

MARYLAND DEPARTMENT OF THE ENVIRONMENT

**Clean Water Act Section 401 Certification For the Conowingo Hydroelectric Project
FERC Project No. P-405 / MDE WSA Application No. 17-WQC-02**

Certification Issued To:

Exelon Generation Company, LLC
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Kennett Square, PA 19348

Table of Contents

1. Authority.....	2
2. Definitions and Administrative Provisions	2
A. Definitions	2
B. Construction and Interpretation	5
C. Plans.....	6
3. Certification.....	7
4. Summary Project Description.....	7
5. Applicable Maryland Water Quality Standards & Criteria	8
A. Reservoir.....	8
B. Downstream.....	8
C. The Bay.....	10
6. Summary of Findings	11
7. Requirements and Conditions.....	13
A. Compliance with WQS, Generally	13
B. Fish Passage.....	13
C. Aquatic Life and Seasonal Migratory Fish - Operational Flow Regime Impacts.....	14
D. Dissolved Oxygen (DO) in the Chesapeake Bay	15
E. DO in the River Downstream of the Dam as Measured at Station 643	16
F. Trash and Debris in Reservoir and Movement Downstream.....	17
G. Chlorophyll-A Levels in the Reservoir.....	18
H. PCB Levels in Fish Tissue.....	19
I. Shoreline Management Plan (SMP).....	19
J. Turtle Management Plans	20
K. Waterfowl Nesting Protection Plan	20
L. Monitoring Stream Flows in the Tailrace	21
M. Sturgeon Protection.....	21
N. Habitat Improvement Projects	21
O. Lower River Fisheries Survey	22
P. Spillway Modifications/Fish Stranding Minimization.....	22
Q. General Requirements and Conditions	22

Attachments:

1. MDE Fish Passage Improvement Plan
 - Appendix A – Calculation of Fishway Capacity for a 6,500 Gallon Hopper
 - Appendix B – Calculating Trap and Transport Credit
 - Appendix C – Trap and Transport Mortality Study
 - Appendix D – Upstream and Downstream Migration Periods for Certain Species
 - Appendix E – Diagram of Fish Passage Definitions
 2. MDE Eel Passage Improvement Plan
 3. MDE Invasive Species Mitigation Plan
 4. Minimum Flow Regime
 5. Year 10 Flow Regime
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1. Authority

This Certification is issued to Exelon Generation Company, LLC (the “Licensee”) by the Maryland Department of the Environment (“MDE” or the “Department”) pursuant to Section 401 of the Federal Water Pollution Control Act, as amended, 33 U.S.C. §1341 et seq. (the “Clean Water Act”), Title 9, Subtitle 3 of the Environment Article, and Section 26.08.02 of the Code of Maryland Regulations (“COMAR”), with respect to the Conowingo Hydroelectric Project, FERC Project Number P-405 (the “Project”).

2. Definitions and Administrative Provisions

A. Definitions

In addition to terms defined elsewhere in this Certification, the following terms have the following meaning when used in this Certification and the Attachments hereto:

“Application” means that certain Application for a Maryland Water Quality Certificate for the Conowingo Hydroelectric Project submitted to the Department by the Licensee with respect to the Project on May 17, 2017, as amended, supplement, or modified.

“Authorization” means any applicable license, permit, approval, consent, exemption or authorization from a federal, State or local governmental authority.

“Bay” means the Chesapeake Bay and its tidal tributaries.

“cfs” means cubic feet per second.

“CPI” means the Consumer Price Index for All Urban Consumers (CPI-U; U.S. City Average; all items, not seasonally adjusted; 1982-84=100 reference base) published from time to time by the U.S. Bureau of Labor Statistics.

“Dam” means the Conowingo Dam, as described in Section 1.1 of the FERC Application.

“DNR” means the Maryland Department of Natural Resources.

“DO” means dissolved oxygen.

“DO Non-Attainment Area” means the portion of the Bay consisting of Chesapeake Bay segments CB4MH (Middle Central Chesapeake Bay Mesohaline deep water and deep channel) and the Maryland portion of CB5MH (Lower Central Chesapeake Bay Mesohaline deep water).

“DOI” means the United States Department of the Interior.

“EAV” means emergent aquatic vegetation.

“Eel” means American eel (*Anguilla rostrata*).

“East Fish Lift” or “EFL” means the east fish lift at the Project.

“Environment Article” means the Environment Article of the Annotated Code of Maryland.

“FERC” means the Federal Energy Regulatory Commission.

“FERC Application” means that certain Application for New License for Major Water Power Project-Existing Dam submitted to FERC by the Licensee with respect to the Project on or about August 9, 2012, as amended, supplemented, or modified.

“Herring” means, interchangeably and collectively, alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*).

“Holtwood” means the Holtwood Hydroelectric Project, FERC Project Number 1881.

“Laws” means applicable laws, statutes, regulations, rules, administrative orders, and judicial orders.

“Lower River” means the River from the Dam to its confluence with the Bay.

“Marietta Gage” means the water stage gage located on the River approximately one mile downstream of Marietta, Pennsylvania, USGS station #01576000.

“MDE-AEPIP” means the MDE American Eel Passage Improvement Plan, set forth in Attachment #2 to this Certification, which is incorporated herein by reference.

“MDE-FPIP” means the MDE Fish Passage Improvement Plan, set forth in Attachment #1 to this Certification, which is incorporated herein by reference.

“MDE-ISMP” means the MDE Invasive Species Mitigation Plan, set forth in Attachment #3 to this Certification, which is incorporated herein by reference.

“Minimum Flow Regime” means the operational flow requirements set forth in Attachment #4 to this Certification, which is incorporated herein by reference.

“Muddy Run” means the Muddy Run Pumped Storage Project, FERC Project Number 2355.

“New License” means the license for the Project to be issued by FERC.

“NMFS” means the National Marine Fisheries Service.

“Peach Bottom” means the Peach Bottom Atomic Power Station.

“PCBs” means polychlorinated biphenyls.

“ppt” means parts per thousand.

“Reservoir” means the water impounded by the Dam, which is sometimes referred to as the Conowingo Pond or Conowingo Pool.

“River” means the Susquehanna River.

“Safe Harbor” means the Safe Harbor Hydroelectric Project, FERC Project Number 1025.

“SAV” means submerged aquatic vegetation.

“Secretary” means the Secretary of the Environment of the State of Maryland, and any successor thereto.

“Shad” means American shad (*Alosa sapidissima*).

“Shoreline Management Plan” or “SMP” means the Licensee’s Shoreline Management Plan dated August 2012, included the Application and in Volume 3 of the FERC Application, which is incorporated herein by reference.

“Station 643” means DO and temperature monitoring station 643, located approximately 0.6 miles downstream of the Dam, which was established at such location by the Licensee in consultation with DNR.

“Sturgeon” means Atlantic and shortnose sturgeon (*Acipenser brevirostrum*, *Acipenser oxyrinchus oxyrinchus*).

“Tailrace” means the area downstream of the Dam that is in the hydraulic influence of Project operations.

“Tailwaters” means the Tailrace, extending to the downstream tip of Rowland Island.

“Term” means the term of the New License.

“TMDL” means a total maximum daily load for a body of water, pursuant to the Clean Water Act.

“USFWS” means the United States Fish and Wildlife Service.

“West Fish Lift” or “WFL” means the west fish lift at the Project.

“Year 10 Flow Regime” means the operational flow requirements set forth in Attachment #5 to this Certification, which is incorporated herein by reference.

“WQS” means applicable Maryland water quality standards.

B. Construction and Interpretation

All references herein to Sections or Attachments are references to Sections of or Attachments to this Certification, unless otherwise indicated. All Attachments to this Certification are deemed to be incorporated by reference and made a part of this Certification. All documents incorporated by reference into this Certification that are not attached hereto are qualified by the provisions, requirements and conditions of this Certification. Whenever the words “include,” “includes,” or “including” are used in this Certification, they shall be deemed to be followed by the words “without limitation.” Every reference herein to any Law shall be deemed to be a reference to such Law as it may be amended, supplemented, modified, renumbered, or re-codified from time to time. The Table of Contents and Section headings contained in this Certification (including the Attachments hereto and documents incorporated herein by reference) are for convenience only and shall not in any way affect the meaning or interpretation of this Certification. All references herein to temperatures are expressed in degrees Fahrenheit, unless otherwise noted. All references herein to “days” are calendar days unless otherwise noted. All references herein to governmental entities are to such governmental entities and any successor(s) thereto.

C. Plans

Where the Licensee is required by this Certificate (including any Attachment hereto) to submit to MDE for review and approval any plans, reports, or other documents, including the NCAP (defined below), the 643 Monitoring Plan (defined below), the Fish Kill Monitoring Plan (defined below), the Chlorophyll-A Monitoring Plan (defined below), the Chlorophyll-A Reduction Plan (defined below), the SMP Updates (defined below), the Bog Turtle Plan (defined below), the Map Turtle Plan (defined below), the Waterfowl Plan (defined below), the Tailrace Gage Plan (defined below), the Sturgeon Plan (defined below), the HIP Plan (defined below), the Fish Protection Plan (defined below), the FPP Updates (defined below), and the Stranding Minimization Plan (defined below) (each, a “Plan”), the following procedures shall apply, unless otherwise specified in this Certification:

i. MDE may approve any Plan, in whole or in part, or decline to approve it and provide written comments. MDE may also request additional information. The Licensee shall consult with MDE at least thirty (30) days prior to submission of any Plan about the subject matter thereof. To be effective, any approval by MDE hereunder must be provided in writing.

ii. MDE may solicit public comments and may hold, or require the Licensee to hold, one or more public hearings or meetings with respect to any Plan submitted by the Licensee. MDE may consult and share relevant information with, and may require the Licensee to consult and share relevant information with, other governmental entities or third parties having particular expertise in connection with the review, implementation, and/or oversight of any Plan, including DNR, USFWS, NMFS, the Susquehanna River Basin Commission and the Eel Passage Advisory Group. In connection with each proposed Plan, the Licensee shall provide MDE with (a) documentation regarding consultation with other governmental entities and third parties, (b) an explanation of how the proposed Plan addresses comments or recommendations from governmental entities or third parties, and (c) an explanation of why any such comments or recommendations are not addressed in the proposed Plan.

iii. Upon approval by MDE in writing, the Plan is incorporated into this Certification, and Licensee shall comply with such Plan as approved by MDE. Any failure to comply with an approved Plan, including any deadlines set forth therein, shall be deemed noncompliance with this Certification.

iv. In the event of MDE’s disapproval, in whole or in part, of any Plan, MDE shall specify any deficiencies in writing to the Licensee. The Licensee shall correct the deficiencies within thirty (30) days from receipt of disapproval by MDE unless MDE grants an extension, and submit the corrected Plan to MDE for review.

v. If the Licensee takes exception to all or part of MDE’s disapproval of any Plan, the Licensee shall submit a written statement of the grounds for the exception to MDE within fifteen (15) days from receipt of disapproval by MDE. Representatives of MDE and the Licensee may confer in person or by telephone in an attempt to resolve any disagreement. If a resolution is reached, that resolution shall be reduced to writing and signed by representatives of each party. In the event that resolution is not reached within fifteen (15) days, unless MDE grants an extension, the Licensee shall modify the Plan as required by MDE.

vi. Each Plan shall include (a) periodic reporting by the Licensee to MDE at such intervals as MDE deems reasonably necessary; and (b) a timeline for implementation of the Plan.

vii. The Licensee shall (a) provide all data and reports, including monitoring results, collected or developed pursuant to any Plan to MDE in electronic format, (b) make all such data and reports publically available on the Web Portal (defined below), (c) make all Plans publicly available on the Web Portal contemporaneously with submission thereof to MDE, and (d) make all approved Plans publicly available on the Web Portal upon receiving approval thereof from MDE.

viii. To the extent any Plan requires sampling, the number of samples, techniques used to obtain samples, and sampling locations shall be subject to approval by MDE.

3. Certification

The Department hereby certifies that the Project's operations and discharge into navigable waters will comply with applicable effluent limitations, other limitations, and water quality standards and requirements issued or approved under Sections 301, 302, 303, 306, and 307 of the Clean Water Act or applicable State Law, provided that Licensee complies with all of the provisions, requirements, and conditions in this Certification.

4. Summary Project Description

The Project consists of (1) the Dam, (2) a spillway, (3) the Reservoir, (4) an intake and powerhouse, and (5) the West Fish Lift and the East Fish Lift, all of which are located on the River approximately 10 miles north of the River's confluence with the Bay.

The West Fish Lift, adjacent to the Dam's right abutment, is currently operated under an agreement with USFWS for Shad egg production and other research purposes. The newer East Fish Lift, located near the midpoint of the Dam, is used primarily to pass Shad, Herring, and other migratory fish during the March-June migration season. The Project also includes a new Eel passage facility on the west side that began operation in May 2017.

The Reservoir serves as the lower reservoir for Muddy Run. It also serves as the source of cooling water for Peach Bottom and the York Energy Center. The Reservoir is also a public water supply source, with the City of Baltimore and Chester Water Authority (in Pennsylvania) having permitted withdrawals of 250 million gallons per day and 30 million gallons a day, respectively.

The powerhouse is integrated with the Dam. There are 13 turbine-generator units, associated draft tubes, and transformer bays. Water flowing through the turbines is discharged via the draft tubes into the Tailrace.

The Project area includes 15 recreation facilities and public access areas: Lock 13, Lock 15, Muddy Creek Boat Launch, Cold Cabin Boat Launch, Dorsey Park, Line Bridge, Broad Creek Public Landing, Glen Cove Marina, Conowingo Swimming Pool and Visitor's Center, Peach Bottom Marina, Conowingo Creek Boat Launch, Funk's Pond, Conowingo Dam Overlook, Fisherman's Park/Shures Landing, and Octoraro Creek Access.

5. Applicable Maryland Water Quality Standards & Criteria

A. Reservoir

The Reservoir has been designated as a Class I-P water, i.e., the Reservoir is to be used for water contact recreation, habitat for non-tidal warmwater aquatic life, and public water supply. The water quality criteria that are currently applicable to the Reservoir and relevant to this Certification are:

- i. DO of at least 5 mg/L;
- ii. Bacteriological criteria;
- iii. PCBs in fish tissue;
- iv. Chlorophyll-A (10 ug/l 30 day average, 90th percentile not greater than 30 ug/l);
- v. Turbidity (150 max, 50 average); turbidity levels may not exceed levels detrimental to aquatic life;
- vi. pH (6.5-8.5);
- vii. Temperature (not to exceed 90 degrees); and
- viii. Narrative criterion that prohibits waters from being polluted with any material in amounts sufficient to: (1) be unsightly; (2) produce taste or odor; (3) change the existing color to produce aesthetically objectionable color; (4) create a nuisance; or (5) interfere directly or indirectly with designated uses.

B. Downstream

The discharge from the Project impacts water quality in the River below the Dam and in the Bay. Applicable water quality standards for these waters, including designated uses, relevant to this Certification are as follows:

- i. *The mainstem of River from the Dam to the confluence with the Bay.* This water has been designated as a Class II-P water. This water is to be used for water contact recreation, public water supply, habitat for non tidal warmwater aquatic life, estuarine and marine aquatic life and shellfish harvesting, migratory spawning and nursery, seasonal shallow water submerged aquatic vegetation (SAV), and Open-Water Fish and Shellfish. The water quality criteria which are currently applicable to this water and relevant to this Certification include:

- a. Narrative criterion that prohibits the water from being polluted with any material in amounts sufficient to: (1) be unsightly; (2) produce taste or odor; (3) change the existing color to produce aesthetically objectionable color; (4) create a nuisance; or (5) interfere directly or indirectly with designated uses; and
- b. DO criteria for Class II-P waters are the same as Class I-P waters (“the [DO] concentration may not be less than 5 milligrams/liter at any time”), except for the following subcategories applicable in the reach downstream of Dam:
 - 1. Seasonal and Migratory Fish Spawning and Nursery: From February 1 through May 31, the DO level must be greater than or equal to 6 milligrams/liter (mg/l) for a 7-day averaging period, with an instantaneous minimum requirement of greater than or equal to 5 mg/l. For all other times during the year, the DO levels are as follows: (A) greater than or equal to 5.5 [mg/l] for a 30-day averaging period . . . in tidal fresh waters (salinity less than or equal to 0.5 ppt); (B) greater than or equal to 5 [mg/l] for a 30-day averaging period . . . (salinity greater than 0.5 ppt); (C) greater than or equal to 4.0 [mg/l] for a 7-day averaging period; (D) greater than or equal to 3.2 [mg/l] as an instantaneous minimum; and (E) for protection of the endangered shortnose sturgeon, greater than or equal to 4.3 [mg/l] as an instantaneous minimum at water column temperatures greater than 77 degrees;
 - 2. Seasonal Shallow-Water SAV: Same as items (A) through (E) in Section 5.B.i.b.1, year-round; and
 - 3. Open-Water Fish and Shellfish: Same as items (A) through (E) in Section 5.B.i.b.1, year-round;
- c. Temperature (not to exceed 90 degrees);
- d. pH: Normal pH values may not be less than 6.5 or greater than 8.5;
- e. Turbidity may not exceed levels detrimental to aquatic life. With regard to turbidity resulting from any discharge, such turbidity “may not exceed 150 units at any time or 50 units as a monthly average” (measured in Nephelometer Turbidity Units);
- f. Color in the surface water may not exceed 75 units as a monthly average. Units shall be measured in Platinum Cobalt Units;
- g. Concentrations of chlorophyll a in free-floating microscopic aquatic plants (algae) may not exceed levels that result in ecologically undesirable consequences that would render tidal waters unsuitable for designated uses; and

2. DO must be greater than or equal to 2.3 milligrams/liter for a 1-day averaging period from June 1 through September 30;
 3. DO must be greater than or equal to 1.7 milligrams/liter as an instantaneous minimum from June 1 through September 30; and
 4. The open-water fish and shellfish subcategory criteria apply from October 1 to May 31.
- e. Seasonal Deep Channel Refuge: DO must be greater than or equal to 1.0 milligrams/liter as an instantaneous minimum from June 1 to September 30 except for Bay segments subject to variances.

6. Summary of Findings

In light of all the evidence before the Department, including the Application, comments and testimony received, and all other studies, modeling, and information reviewed during the Application review process, the Department has determined that the Project adversely impacts water quality in the State of Maryland, including but not limited to the following ways:

A. The Project has significantly and adversely impacted biota in the Lower River and the northern Bay over the past 90 years of operation, as a result of: (i) its highly unnatural operational flow regimes; (ii) the Dam serving as a barrier to fish passage upstream; and (iii) the Dam serving as an obstacle to fish passage and coarse-sediment transport for habitat downstream. Aquatic habitat in the Tailrace is adversely affected by daily peaking flows and the elimination of movement of some coarse-grained sediments that are stored in the Reservoir. Daily peaking hydropower operation also results in high velocities and excessive turbulence in water discharged through the Dam, which reduces deposition of any available coarse-grained sediment and affects the amount of Lower River habitat available to species such as Shad, Herring, Sturgeon, Eels, turtles, and freshwater mussels, as well as SAV and macro-invertebrate communities.

B. When initially constructed and for many decades of its initial operation, the Project had no provision for fish to move upstream and did not maintain any minimum level of water flowing downstream. Fish kills occurred downstream and the quantity and quality of suitable habitat for riverine species in the River were adversely impacted. The duration of time before the Project was required to maintain any amount of daily minimum flow downstream throughout the year, and before any working fishlift was constructed to allow fish to move by their own volition upstream, has had significant consequences for the health of the aquatic system from above the Dam to the northern Bay.

C. As currently operated, the Project's peaking flow regime, characterized by drastic daily changes in water depth below the Dam and velocities of discharge over a period of one hour, continues to cause fish kills downstream by stranding fish in shallow pools with insufficient water and subjecting them to increased threat of predation. The flow regime also delays upstream movement of important migratory spawning species such as Shad and Herring, and adversely impacts downstream habitat and the integrity of the downstream aquatic system.

D. Additional provision for fish passage is necessary to assist in the recovery of historic fish populations. Prior to the construction and operation of the Project, species such as Shad and Herring spawned in prime spawning habitat in the River above the current location of the Dam. The River and northern Bay were vibrant and active fisheries for these species. With a healthy aquatic system, millions of Shad and Herring should be passing upstream in the River every year; in 2017, only 15,000 Shad and 65 Herring passed the Dam. Millions of Eel, an important host species for freshwater mussels that filter pollution out of waters, should be present in the Lower River, including areas upstream of the Dam; in 2017, only thousands were collected at the base of the Dam and transported upstream. Consequently freshwater mussel populations have declined dramatically in the system. The River should support tens of millions of freshwater mussels; today, the freshwater mussel population is significantly diminished above and below the Dam such that it is considered unviable.

E. The Reservoir, formed by the construction of the Project, replaced 14 miles of flowing, dynamic River habitat with an impoundment and fundamentally altered aquatic habitat. The Reservoir lacks suitable habitat for freshwater mussels, which has adverse consequences for water quality, as these organisms provide important ecosystem services of filtration and transformation of sediment and nutrient pollution. Reservoir-adapted fish such as gizzard shad have replaced and continue to threaten populations of riverine species that would typically be dominant. The Reservoir has elevated levels of chlorophyll-A during summer months with increased water temperatures, which impact drinking water supply uses of the water. Elevated PCB levels in fish tissue in fish in the Reservoir and below the Dam impact fish consumption-related uses, and have triggered the development of TMDLs to address these impairments.

F. Invasive fish species, which may be more likely to proliferate in a degraded system, passing the Dam have the potential to suppress native species, alter the food web, and reduce biodiversity. Invasive species including the blue catfish (*Ictalurus furcatus*) and northern snakehead (*Channa argus*) have spread throughout the Bay watershed. Based on information from Licensee, a snakehead or blue catfish has already passed volitionally through a fishlift at the Project in 2017. The blue catfish and snakehead are both top predators in areas where they have become established and would further threaten the ecological balance of the River.

G. Although the Dam has in the past trapped and stored sediment and nutrients and served as a barrier to downstream transport to the Bay, the Reservoir is now full, as no efforts have been undertaken over the life of the Project, such as routine dredging, to maintain any trapping function. As a result, sediments and nutrients move downstream, and during large storm events, significant amounts of trapped sediment and nutrients are scoured from the behind the Dam and discharged downstream. By releasing significant amounts of sediment and nutrients through scouring during storm events, the Dam has altered the nature, timing, and delivery method of these materials with adverse consequences for the Lower River and the Bay. Nutrients discharged as a result of the in-filled state of the Reservoir adversely impact DO levels and thus aquatic life in the DO Non-Attainment Area.

H. In-filling of the Reservoir with sediment increases the velocity of water in the Reservoir, and the altered hydrological dynamics result in unfavorable substrate conditions and a

generally sparse invertebrate community in the lower two-thirds of the Reservoir. Increased water velocity also increases bed shear and induces additional scour and movement downstream of sediment and associated nutrients.

I. The Project traps trash and debris behind the Dam, which accumulates over time, threatening recreational uses of the Reservoir and potentially concentrating pollutants, and if not removed regularly is vulnerable to sudden downstream transport during moderate to large storm events. Significant amounts of trash and debris moving downstream in single events creates hazards for recreational uses and blocks water supply intakes downstream.

J. Absent the Dam, there would be 24 miles of open river between the dam at Holtwood and the Bay, and there would be some natural transformation and attenuation of sediment and nutrients, as the River would be better connected to its floodplain and there would be coarse sediment regularly moving downstream. This would support larger SAV beds, and the area downstream of the head of tide (about 5 miles from the mouth of the River) would have a larger delta formed from deposition of sediment carried by the River as its flow enters the slower moving water in the Bay. More coarse sediment, floodplain connection, and SAV would make the River system more resilient, including its ability to attenuate nutrients and minimize damage associated with moderate to large rainfall events.

7. Requirements and Conditions

A. Compliance with WQS, Generally

The Project shall comply with all WQS and other applicable Laws and Authorizations.

B. Fish Passage

i. The Licensee shall implement and comply with all provisions of:

- (a) the MDE-FPIP;
- (b) the MDE-AEPIP; and
- (c) the MDE-ISMP.

ii. The Licensee shall take such actions as may be necessary to permit at least 5,000,000 Shad and at least 12,000,000 Herring that approach the Project to pass the Dam each year during the Term on a schedule to be determined by MDE as the Licensee implements the MDE-FPIP.

iii. Notwithstanding any provision of the MDE-FPIP to the contrary, if the Shad population immediately upstream of York Haven Dam is determined to be less than 150,000 (using a counting methodology approved by MDE) as of December 31, 2039, MDE will reassess the trap and transport crediting aspects of the MDE-FPIP, and MDE will decide, in consultation with DNR and, as MDE deems appropriate, other fisheries experts, whether and

how to adjust such crediting. The Licensee shall be bound to apply whatever adjustments that MDE makes at that time to the crediting aspects of the MDE-FPIP from that point forward.

iv. Notwithstanding any provision of the MDE-FPIP to the contrary, if the Shad population immediately upstream of York Haven Dam is determined to be less than 400,000 (using a counting methodology approved by MDE) as of December 31, 2054, MDE will reassess the trap and transport crediting aspects of the MDE-FPIP, and MDE will decide, in consultation with DNR and, as MDE deems appropriate, other fisheries experts, whether and how to adjust such crediting. The Licensee shall be bound to apply whatever adjustments that MDE makes at that time to the crediting aspects of the MDE-FPIP from that point forward.

C. Aquatic Life and Seasonal Migratory Fish - Operational Flow Regime Impacts

i. The Licensee shall operate the Project in accordance with the Minimum Flow Regime beginning on September 1, 2018 and ending on December 31, 2028.

ii. The Licensee shall operate the Project in accordance with the Year 10 Flow Regime starting on January 1, 2029, *provided, however*, if MDE determines, based on Adaptive Management Flow Studies, that modifications to the Year 10 Flow Regime are likely to result in benefits to the aquatic system greater than or equal to the benefits MDE expects if the Year 10 Flow Regime is implemented without such modifications, the Secretary will notify the Licensee of such determination in writing prior to January 1, 2029, in which case the Licensee shall operate the Project in accordance with the Year 10 Flow Regime, modified in accordance with such notice from the Secretary (the "Modified Year 10 Flow Regime"), starting on January 1, 2029.

iii. For purposes of this Section 7.C, "benefits to the aquatic system" includes statistically significant improvement in (a) the percentage of Shad and Herring moving from the Tailrace and being captured in the fishlifts within three days of their entry into the Tailrace; (b) the quality of downstream aquatic life as evidenced by reduction in the number of fish strandings; (c) the quality and abundance of the macroinvertebrate community and freshwater mussel community; and (d) the abundance of SAV within the segment of the River between the Project and the head of tide.

iv. For purposes of this Section 7.C, "Adaptive Management Flow Studies" means scientifically sound studies voluntarily completed by or for the Licensee as described more fully below, subject to independent external scientific peer review and submitted by the Licensee to MDE. For each Adaptive Management Flow Study, the Licensee shall develop a study design, with the objective of testing one or more component parts of the Year 10 Flow Regime to determine whether such component part(s) provide benefits to the aquatic system. The Licensee shall subject the study designs to independent external scientific peer review by at least five qualified and independent scientists with specialties in the appropriate scientific disciplines, and incorporate any consensus recommendations into the study design as a result of that process. The Licensee shall provide to MDE for approval a copy of each final study design with the results of the independent external scientific peer review prior to initiating the Adaptive Management Flow Study. For each Adaptive Management Flow Study, a report containing the data collected and an analysis of results shall be subjected to independent external scientific peer

review by at least five qualified and independent scientists with specialties in the appropriate scientific disciplines. Once independent external scientific peer review of the Adaptive Management Flow Study results is completed, the Licensee shall incorporate and/or address any consensus-based comments and provide to MDE the study report and copies of all independent external scientific peer review comments. The study report and the results of independent external scientific peer review shall be submitted to MDE by January 1, 2027, so that MDE has adequate time to review and consider the need for potential changes to the Year 10 Flow Regime.

v. If compliance with the Minimum Flow Regime, the Year 10 Flow Regime, or the Modified Year 10 Flow Regime, as the case may be (each, "Applicable Flow Requirements"), would cause the Licensee, any of its affiliates, or any subsequent owner or operator of Peach Bottom or Muddy Run to violate or breach any Law, Authorization, or agreement with any governmental entity, including the Nuclear Regulatory Commission license for Peach Bottom and any agreement with the City of Baltimore, the Licensee may deviate from the Applicable Flow Requirements to the least degree necessary in order to avoid such violation or breach. In such circumstances, the Licensee shall provide to MDE, within one week of each such deviation, a written report identifying the Law, Authorization, or agreement that necessitated the deviation, describing the actual minimum flows provided during the deviation period, the duration of the actual minimum flows under these circumstances, and any observed adverse impacts to aquatic life (e.g., fish kills, additional observed delays in migratory fish reaching the fishlifts, etc.).

D. Dissolved Oxygen (DO) in the Chesapeake Bay

i. The Licensee shall ensure that Project operations and discharges do not adversely impact DO levels, and consequently aquatic life, in the Bay in any manner that would constitute a violation of WQS including designated and achieved uses.

ii. To ensure the Project's compliance with DO WQS including designated and achieved uses, beginning with calendar year 2025, the Licensee shall annually reduce the amount of nitrogen included in the Project's discharges by six million (6,000,000) pounds and the amount of phosphorus in the Project's discharges by two hundred sixty thousand (260,000) pounds (or such different amounts of phosphorus and nitrogen reductions as may be approved by MDE, provided that such different amounts of nitrogen and phosphorus reductions provide the equivalent protection of DO levels in the DO Non-Attainment Area that would be provided by six million (6,000,000) pounds of nitrogen reductions and two hundred sixty thousand (260,000) pounds of phosphorus reductions) (the "Required Nutrient Reductions").

iii. If, in a final watershed implementation plan intended to mitigate the water quality impacts of the Reservoir in-fill (the "Conowingo WIP"), one or more of Maryland, the District of Columbia, New York, Delaware, Virginia, West Virginia, and Pennsylvania (each, a "Bay Jurisdiction") has committed to actions that will result in some portion(s) of the Required Nutrient Reductions being achieved, the Licensee may credit against its Required Nutrient Reduction obligation the nitrogen and/or phosphorus reductions that are actually achieved by the Bay Jurisdictions. To obtain any such credit, the Licensee shall submit a written request therefor, with supporting documentation, to MDE.

iv. The Licensee shall provide to MDE for review and approval, no later than December 31, 2019, a nutrient corrective action plan (the “NCAP”) for achieving the Required Nutrient Reductions and otherwise ensuring that DO levels in the DO Non-Attainment Area are not adversely impacted by Project operations and discharges. The NCAP may propose any combination of corrective action strategies, including:

- (a) Payment of an in-lieu fee annually at \$17.00 per pound of nitrogen and \$270.00 per pound of phosphorus in accordance with payment instructions provided by MDE from time to time; *provided*, that the in-lieu fee amounts of \$17.00 and \$270.00 are deemed effective as of January 1, 2019 and shall be adjusted for inflation on January 1, 2020 and on January 1 of each year thereafter, based on the cumulative change in the CPI;
- (b) Installation of best management practices and/or ecosystem restoration actions (e.g., restoration of buffers, land conservation, stream and wetland restorations, re-forestation, and/or freshwater mussel and oyster restoration); and/or
- (c) Dredging the Reservoir, subject to Licensee obtaining all necessary Authorizations for such dredging.

v. Subject to the other provisions of this Section 7.D.v, the Licensee shall comply with the NCAP as approved by MDE in writing during the Term. If MDE determines during the Term that the Required Nutrient Reductions are, in whole or in part, either not necessary or not sufficient to meet DO criteria in the River and/or the Bay, MDE may re-open this Certification pursuant to Section 7.Q.xvii to reduce, eliminate, or increase the Required Nutrient Reductions. If MDE re-opens this Certification to increase or reduce the Required Nutrient Reductions, the Licensee shall submit a revised NCAP to MDE for approval within 60 days after MDE notifies the Licensee in writing that this Certification is being re-opened.

vi. The Licensee shall develop and submit for MDE review and approval no later than December 31, 2019, a Sediment & Nutrient Monitoring Plan, the purpose of which shall be to: (a) quantify changes in the extent and amount of sediment and nutrients being discharged from the Dam over the Term; (b) understand the impacts of changing sediment and nutrient conditions on living resources in the Bay; and (c) understand nutrient and sediment changes and impacts resulting from major storm events of greater than 400,000 cfs.

E. DO in the River Downstream of the Dam as Measured at Station 643

i. The Licensee shall ensure that Project operations and discharges do not adversely impact DO levels, and consequently aquatic life, in the River in any manner that would constitute a violation WQS including designated and achieved uses.

ii. No later than June 30, 2019, the Licensee shall submit to MDE for approval a plan for monitoring DO at Station 643 (the “643 Monitoring Plan”). The 643 Monitoring Plan shall provide for continuous monitoring of DO levels in the Tailrace at Station

643 beginning no later than December 31, 2019. The 643 Monitoring Plan shall include a description of data collection and analysis procedures, equipment maintenance and calibration procedures, and schedules for reporting results to MDE.

iii. If the monitoring conducted under the 643 Monitoring Plan identifies violations of the daily average or instantaneous standard, the Licensee shall, within 30 days, notify MDE of the exceedence in writing and submit a plan to MDE for approval proposing corrective actions to prevent similar exceedences in the future. The Licensee shall implement such corrective action plan after it is approved by MDE.

iv. No later than June 30, 2019, the Licensee shall submit to MDE for approval a plan for monitoring and reporting any fish kills exceeding 50 fish in the Reservoir and/or the Tailrace (the "Fish Kill Monitoring Plan"). The Fish Kill Monitoring Plan shall include data collection procedures, analysis methods, and reporting commitments.

F. Trash and Debris in Reservoir and Movement Downstream

i. The Licensee shall employ clamming (or any other equally or more effective measures of its choosing approved by MDE), to remove floating and water surface trash and debris that accumulates in the Reservoir behind the Dam at least weekly (unless storm conditions preclude removal in a particular week). During clamming/trash and debris removal events, the Licensee shall remove all visible trash and debris. Removal shall occur at least forty (40) times per year between January 1 and November 1, starting in January 2019. The Licensee shall monitor and record the duration of the clamming/trash and debris removal events (number of hours), and the amount of debris and trash removed and subsequently disposed of during each clamming/trash and debris removal event (in cubic yards). The Licensee shall submit these data to MDE each year by November 30 and, after 3 years of this effort, and, based on these data, the Licensee may request from MDE a reduction in the required frequency of clamming/trash and debris removal events, and MDE may reduce the required frequency of clamming/trash and debris removal events based on a review of the data.

ii. The Licensee shall, no later than December 31, 2019, employ on a daily basis the use of a self-propelled skimmer barge (unless storm conditions preclude its use during a particular timeframe). If the Licensee seeks to reduce the requirement to use this skimmer barge on a daily basis, the Licensee shall provide MDE with data collected over a 3 year period documenting the days and hours of operation and the amount of material collected and disposed of (in cubic yards) for each week of operation. Based on the data collected, the Licensee may request a from MDE a modification to this requirement for daily operation of the skimmer barge, and MDE may modify the requirement to use a self-propelled skimmer barge daily based on a review of the data.

iii. The Licensee shall respond to any complaint from a marina operator or public boat ramp "monitor" (e.g., DNR) about accumulated trash and debris interfering with recreational uses in the Reservoir by removing any accumulated trash and debris that is interfering with recreational uses within 48 hours of a complaint during the recreational season (between Memorial Day and Labor Day) and properly disposing of removed materials. The Licensee shall maintain for MDE review, records of complaints filed (name, date, time, location,

nature of the trash and/or debris issue and amount), and corrective actions taken (date, time, description of action, and, amount of trash and/or debris removed).

iv. The Licensee shall sponsor at least two annual community-based cleanups of the Reservoir, tributaries upstream of the Project that feed the Reservoir, and the River and tributaries downstream of the Project. The Licensee shall advertise each event, provide all needed supplies, and arrange and pay for the disposal of collected materials.

v. After any storm event which has resulted in trash and debris moving downstream and blocking downstream water supply intakes in the River, the Licensee shall ensure that trash and debris that is blocking downstream water supply intakes is removed as soon as it is safe to enter the water after the storm event.

vi. No later than December 31, 2019, the Licensee shall perform and submit to MDE a study regarding the feasibility of using one or more water wheel trash interceptors powered by solar panels or other renewable sources (a "Trash Wheel"), to remove floating and water surface trash and debris in the Reservoir. If Licensee determines that using one or more Trash Wheels to aid compliance with WQS would be reasonably practical, the Licensee shall submit to MDE for approval a plan for the installation thereof at the Project.

G. Chlorophyll-A Levels in the Reservoir

i. No later than June 30, 2019, the Licensee shall submit to MDE for approval a plan for monitoring chlorophyll-A levels in the Maryland portion of the Reservoir (the "Chlorophyll-A Monitoring Plan"). The Chlorophyll-A Monitoring Plan shall provide for collection of three (3) years of data on chlorophyll-A levels in the Maryland portion of the Reservoir between May 1 and September 30, in accordance with a monitoring protocol to be provided by MDE no later than March 31, 2019, and shall be designed to determine with a high level of statistical confidence whether chlorophyll-A WQS are exceeded in the Maryland portion of the Reservoir between May 1 and September 30 in any particular year.

ii. Pursuant to the Chlorophyll-A Monitoring Plan, the Licensee shall provide MDE with (a) annual reports of all measured chlorophyll-A levels and dates and locations of monitoring in the Maryland portion of the Reservoir by December 31 of the year in which the monitoring occurred; and (b) a final report that analyzes and presents the results of all chlorophyll-A monitoring completed by June 30 of the year after the final year of monitoring.

iii. If any of the reports required by Section 7.G.ii reflect that chlorophyll-A levels in the Maryland portion of the Reservoir exceed WQS, the Licensee shall, within six (6) months after the date on which such report was submitted to MDE, submit to MDE for approval a plan to reduce chlorophyll-A levels in the Maryland portion of the Reservoir between May 1 and September 30 to meet WQS for chlorophyll-A within five (5) years (the "Chlorophyll-A Reduction Plan").

iv. If MDE determines at any time that chlorophyll-A levels in the Maryland portion of the Reservoir exceed WQS, and the City of Baltimore withdrew water from the Reservoir and incurred necessary additional treatment costs associated with elevated chlorophyll-

A levels in that year, the Licensee shall promptly reimburse the City of Baltimore for such additional costs.

H. PCB Levels in Fish Tissue

i. The Licensee shall ensure that Project operations and discharges do not cause or contribute to PCB levels in fish tissue in violation of WQS including designated and achieved uses.

ii. MDE is reviewing available information on the potential sources of PCBs in the Reservoir and downstream of the Project to determine the need for additional data collection and/or corrective actions to address elevated PCB levels in fish tissue in the Reservoir and downstream. MDE may, in the future, require the Licensee to undertake data collection (e.g., sampling of sediment for PCBs) and/or actions to reduce PCB levels in the Reservoir and/or in the Project's discharges to the River.

iii. Should MDE determine that the Licensee needs to undertake data collection and/or reduce PCB levels in the Project's discharges to the River and/or in the Reservoir, MDE may re-open this Certification pursuant to Section 7.Q.xvii to require the Licensee to develop a plan for MDE review and approval for data collection and/or corrective actions to reduce PCB levels in the Reservoir and/or in the Project's discharges to the River. The Licensee shall prepare and submit for MDE approval any such plan requested by MDE within twelve (12) months of MDE's request.

I. Shoreline Management Plan (SMP)

i. The Licensee shall comply with the SMP, subject to the other provisions of this Section 7.I.

ii. Non-Project use of Project Land. If the Licensee intends to make any non-Project use of any Project land, or receives any request from a third party for non-Project use of any Project land, the Licensee shall (a) prepare, or require the third-party requestor to prepare, a written assessment of the impacts on water quality of the proposed use; (b) provide this assessment to MDE for MDE's review and decision regarding whether the proposed use is consistent with WQS including designated and achieved uses; and (c) not engage in or allow such use until MDE notifies the Licensee in writing that MDE has no objections to such proposed use.

iii. Shoreline Vegetation Management. If the Licensee intends to make any modifications to the shoreline vegetation for viewshed maintenance and development and recreation access within the Project boundary, the Licensee shall (a) prepare a written assessment of the impacts on water quality of the proposed modifications; (b) provide this assessment to MDE for MDE's review and decision regarding whether the proposed modifications are consistent with WQS including designated and achieved uses; and (c) not undertake any such modifications until MDE notifies the Licensee in writing that it has no objections to such proposed use.

iv. Sensitive Natural Resources Protection Overlay and Policies. The Licensee shall consult with MDE regarding any proposed modification of an existing use of Project lands in cases where such use may affect any sensitive aquatic resource identified by the Licensee in the “sensitive resources overlays” included in the SMP.

v. SMP Updates. No later than January 1 of 2028, 2038, 2048, and 2058, the Licensee shall submit to MDE for approval proposed improvements to the SMP (each, an “SMP Update”). Each SMP Update shall include an assessment of the impacts of deleted, revised, or new measures on water quality.

J. Turtle Management Plans

i. Notwithstanding anything to the contrary in the SMP, the Licensee shall, no later than September 1, 2019, submit to MDE for approval, a plan for the protection and enhancement of the bog turtle population associated with Project lands (the “Bog Turtle Plan”). The Bog Turtle Plan shall include (a) the restriction of mowing in the wetlands within the Project boundaries that are documented to support bog turtles; (b) invasive plant and woody plant control, particularly red maples and reed canary grass, in the areas around the wetlands within the Project boundaries that are documented to support bog turtles; (c) limits on public access to the wetlands within the Project boundaries that are documented to support bog turtles without advertising the reason; and (d) an assessment of the impacts, if any, of the specific measures planned to be implemented on WQS including designated and achieved uses.

ii. Notwithstanding anything to the contrary in the SMP, the Licensee shall, no later than September 1, 2019, submit to MDE for approval, a plan for the protection and enhancement of the northern map turtle population associated with Project lands (the “Map Turtle Plan”). The Map Turtle Plan shall include (a) annual monitoring of the northern map turtle population at the Project for 10 years, followed by population monitoring every 5 years during the Term; (b) a study to determine the amount of artificial basking habitat needed over the normal range of generation flows to support current and future populations of northern map turtles within the Reservoir and all areas of the downstream River affected by generation flows; (c) a study to determine the proper locations for deployment of artificial basking platforms; (d) nest management and protection measures; (e) annual monitoring of the use and success of both the mitigation and protection measures; (f) an assessment of the northern map turtle’s response to changes in operating practices at the Project that are required by this Certification or the New License; and (g) methods of altering or amending protection and mitigation measures as a result of the monitoring, in consultation with MDE.

K. Waterfowl Nesting Protection Plan

Notwithstanding anything to the contrary in the SMP, the Licensee shall, no later than September 1, 2019, submit for MDE approval a waterfowl nesting protection plan (the “Waterfowl Plan”). The Waterfowl Plan shall: (i) identify specific Project-related effects on nesting waterfowl, such as flooding during the nesting season; (ii) identify which species of nesting waterfowl (including the black-crowned night heron) are affected by the Project, if any; (c) if Project-related effects are identified, describe appropriate protection or mitigation

measures; and (d) provide an assessment of the impacts of such protection and mitigation measures on water quality.

L. Monitoring Stream Flows in the Tailrace

Notwithstanding anything to the contrary in the SMP, the Licensee shall, no later than September 1, 2019, submit to MDE for approval a plan for the re-design, installation, and maintenance of best available real-time flow telemetry at the stream gage in the Tailrace (USGS Station Gage #01578310) (the “Tailrace Gage Plan”). The Tailrace Gage Plan shall provide for Licensee to submit monitoring results from the Tailrace Gage to MDE no less than annually, by December 31 of each year, which results shall be included in the Minimum Stream Flow Operation Plan (MSFOP) annual report.

M. Sturgeon Protection

Notwithstanding anything to the contrary in the SMP, the Licensee shall, no later than September 1, 2020 (or sooner, if required by a federal governmental agency), submit to MDE for approval a plan for the protection and enhancement of the Sturgeon populations associated with the Project (the “Sturgeon Plan”). The Sturgeon Plan shall include: (i) provisions to monitor and report stranded Sturgeon within Project boundaries and in the River downstream from the Project; (ii) provisions to eliminate stranding of Sturgeon as a result of Project operations; (iii) procedures for trapping, handling, and safely returning Sturgeon lifted at any fish lift to the Tailrace; (iv) monitoring of water quality in any tanks used to hold Sturgeon; and (v) procedures for monitoring tagged Sturgeon and other tagged fish below the Dam and in the Bay including Environmental DNA.

N. Habitat Improvement Projects

i. No later than September 1, 2019, the Licensee shall submit to MDE for approval a plan for implementing Habitat Improvement Projects (“HIPs”) in the River extending approximately 4.5 miles downstream of the Dam to the island complex that includes Robert and Spencer Islands (the “HIP Plan”). The HIPs shall target habitat improvements for Shad, Herring, freshwater mussels, native EAV and SAV, shortnose sturgeon, smallmouth bass, and macroinvertebrates at the following locations: (a) the mouth of Octoraro Creek; (b) the north end of Sterret Island; (c) McGibney Island; (d) the Robert, Wood, and Spencer Island complex; (e) the mouth of Deer Creek; (f) Snake Island; (g) downstream of Bird Island; (h) Rowland Island; and (i) the Fish Pot area along the western shore, located southwest of Bird Island. The objectives of the HIPs shall include creating, enhancing, or protecting (1) habitat for Shad and Sturgeon at the spawning and fry life stages; (2) natural vegetation (while minimizing the potentially negative impacts of working near invasive vegetative species); and (3) habitat for other aquatic species.

ii. The Licensee shall develop conceptual HIP designs based on a review of the latest Habitat Suitability Index maps, water surface elevations, depths, velocities, and substrate mapping. Hydraulic analysis shall be used to assist in determining the final location, length, height, and structural design of HIP structures to meet HIP objectives. The HIP Plan shall include for each HIP a description of the proposed HIP, the current habitat suitability, the

limiting factors for specific flow regimes, a preliminary assessment of feasibility, and any potential constraints.

O. Lower River Fisheries Survey

i. No later than September 1, 2019, the Licensee shall submit to MDE for approval a plan for monitoring and protection of fish in the Lower River, specifically targeting the federally-endangered Maryland Darter (“Darter”) and the State-threatened Chesapeake Logperch (“Logperch”) population(s) (the “Fish Protection Plan”). The Fish Protection Plan shall (a) include monitoring by Licensee of the River tributaries’ fish populations and the lower riffle habitats of Deer Creek, Octoraro Creek, Broad Creek, and Conowingo Creek during spring, summer, and fall every five years; (b) provide for monitoring by electrofishing (conventional and trawl), snorkeling, and/or seine surveys, or otherwise as approved by DNR; and (c) require each sampling event in riverine habitat to include sampling technique(s) targeting Darter and Logperch.

ii. No later than September 1 of each year during the Term after 2019, the Licensee shall submit to MDE a comprehensive fisheries report including (a) analysis of fish population trends and correlations with abiotic data, if available, based on data obtained through implementation of the Fish Protection Plan; and (b) the Licensee’s recommendations for continued protection and enhancement of the fish populations below the Dam and statistical methodologies used to estimate sample size and/or extinction probabilities.

iii. No later than September 1 of 2024, 2029, 2034, 2039, 2044, 2049, and 2054, the Licensee shall submit to MDE for approval proposed improvements to the Fish Protection Plan (each, an “FPP Update”).

P. Spillway Modifications/Fish Stranding Minimization

No later than September 1, 2019, the Licensee shall submit to MDE for approval a plan for modifying the spillway Tailrace and/or modifying operational flow practices at the Project to reduce the numbers of rare, threatened, or endangered fish species stranded by Project operations (the “Stranding Minimization Plan”). If the Stranding Minimization Plan includes physical alterations in the spillway tailrace area, the Licensee shall include proposed methods to excavate new exit channels and/or the fill the designated isolated pools. If the Stranding Minimization Plan includes newly constructed exit channels, such new exit channels shall direct fish and other aquatic species towards the River’s thalweg and shall be designed to prevent fish from avoiding the proposed channel exit to the Tailrace.

Q. General Requirements and Conditions

i. Other Authorizations. This Certification does not relieve the Licensee of the responsibility to obtain any other Authorizations related to the Project.

ii. Compliance with WQS / No Unauthorized Discharge or Other Work: The Licensee shall meet all applicable WQS including designated and achieved uses associated with the operations of and discharge from the Project. Except as specifically set forth herein (if at

all), this Certification does not authorize the discharge of any pollutants. The Licensee shall not discharge any waste or wastewater from the Project, unless specifically authorized by MDE. This Certification does not authorize any work to occur in waters of the State, including any dredging or the construction or placing of any physical structures, facilities, fill, or debris or the undertaking of related activities in any waters of the State.

iii. Civil and Criminal Liability: In issuing this Certification, MDE does not waive or surrender any right to proceed in administrative, civil, or criminal action for any violations of any Law occurring before issuance of this Certification. Nothing in this Certification shall be constructed to preclude the institution of any legal action for any reason or relieve the Licensee from any civil or criminal responsibilities, liabilities, or penalties for violation of any Law, including the Environmental Article and the Clean Water Act.

iv. Penalties for Noncompliance with Law and Violations of Certification: The Licensee shall comply at all times with the provisions, requirements, and conditions of this Certification, the Environment Article, the Clean Water Act, and all other applicable Laws and Authorizations. MDE may seek criminal, civil, and administrative penalties to the full extent provided by law for any violations of the provisions, requirements, and conditions set forth in this Certification, or for noncompliance with the Environment Article, the Clean Water Act, or other applicable Laws and Authorizations.

v. Record Keeping: All records and information resulting from the monitoring, sampling, record keeping, inspection, and reporting activities required by this Certification shall be retained during the Term, plus 5 years. This period shall be extended automatically during the course of litigation, or when requested by MDE. For any measurements or sampling taken to satisfy the requirements of this Certification, the Licensee shall record (a) the exact place, date, and time of sampling or measurement; (b) the person(s) who performed the sampling or measurement; (c) the dates and times the analyses were performed; (d) the person(s) who performed the analyses; (e) the analytical techniques or methods used; and (f) the results of all required analyses. The sampling and analytical methods used to shall conform to procedures for the analysis of pollutants as identified in 40 CFR Part 136 - "Guidelines Establishing Test Procedures for the Analysis of Pollutants" unless otherwise specified by MDE in writing.

vi. Right of Entry: In addition to any other right of entry provided for by law, MDE, or its authorized representatives, shall have the right to enter at reasonable times the premises or property that is the subject of this Certification (including the Reservoir and all land within Project boundaries) or where any records are required to be kept under the provisions, requirements, and conditions of this Certification. This right of entry shall include the right to:

- a. Access and copy, at reasonable times, any records that are required to be kept under the provisions, requirements, and conditions of this Certification;
- b. Inspect, at reasonable times, any monitoring equipment or monitoring method required in this Certification;
- c. Inspect, at reasonable times, any discharge facilities subject to this Certification;

- d. Conduct sampling, at reasonable times, of any discharge or of the water column in the River or Reservoir;
- e. Take soil or sediment borings or core samples, at reasonable times, in the bed of the River or the Reservoir; and
- f. Take photographs.

vii. Duty to Provide Information: The Licensee shall submit to MDE, within the time frame stipulated by MDE, any information that MDE may require to determine compliance with this Certification. The Licensee shall also submit to MDE, upon request, copies of any records required to be kept by this Certification. When the Licensee is required to submit to any other federal or State resource agencies any reports that relate to the Project, the Licensee shall also submit a copy to MDE. Subject to the Maryland Public Information Act, all information submitted to MDE or collected as a condition of this Certification may be made publicly available.

viii. Property Rights: The issuance of this Certification does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor does it authorize any infringement of federal, State, or local Laws.

ix. Notice / Reporting of Noncompliance: Unless MDE provides different instructions in writing from time to time, any notice or other submission due to MDE under this Certification shall be provided in writing to:

Maryland Department of the Environment
Water and Science Administration
1800 Washington Boulevard
Baltimore, Maryland 21230

For any violations of the provisions, requirements, or conditions of this Certification, the Licensee shall promptly notify MDE by telephone within twenty four (24) hours of discovery of the violation, at 410-537-3510. In addition, within five (5) days, Licensee shall provide MDE with the following information in writing:

- a. A description of the violation, including the date, time, location, and estimated discharge volume (if applicable), and impact on receiving water;
- b. The cause of the violation, to the extent known;
- c. The anticipated time the cause of the violation is expected to continue, or, if the condition has been corrected, the duration of the period of the violation;
- d. Steps taken by the Licensee to eliminate or correct the violation;
- e. Steps planned or implemented by the Licensee to prevent the recurrence of the violation; and

- f. A description of the Licensee's accelerated or additional monitoring to determine the nature of any impact or harm caused by the violation.

Any notice or other submission due under this Certification to any governmental agency other than MDE shall be provided in writing to such agency in accordance such agency's written instructions from time to time.

x. Web Portal: The Licensee shall maintain at all times during the Term a web site or page specifically designed to provide the public with access to the information contemplated by Section 2.C.vii (the "Web Portal").

xi. Annual Reporting: The Licensee shall submit annual reports to MDE by September 1 of each calendar year following the issuance of this Certification and shall contemporaneously post such reports on the Web Portal. The annual reports shall summarize all work performed by the Licensee to comply with the provisions, requirements, and conditions of this Certification, and shall be in a format approved by MDE.

xii. No Waivers: MDE's failure to enforce any provision, requirement, or condition of this Certification shall not constitute a waiver of MDE's right to enforce any such provision, requirement, or condition, or otherwise relieve the Licensee from compliance with any obligations imposed by this Certification.

xiii. Additional Monitoring: The Licensee shall undertake additional monitoring, studies, or other measures relating to compliance with WQS including designated and achieved uses if MDE determines that there is a likelihood that any violations of WQS including designated and achieved uses have occurred or may occur.

xiv. Transfer: The Licensee shall notify MDE in writing upon transferring property ownership or responsibility for compliance with these conditions to another person. The new owner/operator shall request in writing transfer of this Certification to its name.

xv. Severability: The provisions of this Certification are severable. If any provision of this Certification is held invalid for any reason, the remaining provisions shall remain in full force and effect. If the application of any provision of this Certification is held invalid, its application to other circumstances must not be affected. In the event any provision of this Certification is held invalid, and the Department determines that any applicable effluent limitation, other limitations, or water quality standards or requirements issued or approved under Sections 301, 302, 303, 306, and 307 of the Clean Water Act or applicable State Law will not be met (including the failure to sustain a designated or achieved use) or that State or federal Law will be violated, or that further conditions are necessary to assure compliance, the Department may reevaluate and modify this Certification in accordance with Section 7.Q.xvii to include additional conditions necessary to assurance compliance with all such limitations, standards, or requirements.

xvi. No Third Party Beneficiaries: No provisions of this Certification are intended, nor will be interpreted, to provide or create any third party beneficiary rights. No third party shall have any legally enforceable rights, claims, or benefits under this Certification as to the Department, nor shall forbearance to enforce any term of this Certification by the Department be construed as creating any rights, claims, or benefits for any third party. No third party shall have any rights to enforce the terms of this Certification against the Licensee except as may be expressly provided by federal law, including the citizen suit provisions of the Clean Water Act. This Certification does not affect and is not intended to influence any third party's rights to independently investigate, evaluate, respond to, and file claims regarding any impacts from groundwater or surface water pollution.

xvii. Adaptive Management: This Certification may be re-opened to be modified in order to comply with any applicable effluent limitation, other limitations, or water quality standards or requirements issued or approved under Sections 301, 302, 303, 306, and 307 of the Clean Water Act or applicable State law if the limitation, standard, or requirement so issued or approved contains different conditions or is otherwise more stringent than any requirements of this Certification. If MDE determines that any applicable effluent limitation, other limitations, or water quality standards or requirements issued or approved under Sections 301, 302, 303, 306, and 307 of the Clean Water Act or applicable State law are not being met (including the failure to sustain a designated or achieved use) or that State or federal law are being violated, or that further conditions are necessary to assure compliance, MDE may reevaluate and modify this Certification to include requirements or conditions necessary to assure compliance with all such limitations, standards, or requirements. This includes:

- a. Additional requirements or conditions are necessary to address adverse or potentially adverse Project effects on water quality or designated or achieved uses that did not exist or were not reasonably apparent when this Certification was issued;
- b. There is a change in the Project or its operations that was not contemplated by this Certification that might adversely affect water quality or designated or achieved uses;
- c. The re-licensing of Holtwood and/or Safe Harbor, as well as any changes associated with Muddy Run's FERC license or the Section 401 water quality certification for Muddy Run, requires alignment of flow, fish passage, sediment, nitrogen, and phosphorus-related conditions in this Certification;
- d. Future TMDLs or modifications to existing TMDLs (not otherwise addressed in this Certification) identify impairments that justify additional conditions in order to ensure that WQS including designated and achieved uses are met over the Term;
- e. Revised conditions related to trap and transport credits for fish passage are necessary based on review in subsequent years of the federal license of whether numeric targets for the number of Shad upstream of the York Haven Dam are being met;


- f. MDE obtains any information providing a sound, science-based rationale for modifying any Plans or any requirements or conditions in this Certification, including information pertaining to climate change; or
- g. Any typographical error is found in this Certification.

Any modified conditions of this Certification shall, so long as it is in effect, become a condition of any federal Authorization that is hereafter issued for the Project, and MDE may seek, in accordance with applicable Law, to have any modified Certification condition incorporated into any existing federal Authorization for the Project.

xviii. Reimbursement of Oversight Costs: The Licensee shall reimburse MDE and DNR for the reasonable and actual costs incurred by MDE, DNR and their contractors in connection with the direct administration and oversight of Licensee's compliance with this Certification, including any costs for conducting environment health monitoring or testing, collecting and analyzing soil samples, surface water samples, or groundwater samples, or reviewing any data, plans or information submitted by the Licensee. The maximum amount of costs for which Licensee shall be required to reimburse MDE pursuant to this Section 7.Q.xviii shall be Two Hundred Fifty Thousand (\$250,000) per year, and the maximum amount of costs for which Licensee shall be required to reimburse DNR pursuant to this Section 7.Q.xviii shall be Two Hundred Fifty Thousand (\$250,000) per year *provided*, that each of the foregoing amounts shall be adjusted for inflation after the date of this Certification on July 1, 2019 and on July 1 of each year thereafter, based on the cumulative change in the CPI.

xix. Final Decision; Appeal Rights: This is a final decision on the Application. Any person aggrieved by the Department's decision to issue this Certification may appeal such decision in accordance with COMAR 26.08.02.10F(4). A request for appeal shall be filed with the Department within 30 days of publication of the final decision, and specify in writing (a) the reason why the final decision should be reconsidered; and (b) a detailed description of the requestor's specific legal right, duty, privilege, or interest which may be adversely affected by the Department's final decision. A request for appeal shall be submitted to: Secretary of the Environment, Maryland Department of the Environment, 1800 Washington Boulevard, Baltimore, MD 21230. After issuance of notice of the Department's decision on the request for reconsideration, a contested case hearing shall be available in accordance with the applicable provisions of State Government Article, § 10-201, et seq., Annotated Code of Maryland. Any request for an appeal does not stay the effectiveness of this Certification.

DATED this 27th day of April, 2018.



D. Lee Currey
Director
Water and Science Administration
Maryland Department of the Environment
State of Maryland

ATTACHMENT #1
To Clean Water Act Section 401 Certification For the Conowingo Hydroelectric Project
FERC Project No. P-405 / MDE WSA Application No. 17-WQC-02

MDE Fish Passage Improvement Plan (“MDE-FPIP”)

This MDE-FPIP is based on the requirements of DOI’s Modified Prescription for Fishways Pursuant to Section 18 of the Federal Power Act for the Project, dated June 8, 2016 (the “Prescription”), which shall be authoritative guidance for purposes of interpreting this MDE-FPIP and defining the Licensee’s obligations hereunder. Notwithstanding the foregoing, in the event of any conflict between this MDE-FPIP and the Prescription, this MDE-FPIP shall govern and control.

Without limiting the generality of Section 2.C.ii of the Certification, in all cases where this MDE-FPIP requires the Licensee to consult with or make any submission to MDE, the Licensee shall also consult with, or make such submission to DNR, unless otherwise specified.

1. Initial Fishlift Capacity

The Licensee shall provide a fish lift capacity of at least 7 million pounds of fish per season immediately after issuance of the New License. Two 6,500-gallon hoppers sharing the same holding pool, with a cycle time of 15 minutes, provides capacity to move 7 million pounds of fish in a single season. Based on projected numbers of a successful Shad restoration using the population model, a fish lift capacity of 7 million pounds of fish should provide safe passage at the Project for approximately half of the Term (assuming that the gizzard shad population does not grow larger than 4.4 million fish). For details on calculating fish lift capacity, refer to Appendix A to this MDE-FPIP.

2. Final Potential Fishlift Capacity

The Licensee shall construct sufficient fishlift capacity during the Term to ensure that as populations of Shad and Herring grow in the system, that fishlift capacity is increased as necessary to ensure that upstream passage is not impeded by undersized fishlift capacity preventing the attainment of the restoration objectives. MDE recognizes the potential lack of capacity during the later years of Shad and Herring restoration, and will re-open this Certification to address this issue at a later date if fishway capacity appears to be a limiting factor to population restoration, as reflected in declining upstream fish passage efficiency due to lack of fishway capacity.

3. Design Flows for Fishways/Fishlifts

The Licensee shall design new fishlifts to ensure operation under River flows in the range of 6,330 cfs to 143,000 cfs. However, the Licensee shall not be required to operate the fishlifts at flows greater than 113,000 cfs unless data available at the time demonstrates that operation of fishlifts at flows greater than 113,000 cfs is necessary to achieve the target efficiency.

Furthermore, the fishlifts shall be designed with sufficient freeboard (or other protection) to minimize damage from River flows of up to the 50-year return interval.

4. Efficiency Criteria

The Licensee shall meet the SRAFRC (2010, 2013) and the USFWS (2015b) upstream and downstream passage efficiency criteria for the River basin that are the basis for the Department of the Interior (DOI) 2016 Modified Fishway Prescription (and the requirements of this Certification). MDE defines upstream fish passage efficiency as the proportion of the fish in the Tailwaters that successfully move through the fishlift and continue upstream migrations, calculated as a percentage. Downstream fish passage efficiency is the proportion of the fish that approach the upstream side of the Project and survive unharmed as they pass the Project and continue downstream migrations. Definitions for certain fish passage terms used in this MDE-FPIP are provided in Section 18 of this MDE-FPIP. Where no numeric efficiency criteria are set, MDE's goal is to minimize Project impacts to migratory fish populations, with a goal of 100 percent passage and the understanding that no project is likely to fully achieve that goal despite application of the best available technology. Where MDE, based on DNR analysis, has information or modeling indicating that restoration may be achieved with less than 100 percent passage, MDE has adopted numeric targets that will achieve restoration, and measures to reach those targets.

4.1 Criteria for Upstream Shad Passage Efficiency

The Licensee shall operate the Project to achieve the upstream passage efficiency criterion of passing 85 percent of all adult Shad that enter the Tailwaters ("Target Efficiency"). The Licensee can receive additional credit toward achieving the upstream passage efficiency criterion for adult Shad by trapping at the Project and transporting Shad to upstream of York Haven Dam and thus avoiding upstream passage impediments at the intervening hydroelectric projects on the River (see Section 13 of this MDE-FPIP).

4.2 Criteria for Downstream Shad Passage Efficiency

The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 80 percent of the adult Shad moving downstream past the Dam. The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 95 percent of the juvenile Shad moving downstream past the Dam.

4.3 Criteria for Upstream Herring Passage Efficiency

The Licensee shall operate the Project to provide safe, timely and effective upstream migration for adult Herring that approach the Tailwaters. MDE reserves the right to develop numerical criteria for upstream Herring passage efficiency in the future when additional information about Herring populations becomes available and re-open this Certification in the future to establish required numeric targets for upstream passage efficiency for Herring. Any needed change in fishlift requirements resulting from such new targets is not provided for in this Section 4 and would also be considered a basis for re-opening the Certification.

4.4 Criteria for Downstream Herring Passage Efficiency

The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 80 percent of the adult Herring moving downstream past the Dam. The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 95 percent of the juvenile Herring moving downstream past the Dam.

5. Seasonal Implementation of Fish Passage

5.1 The Licensee shall operate a fishlift for upstream passage of anadromous fish daily during the Shad and Herring upstream Migration Period, as set forth in Appendix D to this MDE-FPIP. The Licensee shall operate the fish lift(s) daily during the upstream Migration Period, and begin releasing attraction flows at least one hour prior to the start of daily lift operations. The fish lift(s) will operate at the following times during the Migration Period: (1) in March, from 7 a.m. to 7 p.m.; (2) in April, from 6:30 a.m. to 7.30 p.m.; and (3) in May and June from 6:00 a.m. to 8:00 p.m.

5.2 The Licensee shall ensure prior to the start of the Migration Periods that all mechanical elements of the fishlifts are working properly. The Licensee shall repair, maintain, and test fishlifts as necessary in advance of the migration period, in accordance with the Fishlift Operation and Maintenance Plan (“FOMP”) so as to begin operations when required.

5.3 The Licensee shall maintain and operate fishlifts to maximize fish passage effectiveness throughout the upstream and downstream migration periods, as set forth in Appendix D to this MDE-FPIP.

6. Fishlift Operation and Maintenance Plan

6.1 The Licensee shall develop and submit a FOMP to MDE approval. The Licensee shall keep the FOMP updated on an annual basis, to reflect any changes in fishlift operation and maintenance planned for the year. If MDE requests a modification of the FOMP, the Licensee shall respond to the requested modification within 30 days of the request by filing a written response with MDE.¹ Any modifications to the FOMP by the Licensee shall require approval by MDE. The FOMP shall include:

- (a) Schedules for routine maintenance, pre-season testing, and the procedures for routine fishlift operations, including seasonal and daily periods of operation, and associated Dam and powerhouse operational measures needed for proper fishlift operation;
- (b) Details of how the Project shall be operated during the migration season to provide for adequate fish passage conditions, including:
 - (i) Pre-season preparation and testing;
 - (ii) sequence of turbine start-up and operation under various flow

¹ Requested modifications to the FOMP will not include changes to turbine operations. Any modifications to turbine operations shall be implemented only pursuant to Section 8.

- regimes to enhance fishlift operation and effectiveness;
- (iii) debris management at the fishway entrance, guidance channels, and the exit; and
- (iv) plant operations to provide near- and far-field attraction flows required for the fishlift zone of passage in the tailrace;
- (c) Trap and transport logistics plan and design plans for west and east fish lift modifications needed for trap and transport, including provisions for planning trap and transport logistics so as to avoid, to the extent possible, trapping a population unrepresentative of the migrating population as a whole.
- (d) Procedures for removing invasives (see Attachment #3 for invasive species requirements) and sturgeon handling;
- (e) Standard operating procedures for monitoring and enumerating fish passage by species;
- (f) Standard operating procedures for collecting biological samples from target species to assess restoration efforts;
- (g) Standard operating procedures for monitoring and reporting operations that affect fish passage;
- (h) Standard operating procedures in case of emergencies and Project outages to first, avoid, and second, minimize, potential negative impacts on fishway operations and the effectiveness of upstream and downstream passage for target species; and
- (i) Plans for post-season maintenance, protection, and winterizing the fish lifts and Eel passage facilities.

6.2 The Licensee shall provide written documentation to MDE that all fishlift operational personnel have reviewed and understand the FOMP and it shall be signed by the operations manager of the Project. Copies of the approved FOMP and any modifications shall be provided to MDE on an annual basis.

6.3 By December 31 of each year, the Licensee shall provide an annual report to MDE detailing: the implementation of the FOMP, including any deviations from the FOMP and a process to prevent those deviations in the future; any proposed modifications to the FOMP, or in the case of emergencies or Project outages, the steps taken by the Licensee to minimize adverse effects on fisheries including any proposed modifications to those steps to further enhance their effectiveness in the future; and operational data for both fishlifts and the Project to allow MDE and others identified by MDE to examine correlations between particular operational patterns and successful or unsuccessful fishlift operation; and to confirm, once an operational regime with known effectiveness is settled upon, that the Project continues to operate under that regime. MDE understands that details of operation constitute confidential business information, and agrees to protect them from disclosure as such to the extent it is able to do so by law. The annual report shall also include:

- (a) Description of routine maintenance as well as repairs made to the fishways or Eel passage facilities during the previous fish passage season;
- (b) Average daily flows at the Marietta Gage;

- (c) Daily water temperature and DO readings in the fish lift and Tailwater areas;
- (d) Hourly individual turbine unit operations and discharge, hourly total discharge from the powerhouse, hourly discharge over the spillway, and hourly passage counts of all fish species at each lifted hopper;
- (e) Index for every lift of each hopper's "fullness" through visual observations and shall be developed in consultation with MDE; provided, that if technology becomes available to quantify the bucket "fullness", then after a written request from MDE, the Licensee shall incorporate this technology;
- (f) Thirty-minute recordings of total flow discharging from behind the hopper, total flow discharging from the attraction water supply diffuser, water surface elevation immediately upstream from the entrance gates, water surface elevation at the Tailwaters, elevation to the crest of the entrance weir gates, and any irregularities such as the identification of a visible boil in the zone over the floor diffusers;
- (g) Number of fish by species trapped and transported, including date, time, and location of release; and
- (h) Daily collection of biological information from adult Shad, gizzard shad, Herring, or other species as designated by MDE to include sex ratio, condition, length, weight, and age.

6.4 In addition to the annual report, the data for daily flows, water quality, Project operations, fishlift operations and fish passage as described above shall be recorded in a database during the fish passage season and MDE and its designees shall be provided open access to that database. Data shall be entered into the database no later than one week after collection. These data shall be used to assess the impacts of River conditions and hydropower operations on successful fish passage through the lifts, with the goal of achieving a better diagnosis of potential fish passage issues at the Project.

6.5 By January 31 of each year, the Licensee shall consult with MDE to discuss the FOMP. This meeting shall occur no later than January 31 of each year unless the Licensee and MDE agree on a different date. At this annual meeting the participants shall discuss the fish passage results from the previous year, review regulatory requirements for fish lift operations, and discuss any modification or testing the Licensee shall conduct during the upcoming season.

7. Sequencing of Upstream Fish Passage Construction and Implementation

Timely construction, operation, and maintenance of fishlifts is necessary to ensure their effectiveness and to achieve restoration goals. Therefore, the Licensee shall: (1) notify, and (2) obtain approval from MDE for any extension of time to comply with conditions MDE has required.

7.1 *Trap and Transport of Shad and Herring*

The Licensee shall trap and transport Shad and Herring to areas upstream of York Haven Dam annually. The number of Shad and Herring trapped and transported annually will be

up to 80 percent of the number of each species captured in the fish lifts up to a maximum of 100,000 of each species annually. Trap and transport operations shall continue until the Licensee achieves a measured 85 percent upstream passage efficiency for Shad at the Project without reliance on the trap and truck credit as provided for in Section 13 of this MDE-FPIP.

7.2 Initial Construction

Unless otherwise stated, the Licensee shall implement the requirements of Section 10.1 of this MDE-FPIP by September 1, 2021. Construction shall be conducted in a way as to allow for trap and transport operations as well as volitional passage at the EFL to continue uninterrupted during this time period. A fish trap shall be constructed in the EFL no later than September 1, 2019. It shall be capable of trapping and holding target fish while continuing to pass fish. Safe and effective transfer of fish from the trap to the tailrace is required. The design must be approved by MDE prior to construction.

7.3 Operation in the First Passage Season after License Issuance

No later than September 1, 2019, trap and transport operations from the EFL and WFL shall begin. A total of 80 percent of the run, up to 100,000 Shad and 100,000 Herring per year shall be trapped and transported to the mainstem River upstream of York Haven.

8. Efficiency Testing and Triggering of Subsequent Modifications

8.1 No later than September 1, 2023, the Licensee shall begin the "Initial Efficiency Test" of fish passage at the Project. The Licensee shall conduct the Initial Efficiency Test as defined in Section 12.2 of this MDE-FPIP in order to evaluate passage performance relative to upstream efficiency criteria for Shad and Herring as described in Section 4 of this MDE-FPIP. Gizzard shad or other designated species (to be designated by MDE with input from DNR) shall be included in all efficiency tests to understand how they affect efficiency for Shad and Herring. In the 5th year after the year in which the New License is issued, the Licensee shall also assess mortality of Shad during the trap and transport process.

8.2 If at the end of the Initial Efficiency Test, the combined results of the three-year study (the combination of measured efficiency of the Initial Efficiency Test and the "Trap and Transport Credit" (as described in Section 13 of this MDE-FPIP) resulting in an "Adjusted Efficiency") meet the Target Efficiency of 85 percent for upstream passage of Shad, the Licensee shall operate the Project using the FOMP implemented during the Initial Efficiency Test. The Licensee shall then conduct a two-year "Periodic Efficiency Test" as defined in Section 12.2 of this MDE-FPIP in every 5th year thereafter to ensure that the upstream-prescribed efficiency criterion continues to be met through the Term.²

8.3 If at the end of the Initial Efficiency Test or after any Periodic Efficiency Test thereafter during the Term, or after any subsequent "Post-Modification Efficiency Test" as defined

² At the Licensee's election, and with MDE concurrence, the Periodic Efficiency Test may be extended an additional one year. Only after the efficiency tests are completed will the Licensee be required to propose, as may be necessary, a course of action to achieve the Target Efficiency.

in Section 12.2 of this MDE-FPIP, the study results indicate that the Licensee is not meeting the required Adjusted Efficiency, the Licensee shall conduct an evaluation of the radio telemetry data and any other data available to MDE and/or the Licensee to determine why passage efficiency is inadequate. Concurrent with the submission of the final report from an efficiency study, the Licensee shall propose a course of action most likely to achieve the Target Efficiency. MDE has designated a tiered list of options and the types of passage or capacity problems which the tiers may address. If the reason for not achieving the Target Efficiency is insufficient fishlift attraction, then the Licensee shall follow the actions in Section 10.2 of this MDE-FPIP.

If the fish lift capacity is insufficient then the Licensee shall follow the actions in Section 11 of this MDE-FPIP. In the event that both fishlift attraction and fish lift capacity are limiting factors to achieving the Target Efficiency, the Licensee shall address items listed under both Sections 10.2 and 11 of this MDE-FPIP, but only to the extent both attraction and capacity measures are necessary to achieve the required Target Efficiency and alleviate over-capacity. The list of measures in Sections 10.2 and 11 of this MDE-FPIP is not exclusive and does not preclude MDE or the Licensee from identifying and proposing other measures commensurate with the required level of improvement and corresponding tier. MDE shall react to the Licensee's proposal for improving fish passage efficiency within 90 days of receipt. It may:

- (a) Say nothing, in which case the Licensee shall proceed with its proposed course of action;
- (b) Agree affirmatively with the Licensee's proposed course of action, in which case the Licensee shall proceed;
- (c) Propose a different option, not on the tiered list of options, which the Licensee shall proceed with if it agrees;
- (d) Require, instead, that the Licensee implement an option or options from the appropriate (or lower numbered) tier to address each problem. MDE will choose that option (s) it deems most likely to achieve the *Target Efficiency*. MDE may select an option from a higher-numbered tier only if all options from an appropriate or lower-numbered tier have been implemented. If two or more options appear equally likely to achieve the efficiency criterion, MDE will present the Licensee with the choice, and the Licensee may proceed with whichever it prefers. MDE shall explain, in writing, its reasons for finding that its choice(s) is more likely than the Licensee's to lead to the desired passage efficiency. The Licensee shall then proceed with the selected course of action.

9. General construction requirements.

All functional (i.e., 30 percent, 60 percent, and 90 percent) and final design plans, operation and maintenance plans, construction schedules, and hydraulic model studies for the new fishlifts or modifications to existing fishlifts described herein shall be submitted to MDE for approval. The planning and design process for structures shall generally include computational fluid dynamics (CFD) modeling prior to construction and post-construction shakedown and testing to confirm modeling.

MDE, DNR, and USFWS shall be consulted during the design and construction of the fishlifts and MDE must approve all plans in writing prior to construction initiation. Upon a decision to build or modify, the Licensee shall meet with MDE, DNR, and USFWS to develop detailed construction plans and schedules, which shall be submitted for MDE approval no later than March 1, 2019, and thereafter, by January 31 of each construction year for approval by MDE. The detailed construction schedules shall be designed to minimize interruption of the fishlift operations and, to the extent possible, fishlift operation interruptions shall be scheduled during the month of June.

10. Fish Passage Facilities

10.1 Initial Construction Items

(a) *East Fish Lift Modifications.* The Licensee shall modify the EFL facility to provide 900 cfs attraction flow to the EFL. If the attraction flow cannot be provided within the current EFL structure without exceeding USFWS design specifications, flow in addition to internal EFL flow will be provided to achieve a total of 900 cfs. Modifications to the EFL facility will include replacing spillway gates A & B, replacing the crowder system, addressing structural vibration issues, replacing diffuser gates A and B, replacing the control system, and upgrading the electrical system to allow for a 15 minute lift cycle.

(b) *Replace the current 3,300-gallon hopper with two 6,500-gallon hoppers at the EFL.* The Licensee shall remove the current hopper and install two 6,500-gallon hoppers within the existing superstructure of the EFL. One hopper will replace the current 3,300-gallon hopper and the second hopper will be located immediately upstream from the current location of the existing EFL hopper (see Figure 10 from the DOI Modified Fishway Prescription of June 2016 showing the conceptual drawing of proposed modifications to the EFL). Access to both hoppers will be provided by the current entrance gates (A, B, and C) and the hoppers will share the same holding pool.

(c) *Trap and Transport Facilities at the EFL.* The Licensee shall reduce cycle time at each hopper at the EFL to be able to lift fish four times per hour and complete modifications to the EFL structure to allow for trapping and sorting fish at the EFL facility and transporting them to the western side of the Dam to a truck for transport upstream. Modifications to the EFL shall include two new sorting tanks; a loading tank; and a by-rail truck and forklift, or functionally similar equipment, to facilitate movement of Shad from sorting tanks at the EFL to the west shore. These improvements shall be accomplished without losing a season of the passage provided by the EFL.

(d) *Trap and Transport Facilities at the WFL.* WFL modifications shall be made to facilitate trap and transport including: decreasing lift cycle time by replacing the crowder linkage system and raising the elevation of the sorting tank(s), and providing a mechanism to allow for direct sluicing of fish into tanks mounted on the transport vehicle. These initial improvements shall be accomplished without losing a season of the passage provided by the EFL or trap and transport from the WFL.

(e) Provide a Zone of Passage (ZOP) to the Fish Passage Facilities. The Licensee shall construct and maintain structures, to provide Shad and Herring a ZOP (i.e., route of passage) as described in this Section 10.1(e). In advance of any ZOP development and/or construction, MDE and the Licensee will review CFD modeling results from the tailrace. The Licensee shall run the model under a predetermined number of structures arrangements (e.g., different angles, different spacing between the weirs, different weir slopes). In consultation with MDE, the Licensee shall choose to construct the configuration of structures that provides the most conducive hydraulic conditions for fish passage of Herring. The area to be considered for potential ZOP improvements includes approximately 2,500 feet on the west bank and 3,500 feet on the east side of Rowland Island. Based on CFD modeling results that analyze discharge velocities and turbulence, the Licensee shall provide stone weirs, and/or other suitable alternatives or measures that provide a contiguous ZOP from the southern tip of Rowland Island to one or both of the lifts. The Licensee shall install up to ten stone weirs, with the option of considering other configurations for structures. Model results will guide the placement and formation of these structures to provide for the hydraulic conditions necessary for the weakest swimmers (Herring) to reach the lifts. Specifically, the ZOP must be designed to maintain instantaneous velocities below 3 feet per second, separated only by brief regions of higher velocity that Herring may traverse in seconds at burst speeds up to 6 feet per second, over the full range of operational flows for the EFL, and in all generation scenarios. After ZOP construction is completed, the Licensee shall assess the ZOP for upstream migrating Herring under the full range of the current fish passage design flows (i.e., up to 113,000 cfs of River flow). These structures shall also minimize or eliminate sheltering areas for predators. The ZOP shall be subject to approval by MDE.

10.2 Improving Attraction Efficiency

Presented below is a list of physical and operational modifications to the Project intended to address observed deficiencies in fishlift attraction efficiency. The tiered process for improving attraction efficiency is based on passage efficiency during the most recent efficiency test. The items included in the different tiers were developed to be commensurate with the degree of shortfall from the *Target Efficiency*. If, based on the *Adjusted Efficiency* of the current test, all appropriate options from the corresponding tier, including any option proposed by the Licensee and approved by MDE have been exhausted, the items from the next highest numbered tier may be required, regardless of the current Project passage efficiency. More than one item from a tier may be completed at one time depending on the degree of the *Adjusted Efficiency* shortfall.

(a) Tier I (Adjusted Efficiency 70%-85%). In the year following any failure by the Licensee to reach the *Target Efficiency* due to inadequate fishway attraction, the Licensee shall implement one or more of the modifications to Project operations and facilities described in this Section 10.2(a).

(i) Correct any Technical Operational Problems and/or Implement Internal Modifications. The Licensee shall correct any technical operational problems that may have been detected during the fish passage season and/or implement internal modifications to the WFL and/or EFL (e.g., energy dissipation, hydraulic attraction).

(ii) *Implementation of preferential turbine operating schemes.* The Licensee shall develop a turbine operation scheme that can range from simply first on/last off to modification of specific Francis and Kaplan unit operation to ensure that fish are able to successfully locate and access the fish lift entrances.

(iii) *Increase attraction flow at the EFL.* The Licensee shall construct an alternative attraction water structure as part of the EFL which shall be constructed to allow more than 1,000 cfs during the fish and Eel migration season and be adaptable for fish and Eel attraction and maintain velocities at or below USFWS criteria. The alternative attraction water structure and velocities must use field verification for the target species.

(b) *Tier II (Adjusted Efficiency 55%-69%).* Within 2 years following any failure to meet the *Target Efficiency*, the Licensee may implement either one of the modifications to the Project facilities described in this Section 10.2(b) to reach upstream passage efficiency.³

(i) *Relocate EFL Entrances A & B.* If the CFD modeling results indicate modifications to Entrances A & B will improve guidance to and accessibility of the lift entrances, then the Licensee shall extend the entrance channel at entrance A with two 45-degree turns in the fish passage facility channel, so as to discharge into the area behind the catwalk piers and upstream from the Kaplan turbine discharge/boil. The attraction flow should be effective along the catwalk and through the space between the piers. The Licensee shall also modify the existing entrance B so that the centerline of the discharge plume will be at a 45-degree angle to the River flow.

(ii) *Construct new Entrances with a separate crowder and holding pool.* No later than December 31, 2033, the Licensee shall build new entrances with a separate crowder and holding pool (Figure 10). The hopper will be accessed from the new entrance and through a proposed collection gallery that will span the full length of the Kaplan turbine section of the powerhouse. The new entrances and the collection gallery are intended to provide access to the EFL from the Francis turbine section of the powerhouse. The new collection gallery will be located against and along the powerhouse wall.

(c) *Tier III (Adjusted Efficiency less than 55%).* Following any failure by the Licensee to reach upstream passage efficiency, the Licensee may implement one or more of the modifications to Project operations and facilities described in this Section 10.2(c).

(i) *Construct an Auxiliary Water Supply (AWS) at the EFL.* The Licensee shall construct a new AWS stilling basin and system so the energy from up to 4,300 cfs

³ MDE may require relocation of Entrances A&B and, if the *Adjusted Efficiency* continues to be between 55%- 69%, Entrance D at a later point. But then, per Tier III (and consistent with the "not before" dates), may only require the AWS, not the WFL. Alternatively, MDE may require the relocation of Entrance A&B, and in subsequent cycles proceed to choose the WFL (again, consistent with the "not before" dates) if(a) the *Adjusted Efficiency* is below 55% and Entrance D has not been constructed or (b) the *Adjusted Efficiency* is between 55%- 69% and MDE determines that Entrance D is not likely to achieve the efficiency criterion.

can be dissipated and incorporated into effective attraction flows emanating from the multiple fish lift entrances.

(ii) *WFL Construction.* No later than December 31, 2043, the Licensee shall construct a new WFL (as described below, in parts 1-5) in the west corner of the powerhouse tailrace. The Licensee shall operate the new WFL as a Tailwater to headpond fish lift with a collection facility for fish sampling that could be used as a fish trap and transport facility. If MDE requires construction of the WFL for reasons of passage efficiency, it agrees not to subsequently require the EFL AWS stilling basin and system before 10 years after the completion of the WFL.

(A) WFL Construction, Part 1. The Licensee shall construct a facility that provides the capability of enumerating fish passage by species, allows for two independent trapping and holding facilities for biological sampling while continuing to pass fish, and that can also be used for trapping and transporting Shad and Herring with the potential for captured fish to be transported upstream of the York Haven Dam.

(B) WFL Construction, Part 2. The Licensee shall install two 6,500-gallon hoppers, with separate crowders, in the new WFL, capable of operating simultaneously.

(C) WFL Construction, Part 3. The Licensee shall construct the WFL to have the ability to provide up to 5 percent of hydraulic capacity of the Project (or up to 4,300 cfs) for attraction flow to the fishway entrance(s). During the design phase and during preconstruction, the Licensee shall conduct CFD modeling and other supporting analysis to develop appropriate fish lift entrance attraction flows, velocities, and hydraulic conditions. The Licensee shall operate the WFL to provide attraction flow of at least 2,600 cfs (3 percent of hydraulic capacity of the Project) during the Upstream Migration Period for Shad and Herring. With the goal of improving fish passage efficiency at the WFL following initial start-up of the new WFL, MDE may require the lift operator to modify operation of the fish lift, the allocation of flows through its AWS, and/or the total amount of flow being supplied to the WFL (up to a maximum of 4,300 cfs or 5 percent of the Project hydraulic capacity).

(D) WFL Construction, Part 4. The Licensee shall design and construct an AWS that meets science-based criteria for energy dissipation of the attraction flow while maintaining water quality standards.

(E) WFL Construction, Part 5. The Licensee shall conduct an assessment of the ZOP downstream of the WFL to ensure that it continues to be passable over the range of flows in which the WFL is operational.

11. Improving Fish Lift Capacity

Presented below are physical and operational modifications to the Project intended to address deficiencies in fish lift capacity. Implementation of modifications in the capacity tiers is independent of the implementation of similar items used to improve passage efficiency. Both

attraction and capacity improvements can be required simultaneously if deemed appropriate from the most recent study results and capacity calculations.

Capacity shall be deemed exceeded if daily capacity is exceeded more than 5 days in a passage season. If an index of fullness indicates that one hopper is consistently fuller than the other, capacity shall be prorated based on that index. Over the Term, depending on the length of the migratory run (as defined by the cumulative five percent to ninety-five percent) the number of days designated to define overcapacity may be changed by MDE in consultation with the Licensee.

11.1 Tier I (Adjusted Efficiency 70% — 85%)

Within 2 years following the Project having been deemed by MDE to have exceeded capacity, the Licensee shall submit to MDE for approval a plan to implement new additional entrances with a separate crowder and holding pool. The new hopper will be accessed from the new entrance and through a proposed collection gallery that will span the full length of the Kaplan turbine section of the powerhouse. The new entrances and the collection gallery are intended to provide access to the EFL from across the Kaplan section and the Francis turbine section of the powerhouse. The new collection gallery will be located against and along the powerhouse and shall be adaptive for fish including Eels. The new collection gallery shall be located against and along the powerhouse wall.

11.2 Tier II (Adjusted Efficiency less than 70%)

Within 3 years following any failure by the Licensee to reach upstream passage efficiency due to inadequate fishlift capacity, the Licensee shall submit to MDE for approval a plan to implement a new WFL (as described in Section 10.2(c)(ii) of this MDE-FPIP) in the west corner of the powerhouse tailrace. The Licensee will operate the new WFL as a Tailwater to headpond fish lift with a collection facility for fish sampling that could be used as a fish trap and transport facility. The WFL shall have a trap system with two independent holding facilities allowing passage while both traps are being operated.

12. Fish Passage Effectiveness Monitoring

Efficiency testing of both upstream and downstream fish passage, and determining mortality rates of Shad when using trap and transport are critical to evaluating the success of fish passage structures and operations, diagnosing problems, and determining both when modifications are needed and what modifications are likely to be effective. These measures are essential to ensuring the effectiveness of fishlifts over the Term, particularly in cases where the increasing size of fish populations as a result of improved upstream passage may also lower upstream fish passage efficiencies due to migrating fish crowding and exceeding daily or annual lift capacity, thus keeping some fish from successfully passing the Dam and limiting net effectiveness.

12.1 Fishway Effectiveness Monitoring Plan

The Licensee shall submit to MDE for approval a Fishway Effectiveness Monitoring Plan (“FEMP”) no later than March 1, 2019. The FEMP will contain the plans for the studies described in Sections 12.2 through 16 of this MDE-FPIP. If MDE requests a modification of the FEMP, the Licensee shall file a written response with MDE within 30 days. Any modifications to the FEMP by the Licensee will require approval by MDE prior to implementation.

The Licensee shall submit yearly interim study reports to MDE following the conclusion of each study year. The interim and final reports for upstream passage studies will be submitted to MDE by December 31st of each study year. The interim and final reports for downstream passage studies will be submitted to MDE by August 1 following each study year. The final study report will include results for each life stage and type of study conducted with a determination of the Licensee’s success or failure in achieving the passage efficiency criteria established in this Plan. In conjunction with submitting the final study report(s), the Licensee shall also provide electronic copies of all data collected from studies to MDE.

The Licensee shall consult with MDE to discuss the FEMP. This meeting will occur no later than January 31 each year unless the Licensee and MDE agree on a different date. At this annual meeting the participants shall discuss with the fish passage results from the previous year, review regulatory requirements for fish lift and Eel passage operations, and discuss any upcoming modification or testing the Licensee proposes for the upcoming fish passage season.

12.2 Initial Efficiency Test, Post-Modification Efficiency Tests, and Periodic Efficiency Tests for Upstream Passage of Shad and Herring

The *Initial Efficiency Test* and any *Post-Modification Efficiency Tests* will consist of a three-year fish tagging and monitoring study of Shad and Herring using radio telemetry, or other best tracking technology. If after two years the criteria cannot mathematically be obtained by a third year of study, the initial efficiency test will be concluded. The *Periodic Efficiency Tests* will consist of a two-year Shad-tagging study using the same techniques unless the Licensee elects, with MDE concurrence, to conduct an additional one year of study. The *Initial Efficiency Test* will begin in the 5th passage season after New License issuance. The *Post-Modification Efficiency Test* will begin in the first fish passage season immediately following any required modification implemented from the tiers. The *Periodic Efficiency Test* will be conducted on every 5th year after a previous study determines that the *Adjusted Efficiency* of the Project is achieving 85 percent passage efficiency for Shad. Early Periodic Efficiency Tests may be delayed by up to two years to coincide with the schedule for tests at Muddy Run agreed upon in the 2015 Settlement Agreement between USFWS and the Licensee.

These studies will use sufficient numbers of test fish to account for drop-back and other fish loss. These fish will be collected from a downstream location, and be representative of the migrating population as a whole. Specific details of the telemetry studies such as sample sizes, collection of and release location of tagged Shad and Herring, arrangement of telemetry receivers,

and appropriate statistical analyses shall be developed by the Licensee in conjunction with MDE and other resource agencies. The Licensee shall submit final study plans to MDE for approval prior to initiating any study.

13. Trap and Transport Credit for Shad

The Licensee shall receive additional credit toward the upstream passage efficiency criterion for adult Shad that are trapped and transported upstream of York Haven Dam. MDE will recognize the benefits to the species by giving credit towards the calculation of whether the efficiency criterion for upstream Shad passage is met, due to the value to restoration of avoiding the passage of impediments at the upstream hydroelectric projects. Details of the credit toward the efficiency criterion are provided in Appendix A to this MDE-FPIP. Part of the calculation of the credit toward efficiency criterion requires an estimate of the mortality associated with trap and transport operations. Beginning January 1, 2023, the Licensee shall work with MDE and other resource agencies to develop a one-year study to estimate the mortality of fish which are trapped and transported to areas upstream of York Haven Dam. Such a study will include assessment of immediate mortality (mortality occurring during transport) as well as delayed mortality (mortality occurring during some time period after release). The results of the study will be used to modify, as necessary, the mortality input utilized in the trap and truck credit. MDE adopts the Service's proposed methodology for this study as described in Appendix C to this MDE-FPIP; however the Licensee and MDE must reach agreement on the final methodology and final study design post-licensing.

14. Downstream Adult and Juvenile Shad and Herring Effectiveness Testing

The Licensee shall conduct downstream passage effectiveness studies of Shad and Herring in 2027 in coordination with MDE. As part of the FEMP for downstream passage, the Licensee shall evaluate both juvenile and adult life stages using a study protocol developed cooperatively with MDE to include a Reservoir route of passage study and an evaluation of passage survival. A route of passage study will be conducted to determine the routes chosen by downstream migrating fish through the Project under various generation conditions to determine if there are preferred routes of passage at the Dam and variations on survival through each of the routes. The route of passage study will be conducted for 2 years to account for inter-annual variation in flow conditions. The Licensee has the option to extend the route of passage study for an additional year.

If the above study is insufficient to determine survival, a one year separate and discrete passage study for both adult and juvenile Shad and Herring shall be conducted to estimate survival through the Kaplan and Francis turbines under best gate efficiency. This study will commence in the year following the completion of the above study. The effects of trauma due to changes in barometric pressure, such as the expansion and rupture of a fish's swim bladder, during turbine passage will be included as part of the turbine survival studies for all life stages when possible. Results of the studies will be used to determine through-Project survival (i.e. via spill, Francis turbines, Kaplan turbines, etc.), and immediate and latent mortality for each route to achieve the passage criteria. If Licensee is unable to achieve the efficiency criteria for

survival based on the results of the downstream studies, MDE may re-open the Certification to address this issue.

15. Fishway Inspections

The Licensee shall provide MDE personnel, DNR personnel, and other MDE-designated representatives, timely access to the fish passage facilities at the Project and to pertinent Project operational records for the purpose of inspecting the fishlifts to determine compliance with the MDE-FPIP.

16. Pre-License Actions Agreed to by the Licensee

16.1 The Licensee agreed to develop and finalize a detailed logistics plan and operating protocol for trap and transport of Shad and Herring from both the EFL and WFL. The Logistics plan was required to address near-term operations, as well as logistics necessary to support the collection and transport of up to 80 percent of the Shad and Herring passing the Project with a maximum transport of 100,000 Shad and 100,000 Herring annually. This plan was to be completed by December 31, 2017. The Licensee shall provide MDE with a status report on the logistics plan and operating protocol for trap and transport of Shad and Herring no later than September 1, 2018. If these items have not yet been completed, Licensee shall complete these items and submit them to MDE by no later than January 1, 2019.

16.2 The Licensee also agreed develop detailed Computational Fluid Dynamics (CFD) models of the zones of passage, in consultation with the Service, to the EFL and WFL to assess the ability of fish to reach the lifts. The Licensee shall provide MDE with a status report on these models no later than September 1, 2018. If these items have not yet been completed, Licensee shall complete these items and submit them to MDE no later than January 1, 2019.

16.3 The Licensee also agreed to develop its initial FOMP (as described earlier) by September 30, 2017. The Licensee shall provide MDE with a status report on the initial FOMP no later than September 1, 2018. If the initial FOMP has not yet been completed, the Licensee shall complete the initial FOMP and submit to MDE no later than September 30, 2018.

17. Items to be completed in 2017 – 2018

The Licensee shall finalize design plans for initial fishlift improvement and improvements to facilitate the trap and transport program by no later than December 31, 2018.

18. Definitions of Certain Terms

In addition to terms defined elsewhere in the Certification and this MDE-FPIP, the following terms have the following meaning when used herein:

Adjusted Efficiency - The calculated fish passage efficiency that accounts for the biological benefit of fish trapped and transported from the Project to areas upstream of other

mainstem dams. This calculated efficiency gives credit towards efficiency targets for the number of fish that are trapped and transported.

Anadromous - migratory fish that spawn in freshwater rivers but spend most of their life in the ocean.

Attraction Efficiency - The proportion of the migrating population that successfully passes a designated downstream point at the Project (i.e. the downstream end of Rowland Island), and successfully enters the fish lift.

Fish Ladder - an engineered ramp-like structure, typically constructed of concrete and/or metal, used to provide upstream fish passage.

Fish Lift - an elevator-like structure with a hopper used to convey fish from the Tailwaters to the headpond of high dams.

Fish Passage Facility - the physical structure of the fishway used to convey fish upstream; with the term being synonymous with "fish lift" at this Project.

Hopper - the structural part of the fish lift used to hold fish as they are transported from the Tailwaters to the head pond.

Safe Passage - the movement of fish through the zone of passage that does not result in any unacceptable stress, incremental injury, or death of the fish.

SRAFRC - Susquehanna River Anadromous Fish Restoration Cooperative.

Trap and Transport or T&T - fish that are collected at a downstream project and loaded in a tank truck and transported and released into some location upstream of that project.

Upstream Fish Passage Efficiency - the percentage of the fish present in the Tailwaters that successfully move through the fish lift and continue upstream migrations; e.g. the proportion of fish that start at point B (downstream end of Rowland Island in the case of the Dam) and passes point E in the diagram set forth in Appendix E to this MDE-FPIP.

Volitional Passage - a fish passage facility that allows fish to swim unimpeded from the Tailwaters to the headpond; fish lifts are not considered volitional passage because the fish rely on the operation of the lifts in order to pass upstream into the headpond.

Zone of Passage (ZOP) - The contiguous area of sufficient lateral, longitudinal, and vertical extent in which adequate hydraulic and environmental conditions are maintained to provide a route of passage through a stream reach influenced by a dam (or stream barrier); e.g. the area between point A and point E in the diagram set forth in Appendix E to this MDE-FPIP.

**Appendix A to Attachment #1
Calculation of Fishway Capacity for a 6,500-Gallon Hopper**

Biological Parameters:

$\lambda_m = 0.052$ (season/day)	Season-to-season run compression coefficient empirically determined design parameter
$\beta = 0.15$ (day/hr)	Hour-to-hour run compression coefficient empirically determined design parameter
$T = 15$ min	Lift cycle time (recommended)

Hopper Size:

$Vol_H = 868.9$ ft. ³	Estimate of proposed hopper volume (6,500 gallons)
$Vol_{fH} = 0.1$ (ft ³ / lbf)	Volume required per fish-pound, USFWS criterion; for lift times greater than 15 minutes, a 30 percent increase in Vol_{fH} is recommended

Allowable peak biological loadings:

$Flb_h =$ $(Vol_H / Vol_{fH} * T)$	$Flb_h = 34,756$ lbf/hr	Allowable loading of fish in pounds per peak hour
$Flb_d = Flb_h / \beta$	$Flb_d = 231,706$ lbf/day	Allowable loading of fish in pounds during the peak day
$Flb_s = Flb_d / \lambda_m$	$Flb^s = 4,455,897$ lbf/season	Allowable loading of fish in pounds during an entire season

Appendix B to Attachment #1 Calculating Trap and Transport Credit

Credit Towards an Overall Efficiency Criterion (85 percent of fish entering the Tailrace)

For a given number of Shad trapped and transported we can estimate the number that would need to pass the Dam via the fish lift to result in the same number of spawners upstream of York Haven Dam. This number is termed "lift equivalents" (L_e) and is calculated as:

$$[1] \quad L_e = \left(\sum_{i=1}^n TT_i \right) \cdot (1 - TT_m) / D$$

Where TT_i refers to the number trapped and transported each year during a single or multi-year study to measure passage efficiency, and TT_m is the mortality associated with trapping and transporting Shad. Harris and Lightower (2011) estimated mortality of trapped and transported Shad in the Roanoke River to be 15 percent. However, SRAFRFC (1997) gave estimates of mortality for holding Shad prior to trap and transport, mortality during the transport, and delayed mortality following release. When all these factors are considered, the overall mortality associated with trap and transport operations was 6 percent, which was used in this model. The denominator (D) in equation [1] will be calculated using the maximum efficiency of each of the two upstream dams with the highest passage efficiency over the three year study and the average of these efficiencies. For example, if the highest efficiencies of Holtwood, Safe Harbor, and York Haven Dams over the three year study were 0.60, 0.78, and 0.50, respectively, then the denominator would be calculated as $D = 0.60 \cdot 0.78 \cdot (0.60+0.78)/2 = 0.3229$. It was assumed that other than the mortality associated with trap and transport operations, no other negative impacts on their fitness occurred compared to Shad that would migrate via multiple fish passage facilities to areas upstream of York Haven Dam.

The L_e can be added to the observed number that were lifted past the Dam during the study period to arrive at an adjusted total number that are passed via the fish lift (L_a).

$$[2] \quad L_a = L_e + \sum_{i=1}^n TT_i L_i$$

where L_i is the observed number lifted in each year.

During a radio telemetry study at the Dam, an estimate of passage efficiency will be made and given the total number of Shad actually passed (lifted and released into the Reservoir + trapped and transported upstream), an estimate of the total number of Shad downstream of the Dam during all years of the study can be made.

$$[3] \quad N = \left(\sum_{i=1}^n P_i \right) / E_a$$

where P_i is the total number passed each year and E_a is the estimated passage efficiency during the study. Equation [3] also assumes that no mortality is suffered while attempting to pass the Dam.

The variance of N can be estimated by the delta method using the estimated variance of E_a .

$$[4] \quad \text{Var}(N) = [\text{Var}(E_a) / E_a^4] \cdot \left(\sum_{i=1}^n P_i \right)^2$$

The adjusted passage efficiency is then the adjusted number that are lifted during the study divided by the total number of Shad downstream of the Dam during all years of the study.

$$[5] \quad E_a = L_a / N$$

The associated variance from the delta method is:

$$[6] \quad \text{Var}(E_a) = [\text{Var}(N) / N^4] \cdot L_a^2$$

The 95 percent confidence interval for E_a can be approximated as:

$$[7] \quad 95\% \text{ C.I. is approximately equal to } 1.96 \cdot \text{square root of } \text{Var}(E_a)$$

If the upper 95% confidence limit is greater than or equal to the efficiency criterion, then the criterion is considered to be met.

Appendix C to Attachment #1 Trap and Transport Mortality Study

To assess the mortality associated with trap and transport of Shad collected at the Dam and transported to areas upstream of York Haven Dam, a study design similar to that of Millard et al. (2005) will be employed. This study will have both a treatment group (Shad trapped and transported) and a control group (Shad not trapped and transported). The purpose of having both a treatment and a control group is to evaluate both the immediate and delayed mortality associated with T&T operations while controlling for mortality associated with handling stress while carrying out the study.

Control groups will consist of Shad that are caught in the lifts at the Dam, sorted from non-target species, and rather than being loaded into a truck and transported upstream, they will be released to a large holding tank located at the Dam (size to be determined) and monitored for 72 hours post-release.

Treatment groups will consist of Shad that are caught in the lifts at the Dam, sorted from non-target species, loaded into a truck, and driven around in the truck for a length of time equivalent to the trip duration to areas upstream of York Haven Dam. After simulating transport, the Shad will be placed into a holding tank located at the Dam and monitored for 72 hours post-release.

Experimental tanks for both treatment and control groups will be located at the Dam in order to eliminate any confounding effects of differences in water temperature/chemistry between treatment and control groups and to isolate the effects of transport. Experimental tanks will be set up with flow through conditions using water pumped from the Tailrace.

Each week throughout the fish passage season, a truck load's worth of fish (exact number yet to be determined) will be used in both treatment and control groups. Thus, the experiment will be temporally replicated for 4 to 8 weeks depending on the duration of the spawning run in a given year. This will allow assessment of mortality over the range of water temperatures experienced by Shad throughout the season.

During the 72 hour monitoring period, dead Shad will be removed from the tank as soon as they are noticed. Mortality will be quantified as the number of dead Shad divided by the number of Shad that entered either the treatment or control group. Mortality in the treatment group will include all Shad that died during the entire process from loading them into the truck to those found dead at the end of the 72 hour monitoring period.

Statistical Analysis

It will be assumed that total mortality of the treatment group consists of two components: 1) mortality associated with transport and release of the Shad; and 2) mortality associated with experimental handling of the Shad. Thus, total mortality of the treatment group = T&T mortality + handling mortality. The control group would only experience mortality associated with experimental handling. The instantaneous handling mortality rate (m_h) will be estimated from the control group as

$$M_h = -\ln(S_c)$$

where S_c is the survival of the control group over all replicates throughout the season. The instantaneous total mortality in the treatment group will be estimated as

$$M_t = -\ln(S_t)$$

where S_t is the survival of the treatment group over all replicates throughout the season. The conditional mortality associated with trap and transport (conditioned on handling mortality) is

$$u_{TT} = A - [(A \cdot M_t) / \ln(1 - A)].$$

where A is the fraction of fish that die from all causes ($1 - S_1$). This equation is based on the traditional fisheries expression $u = A \cdot F/Z$ where u = the expectation of death from fishing, A = total mortality rate from all causes, F = the instantaneous fishing mortality rate, and Z = the total instantaneous mortality rate. Estimation of the conditional mortality associated with trap and transport (u_{TT}) according to the above equation is preferred because it accounts for the probability that the two sources of mortality, trap and transport stress and handling stress, occur simultaneously over the monitoring period (Millard et al. 2005).

Literature cited:

Millard, M.J., J.W. Mohler, A. Kahnle, and A. Cosman. 2005. Mortality associated with catch-and-release angling of striped bass in the Hudson River. *North American Journal of Fisheries Management*. 25:1533-1541

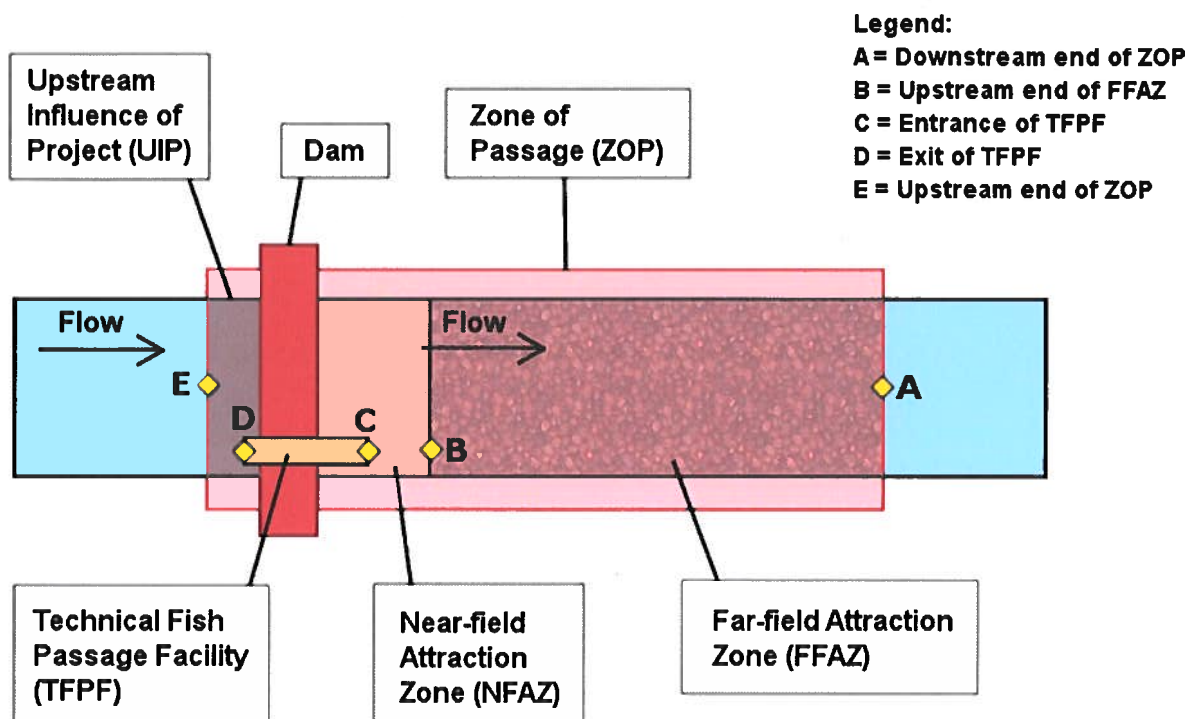
**Appendix D to Attachment #1
Upstream and Downstream Migration Periods for Certain Species**

<i>Species</i>	<i>Upstream Migration Period</i> ^{1,2,3}	<i>Downstream Migration Period</i> ^{1,2,3}
Shad	Starting when River temperature reaches 50 ° F, until River temperatures rise above 72 ° F for four consecutive days, but ending no earlier than June 1, and no later than June 15 ²	July 1 through November 15 (juv.) May 1 through July 1, as long as river temperature is above 65 ° F ² (adult)
Herring	Starting when River temperature reaches 50 ° F, until River temperatures rise above 72 ° F for four consecutive days, but ending no earlier than June 1, and no later than June ^{2,3,4}	June 15 through October 14 (juv.) April 15 1 through July 1 (adult)

Notes:

1. Any of these migration periods may be changed during the Term by MDE, based on new information. At any time during the Term, Licensee may submit new information to MDE in support of a request to change the migration periods. In the event MDE seeks to require downstream passage by means other than through the units, the downstream migration periods automatically will be reviewed jointly by MDE, other fishery agencies, and the Licensee.
2. Water temperatures shall be monitored once daily at 11 a.m. at Station 643 or some other location agreed upon by the Licensee and MDE.
3. MDE recognizes that, because of factors outside of the Licensee's control, safety considerations may preclude the personnel from performing duties necessary to commence fish passage measures at the Project by the commencement date. When such conditions arise, the Licensee shall notify MDE, and MDE and the Licensee shall consult regarding the anticipated schedule for commencing such measures.
4. This migration period is based on alewife migration timing from other tributaries to the Bay (Sutherland 2000, p. 9; Eyler et al. 2002, p. 59; Slacum et al. 2003, p. 13).

**Appendix E to Attachment #1
Diagram of Fish Passage Definitions**



ATTACHMENT #2
To Clean Water Act Section 401 Certification For the Conowingo Hydroelectric Project
FERC Project No. P-405 / MDE WSA Application No. 17-WQC-02

MDE American Eel Passage Improvement Plan (MDE-AEPIP)

The Licensee shall construct, operate, and maintain Eel fishways at the Dam to pass upstream migrating Eels that arrive at the Project in a safe, timely, and efficient manner. The Project shall also be operated to provide safe, timely, and effective downstream passage of Eels.

Without limiting the generality of Section 2.C.ii of the Certification, in all cases where this MDE-AEPIP requires the Licensee to consult with or make any submission to MDE, the Licensee shall also consult with, or make such submission to DNR, unless otherwise specified.

A. General Provisions

1. For purposes of this MDE-AEPIP, “Upstream Eel Migration Season” is defined as May 1 through November 1 or when fall mean daily River temperature below the Dam is 10 degrees Celsius or less for three consecutive days, whichever is later.

2. For purposes of this MDE-AEPIP, “Downstream Eel Migration Season” is defined as September 15 through February 15 (or whenever River temperature is above 37 degrees Fahrenheit for four consecutive days).

3. Water temperatures shall be monitored hourly at Station 643 or some other location agreed upon by the Licensee and MDE. This initial operational period is based on preliminary data on Eel migration timing from other tributaries to the Bay.

4. MDE, in consultation with DNR, will use the results from the downstream Eel effectiveness monitoring studies conducted pursuant to Section B.18 of this MDE-AEPIP to further refine the Downstream Eel Migration Period throughout the Term.

B. Eel Passage Requirements and Conditions

1. During the Eel passage season starting May 1, 2019, the Licensee shall document congregations of juvenile Eels visually via bi-weekly nighttime surveys during the migration period, unless another method is approved in writing by MDE. The locations surveyed shall focus on the EFL area including inside the EFL and stilling pool(s) and the Dam spillway adjacent to the EFL. Based on the results of the site-determination studies and engineering analysis, the Licensee shall submit an Eel siting report by February 1, 2020 and then shall design, install, operate and maintain temporary mobile traps to inform the potential location of one or more additional permanent Eel trapping facility(s).

2. No later than March 15, 2020, the Licensee shall submit to MDE for approval a plan to construct and operate temporary, exploratory traps at various locations below the Dam, based on the visual assessments, during multiple years, to assess the ability to collect Eels at

locations where they congregate (the “Eel Collection Plan”). Collection facilities for the temporary site determination study shall be similar to those used in the 2011 study conducted by the Licensee. The Eel Collection Plan shall include (a) locations of Eel fishways, (b) description of substrates, (c) attraction flow at the ramps, (d) attraction flow from the spill gates, (e) description of holding tanks, and (f) frequency of trap checks with contingency for likely high collection periods.

3. No later than March 15, 2022, the Licensee shall submit to MDE for approval an “Eel Passage and Restoration Plan”, which shall include (a) detailed plans for the design and construction of new permanent East Eel Fishway(s) (“EEF”) located in one or more areas that have high potential to capture Eels migrating up the east side of the mainstem River in the Tailrace; (b) details regarding the annual operation and maintenance of all current and proposed Eel Fishways; and (c) proposed attraction flow speed and volume, slopes of the ramps, matting, and methods to reduce predation.

4. The Licensee shall design and install the EEFs within 12 months of MDE approval of the Eel Passage and Restoration Plan, using paired ramps with different substrates, tanks, etc. to provide sufficient capacity for captured Eels. The number of EEFs and their locations, dependent on survey results, will be determined by MDE. If the number of Eels attempting to migrate within an EEF exceeds the maximum capacity of Eels per unit of ramp area, the Licensee shall redesign and construct the EEF to reduce crowding. In addition, the Licensee shall ensure the holding tank has continuous temperature, DO and water flow exchange monitoring devices with alarms that sound in a permanently staffed location if levels of any parameter are outside established limits. Upon observation, the Licensee shall remove, enumerate and report dead Eels. The holding tank shall be designed and operated to hold Eels at densities not exceeding 10 elvers per liter unless otherwise approved by MDE. If deemed necessary by MDE, the Licensee will provide aeration to the holding tanks. Licensee shall provide daily reports to MDE, DNR, and other resource agencies designated by MDE.

5. Upon completion of the EEFs and thereafter as necessary, the Licensee shall consult at least yearly by February 1, with MDE concerning modifications and adjustments to the passage facilities to improve their operation and efficiency and previous year’s data.

6. The Licensee shall not make any modifications to any EEF, undertake any construction associated with any EEF, or make any changes to the operation of any EEF without MDE’s written approval in advance..

7. Upon modification to any fish lifts, the Licensee shall investigate Eel congregation locations and follow the procedures outlined in Section B.1 of this MDE-AEPIP to assess the need for additional facilities or modification to the existing Eel collection facilities.

8. The Licensee shall include within the Eel Passage and Restoration Plan detailed plans for the conversion of the EEF(s) and the existing West Eel Fishway (“WEF”) to volitional passage, which shall be operational by the Upstream Eel Migration Season in 2031 unless MDE states otherwise in writing. Based on the status of Eel passage at the Holtwood, Safe Harbor and York Haven dams and the results of Eel stocking studies, MDE may delay or eliminate the

requirement to convert to volitional passage if the continuation of the trap and transport program is a preferred option for Eel restoration.

9. The Licensee shall operate the existing WEF annually during each Upstream Shad Migration Season in accordance with the approved Eel Passage and Restoration Plan.

10. The Licensee shall operate the WEF and EEF (interchangeably and collectively, the “Eel Fishways”) continuously (24 hours per day, 7 days per week) during each Upstream Eel Migration Season during the Term, regardless of whether the Eel Fishways are operated as a trap or a volitional fishway. If the Eel Fishway(s) is located within the EFL during the Shad passage season, the Eel Fishway(s) will be operated at night when the EFL is not lifting unless MDE modifies this requirement in writing.

11. Unless MDE determines that no effective technology is available to enable such testing, the Licensee shall submit to MDE upstream Eel Fishway efficiency studies (each, an “Efficiency Study”) for approval, in accordance with this Section B.11. Each Efficiency Study shall be conducted with juvenile Eels in the vicinity and within the Eel Fishways in 2019, or once technology is available, and once every ten years thereafter. Each Efficiency Study shall determine the Eel upstream passage efficiency of all Eel Fishways during the Upstream Eel Migration Season and any issues that impact Eel survival and efficiency through the Eel Fishways. Each Efficiency Study will consist of two components: determining attraction efficiency to the facility and passage efficiency within the facility once an Eel enters the Eel Fishway. If not already tested at the WEF prior to issuance of the Certification, internal Eel Fishway efficiency at the WEF shall be tested in 2019, regardless of testing for attraction and overall passage efficiency. At all other Eel Fishways, internal Eel Fishway efficiency shall be tested in the year immediately after the year in which the Eel Fishway is completed, regardless of testing for attraction and overall passage efficiency. Efficiency Studies will be repeated following all modifications to Eel Fishway operations, physical structures or the fish lifts which impact River flows or the shoreline to evaluate the success of the modifications. If MDE determines that any Efficiency Study cannot be conducted due to the lack of technology, the Licensee shall conduct visual surveys every five years after the Eel Fishway(s) are constructed to locate Eels below the Dam. The Licensee shall provide an annual report on the efficiency or visual study to MDE DNR by December 31 of the study year.

12. Within twelve months after completion of the Eel Fishways on the east side of the Project (at or near the EFL and the east bank of the River), the Licensee will submit to MDE for approval a multi-year study plan to evaluate those facilities, which plan shall include (a) substrate types, (b) attraction flow at each ramp, (c) attraction flow from the EFL attraction flow spill gates, and (d) potential adjustments to the locations of the Eel Fishways.

13. The Licensee shall yearly, or at such other interval as may be approved in writing by MDE, visually assess the numbers and density of Eels using the Eel Fishways during periods when use is anticipated to be high (e.g. increases in discharge or turbidity) to determine if capacity is exceeded.

14. No later than September 1, 2020, the Licensee shall submit to MDE for approval a plan to conduct in-River, post-stocking surveys including one year of baseline (pre-stocking) data to assess the impact of Eel reintroduction into streams (the “Eel Reintroduction Plan”). These post-stocking surveys shall be for three consecutive years and then once every five years thereafter or until MDE agrees in writing to not continue the annual surveys. Provisions in the Eel Reintroduction Plan shall include the following:

- (a) Representative stream segments of the tributaries; provided that the Licensee will propose locations and methods for this survey at least one year in advance to MDE for review and approval;
- (b) The number, length, and location of transects sampled shall be subject to approval by MDE;
- (c) Eels shall be captured by electrofishing or other methods as approved by MDE;
- (d) Block netting shall be required on tributary streams; and
- (e) Sampling shall include bivalves and crayfish.

During sampling, Licensee shall document the number of Eels captured and collect data from a representative subsample of Eels. Sampled Eels shall be scanned for passive integrated transponder (“PIT”) tags and data from recaptured Eels shall be recorded. Captured Eels larger than 200mm will be tagged with PIT tags and released. Should DNR determine that the number of Eels larger than 200mm is excessive, the Licensee shall consult with MDE and DNR to determine if a subsample of Eels may be PIT tagged. Data collected shall include a variety of life history characteristics e.g., length, weight, condition factor and a description of maturity (e.g. elver, yellow phase, silver phase). that can be assessed to determine how well stocked Eels are utilizing the River and tributaries. A portion of the subsample will be sacrificed and examined for age (otolith analysis), gender, and level of *Anguillicoloides crassus* infection.

15. No later than February 1 of each year, beginning in the year after the Eel Reintroduction Plan is implemented, Licensee shall provide MDE an annual report based on the results of the stream surveys performed in the previous year pursuant to the Eel Reintroduction Plan. The report shall include a description of (a) stream segments surveyed, (b) dispersal of the stocked Eels, (c) estimate the density of stocked Eels, (d) an evaluation of the growth, condition, age, gender, (e) level of infestation with *Anguillicoloides crassus* of Eels, (f) mussel and crayfish survey results.

16. The Licensee shall submit to MDE for approval a plan showing proposed stocking locations for collected Eels to MDE for review 90 days prior to each Upstream Eel Migration Season.

17. Transport of juvenile Eels upstream shall occur as necessary based on the capacity of holding tanks at the Eel Fishways. The holding tanks shall have an automatically engaging back up pump and an alarm that sounds in a daily staffed location if the primary pump malfunctions. The holding tank shall have continuous temperature, DO and gallon/minute water exchange monitoring devices with alarms that sound in a daily staffed location if levels of any parameter are outside of established limits. All Eels shall be moved within one week of capture.

Eels from the holding tank(s) shall be transferred to a transport vehicle equipped with an insulated transport container(s) that shall be covered and aerated. The transport vehicle(s) shall have an automatically engaging back up pump and an alarm that sounds in the cab of the vehicle(s). The transport vehicle shall have continuous temperature and DO monitoring devices with alarms that sound in the vehicle cab if levels of any parameter are outside of established limits. The transport vehicle(s) shall be designed and operated to hold Eels at densities not exceeding 10 juvenile Eels per liter unless otherwise permitted by MDE in writing. Eels shall be trucked to appropriate release locations on the same day of removal from holding. Upon observation, dead Eels shall be removed, enumerated, and reported.

18. The trigger date for initiation of downstream Eel passage studies shall be the date on which MDE, determines that available data indicates that Eels are maturing upstream of the Project in sufficient numbers to require downstream Eel passage studies at the Dam ("Downstream Study Trigger Date"). Within six months after receiving written notice from MDE that the Downstream Study Trigger Date has occurred, the Licensee shall submit to MDE for approval a plan to conduct a silver Eel downstream survival study (the "Downstream Survival Plan"). The Downstream Survival Plan shall (a) be designed to demonstrate continued compliance with the 85% downstream silver Eel survival target; and (b) include ballon tagging study(ies). The Licensee shall provide a report of the study results from implementation of the Downstream Survival Plan within 180 days after the date of study completion. If such results indicate that the Licensee can operate the Project so that it achieves at least 85% downstream passage of Eel through the Project, the Licensee shall incorporate into the Eel Passage and Restoration Plan all operational measures needed to meet this survival rate. If such results do not indicate that the Project can be operated to achieve at least 85% downstream passage survival of Eel, the Licensee shall propose a plan and schedule for mitigation to achieve the maximum possible downstream Eel passage.

19. No later than September 1, 2021, the Licensee shall submit to MDE for approval a plan for implementing radio telemetry monitoring of Eel at the Project year-round for at least three consecutive years (the "Telemetry Plan"). The Telemetry Plan must include route of passage, delay estimates, and project related mortality. If there are an insufficient number of Eels after three years of implementing the approved Telemetry Plan to determine route of passage, delay estimates, and project related mortality, the Licensee shall continue the Telemetry Plan until such determinations can be made.

ATTACHMENT #3
To Clean Water Act Section 401 Certification For the Conowingo Hydroelectric Project
FERC Project No. P-405 / MDE WSA Application No. 17-WQC-02

MDE Invasive Species Mitigation Plan (MDE-ISMP)

In order to minimize the introduction and spread of aquatic invasive species (“AIS”) into the River through the fish lifts at the Dam, the Licensee shall, beginning in September of 2018:

1. The Licensee shall notify DNR and USFWS in accordance with Section 7 of this MD-ISMP if an AIS is (a) collected in the WFL, (b) collected in the EFL, or (c) passed in the EFL into the Reservoir.
2. During EFL Operations, the Licensee shall:
 - (a) View the hopper dumping into the fish exit trough. If an AIS is viewed in the hopper or chute, close the gate at the viewing window immediately, and institute a draw-down to remove the AIS from the trough before releasing the remaining fish into the Reservoir.
 - (b) Remove any AIS that are observed while conducting tagging operations in the EFL trough.
3. During WFL Operations, the Licensee shall remove any invasive species that are collected in the WFL.
4. The Licensee shall also:
 - (a) Retrofit/redesign the EFL no later than March 1, 2019 to remove AIS and allow tagging fish when required.
 - (b) Design fishlifts to remove all AIS prior to upstream migration or Tailrace reintroduction while not significantly impacting fish passage.
 - (c) Ensure the proper disposal of all AIS captured in the fish lifts.
5. MDE may require the Licensee to implement the following protocol beginning in the 2019 migratory fish passage season that starts when River temperatures reach 48 degrees for three consecutive days and ends when River temperatures rise above 72 degrees for four consecutive days:
 - (a) For all AIS collected at the Dam, Licensee shall kill or dispatch the AIS and place it in the freezer used for Shad heads during the tank spawning studies, for DNR and/or USFWS to dispose of such AIS.

- (b) If freezer space for storage of AIS becomes limited the Licensee shall notify MDE and DNR.
 - (c) If freezer space for storage of AIS is not limited, at the end of the season, Licensee shall send the frozen AIS with the Shad heads to the Van Dyke Hatchery and notify MDE and DNR as to the number and type of frozen AIS sent to the Van Dyke Hatchery.
6. MDE reserves the right to adaptably modify conditions for invasive species control, based on a sound science and after consultation with DNR, USFWS and the Licensee. Licensee shall implement any modifications to these conditions as required by MDE on a schedule established by MDE.
7. Agency Notification Protocol: If an AIS is captured and removed or passed in a fish lift, the Licensee shall notify DNR and USFWS within 24 hours. Notification shall include: (a) species name and number observed/collected; (b) disposition of the AIS observed/collected; (c) approximate size of AIS observed/collected; (d) date and time of passage; and (e) estimated flow through the Dam at time of passage.

ATTACHMENT #4
To Clean Water Act Section 401 Certification For the Conowingo Hydroelectric Project
FERC Project No. P-405 / MDE WSA Application No. 17-WQC-02

Minimum Flow Regime

Time Period	Minimum Flow
January	4,000 cfs
February	4,000 cfs
March	4,000 cfs
April	18,200 cfs
May	18,200 cfs
June	7,500 cfs
July	5,500 cfs
August	4,500 cfs
September 1-14	3,500 cfs
September 15-30	3,500 cfs
October	4,000 cfs
November	4,000 cfs
December	4,000 cfs

ATTACHMENT #5
To Clean Water Act Section 401 Certification For the Conowingo Hydroelectric Project
FERC Project No. P-405 / MDE WSA Application No. 17-WQC-02

Year 10 Flow Regime

For purposes of the following table, “below normal” at the Marietta Gage means flow less than monthly Q50, and “above normal” means flow greater than or equal to monthly Q50.

Month(s)	Min Flow	Down Ramping Rate	Upramping Rate	Maximum Flow
December-January	11,000 cfs	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	None
February	12,500 cfs	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	None
March	24,000 cfs when upstream inflow at the Marietta Gage is below normal; 30,000 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	None
April	29,000 cfs when upstream inflow at the Marietta Gage is below normal; 35,000 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	None
May	17,500 cfs when upstream inflow at the Marietta Gage is below normal; 25,500 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	65,000 cfs
June	10,000 cfs when upstream inflow at the Marietta Gage is below normal; 14,000 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	65,000 cfs
July	5,500 cfs when upstream inflow at the Marietta Gage is below normal; 8,500 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 10,000 cfs/hour if instream flow is less than 30,000 cfs; Up to 20,000 cfs/hour if upstream flow is between 30,000 and 86,000 cfs	Up to 40,000 cfs/hour	65,000 cfs
August	4,500 cfs when upstream inflow at the Marietta Gage is below normal; 6,000 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	65,000 cfs
September	3,500 when upstream inflow at the Marietta Gage is below normal; 5,500 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	65,000 cfs
October	4,500 cfs when upstream inflow at the Marietta Gage is below normal; 6,000 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	None
November	6,000 cfs when upstream inflow at the Marietta Gage is below normal.; OR 11,000 cfs when upstream inflow at the Marietta Gage is above normal.	Up to 20,000 cfs/hour	Up to 40,000 cfs/hour	None