National Park Service
U.S. Department of the Interior

Chesapeake & Ohio Canal National Historic Park
Maryland, West Virginia, District of Columbia

Proposed Eel Ladder Construction at Dams 4 and 5 on the Potomac River

Environmental Assessment/ Assessment of Effects

ENVIRONMENTAL ASSESSMENT/ ASSESSMENT OF EFFECTS
Proposed Eel Ladder Construction at Dams 4 and 5 on the Potomac River

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EXECUTIVE SUMMARY

This Environmental Assessment (EA) was prepared for the National Park Service (NPS) to support the proposed eel ladder construction at Dams 4 and 5 of the Chesapeake & Ohio National Historic Park (the "park"). The proposed action is needed because the American eel (*Anguilla rostrata*) does not currently have adequate means of upstream passage around either of the dams. Historically, this species occurred in the Potomac River above Dams 4 and 5. The American eel population has been declining throughout its range in recent years partly due to its exclusion from historic habitat by dams. Access to approximately 120 miles of historic habitat above the dams would be improved by the construction of the eel ladders. Providing access to important habitat between and above these dams would complement an effort underway in the Potomac River watershed to reduce fragmentation of aquatic habitat used by American eel and increase connectivity of the riverine ecosystem.

The National Environmental Policy Act (NEPA) of 1969 process was conducted in accordance with the NPS regulations for implementing NEPA, and it examined the consequences of this proposed project on the environment. This EA presents the alternatives considered during the NEPA process, the affected environment, the impacts associated with the proposed project, potential mitigation measures, and the agency consultation and coordination conducted to support this project. The U.S. Fish and Wildlife Service (USFWS) and NPS, in cooperation with Allegheny Energy are preparing this EA, in accordance with its established procedures for implementing NEPA requirements.

In accordance with Section 800.8 of the Advisory Council on Historic Preservation's regulations (36 CFR 800), the process and documentation required for preparation of this Environmental Assessment will also be used to comply with Section 106 of the National Historic Preservation Act (NHPA).

The purpose or goal of the Department of Interior (DOI) in taking this action is to achieve the objectives of the Atlantic States Marine Fisheries Commission's (ASMFC) Interstate Fishery Management Plan (FMP) for American eels by working cooperatively with other partners to restore the American eel population throughout the entire Shenandoah and Potomac River watershed. The proposed action includes constructing and operating an eel ladder at both Dams 4 and 5. The basic design of the eel ladder is not unusual and has been installed successfully at other dams in the watershed. It has the eels entering an ascending ramp at the base of the dam and swimming up an angled ascending ramp by pushing against a tubular substrate. The eels would gather in a live well or collection box where they would be counted and monitored by a project biologist and released. Eels would either be hand released in the upstream impoundment or will swim safely out the live well upstream. The eel ladder would be attached to the structures (dam, abutment, forebay, or powerhouse) using supports. Attraction water flow would be provided by a pump, which would help direct the eels to the ladder. The construction of the eel ladder is estimated to last up to eight weeks. Three Action Alternatives (Alternatives B-D) were considered in this EA for each dam, with some alternatives located along the Maryland shoreline and others located along the West Virginia shoreline. In addition to the Action Alternatives, the No Action Alternative (Alternative A) was also evaluated in this EA.

The potential duration of the impacts (short-term or long-term), the intensity of the impacts (negligible, minor, moderate, or major), and the classification of the impacts (beneficial or adverse) were analyzed in detail for each project alternative. Cumulative effects were also considered. By comparing the Action Alternatives with the No Action Alternative, and identifying mitigation measures that would minimize adverse effects, this EA assists in the decision-making process.

The No Action Alternative would continue to create a long-term, moderate, adverse impact to the American eel. The American eels would be unable to migrate to their upstream feeding and rearing grounds. For the alternatives located along the Maryland shoreline, the No Action Alternative would create long-term, negligible, adverse impacts to recreation since visitors would not have the opportunity to educate themselves on the life history of the American eel. The No Action Alternative would not affect air quality, noise, soils, water resources, wetlands, wildlife, special status species, vegetation, cultural resources, aesthetic resources, or park operations. There would be no impairment to park resources associated with the No Action Alternative.

Both short- and long-term impacts associated with the Action Alternatives would result from the construction activities and the operation of the eel ladder. Regardless of the alternative, the operation of the eel ladder would create a long-term, beneficial impact to the American eel by opening more than 120 miles of historic upstream habitat. Long-term, beneficial impacts are expected for mussel species that use the American eel as a host species. Long-term, beneficial impacts to recreation are anticipated for those alternatives located along the Maryland shoreline due to the additional educational opportunities about American eels that would be offered to park visitors. Construction impacts would include short-term, negligible to minor, adverse impacts to air quality, noise, soils, water quality, vegetation, wildlife, aquatic resources, recreation, aesthetic resources, park operations, and energy resources. The eel ladder would operate during the American eel upstream migration period, which is typically March through October. Impacts associated with the operation of the eel ladder would include long-term, negligible to minor, adverse impacts to air quality, noise, deepwater habitats, wetlands, aesthetic resources, park operations, and energy resources. Long-term, adverse impacts to cultural resources would vary in intensity from negligible to moderate depending on the alternative due to the alteration of the historic viewshed or the loss of the historical material and setting. No impacts to special status species are anticipated. There would be no impairment to park resources associated with the Action Alternatives presented in the EA.

The action alternatives for each dam were examined in detail at the Choosing by Advantages (CBA) meetings in July and September 2008. Elements evaluated for each alternative includes eel passage, cultural and historic resources, visitor experience, and operation and maintenance. Alternative B was chosen as the Preferred Alternative for both Dam 4 and Dam 5. The Preferred Alternative for Dam 4 includes the placement of the eel ladder along the Maryland shoreline at the corner of the dam on the east face of the abutment. The eel ladder would run underground and exit upstream of the dam. This alternative has a high ability to pass eels upstream and provides maximum protection of the historic structures in the area. The Preferred Alternative at Dam 5 would be located along the West Virginia shoreline. The eel ladder would be placed in the tailrace and no non-overflow is needed under this Alternative. The eel ladder would have a very high ability to pass eels upstream during variable flows and historic resources would be protected.

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LIST OF ACRONYMS

ºC	Degrees Celsius
APE	Area of Potential Effect
ASMFC	Atlantic States Marine Fisheries Commission
ASMIS	Archeological Sites Management Information System
B&O	Baltimore and Ohio
C&O	Chesapeake and Ohio
CAA	Clean Air Act
CBA	Choosing By Advantages
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CO	Carbon monoxide
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
DO	Dissolved Oxygen
DOI	Department of the Interior
EA	Environmental Assessment
EAV	Emergent Aquatic Vegetation
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FMP	Interstate Fishery Management Plan
FONSI	Finding of No Significant Impact
gpm	gallons per minute
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
LCS	List of Classified Structures
MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MD SHPO	Maryland State Historic Preservation Office
mg/L	milligrams per liter
MHT	Maryland Historical Trust
MM	Mile Marker
mm	millimeters
MWh	Megawatt hours
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Association
NO_x	Nitrogen oxides
NPS	National Park Service
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NWI	National Wetland Inventory
O_3	Ozone
Park	Chesapeake and Ohio Canal National Historic Park
Pb	Lead
PM_{10}	Particulate Matter
PVC	polyvinyl chloride
SAV	Submerged Aquatic Vegetation
SO_2	Sulfur dioxide
TCP	Traditional Cultural Property
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOCs	Volatile organic compounds
WVDNR	West Virginia Department of Natural Resources
WV SHPO	West Virginia State Historic Preservation Office

1.0 PURPOSE AND NEED

1.1 PURPOSE OF AND NEED FOR THE PROJECT

The National Park Service (NPS) is proposing to construct upstream passage on the Potomac River for the American eel (*Anguilla rostrata*) at Dams 4 and 5 of the Chesapeake & Ohio National Historic Park (the "park").

The American eel population has been declining throughout its range in recent years, to the point where it has been considered for listing under the Endangered Species Act (ESA). One of the major reasons for its decline has been its exclusion from historic habitat by dams. Access to approximately 120 miles of historic habitat above the dams would be improved by the construction of the eel ladders. Providing access to important habitat between and above these dams would complement an effort underway in the Potomac River watershed to reduce fragmentation of aquatic habitat used by American eel and increase connectivity of the riverine ecosystem. This action is needed because the American eel does not currently have adequate means of passage around either dam. The American eel is a catadromous species, meaning that it migrates out of rivers to spawn in the sea, with the juveniles returning to mature in fresh water. Historically, this species occurred in virtually every stream on the Eastern Seaboard, including the Potomac River above Dams 4 and 5. Juveniles will live and grow in fresh water for anywhere from 5 to 40 years before returning to the sea to spawn and die. American eels are important parts of riverine ecosystems; feeding on insects, mollusks, crustaceans, worms, and other fish at night; and providing food for larger fish, birds, and snakes. They have been an economically important fishery at many points in our Nation's history.

This action is taken in the context of an ongoing effort by the United States Fish and Wildlife Service (USFWS) and NPS, in cooperation with Allegheny Energy, to restore American eel populations in the Potomac River by providing safe passage for eels around dams throughout the Potomac River watershed.

The purpose or goal of the Department of Interior (DOI) in taking this action is to achieve the objectives of the Atlantic States Marine Fisheries Commission's (ASMFC) Interstate Fishery Management Plan (FMP) for American eels by working cooperatively with other partners to restore the American eel population throughout the entire Shenandoah and Potomac River watershed. The goal of the NPS is to fulfill the need for upstream American eel passage on the Potomac River while avoiding impairment of park resources, including both fish and wildlife resources and the historic fabric of the Chesapeake & Ohio (C&O) Canal, and without impairing the visitor experience of the park, and at the best possible cost to the Government. These factors have guided the NPS analysis of the alternative means of fulfilling the need for fish passage analyzed in this Environmental Assessment (EA).

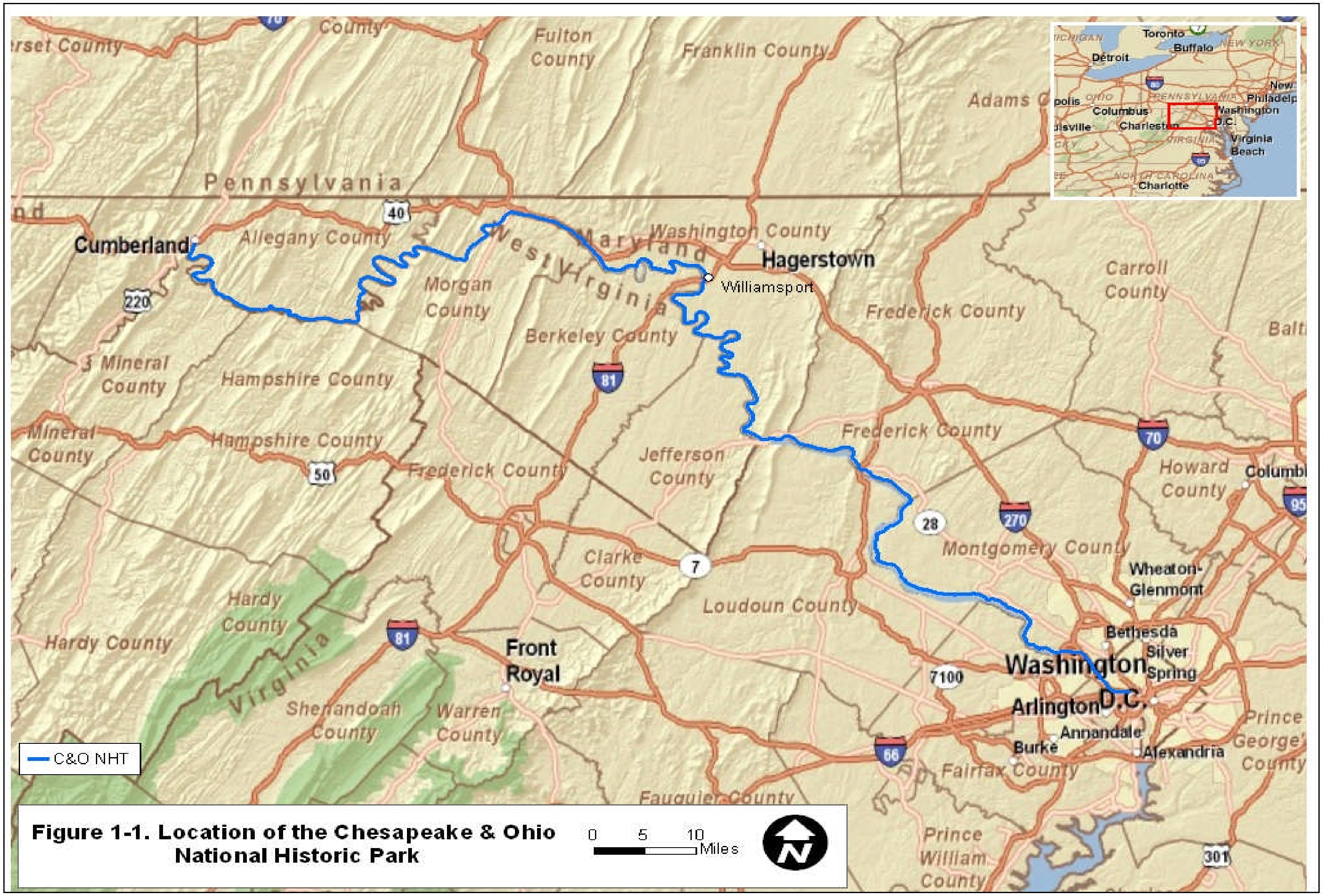
An EA analyzes the proposed action and alternatives and their impacts on the environment. This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and implementing regulations of the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] Parts 1500-1508); National Park Service Director's Order #12 and Handbook, *Conservation Planning, Environmental Impact Analysis, and Decision making*; and Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended, and NHPA implementing regulations, 36 CFR Part 800. The NEPA process is being used to comply with Section 106.

Chapter 1 discusses the purpose and need of the project; the background and scope of the project; the relationship to other planning projects; issues; and the impact topics considered and dismissed from detailed analysis. Chapter 2 discusses the project alternatives, the No Action Alternative, and the environmentally preferred alternative. Chapter 3 describes the affected environment including natural resources, cultural resources, and human resources such as visitor use and safety, visitor experience, and park operations. Chapter 4 discusses the environmental consequences of the alternatives to natural resources, cultural resources, and human resources such as Visitor Use and Safety, Visitor Experience, and Park Operations. Chapter 5 includes internal and external scoping, consultation, and required permits. This chapter is followed by a list of preparers (Chapter 6), references (Chapter 7), and appendices.

1.2 PURPOSE AND SIGNIFICANCE OF THE PARK

The C&O Canal is the last towpath for mule-drawn barge traffic in the United States that remains fully intact. Dams 4 and 5 were constructed on the Potomac River to supply water to the C&O Canal in 1834. The C&O Canal became a national historic park in 1971. The park is located along 184.5 miles of the Potomac River's left bank from the mouth of Rock Creek in Georgetown, Washington DC to Cumberland, Maryland (Figure 1-1). The park's mission is to preserve and protect the natural, cultural, and historic resources of the park. The park provides hiking, biking, camping, canoeing, fishing, and boating to visitors in addition to allowing them to experience the rich history, wildlife, and geologic resources of the canal.

Figure 1-1. Location of the Chesapeake & Ohio National Historic Park



1.3 PROJECT BACKGROUND

1.3.1 Project Background

Chesapeake & Ohio Canal

During the late 1790s and early 1800s more than 3,000 miles of canals were built throughout the United States to transport goods and supplies from coastal areas inland and to aid the migration of people heading west to settle beyond the original thirteen colonies. The C&O Canal began in 1828 when President John Quincy Adams broke ground for a canal that would stretch from Pittsburgh, Pennsylvania to Georgetown, Washington DC. This canal would connect the Chesapeake Bay and the Ohio River. After 22 years of construction and $13 million to build, the canal was completed in 1850, but only extended to Cumberland, Maryland.

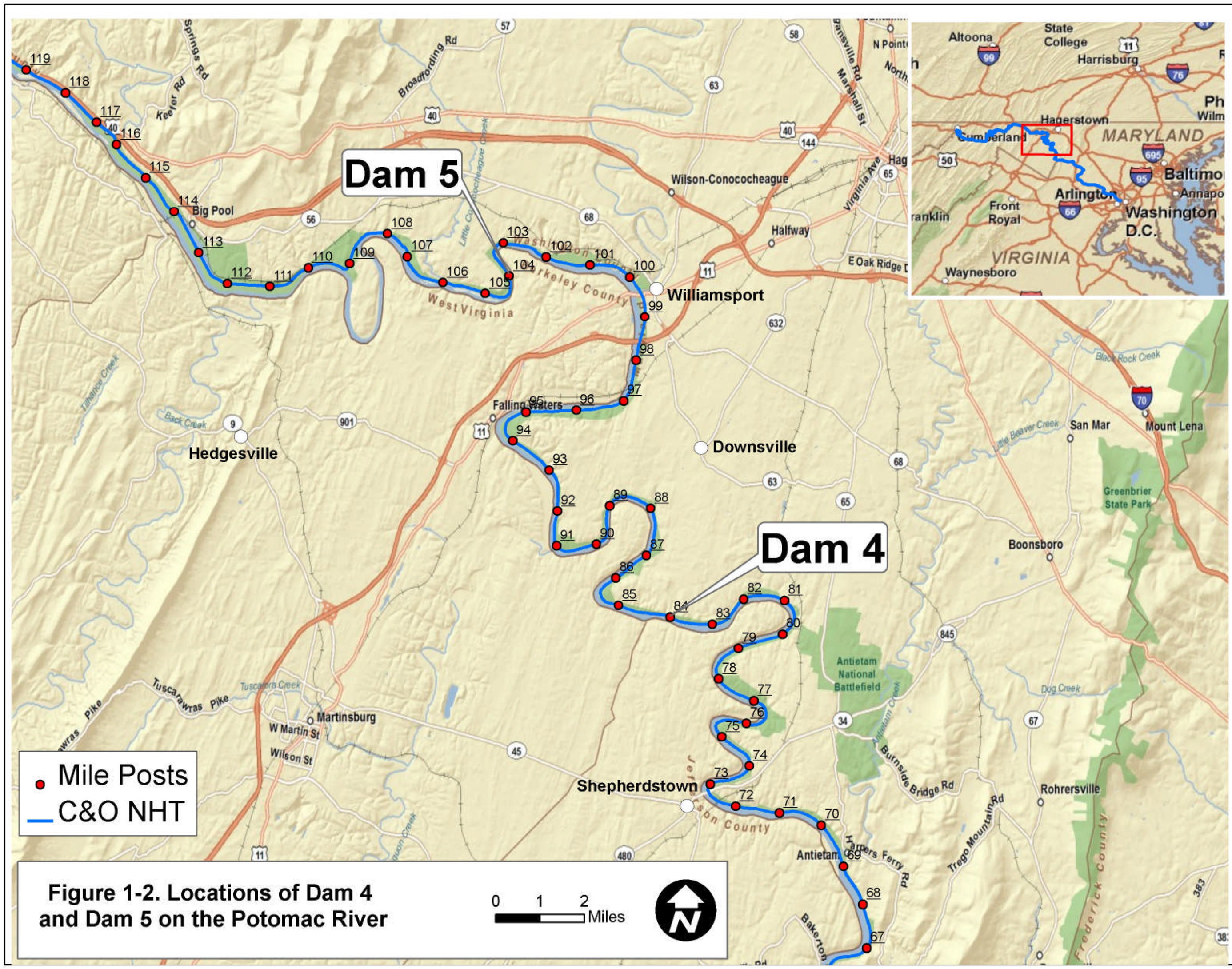
The C&O Canal remained in operation for 96 years, from 1828 to 1924. Mules pulled boats by walking along a 12-foot wide towpath. The boats floated tons of cargo including hay, coal, hydraulic cement, fertilizer, and virtually any product that could be placed on a boat. Seven feeder dams were built on the Potomac River to supply water for the canal. To control the water, 74 lift locks were placed in the canal. These locks, which were typically 100 feet long and 15 feet wide, raised and lowered boats approximately eight feet, allowing them to travel both downstream and upstream. Most boats were approximately 95 feet long and 14.5 feet wide and traveled at a speed of no more than 4 miles per hour. The canal was closed in 1924 after several floods made it impassible.

Dams 4 and 5

Dams 4 and 5 were built in 1834 by the C&O Canal Company to supply water for its canal operations. After the original timber and rubble structures were destroyed by flooding, the dams were replaced and modified by the solid masonry structures that exist today. Dam 4 was replaced in 1860, and Dam 5 was replaced in 1857. Today the dams are owned by the NPS. The backwaters of each dam are used for recreation and hydroelectric power. The hydroelectric power stations are owned and operated by Allegheny Energy.

Dam 4 and the associated hydroelectric station are located on the Potomac River (Milepost 84) approximately four miles northwest of Shepherdstown, West Virginia, in Berkeley and Jefferson Counties and four miles south of Downsville, Maryland (Figure 1-2). Dam 5 and the associated hydroelectric station are on the Potomac River (Milepost 104) approximately five miles northeast of Hedgesville, in Berkeley County and five miles northwest of Williamsport, Maryland (Figure 1-2). The hydroelectric stations at both dams are located along the West Virginia shoreline. The use of mile markers as a locational convenience along the C&O canal follows historical convention. The zero milestone or beginning of the canal is located in Georgetown, where the canal empties into Rock Creek. The canal's terminus is located at mile marker 184.5.

Figure 1-2. Locations of Dam 4 and Dam 5 on the Potomac River



American Eels

The American eel is a catadromous species and begins its life by hatching from eggs in the Sargasso Sea, an area of the Atlantic Ocean north of the Bahamas. The American eel larvae drift with the Gulf Stream currents for nine to twelve months until they eventually reach the Atlantic Coast. Once the eels reach the Atlantic Coast they begin to migrate upstream into the estuaries, including the Chesapeake Bay and Potomac River. At this juvenile stage the eels begin to develop a gray to greenish pigment and are referred to as elvers. The juveniles slowly develop into yellow eels, which are sexually immature adults. The yellow eels remain in the brackish and fresh waters of these rivers for the majority of their lives (USFWS 2005).

As the time approaches for the yellow eels to begin the migration back to the Sargasso Sea, the eels go through many physiological changes. The physiological changes include a pigment color change to a metallic, black-bronze sheen and a pectoral fin color change from yellow/green to black. The yellow eels fatten their body by consuming large amounts of food to build fat deposits for sustenance on the long journey. In addition to building fat deposits the skin of the eel begins to thicken. The eyes of the eel begin to enlarge and there is a change in the visual pigments which prepare the eel for migrating at greater ocean depths. The stomach and intestines of the females shrink to make room for the eggs. Migration typically occurs during autumn nights. As the females begin their migration they will eat less and less along the journey. Once the eels reach the Sargasso Sea the female releases 20 to 30 million eggs, and the male fertilizes them during winter and early spring months (USFWS 2005).

Historically, the American eel were very abundant in the East Coast streams, comprising more than 25 percent of the total fish biomass (ASMFC 2000). The abundance of the species declined from the historic levels but remained stable in the 1970s. Based on the latest harvest and assessment data, although limited, the American eel populations within the tributaries have been in further decline. Harvest pressure and habitat losses are listed as the primary causes for any possible historic and recent decline in American eel abundance (ASMFC 2000). Blockage of stream access, pollution, and nearshore habitat destruction limit habitat availability for eels. It is estimated that 84 percent of the access to Atlantic coastal tributaries have been loss or restricted (ASMFC 2000). The blockage or restriction to upstream migration caused by dams reduce or restricts the amount of habitat available to support eel distribution and growth. There are a total of 12 hydroelectric dams within the Potomac River Basin which prevent the American eel from safely migrating upstream to nurseries and juvenile habitat. Of the 12 dams, 2 eel ladders have been successfully implemented on the Shenandoah and 2 others are planned. A labyrinth weir was built in the Potomac River downstream of Great Falls. These eel ladders have restored access to many miles of native American eel habitat.

1.3.2 Previous Planning

In 2000, The ASMFC created an Interstate FMP for American eel in order to address these declines. The primary objectives outlined in that Plan include, 1) protecting and enhancing total American eel abundance in all watersheds where they now occur, and 2) restoring American eel to all waters where they had a historical presence but now may be absent by providing adequate upstream passage to inland waters. One of the goals of the DOI is to achieve the objectives of this plan by working cooperatively with other partners to restore American eel throughout the entire Shenandoah/Potomac River watershed.

The USFWS has been working with Allegheny Energy since the mid 1990s to address eel passage issues within this watershed. In 2000, Allegheny Energy agreed to conduct field studies, construct an upstream eel passage structure, and evaluate the success of that structure at Millville Dam, the first barrier to upstream eel migration on the Shenandoah River. That structure was installed and became operational in 2004. The USFWS and Allegheny Energy also agreed to a phased approach to constructing American eel upstream passage on the remaining dams on the Shenandoah River including the Warren, Luray, Newport, and Shenandoah hydroelectric stations. The eel ladder at Warren was installed in 2006, and construction of eel ladder on each subsequent dam upstream is planned to occur every three years thereafter until passage at the Shenandoah hydroelectric station (the farthest upstream) is achieved. Downstream passage at the hydroelectric stations on the Shenandoah River is provided by shutting the project down from dusk to dawn from September 15 through December 15 of each year which is estimated to be the primary migration period.

As part of the hydropower relicensing process for Dams 4 & 5, the NPS, USFWS, and Allegheny Energy signed a supplemental agreement for dam use in 2002. In this agreement, Allegheny Energy committed to providing funding to construct upstream eel ladder on Dams 4 and 5, while the DOI committed to being responsible for the planning and construction of the eel ladder. Allegheny Energy also committed to provide downstream passage for outmigrating eels by shutting down the hydropower projects on the two dams from dusk to dawn from September 15 through December 15 of each year. Over the last seven years, key staff from the NPS and USFWS have conducted four site visits at Dams 4 and 5, held a total of 57 meetings (through May 2009), and conducted two Choosing By Advantages (CBA) meetings.

1.3.3 Scoping

This EA was prepared in accordance with NEPA guidelines, and it examines the consequences of a proposed action on the environment. The document analyzes the short-term, long-term, and cumulative effects of the proposed action, alternatives, and the alternative of "No Action." By comparing the proposed action with the alternatives and No Action Alternative, and identifying mitigation measures that would minimize adverse effects, this EA will inform stakeholders about the decision making process and provide a format for submitting public comment.

Internal scoping refers to the interdisciplinary process used to define issues, alternatives, and data needs for the proposed action. The NPS in collaboration with the USFWS began internal scoping in 2002. Initial internal project scoping identified possible alternatives and possible resource and impact topics for consideration in the EA. In November 2007, project team members (NPS and USFWS) met to conduct a site visit and to review potential alternatives and site logistics and constrictions.

After the site visit, the project team held monthly meetings to discuss the development of project alternatives, project funding, and the project schedule. On July 22 and 23, 2008, the project team met at the park headquarters to determine which of the alternatives would be the best location and design for the eel ladder at Dam 4. This was completed by using the CBA Process. The CBA process is a decision-making process based on calculating and compiling the advantages of different alternatives for a variety of factors. The CBA process was completed for Dam 5 on September 16, 2008. This process will be discussed in more detail in Chapter 2.

In accordance with the NPS guidelines for implementing NEPA, external scoping, the process used to gather public input, was conducted. In January 2007 the NPS released a project scoping newsletter describing the proposed project and alternatives (Appendix A). Additionally a public scoping meeting was held on January 17, 2007 to give the public the opportunity to join project staff to learn about the migration of the American eel and the obstacles they encounter on their lifecycle migration between freshwater river habitat and saltwater spawning areas. During this scoping period, the public was invited to identify any issues or concerns they may have with the proposed project so that the NPS could appropriately consider them in this EA (Appendix A). As part of the NEPA process, this draft EA is being made available to the public and resource agencies for 30 days to solicit questions and comments.

Agency consultation was conducted in November 2008. Letters discussing the overview of the project were mailed to federal and state agencies including the USFWS, National Oceanic and Atmospheric Association National Marine Fisheries Service (NOAA NMFS), Maryland Department of Natural Resources (MDNR), West Virginia Department of Natural Resources (WVDNR), Maryland State Historic Preservation Office (MD SHPO), and West Virginia State Historic Preservation Office (WV SHPO). Letters and responses are located in Appendix B.

Consultation letters were mailed to state and federal agencies on November 13, 2008 requesting consultation and comments regarding the proposed project at Dams 4 and 5. Appendix B contains a list of agencies that received the consultation letter and a copy of the consultation letter. Responses were received from NOAA NMFS, USFWS, MDNR, WVDNR, and WV SHPO. Copies of the agency responses are also included in Appendix B.

1.4 ISSUES

Issues can be defined as the relationship between the proposed action and the human, physical, and natural environment (NPS 2001a). Issues are used to define which environmental resources may experience either negative or beneficial consequences from an action. They do not predict the degree or intensity of potential consequences that might result from an action. Issues are usually problems caused by the no action alternative or other alternatives, but may be other questions, concerns, or problems. After receiving information from Allegheny Energy, the public, outside agencies, and other sources, issues have been identified and include the following:

- continued safe downstream passage of eels at the dams
- impact to recreation during the construction of the eel ladders
- concerns of placing the eel ladder at Dam 4 on the West Virginia side of the river due to the large debris load during high flow which could potentially damage the eel ladder structure
- concerns of placing the eel ladder at Dam 5 on the Maryland side of the river due to the large debris load during high flow which could potentially damage the eel ladder structure
- construction of an "over elaborate" eel ladder that will not work.

These issues were evaluated as part of the NEPA process and led to the current impact topics in the subsequent sections.

1.5 IMPACT TOPICS

1.5.1 Derivation of Impact Topics

Impact topics were used to define and focus the discussion of resources that could be affected by the proposed action, and are the focus in the evaluation of the potential environmental consequences of the proposed action.

Potential impact topics were identified based on legislative requirements, Executive Orders, topics in *Director's Order #12 and Handbook* (NPS 2001), NPS *Management Policies* (NPS 2006), guidance from NPS, input from other agencies, public concerns, and resource information specific to the park. A summary of impact topics analyzed is provided below, along with the rationale for their inclusion.

1.5.2 Impact Topics Included in This Document

The following impact topics have the potential to be affected by the proposed action and are evaluated in detail in this EA.

Air Quality – Possible impacts to air quality would result during the installation of the eel ladders at Dams 4 and 5 due to the emissions from operating construction equipment.

Noise – Noise from construction equipment during the installation of the eel ladders would create an adverse impact to current noise levels at Dams 4 and 5.

Soils – The installation of eel ladders may include movement of soils within the two study areas.

Water Quality and Flow Rates – The installation of eel ladders in the Potomac River may temporarily impact the water quality and flow of water over Dams 4 and 5.

Wetlands and Deepwater Habitats – The proposed action is located within identified riverine and lacustrine deepwater habitat areas.

Vegetation – Vegetation may be impacted during the installation of the eel ladders within the two study areas.

Wildlife – Wildlife may be impacted during the installation of the eel ladders within the two study areas.

Aquatic Resources – Aquatic resources within the study areas may be temporarily disturbed during the installation of the eel ladders. The eel ladders would improve access to over 120 miles of river for the American eel.

Historic Structures – The C&O Canal is listed on the National Register of Historic Places (NRHP) as an historic district, and Dams 4 and 5 are recognized as significant historic structures. The Dam 4 Hydroelectric Station and the Dam 5 Hydroelectric Station are also listed in the NRHP.

Visitor Use and Safety – During the installation of the eel ladders, visitor experience may be impacted temporarily.

Visitor Experience – The park provides many recreation activities to park visitors. The areas surrounding Dams 4 and 5 are used by hikers, bikers, fisherman, canoeists, horseback riders, and campers. The installation of the eel ladders may impact the recreation opportunities available to park visitors during the construction phase of the project.

Aesthetics – Aesthetics at the site may be temporarily disrupted during the installation of the eel ladders at Dams 4 and 5.

Park Operations – Park operations would possibly be impacted by the installation of the eel ladders, as the park staff may be needed during the construction these structures.

Energy Resources – The installation of the eel ladders at Dams 4 and 5 may impact the Allegheny Energy hydroelectric generating stations. The proposed action may require an increase in energy use during installation and implementation of the eel ladders.

1.5.3 Impact Topics Dismissed from Further Analysis

A summary of impact topics dismissed from analysis is provided below, along with the rationale for their dismissal.

Topography – The topography surrounding Dams 4 and 5 would not be affected by the installation of the eel ladders.

Geology – The installation of the eel ladders would have no possible effect to the geology of the two study areas. Removal of soils would not affect the geologic features of the area.

Floodplain – NPS has adopted guidelines pursuant to Executive Order 11998 *Floodplain Management* stating that NPS policy is to restore and preserve natural floodplain values and avoid environmental impacts associated with the occupation and modification of floodplains. The guidelines also require that, where practicable alternative exist, Class I action be avoided within a 100-year floodplain. Class I actions include the location or construction of administration, residential, warehouse, and maintenance buildings, non-excepted parking lots, or other man-made features that by their nature entice or require individuals to occupy the site. Dam 4, Dam 5, and the areas of park running along the Potomac River lie within the 100-year floodplain. There would be no possibility of effects to the floodplain since the eel structure would be attached to the dam. There would be no addition of impervious areas within the floodplain.

Special Status Species – Protected species occur throughout the park; however, none occur within the project location. This environmental document will serve as the basis for appropriate consultation with the agencies charged with protecting listed species.

Wild and Scenic Rivers – The Potomac River is not designated as a wild and scenic river as defined in the Wild and Scenic Rivers Act (16 United States Code [USC] 1271 – 1287). Additionally, the Potomac is not designated as a study river. Study rivers are defined as "designated for potential addition to the national wild and scenic rivers system" (NWSRS 2008).

The Nationwide Rivers Inventory (NRI) is a listing of more than 3,400 free-flowing river segments in the United States that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance by the NPS (NPS 2007). Under 1979 President Directive and related CEQ Procedures, all federal agencies must seek to avoid or mitigate actions that would adversely affect one or more NRI segments. A total of seven segments of the Potomac River are included in the NRI, however none of these segments are in the vicinity of the project location (NPS 2007).

Prime and Unique Farmlands – There are no soils within the proposed project area that meet the criteria of prime or unique farmlands.

Archeological Resources - The primary source for archeological resources are the NPS's Archeological Sites Management Information System (ASMIS), which is a database for registration and management of archeological resources. The major archeological studies that have been completed for this section of the park include a draft overview and assessment of the park's archeology and history (Barse and Wuebber 2002), a three-year program of archeological survey (Bedell et al. 2009), and a study for the Big Slackwater towpath rehabilitation project (Fiedel and LeeDecker 2006), between canal milemarker (MM) 85.62 and 88.10. Because none of the proposed alternatives would directly or indirectly affect known archeological resources, this topic was dismissed as an impact topic. There is a remote possibility that archeological remains of the original dams on the river bottom, but as these structures were replaced in the 1850s and 1860s, the possibility that well-preserved remains of these dams have survived is considered remote.

Cultural Landscapes – According to the NPS Cultural Resource Management Guideline (NPS-28), a cultural landscape is:

> "...a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. The character of a cultural landscape is defined both by physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions."

There has not yet been a formal survey to identify cultural landscapes within the park. All potential impacts to the historic features and views are addressed under the historic structures and districts topic; therefore, cultural landscapes were dismissed as a separate impact topic.

Ethnographic Resources - Ethnographic resources are defined by the NPS as any "site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" (Director's Order # 28, Cultural Resource Management Guideline). In this analysis, the NPS term "ethnographic resource" is equivalent to the term "Traditional Cultural Property" (TCP) which is more widely used in cultural resource management. Guidance for the identification of ethnographic resources is found in National Register Bulletin #38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1998). The key considerations in identifying TCPs are their association with cultural practices or beliefs of a living community that are (i) rooted in the community's history and are (ii) important in maintaining the continuing cultural identity of the community (Parker and King 1998:1). There are no properties that meet the definition of a TCP within the project area; therefore ethnographic resources were dismissed as an impact topic.

Museum Collections – None of the alternatives would impact museum collections (historic artifacts, natural specimens, and archival and manuscript material); therefore, museum collections were dismissed as an impact topic.

Land Use – The land surrounding Dams 4 and 5 on the Maryland side of the Potomac River are owned and managed by NPS. The area adjacent to the dams on the West Virginia side is owned and maintained by Allegheny Energy. Land use in these areas would remain unchanged.

Socioeconomic Resources – The proposed action would not affect resources outside of the park including demographics, economy, housing, or environmental justice.

2.0 PROPOSED ACTION AND ALTERNATIVES

This section provides a detailed description of the alternatives that have been considered for the proposed action.

2.1 ALTERNATIVE A - NO ACTION ALTERNATIVE

The No Action Alternative is required for the NEPA process to review and compare feasible alternatives to the baseline conditions. Under the No Action Alternative eel ladders at Dams 4 and 5 would not be constructed. Dams 4 and 5 would continue to obstruct the upstream migration of the American eel from the Sargasso Sea to their native freshwater habitats. Some eels currently occur upstream of the dams due to the unique swimming and climbing abilities of the smaller juvenile eels (elvers). However, the abundance of American eels upstream of the dams would remain low without the installation of the eel ladders (MGIFC 2008). Larger eels would continue to be blocked from migrating upstream. Allegheny Energy is required by license to shut down all turbines during night time hours from September 15 to December 15 to allow out migration of American eels through the projects without risk of turbine mortality.

2.2 COMMON TO ALL ACTION ALTERNATIVES – ALTERNATIVES B, C, AND D

The action alternatives would allow more eels and larger eels to swim past the barriers of Dams 4 and 5 to reach their upstream feeding grounds. The eel ladders would be designed to meet project requirements at each location. The design for each location could be different due to different factors, such as river dynamics. The basic design of an eel ladder is not unusual and has been installed successfully at other dams. It has the eel enter an ascending ramp at the base of the dam. A screen, pump, and flow distribution nozzle, would be used to draw the eels toward the ladder by providing operating flow and side channel attraction water flow. The pump would run during the American eel upstream migratory period, typically from March through October. Once the eels enter the ladder, they swim up the angled ascending ramp by pushing against a tubular substrate. The eels would be monitored and counted either at a collection box within the ladder or at a live circular well at the end of the exit pipe. The following are the eel ladder design characteristics and operation that are typical to eel ladders:

- The ascending ramp would be constructed of marine grade aluminum with the interior constructed of polyvinyl chloride (PVC) pipe or equivalent substrate.
- The eel ladder would be supported by attaching the ladder to structures (dam, abutment, forebay, or powerhouse) using supports including rock bolts, Hilti anchors, thunderbolt anchors, mortar, or an added concrete base with anchor bolts and plates (masonry joint

anchors). The NPS would strive to use masonry joint anchors for attachment; however some brackets would need to be attached to the historic structures.

- Turn pools are typically located at an intermediate point in the ascending ramp, before the eels enter the exit pipe.
- Non-overflows can be used to help maintain proper flow fields to attract eels to the ladder entrance by stopping the veil of water that flows over the dam at a certain location. If needed, the non-overflows would be approximately 3-4 feet high and contain 2 feet by 3 feet piers that are anchored to the concrete coping (top) course of the dam (unless otherwise noted). Stop planks or logs would extend 4-8 feet between the piers.
- A constant head regulating tank, sump pump (10 gallons per minute [gpm]) inside a screened well, and flow nozzle(s) with associated piping would be used to provide an operating flow to the eel ladder.
- Attraction flow would be provided by a pump (80 to 120 gpm), siphon or gravity with a 4-inch diameter PVC piping that discharges along the wall adjacent to the entrance.
- The collection box would be approximately 3 feet in height and 3 feet in diameter and would be secured and camouflaged to match the existing surroundings.
- The collection box would be monitored by project biologists at least twice weekly for the first season to gauge the success of the eel ladder. Eels would either be hand released in the upstream impoundment or eels would swim out of the live well upstream.
- The live well would provide an additional monitoring area and also the intake water for the eel ladder. The live well would be located in the Potomac River and would be supported by large boulders placed in the river.
- Equipment needed to install and operate the proposed eel ladder includes cofferdams and/or sandbags, a backhoe and/or jib crane, a concrete mixer, ladders, welding/cutting tools, and hand tools.
- In order to install the eel ladder and associated structures, the pool located upstream of both Dam 4 and 5 may be lowered or sandbags would be placed on the dam to prevent the water from spilling over the dam. If necessary, the drawdown is estimated to last a total of one week.
- If support structures are needed for the exit pipe, concrete footings would be installed where appropriate. Concrete footings would be circular structures approximately 1-foot in diameter and would be placed to a depth of approximately 4 feet below the ground surface.
- Construction of the eel ladders is estimated to last up to eight weeks.

2.2.1 Dam 4

Dam 4 is the first of the two dams that the eels encounter along this section of the Potomac River. Dam 4 is approximately 715 feet long and 18 feet high. Allegheny Energy operates a hydroelectric station at the dam, located along the West Virginia shoreline. The Dam 4 Hydroelectric Station consists of a 200-foot long, 80-foot wide headrace; a stone and concrete powerhouse containing three generating units with a total installed capacity of 1,900 kilowatts; and a 350-foot long, 90-foot wide tailrace. The Dam 4 Hydroelectric Station is operated in run-of-river mode with a minimum 1-inch veil of water over the dam at all times. Power generation ceases when the 1-inch veil cannot be maintained. The river dynamics at Dam 4 track the heaviest debris flow along the West Virginia shoreline. The location of the key features of Dam 4 Hydroelectric Station including the headrace, tail waters, tailrace, abutment, powerhouse, and forebay are displayed in Figure 2-1. These physical features, along with scientific criteria and preservation of historic resources became factors for the development of potential designs at Dam 4. Details regarding these factors are listed in Section 2.7.

There are three design alternatives for Dam 4 (Alternatives B-D). Alternative B has been chosen as the preferred alternative. Table 2-1 includes the design techniques and details on each alternative. Conceptual designs for each alternative can be found in Appendix C.

Figure 2-1. Location of Key Features at Dam 4

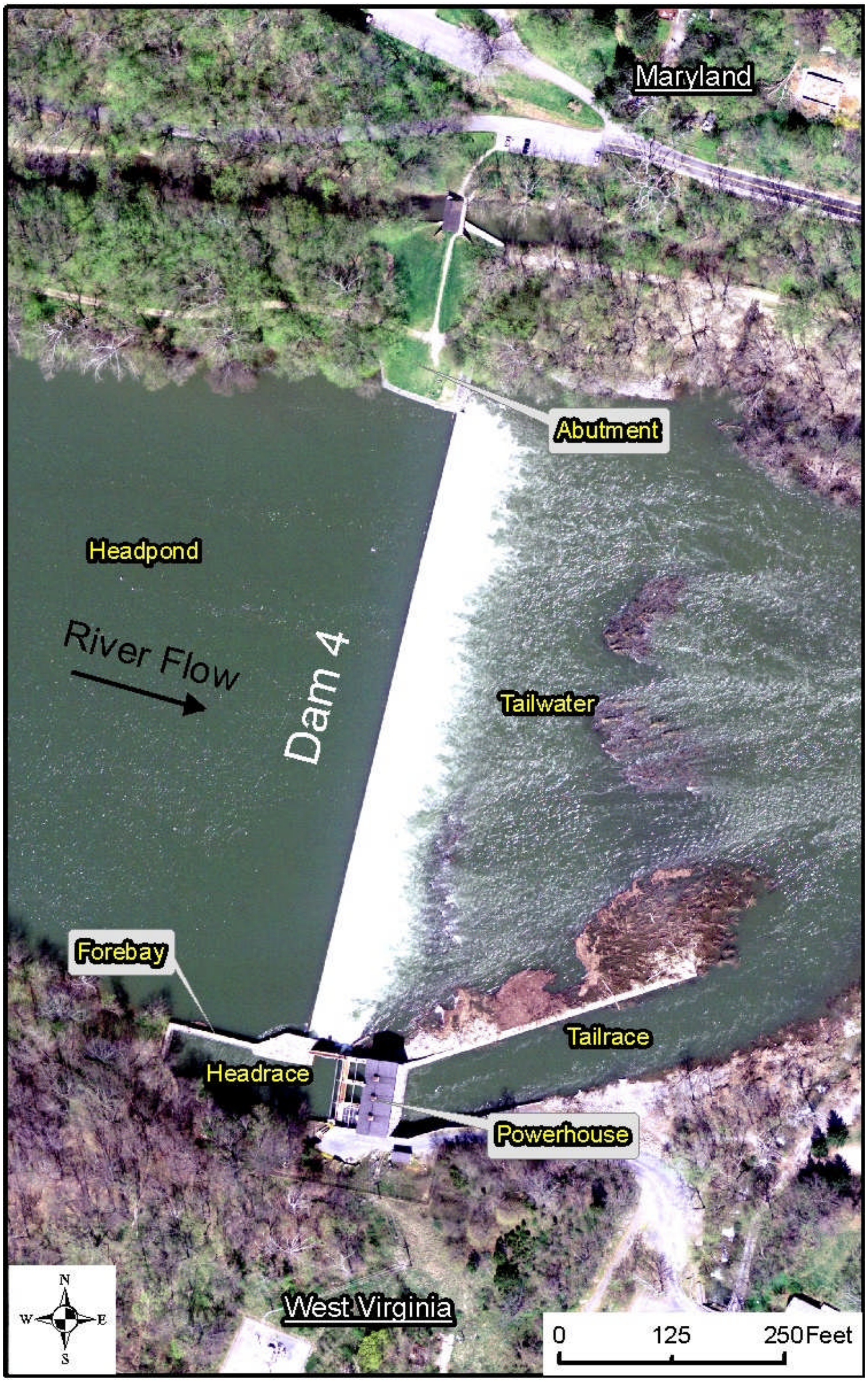


Table 2-1. Design Characteristics of Dam 4 Alternatives

Design Characteristics	Dam 4 Alternatives		
	Alternative B Preferred Alternative	**Alternative C**	**Alternative D**
Location of Eel Ladder	• Maryland shoreline	• West Virginia shoreline	• West Virginia shoreline
Location of Eel Ladder Entrance	• Corner of dam on the east face of the abutment. • Entrance would include an open-end entrance box approximately 4-ft wide and ramp placed at a 35-degree angle with a sloped cover.	• Located in the tailwaters parallel to the dam. • Attached to the ledge and north face of the abutment.	• Located in the tailrace below the powerhouse. • Attached to the powerhouse or tailrace side wall.
Turn Pools	• 90-degree turn pool at the second underground ascent of the ramp. • 90-degree turn pool from exit pipe to the live well.	• No turn pools with ramp directed into collection box	• 180-degree turn pool located on the tailrace sidewall.
Collection Box	• Attached at the top of the ramp at the 90-degree turn to the exit pipe(s).	• Attached at the top of the ramp.	• Located at the powerhouse at the top of the ramp at the 180-degree turn pool.
Non-Overflow	• No non-overflow is needed.	• Short non-overflow approximately 10-15 feet long and 3-4 feet high. • Placed in the tailwater. • Constructed of locally sourced stone.	• No non-overflow is needed.
Exit Pipe	• Exit pipe(s) would slope at 4 to 5 degrees for approximately 100-feet and would be located away from the stone abutment.	• Exit pipe would extend approximately 200-feet and would run along the forebay.	• Exit pipe would extend approximately 200 feet and would run along the shoreline, through the abutment, and along the forebay.
Live Well	• Located upstream of the dam.	• Located upstream of the head gates of the dam.	• Located upstream of the head gates of the dam.
Electricity	• Electricity would be brought in below ground from outside of the park or a solar panel would be installed. • No electricity is available.	• Electricity is available at the site for the attractant flow pump.	• Electricity is available at the site for the attractant flow pump.

Design Characteristics	Dam 4 Alternatives		
	Alternative B Preferred Alternative	**Alternative C**	**Alternative D**
Removable	• The eel ladder would be a permanent structure with exit pipes, collection box, and ramp connection able to be removed. The entire structure is designed to be fully reversible without attachment to existing structures or masonry walls.	• The eel ladder would be easily removable.	• The lowermost section of the eel ladder would be removable.

2.2.2 Dam 5

Dam 5 is 22 miles upstream of Dam 4. Dam 5 is approximately 711-feet long and 22-feet high. Allegheny Energy operates a hydroelectric station at the dam, along the West Virginia shoreline. Dam 5 Hydroelectric Station consists of a 100-foot long, 80-foot wide headrace; a brick and concrete powerhouse containing two generating units with a total installed capacity of 1,210 kilowatts; and a 250-foot long, 90-foot wide tailrace. The Dam 5 Hydroelectric Station is operated in a run-of-river mode with a minimum 1-inch veil of water over the dam at all times. Power generation ceases when the 1-inch veil cannot be maintained. The river dynamics at Dam 5 track the heaviest debris flow along the Maryland shoreline. The location of the key features of Dam 5 Hydroelectric Station including the tail waters, tailrace, abutment, powerhouse, and forebay are displayed in Figure 2-2. These physical features, along with scientific criteria and preservation of historic resources became factors for the development of potential designs at Dam 5. Details regarding these factors are listed in Section 2.7.

The basic design of the eel ladder at Dam 5 would be the same as Dam 4. The design characteristics common to all alternatives are discussed above in Section 2.2 *Action Alternatives*. There are three design alternatives for Dam 5 (Alternatives B-D). Alternative B has been chosen as the preferred alternative. Table 2-2 includes the design techniques and details on each alternative. Conceptual designs for each alternative can be found in Appendix C.

Figure 2-2. Location of Key Features at Dam 5

Table 2-2. Design Characteristics of Dam 5 Alternatives

Design Characteristics	Dam 5 Alternatives		
	Alternative B Preferred Alternative	**Alternative C**	**Alternative D**
Location of Eel Ladder	• West Virginia shoreline	• West Virginia shoreline	• Maryland shoreline
Location of Eel Ladder Entrance	• Located in the tailrace.	• Located in the tailwaters perpendicular to the dam. • Attached to the forebay.	• Located in the tailwaters perpendicular to the dam. • Attached to the abutment.
Turn Pools	• Two 180-degree turn pools once the eels ascend the entrance ramp.	• 90-degree turn at or after collection once eels ascend the ramp.	• 180-degree intermediate turn pool once the eels ascend the entrance ramp.
Collection Box	• Located at the powerhouse after the second turn pool.	• Located at the top of the ramp prior to the exit pipe.	• Attached to the abutment at the top of the ramp. • Security fence would be required.
Non-Overflow	• No non-overflow is needed.	• Short non-overflow, approximately 15 feet long and 3-4 feet high. • Associated low weir would be required. • Low weir and non-overflow would be placed in the tail waters. • Constructed of reinforced concrete or stone masonry.	• Short non-overflow, approximately 12-15 feet long and 3-4 feet high. • Associated low sill would be required. • Non-overflow and low sill would be placed in the tailwaters.
Exit Pipe	• An extensive exit pipe, approximately 300-feet long would be placed along the abutment and forebay.	• An extensive exit pipe, approximately 160-feet long would be placed along the forebay.	• Short exit pipe, approximately 60-feet long would be placed across the dam and into the headpond. If needed concrete footings would be placed on the river bank to support the structure.
Live Well	• Located upstream of the headpond.	• Located upstream of the headpond.	• Located in the headpond upstream of the dam.
Electricity	• Electricity is available at the site for the attractant flow pump.	• Electricity is available at the site for the attractant flow pump.	• No electricity is available. • Electricity would be brought in below ground from outside of the park or a solar panel would be installed.
Removable	• The eel ladder would be retractable.	• The eel ladder would be retractable.	• The eel ladder would be retractable.

2.3 MITIGATION MEASURES OF THE ACTION ALTERNATIVES

Mitigation measures are taken to lessen the adverse effects of the action alternatives. Due to the alternatives and associated environmental impacts, mitigation would be required for impacts to historic resources, human health and safety, and aesthetics. Mitigation measures are summarized below:

- The use of masonry joint anchors would be used when feasible to minimize the impact to the historic dams.
- Live wells would be located upstream of the dams when feasible to ensure a safer environment for project biologists monitoring the eels in the collection boxes.
- Live wells and collection boxes would be camouflaged to minimize the impact to aesthetics and the visual landscape and reduce potential attractive nuisance.
- Tailwater non-overflows would be constructed using materials consistent with the appearance of the original dam to minimize the impacts to aesthetics and cultural landscapes.

2.4 SELECTION OF THE ALTERNATIVES

Due to the large number of potential alternatives for each location, selection of alternatives to be carried through the environmental assessment was accomplished by using the Choosing by Advantages (CBA) process developed by Jim Suhr (Suhr 1999). CBA is a decision making process based on identifying and evaluating the advantages of different alternatives for a variety of factors. By using the CBA process, the NPS and USFWS, along with eel subject specialists, were able to determine which of the alternatives would be the best location and design for the eel ladders. The alternatives were examined in detail, given the information available on existing conditions, and preliminary site plans were developed for each alternative. Among the elements evaluated were eel passage, cultural and historic resources, visitor experience, and operation and maintenance. The project team met at the park headquarters on July 22 and 23, 2008 to complete the CBA process for Dam 4 and on September 16, 2008 to complete the CBA process for Dam 5.

In the CBA process, factors represent areas of concern that were expressed by the NPS technical advisors, park staff, subject specialists, and USFWS. High and low assessment criteria were established for each factor. High criteria describe very favorable or desirable environmental conditions. The minimum criterion generally reflects the minimum standards permitted by federal law or NPS policy. Advantages were determined by calculating the difference between attributes for each factor among the alternatives.

The factors developed for the CBA process for Dams 4 and 5 included: Ability to Pass Eels Upstream, Cultural Landscapes and Structures, Visitor Experience, Operation and Maintenance, Eel Monitoring, Risk and Safety Management, Construction, and Susceptibility to Structural Damage.

Elements of a "factor" are considered "attributes" in CBA parlance. Attributes were identified for each of the factors. For example, under the factor of "Ability to Pass Eels Upstream," the "attributes," or measures, of the factor were determined to be the consistency of the water flow, the ability in attracting eels, operates in low flow conditions, and avoid eel entrainment (eels being pulled into the hydro system). The ability to attract and pass the eels upstream would differ depending on design and location of the eel ladder. The advantage of an alternative is the maximum ability to pass the eels in variable river flow areas and maximum ability to avoid eel entrainment.

The advantages of each factor were determined and these advantages were compared to one another, to determine which advantage was most important to this project, or "paramount." The next step was to compare the other advantages to this "paramount advantage" to determine their importance relative to the paramount advantage and then to assign an appropriate score for each. After this exercise was completed, the scores of each alternative were calculated, and the alternative that scored the highest was considered the most advantageous alternative according to the interdisciplinary team of specialists.

The final steps in analyzing the alternatives involved a cost analysis as well as the CBA process. A preliminary estimate of probable costs based on schematic designs was prepared for each of the alternatives. The results of the CBA for Dam 4 determined Alternative 11 (dismissed alternative) as the preferred alternative for the design and location of the eel ladder. Upon further project development of the alternatives, post CBA, a new alternative (named Alternative B) was evaluated for the Dam 4 location. This alternative located the eel ladder underground behind the dam's abutment on the Maryland shoreline. This alternative removed the eel structure from the face of the abutment, as had been identified in Alternative 11 (dismissed alternative). In evaluating this new design within the framework of the CBA, it met all of the factors. Therefore the preferred alternative for Dam 4 is Alternative B. The results of the CBA for Dam 5 determined Alternative B as the preferred alternative for the design and location of the eel ladder.

2.5 ENVIRONMENTALLY PREFERABLE ALTERNATIVE

In accordance with Director's Order # 12, the NPS is required to identify the "environmentally preferable alternative" in all environmental documents, including environmental assessments. The environmentally preferable alternative is determined by applying the criteria suggested in NEPA of 1969, which is guided by the CEQ. The CEQ provides direction that "[t]he environmentally preferable alternative is the alternative that would promote the national environmental policy as expressed in Section 101 of the NEPA, which considers:

1. Fulfilling the responsibilities of each generation as trustee of the environment for succeeding generations;
2. Assuring for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings;
3. Attaining the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
4. Preserving important historic, cultural, and natural aspects of our national heritage and maintaining, wherever possible, an environment that supports diversity and variety of individual choice;
5. Achieving a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities; and
6. Enhancing the quality of renewable resources and approaching the maximum attainable recycling of depletable resources (NEPA, Section 101)."

2.5.1 Dam 4

Following comparisons of the alternatives for the design and location of the Dam 4 eel ladder, Alternative B has been selected as the environmentally preferable alternative. Alternative B has minimal impacts to cultural resources. In addition, Alternative B has less of a visual component when compared to other alternatives, thereby minimizing the impacts to aesthetics and visual quality of the area. The location of the collection box would provide safer conditions to project staff monitoring eels. In addition the location of the collection box would be more attractive to the eels. A summary of the alternatives for Dam 4 and how each would meet the goal statements is provided in Table 2-3.

Table 2-3. Selection of the Environmentally Preferable Alternative for Dam 4

NEPA Goal Statement	Alternative A - No Action Alternative	Alternative B	Alternative C	Alternative D
(1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations	Interferes with meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal
(2) Ensure for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings	Neither contributes nor detracts from meeting this goal	Neither contributes nor detracts from meeting this goal	Interferes with meeting this goal	Interferes with meeting this goal
(3) Attain the widest range of beneficial uses of the environment without degradation, risk of health and safety, or other undesirable and unintended consequences.	Neither contributes nor detracts from meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal

Table 2-3. Selection of the Environmentally Preferable Alternative for Dam 4

NEPA Goal Statement	Alternative A - No Action Alternative	Alternative B	Alternative C	Alternative D
(4) Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity and variety of individual choice	Neither contributes nor detracts from meeting this goal	Neither contributes nor detracts from meeting this goal	Interferes with meeting this goal	Interferes with meeting this goal
(5) Achieve a balance between population and resource that would permit high standards of living and a wide sharing of life's amenities	Interferes with meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal
(6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources	Neither contributes nor detracts from meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal

2.5.2 Dam 5

Following comparisons of the alternatives for the design and location of the Dam 5 eel ladder, Alternative B has been selected as the environmentally preferable alternative. Alternative B has the highest protection of the historic resources and cultural landscape. When compared to other alternatives, Alternative B has the lowest risk to health and safety of the public, NPS staff, and Allegheny Energy staff. A summary of the alternatives for Dam 5 and how each would meet the goal statements is provided in Table 2-4.

Table 2-4. Selection of the Environmentally Preferable Alternative for Dam 5

NEPA Goal Statement	Alternative A -No Action Alternative	Alternative B	Alternative C	Alternative D
(1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations	Interferes with meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal
(2) Ensure for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings	Neither contributes nor detracts from meeting this goal	Contributes toward meeting this goal	Interferes with meeting this goal	Interferes with meeting this goal
(3) Attain the widest range of beneficial uses of the environment without degradation, risk of health and safety, or other undesirable and unintended consequences.	Neither contributes nor detracts from meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal	Interferes with meeting this goal

Table 2-4. Selection of the Environmentally Preferable Alternative for Dam 5

NEPA Goal Statement	Alternative A -No Action Alternative	Alternative B	Alternative C	Alternative D
(4) Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity and variety of individual choice	Neither contributes nor detracts from meeting this goal	Neither contributes nor detracts from meeting this goal	Interferes with meeting this goal	Interferes with meeting this goal
(5) Achieve a balance between population and resource that would permit high standards of living and a wide sharing of life's amenities	Interferes with meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal
(6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources	Neither contributes nor detracts from meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal	Contributes toward meeting this goal

2.6 ALTERNATIVES CONSIDERED BUT DISMISSED

Additional alternatives were identified during internal scoping between the NPS and USFWS. These alternatives were dismissed from further analysis due to the lack of technical feasibility, potential for major environmental impacts to the park, and conflicts with the purpose and need of the project. Table 2-5 includes a description of the dismissed alternatives and justification for dismissal.

Table 2-5. Alternatives Considered but Dismissed

Alternative	Description	Reason for Dismissal
Dam 4 – Alternative 1	The eel ladder would be located on the West Virginia shoreline at the base of the dam. The eel ladder would pass through the concrete forebay wall. An extended outlet pipe would pass eels upstream of the headgates. The collection box would be located near the bridge or abutment or at the end of the exit pipe. A short non-overflow would be optional.	This alternative presents poor access for construction equipment and eelway operation and maintenance.
Dam 4 – Alternative 2	The eel ladder would be located on the West Virginia shoreline approximately 50 feet from the base of the dam. An extended outlet pipe would pass eels upstream of the headgates. The collection box would be located near the bridge or abutment or at the end of the exit pipe.	The entrance of the ladder would be too far downstream; the eels would have little chance to find the entrance. Other problems include poor access for construction equipment; high chance of ladder removal during floods; and long ramps, switchbacks, and exit piping.
Dam 4 - Alternative 3	The eel ladder would be located on the West Virginia shoreline. A 20-to 30-foot non-overflow would be needed to protect the structure from debris.	The non-overflow device would be too long or large and could cause permitting problems. This option could cause adverse impacts to the historic properties. Other problems include limited construction equipment access and damage to ladder from flooding and debris.
Dam 4 – Alternative 4	The eel ladder would be located on the West Virginia shoreline. The ladder would be small in size and placed parallel to the dam. A long non-overflow would be placed in the tailwaters. The eels would exit the ladder downstream from the headgates.	The non-overflow device placed in the tailwater would be extensive. The location of the eel ladder exit increases the risk of eel entrainment towards the forebay and the turbines intakes.

Table 2-5. Alternatives Considered but Dismissed

Alternative	Description	Reason for Dismissal
Dam 4 – Alternative 5	The eel ladder would be located on the Maryland shoreline. A concrete pier located upstream from the dam would house the ladder exit, pump, screen, and spray bar. The eel ladder track would extend through the dam. There would be extensions of track on both sides of the dam, which would be encased in concrete for stability and protection of the eel ladder.	The permanent concrete pier would require a coffer dam for construction, which would increase construction costs. Electrical service routing would be problematic. This option would require boring a hole for eel passage through the dam, which would pose permitting, engineering, and logistical problems. In addition, highly variable hydraulic conditions located at the entrance of the ladder could cause problems.
Dam 4 – Alternative 6	The eel ladder would be located on the Maryland shoreline. An entrance into the bypass canal would be located downstream of the dam. The eels would travel along the bypass channel where they would reach the eel ladder approximately 1 mile upstream and exit back into the main stem of the river in the headpond.	The entrance to the bypass canal would be located too far from the dam and the eels would have little chance to find the entrance. This alternative is prohibitively expensive and construction activities would be invasive. The hydraulic modeling required to create flow in the canal would be very involved and does not guarantee an acceptable outcome.
Dam 4 – Alternative 7	The eel ladder would be located on the Maryland shoreline. The entrance to the eel ladder would be located at the base of the abutment. The eels would travel one mile in the historic canal to the exit pipe which places the eels into the main stem of the river in the headpond.	There is not enough water velocity in the historic canal to attract the eels upstream to the head gate area. The exit pipes at the headgate would penetrate the canal wall. This alternative would likely not provide successful eel passage. This alternative would have a high susceptibility to flood damage and would require extensive maintenance.
Dam 4 – Alternative 8	The eel ladder would be placed on the Maryland shoreline. A trapezoidal notch in the top of the dam would provide continuous attractant flow. The sides of the eel ladder would contain rebar grid climbing media.	The alterations proposed to the dam would create adverse impacts to the historic structure. Other problems include no control of flow into the climbing ramp, no safe way to collect the eels, and difficult access for cleaning and maintenance.

Table 2-5. Alternatives Considered but Dismissed

Alternative	Description	Reason for Dismissal
Dam 4 – Alternative 9	The eel ladder would be placed on the West Virginia shoreline in the tailwaters perpendicular to the dam. A non-overflow approximately 12-15 feet long would be placed on the concrete coping of the dam.	The entrance to the eel ladder would have a lower probability of attracting eels. The placement of the non-overflow on the dam would create adverse impacts to historic resources and there is a greater chance of damaging the structure since heavy debris loads are located on the West Virginia shoreline.
Dam 4 – Alternative 10	The eel ladder would be placed on the Maryland shoreline in the bypass channel parallel to the dam. An extensive non-overflow approximately 25-30 feet long would be placed on the dam.	The extensive non-overflow could adversely affect the dam both physically and visually. This alternative places the exit over fast moving and deep water which could cause a safety issue. Also this alternative would require substantial support structures that would be an impact to visual resources.
Dam 4 – Alternative 11	The eel ladder would be placed on the Maryland shoreline in the corner of the dam. The eel ladder would run along the abutment and wrap behind the abutment.	This alternative was replaced with Alternative B. This alternative would attach to the outside faces of the abutment potentially causing adverse effects to historic resources. The exposure of the eel ladder would also make it susceptible to flood damage.
Dam 5 – Alternative 12	The eel ladder would be located on the West Virginia shoreline. The eel ladder entrance would be located perpendicular to the base of the dam in the tailwaters. A short non-overflow would be placed on the dam. The eels would exit the eel ladder in the headpond above the forebay through an extended exit pipe.	The non-overflow section would be too short to provide and insure good hydraulic conditions all the time. This alternative would have a high susceptibility to flood damage and would require extensive maintenance.

Table 2-5. Alternatives Considered but Dismissed

Alternative	Description	Reason for Dismissal
Dam 5 – Alternative 13	The eel ladder would be located on the West Virginia shoreline. The eel ladder would be placed parallel to the dam. A permanent extension to the existing steel plate would create a non-overflow. A collection box would sit behind the steel plate and would be accessed from the abutment. The eels would exit the eel ladder downstream of the headgates.	Problems associated with this option include an extensive non-overflow, possible damage to eel ladder due to flooding, and difficult and unsafe construction and operation access. In addition, there would be a need to deliver the eels farther upstream. The eels exit the eel ladder downstream from the headgates which increases the risk of entrainment towards the forebay and the turbine intakes.
Dam 5 – Alternative 14	The eel ladder would be located on the West Virginia shoreline. The eel ladder entrance would be placed parallel to the dam. A long non-overflow would be placed in the tailwaters below the dam. The eels would exit the eel ladder downstream of the headgates.	Problems associated with this option include an extensive non-overflow, possible damage to eel ladder due to flooding, and difficult and unsafe construction and operation access. In addition, there would be a need to deliver the eels farther upstream. The eels exit the eel ladder downstream from the headgates which increases the risk of entrainment towards the forebay and the turbine intakes.
Dam 5 – Alternative 15	The eel ladder would be located on the Maryland shoreline. The eel ladder would be placed perpendicular to the dam, attached to the west façade of the abutment. The entrance to the eel ladder would be 30 feet from the face of the dam. A short non-overflow would be permanently attached into the concrete cap of the dam.	The entrance to the ladder would be too far downstream; the eels would have little chance to find the entrance. The permanent addition to the historic dam would create adverse impacts to cultural resources. The ladder would be subject to damage from flooding and debris, since Maryland is the debris side of this dam. Additionally, there is a need to deliver the eels farther upstream.
Dam 5 – Alternative 16	The eel ladder would be located on the Maryland shoreline. The entrance to the eel ladder would be located downstream of the stone abutment. An extended exit would run behind the abutment and discharge the eels upstream of the headgates.	The entrance to the eel ladder is located too far from the dam and the eels would have little chance to find the entrance. Numerous impediments with construction exist with this alternative.

Table 2-5. Alternatives Considered but Dismissed

Alternative	Description	Reason for Dismissal
Dam 5 – Alternative 17	The eel ladder would be located on the Maryland shoreline. The entrance to the eel ladder would be located downstream of the stone abutment. A short exit pipe would run along the abutment.	The entrance to the eel ladder is located too far from the dam and the eels would have little chance to find the entrance. The eel ladder is designed to be visible and accessible to users of the river and the park, therefore there is a high potential of vandalism.
Dam 5 – Alternative 18	The eel ladder would be located on the Maryland shoreline. The entrance to the eel ladder would be located downstream of the stone abutment at the Roller Compacted Concrete. An extended exit would run through the abutment and dam and discharge eels upstream of the headgates.	The entrance to the eel ladder is located too far from the dam and the eels would have little chance to find the entrance. This alternative would be expensive to engineer and construct. The staging of boring equipment would be difficult due to the access over the canal. The permanent addition to the historic dam would create adverse impacts.
Dam 5 – Alternative 19	The eel ladder would be located on the Maryland shoreline. The entrance would be located in the tailwaters perpendicular to the dam. A non-overflow and coffer dam would be placed on the dam.	This alternative has a lower ability to pass eels over the dam. The placement of the non-overflow and coffer dam on the eel ladder would cause a potential impact to historic resources and visual resources.
Dam 5 – Alternative 20	The eel ladder would be placed on the Maryland shoreline in the tailwaters perpendicular to the dam. An extensive non-overflow would be placed on the dam.	The extensive non-overflow may cause an adverse impact to historic resources and visual resources. The exit for this alternative is located above fast moving, deep water which could potentially cause safety issues.
Dam 5 – Alternative 21	The eel ladder would be placed on the Maryland shoreline in the tailwaters perpendicular to the dam. An extensive non overflow would be placed in the tailwaters.	The extensive non-overflow may cause an impact to the historic dam and visual resources. The exit for this alternative is located above fast moving, deep water which could potentially cause safety issues.

Table 2-5. Alternatives Considered but Dismissed

Alternative	Description	Reason for Dismissal
Dam 4 and 5 – Alternative 22	An eel trap would be placed on the Maryland side of each dam in lieu of an eel ladder. The eel trap would be located behind the abutment at each dam.	The eel trap would require continual operational inspections by biologists. The biologists would transport the eels to a safe release point upstream. The risk of eel mortality would be high. There is a high potential for vandalism, as the eel trap would be an attractive target to boaters, anglers, and pedestrians.

2.7 ALTERNATIVES COMPARISON TABLE

Tables 2-6 and 2-7 compare and contrast each action alternative for Dams 4 and 5, respectively, including the degree to which each alternative accomplishes the purpose and fulfills the need of the project. High and low assessment criteria established during the CBA process was used to compare the alternatives in Table 2-6 and 2-7. The purpose of this project is to fulfill the need of upstream American eel passage while avoiding impacts to park resources including historic resources, visitor experience, and natural resources.

Table 2-6. Comparison of Dam 4 Alternatives

Alternative	Project Objectives			
	Ability to Pass Eels Upstream	**Avoid Impacts to Cultural Resources and Landscapes**	**Avoid Impacts to Visitor Experience**	**Avoid Impacts to Wildlife and Vegetation**
Alternative A - No Action Alternative	Unable to pass American eels safely upstream.	Maintains current conditions. No impacts to cultural resources.	Maintains current conditions. No potential for visitor education on eels.	Maintains current conditions. Aquatic wildlife would continue to be impacted by dam operation.
Alternative B Preferred Alternative	High ability to pass eels upstream during variable flows. Eels would be attracted to the Maryland shoreline.	Offers maximum protection of historic resources by avoiding attachment to the dam. High protection of cultural landscape due to running the eel ladder underground.	Education/interpretation of eels would be available to visitors. Eel ladder would be minimally visible since it would run underground.	American eels would benefit from the eel ladder. The eel ladder would neither benefit nor harm other wildlife or vegetation in the area.
Alternative C	Low ability to pass eels upstream of Dam 4 (during variable flows). Eels would be less attracted to the West Virginia shoreline. There would be some entrainment hazards.	High protection of the cultural landscape since the eel ladder would be placed on the east side of the abutment on the West Virginia shoreline. Medium preservation of the historic resources due to the attachment of the eel ladder and use of a short non-overflow.	Education/interpretation of eels would be minimal since the structure is located off of park property. Eel ladder would be visible to visitors on the Maryland shoreline.	American eels would benefit from the eel ladder. The eel ladder would neither benefit nor harm other wildlife or vegetation in the area.
Alternative D	Medium ability to pass eels upstream of Dam 4 during normal flows, however low ability during high and low flow events. Eels would be less attracted to the West Virginia shoreline. There would be some entrainment hazards.	Medium protection of cultural landscape since the eel ladder would be placed on the West Virginia side. High protection of historic resources since no non-overflow would be needed; however, the eel ladder would be attached to the powerhouse.	Education/interpretation of eels would be minimal since the structure is located off of park property. Eel ladder would be visible to visitors on the Maryland shoreline.	American eels would benefit from the eel ladder. The eel ladder would neither benefit nor harm other wildlife or vegetation in the area.

Table 2-7. Comparison of Dam 5 Alternatives

Alternative	Project Objectives			
	Ability to Pass Eels Upstream	**Avoid Impacts to Cultural Resources and Landscapes**	**Avoid Impacts to Visitor Experience**	**Avoid Impacts to Wildlife and Vegetation**
Alternative A - No Action Alternative	Unable to pass American eels safely upstream.	Maintains current conditions. No impacts to cultural resources.	Maintains current conditions. No potential for visitor education on eels.	Maintains current conditions. Aquatic wildlife would continue to be impacted by dam operation.
Alternative B Preferred Alternative	Very high ability to pass eels upstream during variable flows. Eels would be attracted to the West Virginia shoreline. There would be some entrainment hazards in the power house turbines.	Offers medium protection of historic resources by avoiding the use of a non-overflow. High protection of cultural landscape since the eel ladder would be placed in the tailrace and run along the abutment and forebay.	Education/interpretation of eels would be minimal since the structure is located off of park property. Eel ladder would be visible to visitors on the Maryland shoreline.	American eels would benefit from the eel ladder. The eel ladder would neither benefit nor harm other wildlife or vegetation in the area.
Alternative C	High ability to pass eels upstream of Dam 5 during variable flows. Eels would be attracted to the West Virginia shoreline. There would be some entrainment hazards in the power house turbines.	Offers medium protection of historic resources by using a short non-overflow in the tailwaters. High protection of cultural landscape since the eel ladder would be placed in the tailwaters on the West Virginia side.	Education/interpretation of eels would be minimal since the structure is located off of park property. Eel ladder would be perpendicular to the dam which would maximize the visibility of the structure to visitors on the Maryland shoreline.	American eels would benefit from the eel ladder. The eel ladder would neither benefit nor harm other wildlife or vegetation in the area.

Table 2-7. Comparison of Dam 5 Alternatives

Alternative	Project Objectives			
	Ability to Pass Eels Upstream	**Avoid Impacts to Cultural Resources and Landscapes**	**Avoid Impacts to Visitor Experience**	**Avoid Impacts to Wildlife and Vegetation**
Alternative D	Low ability to pass eels upstream of Dam 5 (during full or partial turbine flows). Eels would be less attracted to the Maryland shoreline. There would be a high avoidance of entrainment hazards.	Low protection of the cultural landscape since the eel ladder would be placed on the Maryland side and the design would be extensive. Low preservation of the historic resources due to the attachment of the non-overflow and low sill to the dam.	Many education and volunteer opportunities about eels would be available since the structure would be located on park property. Eel ladder would be visible from the West Virginia shoreline.	American eels would benefit from the eel ladder. The eel ladder would neither benefit nor harm other wildlife or vegetation in the area.

2.8 SUMMARY OF ENVIRONMENTAL CONSEQUENCES/ IMPACT COMPARISON MATRIX

Table 2-8 and 2-9 includes a summary of each alternative's potential effects by impact topic for Dams 4 and 5.

Table 2-8. Summary of Impacts at Dam 4

Resource	Alternative A - No Action Alternative	Alternative B – Preferred Alternative	Alternative C	Alternative D
Air Quality	No additional beneficial or adverse impact.	Short-term, negligible, adverse impacts during construction. Long-term, negligible, adverse impact during operation of the eel ladder due to the use of the attractant flow pump.	Short-term, negligible, adverse impacts during construction. Long-term, negligible, adverse impact during operation of the eel ladder due to the use of the attractant flow pump.	Short-term, negligible, adverse impacts during construction. Long-term, negligible, adverse impact during operation of the eel ladder due to the use of the attractant flow pump.
Noise	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction. Long-term, negligible, adverse impacts during the operation of eel ladder due to the use of the attractant flow pump.	Short-term, minor, adverse impacts during construction. Long-term, negligible, adverse impacts during the operation of eel ladder due to the use of the attractant flow pump.	Short-term, minor, adverse impacts during construction. Long-term, negligible, adverse impacts during the operation of eel ladder due to the use of the attractant flow pump.
Soils	No additional beneficial or adverse impact.	Short-term, negligible, adverse impacts during construction activities and the installation of the electrical lines and exit pipe. No long-term impacts are anticipated.	Short-term, negligible, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, negligible, adverse impacts during construction activities. No long-term impacts are anticipated.
Water Quality and Flow	No additional beneficial or adverse impact.	Short-term, minor adverse impacts during the construction period due to erosion, sedimentation, turbidity, and upstream drawdown. No long-term impacts are anticipated.	Short-term, minor adverse impacts during the construction period due to erosion, sedimentation, turbidity, and upstream drawdown. Long-term, negligible, adverse impacts to water flow due to use of a non-overflow.	Short-term, minor adverse impacts during the construction period due to erosion, sedimentation, turbidity, and upstream drawdown. No long-term impacts are anticipated.

Table 2-8. Summary of Impacts at Dam 4

Resource	Alternative A - No Action Alternative	Alternative B – Preferred Alternative	Alternative C	Alternative D
Wetlands and Deepwater Habitats	No additional beneficial or adverse impact.	Long-term, minor, adverse impacts to deepwater habitats due to the placement of cobble stone and river rocks in the river to support the live well. Long-term, minor, adverse impacts to wetlands along the shoreline due to the placement of concrete footings. No short-term impacts are anticipated.	Long-term, minor, adverse impacts to deepwater habitats due to the placement of cobble stone and river rocks in the river to support the live well. Long-term, minor, adverse impacts to wetlands along the shoreline due to the placement of concrete footings. No short-term impacts are anticipated.	Long-term, minor, adverse impacts to deepwater habitats due to the placement of cobble stone and river rocks in the river to support the live well. Long-term, minor, adverse impacts to wetlands along the shoreline due to the placement of concrete footings. No short-term impacts are anticipated.
Vegetation	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction activities, installation of electrical lines, and installation of the underground exit pipe. No long-term impacts are anticipated.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.
Wildlife	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.
Aquatic Resources	Long-term, major, adverse impacts to the American eel.	Short-term, minor, adverse impacts during construction activities. Long-term, beneficial to the American eel.	Short-term, minor, adverse impacts during construction activities. Long-term, beneficial to the American eel.	Short-term, minor, adverse impacts during construction activities. Long-term, beneficial to the American eel.
Historic Structures	No additional beneficial or adverse impact.	Long-term, moderate, adverse impact due to the attachment of non-historic material to the dam.	Long-term, negligible to minor, adverse impact due to the loss of historical material and setting.	Long-term, negligible to minor, adverse impact due to the loss of historical material and setting.

Table 2-8. Summary of Impacts at Dam 4

Resource	Alternative A - No Action Alternative	Alternative B – Preferred Alternative	Alternative C	Alternative D
Visitor Use and Safety	No additional beneficial or adverse impact.	No impact to park visitation. Short-term, minor, adverse impacts to safety during the construction period. Long-term, negligible to minor, adverse impacts to park safety during the operation of the eel ladder.	No impact to park visitation. No impact to the safety of park staff or visitors.	No impact to park visitation. No impact to the safety of park staff or visitors.
Visitor Experience	Long-term, negligible adverse impacts due to the unavailability of educational opportunities of the American eel.	Short-term, negligible, adverse impacts due to the drawdown of water upstream of the dam and other construction activities on park property. Long-term, beneficial impacts to the additional educational opportunities on American eels available to visitors.	Short-term, negligible, adverse impacts due to the drawdown of water upstream of the dam.	Short-term, negligible, adverse impacts due to the drawdown of water upstream of the dam.
Aesthetic Resources	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction activities. Long-term, negligible, adverse impacts during operation of the eel ladder.	Short-term, negligible, adverse impacts due to the visible construction equipment. Long-term, negligible, adverse impacts due to the visibility of the eel ladder and associated structures.	Short-term, negligible, adverse impacts due to the visible construction equipment. Long-term, negligible, adverse impacts due to the visibility of the eel ladder and associated structures.
Park Operations	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction. Long-term, minor, adverse impacts during the operation of the eel ladder.	Short-term, minor, adverse impacts during construction. Long-term, moderate, adverse impacts during the operation of the eel ladder.	Short-term, minor, adverse impacts during construction. Long-term, moderate, adverse impacts during the operation of the eel ladder.

Table 2-8. Summary of Impacts at Dam 4

Resource	Alternative A - No Action Alternative	Alternative B – Preferred Alternative	Alternative C	Alternative D
Energy Resources	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during the construction phase. Long-term, minor, adverse impacts during operation of the attractant flow pump.	Short-term, minor, adverse impacts during the construction phase. Long-term, minor, adverse impacts during operation of the attractant flow pump.	Short-term, minor, adverse impacts during the construction phase. Long-term, minor, adverse impacts during operation of the attractant flow pump.

Table 2-9. Summary of Impacts at Dam 5

Resource	Alternative A - No Action Alternative	Alternative B – Preferred Alternative	Alternative C	Alternative D
Air Quality	No additional beneficial or adverse impact.	Short-term, negligible, adverse impacts during construction. Long-term, negligible, adverse impact during operation of the eel ladder due to the use of the attractant flow pump.	Short-term, negligible, adverse impacts during construction. Long-term, negligible, adverse impact during operation of the eel ladder due to the use of the attractant flow pump.	Short-term, negligible, adverse impacts during construction. Long-term, negligible, adverse impact during operation of the eel ladder due to the use of the attractant flow pump.
Noise	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction. Long-term, negligible, adverse impacts during the operation of eel ladder due to the use of the attractant flow pump.	Short-term, minor, adverse impacts during construction. Long-term, negligible, adverse impacts during the operation of eel ladder due to the use of the attractant flow pump.	Short-term, minor, adverse impacts during construction. Long-term, negligible, adverse impacts during the operation of eel ladder due to the use of the attractant flow pump.
Soils	No additional beneficial or adverse impact.	Short-term, negligible, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, negligible, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, negligible, adverse impacts during construction activities and installation of electrical lines. Long-term, minor, adverse impacts due to the installation of concrete footings to support the exit pipe along the bank.
Water Quality and Flow	No additional beneficial or adverse impact.	Short-term, minor adverse impacts during the construction period due to erosion, sedimentation, turbidity, and upstream drawdown. No long-term impacts are anticipated.	Short-term, minor adverse impacts during the construction period due to erosion, sedimentation, turbidity, and upstream drawdown. Long-term, negligible, adverse impacts to water flow due to use of a non-overflow.	Short-term, minor adverse impacts during the construction period due to erosion, sedimentation, turbidity, and upstream drawdown. Long-term, negligible, adverse impacts to water flow due to use of a non-overflow.

Table 2-9. Summary of Impacts at Dam 5

Resource	Alternative A - No Action Alternative	Alternative B – Preferred Alternative	Alternative C	Alternative D
Wetlands and Deepwater Habitats	No additional beneficial or adverse impact.	Long-term, minor, adverse impacts to deepwater habitats due to the placement of cobble stone and river rocks in the river to support the live well. Long-term, minor, adverse impacts to wetlands along the shoreline due to the placement of concrete footings. No short-term impacts are anticipated.	Long-term, minor, adverse impacts to deepwater habitats due to the placement of cobble stone and river rocks in the river to support the live well. Long-term, minor, adverse impacts to wetlands along the shoreline due to the placement of concrete footings. No short-term impacts are anticipated.	Long-term, minor, adverse impacts to deepwater habitats due to the placement of cobble stone and river rocks in the river to support the live well. Long-term, minor, adverse impacts to wetlands along the shoreline due to the placement of concrete footings. No short-term impacts are anticipated.
Vegetation	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, minor, adverse impacts during construction activities and installation of the electrical lines. Long-term, minor, adverse impacts due to the placement of concrete footings to support the exit pipe.
Wildlife	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, minor, adverse impacts during construction activities. No long-term impacts are anticipated.	Short-term, minor, adverse impacts during construction activities.
Aquatic Resources	Long-term, major, adverse impacts to the American eel.	Short-term, minor, adverse impacts during construction activities. Long-term, beneficial to the American eel.	Short-term, minor, adverse impacts during construction activities. Long-term, beneficial to the American eel.	Short-term, minor, adverse impacts during construction activities. Long-term, beneficial to the American eel.

Table 2-9. Summary of Impacts at Dam 5

Resource	Alternative A - No Action Alternative	Alternative B – Preferred Alternative	Alternative C	Alternative D
Historic Structures	No additional beneficial or adverse impact.	Long-term, negligible to minor, adverse impacts due to the loss of historic fabric and introduction of non-historical elements into the cultural landscape and the dam.	Long-term, negligible to minor, adverse impacts due to the loss of historic fabric and introduction of non-historical elements into the cultural landscape and the dam.	Long-term, minor to moderate, adverse impacts due to the attachment of non-historic elements onto the dam.
Visitor Use and Safety	No additional beneficial or adverse impact.	No impact to park visitation. No impact to the safety of park staff and visitors.	No impact to park visitation. No impact to the safety of park staff and visitors.	No impact to park visitation. Short-term, minor, adverse impacts to safety during the construction period. Long-term, negligible to minor, adverse impacts to park safety during the operation of the eel ladder.
Visitor Experience	Long-term, negligible adverse impacts due to the unavailability of educational opportunities of the American eel.	Short-term, negligible, adverse impacts due to the drawdown of water upstream of the dam.	Short-term, negligible, adverse impacts due to the drawdown of water upstream of the dam.	Short-term, negligible, adverse impacts due to the drawdown of water upstream of the dam and other construction activities on park property. Long-term, beneficial impacts to the additional educational opportunities on American eels available to visitors.
Aesthetic Resources	No additional beneficial or adverse impact.	Short-term, negligible, adverse impacts due to the visible construction equipment. Long-term, negligible, adverse impacts due to the visibility of the eel ladder and associated structures.	Short-term, negligible, adverse impacts due to the visible construction equipment. Long-term, negligible, adverse impacts due to the visibility of the eel ladder and associated structures.	Short-term, negligible, adverse impacts due to the visible construction equipment. Long-term, negligible, adverse impacts due to the visibility of the eel ladder and associated structures.

Table 2-9. Summary of Impacts at Dam 5

Resource	Alternative A - No Action Alternative	Alternative B – Preferred Alternative	Alternative C	Alternative D
Park Operations	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during construction of the eel ladder. Long-term, minor, adverse impacts during the operation of the eel ladder.	Short-term, minor, adverse impacts during construction of the eel ladder. Long-term, minor, adverse impacts during the operation of the eel ladder.	Short-term, minor, adverse impacts during construction of the eel ladder. Long-term, moderate, adverse impacts during the operation of the eel ladder.
Energy Resources	No additional beneficial or adverse impact.	Short-term, minor, adverse impacts during the construction phase. Long-term, minor, adverse impacts during operation of the attractant flow pump.	Short-term, minor, adverse impacts during the construction phase. Long-term, minor, adverse impacts during operation of the attractant flow pump.	Short-term, minor, adverse impacts during the construction phase. Long-term, minor, adverse impacts during operation of the attractant flow pump.

3.0 AFFECTED ENVIRONMENT

3.1 OVERVIEW

This section describes the existing environment at the proposed project locations (Dam 4 and Dam 5) that could be potentially impacted by the proposed action. In accordance with NEPA, CEQ guidelines, 32 CFR Part 989, and the NHPA, the description of the affected environment focuses on those resources and conditions likely subject to impacts, including physical resources (air quality, noise, and soils), aesthetic resources, water resources (water quality and flow), natural resources (wetlands, vegetation, wildlife, and aquatic resources), historic structures, visitor use, safety, visitor experience, park operations, and energy resources.

3.2 PHYSICAL RESOURCES

3.2.1 Air quality

The federal Clean Air Act (CAA) requires all federal agencies to comply with existing federal, state, and local air pollution control laws and regulations. The United States Environmental Protection Agency (USEPA) sets primary National Ambient Air Quality Standards (NAAQS) required by the CAA for air pollutants that cause health threats. The CAA defines six criteria pollutants. These criteria pollutants are carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM) with size less than 10 μm^3 or 2.5 μm^3 (PM_{10} or $PM_{2.5}$), nitrogen oxides (NO_X), ozone (O_3), and lead (Pb). Volatile organic compounds (VOCs) are not criteria pollutants, but are of interest since they participate in the formation of ozone.

Dam 4 is located four miles northwest of the Town of Shepherdstown in Berkeley and Jefferson Counties, West Virginia. Dam 5 is located five miles northeast of the Town of Hedgesville, in Berkeley County, West Virginia. Jefferson County is in attainment for all 6 criteria pollutants (USEPA 2008). Berkeley County is in attainment for all criteria pollutants except $PM_{2.5}$ (USEPA 2008). The NPS property lying adjacent to Dams 4 and 5 is located in Washington County, Maryland. Washington County is in attainment for all criteria pollutants, except $PM_{2.5}$ (USEPA 2008). The area in nonattainment for $PM_{2.5}$ includes the area between Martinsburg, West Virginia (Berkeley County) and Hagerstown, Maryland (Washington County).

3.2.2 Noise

Current noise sources in the surrounding area of Dams 4 and 5 are predominantly the hydropower stations. These include the noise generated from the three generating units at Dam 4 and the two units at Dam 5. In addition, park visitors fishing, hiking, biking, and picnicking in the areas are a secondary source of noise. Natural sources of noise include calls from birds and other wildlife, and the sound of the river flowing over the dam.

3.2.3 Soils

The park lies adjacent to the Potomac River for 184.5 miles between Georgetown, Washington DC and Cumberland, Maryland and spans over four physiographic provinces. The four physiographic provinces include the Coastal Plain, the Piedmont, the Blue Ridge, and the Ridge and Valley (NPS 2004).

Dam 4 and Dam 5 are located within the Ridge and Valley geographic province. The Ridge and Valley geographic province contains strongly folded and faulted sedimentary rocks. The area is composed of clay and clay loams, as well as sandy and stony loams. The soils are often shallow, and shale barrens may be found. The eastern portion of this province contains a wide, open valley called the Great Valley. This valley was formed on Cambrian and Ordovician limestone and dolomite (MGS 2007).

Dam 4 and Dam 5 are located in close proximity to the western edge of the Blue Ridge geographic province. The Blue Ridge province is located on the eastern edge of the Appalachian Mountains. This area contains mountainous soils composed of sandy or stony loams (MGS 2007).

The soils surrounding Dam 4 include Bigpool silt loam and Downsville gravelly loam on the left bank (Maryland shoreline) and Rock outcrop–Opequon complex on the right bank (West Virginia shoreline) (NRCS 2006 and 2007). Bigpool silt loam consists of very deep, moderately well-drained soils with a slope of 0 to 3 percent. The soils were formed in alluvium derived from limestone, sandstone, and shale. Downsville gravelly loam consists of very deep, well-drained, moderately permeable soils with a slope of 15 to 25 percent. The soils were formed in gravelly old alluvium derived from limestone, sandstone, and shale (NRCS 2007). The Rock outcrop–Opequon complex consists of 50 percent rock outcrop, 40 percent Opequon soils, and 10 percent of additional minor components. Opequon soils are well drained and have a slope of 35 to 60 percent. The soils were formed in clayey residuum weathered from limestone (NRCS 2006).

The soils surrounding Dam 5 include Combs fine sandy loam and Downsville gravelly loam on the Maryland shoreline (NRCS 2007). On the West Virginia shoreline soils include Combs fine sandy loam, Hagerstown silt loam, Hagerstown-Opequon-Rock outcrop complex, and Rock outcrop-Opequon complex (NRCS 2006). Combs fine sandy loam consists of deep, well-drained soils with a slope of 0 to 3 percent. The soils were formed in coarse-loamy alluvium derived from limestone, sandstone, and shale. Hagerstown silt loam consists of deep, well-drained soils with a slope of 3 to 8 percent. The soils were formed in clayey residuum weathered from hard gray limestone. The Hagerstown-Opequon-Rock outcrop complex consists of 40 percent Hagerstown soils, 30 percent Opequon soils, 20 percent rock outcrop, and 10 percent of additional minor components. Both the Hagerstown soils and Opequon soils are well-drained with a slope of 15 to 35 percent. The soils were formed in clayey residuum weathered from limestone (NRCS 2006). Two types of Downsville gravelly loam soils are found in areas surrounding the dam. They both are very deep, well-drained, moderately permeable soils formed in gravelly old alluvium derived from limestone, sandstone, and shale. One type has a slope of 8 to 15 percent, while the other has a slope of 15 to 25 percent (NRCS 2007).

3.3 WATER RESOURCES

3.3.1 Water Quality and Flow

Dam 4 is located on the Potomac River at Milepost 84. The Potomac River has a drainage area of approximately 5,886 square miles at the dam. Dam 5 is located on the Potomac River at Milepost 104. The drainage area at this dam is 5,196 square miles (FERC 2004)

Data from the United States Geological Survey (USGS) Gauging Station in Hancock, Maryland (Milepost 239) shows that the average monthly stream flows in the Potomac River are highest during the winter and spring months (December through May). Over the past 75 years, mean monthly flow was highest in March (9,310 cubic feet per second [cfs]) and lowest in July and August (1,580 cfs) (Figure 3-1) (USGS 2008).

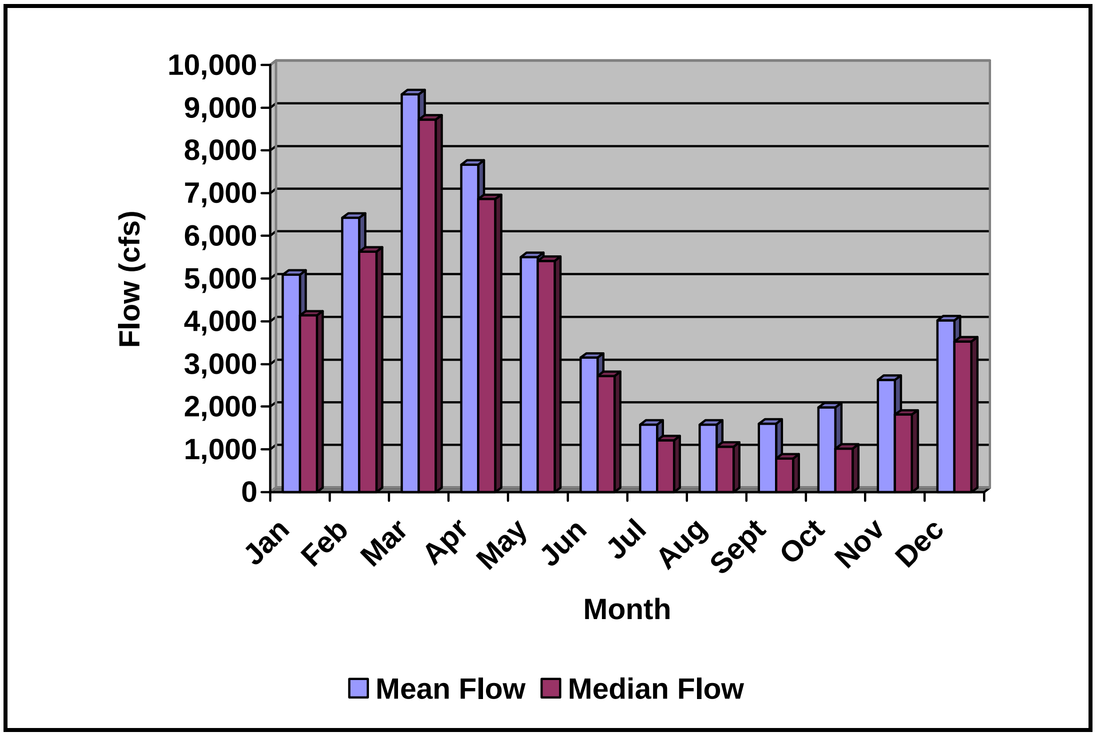


Figure 3-1. Monthly Mean and Median Flow of the Potomac River at Hancock, MD (October 1932 – September 2007)

Dams 4 and 5 are located on the Upper Branch of the Potomac River. The Clean Water Act (CWA) requires that surface waters for each state be classified according to the state's designated uses. The region of the Potomac River from the confluence of the Shenandoah River to the confluence of the North and South Branch of the Potomac River, including Dams 4 and 5, has a surface water designation of I-P (Code of Maryland Regulations [COMAR] 26.08.02.08). The I-P designation includes waters that are suitable for water contact sports; fishing; growth, propagation, and protection of aquatic life and wildlife; and agricultural, industrial, and public water supply.

The Maryland Department of Natural Resources (MDNR) records temperature, dissolved oxygen (DO) and pH measurements on the Potomac River at the Route 34 Bridge in Shepherdstown, West Virginia. In 2007, average monthly temperatures ranged from 2.9 degrees Celsius (ºC) in January to 26.1 ºC in July. Average monthly DO values ranged from 7.46 milligrams per liter (mg/L) in August to 13.23 mg/L in February. The lowest individual DO reading was 6.09 mg/L in July. Average monthly pH readings ranged from 7.79 in May to 7.95 in October. The lowest individual recording was 6.2 in February and the highest individual recording was 8.8 in January (MDNR 2008). Maryland water quality criteria for areas designated as I-P include DO greater than 5 mg/L and pH levels between 6.5 and 8.5. Individual pH readings greater than 8.5 were recorded at the Shepherdstown water quality station during January, February, May, June, November, and December 2007, however average values for these months remained in the acceptable limit. February was the only month when pH was less than 6.5.

Allegheny Energy monitored water temperature and dissolved oxygen levels in the tailrace (the area below the dam where water is discharged) at Dams 4 and 5 from June through October in 2000. Monitoring equipment was placed approximately 30 feet from the unit discharge boils at Dam 4 and directly in the unit discharge boils at Dam 5. Dissolved oxygen and water temperature was recorded at 15-minute intervals. Tailrace water temperatures ranged from 13.7 ºC to 27.7 ºC at Dam 4 and 12.2 ºC to 28.4 ºC at Dam 5 (Normandeau Associates 2000). At both dams, the mean average daily water temperature was highest in July followed by August and June and lowest in October. Tailrace water temperature conditions at both dams varied with changes in river inflow, displaying a pattern of a decrease in temperature with high flow events and a general increase in temperature at lower flow conditions (Normandeau Associates 2000).

Dissolved oxygen levels in the tailrace were greater than 5.0 mg/L at both dams from June through October 2000. Measured DO values ranged from 6.0 to 11.1 mg/L at Dam 4 and 5.6 to 10.3 mg/L at Dam 5. Mean daily values ranged from 7.3 mg/L in July to 9.4 mg/L in October at Dam 4 and 7.4 mg/L in June to 9.4 mg/L in October at Dam 5. Values less than 6.0 mg/L or less than 70 percent saturation occurred less than 1 percent of the time from June through October (Normandeau Associates 2000). Compared to the Interstate Commission on the Potomac River Basin classification criteria, DO conditions in the tailrace at both dams were good (6.0 to 7.9 mg/L) to excellent (8.0 to 9.5 mg/L) during the study months.

American eel movements (upstream and downstream) are triggered by environmental cues including water temperature, precipitation, water flow, and lunar phase (Hammond 2003). Water temperatures between 10 and 16 ºC cue upstream movements during the spring. Additionally, fluctuations or sudden changes to water temperature within a short time period may also elicit eel movement (Hammond 2003). In 2003 a seasonal movement study of American eels was conducted on the Shenandoah River in West Virginia near the Millville Dam. The study found that the American eel had highest rates of upstream passage during spring and highest rates of downstream movement during the fall (Hammond 2003). The data supported an association between upstream migration and water temperature and stream flow in the spring. Due to spring rains, water flow and temperature increase concurrently and influence the upstream migration. The same study found that as water temperatures began to decrease in the fall, the downstream migration rates began to rise. During the winter months when water temperatures drop below 10 ºC the American eel becomes torpid and movements are minimal (Walsh et al. 1983).

3.4 NATURAL RESOURCES

3.4.1 Wetlands and Deepwater Habitats

Section 404 of the CWA and a number of state laws and provisions regulate activities in wetlands. Executive Order 11990 – *Protection of Wetlands*, directs all federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. In the absence of such alternatives, parks must modify actions to preserve and enhance wetland values and minimize degradation. Consistent with Executive Order 11990 and Director's Order #77-1: *Wetland Protection*, NPS adopted a goal of "no net loss of wetlands." Director's Order #77-1 states that for new actions where impacts to wetlands cannot be avoided, proposals must include plans for compensatory mitigation that restores wetlands on NPS lands, where possible, at a minimum acreage ratio of 1:1.

In Maryland wetlands are protected under the following regulations:

- Clean Water Act, Section 404
- Maryland Nontidal Wetlands Protection Act
- Maryland Tidal Wetlands Act

The Nontidal Wetlands Protection Act enforced by the Maryland Department of the Environment (MDE), seeks to protect nontidal wetlands by regulating and restricting all activities that could impact nontidal wetlands or waters of the state. The Act also helps to render "no net loss" in wetlands, by requiring mitigation or compensation for any wetland loss. All activities within a nontidal wetland or its 25-foot buffer require a nontidal wetland permit or a letter of exemption. MDE regulates activities within nontidal wetlands including grading or filling, excavating or dredging, changing existing drainage patterns, disturbing the water level or water table, and destroying or removing vegetation.

In West Virginia wetlands are protected under Section 404 of the CWA. The West Virginia Environmental Quality Board also currently regulates wetlands under its requirements governing water quality standards. In 2001, a bill was introduced in the West Virginia legislature that would expand the state's water quality laws by authorizing the Division of Environmental Protection to promulgate rules relating to operating permits. Under the current law wetlands are protected as waters of the state. West Virginia issues certification based on a project's compliance with state water quality standards.

For the purpose of implementing Executive Order 11990, an area in an NPS unit that is classified as a wetland according to the USFWS “Classification of Wetlands and Deepwater Habitats of the United States” is subject to Director’s Order #77-1 (with the exception of deepwater habitats, which are not subject to DO #77-1) (Cowardin 1979). The Cowardin wetland definition encompasses more aquatic habitat types than the definition and delineation manual used by the United States Army Corps of Engineers (USACE) for identifying wetlands subject to Section 404 of the Clean Water Act. The 1987 “USACE Wetlands Delineation Manual” requires that three parameters (hydrophytic vegetation, hydric soil, wetland hydrology) must all be present in order for an area to be considered a wetland. The Cowardin wetland definition includes such wetlands, but also adds some areas that, though lacking vegetation and/or soils due to natural physical or chemical factors such as wave action or high salinity, are still saturated or shallow inundated environments that support aquatic life (e.g., unvegetated stream shallows, mudflats, and rocky shores). This document presents wetlands as defined by Cowardin et al. (1979) and consistent with DO #77-1. Under the Cowardin definition, a wetland must have one or more of the following three attributes:

1. At least periodically, the land supports predominantly hydrophytes (wetland vegetation);
2. The substrate is predominantly undrained hydric soil; or
3. The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

The Cowardin wetland definition includes wetlands with one of the three criteria discussed above, but also adds some areas that, though lacking vegetation and/or soils due to natural physical or chemical factors such as wave action or high salinity, are still saturated or shallow inundated environments that support aquatic life (e.g., unvegetated stream shallows, mudflats, rocky shores). The National Wetlands Inventory (NWI) of the USFWS produces information on the characteristics, extent, and status of the nation’s wetlands and deepwater habitats. The USFWS definition of wetlands is similar to the NPS definition of wetlands in that only one of three parameters (hydric soils, hydrophytic vegetation, and hydrology) is required to characterize an area as a wetland, based upon the Cowardin Classification of Wetlands (Cowardin et al 1979). The USFWS’s objective of mapping wetlands and deepwater habitats is to produce “reconnaissance-level information on the location, type and size of these resources” (USFWS 2005). NWI maps are prepared by the USFWS from the analysis of high altitude imagery and wetlands are identified based on vegetation, visible hydrology and geography.

Based on the NWI maps at the site from the USFWS and NPS definition of wetlands, the area upstream of Dam 4 is characterized as a lacustrine, limnetic, unconsolidated bottom, permanently flooded deepwater habitat (L1UBHH). The area downstream of Dam 4 is characterized as a riverine, unknown perennial, unconsolidated bottom, permanently flooded deepwater habitat (R5UBH). As per Cowardian's Classification System, these areas are considered deepwater habitats since the area is permanently flooded lands lying below the deepwater boundary of wetlands (Cowardin 1979). The substrate is considered nonsoil because the water is too deep to support emergent vegetation, but may support aquatic vegetation. The area upstream of Dam 4 is likely characterized by NWI as a Lacustrine System (versus Riverine System) because it is situated in a dammed river channel (Cowardin et al. 1979). In addition, a 6.5-acre palustrine, emergent, seasonally flooded wetland is located downstream of Dam 4 on the West Virginia shoreline (USFWS 2008). Figure 3-2 presents a map of the wetlands as mapped by NWI by Cowardin Classification for Dam 4.

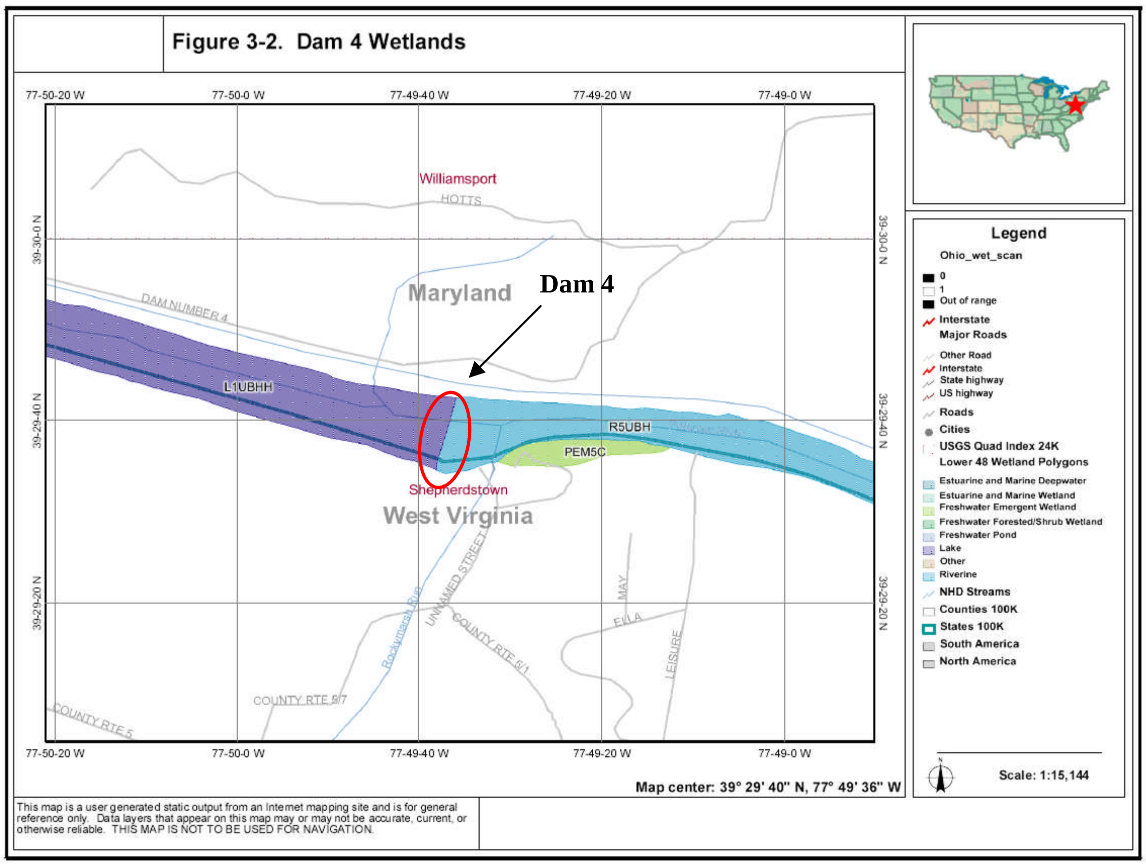


Figure 3-2. National Wetland Inventory Map in the Vicinity of Dam 4

Based on the NWI maps at the site from the USFWS and NPS definition of wetlands, the area upstream of Dam 5 is characterized as a lacustrine, limnetic, unconsolidated bottom, permanently flooded deepwater habitat (L1UBHH). In addition three wetland areas are located along the banks of the river. A 0.5-acre palustrine, forested, broad-leaved deciduous, seasonally flooded wetland (PFO1E) is located upstream of the dam on the Maryland shoreline. A 10-acre palustrine, forested, broad-leaved deciduous, temporarily flooded wetland (PFO1A) and a 1-acre palustrine, emergent, seasonally flooded wetland (PEM5C) are located upstream of the dam on the West Virginia shoreline. Like Dam 4, the area downstream of Dam 5 is characterized as riverine, unknown perennial, unconsolidated bottom, permanently flooded deepwater habitat (R5UBH). Two areas of palustrine, forested, broad-leaved deciduous, temporarily flooded wetland (PFO1A) totaling approximately 6.7 acres are located within the river channel. A 1.4-acre palustrine, forested, broad-leaved deciduous, temporarily flooded wetland (PFO1A) is located on the West Virginia shoreline (USFWS 2008). The lacustrine habitat upstream of Dam 5 and the riverine habitat downstream of Dam 5 are considered deepwater habitats as per Cowardin Classification of Wetlands (Cowardin 1979). The area upstream of Dam 5 is likely characterized by NWI as a Lacustrine System (versus Riverine System) because it is situated in a dammed river channel (Cowardin et al. 1979). Figure 3-3 presents a map of wetlands mapped by NWI Cowardin Classification for Dam 5.

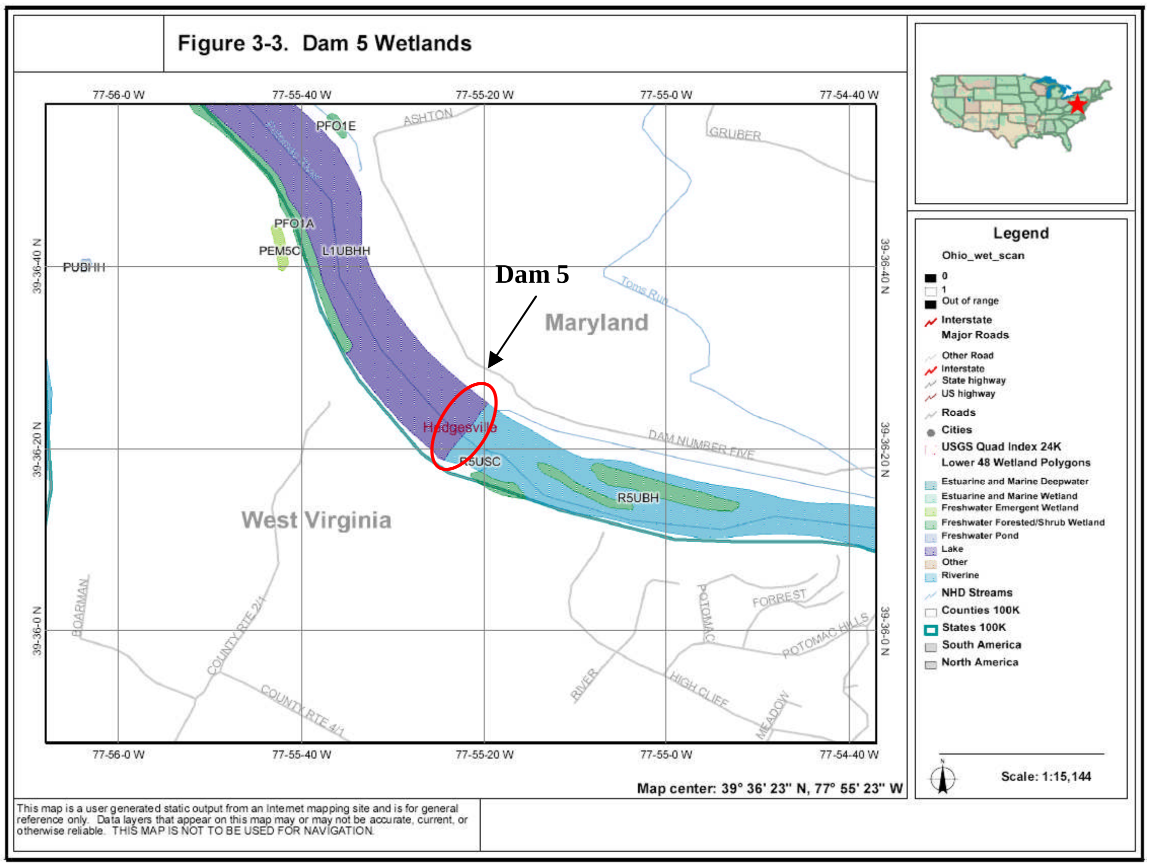


Figure 3-3. National Wetland Inventory Map in the Vicinity of Dam 5

The NWI map of the site in areas upstream of the dams in both states was ground-truthed during an October 2009 Site Visit. During this site visit, it was determined that in addition to the wetland areas characterized by NWI within the river channel of the Potomac River as discussed above (Riverine and Lacustrine Systems), wetland areas along the shoreline also exist in the vicinity of Dams 4 and 5 in both Maryland and West Virginia as defined by Cowardin et al. (1979) and also by the USACE. The paragraphs below detail the results of the wetland delineation conducted for the sites in the vicinity of Dams 4 and 5.

DAM 4, Maryland

A narrow, forested wetland (approximately 5 to 20 ft wide) exists along the shoreline of the Potomac River and a very small area (approximately 100 ft^2) characterized as an emergent wetland was also observed along the shoreline in the vicinity of Dam 4. This area is depicted in Figure 4-1 of Chapter 4. Using the Cowardin et al. (1979) classification, the forested wetland is characterized as a palustrine, forested, broad-leaved deciduous, temporarily flooded wetland (PFO1A) and the emergent wetland is characterized as palustrine, emergent, nonpersistent temporarily flooded wetland (PEM2A). Hydrology that exists at this site includes the fluctuation of the river, which temporarily inundates the mapped wetland areas. Soils along the shoreline were saturated within the emergent wetland but not the forested wetland, although drift deposits (a primary hydrology indicator) of Asiatic clams were observed scattered along the shoreline. Generally, a steep elevation change exists from the waterline inland to the riparian buffer. A soil sample was collected at this site and revealed low chroma soils within the wetland areas. The soil sample was classified as silty clay loam; at a depth of 0-6 inches, the soil matrix had a chroma value of 10YR3/2 with no mottles and at a depth of 6-12 inches the soil matrix had a chroma value of 10YR3/1; mottles were present at 10 percent and had a chroma value of 10YR4/6 as concentrations in the pore lining. Therefore, the soil collected from this location was characterized as hydric soil due to low chroma (depleted matrix that has 60 percent or more chroma of 2 or less as stated in USACE 2008).

Very little vegetation was observed immediately along the shoreline with the exception of a tree layer consisting of box elder (*Acer negundo*) and silver maple (*Acer saccharinum*) and the following herbaceous plants: false nettle (*Boehmeria cylindrica*), water purslane (*Ludwigia palustris*), sneezeweed (*Helenium autumnale*), and poison ivy (*Toxicodendron radicans*). The very small area characterized as an emergent wetland was also observed along the shoreline and was dominated by lizard's tail (*Saururus cernuus*) and water-willow (*Justicia americana*). Over 50 percent of the dominant vegetation species listed above have a wetland indicator status and are characterized as hydrophytic vegetation. The submerged aquatic vegetation species (SAV) known as wild celery (*Vallisneria americana*) and hydrilla (*Hydrilla verticillata*) were observed rooted in the Potomac River in the vicinity of the site. All three wetland criteria were observed and recorded at this site and the area would be considered a wetland by the USACE as well as the NPS.

DAM 4, West Virginia

A narrow, forested wetland (approximately 5 to 10 ft wide) exists along the shoreline of the Potomac River in the vicinity of Dam 4. This area is depicted in Figure 4-2 of Chapter 4. Using the Cowardin et al. (1979) classification, the forested wetland is characterized as a palustrine, forested, broad-leaved deciduous, temporarily flooded wetland (PFO1A). Hydrology that exists at this site includes the fluctuation of the river, which temporarily inundates the mapped wetland area. Soils along the shoreline were saturated and drift deposits (a primary hydrology indicator) of Asiatic clams were observed scattered along the shoreline. Generally, a steep elevation change exists from the waterline inland to the riparian buffer. A soil sample revealed gleyed and low chroma soils within the wetland area. The soil sample within the PFO1A wetland was classified as silty clay loam; at a depth of 0-6 in the soil matrix had a chroma value of 10YR3/6; mottles were present at 10 percent and had a chroma value of 10YR3/6 as concentrations in the matrix. At a depth of 6-12 inches the soil matrix had a chroma value of GLEY1(5/10Y).

Woody vegetation observed immediately along the shoreline included sycamore, spicebush (*Lindera benzoin*), and buttonbush; herbaceous vegetation included false nettle and water purslane. Over 50 percent of the dominant vegetation species listed above have a wetland indicator status and are characterized as hydrophytic vegetation. All three wetland criteria were observed and recorded at this site and the area would be considered a wetland by the USACE as well as the NPS.

DAM 5, Maryland

A narrow, forested wetland (approximately 5 to 10 ft wide) exists along the shoreline of the Potomac River and a very small area (approximately 100 ft^2) characterized as an emergent wetland was also observed along the shoreline in the vicinity of Dam 5. This area is depicted in Figure 4-3 of Chapter 4. Using the Cowardin et al. (1979) classification, the forested wetland is characterized as a palustrine, forested, broad-leaved deciduous, temporarily flooded wetland (PFO1A) and the emergent wetland is characterized as palustrine, emergent, nonpersistent, temporarily flooded wetland (PEM2A). Hydrology that exists at this site includes the fluctuation of the river, which temporarily inundates the mapped wetland areas. Soils along the shoreline were saturated within the emergent wetland but not the forested wetland, although drift deposits (a primary hydrology indicator) of Asiatic clams were observed scattered along the shoreline. Generally, a steep elevation change exists from the waterline inland to the riparian buffer. A soil sample revealed low chroma soils within the wetland areas, including gleyed soils within the emergent wetland and mottles in the soil within the forested wetland. The soil sample within the PFO1A wetland was classified as silty clay loam; at a depth of 0-12 inches the soil matrix had a chroma value of 10YR4/2; mottles were present at 10 percent and had a chroma value of 10YR5/6 as concentrations in the matrix. The soil sample within the PEM2A wetland was gleyed and classified as silty clay loam; at a depth of 0-18 inches the soil matrix had a chroma value of GLEY1(3/10Y). Therefore, the soil samples collected from this location were characterized as hydric soil due to low chroma (depleted matrix that has 60 percent or more chroma of 2 or less as stated in USACE 2008) and a loamy gleyed matrix (USACE 2008).

The forested wetland within the riparian buffer consisted of the following dominant vegetation: box elder, sycamore (*Platanus occidentalis*), silver maple, river birch *(Betula nigra),* slippery elm (*Ulmus rubra*). The shrub layer was dominated by buttonbush *(Cephalanthus occidentalis)*. The emergent wetland was dominated by lizard's tail, water-willow, and water purslane. Over 50 percent of the dominant vegetation species listed above have a wetland indicator status and are characterized as hydrophytic vegetation. All three wetland criteria were observed and recorded at this site and the area would be considered a wetland by the USACE as well as the NPS.

<u>DAM 5, West Virginia</u>

A narrow, wetland (approximately 7 ft wide) exists along the shoreline of the Potomac River in the vicinity of Dam 5, but is partially non-vegetated and exists below a concrete retaining wall for the power station. Using the Cowardin et al. (1979) classification, this wetland is characterized as a riverine, unknown perennial, unconsolidated shore, mud, temporarily flooded wetland (R5US3A) and the narrow forested wetland is characterized as a palustrine, forested, broad-leaved deciduous, temporarily flooded wetland (PFO1A). These areas are depicted in Figure 4-4 of Chapter 4. The R5US3A wetland is a steep, unvegetated shoreline that is mapped as a NPS wetland primarily due to hydrology; the fluctuation of the river temporarily inundates the area. However, the soil sample did reveal low chroma soils, including saturation in the upper 12 inches of the sample. Bare soil and minimal vegetation exists at the site. Vegetation includes scattered weedy herbaceous species with no wetland indicator status such as annual wormwood (*Artemesia annua*), common mullein (*Verbascum thapsus*), and primrose species (*Oenothera* sp.). Water purslane was observed rooted along the shoreline. Further upstream from the site, a narrow riparian area (one tree wide in some areas and wider further upstream) of mature silver maple exists along the shoreline (PFO1A) with a diameter at breast height (DBH) of at least 36 inches. At least four different species of SAV were observed rooted in the Potomac River in the vicinity of the site, including wild celery and hydrilla. The three criteria were not observed and recorded at this site; the area would be considered a wetland by NPS but not by the USACE. A soil sample was collected in between the unvegetated and forested wetland areas. The soil sample within the area was classified as silty clay; at a depth of 0-12 inches the soil matrix had a chroma value of 10YR4/2, indicating hydric soil. Some drift deposits (a primary hydrology indicator) of Asiatic clams were also observed scattered along the shoreline. All three wetland criteria were observed and recorded at the PFO1A wetland and this area would be considered a wetland by the USACE as well as the NPS; the unvegetated wetland (R5US3A) only had two of three wetland criteria because no wetland plants were observed vegetated in the shoreline.

3.4.2 Vegetation

The park has recorded over 1,200 species of vascular plants in Maryland and the District of Columbia. The State of Maryland Natural Heritage Program considers the park to have the most significant biodiversity resources in the Mid-Atlantic States (NPS 2004).

Deciduous trees dominate the vegetation in the immediate vicinity of both Dam 4 and Dam 5 on the West Virginia shoreline. Dominant species identified during a site visit in November 2007 include red maple (*Acer rubrum*), box elder, sycamore, tulip poplar (*Liriodendron tulipifera*), black walnut (*Juglans nigra*), red mulberry (*Morus rubra*), and ash species (*Fraxinus sp.*).

On the Maryland shoreline, a small area of mowed, maintained grass lies directly adjacent to the dams. Forests, dominated by deciduous species are connected to the grass areas providing a buffer to the Potomac River. Dominant species in these areas are similar to those of the West Virginia shoreline. Common species identified during a site visit in November 2007 include red maple, box elder, tulip poplar, American sycamore, silver maple and willow species (*Salix* sp.). Common understory species observed include slippery elm, hackberry (*Celtis occidentalis*), and ground ivy (*Glechoma hederacea*).

According to the Vegetation Map of Maryland, the proposed project areas lie within the River Birch-Sycamore Association and the Sycamore-Green Ash-Box Elder-Silver Maple Association. Additional species potentially occurring in these areas include sweet gum (*Liquidambar styraciflua*), flowering dogwood (*Cornus florida*), sassafras (*Sassafras albidum*), and pignut hickory (*Carya glabra*) (Brush et al. 1980). Potential understory species may include Virginia creeper (*Parthenocissus quinquefolia*), poison ivy, Japanese honeysuckle (*Lonicera japonica*), and spicebush (Brush et al. 1980).

Vegetation observed within the wetland areas during the October 2009 site visit were discussed above in Section 3.4.1 *Wetlands and Deepwater Habitats*.

3.4.3 Wildlife

The park provides important habitat to many terrestrial species during breeding and migration seasons and throughout the year. The wildlife species expected to occur within the proposed project areas near Dams 4 and 5 on the Potomac River are typical of riparian habitats in Western Maryland.

Mammal species potentially occurring within the proposed project areas include upland species and true wetland species (aquatic mammals). Upland species occupying the deciduous forest and riparian areas often are found feeding along the river bank. These species include white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), Eastern cottontail (*Sylvilagus palustris*), and gray squirrel (*Sciurus carolinensis*). Aquatic mammals common to the area include the muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), and river otter (*Lutra canadensis*).

Numerous bird species can be observed throughout the year at the park. Many of these birds are year round inhabitants while others are neo-tropical migratory birds traveling through the park from South and Central America, the Caribbean and southern United States to North American nesting habitats. The American Bird Conservancy and National Audubon Society have designated two areas in the park as an Important Bird Area in the United States. Areas designated include the Lower C&O Canal and an area near Greenridge State Forest. The District of Columbia Audubon Society have conducted mid winter bird counts for each mile of the Canal for the last 11 years (1999-2008). Wading birds, including the great blue heron (*Ardea herodias*) and great egret (*Casmerodius albus*) feed on fish, insects, crustaceans, and frogs. Waterfowl species can be found along the river feeding on seeds, grasses, and submerged aquatic vegetation (SAV). Potential waterfowl found within the proposed project areas may include Canada goose (*Branta canadensis*), mallards (*Anas platyrhynchos*), ring-necked ducks (*Aythya collaris*), and wood ducks (*Aix sponsa*). Other birds potentially occurring within the proposed project areas include the belted kingfisher (*Ceryle alcyon*), bank swallow (*Riparia riparia*), marsh wren (*Cistothorus palustris*), Carolina chickadee (*Poecile carolinensis*), Eastern bluebird (*Sialia sialis*), red-bellied woodpecker (*Melanerpes carolinus*), and red-tailed hawk (*Buteo jamaicensis*).

The areas surrounding Dams 4 and 5 are prime habitat for many species of reptiles and amphibians. Potential amphibian species breeding and feeding within the proposed project area may include the American bullfrog (*Rana catesbieana*), green frog (*Rana clamitans*), pickerel frog (*Rana palustris*), two-lined salamander (*Eurycea bislineata*), and Northern dusky salamander (*Desmognathus fuscus*). Turtle and snake species are commonly seen basking on logs and rocks along the banks or swimming in the river. Reptiles potentially occurring within the proposed project areas include the common snapping turtle (*Chelydra serpentina*), Eastern mud turtle (*Kinosternum subrubrum*), Eastern painted turtle (*Chrysemys picta*), Northern water snake (*Nerodia sipedon*), Queen snake (*Regina septimvittata*), and black ratsnake (*Elaphe guttata*).

3.4.4 Aquatic Resources

Aquatic Habitat

An aquatic habitat assessment of the Potomac River was conducted by Allegheny Energy in 2000. The study area included 31 miles of river, extending from four miles downstream of Dam 4 (Taylors Landing, Milepost 81) to seven miles upstream of Dam 5 (McCoys Ferry, Milepost 112). A total of five study areas were surveyed within the entire reach. These study areas included one station upstream of Dam 4 (Pool 4), downstream of Dam 4 (Dam 4 Riverine), upstream of Dam 5 (Pool 5), downstream of Dam 5 (Dam 5 Riverine), and one reference location (Lock 44). The majority of the 31-mile study area was comprised of riverine habitat. The most common microhabitat type of the riverine sections of the study area was deep run (43 percent), followed by pool (26 percent), shallow run (13 percent), riffle (6 percent), and tailwater (3.5 percent). The areas upstream of Dams 4 and 5 were considered pool habitat. The Dam 5 Riverine reach supported approximately 41 acres of islands, water willow (*Justicia americana*) beds, and water willow complexes, while Dam 4 supported approximately 19 acres of islands and water willow beds and complexes (Normandeau Associates 2001a).

Reported substrate types in the vicinity of Dams 4 and 5 include gravel (2 millimeters [mm] to 64 mm), cobble (64 mm to 256 mm), boulder (>256 mm), sand and silt, and bedrock. The substrate downstream of Dam 4 is predominately bedrock and boulder. The substrate downstream of Dam 5 is a mixture of bedrock, boulder, cobble, and gravel (Normandeau Associates 2001a). Sand and silt dominated the substrate in the pool areas upstream of Dams 4 and 5 (Versar et al. 1992). In addition to the sand and silt, some areas had a bedrock and boulder substrate.

Aquatic Vegetation

During the spring of 2000, the 31 miles of river were also surveyed for SAV and emergent aquatic vegetation (EAV). Approximately 69.5 acres of the study area were covered with SAV. Curly pondweed (*Potamogeton crispus*) was the most abundant species within the riverine sections, while Eurasian water milfoil (*Myriophyllum spicatum*) was abundant in the pools. Water stargrass (*Zostera dubia*) was abundant in both riverine and pool habitats. Additional SAV species included water celery (*Vallisneria americana*), water weed (*Elodia* sp.), water naiad (*Najas* sp.), and sago pondweed (*Potamogeton pectinatus*) (Normandeau Associates 2001a).

Water willow and lizard tail (*Saururus cernuus*) were the most abundant EAV observed between Milepost 81 and 112. Other species observed include Canada rush (*Juncus canadensis*), purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*), broad-leaved cattail (*Typha lattifolia*), and Olney's threesquare (*Scirpus olneyi*) (Normandeau Associates 2001a).

Macroinvertebrates

The park contains a diverse native mussel community. Native mussels are the most imperiled aquatic fauna in North America and continue to decline as a result of habitat loss and invasive non-indigenous species. Of the twenty species of mussels found in Maryland, ten are located within the park (NPS 2004).

As part of the Potomac River habitat assessment, Allegheny Energy conducted mussel surveys upstream and downstream of Dams 4 and 5. Four taxa of Unionoid mussels were collected in the vicinity of Dams 4 and five taxa were collected in the vicinity of Dam 5 (Table 3-1). The most abundant taxa observed in the riverine reaches were *Elliptio complanata* and *Lampsilis* sp. The most abundant taxa found in the pool areas upstream of each dam were *Ellipitio producta* and *Utterbackia imbecilis* (Normandeau Associates 2001a). The general abundance of mussels was highest upstream and downstream of Dam 5. The non-Unionoid Asiatic clam (*Corbicula fluminea*) was abundant and ubiquitous throughout the study area. Freshwater mussels are parasitic in their larval form. During this stage of development the larvae (glochidia) attach themselves to a fish host. They remain attached for the duration of this life-cycle stage. The American eel is a host species for *Elliptio complanata*, the most abundant mussel found within the Dam 4 and 5 areas.

Table 3-1. Total Number of Mussels Found in the Vicinity of Dams 4 and 5

Species	Dam 4 Riverine	Dam 4 Pool	Dam 5 Riverine	Dam 5 Pool
Utterbackia imbecilis	-	18	-	61
Elliptio complanata	79	-	99	1
Elliptio producta	-	6	4	36
Lampsilis sp.	66	-	23	-
Lasmigona subviridus	-	-	1	1
Total	**145**	**24**	**127**	**99**

Source: Normandeau Associates 2001a

Versar et al. conducted a long-term benthic monitoring study of the Potomac River from 1983 to 1991. The study area included Dams 4 and 5. The benthic macroinvertebrate community of this area was described as typical of the mid-Atlantic region. The benthic community was comprised of 80 percent insects and 20 percent non-insect taxa. Insects were represented by Chironomidae, Diptera, and Insecta (Versar et al. 1992). The common and scientific names of the insects that constituted nearly 45 percent of the fauna are listed in Table 3-2. Non-insect taxa included

Oligochaetes, Turbellaria, Gastropoda, Pelecypoda, Crustacea, and other minor taxonomic groups (Versar et al. 1992). The most abundant taxa observed during the study are listed in Table 3-3.

Table 3-2. Abundant Taxa of Insects Found in the Vicinity of Dams 4 and 5

Family or Order	Common Name
Ephemeroptera	Mayflies
Trichoptera	Caddisflies
Plecoptera	Stoneflies
Coleoptera	Beetles
Odonata	Dragonflies and Damselflies
Megaloptera	Dobsonflies and Helgramites
Hemiptera	True Bugs

Table 3-3. Most Abundant Macroinvertebrates Found in the Vicinity of Dams 4 and 5

Family or Order (Common Name)	Genus
Midges	*Dicrotendipes*
	Polypedilum
	Rheotanytarsus
Mayflies	*Potamanthus*
	Caenis
	Tricorythidae
Clams	*Corbicula*
Worms	*Naididae*
Beetles	*Stenelmis*

Finfish

Fish monitoring surveys have been carried out in the vicinity of Dams 4 and 5 for over 25 years. The MDNR conducts annual fish surveys at five locations in the freshwater Potomac River from Hancock, Maryland to White's Ferry, Maryland. One sampling station is located 3 miles downstream of Dam 4. The MDNR efforts are largely directed at census and analysis of game species; however the survey includes a general inventory of finfish using seining and electro fishing techniques. Table 3-4 includes a listing of all species collected during the 2007 survey. A total of 42 species were recorded, including 15 species of minnows and 9 species of sunfish. Some of the most abundant species included smallmouth bass (*Micropterus dolomieu*), walleye

(*Stizostedion vitreum*), bluntnose minnow (*Pimephalas notatus*), American eel, tessellated darter (*Etheostoma olmstedi*), and redbreast sunfish (*Lepomis auritus*). The most abundant species collected at Taylor's Landing, 3 miles downstream of Dam 4, include smallmouth bass, golden redhorse (*Moxostoma erythrurum*), bluntnose minnow, rosyface shiner (*Notropis rubellus*), and spotfin shiner (*Notropis hudsonius*) (Henesy 2008).

Table 3-4. Fish Species Collected in the Potomac River by the MDNR in 2007

Scientific Name	Common Name	Scientific Name	Common Name
Family Anguillidae	**Freshwater eels**	**Family Ictaluridae**	**Bullhead Catfishes**
Anguilla rostrata	American eel	*Amieurus nebulosus*	Brown Bullhead
Family Catostomidae	**Suckers**	*Amieurus natalis*	Yellow Bullhead
Erimyzon oblongus	Creek Chubsucker	*Ictalurus punctatus*	Channel Catfish*
Moxostoma erythrurum	Golden Redhorse*	*Notorus insignis*	Margined Madtom
Hypentilium nigricans	Northern Hog Sucker*	**Family Fundulidae**	**Killifishes**
Moxostoma macrolepidotum	Shorthead Redhorse	*Fundulus diaphanus*	Banded Killifish
Catostomus commersoni	White Sucker*	**Family Esocidae**	**Pikes**
Family Cyprinidae	**Minnows**	*Esox masquinongy*	Muskellunge
Pimephalas notatus	Bluntnose Minnow*	*Esox masquinongy lucius*	Tiger Muskellunge
Rhinichthys cataractae	Longnose Dace	**Family Percidae**	**Perches, Darters, Walleye**
Notropis amoenis	Comely Shiner*	*Stizostedion vitreum*	Walleye*
Exoglossum maxillingua	Cutlips Minnow	*Etheostoma blennioides*	Greenside Darter*
Cyprinus carpio	Common Carp*	*Etheostoma olmstedi*	Tesselated Darter *
Notemigonus crysoleucas	Golden Shiner	*Etheostoma caeruleum*	Rainbow Darter
Notropis rubellus	Rosyface Shiner	**Family Centrarchidae**	**Sunfishes and Basses**
Ericymba buccata	Silverjaw Minnow	*Micropterus dolomieu*	Smallmouth Bass*
Cyprinella spilopterus	Spotfin Shiner*	*Micropterus salmoides*	Largemouth Bass
Notropis hudsonius	Spottail Shiner*	*Pomoxis nigromaculatus*	Black Crappie
Notropis procne	Swallowtail Shiner	*Lepomis macrochirus*	Bluegill*
Nocomis micropogon	River Chub*	*Ambloplites rupestris*	Rock Bass*
Semotilis corporalis	Fallfish*	*Lepomis cyanellus*	Green Sunfish
Campostoma anomalum	Central Stoneroller*	*Lepomis megalotis*	Longear Sunfish*
Family Poeciliidae	**Livebearers**	*Lepomis gibbosus*	Pumpkinseed Sunfish*
Gambusia affinis	Mosquitofish	*Lepomis auritus*	Redbreast Sunfish*

*Abundant species

American Eels

The American eel is a catadromous species that begins its life by hatching from eggs in the Sargasso Sea, an area of the Atlantic Ocean north of the Bahamas. The eels then migrate to estuaries of the Atlantic Coast where they spend most of their lives before returning to the Sargasso Sea to spawn. American eels are abundant in all tributaries of the Chesapeake Bay (Murdy et al. 1997). They spend most of their life in the yellow eel phase, in which they are nocturnally active omnivores, feeding on insects, mollusks, crustaceans, worms, and other fish. Yellow eels can live in the freshwater Potomac River from five to twenty years, depending on when they begin their reproductive migration. Once the eels become sexually mature, they undergo many physical changes prior to emigration in order to adapt the eel to an oceanic existence. The physiological changes include a pigment color change to a metallic, black-bronze sheen and a pectoral fin color change from yellow/green to black. The yellow eels fatten their body by consuming large amounts of food to build fat deposits for sustenance of the long journey. In addition to building fat deposits the skin of the eel begins to thicken. The eyes of the eel begin to enlarge and there is a change in the visual pigments which prepare the eel migrating at greater ocean depths. The stomach and intestines of the females shrink to make room for the eggs. As the females begin their migration they will eat less and less along the journey. Emigration occurs on autumn nights (Normandeau Associates 1999). The American eel population has been declining throughout its range in recent years due to its exclusion from historic habitat by dams.

Historically American eels were found throughout the East Coast streams, comprising more than 25 percent of the total fish biomass (ASFMC 2000). As development of the rivers began and eel harvesting increased, the American eel populations began to decline throughout its range. During the upstream migration from the Sargasso Sea to the tributaries and estuaries of the Atlantic Ocean, American eels are forced to go through many obstacles in order to successfully reach their nursery grounds. Upstream migration within the Potomac River Basin typically occurs during the months of March through October. There are a total of twelve hydroelectric dams throughout the Potomac River Basin that block the majority of eels from continuing the migration. There are a small abundance of eels occurring upstream of Dams 4 and 5. Small eels (elvers) have found ways to swim or climb past the dam; however larger eels continue to be blocked by the dams.

American eel downstream migration studies were conducted at three hydroelectric stations within the Potomac River Basin from 1991 to 1994. The three stations included Dam 4, Luray, and Millville (located on the Shenandoah River). All three studies evidenced a common response by eels to the lunar cycle with peak movements occurring in the nights leading to a new moon. Additionally, peak downstream movements occurred during comparable water temperature windows: 9-13ºC at Luray; 7-14ºC at Millville; and 8-13ºC at Dam 4. Downstream movement occurred in mid-September as water temperatures declined to approximately 21ºC, and typically peaked, as governed by the lunar cycle, in late October to mid-November (Normandeau Associates 1999). In the fall of 1992, the Federal Energy Regulatory Commission (FERC) estimated a total passage of 465 eels at the Dam 4 Hydroelectric Station (Normandeau Associates 1999).

Fish entrainment studies were conducted at Dam 4 in 1986 and 1992. Results from this study were used to estimate entrainment mortality at Dam 5. In 1986 the loss was dominated by bluegill (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieu*), rock bass (*Ambloplites rupestris*), and channel catfish (*Ictalurus punctatus*). In 1992, the loss was dominated by rock bass, greenside darter (*Etheostoma blennioides*), bluegill, and smallmouth bass. The American eel accounted for approximately nine to ten percent of the fish entrained each year. Annual entrainment for the American eel was estimated to be 1,335 eels at Dam 4 and 983 eels at Dam 5 (Normandeau Associates 2001b). Approximately 18 percent of these entrained eels at Dam 4 and 15 percent of eels at Dam 5 would be killed during turbine passage (Normandeau Associates 1999). Most eels entrained and killed were maturing eels emigrating out of the Potomac River. The range of potential cumulative mortality during downstream passage at Dams 4 and 5 was estimated at 15 percent to 37 percent, depending on river flow and unit operation at the hydroelectric stations (Normandeau Associates 2001b).

Since 1993, to minimize the mortality of the American eel during downstream passage, Allegheny Energy performs nighttime shutdowns of all running hydroelectric units from 15 September through 15 December. During these three months, hydroelectric station personnel take all generating units off line in the evening prior to sunset and restart the units the next morning. During the shutdown, the emigrating eels are able to leave the river via spillage, open trash sluices, or other watered routes. However, spillage is the most likely passage routes by eels (Normandeau Associates 1999).

3.5 CULTURAL RESOURCES

The National Park Service defines cultural resources to include prehistoric and historic archeological sites, historic structures, ethnographic resources buildings, cultural landscapes, or museum objects that are eligible for or listed in the NRHP. The consideration of these resources by the NPS meets pertinent requirements of the NHPA, the NEPA, and related legislation and implementing regulations. For purposes of this EA, analysis of cultural resources have been limited to a consideration of historic districts and structures, as all other categories of cultural resources have been dismissed as impact topics (archeological resources, cultural landscapes, ethnographic resources, and museum collections). The rationale for dismissal of these impact topics is given in Chapter 1, Section 1.5.3, *Impact Topics Dismissed From Further Analysis*.

For this study, efforts to identify cultural resources included a review of information provided by the park, supplemented by interviews with park staff and other published and unpublished sources. The C&O Canal is listed on the NRHP as an historic district. In addition to the NRHP nomination form, which contains extensive photographic and narrative description of the canal, there is also important documentation of the C&O Canal in the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) files for many of the locks, bridges, culverts, tunnels, aqueducts and associated industrial structures (Romigh and Mackintosh 1979). The NPS's List of Classified Structures (LCS) database also contains an extensive inventory of the park's numerous ruins, foundations, military earthworks, and industrial sites that have been field-verified along the canal lands. Guidebooks to the canal and the Thomas Hahn manuscript collections are important sources of historical information for the history of the canal and its related structures (Hahn 1997; NPS 1991; Hahn n.d.).

The Dam 4 Hydroelectric Plant and the Dam 5 Hydroelectric Plant are also individually recognized historic structures, and both are listed in the NRHP (Wood 1980a, 1980b). They have been documented in the received HABS/HAER with extensive written and descriptive data, measured drawings and photographs (Scott 1982a, 1982b).

3.5.1 Historic Structures and Districts

The C&O Canal is one of the most intact and impressive engineered structural features of the American canal-building era, and its historical importance is the basis for creation of the park. The C&O Canal is historically significant primarily because it embodies nineteenth-century engineering and architectural technology. The entire 184.5 miles of the canal is listed on the NRHP, having historical significance merits under architecture, engineering, commerce, transportation, military history and conservation. The magnitude of the engineering achievement is exemplified by the 184.5 mile length of the canal, which includes 74 lift locks that cumulatively rise 605 feet. Eleven stone aqueducts were built to carry the canal prism over large Potomac River tributaries and 241 historic culverts were built to carry smaller streams and roads under the canal. Seven supporting dams were also constructed (Romigh and Mackintosh 1979).

Historical Overview of the C&O Canal

The C&O Canal had its origins in 1784, when the Virginia Assembly passed an act incorporating the Patowmack Company. The charter was affirmed by the Maryland Assembly in November of that year. Between 1785 and 1802, the Patowmack Company proceeded to develop a series of slackwaters where the river was navigable, and artificial waterways where the fall of the Potomac made the river unusable.

After completion of locks at Great Falls, Virginia, in 1802, lack of financing from either the federal government or the adjacent states forced the Patowmack Company to delay new construction for over 20 years. By the mid-1820s, however, renewed interest in inland navigation resulted in reformation of the company as the C&O Canal Company, incorporated by the Virginia Act of January 27, 1824. Within the next two years, the company's charter was validated by the legislatures of Maryland and Pennsylvania, and by the U.S. Congress.

The C&O Canal was initially conceived as a completely artificial waterway paralleling the Potomac River from Georgetown, Washington DC to Cumberland, Maryland; from Cumberland, an overland route would extend through the Allegheny Mountains to Wheeling, Virginia (now West Virginia). The canal employed a system of lift locks to raise and lower commercial barges moving up and down a route that began in the mountains and ended in estuary waters near Georgetown. Although ground was broken with much fanfare on July 4, 1828, the enormous scale of the project brought the C&O Canal Company to the brink of failure on multiple occasions. Construction quickly fell behind schedule and ran over budget, as almost everything associated with building the canal took longer and cost more than the company had anticipated. At first progress was fair. The canal reached Seneca by 1830 and Harper's Ferry by 1833, but then construction bogged down. Money ran out, and a long, costly legal battle with the Baltimore & Ohio (B&O) Railroad caused further delays. By the time the Canal reached Cumberland, in 1850, the plan to complete the overland route through the mountains to the Monongahela River had been abandoned.

The B&O Railroad began construction on the same day as the canal company. The B&O started slowly, taking more than two years to reach Ellicott's Mills, just 13 miles west of Baltimore, but then proceeded swiftly. By 1836 it had passed the canal, and in 1842 the railroad reached Cumberland, eight years before the canal finally arrived there. Much of the freight that the canal's planners had hoped would ride in their boats instead rode the rails, especially the coal that was already being mined by the hundreds of tons. The race to connect Chesapeake Bay with the Ohio valley was won by the railroad, and the canal never really recovered. It did have a long history of hauling grain, coal, and other goods down to the docks in Georgetown, and also of providing water power for mills, but it disappointed both the financial aspirations of its inventors and the expectations of the federal and state governments that had approved its creation.

Irretrievably bankrupt, the C&O Canal ceased operations in 1924. The Federal government acquired the canal as a public works project in 1938. Twenty years later, President Dwight D. Eisenhower designated that portion of the canal between Seneca and Cumberland as a National

Monument, thereby formally making that portion part of the National Park System. In 1971, President Richard M. Nixon signed into law a bill creating the C&O Canal National Historical Park, incorporating both the upper National Monument and the lower portion of the canal down to Georgetown (Mackintosh 1991).

The proposed eel ladders would be located on two of the historic dams associated with the C&O Canal: Dam 4 and Dam 5 (Appendix D, Photo 1 and 2). These two dams are among the six built by the Canal Company above Harper's Ferry. The original dams were built of rock-filled timber cribbing, but these were replaced in the 1850s and 1860s.

The physical features and the history of the canal are well documented in the NRHP and HABS/HAER documentation, as well as numerous scholarly and popular books and articles. Much less is known about the daily lives of the workmen who built the canal. The canal was built by hand, mostly by thousands of Irish laborers. They lived in temporary camps or "shanties" along the canal; traces of these camps, if they exist, would be in the form of archeological sites. It is believed that large camps were established at the major dams, as construction of these major works would have required a great deal of labor. The areas near Dam 4 and Dam 5 are of particular interest, as these were sites of significant labor unrest (Way 1993).

During the Civil War, there were numerous skirmishes around the canal, as the canal had great strategic importance. Troops in transit to and from combat at the major battles (Antietam and Gettysburg) engaged in numerous skirmishes and raids, but few of these actions would have left a lasting mark on the landscape. After the Battle of Antietam, there was a camp along the canal at Antietam Furnace.

Canal-Related Historic Structures in the Dam 4 Area

The Dam 4 area includes a complex of functionally related historic structures (Table 3-5) that were designed and built to allow canal boats to use the river as a navigation channel around Galloway's and Charles Cliffs, great limestone formations that rose from the river bank to heights of over 100 feet. To avoid the difficulty and expense of excavating through or around these massive cliffs, the canal company chose to route boats out of the manmade canal into the relatively still water ("slackwater") behind the dam, and build the towpath directly along the river bank.

Big Slackwater is the historic name given to the waters impounded above historic Dam 4. During the years of the canal's commercial operation, boats travelling upriver left the canal prism at Inlet Lock (or Guard Lock) 4 and entered the Potomac River at Big Slackwater. From that point they followed the river bank northward; the towpath in this section was built into the river bank, providing an avenue for mules to pull the canal boats. The canal proper resumed at Lock 41, located at Milepost 88.9. Big Slackwater is one of only two places on the 184.5-mile-long C&O Canal where canal boats traveled on the Potomac River instead of on an artificial waterway. (The other is Little Slackwater at Dam 5.)

The original Dam 4 was a rock-filled, timber-cribbed structure that was completed in 1835. Due to severe leakage and damage from flooding and ice floes, it was replaced by a masonry structure that was completed in 1860, slightly downstream from the original location. The newer structure has been repaired, strengthened and raised on several occasions, and it survives today in good condition.

Upstream of the dam, river water entered the canal at Guard Lock 4 (Appendix D, Photo 3), passing through a set of retaining walls that flank the upper end of Guard Dike-Dam 4. The guard dike was designed simply to protect the canal from flooding, and it was a simple earthen embankment that extended for a distance of 1.1 miles along the canal. It was made of compact earthen clay with 1:1.5 sideslopes and flat top about 12 feet wide that stands 18 feet above the towpath. Guard Lock 4 was completed about 1834, and is still in good condition, although lacking the wooden gates. Measuring 91.5 feet between gate pockets, this lock lowered the water level in the canal by about 7 feet, depending on the river level. Because the upper end of the lock has been filled in, water is now confined to the river channel. The ruins of the Guard Lock 4 Lockkeeper's House have been recorded as archeological site 18WA513. The masonry foundation measures 16x24 feet in plan, with a single doorway in the front.

Winch House-Dam 4 is located along the canal at Dam 4 approximately 1.2 miles below Guard Lock 4. The winch house contained machinery that regulated the flow of water in the canal, by raising and lowering a drop gate. During periods of normal use, the drop gate was fully raised to allow passage through the canal, and it was lowered to control floodwaters. The winch house also served as a bridge across the canal, providing access to Dam 4. The present winch house (Appendix D, Photo 4) is a reconstruction, but the stone retaining walls that support it are original.

Table 3-5. Historic Structures in the Dam 4 Area

Structure Name	Description and Location
Dam 4	The present Dam 4, built in 1860, replaced a rock-filled structure of timber cribbing that was completed in 1835. Dam 4 is 715 feet long and originally stood 20 feet above the river bed. Since its original construction, Dam 4 has been repaired and raised, so that it now impounds 24 feet of water. Dam 4 is in good condition and its impounded waters power a hydroelectric station.
Guard Dike - Dam 4	Guard Dike-Dam No. 4 is a large earthen dike built to protect the canal from flooding. The specific construction date is not known. The dike was built of compacted clay on a 1:1.5 slope on both sides with a 12-foot wide flat top. It stands 18 feet above the towpath and extends for approximately 1.1 miles. The canal passes through this dike at its lower end and again at its upper end. The current pedestrian path extends along the guard dike instead of the historic towpath.
Guard Lock 4	Guard Lock 4 connected the impoundment upstream of Dam 4 (Big Slackwater) with the inland canal. It was built c. 1834 of limestone rock and measures 91.5 feet between gate pockets. The upper end of the lock passes through the guard dike which is confined by retaining walls, and a service bridge at this end allowed the tow mules to cross the lock, because the riverbank became the towpath along Big Slackwater. The lock is in good condition, although lacking its wooded gates. The upper end has been barricaded and filled in to prevent river water from entering the canal.

Structure Name	Description and Location
Winch House – Dam 4	The winch house at Dam No. 4 is a wood frame structure that sits directly above 2 stone retaining walls. The current structure is a reconstruction, based on canal company records and historic architectural drawings. This structure housed the machinery to lower a large wooden drop gate that regulated the flow of water in the canal during a flood event. The winch house sits astride parallel masonry abutment walls along the canal channel. The winch house also served as an access bridge to the Dam No. 4. The current winch house is a reconstruction, without the machinery or drop gate.
Wasteweir - Dam 4	Wasteweir – The wasteweir is located 250 feet downstream from Dam 4. This feature provided a means to drain excess water from the canal, at times of high water or in anticipation of a flood. The present structure is a concrete replacement (c. 1920) for an earlier stone structure. It is divided into three openings, each about 3.3 feet wide and 8.3 feet high. It is capped by a concrete slab. The structure is in fair condition.
Canal Prism	Between Milepost 84 and 85, the canal channel was about 50 feet wide and 6 feet deep. It is currently heavily overgrown and silted in. At Milepost 85.62 (Guard Lock 4), the impoundment upstream of Dam 4 (Big Slackwater) was used as the canal channel.
Towpath	Between Milepost 84 and 85, the towpath was an 8-foot wide earthen berm for mules. It stood about 2 feet above the water level of the canal and sloped slightly. In its historical condition, the towpath was clear of vegetation, but it is now somewhat overgrown.
Lockhouse- Guard Lock 4 (ruins)	Built c. 1833, the lock keeper’s house at Guard Lock 4 is a limestone masonry foundation that measures about 16x24 feet with a single doorway in the front. It originally was a 1-1/2 story frame house. The site has been recorded as archeological site number 18WA513.

Structure Name	Description and Location
Dam 4 Hydroelectric Station	Designed in 1906 and completed in 1909, the hydroelectric station at Dam 4 still generates electricity. Located on the West Virginia embankment, it is a 30x80-foot concrete structure with two main floors. The impounded waters behind Dam 4 drive turbines connected to generators in the powerhouse.

Canal-Related Historic Structures in the Dam 5 Area

The complex of canal-related structures at Dam 5 (Table 3-6) is similar to that of Dam 4. Dam 5 formed an impoundment known as Little Slackwater that allowed canal boats to use the river for navigation, rather than a separate man-made channel. Like Dam 4, the original Dam 5 was a rock-filled, timber-cribbed structure that was subsequently replaced by a masonry structure that was completed in 1868. The original location of Dam 5 was slightly downstream from the present structure.

Upstream-bound canal boats left the canal through Guard Lock 5, about 600 feet upstream from Dam 5. From that point, they traveled along the impounded waters for a distance of about one-half mile where they reentered the canal at Lock 45. The lock keeper's house at Guard Lock 5 is still standing (Appendix D, Photo 5), overlooking the dam and canal. As an added precaution/protective measure against flooding, a bypass flume diverted floodwater around Guard Lock 5, though an open ditch that was cut into bedrock. Downstream from Dam 5, a wasteweir allowed excess water to drain from the canal at times of high water.

Table 3-6. Historic Structures in the Dam 5 Area

Structure Name	Description
Dam 5	The original timber-cribbed dam that was built c. 1832-1834, at a location just upriver from the current Dam 5. The impoundment above Dam 5 extended only 3.5 miles and is known as Little Slackwater. Work on the present masonry dam began in 1857 but was interrupted by flooding and the Civil War, finally being completed in 1868. Dam 5 is 710 feet long and originally stood 22 feet above the river bed. Dam 5 is in good condition and its impounded waters power a hydroelectric station, located on the West Virginia bank.

Structure Name	Description
Guard Lock 5	Located adjacent to and just upriver from Dam 5, Guard Lock 5 linked the impounded waters of the Potomac River to the inland canal channel, so that canal boats could use the river upstream of the dam. The masonry structure was completed in 1834 and measures 90.5 feet between gate pockets. The upstream end of the lock is filled.
Lockhouse - Guard Lock 5	The lockhouse at Guard Lock 5 was built c. 1835 according to a standard plan. It is a 2-1/2 story whitewashed brick structure that rests on a 18x32-foot stone foundation. The site has been recorded as archeological site number 18WA537.
Guard Dike - Dam 5	Guard Dike-Dam 5 is an earthen embankment that designed to protect the canal against flooding. It begins just below Dam 5 and extends upriver for about 1000 feet. It is faced with stone riprap.
Wasteweir	The wasteweir at Milepost 106.81 is located 500 feet downstream from Dam 5. It provided a means to drain excess water from the canal, at times of high water or in anticipation of a flood. The present structure is a concrete replacement (c. 1900) for an earlier stone structure. It is similar to the wasteweir below Dam 4, with three openings, each about 3.3 feet wide and 8.3 feet high. It is capped by a concrete slab.
Bypass Flume - Dam 5	The bypass flume at Dam 5 is a channel that diverted water around Guard Lock 5. It cuts partially into the naturally outcropping adjacent bedrock. It is currently an open channel but historically it is believed to have been a closed culvert that would have allowed the gatekeeper to "walk" the gate boom for the lock. The upstream end is closed off with a stone wall, believed to be the same age as the closure of the lock; the lower end has been reworked in stone and concrete.
Culvert 136	Culvert 136 was built c. 1835 of rough limestone, with an arched 22.35-foot opening to carry the waters of Little Conococheague Creek beneath the canal.

Structure Name	Description
Canal Prism	At Guard Lock 5 (Milepost 106.80), the canal prism changed from an artificial channel to the impounded waters above Dam 5 (Little Slackwater). Below Guard Lock 5, the canal prism was c. 50 feet wide at the top and about 6 feet deep. The canal prism is now mostly silted in and overgrown with trees.
Towpath	Above Guard Lock 5, the towpath is an 8-foot wide berm directly adjacent to the impounded waters above Dam 5. Below Dam 5, the towpath was an 8-foot wide earthen berm for mules, standing about 2 feet above the water level of the canal. In its historical condition, the towpath was clear of vegetation, but it is now somewhat overgrown.
Dam 5 Hydroelectric Station	The present structure was built in 1917 to replace an earlier hydro-powered mill that had been converted to a hydroelectric station in 1903. The station currently houses two vertical-shaft turbines powered by the impounded waters above Dam 5. Dam 5 originally had a continuous rope drive system that connected turbines to the generators, comparable to that of Dam 4.

Hydroelectric Stations at Dam 4 and Dam 5.

The historical significance of the hydroelectric stations at Dam 4 and Dam 5 is recognized by their listing in the NRHP. Both stations have operated continuously for more than 100 years without significant changes to the building or the equipment and they have contributed to the economic growth and industrial development of the mid-Potomac River Valley.

Dam 4 Hydroelectric Station

The hydroelectric station at Dam 4 (Appendix D, Photos 6 and 7) was constructed of local limestone beginning in 1906. It is a large rectangular structure rising two stories atop a very tall basement with a 39-foot ceiling. The building is capped with a front-gable roof topped with three large metal ridge ventilators and there is one interior stone chimney. The building is punctuated with two-over-two wood-framed windows typical of the period. Entrance into the power station is on the south elevation directly onto the main floor through a metal roll-up garage door or a flanking single-leaf door.

Extending out from the body of the main structure are three turbine pits which siphons the overspill water into the turbines. The pits are 12 feet deep, open up to the main level of the station (Scott 1982a). Steel frame vertical trash slats on the exterior of the turbine pits prevent debris from flowing into the pit. A wooden pit gate when raised allows the water to enter into the actual turbine pit. Once the water is within the pit water flow is controlled by wicket gates into two tandem 40-inch Samson-type turbines. Only two of the turbine pits were finished, whereas the third pit was rough framed but no machinery was installed.

The turbines in pit one and two are connected to a 10-foot sheave wheel, which is located in the sheave pit (basement of the power station). Two 1250-foot sisal ropes extend from the lower sheave wheel in the basement up to the upper sheave wheel on the main floor. The upper sheave wheel is directly connected to a generator, and three transformers are placed outside. In the design of the system due to the high probability of flooding, the generators were placed 28 feet above the river level (Scott 1982a). Generators could not be directly connected to the submerged turbines; therefore, the innovative rope-drive system connected the two machines and allowed the low-speed turbines to propel the high-speed generators. The Dam 4 Powerhouse is believed to be the last commercially operated rope driven hydroelectric power station in the United States (Scott 1982a).

Dam 5 Hydroelectric Station

The first dam at this location was constructed in 1835 and a water-powered mill was also erected at the same time. The dam was subsequently replaced by a masonry structure in 1869. The mill transferred hands several times before its conversion into a hydroelectric station in 1903 by a predecessor of Allegheny Energy. The American continuous rope drive system was installed to transfer power from the turbines to the generators, which is the same system installed at Dam 4 a few years later (Scott 1982b). The rope drive system deteriorated and it could not produce sufficient amounts of desired power so it was replaced in 1917 (Scott 1982b).

The two-story 1917 station is (Appendix D, Photos 8 and 9) four bays across on the long elevations with a reinforced concrete foundation and steel frame upper floors. Three walls are laid in brick and the south elevation is clad with weatherboard siding. Wood siding was used for the entrance elevation to easily allow for large equipment to be moved in and out of the building. Siding could be removed and replaced without any serious complications more easily than brick. The walls are pierced with and just under the eaves are fixed rectangular window bays. The building has a gable roof detailed with three metal ventilators. Two vertical-shaft turbines placed in the basement operated under 16 feet of head (height of the water drop) and were directly connected to two 2300 Volt generators.

The hydroelectric station at Dam 5 is historically significant because it dramatically increased power in the area, particularly Martinsburg and Berkeley County. The increase in available power boosted the local economy and industrial development of the mid-Potomac River Valley (Wood 1980b).

3.6 VISITOR USE AND EXPERIENCE

3.6.1 Visitor Use and Safety

In 2007, the estimated number of visitors at the park was 2,809,968 guests. The busiest months were May and July, when monthly attendance exceeded 300,000 guests. December and January were the least visited months with less than 150,000 visitors per month (NPS 2008).

Since the park extends for 184.5 miles along the Potomac River from Georgetown to Cumberland, it is divided into five districts. The five districts include Washington DC, Montgomery County, Frederick County, Allegheny County, and Washington County. Dams 4 and 5 lie within the Washington County District. In 2007, it was estimated that 227,245 people visited the park in the Washington County district (NPS 2008). This was 8 percent of the park's total visitation. Areas lying between Dam 4 and Dam 5 include the Big Slackwater Area, McMahons Mill, Opequon Junction, Cumberland Valley, Williamsport Visitor Center, and Jordan Junction.

It is the policy of the park to provide environmental protection, healthful conditions, a safe work place, and hazard free visitor areas. To accomplish this, the park maintains a comprehensive and effective loss control management program that meets the requirements of higher authority and the needs of the park. Safety, health, and environmental concerns take precedence over all other concerns involving park activities and operations. The Risk Management Action Plan has eight principal elements to ensure further improvement of the park's safety performance. These elements include the following:

- Maintain a central safety committee
- Enhance communications throughout the park's jurisdictions
- Enhance park employee's knowledge, skills, and abilities of their duties
- Enhance the park's inspection and audit system
- Create an employee recognition system
- Enhance the hazard reporting system
- Enhance the performance management system
- Enhance the park's behavior-based observation process

Safety risks at Dams 4 and 5 for both park employees and visitors include falling into the water or over the dam. There are currently no guardrails present at the dams to prevent any form of falls to occur. There have currently been no reported incidences of falling into the river at this exposure. Signs warning visitors of this danger have been posted on the visitor bulletin boards at access points. In addition the park safety officer working with the maintenance division chief and park engineer developed a fall protection plan for park employees.

3.6.2 Visitor Experience

Visitor experience in areas surrounding Dams 4 and 5 include swimming, canoeing, kayaking, water skiing, high speed power boating, personal water craft, small boat fishing, bank fishing, wade fishing, hiking, biking, camping, picnicking, wildlife viewing, and hunting. The primary recreational use of the canal is hiking and biking along the original towpath. Parking is available at Dam 4, Big Slackwater, McMahons Mill, and Dam 5. Overnight camping is available to hikers and bikers at various intervals along the river. Big Woods campground is located along the towpath approximately 1.6 miles downstream of Dam 4 and Opequon Junction campground is approximately 6 miles upstream of Dam 4. Camping facilities near Dam 5 include Jordan Junction campground and North Mountain campground. Jordan Junction is located 5.6 miles downstream of Dam 5 and North Mountain is located 8 miles upstream. The towpath is also used for picnicking, wildlife viewing, and horseback riding in designated areas. Picnic areas are available at the Big Slackwater Area, Dam 4, Four Locks, and McCoys Ferry. Interpretive displays are provided throughout the park system.

Swimming primarily takes place in the Big Slackwater area above Dam 4. Canoeing and kayaking take place throughout the year with the peak use being in the spring. Boat ramps are located at McCoys Ferry and Four Locks upstream of Dam 5 and at Big Slackwater upstream of Dam 4. The use of high speed power boats, water skiing, and personal water craft peak during the summer weekends and on the holidays.

Fishing occurs along the banks of the river and in the tailwaters of Dams 4 and 5. People fish from small boats along the entire river, both above and below the dams when the water is navigable. Anglers also wade fish in shallow waters in the river when flows are low enough.

Hunting occurs in designated areas outside of park boundaries near Dams 4 and 5. Squirrel and duck hunting occurs from October through December, and trapping muskrat, beaver, and otter occurs from November through February.

The Williamsport Visitor Center is open Wednesday through Sunday year round. The Visitor Center includes a museum, orientation to the park, exhibits, and park information. Visitors have the opportunity for self-guided walking tours of the historic structures in the area, including the aqueduct and lockhouse.

3.6.3 Aesthetic Resources

The predominant aesthetic resource within the study area is the Potomac River itself. Other related aesthetic resources include the riparian vegetation, cliffs, the wooded shoreline along the canal towpath, the dams, and the historic dam powerhouses. The areas are used by many hikers, bikers, and fisherman. Lawn areas are located adjacent to Dams 4 and 5 so that visitors of the park can view the dams.

3.6.4 Park Operations

NPS staff is responsible for maintaining the 19,586 acres of parkland from Georgetown, Washington DC to Cumberland, Maryland. The park has designated access points that serve maintenance, law enforcement, river rescue, emergency medical, interpretive ranger, and other support personnel. There are approximately 93 park personnel. Some of the park personnel include park rangers, historians, biologists, maintenance workers, volunteer coordinators, and resource managers. To manage the diverse resources of the canal, staff works out of multiple field offices in addition to the main headquarters within the park. Dam 4 is within the Conococheague Maintenance District and Dam 5 is within the Four Locks Maintenance District. The Four Locks Maintenance District is responsible for performing a weekly inspection of Dam 5. Four permanent employees are located within the Four Locks Maintenance District.

A total of 9 permanent employees work within the Williamsport area. These include seven maintenance employees and two interpretive rangers. The maintenance crew is responsible for clearing the towpath of trees and limbs, removing vegetation, maintaining the visual quality of the area, trash collection, and routine maintenance projects. One employee of the maintenance crew is responsible for inspecting Dam 4 on a weekly basis.

Volunteers play an important role at the park. A total of 75 volunteers completed approximately 8,770 hours in 2008 in the Williamsport area. Volunteers primarily serve two roles at the park, which include bike patrol and visitor center assistants. Volunteers that do bike patrol bicycle along the towpath and engage visitors with informal interpretation and information. Visitor center assistants staff the front desk of the Williamsport Visitor Center and provide information to the public. In addition, visitor center assistants also volunteer at the National Canal Museum where they provide information to the public regarding the exhibits.

Allegheny Energy is responsible for operation and maintenance of its powerhouses at Dams 4 and 5.

3.7 ENERGY RESOURCES

Allegheny Energy uses Dams 4 and 5 on the Potomac River to produce energy. Dam 4 generates an average of 5,757 megawatt hours (MWh) of energy annually. Dam 5 generates an average of 4,604 MWh of energy annually. Both Dams 4 and 5 operate in a run-of-river mode with a minimum 1-inch veil of water over the dam at all times. Power generation ceases when the 1-inch veil cannot be maintained. The R. Paul Smith Power Station, a coal generated facility owned and operated by Allegheny Energy, is located between Dams 4 and 5 on the Potomac River in Williamsport, Maryland.

There is currently no electric power along the Maryland shoreline at either Dams 4 or 5. Historically power was available at the Dam 4 winch house. At Dam 5, residences located just outside of the park boundary do receive electric power.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 OVERVIEW

NEPA requires the disclosure of environmental impacts associated with the alternatives including the No Action Alternative. This section presents the environmental impacts of the Proposed Alternatives for Dams 4 and 5 and the No Action Alternative on physical resources, water resources, natural resources, cultural resources, visitor use and experience, park operations, and energy resources. These analyses provide a basis for comparing the effects of the action alternatives with the no-action alternative. NEPA requires consideration of context, intensity, adverse or beneficial impacts, duration of impacts, cumulative impacts, and measures to mitigate for impacts. NPS policy also requires that "impairment" of resources be evaluated in all environmental documents.

4.1.1 Methodology

As required by NEPA, potential impacts are described in terms of type (beneficial or adverse), context (site-specific, local, or regional), duration, and level of intensity (negligible, minor, moderate, or major). Both indirect and direct impacts are also described; however, they may not be identified specifically as direct or indirect. These terms are defined below. Overall, these impact analyses and conclusions were based on the review of existing literature and studies, information provided by on-site experts and other government agencies, professional judgements, and park staff insight. The impact analyses presented in this document are intended to comply with both NEPA and Section 106 of the NHPA; therefore, Section 106 summaries for each cultural resource topic are also included.

4.1.2 Impact Types

Impacts can be beneficial or adverse. Beneficial impacts would improve resource conditions, while adverse impacts would deplete or negatively alter resources.

Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.

Adverse: A change that moves the resource away from a desired condition or detracts from its appearance or condition.

Direct: An impact that is caused by an action and occurs at the same time and place.

Indirect: An impact that is caused by an action but is later in time or farther removed in distance but still reasonably foreseeable.

Context is the setting within which an impact occurs and can be site specific, local, parkwide, or regional. Site-specific impacts would occur at the location of the action, local impacts would occur within the general vicinity of the study area, parkwide impacts would affect a greater portion outside the study area yet within the park, and regionwide impacts would extend beyond park boundaries.

Site-specific: The impact would affect the project sites.

Parkwide: The impact would affect areas outside the project site yet within the park.

Regional: The impact would affect localities, cities, or towns surrounding the park.

4.1.3 Impact Definitions

Each potential impact is described in terms of its duration (short-term or long-term), and intensity (negligible, minor, moderate, or major). For the purposes of this analysis, the following definitions, unless stated otherwise, are used for all impact topics:

Duration

Short-term impacts: Impacts that might occur during the site preparation and construction phases of the eel ladder installation or in the short-term after the eel ladder installation. Short-term impacts would last up to 6 months following the start of the construction period.

Long-term impacts: Those impacts lasting greater than 6 months following the implementation of the eel ladders.

Intensity

Negligible: Impacts to the resource would be barely measurable or perceptible.

Minor

Adverse: Impacts would be measureable or perceptible but the overall viability of the resource would not be affected and, if left alone, would recover.

Moderate

Adverse: Impacts would cause a change in the resource and would be readily apparent.

<u>*Major*</u>

Adverse: Impacts would be substantial, highly noticeable, and permanent.

4.1.4 Impairment

The *NPS Management Policies 2006* requires an analysis of potential effects to determine whether or not actions would impair park resources. The primary purpose of the NPS, as established by the Organic Act and re-affirmed by the General Authorities Act, as amended, is to conserve park resources and values. Impacts to park resources and values are allowed when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Impairment is an impact that would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values.

NPS Management Policies conducted an analysis to determine whether the magnitude of impacts identified for specific impact topics reached the level of "impairment", as defined. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:

- Necessary to fulfill specific park purposes identified in the establishing legislation or proclamation of the park; or
- key to the natural or cultural integrity of the park or to the opportunities for enjoyment of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

An impact would be less likely to constitute impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or park values and it cannot be further mitigated.

An impact that may, but would not necessarily, lead to impairment may result from visitor activities; NPS administrative activities; or activities undertaken by concessionaires, contractors, and others operating in the park. Impairment may also result from sources or activities outside of the park (NPS 2006).

4.1.5 Cumulative Impacts

Cumulative impacts, as defined in regulations developed by the CEQ (CFR Title 40, Section 1508.7) are the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The following projects were considered during the cumulative impact analysis:

Big Slackwater – The project includes the reconstruction and stabilization of the historic stone wall and towpath along the Big Slackwater area of the C&O Canal located downstream of McMahons Mill. The historic stone masonry retaining wall that supports the towpath has been badly damaged by repeated floods and has not been repaired adequately since the canal ceased operations in 1924. Reconstruction will reestablish the towpath along a 4000-foot stretch of historic walls, between McMahons Mill and the Dam 4 boat ramp (approximately river mileposts 88 to 85). Intermittent sections where the stone masonry wall exists will require reinforcing of the existing historic wall and reconstruction of the towpath. Other sections of the towpath will require construction of new precast concrete retaining structures to support new towpath sections. This project is located within the Dam 4 project area and approximately 16 river miles from Dam 5.

Boat Ramp Restroom – The Boat Ramp Restroom project will take place throughout the park. One restroom would be located at the Dam 4 boat ramp. The restroom would be a self-contained facility, constructed as aesthetically pleasing modular cement buildings. Compliance for this project is complete and the installation of the restroom is planned to be complete by December 2009. This project is located within the Dam 4 project area and approximately 16 river miles from Dam 5.

Eel Passage – Additional efforts have been completed or are planned to allow eel passage throughout the Potomac River Basin. Two eel ladders were installed on the Shenandoah River. In addition, two eel ladders are proposed to being built on the Shenandoah River. A labyrinth weir was built on the Potomac River downstream of the Great Falls area. In addition to the above mentioned projects the installation of the eel ladders at Dam 4 and 5 would also be considered for cumulative impacts.

4.2 PHYSICAL RESOURCES

This section discusses the impacts of the alternatives including the No Action Alternative on the physical environment including air quality, noise, and soils.

4.2.1 Air Quality

Dam 4

Alternative A - No Action Alternative: Under the No Action Alternative the eel ladder at Dam 4 would not be constructed; therefore there would be no increase or decrease in generation of air quality pollutants.

Common to All Action Alternatives: During the construction process of the eel ladder, short-term, negligible, adverse impacts are anticipated to the local air quality regardless of the alternative. The operation of construction equipment including a backhoe, jib crane, concrete mixer, and welding tools would generate some criteria pollutant emissions, including carbon monoxide, nitrogen oxides, and particulate matter. Berkeley County, West Virginia and Washington County, Maryland are in attainment for all criteria pollutants except $PM_{2.5}$. Jefferson County, West Virginia is in attainment for all criteria pollutants. Impacts are expected to be short-term in nature, lasting only the duration of the construction activities, which is estimated to be approximately eight weeks.

Long-term, negligible, adverse impacts to air quality would result from the operation of the eel ladder. A pump would be used to create the attractant flow. The attractant flow pump would operate and generate criteria pollutant emissions during the American eel migration period, generally March through October. Impacts would be long term since criteria pollutant emissions would be generated during the migration period for the life of the project. If feasible, impacts to air quality would be minimized by installing a solar panel to operate the attractant flow pump. Impacts to air quality would be regional in context; however, emissions would be barely measureable or perceptible.

Cumulative Impacts: The short-term, negligible, adverse impacts to air quality from construction activities would contribute undetectable amounts of pollutants in the regional area. There would be no cumulative impacts to air quality associated with this project when combined with the Big Slackwater towpath reconstruction, Dam 4 boat ramp restroom construction, and other eel passage techniques. These projects would likely occur during different time periods.

Conclusion: Implementation of the proposed action at Dam 4 would result in short-term, negligible, adverse impacts to air quality due to the use of construction equipment regardless of the alternative. The operation of the attractant flow pump would create long-term, negligible, adverse impacts. The No Action Alternative would not impact air quality. None of the proposed alternatives, including No Action Alternative, would cause impairment to park resources.

<u>Dam 5</u>

Alternative A - No Action Alternative: Under the No Action Alternative the eel ladder at Dam 4 would not be constructed; therefore there would be no increase or decrease in generation of air quality pollutants.

Common to All Action Alternatives: Impacts to air quality as a result of the construction and implementation of an eel ladder at Dam 5 would be the same as those of Dam 4. Short-term, negligible impacts to air quality are anticipated due to the use of construction equipment. Impacts would last only the duration of the construction activities. Long-term, negligible, adverse impacts to air quality would result from the generation of emissions from the use of the attractant flow pump for the attractant water flow. If feasible, impacts would be minimized by installing a solar panel to operate the attractant flow pump.

Cumulative Impacts: The implementation of the proposed action would not result in cumulative impacts, as there are no other projects planned in the Dam 5 area of the park. On a regional level, the short-term, negligible impacts to air quality would be undetectable.

Conclusion: The implementation of the proposed action at Dam 5 would result in short-term, negligible impacts to air quality due to the use of construction equipment and long-term, negligible, adverse impacts to air quality due to the use of the pump for the attractant water flow. The No Action Alternative would not impact air quality. None of the alternatives would cause impairment of park resources.

4.2.2 Noise

<u>Dam 4</u>

Alternative A - No Action Alternative: Under the No Action Alternative the eel ladder at Dam 4 would not be constructed. There would be no impact to the current noise in the surrounding area of the dam.

Common to All Action Alternatives: Short-term, minor, adverse impacts to noise are anticipated as a result of the construction phase of the eel ladder regardless of the alternative. Impacts would be short-term in nature, lasting only for the duration of the construction activities, which is estimated to last up to eight weeks. Noise is expected, but noise impacts would be temporary and site-specific, and would not disrupt the surrounding undeveloped area. Construction noise is expected to temporarily impact visitor experience at the park. Short-term sources of noise include the use of construction equipment such as a backhoe, jib crane, concrete mixer, welding tools, hand tools, and the use of large vehicles to bring equipment to and from the site. Short-term, temporary noise impacts may cause avian and other wildlife to avoid areas in close proximity to the construction site. These impacts would cease after construction.

During the operation of the eel ladder at Dam 4 a pump would be used to provide water flow to draw the eels to the ladder. The pump would operate to create flow during the American eel migratory season, which is typically when water temperature is above 10ºC (March through October). Noise associated with the pump operation would be drowned out by the current noise at the site which includes the operation of the power stations and the water flowing over the dam. Therefore, operational noise of the eel ladder would be negligible and site specific.

Cumulative Impacts: Noise associated with the Dam 4 area includes the operation of the power station and the water flowing over the dam. Cumulative impacts to noise are not anticipated as the construction of the eel ladder, reconstruction of the towpath, and construction of the restrooms would not occur simultaneously. A short-term, minor impact to noise during the construction phase of the project and the operational noise of the pump would contribute to an undetectable increase in noise in the area near the dam.

Conclusion: The implementation of the proposed project would result in short-term, minor, adverse impacts during the construction phase of the project and long-term, negligible, adverse impacts during the operational phase of the project. Current noise sources within the park would remain unchanged under the No Action Alternative. None of the alternatives would cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative the eel ladder at Dam 5 would not be constructed. There would be no impact to the current noise in the surrounding area of the dam.

Common to All Action Alternatives: Impacts to noise as a result of the construction and operation of an eel ladder at Dam 5 would be the same as those of Dam 4 regardless of the alternative. During the construction phase of the project, short-term, minor, adverse impacts to noise are anticipated as a result of the use of construction equipment and large vehicles. Impacts would be temporary and site-specific.

Impacts to noise during the operation of the eel ladder would include noise associated with the attractant flow pump. Like Dam 4, the current noise of the power station and the noise of the water flowing over the dam would override the noise associated with the pump. Operational noise impacts would be long-term, negligible, and adverse.

Cumulative Impacts: Noise associated with the Dam 5 area includes the operation of the power station and the water flowing over the dam. Cumulative impacts to noise are not anticipated as there are no other projects planned in this area. A short-term, minor impact to noise during the construction phase of the project and the operational noise of the pump would contribute to an undetectable increase in noise in the area of the dam.

Conclusion: The implementation of the proposed project at Dam 5 would result in short-term, minor, adverse impacts during the construction phase of the project and long-term, negligible, adverse impacts during the operational phase of the project. Current noise sources within the park would remain unchanged under the No Action Alternative. None of the alternatives would cause impairment to park resources.

4.2.3 Soils

Dam 4

Alternative A - No Action Alternative: Under the No Action Alternative, the Dam 4 eel ladder would not be constructed. There would be no impact to the soil within the area.

Common to All Action Alternatives: Short-term, negligible, adverse impacts to soils are anticipated during the construction phase of the proposed project. The construction equipment used including the backhoe and jib crane has the potential to compact soils in the staging and construction area. Disturbed areas where compaction occurred would be re-stabilized with vegetation following construction; therefore soil compaction would be a temporary impact. Impacts to soils would be site-specific. No long-term impacts are anticipated.

Alternative B (Preferred Alternative): Alternatives B is located along the Maryland shoreline. There is currently no electricity available within this area of the park; therefore electric lines would be brought in below grade from outside the park to provide power for the pump. In order to bring electricity in below grade, soils would be removed using a backhoe. Electrical lines would be installed and the soil would be returned to its existing grade and re-vegetated. Short-term, minor, adverse impacts are anticipated as a result of the movement and displacement of the soil. If feasible, in order to avoid impacts to soils, a solar panel may be installed to operate the attractant flow pump.

In addition, Alternative B includes installing the exit pipe underground through the abutment for approximately 100 feet. In order to install the exit pipe, soils within the abutment area along the Maryland shoreline would also be removed with a backhoe. Once the pipeline is installed the soil would be replaced and returned to the original grading of the area. Short-term, minor, adverse impacts are anticipated as a result of the Preferred Alternative due to the movement and displacement of the soil. Impacts to soils would be temporary and localized within the abutment area.

Cumulative Impacts: As a result of the installation of the eel ladder, there would be short-term, negligible, adverse impacts to soil. Alternatives located on the Maryland shoreline would also create short-term, minor, adverse impacts to soils due to the movement of soils to install electrical lines. The Preferred Alternative would include additional movement of soils to install the exit pipe underground. The compaction and movement of soils at Dam 4 would not contribute to a cumulative impact to this resource.

Conclusion: The construction phase of the project would create short-term, negligible impacts to soils at Dam 4 regardless of the alternative due to the soil compaction from the construction equipment in the staging and work area. Short-term, minor, adverse impacts are expected due to the movement of soils to install below grade electrical lines along the Maryland shoreline and due to the movement of soils within the abutment along the Maryland shoreline. There would be no impacts to soils associated with the No Action Alternative. None of the alternatives would cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative the eel ladder at Dam 5 would not be installed; therefore, there would be no impact to soils.

Common to All Alternatives: Impacts to soils during the construction phase would be the same as those associated with Dam 4. Short-term, negligible, adverse impacts to soils are expected due to soil compaction from the construction equipment within the staging and work areas. Impacts would be temporary and would only last the duration of the construction period. The impacted areas would be re-vegetated at the termination of the construction. Impacts to soils would be site-specific. No long-term impacts are anticipated.

Alternative D: Alternative D is located along the Maryland shoreline. In order to provide access to construction equipment via the towpath, a land bridge would be created three feet over the lock. Soil would be used to infill the lock. At the completion of the project the soil would be removed and the lock would be returned to its original condition. Therefore, impacts to soil would be short-term, negligible, and adverse.

Like Dam 4, there is no electricity currently available at the Dam 5 site. In order to supply power for the attractant flow pump, electricity would be brought to the site below ground from outside of the park. Soils would be removed with a back hoe. The soil would be replaced to the original grade after electrical lines are installed. Impacts to soils from the construction equipment access and installation of electrical lines are expected to be short-term, minor, and adverse. In addition, long-term, minor, adverse impacts are anticipated as a result of the installation of support footings for the exit pipe.

Cumulative Impacts: There would be no cumulative impact to soils as a result of the installation of the Dam 5 eel ladder. Short-term, negligible impacts would result from the use of construction equipment and short-term, minor adverse impacts would result from the movement of soils along the Maryland shoreline. Overall, there would be unmeasureable changes in the soils in the project area; therefore, no cumulative impacts to soil are anticipated from the proposed project.

Conclusion: Like Dam 4, the construction phase of the project would create short-term, negligible, adverse impacts to soils regardless of the alternative. Short-term, minor, adverse impacts to soils are anticipated from the alternative on the Maryland shoreline (Alternative D) due to the movement of soils to create a land bridge over the lock and from the installation of an electric supply line. Long-term, minor, adverse impacts to soils would result from the placement of support footings along the exit pipe on the Maryland shoreline. No impacts are expected as a result of the No Action Alternative. None of the alternatives would cause impairment to park resources.

4.3 WATER RESOURCES

This section discusses the impacts of the alternatives including the No Action Alternative on the water resources including water quality and water flow.

4.3.1 Water Quality and Flow

<u>Dam 4</u>

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 4 would not be installed. There would be no impact to water resources.

Common to All Action Alternatives: Short-term, minor, adverse impacts to water quality are anticipated regardless of the alternative. The use of construction equipment along the riverbanks has the potential to contribute to erosion and increase the sediment load and turbidity of the river. To minimize impacts, best management practices, including silt fences, would be used during the construction period. Best management practices would also be used during the soil movement activities associated with the installation of below grade electric supply lines along the Maryland shoreline and with the installation of the underground exit pipe (Alternative B). Impacts would be site-specific since turbidity levels would decrease as the water flowed downstream.

In order to install the eel ladder at Dam 4, the water level of the upstream pool may be lowered or sandbags would be placed on the dam to prevent the water from spilling over the dam. Currently a 1-inch veil is required over the dam at all times to protect water quality and aquatic communities in the river below the dam. The drawdown would cause the temporary loss of the veil, and therefore the loss of the benefit it provides to water quality immediately below the dam. This would create short-term, minor, adverse impacts to water flow and quality in the area. These impacts would be short-term in nature and are expected to only last one week. Water levels would be returned to normal operations at the completion of the construction period.

Alternative C: Alternative C would create long-term, negligible, adverse impacts to water quality at Dam 4. Water flow would be slightly altered due to the placement of a non-overflow structure in the tailwaters of the dam. The change of the location of flow would impact the aeration or dissolved oxygen of the water within the immediate area.

Cumulative Impacts: There would be no cumulative impacts to water quality and water flow associated with this project since the area of impact would be relatively small when compared to the size of the Potomac River. In addition, the planned projects in the area would have no impact to this resource.

Conclusion: Regardless of the alternative, the use of construction equipment along the riverbanks and the drawdown of the water upstream of Dam 4 would create short-term, minor, adverse impacts to water quality. Long-term, negligible, adverse impacts during the operation of the eel ladder are anticipated under Alternative C. Impacts would result from the placement of the non-overflow structure, which would alter the dissolved oxygen of the water in the immediate vicinity of the dam. There would be no impacts to water quality and flow associated with the No Action Alternative. The installation of an eel ladder at Dam 4 would not cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 5 would not be installed. There would be no impact to water resources.

Common to All Action Alternatives: Short-term, minor, adverse impacts to water quality are anticipated regardless of the alternative. The use of the construction equipment along the river may increase turbidity, sediment load, and erosion potential. To minimize the impacts to water quality, best management practices, including silt fences, would be used during the construction period. Best management practices would also be used during the installation of the below grade electrical lines along the Maryland shoreline.

The drawdown of the water upstream of Dam 5 would create additional short-term, minor, adverse impacts to water flow. The drawdown would last approximately one week to prevent water from spilling over the dam. Currently a veil is required over the dam at all times to protect water quality and aquatic communities in the river below the dam. The drawdown would cause the temporary loss of the veil, and therefore the loss of the benefit it provides to water quality immediately below the dam. This would create short-term, minor, adverse impacts to water flow and quality in the area. These impacts would be short-term in nature and are expected to only last one week. Water levels would be increased once the construction of the eel ladder is complete.

Alternatives C and D: A non-overflow structure would be installed at Dam 5 under Alternatives C and D. Like Dam 4, the non-overflow structure would stop the water flow within a limited area to help attract the American eels to the eel ladder. Impacts to water quality are expected to be long-term and negligible, since the change in overflow location would change the aeration or dissolved oxygen of the water. The alteration of water quality would be localized within the area of the eel ladder.

Cumulative Impacts: There would be no cumulative impacts to water quality or water flow associated with the proposed alternatives as no other projects are planned in this area. The short-term impacts to water quality and long-term impacts to water flow would be confined to the small project area.

Conclusion: The use of the construction equipment along the river has the potential to create short-term, minor, adverse impacts to water quality. Best management practices would be used to minimize this impact. The decrease in water level upstream of Dam 5 would create additional short-term, minor, adverse impacts to water flow. The placement of the non-overflow associated with all alternatives except Alternative B would create long-term, negligible, adverse impacts to water quality. There would be no impacts to water quality and flow associated with the No Action Alternative. The installation of an eel ladder at Dam 5 would not cause impairment to park resources.

4.4 NATURAL RESOURCES

This section discusses the impacts of the alternatives including the No Action Alternative on natural resources including wetlands, vegetation, wildlife, and aquatic resources.

4.4.1 Wetlands and Deepwater Habitat

<u>Dam 4</u>

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder and associated structures would not be installed at Dam 4. There would be no impacts to wetlands or deepwater habitats.

Common to All Action Alternatives: The area within the Potomac River upstream of Dam 4 is characterized as a lacustrine, limnetic, unconsolidated bottom, permanently flooded deepwater habitat. The area within the Potomac River downstream of Dam 4 is characterized as a riverine, unknown perennial, unconsolidated bottom, permanently flooded deepwater habitat. These areas are considered deepwater habitat as per Cowardin Classification of Wetlands (Cowardin 1979). Regardless of the alternative the eel ladder at Dam 4 would be placed within the deepwater habitat downstream of the dam. The eel ladder would be attached to the dam, forebay, or abutment, and would not be attached to the river bottom. The exit pipe would run along the shoreline at each alternative and release the eels into a live well which would be located upstream of the dam. The live well would be placed within the upstream deepwater habitat. In order to stabilize the live well, cobble and river stone would be placed on the river bottom. The placement of the boulders in the deepwater habitat would create a long-term, minor, adverse impact to deep water habitats. Wetlands along the Maryland and West Virginia shorelines are characterized as palustrine, forested, broad-leaved deciduous, temporarily flooded wetlands (PFO1A); a palustrine, emergent, nonpersistent, temporarily flooded wetland (PEM2A) is also located along the shoreline in Maryland as well. Because the exit pipe would run along the shoreline at each alternative and release the eels into a live well located upstream of the dam, impacts to the shoreline wetland would occur as a result of the pipe footings. These structures are necessary to support the exit pipe and would be installed above ground where appropriate; a maximum of 20 footings (2 footings per location) would be necessary to support the pipe. The footings would be circular concrete structures, approximately 1-foot in diameter and would be placed to a depth of approximately 4 feet below the ground surface. Therefore, all alternatives would affect a maximum of 20 ft^2 of shoreline wetland areas characterized as PFO1A and/or PEM2A creating a long-term, minor, adverse impacts (Figures 4-1 and 4-2).

Because the proposed project would be located within a nontidal wetland (as defined by the USACE) and would be located within the 25-foot buffer of the wetland (as defined by MDE), a letter of exemption from MDE would be required. MDE regulates activities within nontidal wetlands including grading or filling, excavating or dredging, changing existing drainage patterns, disturbing the water level or water table, and destroying or removing vegetation. Similarly, the West Virginia Environmental Quality Board would be notified and compliance with both state's water quality standards would be required.

The NPS uses a conservative estimate of wetlands, which includes requiring only one of the three criteria that the USACE requires for the characterization of a wetland. Therefore, a Statement of Findings (SOF) describing wetlands and impacts according to the NPS definition is normally required for impacts to wetlands as a result of a proposed project. However, as described in Section 4.2 of DO #77-1, some NPS requirements (SOF and wetland compensation) may be waived for certain Excepted Actions (NPS 2008). As stated in Chapter 1, the proposed action is taken in the context of an ongoing effort by USFWS and NPS, in cooperation with Allegheny Energy, to restore American eel populations in the Potomac River by providing safe passage for eels around dams throughout the Potomac River watershed. Therefore, this project is considered an Excepted Action under Section 4.2.1h (actions designed for the purpose of restoring degraded aquatic habitats or ecological processes) because the purpose of the project is to restore safe passage (an ecological process) for the American eel. Additionally, under this Excepted Action up to 0.25 acres of new long-term, adverse impacts on wetlands are allowed if directly associated with and necessary for the restoration (e.g., small structures) (NPS 2008).

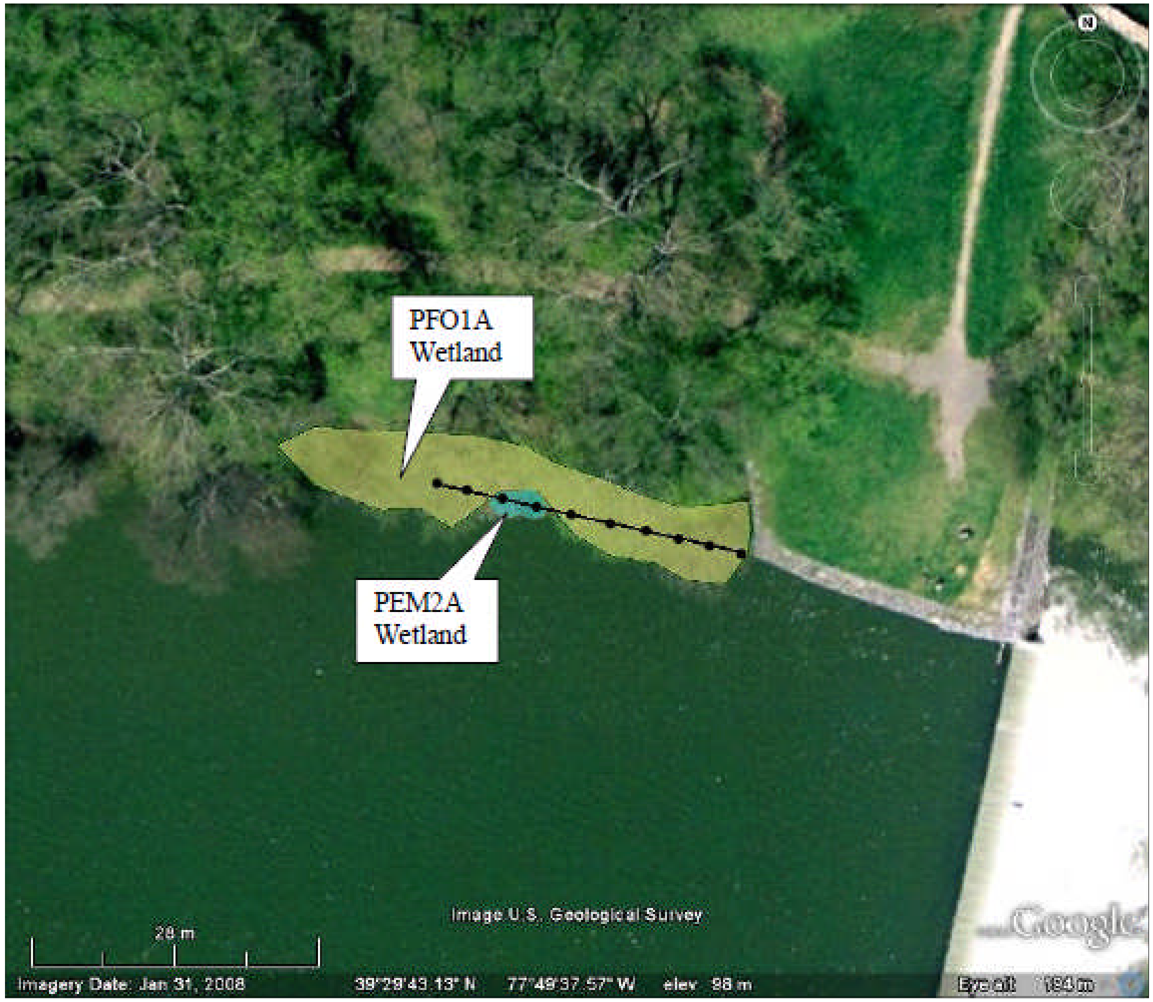


Figure 4-1. Location of Wetland Areas and Proposed Pipeline and Footers Along Shoreline of Potomac River in Maryland at Dam 4

Note: Wetland areas and pipeline location is approximate and presents maximum wetland areas affected by project.

Figure 4-2. Location of Wetland Areas and Proposed Pipeline and Footers Along Shoreline of Potomac River in West Virginia at Dam 4

Note: Wetland areas and pipeline location is approximate and presents maximum wetland areas affected by project.

Because this project is considered a restoration project and because the total footprint of wetland impacts is so small (less than 0.25 acres of wetland impact), this project qualifies as an Excepted Action, as described in DO #77-1 (NPS 2008). This determination was approved by Mr. Joel Wagner, Wetland Program Leader for NPS Natural Resources Program Center during a phone conversation. The conversation is included in Appendix E as a phone record. When actions are excepted, however, conditions and best management practices (BMPs) must be satisfied as described in Appendix 2 of DO#77-1) and requirements to avoid wetlands and minimize unavoidable wetland impacts to the extent practicable still apply (NPS 2008). The conditions and BMPs described in Appendix 2 would be satisfied for this project as described in the applicable resource sections of this chapter, including the following applicable actions:

1. **Effects on hydrology:** site hydrology would not be affected.

2. **Water quality protection and certification:** water quality would not be degraded and action would be consistent with state water quality standards and Clean Water Act Section 401 certification requirements

3. **Erosion and siltation controls:** Appropriate erosion and siltation would be maintained during construction, and all exposed soil or fill material would be permanently stabilized at the earliest practicable date.

4. **Effects on fauna:** Action would benefit aquatic fauna and would not affect terrestrial fauna

5. **Proper maintenance:** Structure would be properly maintained to avoid adverse impacts on aquatic environments or public safety.

6. **Heavy equipment use:** Heavy equipment use in wetlands would be avoided if at all possible. Heavy equipment used in wetlands would be placed on mats, or other measures must be taken to minimize soil and plant root disturbance and to preserve preconstruction elevations.

7. **Stockpiling material:** Whenever possible, excavated material would be placed on an upland site. However, when this is not feasible, temporary stockpiling of excavated material in wetlands must be placed on filter cloth, mats, or some other semipermeable surface, or comparable measures must be taken to ensure that underlying wetland habitat is protected. The material would be stabilized with straw bales, filter cloth, or other appropriate means to prevent reentry into the waterway or wetland.

8. **Removal of stockpiles and other temporary disturbances during construction:** Temporary stockpiles in wetlands would be removed in their entirety as soon as practicable.

Wetland areas temporarily disturbed by stockpiling or other activities during construction would be returned to their pre-existing conditions as soon as practicable.

9. **Topsoil storage and reuse:** Revegetation of disturbed soil areas would be facilitated by salvaging and storing existing topsoil and reusing it in restoration efforts in accordance with NPS policies and guidance.

10. **Native plants:** N/A

11. **Boardwalk elevations:** N/A

12. **Wild and Scenic Rivers:** N/A.

13. **Coastal zone management:** N/A.

14. **Endangered species:** N/A

15. **Historic properties:** Action must not have adverse effects on historic properties listed or eligible for listing in the National Register of Historic Places. The Preferred Alternative would not affect the historic Dam 4 structure or the cultural landscape. However, Alternatives C and D propose attaching the eel ladder to the Dam 4 structure, which would not degrade historic properties, but would affect the cultural landscape.

Cumulative Impacts: The minor loss of wetlands (maximum of 20 ft^2) would not contribute to the cumulative impacts to this resource. Therefore, no cumulative impacts to wetlands associated with the proposed project are anticipated. None of the projects that are ongoing or proposed include the take of wetlands within the Dam 4 area.

Conclusion: The placement of the eel ladder in the wetland downstream of Dam 4 and the exit pipe upstream of Dam 4 would have no adverse impact to deepwater habitat within the area; the footings of the exit pipe would have a long-term, adverse, minor affect to wetlands from a maximum of 20 ft^2 of shoreline wetlands affected, including PFO1A and/or PEM2A wetlands. The placement of cobble and river stone on the river bottom to support the live well upstream of Dam 4 would result in long-term, minor, adverse impacts to deepwater habitat. There would be no impact to wetlands under the No Action Alternative. The installation of the eel ladder at Dam 4 would not cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder and associated structures would not be installed at Dam 5. There would be no impacts to wetlands.

Common to All Action Alternatives: Like Dam 4, the area within the Potomac River upstream of Dam 5 is characterized as a lacustrine, limnetic, unconsolidated bottom, permanently flooded deepwater habitat. The area within the Potomac River downstream of Dam 5 is characterized as a riverine, unknown perennial, unconsolidated bottom, permanently flooded deepwater habitat. These areas are considered deepwater habitats. Regardless of the alternative the eel ladder at Dam 5 would be placed within the deep water habitat downstream of the dam. The eel ladder would be attached to the dam, forebay, or abutment, and would not be attached to the river bottom. The exit pipe would run along the shoreline at each alternative and release the eels into a live well which would be located upstream of the dam. Cobble and river stone would be placed on the river bottom to support the live well. Due to the placement of boulders within the deepwater habitat, impacts are expected to be long-term, minor, and adverse.

In addition to the deepwater habitat described above, shoreline wetland areas located upstream of Dam 5 also exist immediately adjacent to the Potomac River. These areas are located in both Maryland and West Virginia and characterized as palustrine, forested, broad-leaved deciduous, temporarily flooded wetlands (PFO1A). A palustrine, emergent, nonpersistent, temporarily flooded wetland (PEM2A) is also located along the shoreline in MD and a riverine, unknown perennial, unconsolidated shore, mud, temporarily flooded wetland (R5US3A) is located in WV, but is primarily nonvegetated. Because the exit pipe would run along the shoreline at each alternative and release the eels into a live well located upstream of the dam, impacts to the shoreline wetland would occur as a result of the pipe footings. These structures are necessary to support the exit pipe and would be installed above ground where appropriate; a maximum of 20 footings (2 footings in 10 locations) would be necessary to support the pipe. The footings would be circular concrete structures, approximately 1-foot in diameter and would be placed to a depth of approximately 4 feet below the ground surface. Therefore, all alternatives would affect a maximum of 20 ft^2 of shoreline wetland areas characterized as PFO1A, PEM2A, or R5US3A (Figures 4-3 and 4-4).

As stated above, a letter of exemption from MDE would be required and the West Virginia Environmental Quality Board would be notified and compliance with both state's water quality standards would be required. Also, stated above, this project is considered a restoration project and qualifies as an Excepted Action, as described in PM #77-1 (NPS 2008). This determination was approved by Mr. Joel Wagner, Wetland Program Leader for NPS Natural Resources

Program Center during a phone conversation. The conditions and BMPs described in Appendix 2 of PM #77-1 would be satisfied for this project as described above for Dam 4, with the exception of the Alternative D discussion that follows.

Alternative D: An exit pipe would run along the river bank under Alternative D. Concrete footings would be placed along the bank to support the structure. Therefore, a maximum of 20 ft^2 of shoreline wetlands (PFO1A and R5US3A) in West Virginia would be affected by Alternative D. The conditions and BMPs described in Appendix 2 of PM #77-1 would be satisfied for Alternative D, with the exception of the following:

15. **Historic properties:** Action must not have adverse effects on historic properties listed or eligible for listing in the National Register of Historic Places. Alternative D proposes to attach the eel ladder to the Dam 5 structure, which would not degrade historic properties, but would affect the cultural landscape.

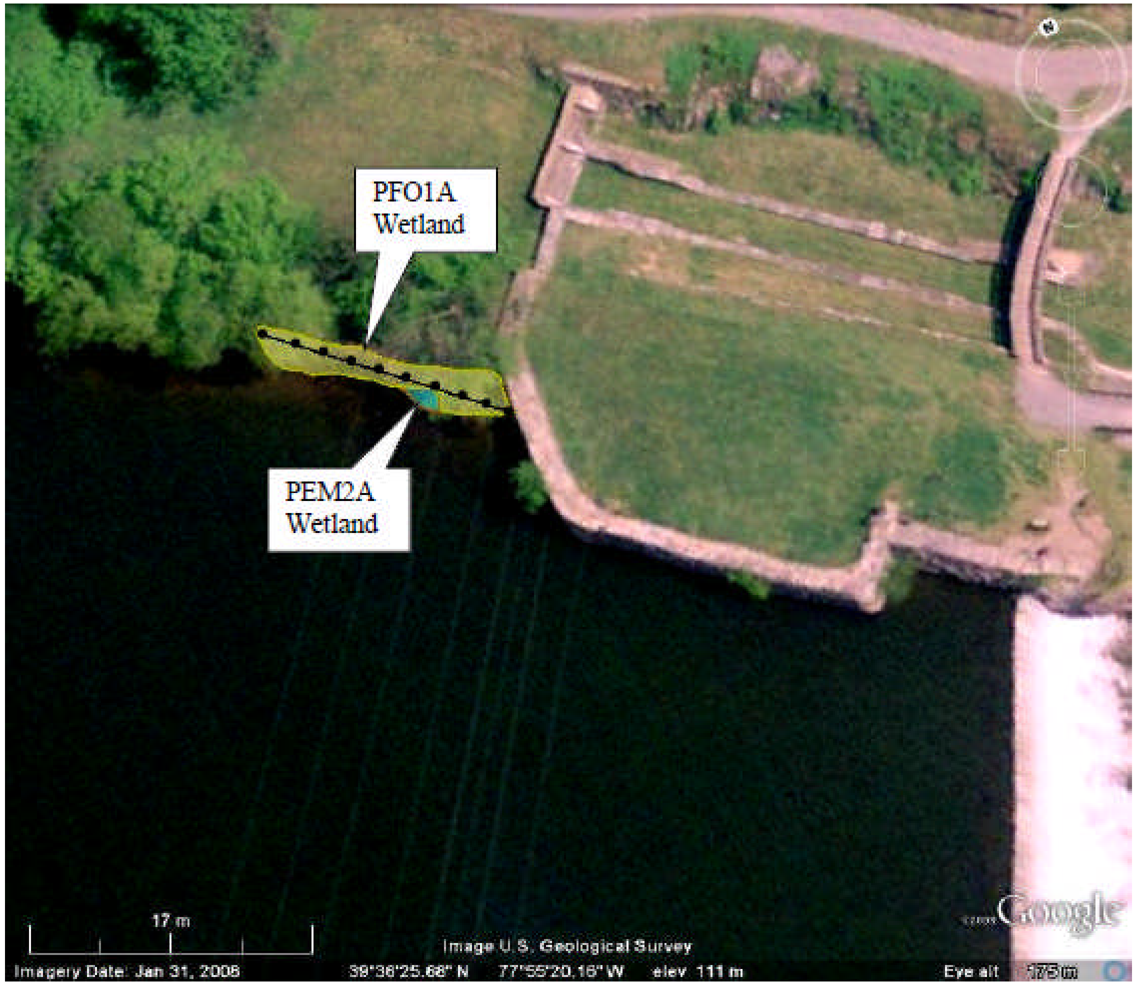


Figure 4-3. Location of Wetland Areas and Proposed Pipeline and Footers Along Shoreline of Potomac River in Maryland at Dam 5

Note: Wetland areas and pipeline location is approximate and presents maximum wetland areas affected by project.

Figure 4-4. Location of Wetland Areas and Proposed Pipeline and Footers Along Shoreline of Potomac River in West Virginia at Dam 5

Note: Wetland areas and pipeline location is approximate and presents maximum wetland areas affected by project.

Cumulative Impacts: The minor loss of wetlands (maximum of 20 ft^2) would not contribute to the cumulative impacts to this resource. Therefore, no cumulative impacts to wetlands associated with the proposed project are anticipated. None of the projects that are ongoing or proposed include the take of wetlands within the Dam 5 area.

Conclusion: Impacts to deepwater habitat would result due to the placement of cobble and river stones on the river bottom to support the live well placed upstream of Dam 5. There would be no adverse impacts to deepwater habitats associated with the placement of the eel ladder downstream of Dam 5 or the placement of the exit pipe along the Maryland shoreline. The footings of the exit pipe upstream of Dam 5 would have a long-term, adverse, minor affect to wetlands from a maximum of 20 ft^2 of shoreline wetlands affected, including PFO1A and/or PEM2A wetlands. There would be no impact to wetlands under the No Action Alternative. The installation of the eel ladder at Dam 5 would not cause impairment to park resources.

4.4.2 Vegetation

<u>Dam 4</u>

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 4 would not be installed. There would be no impact to vegetation.

Common to All Action Alternatives: The construction phase of the proposed project would create short-term, minor, adverse impacts to vegetation. The construction equipment including a backhoe, jib crane, and associated vehicles would be brought to the site of Dam 4. The use of the construction equipment may damage vegetation within the area during the construction phase. Impacts to the vegetation would be short-term, as disturbed areas would be planted with native species at the end of the construction period. Impacts to vegetation would be site specific.

Alternative B (Preferred Alternative): Additional vegetation impacts would be associated with the alternative proposed on the Maryland shoreline. There is currently no electrical service available at the site; therefore it would be brought in from outside the park underground. Vegetation would be removed along the area for the electric line. Disturbed areas would be vegetated with native species after the installation is complete; therefore impacts would be short-term, minor, and adverse. Additional impacts associated with Alternative B would include the removal of grass within the abutment area to install the underground exit pipe. These impacts would also be short-term, minor, and adverse. The area would be re-vegetated with native species after completion of the construction phase.

Cumulative Impacts: When combined with the Big Slackwater Project, Dam 4 Boat Ramp Restroom project, and other eel passage project, long-term, negligible to minor cumulative impacts to vegetation may occur. The placement of the eel ladder along the Maryland shoreline would require the loss of vegetation along the exit pipe. It is likely that other projects within the area would include the removal of additional vegetation.

Conclusion: The construction phase of the project would create short-term, minor, adverse impacts regardless of the alternative due to the large equipment and vehicles accessing the site and damaging or removing vegetation. Additional short-term, minor, adverse impacts would be associated with the alternative located on the Maryland shoreline due to the installation of underground electrical lines and exit pipe (at Alternative B). There would be no impact to vegetation under the No Action Alternative. The installation of the eel ladder at Dam 4 would not cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 5 would not be installed. There would be no impact to vegetation.

Common to All Action Alternatives: Impacts to vegetation would be similar to those of Dam 4. The construction phase of the proposed project would create short-term, minor, adverse impacts to vegetation. The construction vehicles and equipment would be brought to the Dam 5 site via the towpath and created land bridge over the lock. The use of the construction equipment may damage vegetation within the area during the construction phase. Impacts to the vegetation would be short-term, as disturbed areas would be re-vegetated with native species at the end of the construction period.

Common to Alternative D: The electrical line proposed to be installed below grade along the Maryland shoreline in Alternative D would create short-term, minor, adverse impacts to vegetation. During the installation of the electric line, vegetation may be removed. Impacts are expected to be temporary as the disturbed areas would be re-vegetated after installation is complete.

Like Dam 4, long-term, minor, adverse impacts to vegetation are anticipated due to the removal of vegetation associated with the placement of concrete footings to support the exit pipe along the Maryland shoreline.

Cumulative Impacts: Impacts to vegetation are expected to be minor and adverse. Impacts would be localized within the small construction area and would therefore contribute to an unmeasureable change to vegetation in the area. There would be no cumulative impacts associated with the installation of the eel ladder at Dam 5, as there are no other projects planned in the immediate area.

Conclusion: Short-term, minor, adverse impacts to vegetation are anticipated regardless of the alternative due to the use and transportation of construction equipment and vehicles. The installation of the electric line along the Maryland shoreline would create addition short-term, minor, adverse impacts due to the removal of the vegetation along the proposed electric line. Impacts would be minimized by re-vegetating disturbed areas with native species at the end of the construction period. Long-term, minor, adverse impacts would occur due to the removal of vegetation for the placement of cement footings along the Maryland shoreline for the exit pipe. There would be no impacts to vegetation associated with the No Action Alternative. The installation of the eel ladder at Dam 5 would not cause impairment to park resources.

4.4.3 Wildlife

<u>Dam 4</u>

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 4 would not be installed. There would be no impact to the terrestrial wildlife.

Common to All Action Alternatives: The construction phase of the project would create short-term, minor, adverse impacts to terrestrial wildlife within the Dam 4 project area. The noise associated with the construction equipment may cause avian and other wildlife to avoid areas in close proximity to the construction area. Impacts are expected to be temporary lasting up to eight weeks; wildlife would be expected to return to the area after the construction period has ended. Wildlife occurring along the West Virginia shoreline may be less impacted from the construction noise since wildlife is likely accustomed to the noise associated with the hydroelectric station. The operation of the eel ladder at Dam 4 would not impact wildlife in the immediate area. Impacts to wildlife would be site-specific.

Cumulative Impacts: The proposed project is expected to create short-term, minor, adverse impacts to wildlife during the construction phase of the project. The impacts would be temporary and localized to the Dam 4 area. Overall there would be no cumulative impacts to wildlife, as the other projects within the Dam 4 area would likely occur during different time periods.

Conclusion: Terrestrial wildlife within the immediate vicinity of Dam 4 is anticipated to be temporarily impacted during the construction period due to the increased levels of noise in the area. It is expected that these impacts would be temporary and the wildlife would return to the area once installation is complete. The No Action Alternative would have no impact to wildlife. The installation of the eel ladder at Dam 4 would not cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 5 would not be installed. There would be no impact to terrestrial wildlife.

Common to All Action Alternatives: Impacts associated with the construction phase of the project would be the same as Dam 4 regardless of the alternative. Short-term, minor, adverse impacts to wildlife are anticipated as a result of the noise associated with the construction of the eel ladder. Impacts to wildlife would be site-specific.

Cumulative Impacts: The installation of the eel ladder at Dam 5 would create short-term, minor, adverse impacts to wildlife. The noise associated with the construction of the eel ladder would contribute to an undetectable amount of disturbance to wildlife in the regional area. There would be no cumulative impacts associated with the installation of the eel ladder at Dam 5 as there are no other projects planned in the area.

Conclusion: Terrestrial wildlife within the immediate vicinity of Dam 5 is anticipated to be temporarily impacted during the construction period due to the increased levels of noise in the area. It is expected that these impacts would be short-term and the wildlife return to the area once installation is complete. The No Action Alternative would have no impact to wildlife. The installation of the eel ladder at Dam 5 would not cause impairment to park resources.

4.4.4 Aquatic Resources

Dam 4

Alternative A - No Action Alternative: Long-term, moderate, adverse impacts to American eels would result under the No Action Alternative. American eels would be unable to migrate to their upstream feeding grounds.

Common to All Action Alternatives: Construction of the eel ladder would create short-term, minor, adverse impacts to the aquatic resources including macroinvertebrates and finfish in the immediate vicinity of Dam 4. Impacts to aquatic resources may result from an increase in water turbidity and the increased activity in the water. Aquatic species would be expected to avoid these areas until the installation is complete. In addition, in order to install the eel ladder at Dam

4, the upstream pool would be drawn down for one week, causing a loss of the veil of water over the dam. The drawdown would create short-term, minor, adverse impacts to spawning fish and other aquatic resources in the area immediately below the dam. The MDNR has requested that the construction of the eel ladder should occur mid to late summer to minimize the possible impacts to spawning fish in the area.

The operation of the eel ladder at Dam 4 would result in long-term, beneficial impacts to the American eel. The operation of the eel ladder would allow American eels to safely pass over the dam and continue their migration to reach their upstream feeding grounds. Approximately 20 miles of the American eel historic habitat would be restored by the installation and operation of the Dam 4 eel ladder. The operation of the eel ladder would have no adverse or beneficial impacts to other fish species in the area as the design of the ladder is specific to the American eel. Long-term, beneficial impacts to the mussel species, *Elliptio complanata* are expected from the operation of the eel ladder. *Elliptio complanata* is the most abundant mussel within the Potomac River. The host species of *Elliptio complanata* is the American eel. The passage of eels over Dams 4 and 5 would promote the abundance of *Elliptio complanata* in reaches upstream of Dams 4 and 5. Glochidia (mussel larvae) would be transported over the dam as the eels pass through the eel ladder. Impacts to the American eel and *Elliptio complanata* would be regional in context.

The Northern snakehead (*Channa argus*) is an invasive species that has been found within the Potomac River Basin, below Great Falls. While it is believed that Great Falls is an impediment to the natural migration of the Northern snakehead, fishery specialists offer the following information to ensure that the eel ladder project would not inadvertently provide a means of upstream migration for the snakeheads, should they one day be found in the vicinity of Dams 4 and 5. The installation of the eel ladder at Dam 4 would not promote the establishment of a population upstream of the dam because snakeheads would be unable to navigate through the eel ladder. If a snakehead were to fit into the eel ladder, the pectoral fins are not designed for the type of climbing or walking needed to make its way up the ladder. In addition the snakehead would also need a significant flow of water to be able to swim up the ladder, which would be more than the flow proposed to be used for the eel ladder. The angle of the eel ladder would further limit the ability of the snakehead to climb or enter the ladder (USFWS 2009).

Cumulative Impacts: The construction of the eel ladder would create short-term, minor, adverse impacts to aquatic resources within the immediate vicinity of Dam 4. Impacts would be temporary and localized and would contribute to an undetectable increase in turbidity to the Potomac River area. The operation of the eel ladder, in combination with the eel ladders and other measures taken elsewhere in the Potomac River basin, would create long-term, beneficial impacts to the American eel throughout the basin, a stated goal of the Atlantic States Marine Fisheries Commission American Eel Management Plan.

Conclusion: Impacts to aquatic resources including macroinvertebrates and finfish are expected to be short-term, minor, and adverse during the construction phase of the proposed project. Long-term, beneficial impacts to the American eel would result from the operation of the eel ladder. The safe movement of the eels over the dam would allow American eels to continue their upstream migration. In addition, the movement of the eels over the dam would promote the abundance of *Elliptio complanata* within the Potomac River ecosystem. Under the No Action Alternative, American eels would be unable to migrate to native feeding grounds. Impacts would continue to be long-term and adverse as the dam would prevent many eels from utilizing upstream habitat. The installation of the eel ladder at Dam 4 would not cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, American eels would continue to be blocked from migrating to their native upstream feeding grounds. American eels and other aquatic species would continue to be impinged and entrained by the operation of the turbines at the hydroelectric plant.

Common to All Action Alternatives: Impacts to aquatic resources would be the same as those of Dam 4. During the construction phase of the project short-term, minor, adverse impacts are anticipated. Aquatic resources including macroinvertebrates and finfish are expected to avoid the project area due to the increase in water turbidity and the increased activity in the area. These organisms are expected to return after the construction is complete. Additionally, the decrease in water level upstream of the dam would create short-term, minor, adverse impacts to spawning fish. To minimize impacts the MDNR has requested that the construction period would occur in mid to late summer.

The operation of the eel ladder would create long-term, beneficial impacts to the American eel. The eel ladder would allow safe passage and movement over Dam 5, which would restore approximately 100 miles of native feeding grounds. The operation of the eel ladder would have no adverse or beneficial impacts to other fish species in the area as the design of the ladder is specific to the American eel. Impacts to *Elliptio complanata* would be the same as Dam 4; the passage of eels over the dams would create long-term, moderate, beneficial impacts to the abundance of this mussel throughout the Potomac River.

Like Dam 4, the installation of eel ladders at Dam 5 would not promote the establishment of a Northern snakehead population upstream of the dam. The snakehead would be unable to navigate its way through the ladder (USFWS 2009).

Cumulative Impacts: The cumulative effect of the Dams 4 and 5 eel ladders, along with other ladders installed or planned to be installed within the Potomac River basin, would cause a beneficial cumulative impact for the American eel population in the basin. The short-term, adverse impacts to aquatic resources during the construction period would be localized to a relatively small area.

Conclusion: The installation of an eel ladder at Dam 5 would create short-term, minor, adverse impacts to aquatic resources during the construction period. Impacts would result from the increase in activity and turbidity within the water and the decrease in water level upstream of the dam. Long-term, beneficial impacts to the American eels are expected as the eels would move safely over the dam to their native feeding grounds. Long-term, beneficial impacts to *Elliptio complanata* are anticipated. The installation of the eel ladder at Dam 5 would not cause impairment to park resources.

4.5 CULTURAL RESOURCES

The analyses of effects on cultural resources that are presented in this section respond to the requirements of both NEPA and Section 106 of the NHPA, although the Section 106 compliance is being handled separately through ongoing consultation with the Maryland Historical Trust. In accordance with the Advisory Council's regulations implementing Section 106 (36 CFR Part 800, *Protection of Historic Properties*), impacts on cultural resources were identified and evaluated by (1) determining the Area of Potential Effects (APE); (2) identifying cultural resources present in the APE that are either listed in or eligible to be listed in the National Register (i.e., historic properties); (3) applying the criteria of adverse effect to affected historic properties; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the implementing regulations for Section 106, a determination of either *adverse effect* or *no adverse effect* must also be made for affected historic properties. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the National Register (for example, diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5). A determination of *no adverse effect* means there is either no effect or that the effect would not diminish, in any way, the characteristics of the cultural resource that qualify it for inclusion in the National Register.

Impact definitions for cultural resources differ from those presented in Section 4.13 *Impact Definitions*. Impact definitions for this resource are described below:

Intensity

<u>*Negligible*</u>

The impact is at the lowest level of detection with neither adverse nor beneficial consequences. For purposes of Section 106, the determination of effect would be no adverse effect.

<u>*Minor*</u>

Adverse— Alteration of a pattern(s) or feature(s) of a historic district or structure listed on or eligible for the National Register of Historic Places would not diminish the integrity of a character-defining feature(s) or the overall integrity of the historic property. For purposes of Section 106, the determination of effect would be no adverse effect.

<u>*Moderate*</u>

Adverse— The impact would alter a character-defining feature(s) of a historic district or structure and diminish the integrity of that feature(s) of the historic property. For purposes of Section 106, the determination of effect would be adverse effect.

<u>*Major*</u>

Adverse— The impact would alter a character-defining feature(s) of the historic district or structure and severely diminish the integrity of that feature(s) and the overall integrity of the historic property. For purposes of Section 106, the determination of effect would be adverse effect.

4.5.1 Historic Structures and Districts

<u>Dam 4</u>

Alternative A - No Action Alternative: Under the No Action Alternative the eel ladder at Dam 4 would not be constructed. There would be no direct or indirect impacts to the cultural resources in the surrounding area.

Alternative B (Preferred Alternative): Alternative B would require construction of the eel ladder on the Maryland side of the river at Dam 4. The entrance box and attraction water flume would be mounted on the abutment at the north end of Dam 4, and the exit well would be located in the upstream waters above Dam 4. The eel ladder would be built below grade through the abutment, thereby obscuring it from view. There would be direct attachment to Dam 4, so there would be no loss to the historic fabric of Dam 4. Long-term indirect adverse impacts would result from the alteration of the views of Dam 4 and its viewshed, which would be apparent to visitors at downstream vantage points and from those standing atop the abutment. Direct impacts to the abutment will result from the need to place the eel ladder through the abutment, but these must be considered in light of the fact that the abutment has already lost a degree of its historical integrity due to severe damage during a previous flood; repairs to the abutment that were completed in 1964 required the addition of some non-historical material.

There will be no appreciable direct or indirect effects to Dam 4 Hydroelectric Station. Construction of the eel ladder on the Maryland side of the river will avoid any direct impacts to that structure, and the introduction of non-historical elements at Dam 4 would result in a negligible alteration of the viewshed from the hydroelectric station.

Alternatives C and D: Under Alternatives C and D, the eel ladder would be built on the West Virginia side of the river. The various elements of the eel ladder apparatus would be directly attached to the Dam 4 Hydroelectric Station, which would result in some loss of historical material and setting, and which would be a long-term direct adverse impact. By the introduction of non-historic elements, views of the Dam 4 Hydroelectric Station would be slightly altered, but this would be noticeable only from the West Virginia side of the river where public access is limited or from watercraft in the impoundment above Dam 4. Under Alternatives C and D, there would be no direct impacts to any of the historic structures associated with the C&O Canal in the Dam 4 area. The attachment of the eel ladder structure to the Dam 4 Hydropower Station would alter the integrity of the historical setting or viewshed surrounding Dam 4, but given the relatively great distance from across the river, these alterations would be almost unnoticeable from the Maryland side of the river. Although long-term, direct and indirect adverse impacts would occur to cultural resources as a result of Alternatives C and D, these impacts would range from negligible to minor (no adverse effect under Section 106). These adverse effects would be mitigated by context sensitive design.

Cumulative Impacts: Considered in conjunction with the proposed Big Slackwater Rehabilitation and the Boat Ramp Restroom projects, the installation and operation of the eel ladder at Dam 4 would not result in any cumulative impacts to cultural resources in the Dam 4 area regardless of the alternative.

Conclusion: Taken together, the impacts from Alternative B would be indirect, long-term, and moderate in intensity (adverse effect under Section 106). Alternatives C and D would result in direct and indirect adverse impacts to the Dam 4 Hydropower Station and Dam 4 that would be long-term but negligible to minor in intensity. These impacts would be mitigated by context sensitive design. Impacts to Dam 4 regardless of the alternative would be mitigated by context-sensitive design and by a public interpretation program such as a wayside exhibit that would explain the presence of non-historic elements (the eel ladder) at Dam 4. Specific design measures that will be considered are the use of solar-panels to power the pump (eliminating the need for direct electrical service) and the use of surface treatments for the exposed apparatus that would be minimally intrusive in terms of color and surface texture. The installation of an eel ladder at Dam 4 would not result in impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative the eel ladder at Dam 5 would not be constructed. There would be no direct or indirect impacts to the cultural resources in the surrounding area. Cumulative impacts would not occur as there are no other projects planned for this area of the park. Under the No Action Alternative there would be no impairment to cultural resources.

Alternatives B (Preferred Alternative) and C: Under Alternatives B and C, the eel ladder would be built on the West Virginia side of the river. The various elements of the eel ladder would be directly attached to the Dam 5 Hydroelectric Station, which result in some loss of its historical material, which would be a direct, long-term adverse impact. By the introduction of non-historic elements, the historical setting of the Dam 5 Hydroelectric Station would be slightly altered, resulting in an indirect long-term adverse impact. Under Alternatives B and C, there would be no direct impacts to any of the historic structures associated with the C&O Canal in the Dam 5 area. Views of Dam 5 from downstream would be slightly altered by the introduction of non-historic elements. Although long-term direct and indirect adverse impacts would occur to cultural resources under Alternatives B and C, the overall impacts to cultural resources are considered negligible to minor (no adverse effect under Section 106), as there would be very little, if any, loss of the historic fabric associated with the Dam 5 Hydroelectric Station, and alteration of historical views would be barely noticeable, especially from the Maryland side of the river, where most visitors experience the historical scene surrounding Dam 5. These impacts would be mitigated by context-sensitive design.

Alternative D: Alternative D would require construction of the eel ladder on the Maryland side of the river at Dam 5. All of the various configurations would require the attachment of non-historic elements to Dam 5, which would result in a reduction of the structure's historical material and setting. The loss of historical fabric at Dam 5 would result from the need to attach the apparatus to the dam and abutment, which would be a direct, long term adverse impact. Long-term indirect adverse impacts would result from the alteration of the views of the Dam 5, which would be readily apparent to visitors to the area, especially from downstream vantage points. There would be no direct effects to Dam 5 Hydroelectric Station from this alternative, but the associated historical viewshed or setting would be slightly altered. Alterations of the historical viewshed from the Dam 5 Hydroelectric Station would be negligible to minor (no adverse effect under Section 106), depending on the size and configuration of the eel ladder apparatus.

Cumulative Impacts: There would be no cumulative impacts to cultural resources associated with any of the alternatives, as there are no other projects planned in this area of the park.

Conclusion: Alternatives B and C would result in long-term direct and indirect impacts to cultural resources, through the loss of historic fabric and the introduction of non-historical elements into the viewsheds. These impacts would range from negligible to minor, but would be mitigated by context-sensitive design. Overall, there would be long-term direct and indirect adverse impacts to cultural resources that would range from minor (no adverse effect under Section 106) to moderate (adverse effect under Section 106) associated with Alternative D. These adverse effects would be mitigated by context sensitive design and by a public interpretation program such as a wayside exhibit that would explain the presence of non-historic elements (the eel ladder) at Dam 5. The installation of an eel ladder at Dam 5 would not result in impairment to cultural resources.

4.6 VISITOR USE AND EXPERIENCE

This section discusses the impacts of the alternatives including the No Action Alternative on visitor use and experience including visitation patterns, recreation, aesthetic resources, and park operations.

4.6.1 Visitor Use and Safety

Dam 4

Alternative A - No Action Alternative: Under the No Action Alternative, visitation to the Dam 4 area would remain unchanged. There would be no additional safety concerns at the site.

Alternative B (Preferred Alternative): Alternative B is located along the Maryland shoreline. During the construction phase, visitors would still be allowed in the Dam 4 area; however visitors would be detoured around the staging area and construction zones. Therefore, there would be no change in the total visitation at the park. The operation of the eel ladder would not impact the visitation at the site or the park in general.

During the construction period, there is potential for a short-term, minor, adverse impact to the safety of both park visitors and park employees. Park visitors would still be allowed within the Dam 4 area. To minimize impacts to safety the construction site would be barricaded from visitors. Impacts to park staff may result from handling construction equipment and participating in the construction activities. The operation of the eel ladder would have long-term, negligible, adverse impacts to the safety of park visitors and long-term, minor, adverse impacts to the safety of park staff. Impacts to park visitors would be negligible since visitors would not have access to the eel ladder. There may be a potential for increased safety risks of park staff since the eel ladder would be placed over moving, deep water.

Alternatives C and D: Alternatives C and D are located along the West Virginia shoreline. There would be no impact to the park visitation since the project location is outside of the park boundary.

There would be no impacts to the safety of park visitors and staff if the eel ladder is placed along the West Virginia shoreline. Park staff would not be responsible for the eel ladder since it is off the NPS property.

Cumulative Impacts: There would be no cumulative impacts to the visitation statistics associated with the installation of the eel ladder at Dam 4. Other projects that are on-going or proposed in the area would likely not impact park visitation. There would be no cumulative impact to the safety of park visitors or staff.

Conclusion: There would be no impact to park visitation associated with Alternatives C and D because they are located outside of the park boundary. There would be no impact to the amount of visitation at Dam 4 under Alternative B since visitors would still be allowed in the area. There would be no impact to visitation under the No Action Alternative.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, the Dam 5 eel ladder would not be installed. There would be no impact to park visitation.

Alternatives B (Preferred Alternative) and C: No impacts to park visitation would occur under Alternatives B and C. These alternatives are located along the West Virginia shoreline outside of the park boundary.

There would be no impacts to the safety of park visitors and staff if the eel ladder is placed along the West Virginia shoreline. Park staff would not be responsible for the eel ladder since it is off the NPS property.

Alternative D: Like Dam 4, visitors would be allowed within the Dam 5 area during the construction period; however they would be detoured around the staging area and construction zone. There would be no impact to park visitation during the construction or operation of the eel ladder.

Impacts to safety would be the same as Dam 4. During the construction phase, short-term, minor, adverse impacts to safety are expected to both park staff and park visitors. Operational impacts would include long-term, negligible, adverse impacts to park visitors and long-term, minor, adverse impacts to park staff..

Cumulative Impacts: There would be no cumulative impacts associated with the Dam 5 alternatives. There are currently no projects planned in the Dam 5 area.

Conclusion: There would be no impact to park visitation associated with any of the alternatives. Park visitors would be permitted within the Dam 5 area, but must avoid the staging area and construction zone. There would be no impacts associated with the No Action Alternative. There would be no impact to the safety of visitors and staff under Alternatives B and C since the eel ladder would be placed off of park property. Impacts to safety are anticipated under Alternative D.

4.6.2 Visitor Experience

<u>Dam 4</u>

Action Alternative - No Action Alternative: Under the No Action Alternative, there would be a long-term, negligible, adverse impact to recreational activities. Recreational opportunities at the dam and along the towpath would continue; however, visitors would not have the opportunity to educate themselves on the life history and importance of the American eel.

Common to All Action Alternatives: During the construction period of the Dam 4 eel ladder, the water level in the pool upstream of the dam would be lowered to prevent water from spilling over the dam. As requested by the MDNR, the construction period would occur during mid to late summer to minimize the impact to breeding fish. The lowering of the water level in the upstream pool would create short-term, negligible, adverse impacts to recreation in the area. Recreational uses that would be impacted during this time would include boating and fishing.

Boaters and fishermen would have trouble accessing the water, navigating through the low water, and stranding may occur. The duration of the drawdown would be minimized to last one week to lessen the impact to boat access and boat stranding in the area.

Alternative B (Preferred Alternative): Alternative B is located along the Maryland shoreline. During the construction phase, visitors using the area for recreational activities such as fishing, biking, hiking, running, and swimming would be detoured around the staging and construction zones. Visitors would have the opportunity to partake in recreational activities in other areas within the park. Impacts to recreation during the construction period would be short-term, minor, and adverse.

It is anticipated that the operation of the eel ladder at Dam 4 would create a long-term, beneficial impact to recreation. The presence of the eel ladder at Dam 4 would provide an additional educational opportunity to park visitors through ranger led activities or through a wayside exhibit. Visitors would have the chance to learn about the life history and conservation of the American eel.

Alternatives C and D (West Virginia Shoreline): Alternatives C and D are located along the West Virginia shoreline. Since these sites are located outside of the park boundary, there would be no additional impacts other than the water level drawdown to recreation at the park.

Cumulative Impacts: Short-term, minor, adverse impacts to recreation would occur as a result of the construction of the Dam 4 eel ladder. The operation of the eel ladder is expected to create long-term, beneficial impacts to recreation under Alternative B. There would be no cumulative impacts as other projects within the area would likely occur during a different time period.

Conclusion: Regardless of the alternative, short-term, minor, adverse impacts to recreation would occur due to the lack of boating access from the water level drawdown during one week of the construction process. Besides the water level drawdown, no additional impacts are expected under Alternatives C and D because these alternatives are located outside of the park boundary. Additional short-term, minor, adverse impacts are expected to occur under the preferred alternative located along the Maryland shoreline. Visitors would be expected to continue their activities at a different location within the park system. The operation of the eel ladder along the Maryland shoreline would create long-term, beneficial impacts to recreation by providing additional education opportunities to park visitors. Under the No Action Alternative, visitors would not experience the beneficial education opportunity on American eels. Therefore the No Action Alternative would create long-term, negligible adverse impacts to recreation.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, the Dam 5 eel ladder would not be installed. Visitors would not have the opportunity to be educated on the life history and importance of the American eel. The No Action Alternative would create long-term, negligible, adverse impacts to recreation.

Common to All Action Alternatives: Like Dam 4, the construction period of the eel ladder would require the water level in the pool upstream of the dam to be lowered. As requested by the MDNR, the construction period would occur during mid to late summer. The lowering of water level in the upstream pool would create short-term, minor, adverse impacts to recreation in the area. User groups expected to be impacted include those boating and fishing. The duration of the drawdown would be minimal to lessen the impact to boating access in the area.

Alternatives B (Preferred Alternative) and C: No additional impacts to recreation would occur under Alternatives B and C. These alternatives are located along the West Virginia shoreline outside of the park boundary.

Alternative D: Impacts to recreation would be similar to those of Dam 4. Short-term, minor, adverse impacts to recreation would occur during the construction phase of the project at the alternative located along the Maryland shoreline. During the construction period, visitors would be detoured around the staging and construction zones.

It is anticipated that a long-term, beneficial impact to recreation would occur as a result of the operation of the eel ladder along the Maryland shoreline. Visitors would have an opportunity to learn about the life history and conservation of American eels through ranger led programs or wayside exhibits.

Cumulative Impacts: There would be no cumulative impacts to recreation associated with the Dam 5 eel ladder as there are no other projects planned for the area. The short-term, adverse impacts during construction and long-term, beneficial impacts during operation of the eel ladder would contribute to undetectable impacts on recreation throughout the entire park.

Conclusion: Short-term, minor adverse impacts to recreation (particularly boaters) would occur due to the drawdown of the upstream pool regardless of the alternatives. There would be no additional impacts to park recreation associated with alternatives located along the West Virginia shoreline (Alternatives B and C). Park visitors would be restricted from participating in recreation activities within the Dam 5 area during the construction period. Impacts are expected to be short-term, minor, and adverse. The operation of the eel ladder would create long-term, beneficial impacts by creating additional educational opportunities for visitors. There would be no American eel educational opportunities associated with the No Action Alternative; therefore long-term, negligible, adverse impacts to recreation are anticipated.

4.6.3 Aesthetic Resources

<u>Dam 4</u>

Alternative A - No Action Alternative: Under the No Action Alternative, there would be no impact to the aesthetics within the vicinity of Dam 4.

Alternative B (Preferred Alternative): Impacts to the aesthetic experience during the construction of the eel ladder at Dam 4 would be short-term, minor, and adverse for Alternative B. Like other alternatives located along the Maryland shoreline, the staging area and construction zone would be visible to park visitors in the area. Additional impacts would result from the installation of the underground exit pipe. The mowed grass area at the abutment would be excavated using a back hoe. Aesthetic impacts would only last for the duration of the construction period.

Operational impacts to the aesthetic experience would be long-term, negligible, and adverse. Impacts would be minimized since the majority of the eel ladder and exit pipe would be installed underground. There would only be a small section of the eel ladder visible, therefore impacts would be negligible.

Alternatives C and D: The construction phase of the project at Alternatives C and D would create short-term, negligible, adverse impacts to the aesthetic experience of park visitors. Although the construction would take place along the West Virginia shoreline, construction equipment and materials would still be visible to park visitors on the Maryland shoreline. However, the impacts would be temporary, only lasting the duration of the construction period. Although placing the eel ladder along the West Virginia shoreline offers a high protection of the aesthetic experience, long-term, negligible, adverse impacts would be associated with the operation of the eel ladder. The eel ladder and the associated structures would be visible from park visitors along the Maryland shoreline. To minimize the impact to aesthetics, materials consistent in appearance of the original dam would be used to construct the coffer dams located within the tailrace (Alternative C).

Cumulative Impacts: When combined with other projects in the area, the Dam 4 eel ladders would create negligible, adverse impacts to the aesthetics of the area. Impacts during the construction period would be short-term. Operational impacts would be minimized by camouflaging the eel ladder and associated structures to the existing background.

Conclusion: Short-term, minor, adverse impacts to the aesthetic experience are anticipated during the construction period of the alternatives located along the Maryland shoreline. Construction and operational impacts are anticipated to be negligible under the alternatives located on the West Virginia shoreline. Operational impacts associated with the Preferred Alternatives are expected to be negligible since the eel ladder and exit pipe would be installed underground. To minimize impacts to the aesthetic experience, structures would be camouflaged to the existing background when feasible under all alternatives. There would be no impact to aesthetics under the No Action Alternative. The installation of the eel ladder at Dam 4 would not cause impairment to park resources.

<u>Dam 5</u>

Alternative A - No Action Alternative: Under the No Action Alternative, the Dam 5 eel ladder would not be installed. There would be no impact to the aesthetics of the area.

Alternatives B (Preferred Alternative) and C: Impacts to the aesthetic experience under the alternatives located along the West Virginia shoreline would be similar to those of Dam 4. The construction phase of the project at Alternatives B and C would create short-term, negligible, adverse impacts to the aesthetic experience of park visitors. Construction equipment and materials would be visible by park visitors on the Maryland shoreline. The impacts would be temporary, only lasting the duration of the construction period.

Although placing the eel ladder along the West Virginia shoreline offers a high protection of the aesthetic experience, long-term, negligible, adverse impacts would be associated with the operation of the eel ladder. The eel ladder and the associated structures would be visible to park visitors along the Maryland shoreline. To minimize the impact to aesthetics, coffer dams located within the tailrace would be constructed using materials consistent in appearance of the original dam to minimize the impacts to aesthetics (Alternative C).

Alternative D: Short-term, minor, adverse impacts to visitors' aesthetic experience are anticipated during the construction phase of the alternatives located along the Maryland shoreline. The view of the dam and historic powerhouses would be temporarily disrupted by the addition of the construction equipment in the area.

The operation of the eel ladder at Dam 5 would create long-term, minor, adverse impacts to the aesthetic experience in the area. The eel ladder and associated structures would be visible to the park visitors. Each of these alternatives includes the addition of a non-overflow and a security fence around the collection box. The impacts would be minimized by camouflaging the structures to the current background.

Cumulative Impacts: Short-term, adverse impacts to the aesthetic experience would result from the construction of the eel ladder at Dam 5. Impacts would be negligible for Alternatives B and C, and minor for Alternative D. Operational impacts would be long-term. There would be no cumulative impacts associated with the installation of the eel ladder at Dam 5 as there are no other projects planned in the area.

Conclusion: Short-term, negligible, adverse impacts to the aesthetic experience would be associated with those alternatives located along the West Virginia shoreline during the construction phase. Impacts during the construction phase of the alternative located along the Maryland shoreline would be short-term, minor, and adverse. The operation of the eel ladder would create long-term, minor, adverse impacts to visitors' aesthetic experience due to the visibility of the eel ladder and associated structures. The impacts along the West Virginia shoreline would be negligible. There would be no impacts associated with the No Action Alternative. The installation of the eel ladder at Dam 5 would not cause impairment to park resources.

4.6.4 Park Operations

Dam 4

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 4 would not be installed. There would be no impact to park operations.

Alternative B (Preferred Alternative): The construction phase of the project along the Maryland shoreline would create short-term, minor, adverse impacts to park operations. Some park staff would be required to oversee the construction of the eel ladder. The job duties of the park staff would be slightly altered during the eight week construction period.

The operation of the eel ladder along the Maryland shoreline would create long-term, minor, adverse impacts to park operations. Maintenance staff would be tasked with performing maintenance to the eel ladder at Dam 4. Maintenance is not anticipated to be needed on a regular basis since debris is more often located along the West Virginia shoreline. Since less maintenance would be needed, the cost of materials for maintenance and repair would be minimal. During emergency high flow or weather events, the NPS would need to remove or secure the eel ladder. Additional staff hours would be associated with coordinating with outside agencies and volunteers or performing eel monitoring at the collection boxes.

Alternatives C and D: The construction and operation of the eel ladder along the West Virginia shoreline would have no impact to park operations. Since the eel ladders would not be located on the park property, the NPS would not be responsible for maintaining the structures. Allegheny Energy has agreed to allow the eel ladder to be placed on their property.

Cumulative Impacts: Under Alternative B, the installation of the eel ladder at Dam 4 would create short-term, minor, adverse impacts to park operations during the construction phase of the project and long-term, minor, adverse impacts during the operation of the eel ladder. Cumulative impacts are anticipated to park operations. When combined with other projects occurring in the area, including the re-establishment of the towpath within the Big Slackwater Area and the installation of new restrooms at the Dam 4 Boat Ramp area, short-term, minor, adverse impacts to park operations are expected. Park staff would need to shift their daily work duties to accommodate the construction and operation of these new projects. Additionally, there would be an increase in the number of park staff hours to accommodate these new projects. No impacts would be associated with the eel ladders located on the West Virginia shoreline under Alternatives C and D.

Conclusion: Short-term, minor, adverse impacts to park operations are expected under Alternative B. Impacts would be temporary as the construction period is anticipated to last up to eight weeks. Long-term, minor, adverse impacts to park operations would occur during the operation of the eel ladder along the Maryland shoreline. Since the Maryland shoreline does not receive large amounts of debris, maintenance would not be necessary on a regular basis, which would minimize the number of staff hours and costs of eel ladder repair. There would be no impact to park operations under Alternative C or D. There would be no impact to park operations under the No Action Alternative. The installation of the eel ladder at Dam 4 would not cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 5 would not be installed. There would be no impact to park operations.

Common to All Action Alternatives: The construction of the eel ladder at Dam 5 would create short-term, minor, adverse impacts to park operations regardless of the alternative. The construction phase of the project is expected to last approximately eight weeks. Some park staff would be on site during the construction period. Job duties for park staff would be altered slightly during this eight week period.

Alternative B (Preferred Alternative) and C : There would be no impact to park operations under Alternative B or C. Since these alternatives would be located off of park property, the NPS would not be responsible for maintaining the structures. Allegheny Energy has agreed to allow the eel ladder to be placed on their property.

Alternative D: The construction of the eel ladder at Dam 5 would create short-term, minor, adverse impacts to park operations. The construction phase of the project is expected to last approximately eight weeks. Some park staff would be on site during the construction period. Job duties for park staff would be altered slightly during this eight week period.

The operation of the eel ladder at Dam 5 would create long-term, moderate, adverse impacts to park operations under Alternative D. The Maryland shoreline receives the most debris buildup along the dam. Since the ladder would be located on the debris loaded side of the river, staff would have to monitor the eel ladder for structural damage periodically and perform maintenance to the structure, non-overflows, and exit pipes. Due to the high probability of damage from the large amounts of debris, the NPS anticipates spending more money on supplies and materials associated with fixing the eel ladder. The duties of the maintenance staff at the park would be altered to include the operation of the eel ladder. The park would spend additional staff hours on the monitoring of the eels in the collection boxes through coordinating with outside agencies and volunteers.

Cumulative Impacts: Short-term, minor, adverse cumulative impacts to park operations are anticipated under Alternative D, since it would be located within park property. The installation and operation of the Dam 5 eel ladder in addition to the re-establishment of the towpath at Big Slackwater and the installation of restrooms at the Dam 4 boat ramp would create changes to staffing and costs at the park. Park staff would need to shift their daily work duties to accommodate the construction and operation of these new projects. Additionally, there would be an increase in the number of park staff hours and operational costs to accommodate these new projects. No cumulative impacts would be associated with Alternatives B and C.

Conclusion: There would be no impact to park operations associated with Alternatives B and C. Under Alternative D the construction of the eel ladder at Dam 5 would create short-term, minor, adverse impacts to park operations. Operation of the eel ladder along the West Virginia shoreline would create long-term, minor. Impacts during the operation of the eel ladder would be long-term, moderate, and adverse. The Maryland shoreline receives large amounts of debris which could damage the eel ladder. Maintenance staff would spend additional hours monitoring the eel ladder for damages and making repairs.

4.7 ENERGY RESOURCES

<u>Dam 4</u>

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 4 would not be installed. There would be no additional use of the energy resources at the park; therefore there would be no impacts.

Common to All Action Alternatives: The construction of the eel ladder would create short-term, minor, adverse impacts to energy resources. During the construction phase fuel and electricity would be used to operate the construction equipment regardless of the alternative. Electricity is currently unavailable at the sites along the Maryland shoreline (Alternative B). Electricity would need to be brought in underground from outside of the park. If a drawdown of water upstream of the dam were necessary to install the eel ladder, short-term, moderate, adverse impacts to energy production at the hydroelectric station would result. If the water level and flow are low, Allegheny Energy would be unable to operate. Once the river returns to normal conditions, operation of the hydroelectric station would continue. Allegheny Energy is required to maintain a 1-inch veil over the dam.

During the operation of the eel ladder, long-term, minor, adverse impacts to energy resources would be anticipated. Electricity would be used to operate the attractant flow pump. Although the pump would only operate during the American eel migratory season (April through October), impacts would be long-term since the use of energy would last the lifetime of the project. To minimize the use of energy resources, the park would place solar panels at the site if feasible.

Cumulative Impacts: There would be no cumulative impacts associated with the installation of the eel ladder at Dam 4. Electricity would be needed to operate the attractant flow pump regardless of the alternative. There is no electrical service available along the Maryland shoreline; therefore long-term, minor, adverse impacts would be expected due to the installation of new electrical lines or solar panels. Impacts along the West Virginia shoreline are expected to be long-term, negligible, and adverse since electrical service is available at the site.

Conclusion: Short-term, minor, adverse impacts to energy resources would result during the construction process due to the use of fuel and electricity. The operation of the eel ladder would create long-term, minor, adverse impacts to energy resources. There would be no impact to energy resources under the No Action Alternative. The installation of the eel ladder at Dam 4 would not cause impairment to park resources.

Dam 5

Alternative A - No Action Alternative: Under the No Action Alternative, the eel ladder at Dam 5 would not be installed. There would be no additional use of the energy resources at the park; therefore there would be no impacts.

Common to All Action Alternatives: Impacts to energy resources would be the same as Dam 4. Impacts during the construction phase of the project would be short-term, minor, and adverse due to the use of fuel and electricity. Electricity would need to be brought in to the sites along the Maryland shoreline. Short-term, moderate, adverse impacts to energy production would result if a water drawdown is needed. Operational impacts would be long-term, minor, and adverse due to the use of electricity for the attractant flow pump.

Cumulative Impacts: There would be no cumulative impacts to energy resources associated with the installation of the eel ladder at Dam 5. Long-term, minor, adverse impacts are expected along the Maryland shoreline since no electrical service is available. Long-term, negligible, adverse impacts are expected along the West Virginia shoreline. The use of the attractant flow pump would require electricity regardless of the alternative.

Conclusion: Impacts during the construction phase are expected to be short-term, minor, and adverse due to the use of fuel and electricity for construction equipment. Short-term, moderate, adverse impacts to energy production would result if a water drawdown is needed. Long-term, minor, adverse impacts would result from the operation of the eel ladder. There would be no impact to energy resources under the No Action Alternative. The installation of the eel ladder at Dam 5 would not cause impairment to park resources.

5.0 CONSULTATION AND COORDINATION

Scoping is the effort to involve agencies and the general public in determining the scope of issues to be addressed in the environmental document. Among other tasks, scoping determines important issues and eliminates issues determined to be not important; allocates assignments among the interdisciplinary team members and/or participating agencies; identifies related projects and associated documents; identifies other permits, surveys, consultations, etc. required by other agencies; and creates a schedule that allows adequate time to prepare and distribute the environmental document for public review and comment before a final decision is made. Scoping includes consultation with any interested agency, or any agency with jurisdiction by law or expertise to obtain early input and permits needed for implementation.

5.1 AGENCY CONSULTATION

Internal scoping refers to the interdisciplinary process used to define issues, alternatives, and data needs. Consultation letters were mailed to state and federal agencies on November 13, 2008 requesting consultation and comments regarding the proposed project at Dams 4 and 5. Appendix B contains a list of agencies that received the consultation letter and a copy of the consultation letter. Responses were received from NOAA NMFS, USFWS, MDNR, WVDNR, and WV SHPO. Copies of the agency responses are also included in Appendix B.

5.1.1 Section 7 Consultation

In accordance with the federal and state requirements for special status species, consultation letters were mailed to state and federal agencies on November 13, 2008, including the MDNR Wildlife and Heritage Service, WVDNR Wildlife Resource Section, USFWS Chesapeake Bay Field Office, and NOAA NMFS Northeast Regional Office. Information about the proposed project was included in the consultation letter. Responses were received from all four agencies. The NOAA NMFS stated that although a population of the endangered shortnose sturgeon is recognized to exist in the Chesapeake Bay and in the Potomac River, no shortnose sturgeon are expected to occur within the proposed project area. The USFWS stated that except for the occasional transient individuals, no federally proposed or listed endangered or threatened species are known to exist within the proposed project area. Both agencies concurred that no consultation pursuant to Section 7 of the Endangered Species Act is required. The WVDNR identified the American eel as the only state species of special concern occurring within the project area. Additionally, the MDNR did not identify any special status species occurring in the project area.

5.1.2 Section 106 Consultation

Consultations with the SHPOs of Maryland and West Virginia, as mandated by the implementing regulations (36 CFR 800) for Section 106 of the NHPA of 1966, as amended, are occurring in conjunction with the development of this EA. Formal consultation letters were sent to the Maryland Historical Trust and the West Virginia Division of Culture and History on November 13, 2008 (Appendix B). The consultation letters included information about the proposed project, including the various alternatives that are evaluated in this EA. The West Virginia Division of Culture and History responded in a letter of December 8, 2008 in which it concluded that the project would have no adverse effect on cultural resources. NPS staff met with the MHT on October 16, 2008 to discuss the project and its effects, with specific attention to Dam No. 4 where some of the alternatives may have an adverse effect under Section 106. Consultations are continuing with the MHT to resolve potential adverse effects. This EA will be forwarded to the SHPO as part of the consultation process. This EA includes an Assessment of Effect under Section 106 of the NHPA in the "Environmental Consequences" chapter under "Cultural Resources."

5.2 PUBLIC INVOLVEMENT

External scoping is the process used to gather public input. For this project, a scoping newsletter was mailed to numerous individuals, organizations, stakeholders, and agencies in order to notify the public that an environmental assessment is being completed for this project. The newsletter provided the project history, current conditions at the site, a project description, a description of the NEPA process, and a description of the public scoping period. The newsletter was available for public comment for a total of 34 days (January 8, 2007 thru February 10, 2007). A total of 10 correspondences were received. The newsletter and comments are included in Appendix A. Issues identified during the scoping process included the following:

- continued safe downstream passage of eels at the dams,
- impact to recreation during the construction of the eel ladders,
- concerns of placing the eel ladder at Dam 4 on the West Virginia side of the river due to the large debris load during high flow which could potentially damage the eel ladder structure,
- concerns of placing the eel ladder at Dam 5 on the Maryland side of the river due to the large debris load during high flow which could potentially damage the eel ladder structure,
- construction of an "over elaborate" eel ladder that will not work.

This EA will be distributed to agencies for public and agency review and comment for a period of 30 days. During the public comment period a public meeting would be held on December 8, 2009 from 7:00 PM to 9:00 PM at the park in the Cushwa Basin's Trolley Barn (205 W. Potomac Street, Williamsport, MD 21795). If no substantive issues are raised, then the process will move forward toward a Finding of No Significant Impact (FONSI).

5.3 COMPLIANCE NEEDS

The following is a list of required permits, licenses, certifications, and assessments that would be required for the construction and implementation of the eel ladders at Dams 4 and 5.

- USACE Nationwide Permit or Individual Permit

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