and Encroachment Permit and, therefore, a signed agreement from CWA (the landowner) was necessary so Constellation could apply for this permit. Constellation received the CWA-signed agreement on December 2, 2019, and applied for the Chapter 105 permit on December 27, 2019. On January 16, 2020, the Chapter 105 Permit application package was deemed complete by PA DEP, and the permitting public comment period closed on March 2, 2020. Constellation received a permit on May 8, 2020. Meanwhile, in March 2020, CWA reviewed the OCEF project plans again and had concerns with the proposed upgraded eel structure plans along the left bank of Octoraro Creek due to an abandoned underground buried tailrace that runs below the proposed gazebo platform. The existing OCEF was revised, and improvement plans were reconsidered for safety and constructability. Constellation had an underground survey crew perform studies to identify the exact location of this

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¹ EPAG members include the Pennsylvania Department of Environmental Protection, United States Fish and Wildlife Service, Pennsylvania Fish and Boat Commission, Maryland Department of Natural Resources, Susquehanna River Basin Commission, and Exelon. Maryland Department of Environment was added to the EPAG group on March 19, 2021.

² On March 1, 2018, FERC issued a letter that stated, "Review of your filing indicates that it fulfils the pertinent WQC and fishway prescription requirements. Pursuant to the PADEP's WQC, because you have determined the Octoraro facility to be successful..." This approval was based on the OCEF being deemed successful and determining it as a permanent installation (Accession number: 20180301-3083; <u>FERC, 2018</u>)

structure. In early May 2020, the underground survey was scheduled and completed, and the results of the survey were distributed to EPAG prior to a conference call on June 2, 2020. During this conference call, alternative options for the eel facility were discussed, and a decision was made and agreed to by all parties to construct a longer ramp with the collection tank and scaffolding placed at the top of the hill near the driveway. With the scaffolding at the top of the hill and the existing water line exiting at the mid hillside level near the previous scaffolding location, Constellation agreed to relocate the water line and have it exit at the top of the hill near the new scaffolding location. This approach was used to decrease the head loss and increase the total attraction flow of the OCEF, and this work was completed on August 13, 2021.

Constellation conducted a topographic land survey on October 18, 2021, and developed a plan for the OCEF according to those results. The original shoreline protection design was changed from riprap to articulate concrete block (ACB) to reduce the depth of excavation and lessen the amount of weight placed over the buried tailrace. The shoreline stabilization project for the permanent OCEF was completed in August 2022 to be compliant with an in-water work timing restriction due to the presence of threatened Chesapeake Logperch Percina bimaculata habitat at the site. This work included the regrade of the eroded shoreline to a suitable slope and placing ACBs throughout an approximately 2,000-square-foot area. Constellation installed ACBs from the Art Building downstream, approximately 21 feet (ft). The OCEF eel ramp entrances, prior to the 2022 eel season, were underwater at all tailwater elevations and the ramp entrance was shown to be underwater in the design drawings. Riprap needed to be placed on top of the ACBs at the normal tailrace elevation to help hold them in place causing the ramp entrance to be out of the water when the creek flow was below 182 cubic feet per second (cfs, Figures 1 and 2). An additional section (13 ft) of riprap was added downstream, after the blocks ended, until the beach like area started (Figure 3). In addition, upgrades were made to the collection platform to move it upslope to a flat, easily accessible area to provide a larger working platform.

The OCEF operated from September 5 until November 20, 2022, when the Octoraro Creek water temperature at CWA decreased below 10.0° Celsius (C) for three consecutive days. The OCEF in 2022 contained two longer ramps, one with Enkamat substrate and one with Milieu substrate, the same substrates used from 2015-2019 and 2021. The entrances to the ramps were out of water during normal and low creek flow periods, but smooth transitions from the ramp entrances and the ACBs were created by ensuring that the substrate material of the ramps were flush to ACBs (gaps between the ramp entrances and the blocks were minimized). The entrances were near the shoreline riprap of the tailwater.

The OCEF was placed back into service on May 1, 2023, and set-up and placed identically to 2022. On May 8, 2023, the USFWS performed their yearly inspection of the Constellation fishways in the lower Susquehanna River drainage. From this inspection, a concern about the location of the entrance of the ramp was received by Constellation on June 26, 2023 (<u>Appendix A, USFWS, 2023</u>). The USFWS also distributed a new protocol for observational surveys for upstream migrant eels that was produced by the USGS in March 2023 (<u>Haro and Gephard, 2023</u>) It was decided that nighttime red-light surveys would be performed to assess the interaction of the ramp entrance, the wetted adjacent surfaces, and eel congregations from the art building downstream to the beach.

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Methods

The USGS protocol document is designed for conducting surveys prior to siting a new facility and not for established ramps. The observational surveys for this site were conducted during the summer and at night. The shoreline of Octoraro Creek near the entrance of the current eel ramp was examined for congregation of eels using supplemental lighting (red headlamps); visual observations were documented, and video recordings were also taken using a Go Pro camera.

A foot survey was used at the site, during active migrating periods (summer), one to two hours after sunset, and typically for one to two hours. Since the position of the ramp entrance was most concerning to the USFWS, it was decided that surveys would be performed when the ramp entrance was underwater and when the entrance was out of water. The number of American Eel collected at the OCEF can vary from day to day.

The observation area for this survey is defined from the Art Building to the beach downstream of the entrance. The observation area was broken down into sites to help define where eels could possibly congregate (Figures 4 and 5).

Site 1 – Along the Art Building

This site is upstream of the riprap shoreline and the ACBs. The creek flow is generally in a downstream direction with a small back eddy just upstream of the riprap. This area is deep due to the location where the tailwater meets the art building. This site is five feet long.

Site 2 – Art Building Riprap Shoreline Downstream Just Above Ramp Entrance This shoreline site consists of all riprap placed on top of the ACBs to hold them in place. The section is from the Art Building downstream towards the ramp entrance. The general creek flow is downstream, but in this site the creek flow is the fastest since it is closest to the low flow notch of the field stone dam. This site is eight feet long.

Site 3 - Ramp Entrance and Adjacent Upstream Riprap Shoreline

This shoreline site consists of all riprap placed on top of the ACBs to hold them in place. The site is immediately upstream of the ramp entrance and the general creek flow pattern is downstream. The ramp attraction flow creates rivulets of water that flow in the grooves of the ACBs to help direct eels to the entrance. The attraction flow from the ramp flows in an upstream direction, opposite of the creek flow. This site is three feet long and includes the area below the Milieu substrate ramp entrance.

Site 4 – Downstream Adjacent Riprap Shoreline to Ramp Entrance

This shoreline site consists of all riprap placed on top of the ACBs to hold them in place. The site is immediately downstream of the ramp entrance and the general creek flow direction is downstream. Attraction flow from the ramp creates rivulets of water that flow in the grooves of the ACBs to help direct eels to the entrance. This site is five feet long and includes the area below the Enkamat substrate ramp entrance.

Site 5 – Riprap at Transition to ACBs

This site consists of the transition of the normal creek shoreline to the improved area where the ACBs start. The site is downstream of the ramp entrance and the general creek flow direction is downstream. The shoreline area is all boulders. This site is ten feet long, which is split evenly between normal creek shoreline and ACBs.

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Site 6 – Transition from Beach to Riprap

This site includes the last few feet of riprap and the transition from the riprap to the beach. The site is downstream of the ramp entrance and the creek flow pattern is an eddy. This site is mostly small boulders, gravel, and sand. This site is seven feet long.

Site 7 - Beach

This site extends from the beach area to the tall grass which is in-line with the start of the most upstream riffle below the field stone dam. It contains mostly sand and gravel with a few mixed sizes of cobble, and one or two boulders. This site is the shallowest of all sites included in this observational area. The direction of the water flow is in a downstream direction. The beach site is 26 feet long.

Each field biologist was equipped with a Red-Light headlamp (Noxx Outdoor Products' Red Dagger X) during the observation survey. This red-light headlamp has a 5-watt high intensity diode light chip as a light source, with a beam intensity over 900 lumens. A single Go Pro Hero 4 video camera was used to help supplement visual observations made by field biologists. The camera was used to video record the shoreline area during observations. The Go Pro video camera was set to 720 Super View resolution, 60 frame per second, and 6400 ISO.

All data including date, time, creek flow, weather, temperature, and eel observation were entered into a field book during each observation period. The Go Pro video was downloaded and backed-up after each survey for later viewing.

Normandeau Associates, Inc.

Results - ramp entrance underwater

The first survey of the eel ramp entrance was completed on July 10, 2023, when the ramp entrance was underwater. Sunset on July 10 was 2035 hour (hr), with last light at 2107 hr (Table 1). Weather conditions were 22.8 °C with partly cloudy skies. The Octoraro Creek flow was 251 cubic feet per second (cfs) with water clarity about 18 inches, and the ramp entrance was approximately one inch underwater. A total of 8,521 eels were captured and removed from the OCEF collection on the morning of July 10, 2023 and on July 11, 2023 a record number of 17,082 eels were collected and removed.

After arriving at the OCEF at 2200 hr, the collection tank already contained many eels.

First pass

The first pass occurred from 2230-2315 hr and occurred in a downstream direction starting at the Art Building and continuing to the beach (<u>Table 2</u>).

One eel was observed at Site 1 swimming upstream towards the field stone dam (Table 2), and no eels were observed in Site 2.

Site 3 contained rivulets of water flowing from ramp attraction within the grooves of the ACBs. This guided eels to the ramp entrance. The attraction flow from the ramp was flowing in an upstream pattern, opposite of the creek flow. Twenty eels were observed within the riprap and the rivulets of water (<u>Table 2</u>). These 20 eels were orienting themselves towards the ramp attraction flow or were stationary.

Many of the eels (60 of the 89, 67.4%) observed on the first pass were observed near the ramp entrance or within four feet downstream of the ramp (Site 4, <u>Table 2</u>). Within Site 4, attraction flows from the ramp creates rivulets of water within the grooves of the ACBs to help direct eels to the entrance. Only a few of these eels were stationary, a majority were actively swimming up the rivulets of water headed towards the ramp or within the riprap near the entrance.

Three eels were observed in Site 5, the riprap near the transition of the ACBs to creek shoreline (<u>Table 2</u>). These eels were swimming against the current and in the direction of the ramp entrance. No eels were observed in Site 6. Site 6 creates an eddy which causes the creek flow to be opposite of the current located herein.

While at Site 7, a total of five eels were observed (<u>Table 2</u>). Eels located at this site were spread out throughout the beach. These eels were actively swimming in the water column and headed in the direction of the ramp entrance or against the current.

A few eels were originally observed in the ramp substrate. Upon closer inspection, more eels were in both ramp substrates. The eels in the substrate were hard to see with the glare of the red light and the amount of attraction flow. Attraction flow in the substrate is from the spray bar minus the backside of the ramp and the scent line flow (otherwise known as the collection tank discharge). The eels were passing through the transition of the ramp entrance without hesitation, evident due to the number of eels observed in the substrate. The eels observed in the substrate had no problem

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climbing through or over the substrate and typically would surge at a fast rate after entering the ramp entrance.

Second pass

The second pass occurred from 2330 on July 10 and continued until 0025 hr on July 11, 2023. This pass occurred in an upstream direction starting at the beach and continuing to the Art Building (<u>Table 2</u>).

A total of three eels were observed at Site 7, (<u>Table 2</u>). Eels located at this site were spread out throughout the beach. These eels were actively swimming in the water column and headed in the direction of the ramp entrance or against the current.

No eels were observed in Site 5 or Site 6 (Table 2).

Several eels (80 of the 123, 65.0%) observed on the second pass were observed near the ramp entrance or downstream within four feet of the ramp (Site 4, <u>Table 2</u>). Within Site 4, attraction flows from the ramp creates rivulets of water within the grooves of the ACBs to help direct eels to the entrance. Only five of these eels were stationary, most were actively swimming up the rivulets of water headed towards the ramp or within the riprap near the entrance.

Site 3 also contained rivulets of water flowing from the ramp attraction flow within the grooves of the ACBs. This guided eels to the ramp entrance. The attraction flow from the ramp is flowing in an upstream pattern, opposite of the creek flow. Forty eels were observed within the riprap and the rivulets of water (Table 2). A majority of the 40 eels were orienting themselves towards the ramp attraction flow or were stationary.

No eels were observed in Sites 1 and 2 (<u>Table 2</u>). A northern water snake *Nerodia sipedon* was briefly observed.

During this pass, more eels were observed in both ramp substrates above the entrance of the ramp, than in the first pass.

Overall

The total number of eels observed during the ramp entrance underwater survey on July 10, 2023, was 212 eels (<u>Table 2</u>). Nearly two-thirds of the 212 eels (140 or 66.0%) were observed in Site 4, whereas 60 eels or 28.3% were observed in Site 3. No eels were observed in Sites 2 or 6 during this survey.

2

Results - ramp entrance out of water

The second survey of the eel ramp entrance was completed on August 16, 2023, when the ramp entrance was out of water. Sunset on August 16 was 2001 hr, with last light at 2030 hr (Table 1). The weather conditions were 20.6 °C with partly cloudy skies. The Octoraro Creek flow was 52.7 cfs, the water clarity was about 18 inches, and the ramp entrance was approximately 12 to 15 inches out of water. The attraction flow from the ramp provided a continuous flow. A total of three eels were captured and removed from the OCEF collection on the morning on August 16, 2023, and two eels on August 17, 2023 were collected and removed.

After arriving at the OCEF at 2115 hr, no eels were observed in the collection tank.

First pass

The first pass occurred from 2140-2215 hr and occurred in an upstream direction starting at the beach and continuing to the Art Building (<u>Table 3</u>).

Zero eels were observed at Site 7 (Table 3). Although no eels were observed there was plenty of aquatic life present including five Bluegills *Lepomis macrochirus*, three Smallmouth Bass *Micropterus aloomieu*, one Largemouth Bass *Micropterus salmoides*, five darter Etheosomatidae spp., one small catfish, thirty Chinese Mystery snails *Cipangopaludina chinensis*, and twenty crayfish. All fish species were less than two inches in length.

No eels were observed in Site 6, but 15 Chinese Mystery snails, and five crayfish were observed (<u>Table 3</u>). This area was an eddy which created a change in natural river flow direction.

One eel was briefly observed in the riprap for in Site 5 (<u>Table 3</u>). Additionally, a northern water snake was briefly observed where the eel was observed. An additional 15 Chinese Mystery Snails were observed.

No eels were observed in Site 4 (<u>Table 3</u>). Most of the rivulets of water in the ACB's were covered by large riprap at the tailwater area. Attraction flow from the ramp was observed flowing continuously to the tailrace under and around this large riprap. Due to the flowing tailrace and water depth which drops off drastically on the outside of the riprap, it was difficult to make observations of eel presence or movement as the beam of the redlight headlamps could not penetrate far enough to see the creek bottom.

No eels were observed in Sites 1, 2, and 3, which includes the riprap from the ramp entrance upstream and along the Art Building (Table 3).

During this pass, no eels were observed in either ramp substrate or attraction flows below the ramp entrance.

Second pass

The second pass occurred from 2255-2310 hr and occurred in a downstream direction starting at the Art Building and continuing to the beach (<u>Table 3</u>).

No eels were observed in Sites 1, 2, 3, or 4, which includes the area adjacent to the Art Building and the riprap from the Art Building to four feet downstream of the ramp entrance (<u>Table 3</u>).

3

One eel was observed at Site 5 resting between riprap but facing upstream towards the ramp entrance (Table 3).

Zero eels were observed in Site 6 (Table 3).

A single eel was observed near larger cobble midway through Site 7 (<u>Table 3</u>). This site basically included the same miscellaneous fish and aquatic species as during the first observation.

No northern water snakes were observed during the second observation period. No eels were observed in the attraction flow of the ramp, the ramp substrate, at the apex of the ramp, or in the collection tank at this time.

Third pass

The first pass occurred from 2335-2355 hr and occurred in an upstream direction starting at the beach and continuing to the Art Building (Table 3).

A total of two eels were observed at Site 7, (<u>Table 3</u>). One eel was observed at the downstream most portion of this site near the tall grass and the other eel was observed near the midway point of this site near some larger cobble. Both eels were resting and not swimming. The eel observed near the midway point of this site could have been the same eel observed during the second pass. This site included the same miscellaneous fish and aquatic species as during the previous observations.

No eels were observed in Site 6 (Table 3).

One eel was observed in the riprap and swimming in an upstream pattern towards the ramp attraction flow in Site 5 (Table 3).

No eels were observed in Sites 1, 2, 3, or 4, which includes the area adjacent to the entrance of the ramp upstream to the Art Building (Table 3).

No northern water snakes were observed during the third pass. No eels were observed in the attraction flow of the ramp, the ramp substrate, at the apex of the ramp, or in the collection tank at this time.

Overall

The total number of eels observed during the ramp entrance out of water survey on August 16, 2023 was six eels (<u>Table 3</u>). Half of the six eels (3 eels or 50.0%) were observed in Site 7, whereas the other half (3 eels or 50.0%) were observed in Site 5. No eels were observed in Sites 1, 2, 3, 4, or 6 during this survey.

4

Conclusion

The nighttime red-light survey was very beneficial for documenting American Eel at the OCEF. Although the two surveys were completed during two totally different collection periods of the American Eel passage season in 2023, it was evident that the OCEF ramp entrance is in an optimal location. The shoreline area was changed due to the bank stabilization project. When summarized, most of the eels observed were adjacent to the ramp entrance and not at other locations that were monitored during these surveys. Nearly 92% (180 of 218 individuals) were observed in the two sites adjacent to the eel ramp entrance when the results of both surveys were combined (<u>Tables 2 and 3</u>).

Unfortunately, the videos at night were not clear due to the large amount of moving and splashing water in the tailrace and around the ramp entrance. Some activity could be observed but detailed counts/observations could not be verified by viewing the video footage.

Nearly 70,000 American Eel have been captured at the OCEF facility since the bank stabilization project was completed in August 2022. The facility is positioned in an optimal location at the water's edge (Normandeau Associates, Inc. 2023 and 2024 draft) and has consistently collected eels since its deployment. The current configuration of the OCEF has the entrance of the ramp out of water when the creek flow is below 182 cfs as measured at the United States Geological Survey (USGS) Gage 01578475 on Octoraro Creek at Richardsmere, MD. The USGS Gage is located approximately 21 kilometers (km) downstream of CWA's Pine Grove Low-Head Dam (Figures 1 and 2). Modifying the facility to reposition the eel ramp entrance underwater 100% of the time would require the ramp to be much longer, with the ramp entrance further away from the shoreline. The slope of the ramp would increase due to the ramp having to be installed above the existing riprap on top of the ABCs and would cause the ramp to end in the deep pool with faster creek flow downstream of the low flow notch. The upgraded facility is currently in a location that provides the best available protection of the equipment, safe worker accessibility when performing daily monitoring checks, and adequate habitat and water flow to attract eels to its entrance that then successfully ascend the ramp. It is strongly recommended that the OCEF ramp continues to be installed and operated at the current configuration annually.

Normandeau Associates, Inc.

SUMMARY OF Red-light nighttime survey at the Octoraro Creek Eel Collection Facility ramp entrance for American Eel, 2023

Literature Cited

- Federal Energy Regulatory Commission. Project No. 2355-026-Pennsylania Muddy Run Pumped Storage Project. Exelon Generation Company, LLC., March 1, 2018.
- Haro, Alex and Gephard, Steve. 2023.Protocol for Observational Survey for Upstream Migrant Eels. Prepared by U.S. Geological Survey.
- Normandeau Associates, Inc. 2024 (draft). Muddy Run Pumped Storage Project. American Eel Collection Facility in Octoraro Creek, FERC Project No. 2355. Prepared for Constellation
- Normandeau Associates, Inc. 2023. Muddy Run Pumped Storage Project. American Eel Collection Facility in Octoraro Creek, FERC Project No. 2355. Prepared for Constellation

United States Fish and Wildlife Service. 2023. 2023 Inspection of Conowingo Fish Passage Facilities.

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Tables

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Table 1.Environmental and Miscellaneous Data on Red-Light Nighttime Observation
Days at Octoraro Creek Eel Facility, July 10 and August 16, 2023.

Date	7/10/2023	8/16/2023
Sunset (hr)	2035	2001
Last Light (hr)	2107	2030
Survey period (hr)	2230 - 0025 (July 11)	2140 - 2355
Beginning Air temperature (°C)	22.8	20.6
Weather	Partly Cloudy	Partly Cloudy
Creek Flow (cfs)	251	52.7
Ramp Entrance Location	1 inch underwater	12-15 inches out of water
Water Clarity (inches)	18	18
Number Eels Collected		
Morning of Survey	8,521	3
Morning after Survey	17,082	2

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SUMMARY OF Red-light nighttime survey at the Octoraro Creek Eel Collection Facility ramp entrance for American Eel, 2023

Location	Number of eels on first observation (%) 2230-2315 hr	Number of eels on second observation (%) 2330-0025 hr	Total number of eels observed (%)
Site 1	1 (1.1%)	0 (0.0%)	1 (0.5%)
Site 2	0 (0.0%)	0 (0.0%)	0 (0.0%)
Site 3	20 (22.5%)	40 (32.5%)	60 (28.3%)
Site 4	60 (67.4%)	80 (65.0%)	140 (66.0%)
Site 5	3 (3.4%)	0 (0.0%)	3 (1.4%)
Site 6	0 (0.0%)	0 (0.0%)	0 (0.0%)
Site 7	5 (5.6%)	3 (2.4%)	8 (3.8%)
Total	89	123	212

 Table 2.
 Location of observed American Eel during ramp entrance underwater during red headlight survey, July 2023

 Table 3.
 Location of observed American Eel during ramp entrance out of water during red headlight survey, August 2023

Location	Number of eels on first observation (%) 2140-2215 hr	Number of eels on second observation (%) 2255-2310 hr	Number of eels on third observation (%) 2335-2355 hr	Total number of eels observed (%)
Site 1	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Site 2	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Site 3	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Site 4	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Site 5	1 (100.0%)	1 (50.0%)	1 (33.3%)	3 (50.0%)
Site 6	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Site 7	0 (0.0%)	1 (50.0%)	2 (66.7%)	3 (50.0%)
Total	1	2	3	6

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Figures

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Figure 1. Image of Octoraro Creek Eel Facility Ramp Entrance at 182 Cubic Feet per Second, 2023

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Figure 2. Image of the Octoraro Creek Eel Facility Ramp Entrance at 42.7 cfs, 2023

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SUMMARY OF RED-LIGHT NIGHTTIME SURVEY AT THE OCTORARO CREEK EEL COLLECTION FACILITY RAMP ENTRANCE FOR AMERICAN EEL, 2023



Figure 4. Individual sites within survey area (upstream section) at the Octoraro Creel eel facility ramp entrance during the red-light nighttime survey, 2023

Summary of Red-light nighttime survey at the Octoraro Creek Eel Collection Facility ramp entrance for American Eel, 2023



Figure 3. Overview of the Octoraro Creek Eel Facility After Protecting the Hillside from Erosion in 2022

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SUMMARY OF RED-LIGHT NIGHTTIME SURVEY AT THE OCTORARO CREEK EEL COLLECTION FACILITY RAMP ENTRANCE FOR AMERICAN EEL, 2023



Figure 5. Individual sites within survey area (downstream section) at the Octoraro Creel eel facility ramp entrance during the red-light nighttime survey, 2023

Appendix A: USFWS 2023 Inspection of the Conowingo Fish Passage Facilities

Normandeau Associates, Inc.



United States Department of the Interior

FISH AND WILDLIFE SERVICE Mid-Atlantic Fish and Wildlife Conservation Office 177 Admiral Cochrane Drive Annapolis, MD 21401



June 26, 2023

Andrea Danucalov Senior Manager Regulatory and Licensing Constellation 2569 Shures Landing Road Darlington, MD 21034

RE: 2023 Inspection of Conowingo Fish Passage Facilities

Ms. Danucalov,

The U.S. Fish and Wildlife Service (Service) completed an inspection of the fish passage facilities associated with the Conowingo Hydroelectric Project on May 8, 2023. Below is a summary of issues identified by Jesus Morales, fishway engineer, in coordination with other Service and resource agency staff attending the inspection.

Note that Service has ongoing concerns about the hydraulics within the fishways and potential overcrowding of the hoppers. These concerns have been identified in previous inspection reports and are not repeated in this report. The Service expects that these concerns will be remedied with the implementation of the fishway improvements that will be required to be constructed upon license issuance at the Project.

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1

Conowingo East Fish Lift:

Damaged rubber seal between transfer sluice and sorting tank. Personnel from the
resource agencies noticed that the rubber seal that maintains a hydraulic connection
between the hopper and the transfer sluice (see photo below) was broken. As the
operators described it, the hopper is designed to slowly rise while it empties, and while
the fish are sluiced from the hopper into the sorting tank. The rubber seal should be
flexible enough to keep water, and fish, from falling through the growing space as the
hopper continues to discharge water and fish.



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2

Conowingo East Fish Lift:

Little water cushion inside the sorting tank. The Service continues to be concerned about potential fish injuries from fish hitting the bottom, sidewall, and backwall of the sorting tank immediately after entering the tank through the high-velocity transfer sluice. The discharge of fish from the hopper and lack of initial water depth at the start of a fish transfer event from a hopper lift does not meet recommended fish passage guidance for plunging pools. Please consider maintaining a deeper water cushion inside the sorting tank before discharging the full volume of a hopper lift into it. If physical modifications are required to the tank to support a deeper initial receiving pool, one possible solution would be a double-walled sorting tank, where the inner wall would be shorter than the outer wall and have a porous grating on the top section to shed water into a channel that drains the excess water.



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3

Octoraro Eel Ladder:

Nightly assessments at the entrances to the eel ramps: Please consider implementing nightly assessments to determine whether eels are finding the ramp entrances with ease, or if there is evidence that a portion of motivated eel migrants miss these entrances and end up at other locations in the adjacent wetted riprap. These observations should confirm if the entrances to the ramps are set in the best location possible, and if the extended substrate and corresponding attraction spray bars are meeting their intended purpose. Based on these observations, the relocation of the entrances, or the addition of another ramp could be considered, if deemed as potential improvements to eel collection at this location.



 $Please \ contact \ meat \ Sheila_Eyler@fws.gov or \ 717-387-2117 \ if \ you \ have \ any \ questions \ or \ need \ further \ clarification \ of \ these \ items.$

Sincerely, Shih Ef.

Sheila Eyler Project Leader Mid-Atlantic Fish & Wildlife Conservation Office U.S. Fish and Wildlife Service

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Appendix B: Agency Comments on Draft 2023 Summary of Redlight nighttime survey at the Octoraro Creek Eel Collection Facility ramp entrance for American Eel

Normandeau Associates, Inc.

Summary of Red-light nighttime survey at the Octoraro Creek Eel Collection Facility ramp entrance for American Eel, 2023 Comments Received by Resource Agency and Date

Resource Agency	Date of Receipt by Constellation
Susquehanna River Basin Commission	December 15, 2023
Pennsylvania Fish and Boat Commission	No Comment Received
United States Fish and Wildlife Service	December 14, 2023
Maryland Department of the Environment	
Maryland Department of Natural Resources	December 15, 2023
Pennsylvania Department of Environmental Protection	December 14, 2023

Responses to Resource Agency Comments for the Summary of Red-light nighttime survey at the Octoraro Creek Eel Collection Facility ramp entrance for American Eel, 2023

SRBC

The Commission appreciates Constellation and Normandeau conducting this survey and the
observations it generated. We continue to support exploring elver arrival and usage of this
ramp through additional red-light surveys, night-time snorkeling surveys and use of
underwater cameras or ROV technology.

Constellation response: Constellation suggests performance of one redlight nighttime survey during the 2024 season when eel collection numbers are high and the ramp entrance is out of water and another redlight nighttime survey during the 2024 season when eel collection numbers is low and the ramp entrance is out of water. Out of water is defined as then the transition of the ramp to the substrate is below the tailrace level, which typically occurs when creek flow at the Richardsmere gage, 10 miles downstream of the OCEF is below 182 cfs. When the ramp is out of water, there is still connectivity to the ramp entrance to the tailrace from the attraction flow of the spray bar and scent line from the collection tank.

Additional usage of other equipment will be internally discussed with concerns of safety and accessibility during these nighttime surveys.

PFBC

No Comments were received.

USFWS

• The Octoraro eel ramp catch appears to reflect the magnitude of eels available at the site. Though the survey is not designed to conclusively determine differences in efficiency at different water levels. At a time when there is technology to adequately assess passage efficiency at the Constellation eel collection facilities, the Service recommends that assessment also occur at the Octoraro facility to determine if passage effectiveness is similar under different flow conditions at this site.

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Constellation response: When technology is available to test efficiency of eel ramps for the range of eel sizes being captured. An assessment will be conducted at the Conowingo West Eel Collection Facility. The tailwater elevation at CWA Pine Grove cannot be regulated but having the attraction flow during the whole season is an operational component that can be controlled.

• The facility was assessed under dates of relatively high and low flow conditions. The Service requests that Constellation conduct another redlight survey at a median flow condition in mid-summer, during a time that is generally around the peak collection time for the facility. Constellation response: Constellation suggests performance of one redlight nighttime survey during the 2024 season when eel collection numbers are high and the ramp entrance is out of water and another redlight nighttime survey during the 2024 season when eel collection numbers are high and the ramp entrance is out of water and another redlight nighttime survey during the 2024 season when eel collection numbers is low and the ramp entrance is out of water. Out of water is defined as then the transition of the ramp to the substrate is below the tailrace level, which typically occurs when creek flow at the Richardsmere gage, 10 miles downstream of the OCEF is below 182 cfs. When the ramp is out of water, there is still connectivity to the ramp entrance to the tailrace from the attraction flow of the spray bar and scent line from the collection tank.

MDE

 Please consider additional red-light surveys on alternate dates and at alternative river flows and lunar phases.

Constellation response: Constellation suggests performance of one redlight nighttime survey during the 2024 season when eel collection numbers are high and the ramp entrance is out of water and another redlight nighttime survey during the 2024 season when eel collection numbers is low and the ramp entrance is out of water. Out of water is defined as then the transition of the ramp to the substrate is below the tailrace level, which typically occurs when creek flow at the Richardsmere gage, 10 miles downstream of the OCEF is below 182 cfs. When the ramp is out of water, there is still connectivity to the ramp entrance to the tailrace from the attraction flow of the spray bar and scent line from the collection tank.

PA DEP

• PADEP acquired useful information from the eel nighttime red-light survey st flows of 251 cfs and 52.7 cfs. PADEP recommends conducting another nighttime red-light survey when flows are between 152-182 cfs.

Constellation response: Constellation suggests performance of one redlight nighttime survey during the 2024 season when eel collection numbers are high and the ramp entrance is out of water and another redlight nighttime survey during the 2024 season when eel collection numbers is low and the ramp entrance is out of water. Out of water is defined as then the transition of the ramp to the substrate is below the tailrace level, which typically occurs when creek flow at the Richardsmere gage, 10 miles downstream of the OCEF is below 182 cfs. When the ramp is out of water, there is still connectivity to the ramp entrance to the tailrace from the attraction flow of the spray bar and scent line from the collection tank.

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Mike Martinek

From:	Mike Martinek	
Sent:	Friday, December 15, 2023 12:07 PM	
To:	Mike Martinek	
Subject:	FW: Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft	
	reports for review	

From: Henning, Aaron <ahenning@srbc.gov> Sent: Friday, December 15, 2023 10:07 AM Subject: RE: Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

Andrea,

The Susquehanna River Basin Commission appreciates the opportunity to provide comments on the Octoraro Creek Eel Collection Facility Report and the Red-light Nighttime Survey. We offer the following comments:

Red-light Nighttime Survey

The Commission appreciates Constellation and Normandeau conducting this survey and the observations it
generated. We continue to support exploring elver arrival and usage of this ramp through additional red-light
surveys, night-time snorkeling surveys and the use of underwater cameras or ROV technology

Thank you.

Aaron

Aaron Henning

Fisheries Biologist Susquehanna River Basin Commission 4423 North Front St. Harrisburg, PA 17110 Office: (717) 238-0423 ext.1184 Mobile: (717) 884-5937 <u>ahenning@srbc.gov</u> https://www.srbc.gov/our-work/american-eels/

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MUDDY RUN PUMPED STORAGE PROJECT - FERC PROJECT NUMBER 2355

Mike Martinek

From:	Mike Martinek
Sent:	Friday, December 15, 2023 7:45 AM
To:	Mike Martinek
Subject:	FW: [EXTERNAL] Red-light nighttime survey and the Octoraro Creek Eel Collection
	Facility draft reports for review

From: Eyler, Sheila <sheila_eyler@fws.gov> Sent: Thursday, December 14, 2023 2:27 PM

Subject: Re: [EXTERNAL] Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

Mike et al.

Thank you for the opportunity to review the Octoraro Red-Light Nighttime Survey and the Octoraro Creek Eel Collection Facility draft reports.

The Service provides the following comments:

- 1. Octoraro Red-Light Nighttime Survey
- The Octoraro eel ramp catch appears to reflect the magnitude of eels available at the site. Though the
 survey is not designed to conclusively determine differences in efficiency at different water levels. At a
 time when there is technology to adequately assess passage efficiency at the Constellation eel
 collection facilities, the Service recommends that assessment also occur at the Octoraro facility to
 determine if passage effectiveness is similar under different flow conditions at this site.
- The facility was assessed under dates of relatively high and low flow conditions. The Service requests
 that Constellation conduct another redlight survey at a median flow condition in mid-summer, during a
 time that is generally around the peak collection time for the facility.

Sheila Eyler U.S. Fish and Wildlife Service Mid-Atlantic Fish & Wildlife Conservation Office 717-387-2117

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MUDDY RUN PUMPED STORAGE PROJECT - FERC PROJECT NUMBER 2355

Mike Martinek

From:	Mike Martinek
Sent:	Monday, December 18, 2023 8:25 AM
To:	Mike Martinek
Subject:	FW: Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

From: David Seaborn -MDE- <david.seaborn@maryland.gov> Sent: Friday, December 15, 2023 2:02 PM Subject: Re: Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

Mike,

Maryland (MDE working together with MDNR) has the following comment:

Please consider additional red-light surveys on alternative dates and at alternative river flows and lunar phases.

 David Seaborn, Ph.D. Deputy Program Manager, Wetlands and Waterways Protection Program Water and Science Administration Maryland Department of the Environment 1800 Washington Boulevard Baltimore, Maryland 21230 david.seaborn@maryland.gov 410-537.4465 (0) 443-621-1009 (C) Wohertin L Econcheck L Turittee
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Normandeau Associates, Inc.

MUDDY RUN PUMPED STORAGE PROJECT - FERC PROJECT NUMBER 2355

Mike Martinek

Mike Martinek
Thursday, December 14, 2023 12:11 PM
Mike Martinek
FW: [External] Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review
2023_Octoraro Creek_redlightsurvey_finaldraft.pdf; 2023 _Octoraro_Creek_Eel_Ramp_Collection_Report_finaldraft.pdf

From: Eberts, Ron <reberts@pa.gov> Sent: Thursday, December 14, 2023 10:57 AM Subject: RE: [External] Red-light nighttime survey and the Octoraro Creek Eel Collection Facility draft reports for review

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

Andrea,

PADEP has reviewed the attached 2023 Octoraro Creek Red-light Survey DRAFT Report and the 2023 Octoraro Creek Eel Ramp Collection DRAFT Report received on November 17, 2023. We offer the following comments:

2023 Octoraro Creek Red-light Survey

1. PADEP acquired useful information from the eel nighttime red-light survey at flows of 251 cfs and 52.7 cfs. PADEP recommends conducting another nighttime red-light survey when flows are between 152-182 cfs.

Thank you for the opportunity to comment.

Ronald C. Eberts, Jr. | Environmental Protection Compliance Specialist Department of Environmental Protection Southcentral Regional Office Waterways & Wetlands Program 909 Elmerton Avenue | Harrisburg, PA 17110 Phone: 717.705.4819| Fax: 717.705.4760

THE SOUTHCENTRAL REGIONAL OFFICE AFTER HOURS REPORTING & 24 HOUR EMERGENCY RESPONSE NUMBER: 1-800-541-2050.

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Normandeau Associates, Inc.