MULTI-PROJECT

ENVIRONMENTAL ASSESSMENT

FOR HYDROPOWER LICENSE

Emsworth Locks and Dam Hydroelectric Project, FERC Project No. 13757-002

Emsworth Back Channel Hydroelectric Project, FERC Project No. 13761-002

Montgomery Locks and Dam Hydroelectric Project, FERC Project No. 13768-002

Pennsylvania

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
888 First Street, NE
Washington, D.C. 20426

June 2016

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

Advisory Council	Advisory Council on Historic Preservation
APE	area of potential effects
APLIC	Avian Power Line Interaction Committee
BMP	best management practices
°C	degrees Celsius
certification	water quality certification
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission or FERC
Corps	U.S. Army Corps of Engineers
CZMA	Coastal Zone Management Act
DO	dissolved oxygen
EA	environmental assessment
Emsworth Project	Emsworth Locks and Dam Hydroelectric Project
Emsworth Back Channel Project	Emsworth Back Channel Dam Hydroelectric Project
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
°F	degrees Fahrenheit
FERC	Federal Energy Regulatory Commission
FFP 5 LLC	FFP Missouri 5, LLC
FFP 6 LLC	FFP Missouri 6, LLC
FPA	Federal Power Act
fps	feet per second
FWS	U.S. Fish and Wildlife Service
HPMP	historic properties management plan
Interior	U.S. Department of the Interior
kV	kilovolt
mg/L	milligram per liter
MOA	Memorandum of Agreement
Montgomery Project	Montgomery Locks and Dam Hydroelectric Project
MW	megawatt
MWh	megawatt-hour
National Register	National Register of Historic Places
NERC	North American Electric Reliability Corporation
NGVD	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
ORSANCO	Ohio River Valley Water Sanitation Commission
PA	Programmatic Agreement
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyls

Pennsylvania DCNR	Pennsylvania Department of Conservation and Natural Resources
Pennsylvania DEP	Pennsylvania Department of Environmental Protection
Pennsylvania FBC	Pennsylvania Fish and Boat Commission
Pennsylvania SHPO	Pennsylvania Bureau for Historic Preservation
PJM	PJM Interconnection LLC
PM&E	protection, mitigation, and enhancement
PNDI	Pennsylvania Natural Diversity Inventory
RM	river mile
ROW	right-of-way
Solia 6 LLC	Solia 6 Hydroelectric, LLC
U.S.C.	United States Code
USGS	U.S. Geological Survey
WUA	weighted useable area

EXECUTIVE SUMMARY

Proposed Action

On March 14, 2014, applications were filed with the Federal Energy Regulatory Commission (Commission or FERC) for the construction and operation of the following three hydropower projects to be located at the U.S. Army Corps of Engineers' (Corps') dams on the Ohio River:

- FFP Missouri 5, LLC's, proposed 24-megawatt (MW) Emsworth Locks and Dam Hydroelectric Project No. 13757 (Emsworth Project) would be located at river mile (RM) 6.2 on the Ohio River in Allegheny County, Pennsylvania. The project would occupy 9.7 acres of federal land owned by the Corps.

- FFP Missouri 6, LLC's, proposed 12-MW Emsworth Back Channel Dam Hydroelectric Project No. 13761 (Emsworth Back Channel Project) would be located at RM 6.8 on the Ohio River in Allegheny County, Pennsylvania. The project would occupy 2.3 acres of federal land owned by the Corps.

- Solia 6 Hydroelectric, LLC's, proposed 42-MW Montgomery Locks and Dam Hydroelectric Project No. 13768 (Montgomery Project) would be located at RM 31.7 on the Ohio River in Beaver County, Pennsylvania. The project would occupy 5.1 acres of federal land owned by the Corps.

Existing Corps Facilities

The Monongahela and Allegheny Rivers join to form the Ohio River in Pittsburgh, Pennsylvania. The Corps owns 38 locks and dams on these rivers—9 locks and dams on the Monongahela River, 8 on the Allegheny River, and 21 on the Ohio River. The Corps operates these locks and dams for commercial and recreational navigation.

The proposed projects would be located at three existing locks and dams on the Ohio River—Emsworth Locks and Dam, Emsworth Back Channel Dam, and Montgomery Locks and Dam—and are referred to herein as the Ohio River Projects. The applicants are subsidiaries of FFP New Hydro, LLC. Rye Development, LLC, is acting as agent for the projects.

Emsworth Locks and Dam consists of a 1,000-foot-long, 18-foot-high concrete dam with a full length spillway equipped with eight 100-foot-wide, 12-foot-high vertical lift crest gates, and a 34-foot-long fixed crest bay; a 600-foot-long, 110-foot-wide land-side navigational lock; and a 360-foot-long, 56-foot-wide river-side navigational lock.

The normal water surface elevation of the pool upstream of the dam is 710 feet National Geodetic Vertical Datum of 1929 (NGVD29).[1]

Emsworth Back Channel Dam consists of a 750-foot-long, 18-foot-high concrete dam with a full length spillway equipped with six 100-foot-wide, 12-foot-high vertical lift crest gates. The normal water surface elevation of the pool upstream of the dam is at elevation 710 feet.

Montgomery Locks and Dam consists of a 1,379-foot-long, 62-foot-high concrete dam with a full length spillway equipped with ten 100-foot-wide, 16-foot-high vertical lift crest gates; an approximately 101-foot-wide fixed crest bay on the right (north) side; an approximately 101-foot-wide fixed crest bay on the left side between the gated spillway and the locks; a 600-foot-long, 110-foot-wide land-side navigational lock; and a 360-foot-long, 56-foot-wide river-side navigational lock. The normal water surface elevation of the pool upstream of the dam is at elevation 682 feet.

Proposed Hydropower Facilities

The Emsworth Project would consist of a new 205-foot-long, 180-foot-wide intake channel to be excavated into the riverbed immediately downstream of the Corps' gates 7 and 8 leading to a concrete intake structure that would convey flows past a trash rack with 5-inch clear bar spacing to a new, 180-foot-long, 180-foot-wide, 77-foot-high reinforced concrete powerhouse housing four equally sized horizontal pit Kaplan turbine-generator units with a combined capacity of 24 MW. Flows would exit the powerhouse into a 380-foot-long, 280-foot-wide tailrace excavated into the riverbed. Four 50-foot-wide, 40-foot-high spill gates would be constructed within the intake channel to pass flow equivalent to the Corps' spillway gates 7 and 8. Project power would be transmitted from the powerhouse to a new project substation with an 88-foot-long, medium-voltage, buried cable, and from there to an existing substation with a 1,893-foot-long, 69-kilovolt (kV), overhead transmission line. No recreational facilities are proposed.

The Emsworth Back Channel Project would consist of a new 100-foot-long, 165-foot-wide intake channel to be excavated into the riverbed immediately downstream of the Corps' spillway gate 6 leading to a concrete intake structure that would convey flows past a trash rack with 5-inch clear bar spacing to a new, 150-foot-long, 90-foot-wide, 77-foot-high reinforced concrete powerhouse housing two equally sized horizontal pit Kaplan turbine-generator units with a combined capacity of 12.0 MW. Flows would exit the powerhouse into a 190-foot-long, 105-foot-wide tailrace excavated into the riverbed.

[1] All elevations are provided in NGVD29 datum unless otherwise noted.

Two 50-foot-wide, 40-foot-high spill gates would be constructed within the intake channel to pass flow equivalent to the Corps' spillway gate 6. Project power would be transmitted from the powerhouse to a new project substation with a 188-foot-long, medium-voltage, buried cable and from there to an existing substation with a 3,758-foot-long, 69-kV, overhead transmission line. No recreational facilities are proposed.

The proposed Montgomery Project would consist of a new 340-foot-long, 205-foot-wide intake channel to be excavated into the riverbed immediately downstream of Corps' spillway gate 10 and the fixed crest section of the dam on the north side of the river leading to a concrete intake structure that would convey flows past a trash rack with 5-inch clear bar spacing to a new 315-foot-long, 205-foot-wide, 105-foot-high reinforced concrete powerhouse housing three equally sized horizontal bulb Kaplan-type turbine-generator units with a combined capacity of 42 MW. Flows would exit the powerhouse into a 280-foot-long, 210-foot-wide tailrace excavated into the riverbed. Two 100-foot-wide spill gates would be constructed within the intake channel to pass flow equivalent to the Corps' spillway gate 10 and the fixed crest section. Project power would be transmitted from the powerhouse to a new project substation with a 15-foot-long, medium-voltage, buried cable and from there to an existing distribution line with a 392-foot-long, 69-kV, overhead transmission line. The project would include the following new recreational facilities: a fishing platform constructed in the tailrace of the project and a walkway leading from a parking area with eight designated parking spaces to the fishing platform.

Project Operation

The projects would operate in run-of-release mode, using flows made available by the Corps that would normally be released through the Corps' gates or spillways.[2] The existing water surface elevation of each pool upstream of the dams would be maintained in accordance with the Corps' management practices.

When river flows available after lockage requirements are less than the minimum hydraulic capacity required to operate a single unit at each project, the projects would cease generating and all flows would be passed via the Corps' gates or spillway in accordance with existing Corps' practices. When river flows available after lockage requirements are between the minimum and maximum hydraulic capacity of the powerhouse, all flows not used for the Corps' lockage would pass through the project powerhouse. When river flows available after the Corps' lockage requirements exceed

[2] Although the applicants describe their proposed operating mode as run-of-river, it is better defined as run-of-release because the projects would generate from flows "released" (i.e., made available) to the projects by the Corps.

the hydraulic capacity of the project powerhouse, but do not exceed the hydraulic capacity of the Corps' spillway, any additional flow would be released via the Corps' spillway and/or the projects' proposed spill gates. When river flows exceed the hydraulic capacity of the Corps' existing spillway, the powerhouse would be shut down, and all flows would be passed in accordance with the Corps' management practices.

The Emsworth, Emsworth Back Channel, and Montgomery Projects would produce an annual average of 101,300 megawatt-hours (MWh), 53,500 MWh, and 194,370 MWh of electricity, respectively.

Proposed Environmental Measures

The applicants propose to construct and operate the projects with the environmental protection, mitigation, and enhancement (PM&E) measures described below. All of the following PM&E measures apply to all three projects unless otherwise noted.

Geology and Soil Resources

- Develop an erosion and sedimentation control plan in consultation with the Corps and the Pennsylvania Department of Environmental Protection that includes procedures and best management practices to reduce runoff and sedimentation during construction and final stabilization.

Aquatic Resources

- Develop a detailed soil disposal plan to ensure excavated sediment is handled and disposed of appropriately.

- Operate in a run-of-release mode to avoid project-related impacts on the Corps' operations of its facilities.

- Conduct 3 years of post-construction water quality monitoring from June through September to monitor for project effects on water quality.

- Install trash racks at the project intake with a 5-inch clear bar spacing, and provide approach velocities of less than 2 feet per second (fps) to mitigate for the entrainment and impingement of fish.

- When warranted and to the extent feasible, coordinate the timing of any construction-related hydraulic changes, such as changes in flow direction, to minimize effects on spawning fish and other aquatic organisms downstream of the project.

Terrestrial Resources

- Develop an avian protection plan consistent with Avian Power Line Interaction Committee (APLIC) and U.S. Fish and Wildlife Service (FWS) guidelines that includes provisions for protecting bald eagles, osprey, and other raptors from project-related effects.

- Develop a transmission line corridor management plan that includes provisions for protecting botanical resources from project-related effects and controlling invasive species along the transmission line right-of-way.

Recreation and Land Use

- Implement a recreation resource management plan at the Montgomery Project with provisions for installing a fishing platform downstream of the project's tailrace, designated parking, and an accessible walkway that leads from the designated parking area to the fishing platform.

Aesthetics

- Restore areas temporarily affected by construction activities to protect the sites' aesthetics.

- Remove and properly dispose of any non-organic debris or trash that is collected during trash rack cleaning.

Cultural Resources

- Prepare a historic properties management plan (HPMP) in accordance with an anticipated Programmatic Agreement (PA) between the Commission and the Pennsylvania Bureau for Historic Preservation (Pennsylvania SHPO).

Public Involvement

Before filing license applications, the applicants conducted pre-filing consultation under the traditional licensing process. The intent of the Commission's pre-filing process is to initiate public involvement early in the project planning process and to encourage citizens, governmental entities, tribes, and other interested parties to identify and resolve issues prior to an application being formally filed with the Commission.

After the applications were filed, we conducted scoping to determine what issues and alternatives should be addressed. We issued a scoping document for the Ohio River Projects on September 2, 2014; conducted an environmental site review on October 9, 2014; and conducted scoping meetings on October 9 and 10, 2014. Based on discussions

during the site review and scoping meetings and written comments received during the comment period, we issued a revised scoping document on December 17, 2015. On the same date, we issued notice that the applications were ready for environmental analysis and requested terms and conditions, comments, and recommendations for each project.

Alternatives Considered

This multi-project environmental assessment (EA) analyzes the effects of the proposed action and recommends conditions for any original licenses that may be issued for the three projects. This EA considers the following alternatives: (1) the applicants' proposals, as outlined above; (2) the applicants' proposals with staff modifications (staff alternative); and (3) no action or license denial, meaning the projects would not be constructed and there would be no change to the existing environment.

Staff Alternative

Under the staff alternative, the projects would be constructed, operated, and maintained as proposed by the applicants with the following modifications and additional staff-recommended measures. Unless otherwise noted, the following measures apply to all three projects.

- A contaminated sediment testing and disposal plan that includes the applicants' soil disposal plan, as well as provisions for testing sediment from the river bed to ensure sediment is handled and disposed consistent with state standards and to ensure minimal impacts of contaminated sediment on aquatic species and their habitat.

- An operation compliance monitoring plan to document compliance with the operating requirements of any licenses issued for the projects.

- A stand-alone spill prevention, containment, and countermeasures plan to guide the handling of hazardous substances and protect water quality and aquatic biota during project construction and operation.

- A water quality monitoring plan that includes the applicants' proposal to monitor water quality for 3 years post-construction and an additional provision to monitor water quality during construction.

- A vegetation management plan for each project that would apply the measures included in the applicants' transmission line corridor management plans to all project lands.

- A temporary staircase and fishing pier at the Montgomery Project that would provide access to anglers and minimize construction-related effects on angler use.

- A debris management plan that includes the applicants' proposed measures to remove and dispose of trash that accumulates upstream of the proposed projects' trash racks, as well as procedures that describe how debris would be sorted, stored, and disposed to minimize the effect of floating debris on local recreation and aesthetics.

- Execution and implementation of a PA that requires revision of the draft HPMP to address the management of historic properties and unevaluated cultural resources.

Environmental Impacts and Measures of the Staff Alternative

The primary issues associated with licensing the proposed projects are the potential effects of the projects on dissolved oxygen (DO) concentrations and aquatic habitat downstream of the proposed projects, fish entrainment, and terrestrial, recreation, aesthetics, and cultural resources. The environmental effects of the staff alternative are described as follows.

Geology and Soil Resources

Ground-disturbing activities associated with constructing the proposed projects would involve excavation of the riverbed, disturbance to shorelines, and installation/removal of cofferdams which could cause erosion, and a temporary increase in suspended sediment and turbidity in the Ohio River. The staff-recommended erosion and sedimentation control plans that include provisions for the placement of turbidity curtains upstream and downstream of cofferdams, silt fencing, stabilization of temporarily disturbed soils, and final site stabilization would minimize soil erosion and sedimentation and protect water quality.

Aquatic Resources

Polycyclic aromatic hydrocarbons have been reported in river sediment samples collected by the applicants. The staff-recommended contaminated sediment testing and disposal plans would specify sampling methodologies, locations, and frequency of testing and describe how to remove, handle, and dispose of any contaminated sediments. These measures would ensure excavated sediment is tested, stored, and disposed of appropriately, ensuring that aquatic resources and human health are protected during project construction.

Construction activities may also affect flow patterns downstream of the dams, suspend sediment, or cause erosion that could increase turbidity and affect aquatic habitat. If the timing of construction could be coordinated to avoid the spring spawning season, as the applicants propose, then any spawning habitat downstream of the dams would be protected from construction-related effects.

Operating the projects as proposed in run-of-release mode would maintain pool elevations and discharge in accordance with the Corps' existing operations. This operating mode would minimize effects on water depth and velocities upstream and downstream of the dams and protect fish and mussel habitat. Developing operation compliance monitoring plans, as recommended by staff, would provide a means to verify compliance with the operational requirements of any licenses issued for the projects and ensure aquatic resources are protected.

During project operation, river flows that currently discharge over the existing dams would be diverted through the proposed turbines, potentially reducing aeration at the dams and lowering DO concentrations downstream of the projects. Staff-recommended water quality monitoring plans that include provisions for turbidity, temperature, and DO monitoring during construction; and the applicants' proposed water temperature and DO monitoring from June 1 to September 30 during the first 3 years of operation, would provide information to make adjustments to construction and project operation if needed to protect water quality, fish, and other aquatic organisms.

Operation of the projects would also result in some unavoidable fish impingement and entrainment-related mortality as fish pass through the turbines. However, the applicants' proposals to limit intake velocities at the projects' trash racks to less than 2 fps and to install trash racks with 5-inch bar spacing would allow most adults and juveniles of nearly all species to avoid both impingement and entrainment. Verifying intake velocities at the trash racks, as part of the staff-recommended operation and compliance monitoring plans, would ensure that intake velocities are sufficiently low to prevent impingement and minimize fish entrainment.

Terrestrial Resources

Construction of the projects' generation facilities, access roads, parking areas, and transmission lines would disturb a total of 6.6 acres of upland habitat in the proposed project boundaries and could potentially lead to the spread of invasive plants. The staff-recommended vegetation management plans would incorporate the applicants' proposed revegetation and invasive species control measures for the transmission line corridors, but would expand the scope of these measures to the entire project boundary to protect botanical resources in all areas affected by construction. The vegetation management plans would also include monitoring to ensure that revegetation and invasive species control measures are successful.

Construction of the projects may also disturb or remove habitat for bald eagles, osprey, and other raptors if trees are removed. In addition, raptors may be electrocuted by the projects' transmission lines or other electrical equipment. The applicants' proposed avian protection plans would be developed in accordance with APLIC and FWS guidelines and include provisions to protect raptors from habitat disturbance and electrical equipment.

Threatened and Endangered Species

Five federally listed freshwater mussel species (northern riffleshell, clubshell, rayed bean, snuffbox, and rabbitsfoot) and two federally listed terrestrial species (Indiana bat and northern long-eared bat) have historically occurred or may occur in the counties where the projects would be located.

Mussel surveys conducted by the applicants and Pennsylvania Natural Diversity Inventory (PNDI) reports dated August 2, 2013, and March 4, 2015, filed by the applicants on March 14, 2014 (Montgomery Project), and September 18, 2015 (Emsworth Back Channel and Emsworth Projects), respectively, indicate that no federally listed mussel species occur in the vicinity of the proposed projects. As such, construction and operation of the projects would have no effect on any federally listed mussels.

FWS' Species Search web page indicated that Indiana and northern long-eared bats are known to occur in the counties where the projects are located. However, the species have not been documented in the immediate project areas, habitat in the project areas is unlikely to support either bat species, and the projects are more than 10 miles from known hibernaculum and not near any known maternity roosts or summer detection sites. The PNDI report correspondence from FWS filed by the applicants on March 14, 2014, and September 18, 2015, did not identify any known effects for either bat species and indicated that no further review was required. Because neither bat is known to inhabit the project areas, and the construction, operation, and maintenance of the proposed projects would not substantially alter the existing environment or any potential bat roosting habitat, construction and operation of the projects would have no effect on the Indiana bat or northern long-eared bat or their habitat.

Recreation Resources

Construction and operation of the Emsworth Locks and Dam and Emsworth Back Channel Projects would not affect recreational resources because recreation access is limited by the highly industrialized character of the area and fishing from Neville Island is prohibited. Construction of the Montgomery Project would permanently affect public access to informal shoreline fishing areas on the north river bank immediately downstream of the dam.

The staff-recommended recreation amenities include the applicant's proposed recreation facilities located downstream of the Montgomery Project that would mitigate for the permanent loss of shoreline fishing access. Specifically the applicant's proposal includes construction of an accessible/barrier-free fishing platform, a designated parking area with eight parking spaces, and an accessible walkway that leads from the parking area to the fishing platform that would be located in the Montgomery Project's tailrace. To mitigate the temporary loss of access during construction, which could last up to 3 years, the staff-recommendation also includes provisions for installing a temporary staircase and fishing pier downstream of the Montgomery Project's construction site prior to the start of construction to preserve existing recreational access.

Land Use and Aesthetics

Construction activity could cause a temporary, localized disruption of existing land use in the immediate vicinity of the projects. Short-term, unavoidable effects during construction would include increased traffic, noise, and activity. The applicants' proposals to restore areas after construction by clearing construction debris and revegetating the landscape would protect existing aesthetics and historic properties at each site. The staff-recommended HPMPs also include a provision to visually blend the powerhouses with the locks and dams to ensure that new project facilities are less obtrusive to viewers.

Debris and trash, which can affect the visual character of the river, accumulates behind the existing dams and would concentrate upstream of the projects' trash racks during operation. The staff-recommended debris management plans would include the applicants' proposals to remove trash from the river as well as procedures that describe how debris would be sorted, stored, and disposed to ensure trash is removed appropriately and visual resources are protected.

Cultural Resources

Construction of the proposed projects has the potential to affect historic properties associated with the existing Corps' locks and dams and also the Ohio River Navigation System, all of which are eligible for listing in the National Register of Historic Places. The proposed projects could also adversely affect other cultural resources located within each project's area of potential effects. However, revision of the filed HPMPs to contain the applicants proposals to restore areas temporarily affected by construction (discussed above) and additional staff-recommended measures (listed in section 3.3.7.2, *Management of Historic Properties*), including specific management measures to resolve project-related adverse effects in consultation with the Pennsylvania SHPO and the Corps would avoid, lessen, or mitigate any adverse effects on historic properties.

No-action Alternative

Under the no-action alternative, no licenses would be issued, and the proposed projects would not be constructed. Environmental conditions would remain the same.

Conclusions

Based on our analysis, we recommend licensing the projects under the staff alternative.

In section 4.2 of the EA, we estimate the likely cost of alternative power for each of the three alternatives identified above. For the Emsworth Project, our analysis shows that, during the first year of operation under the proposed action alternative, project power would cost $1,648,880, or $16.28/MWh, more than the likely alternative cost of power. Under the staff alternative, project power would cost $1,162,740, or $16.41/MWh, more than the likely alternative cost of power.

For the Emsworth Back Channel Project, our analysis shows that, during the first year of operation under the proposed action alternative, project power would cost $1,146,390, or $21.43/MWh, more than the likely alternative cost of power. Under the staff alternative, project power would cost $1,160,250, or $21.69/MWh, more than the likely alternative cost of power.

For the Montgomery Project, our analysis shows that, during the first year of operation under the proposed action alternative, project power would cost $5,576,910, or $28.69/MWh, more than the likely alternative cost of power. Under the staff alternative, project power would cost $5,590,770, or $28.76/MWh, more than the likely alternative cost of power.

We chose the staff alternative as the preferred alternative for each project because: (1) the projects would provide a dependable source of electrical energy for the region (349,170 MWh annually); (2) the combined 78 MW of electric capacity comes from a renewable resource that does not contribute to atmospheric pollution, including greenhouse gases; and (3) the recommended environmental measures would adequately protect and enhance environmental resources affected by the projects. The overall benefits of the staff alternative would be worth the cost of the recommended environmental measures.

We conclude that issuing original licenses for the projects with the environmental measures we recommend would not be a major federal action significantly affecting the quality of the human environment.

MULTI-PROJECT

ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, D.C.

Emsworth Locks and Dam Hydroelectric Project, FERC Project No. 13757-002

Emsworth Back Channel Hydroelectric Project, FERC Project No. 13761-002

Montgomery Locks and Dam Hydroelectric Project, FERC Project No. 13768-002

Pennsylvania

1.0 INTRODUCTION

1.1 APPLICATION

On February 27, 2014, February 3, 2014, and March 14, 2014, applications were filed with the Federal Energy Regulatory Commission (Commission or FERC) for the construction and operation of the following 10 hydropower projects to be located at the U.S. Army Corps of Engineers' (Corps') existing dams on the Monongahela River (six projects; filed on February 27, 2014), Allegheny River (one project; filed on February 3, 2014), and Ohio River (three projects; filed on March 14, 2014). Collectively, these 10 projects are referred to as the Upper Ohio River Basin Projects (figure 1-1). All 10 applicants are subsidiary companies of FFP New Hydro, LLC. Rye Development, LLC, is acting as agent on behalf of FFP New Hydro, LLC and its subsidiary companies for the projects. This environmental assessment (EA) addresses the project-specific environmental effects of licensing the three proposed projects that are located on the Ohio River, which we refer to as the Ohio River Projects (or projects). We consider the effects of licensing all 10 proposed projects in our evaluation of cumulative effects.

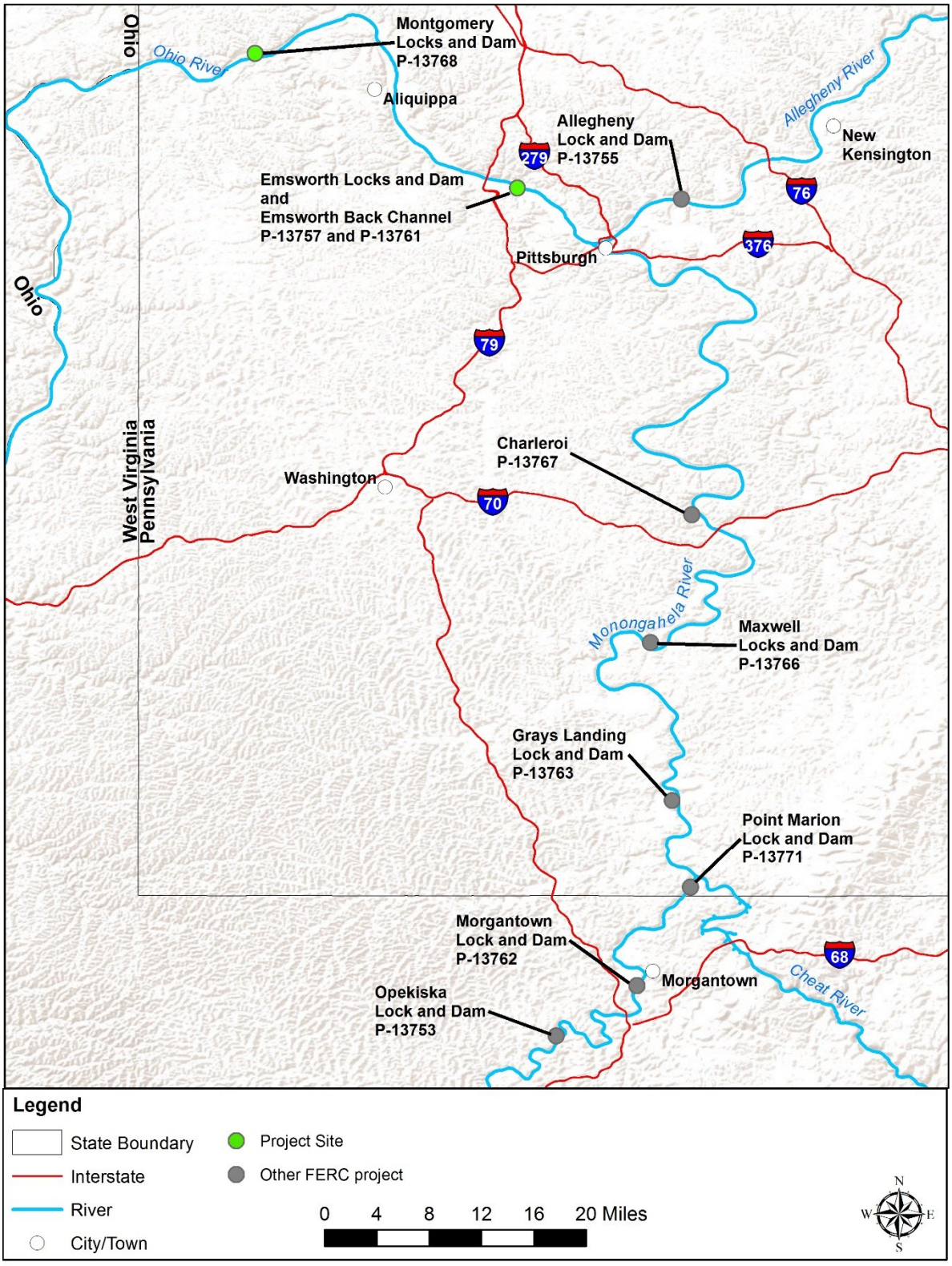

Figure 1-1. Location map of the Upper Ohio River Basin Projects (Source: staff).

Emsworth Locks and Dam Hydroelectric Project

On March 14, 2014, FFP Missouri 5, LLC (FFP 5 LLC), filed an application for an original license with the Commission to construct and operate its proposed Emsworth Locks and Dam Hydroelectric Project No. 13757 (Emsworth Project). The project would be located on the Ohio River at river mile (RM) 6.2 in Allegheny County, Pennsylvania, at the existing Emsworth Locks and Dam owned and operated by the Corps (figures 1-1 and 1-2). Emsworth Locks and Dam is located on the north side of Neville Island, a mid-channel island that forms the main channel of the Ohio River on the north side of the island and the back channel on the south side of the island. The proposed project would consist of constructing an intake, spill gates, powerhouse, tailrace, substation, and transmission line. The project would have an installed capacity of 24 megawatts (MW) and an estimated annual generation of 101,300 megawatt-hours (MWh). The project would occupy 9.7 acres of federal land owned by the Corps.

Emsworth Back Channel Hydroelectric Project

On March 14, 2014, FFP Missouri 6, LLC (FFP 6 LLC), filed an application for an original license with the Commission to construct and operate its proposed Emsworth Back Channel Dam Hydroelectric Project No. 13761 (Emsworth Back Channel Project). The project would be located on the Ohio River at RM 6.8 in Allegheny County, Pennsylvania, at the existing Emsworth Back Channel Dam owned and operated by the Corps (figures 1-1 and 1-3). Emsworth Back Channel Dam is located on the south side of Neville Island. The proposed project would consist of constructing an intake, spill gates, powerhouse, tailrace, substation, and transmission line. The project would have an installed capacity of 12 MW and an estimated annual generation of 53,500 MWh. The project would occupy 2.3 acres of federal land owned by the Corps.

Montgomery Locks and Dam Hydroelectric Project

On March 14, 2014, Solia 6 Hydroelectric, LLC (Solia 6 LLC), filed an application for an original license with the Commission to construct and operate its proposed Montgomery Locks and Dam Hydroelectric Project No. 13768 (Montgomery Project). The project would be located on the Ohio River at RM 31.7 in Beaver County, Pennsylvania, at the existing Montgomery Locks and Dam owned by the Corps (figures 1-1 and 1-4). The proposed project would consist of constructing an intake, spill gates, powerhouse, tailrace, substation, and transmission line. The project would have an installed capacity of 42 MW and an estimated annual generation of 194,370 MWh. The project would occupy 5.1 acres of federal land owned by the Corps.

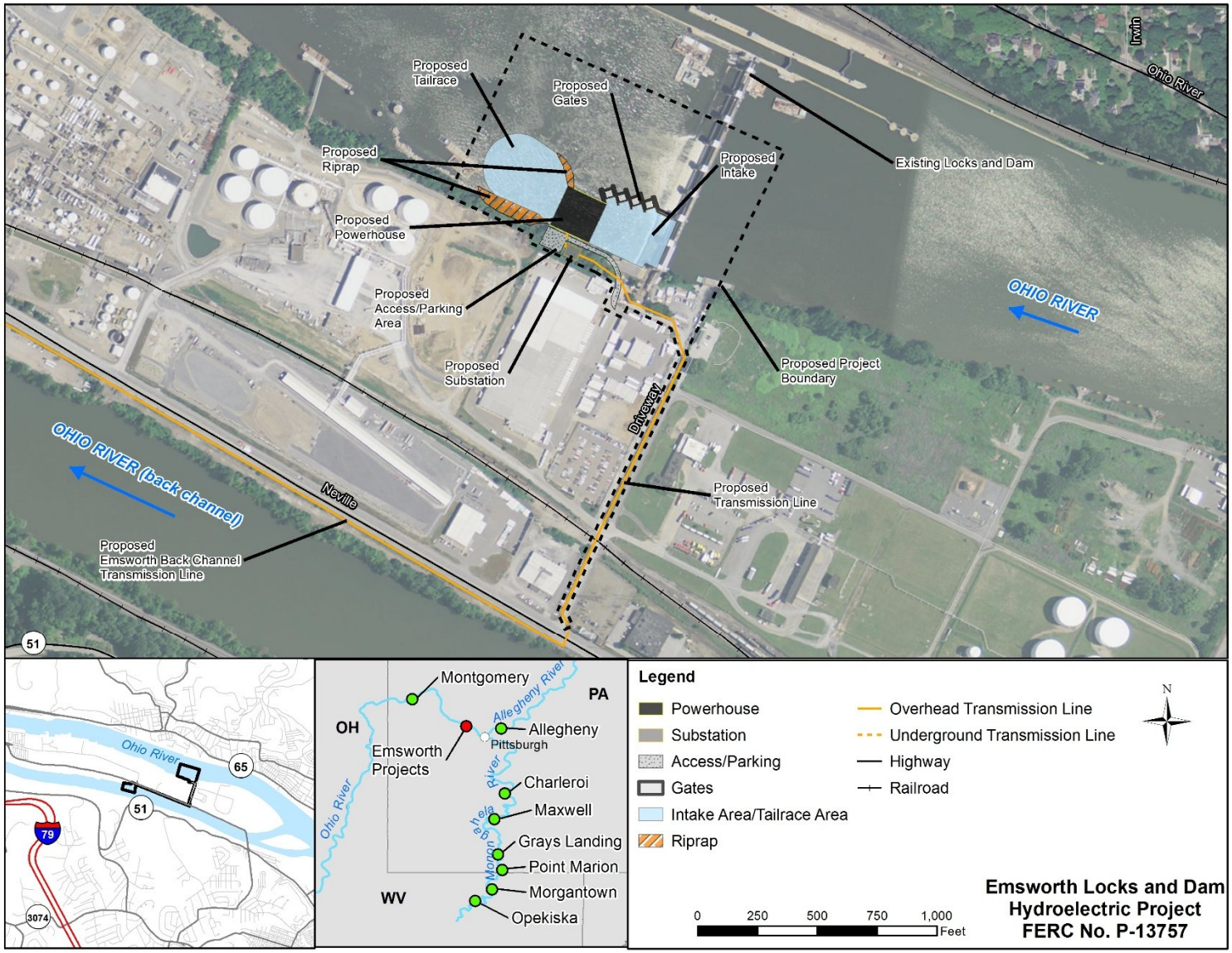

Figure 1-2. Location map of the Emsworth Project (Source: staff).

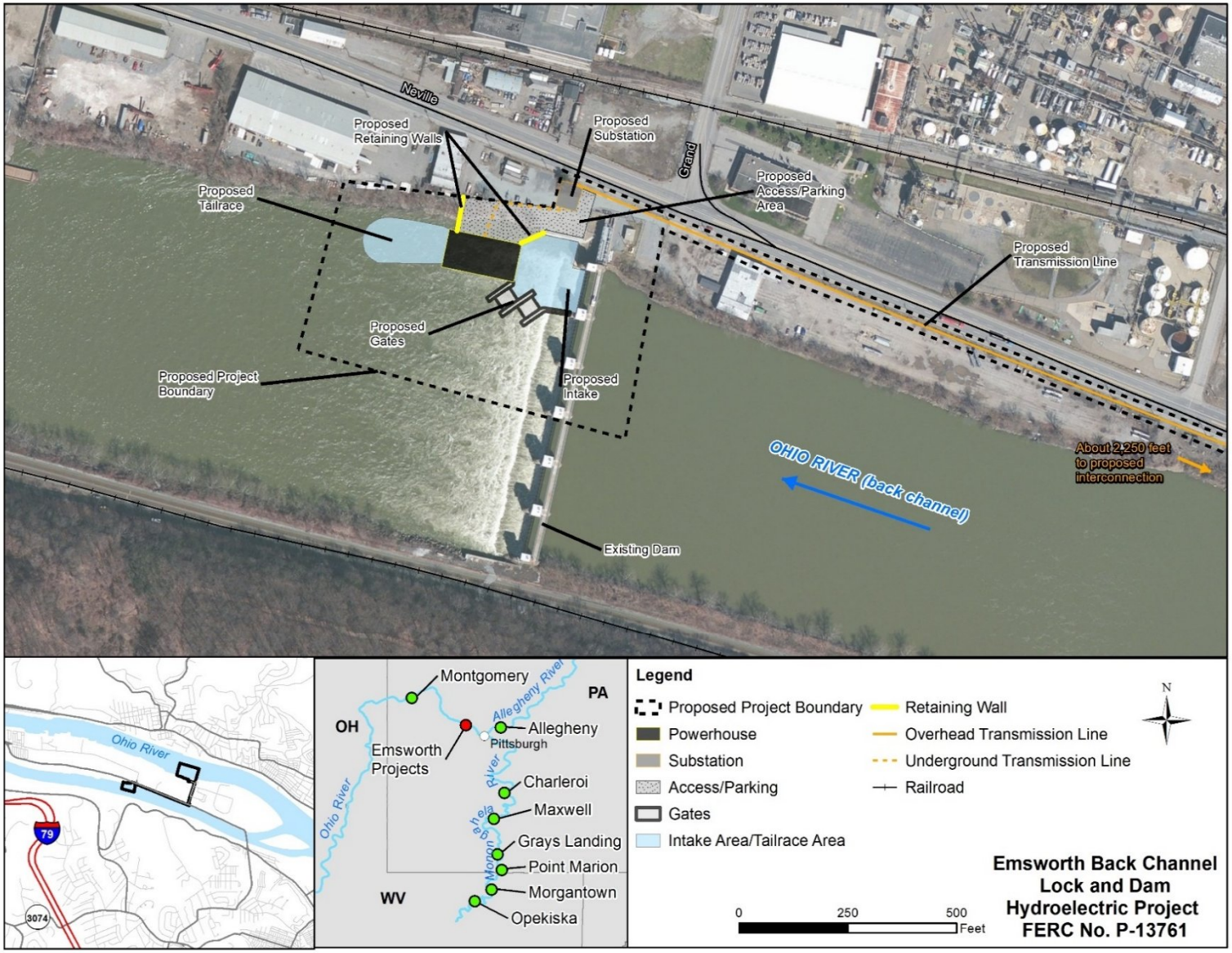

Figure 1-3. Location map of the Emsworth Back Channel Project (Source: staff).

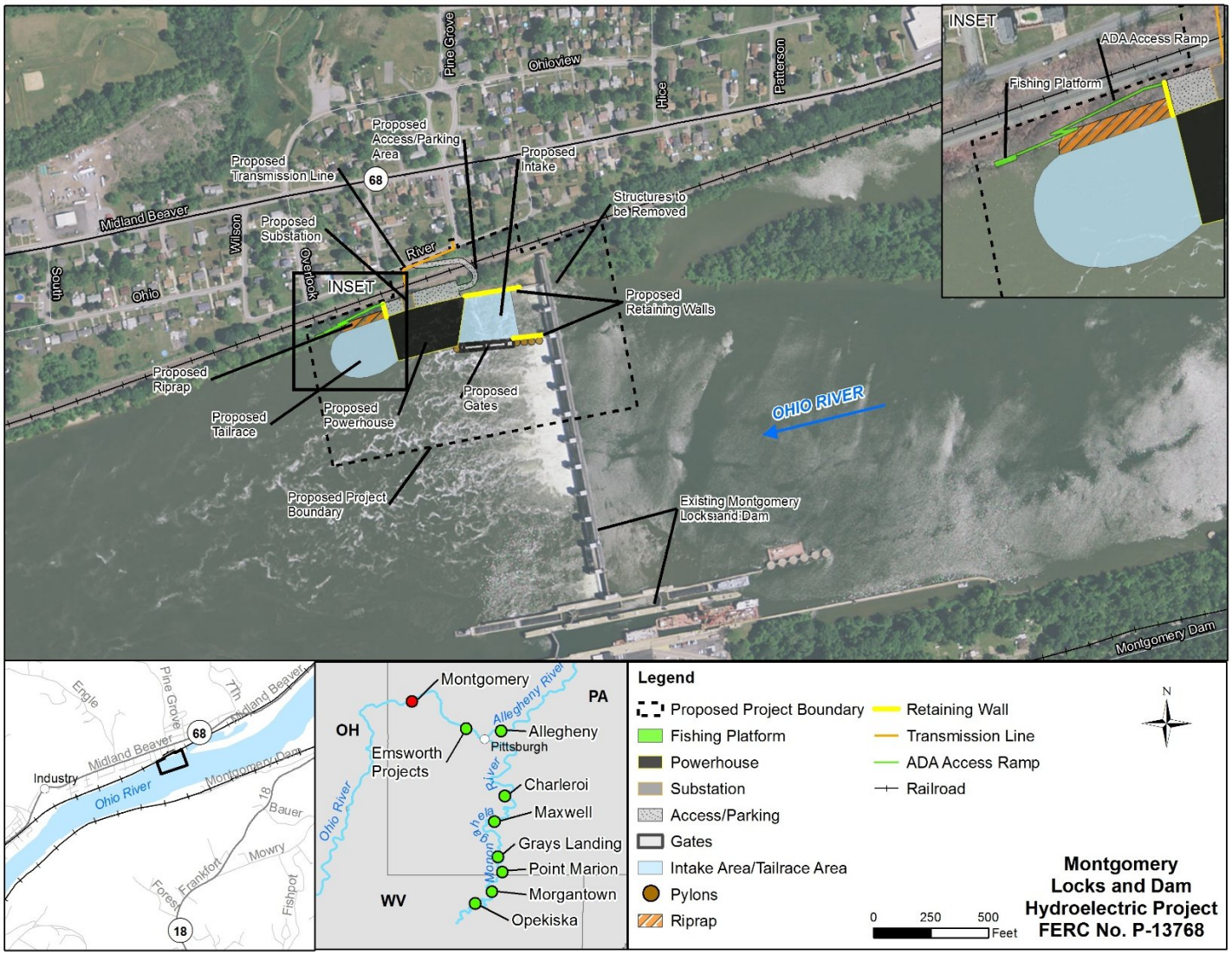

Figure 1-4. Location map of the Montgomery Project (Source: staff).

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the proposed Ohio River Projects is to provide new sources of hydroelectric power. Therefore, under the provisions of the Federal Power Act (FPA), the Commission must decide whether to issue licenses to FFP 5 LLC, FFP 6 LLC, and Solia 6 LLC (the applicants) for the projects and what conditions should be placed on any licenses issued. In deciding whether to issue a license for any hydroelectric project, the Commission must determine that the project will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued (such as flood control, irrigation, or water supply), the Commission must give equal consideration to the purposes of: (1) energy conservation; (2) the protection of, mitigation of damage to, and enhancement of fish and wildlife resources; (3) the protection of recreational opportunities; and (4) the preservation of other aspects of environmental quality.

Issuing licenses for the proposed Ohio River Projects would allow the applicants to generate electricity for the term of each license, making electric power from a renewable resource available to their customers.

This multi-project EA has been prepared in compliance with the National Environmental Policy Act of 1969 to assess the environmental and economic effects associated with construction and operation of the Ohio River Projects and alternatives to the proposed projects, and makes recommendations to the Commission on whether to issue a license for each project, and if so, recommends terms and conditions to become a part of any license issued for each project.

In this EA, we assess the environmental and economic effects of constructing, operating, and maintaining the Ohio River Projects: (1) as proposed by the applicants (proposed action); and (2) with our recommended measures (staff alternative). We also consider the effects of the no-action alternative. Important issues that are addressed include the potential effects of project construction on soils and sedimentation, effects of project operation on dissolved oxygen (DO) concentrations and aquatic habitat downstream of the Corps' dams, fish entrainment, vegetation and wildlife, and recreation, aesthetic, and cultural resources.

1.2.2 Need for Power

The three Ohio River Projects would provide hydroelectric generation to meet part of Pennsylvania's power requirements, resource diversity, and capacity needs. The projects would have a combined installed capacity of 78 MW and, over the term of the licenses, would generate an average of about 349,170 MWh per year.

The North American Electric Reliability Corporation (NERC) annually forecasts electrical supply and demand nationally and regionally for a 10-year period. The Ohio River Projects are located within the jurisdiction of the PJM Interconnection LLC (PJM), a subregion of the Reliability First Corporation, a region of the NERC. PJM is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia. According to NERC's most recent (2015) forecast, the total internal demand is expected to grow at a compound annual rate of 0.93 percent in summer and 0.82 percent in winter over the next 10 years (NERC, 2015).

We conclude that power from the Ohio River Projects would help meet a need for power in the PJM subregion in both the short and long term. The projects would provide power that could displace non-renewable, fossil-fired generation and contribute to a diversified generation mix. Displacing the operation of non-renewable facilities may avoid some power plant emissions and create an environmental benefit.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

Licenses for the proposed projects are subject to numerous requirements under the FPA and other applicable statutes. The major regulatory and statutory requirements are described in the following sections.

1.3.1 Federal Power Act

1.3.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA states that the Commission is to require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of the U.S. Department of Commerce or the U.S. Department of the Interior (Interior). Interior, by letter filed on February 11, 2016, requests including a reservation of authority to prescribe fishways under section 18 in any licenses issued for the projects.

1.3.1.2 Section 10(j) Recommendations

Under section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

Interior timely filed, on February 11, 2016, recommendations under section 10(j), as summarized in table 5-1, in section 5.3, *Fish and Wildlife Agency Recommendations.* In section 5.3, we also discuss how we address agency recommendations and comply with section 10(j).

1.3.2 Clean Water Act

Under section 401(a)(1) of the Clean Water Act (CWA), a license applicant must obtain either water quality certification (certification) from the appropriate state pollution control agency verifying that any discharge from a project would comply with applicable provisions of the CWA or a waiver of certification by the appropriate state agency. The failure to act on a request for certification within a reasonable period of time, not to exceed one year, after receipt of such request constitutes a waiver.

On January 8, 2016, FFP 5 LLC, FFP 6 LLC, and Solia 6 LLC mailed applications to the Pennsylvania Department of Environmental Protection (Pennsylvania DEP) for a section 401 certification for licensing the Emsworth, Emsworth Back Channel, and Montgomery Projects, respectively. Pennsylvania DEP received the applications on January 11, 2016.[3] Pennsylvania DEP has not yet acted on the certification requests.[4]

1.3.3 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species.

Based on staff's review of information available through the U.S. Fish and Wildlife Service (FWS) records and the Pennsylvania Natural Heritage Program, five federally listed freshwater mussel species (northern riffleshell, clubshell, rayed bean, snuffbox, and rabbitsfoot) and two federally listed terrestrial species (Indiana bat and northern long-eared bat) have historically occurred or may occur in the counties where the projects would be located. No designated or proposed critical habitat for these

---

[3] The applicants filed a copy of the certification requests and receipts of delivery to Pennsylvania DEP on February 16, 2016.

[4] In letters filed on April 18 and May 16, 2016, Pennsylvania DEP determined that the applications for the Emsworth Back Channel and Emsworth Projects, respectively, are incomplete and requested that the applications be resubmitted with the additional information it specified.

species is presently found within the proposed project boundaries. Our analysis of project impacts on threatened and endangered species is presented in section 3.3.4, *Threatened and Endangered Species*.

No federally listed mussel species were documented at any of the proposed projects during the applicants' 2013 mussel surveys. Based on Pennsylvania Natural Diversity Inventory (PNDI) reports dated August 2, 2013 and March 4, 2015, filed by the applicants on March 14, 2014 (Montgomery Project), and September 18, 2015 (Emsworth Back Channel and Emsworth Projects), respectively, no impacts on federally listed aquatic species from the proposed projects are anticipated, and no further coordination with FWS is required. Because no federally listed mussel species have been documented to occur in the project area, we conclude that construction and operation of the projects would have no effect on federally listed threatened or endangered mussel species.

FWS' Species Search website indicated that Indiana bats and northern long-eared bats are known to occur in the counties where the projects are located. Neither bat species was observed during general habitat surveys at the projects. Further, the PNDI report correspondence from FWS filed by the applicants on March 14, 2014, and September 18, 2015, did not identify any known effects for either bat species and indicated that no further review was required.

Each project would disturb less than 1 acre of limited quality riparian forest, which considering the highly disturbed condition of the project area, is not likely to support either bat species. The projects are also more than 10 miles from known hibernaculum and not near any known maternity roosts or summer detection sites. Given the small footprints of the projects and the disturbed condition and limited quality of the riparian forest available in the project areas, construction and operation of the projects would have no effect on the Indiana bat or northern long-eared bat or their habitat.

1.3.4 Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act requires the Corps' authorization for the construction, excavation, or deposition of materials in, on, over, or under navigable waters of the United States, or for any work that would affect the course, location, condition, or capacity of those waters. However, section 4(e) of the FPA provides the Commission with the sole licensing authority for construction of hydroelectric plants on navigable waters.

1.3.5 Coastal Zone Management Act

Under section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 United States Code (U.S.C.) § 1456(3)(A), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state CZMA agency concurs

with the license applicant's certification of consistency with the state's CZMA program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

Pennsylvania DEP, in letters filed May 4, 2011 (Montgomery Locks and Dam), and June 22, 2011 (Emsworth Locks and Dam, Emsworth Back Channel Dam), indicates that the proposed Ohio River Projects would be located outside of Pennsylvania's designated coastal zones. Therefore, the projects are not subject to the Pennsylvania coastal zone program review, and no consistency certifications are needed for the actions.

1.3.6 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA)[5] requires that every federal agency "take into account" how each of its undertakings could affect historic properties. Historic properties are districts, sites, buildings, structures, traditional cultural properties, and objects significant in American history, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register).

On October 11, 2012, the Commission designated the applicants as its non-federal representatives for the purposes of conducting section 106 consultation under the NHPA. Pursuant to section 106, and as the Commission's designated non-federal representative, the applicants consulted with the Pennsylvania Bureau for Historic Preservation (Pennsylvania SHPO) to identify historic properties, determine its National Register-eligibility, and assess potential adverse effects on historic properties within the projects' areas of potential effects (APE). These consultations and other investigations concluded that the projects would adversely affect all three of the locks and dams, which are contributing elements of the historic Ohio River Navigation System. The dams individually and the Ohio River Navigation System are eligible for inclusion in the National Register. The Pennsylvania SHPO has not commented on potential effects to other cultural resources that were identified within the projects' APEs.

To meet the requirements of section 106 of the NHPA, we intend to execute Programmatic Agreements (PAs) with the Pennsylvania SHPO for the protection of historic properties from the effects of construction, operation, and maintenance of the Ohio River Projects. The terms of the PAs would ensure that the applicants address and treat all historic properties identified within the projects' APEs through the finalization of the proposed historic properties management plans (HPMPs).

---

[5] 54 U.S.C. § 306108 (2014).

1.4 PUBLIC REVIEW AND COMMENT

The Commission's regulations (18 Code of Federal Regulations [CFR] § 4.38) require that applicants consult with appropriate resource agencies, tribes, and other entities before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act, the ESA, the NHPA, and other federal statutes. Pre-filing consultation must be complete and documented according to the Commission's regulations.

1.4.1 Scoping

Before preparing this EA, we conducted scoping for all three projects to determine what issues and alternatives should be addressed. A scoping document for the Ohio River Projects was distributed to interested agencies and others on September 2, 2014. The document was noticed in the Federal Register on September 30, 2014. Environmental site reviews at each of the Ohio River Projects were held on October 9, 2014. Scoping meetings were held in Pittsburgh, Pennsylvania, on October 9 and 10, 2014, to request oral comments on the projects. A court reporter recorded all comments and statements made at the scoping meetings, and these are part of the Commission's public record for the projects. In addition to comments provided at the scoping meetings, the following entities provided written comments:

Commenting Entity	**Date Filed**
U.S. Army Corps of Engineers	November 6, 2014
Pennsylvania Fish and Boat Commission	November 7, 2014
John Stephen	November 10, 2014

A revised scoping document was issued on December 17, 2015.

1.4.2 Interventions

On July 18, 2014, the Commission issued a notice accepting the applications. The notice set September 16, 2014, as the deadline for filing motions to intervene and protests and requests for cooperating agency status. On September 16, 2014, FirstEnergy Nuclear Operating Company intervened in the licensing proceedings for the Ohio River Projects.

On January 29, 2016, Interior filed a late intervention for the three Ohio River Projects. On February 16, 2016, the Commission granted late intervention to Interior.

1.4.3 Comments on the License Applications

The Commission issued a Ready for Environmental Analysis Notice for the projects on December 17, 2015, and requested comments, recommendations, terms and conditions, and fishway prescriptions. The following entities filed comments, terms and conditions, recommendations, or prescriptions:

Commenting Agency and Other Entity	Date Filed
U.S. Department of the Interior	February 11, 2016
Ecosophic Strategies, LLC	February 16, 2016
Pennsylvania Fish and Boat Commission	February 19, 2016
U.S. Army Corps of Engineers	March 4, 2016

1.4.4 U.S. Army Corps of Engineers – Terms and Conditions

Pursuant to the Memorandum of Understanding between the Commission and the Department of the Army,[6] licensed hydropower facilities that would be an integral part of or that could affect the structural integrity or operation of Corps' projects shall be designed and constructed in consultation with and subject to the review and approval of the appropriate Corps' District Engineer. Consistent with the Memorandum of Understanding, the Commission routinely includes special license articles that do the following:

- require the licensee to submit final plans and specifications for cofferdams and deep excavations to the Corps and Commission for review and approval;

- require the licensee to enter into a comprehensive agreement with the Corps within 90 days after a license is issued to coordinate its plans for access to and site activities on lands and property administered by the Corps, so that the authorized purposes, including operation of the federal facilities, are protected;

[6] See *Memorandum of Understanding between the United States Army Corps of Engineers and The Federal Energy Regulatory Commission on Non-federal Hydropower Projects,* March 2011. http://www.ferc.gov/legal/maj-ord-reg/mou/mou-asace.pdf.

- authorize the Corps to (a) inspect the construction, operation, and maintenance of any licensed facilities that may affect the structural integrity or operation of the Corps' project, and (b) order the licensee to stop any activity that may endanger the structural integrity or safety of the Corps' project;

- require the licensee to submit a regulating (or operating) plan to the Corps for approval at least 60 days prior to the start of construction, and to enter into an operating Memorandum of Agreement (MOA) with the Corps describing the detailed operation of the power facilities acceptable to the Corps;

- provide that the licensee shall have no claim under the license against the United States arising from the effect of any changes made in the operation or reservoir levels of the Corps' project; and

- require the licensee to provide the Commission's Regional Director two copies of all correspondence between the licensee and the Corps and provide that the Commission's Regional Director shall not authorize construction until the Corps provides final written approval of the project.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO-ACTION ALTERNATIVE

The no-action alternative is license denial. Under the no-action alternative, the projects would not be built, and the environmental resources in the project areas would not be affected.

2.2 APPLICANTS' PROPOSALS

2.2.1 Existing Corps Facilities

The Monongahela and Allegheny Rivers join to form the Ohio River in Pittsburgh, Pennsylvania. The Corps owns a total of 38 locks and dams on these rivers, including 9 locks and dams on the Monongahela River, 8 locks and dams on the Allegheny River, and 21 locks and dams on the Ohio River. The Corps operates the locks and dams for commercial and recreational navigation.

The proposed projects would be located at three existing locks and dams on the Ohio River: Emsworth Locks and Dam, Emsworth Back Channel Dam, and Montgomery Locks and Dam.

2.2.1.1 Emsworth Locks and Dam

Emsworth Locks and Dam is located on the north side of Neville Island at RM 6.2 on the Ohio River in Emsworth, Pennsylvania.[7] The locks and dam consist of a 1,000-foot-long, 18-foot-high, concrete dam with a full length spillway equipped with eight 100-foot-wide, 12-foot-high vertical lift crest gates and a 34-foot-long fixed crest section; a 600-foot-long, 110-foot-wide navigational lock; and a 360-foot-long, 56-foot-wide navigational lock. The normal water surface elevation of the upper pool is at elevation 710 feet National Geodetic Vertical Datum of 1929 (NGVD29).[8] At that elevation, the upper pool has a surface area of 2,870 acres and a volume of 42,700 acre-feet.

2.2.1.2 Emsworth Back Channel Dam

The Emsworth Back Channel Dam is located on the south side of Neville Island at RM 6.8 on the Ohio River near Coraopolis and Neville Township, Pennsylvania. The

---

[7] River miles are measured from the confluence of the Monongahela and Allegheny Rivers at Pittsburgh, Pennsylvania.

[8] All elevations are provided in NGVD29 datum unless otherwise noted.

dam consists of a 750-foot-long, 18-foot-high, concrete dam with a full length spillway equipped with six 100-foot-wide, 12-foot-high vertical lift crest gates. The normal water surface elevation of the upper pool is at elevation 710 feet. At that elevation, the upper pool has a surface area of 2,870 acres and a volume of 42,700 acre-feet.

2.2.1.3 Montgomery Locks and Dam

The Montgomery Locks and Dam is located at RM 31.7 on the Ohio River downstream of Beaver, Pennsylvania. The locks and dam consist of a 1,379-foot-long, 62-foot-high, concrete dam with a full length spillway equipped with ten 100-foot-wide, 16-foot-high vertical lift crest gates; a 101-foot-wide fixed crest bay on the right (north) side; a 101-foot-wide fixed crest bay on the left side between the gated spillway and river wall of the locks; a 600-foot-long, 110-foot-wide navigational lock; and a 360-foot-long, 56-foot-wide navigational lock. The normal water surface elevation of the upper pool is at elevation 682 feet. At that elevation, the upper pool has a surface area of 2,990 acres and a volume of 57,500 acre-feet.

2.2.2 Existing Corps Operations

The Corps' operation of the Emsworth, Emsworth Back Channel, and Montgomery Dams is integrated with its operation of the other locks and dams on the river to maintain the navigation channel. At each dam, gates are repositioned on a daily basis to regulate discharge and maintain the desired pool elevation and corresponding navigational channel depth (a minimum depth of 9 feet). Although the Corps uses established gate schedules to guide gate selection and position, other factors can influence daily operations. Factors that influence gate selection and position include controlling detrimental scour and shoaling, avoiding adverse effects on navigation, and managing debris passage.

2.2.3 Proposed Project Facilities

Each of the proposed hydroelectric facilities would include an intake channel, intake structure, powerhouse, tailrace, substation, transmission lines, and access roads. Only the Montgomery Project would include recreational facilities. The transmission lines would connect to existing substations or distribution lines of nearby local utilities. The proposed project boundaries, shown in figures 1-2 through 1-4, would enclose the facilities described below, including transmission line rights-of-way (ROWs).

2.2.3.1 Emsworth Project

The proposed Emsworth Project would be located downstream of spillway gates 7 and 8 at Emsworth Locks and Dam and would consist of the following new facilities: (1) a 205-foot-long, 180-foot-wide intake channel excavated into the riverbed immediately downstream of the Corps' spillway gates 7 and 8 on the south side of the river[9]; (2) four 50-foot-wide, 40-foot-high spill gates located within the intake channel to pass flow equivalent to the Corps' spillway gates 7 and 8; (3) a 30-foot-long, 180-foot-wide, 63.5-foot-high, reinforced concrete intake structure and trash rack with 5-inch spacing; (4) a 180-foot-long, 180-foot-wide, 77-foot-high reinforced concrete powerhouse on the south bank of the river; (5) four equally sized horizontal pit Kaplan-type turbine-generator units with a combined capacity of 24 MW; (6) a 380-foot-long, 280-foot-wide tailrace excavated into the riverbed to discharge water from the powerhouse; (7) an 88-foot-long, medium-voltage, buried cable from the powerhouse to the substation; (8) a 50-foot-long by 60-foot-wide substation; (9) a 1,893-foot-long, 69-kilovolt (kV), overhead transmission line within a 35-foot-wide ROW to connect the project substation to an existing substation; (10) an approximately 420-foot-long, 28-foot-wide access road with a parking area; and (11) appurtenant facilities.

The proposed project would not include recreational facilities.

The proposed project boundary would include the new hydroelectric facilities listed above, some Corps gates and other structures, and a portion of the river upstream and downstream of the project. In section 3.3.5.2, *Recreation and Land Use, Environmental Effects*, we discuss potential modifications to the proposed project boundary.

2.2.3.2 Emsworth Back Channel Project

The proposed Emsworth Back Channel Project would be located downstream of spillway gate 6 at Emsworth Back Channel Dam and would consist of the following new facilities: (1) a 100-foot-long, 165-foot-wide intake channel excavated into the riverbed immediately downstream of the Corps' spillway gate 6 on the north side of the river directing flow to a 32-foot-long, 90-foot-wide, 63.5-foot-high, reinforced concrete intake structure and trash rack with 5-inch spacing; (2) two 50-foot-wide, 40-foot-high spill gates located within the intake channel to pass flow equivalent to the Corps' spillway gate 6; (3) a 32-foot-long, 90-foot-wide, 63.5-foot-high, reinforced concrete intake structure and trash rack with 5-inch spacing; (4) a 150-foot-long, 90-foot-wide, 77-foot-

[9] As currently proposed by the applicants, the Corps gates and spillways would remain intact at all of the proposed Ohio River Projects.

high, reinforced concrete powerhouse; (5) two equally sized horizontal pit Kaplan-type turbine-generator units with a combined capacity of 12 MW; (6) a 190-foot-long, 105-foot-wide tailrace excavated into the riverbed to discharge water from the powerhouse; (7) a 188-foot-long, medium-voltage, buried cable from the powerhouse to the substation; (8) a 50-foot-long by 60-foot-wide substation; (9) a 3,758-foot-long, 69-kV, overhead transmission line within a 35-foot-wide ROW to connect the project substation to an existing substation; (10) an approximately 78-foot-long, 28-foot-wide access road with a parking area; and (11) appurtenant facilities.

The proposed project would not include recreational facilities.

The proposed project boundary would include the new hydroelectric facilities listed above, some Corps facilities, and a portion of the river upstream and downstream of the project. In section 3.3.5.2, *Recreation and Land Use, Environmental Effects*, we discuss potential modifications to the proposed project boundary.

2.2.3.3 Montgomery Project

The proposed Montgomery Project would be located downstream of the Corps' spillway gate 10 and the northern fixed crest section of Montgomery Locks and Dam and would consist of the following new facilities: (1) a 340-foot-long, 205-foot-wide intake channel excavated into the riverbed immediately downstream of spillway gate 10 and the fixed crest section on the north side of the river; (2) two 100-foot-wide spill gates located within the intake channel to pass flow equivalent to the Corps' spillway gate 6 and the fixed crest section; (3) a 150-foot-long, 205-foot-wide, 90-foot-high, reinforced concrete intake structure and trash rack with 5-inch spacing; (4) a 315-foot-long, 205-foot-wide, 105-foot-high, reinforced concrete powerhouse on the north bank of the river; (5) three equally sized horizontal bulb Kaplan-type turbine-generator units with a combined capacity of 42 MW; (6) a 280-foot-long, 210-foot-wide tailrace excavated into the riverbed to discharge water from the powerhouse; (7) a 15-foot-long, medium-voltage, buried cable from the powerhouse to the substation; (8) a 50-foot-long by 60-foot-wide substation; (9) a 392-foot-long, 69-kV, overhead transmission line within a 35-foot-wide ROW to connect the project substation to an existing distribution line; (10) an approximately 383-foot-long, 28-foot-wide access road; and (11) appurtenant facilities.

The project would also include a new fishing access walkway leading from a parking area with eight designated parking spaces to a fishing platform in the project tailrace.

The proposed project boundary would include the new hydroelectric facilities listed above, the proposed recreation enhancements, some Corps facilities, and a portion of the river upstream and downstream of the project. In section 3.3.5.2, *Recreation and Land Use, Environmental Effects*, we discuss potential modifications to the proposed project boundary.

2.2.4 Project Safety

Under original hydropower licenses, the proposed Ohio River Projects would be subject to the Commission's project safety requirements. As part of the licensing process, Commission staff would evaluate the adequacy of the proposed project facilities. Special articles would be included in any licenses issued, as appropriate. Before the projects are constructed, engineers from the Commission's New York Regional Office would review the designs, plans, and specifications of the proposed generating structures. During construction, engineers from the Commission would frequently inspect the projects to ensure adherence to approved plans and specifications; special license articles relating to construction, operation, and maintenance; and accepted engineering practices and procedures. Once construction is complete and the projects enter the operation phase, Commission engineers would inspect them on a regular basis. Because the Corps maintains and operates the lock and dams, the Commission would coordinate with the Corps to fulfill its obligation to ensure that project safety requirements are met for each project.

2.2.5 Proposed Project Operation

The projects would operate in run-of-release mode, using only the flows made available by the Corps that would normally be released through the Corps' gates or spillways. The applicants propose to maintain the existing water surface elevations of each pool upstream of the dams in accordance with the Corps' management practices.

Table 2-1 presents the hydraulic characteristics of each hydroelectric project, lock, and dam spillway. When river flows available after lockage requirements are less than the minimum hydraulic capacity required to operate a single unit at each project, the projects would cease generating and all flows would be passed via the Corps' gates or spillway in accordance with existing Corps' practices. When river flows available after lockage requirements are between the minimum and maximum hydraulic capacity of the powerhouse, all flows not used for the Corps' lockage would pass through the project powerhouse. When river flows available after the Corps' lockage requirements exceed the hydraulic capacity of the project powerhouse, but do not exceed the hydraulic capacity of the Corps' spillway, any additional flow would be released via the Corps' spillway and/or the projects' proposed spill gates. When river flows exceed the hydraulic capacity of the Corps' existing spillway, the powerhouse would be shut down, and all flows would be passed in accordance with the Corps' management practices.

Table 2-1. Hydraulic characteristics of the projects, locks, and spillways (Source: FFP 5 LLC, 2014; FFP 6 LLC, 2014; Solia 6 LLC, 2014).

Project	Minimum Discharge (cfs, one unit)	Maximum Discharge (cfs, one unit)	Number of Units	Maximum Discharge (cfs, total all units)	Average Lockage Flow (cfs)[a]	Existing Spillway Capacity (cfs, total)
Emsworth	450	4,500	4	18,000	870	97,648
Emsworth Back Channel	450	4,500	2	9,000	NA	55,254
Montgomery	1,000	10,000	3	30,000	1,350	177,000

[a] This value is the amount of lockage losses or continuous flow through lock chambers when the locks are closed.

The Emsworth, Emsworth Back Channel, and Montgomery Projects would produce an annual average of 101,300 MWh, 53,500 MWh, and 194,370 MWh of electricity, respectively.

2.2.6 Proposed Environmental Measures

In addition to the project design and operational measures described in the previous section, the applicant for each project proposes the following protection, mitigation, and enhancement (PM&E) measures to protect or enhance environmental resources and improve recreational opportunities. Unless otherwise noted, each PM&E measure applies to all three projects.

Geology and Soil Resources

- Develop an erosion and sedimentation control plan in consultation with the Corps and the Pennsylvania DEP that includes procedures and best management practices (BMPs) to reduce runoff and sedimentation during construction and final stabilization.

Aquatic Resources

- Develop a detailed soil disposal plan to ensure excavated sediment is handled and disposed of appropriately.

- Operate in a run-of-release mode to avoid project-related impacts on the Corps' operations of its facilities.

- Conduct 3 years of post-construction water quality monitoring from June through September to monitor for project effects on water quality.

- Install trash racks at the project intake with a 5-inch clear bar spacing, and provide approach velocities of less than 2 feet per second (fps) to mitigate for the entrainment and impingement of fish.

- When warranted and to the extent feasible, coordinate the timing of any construction-related hydraulic changes, such as changes in flow direction, to minimize effects on spawning fish and other aquatic organisms downstream of the project.

Terrestrial Resources

- Develop an avian protection plan consistent with Avian Power Line Interaction Committee (APLIC) and U.S. Fish and Wildlife Service (FWS) guidelines that includes provisions for protecting bald eagles, osprey, and other raptors from project-related effects.

- Develop a transmission line corridor management plan that includes provisions for protecting botanical resources from project-related effects and controlling invasive species along the transmission line right-of-way.

Recreation and Land Use

- Implement a recreation resource management plan at the Montgomery Project with provisions for installing a fishing platform downstream of the project's tailrace, designated parking, and an accessible walkway that leads from the designated parking area to the fishing platform.

Aesthetics

- Restore areas temporarily affected by construction activities to protect the sites' aesthetics.

- Remove and properly dispose of any non-organic debris or trash that is collected during trash rack cleaning.

Cultural Resources

- Prepare an HPMP in accordance with an anticipated PA between the Commission and the Pennsylvania SHPO.

2.3 STAFF ALTERNATIVE

Under the staff alternative, the projects would be constructed, operated, and maintained as proposed by the applicants, with the following modifications to the

applicants' proposals and some additional staff-recommended measures, which apply to all three projects unless otherwise noted.

- A contaminated sediment testing and disposal plan that includes the applicants' soil disposal plan, as well as provisions for testing sediment from the river bed to ensure sediment is handled and disposed consistent with state standards and to ensure minimal impacts of contaminated sediment on aquatic species and their habitat.

- An operation compliance monitoring plan to document compliance with the operating requirements of any licenses issued for the projects.

- A stand-alone spill prevention, containment, and countermeasures plan to guide the handling of hazardous substances and protect water quality and aquatic biota during project construction and operation.

- A water quality monitoring plan that includes the applicants' proposal to monitor water quality for 3 years post-construction and an additional provision to monitor water quality during construction.

- A vegetation management plan for each project that would apply the measures included in the applicants' transmission line corridor management plans to all project lands.

- A temporary staircase and fishing pier at the Montgomery Project that would provide access to anglers and minimize construction-related effects on angler use.

- A debris management plan that includes the applicants' proposed measures to remove and dispose of trash that accumulates upstream of the proposed projects' trash racks, as well as procedures that describe how debris would be sorted, stored, and disposed to minimize the effect of floating debris on local recreation and aesthetics.

- Execution and implementation of a PA that requires revision of the draft HPMP to address the management of historic properties and unevaluated cultural resources.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

In the final license applications, the applicants evaluated several alternatives at each dam, including: (1) placement of turbines in lock chambers; and (2) the use of a single large turbine unit. Placement of turbines in the lock chambers was eliminated

from further consideration because of potential impacts on navigation and recreation. The use of a single large turbine was eliminated because of the depth of excavation that would be required near the dam and spillway, and because a single turbine unit configuration would offer less operational and maintenance flexibility than multiple unit configurations.

In addition, the Corps indicated that developing all 10 of the proposed projects in the Ohio, Monongahela, and Allegheny Rivers may not be environmentally sustainable.[10] In its March 4, 2016, letter, the Corps recommends that the Commission prioritize a subset of the 10 proposed projects that would be considered in the alternatives analyses. Specifically, the Corps recommends that projects that support unique biological resources, provide greater aeration benefits (fixed-crest dams), and require substantial alteration of the Corps' facilities (i.e., projects that require in-river powerhouses and/or crest gates) should be prioritized for exclusion.

At least one or more of the Corps' exclusion criteria would apply to some degree at each of the Ohio River Projects and other proposed projects on the Monongahela and Allegheny Rivers. Based on the license applications, scoping comments, and other comments on the license applications, we have not identified any environmental issues that would preclude development of the proposed projects prior to our analysis. As such, we consider the proposed action, the staff alternative, and the no-action alternative (license denial) for each of the Ohio River Projects in *Section 3.0, Environmental Analysis,* of this document.

[10] Rye Development's other related projects in the Upper Ohio River Basin include, Opekiska Lock and Dam (P-13753), Morgantown Lock and Dam (P-13762), Point Marion Lock and Dam (P-13771), Grays Landing Lock and Dam (P-13763), Maxwell Locks and Dam (P-13766), and Charleroi Locks and Dam (P-13767) on the Monongahela River; and Allegheny Lock and Dam 2 (P-13755) on the Allegheny River.

3.0 ENVIRONMENTAL ANALYSIS

In this section, we present: (1) a general description of the project vicinities; (2) an explanation of the scope of our cumulative effects analysis; and (3) our analysis of the proposed action and other recommended environmental measures. Sections are organized by resource area. Under each resource area, historic and existing conditions are first described. The existing condition is the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of proposed PM&E measures, and any potential cumulative effects of the proposed action and alternatives. Staff conclusions and recommended measures are discussed in section 5.1, *Comprehensive Development and Recommended Alternative*, of this EA.[11]

3.1 GENERAL DESCRIPTION OF THE RIVER BASIN

The proposed Ohio River Projects would be located on the Ohio River in southwestern Pennsylvania. The Ohio River Basin has a total drainage area of 203,940 square miles; however, most of that drainage is located downstream of the proposed projects. The Allegheny and Monongahela Rivers are the primary tributaries of the Upper Ohio River with a total drainage area of 19,184 square miles.

The Monongahela, Allegheny, and Ohio Rivers flow into the Pittsburgh Low Plateau sections of the Appalachian Plateau province, where the proposed Ohio River Projects are located. Flood events are common in the rivers of the Appalachian Plateau because of the region's extreme dissection, high local relief, precipitous slopes, and narrow and discontinuous floodplains. This physiographic region is known as mostly unglaciated uplands with many streams forming a dendritic pattern (Pennsylvania FBC, 2011).

The dominant land use in the Upper Ohio River Basin is forest cover (Pennsylvania FBC, 2011). Most of the forest area comprises deciduous trees, whereas evergreen forests make up about 8 percent of the land cover. Agriculture, including both pasture and row crops, is the second highest land use. About 7 percent of the land is developed for residential and commercial uses. Most of the developed areas, and areas with more impervious surfaces, are concentrated in communities situated where the three rivers converge in Pittsburgh, Pennsylvania. The greater Pittsburgh metropolitan area has

[11] Unless otherwise indicated, our information is taken from the applications for license for these projects (FFP 5 LLC, 2014; FFP 6 LLC, 2014; and Solia 6 LLC, 2014) and additional information filed by the applicants as noted in section 7.0, *Literature Cited*.

a history of extractive mining; mining of coal, sand, and limestone and extraction of oil and natural gas are major industries, evidence of which can be seen along the river valleys (Pennsylvania FBC, 2011).

The Upper Ohio River Basin maintains a temperate climate pattern with a mean average temperature of 52 degrees Fahrenheit (°F), with average maximum temperatures ranging from 82.9°F in July to 17.3°F in February. Precipitation averages 38.2 inches per year, with most rain falling in the late spring and early summer. Snowfall in the area averages 35.2 inches per year, with the highest amount of snow falling in December and January.

3.2 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (40 CFR § 1508.7), a cumulative effect is 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 what agency (federal or non-federal) or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions taking place over time, including hydropower and other land and water development activities.

Based on our review of the license applications and agency and public comments, we identified aquatic resources (water quality, habitat, and aquatic species) as having the potential to be cumulatively affected by the proposed projects, in combination with other past, present, and foreseeable future activities. Aquatic resources were selected because construction and operation of the projects may affect water quality, especially DO concentrations, within and downstream of the project areas; and may affect aquatic species such as mussels, fish, and their habitat downstream, within, and upstream of the project areas. Other activities, in combination with the proposed actions, such as additional hydropower development, water withdrawals, wastewater discharges, and existing management of flows and water levels in the three rivers (Monongahela, Allegheny, and Ohio) and adjacent waterways may collectively affect aquatic resources in a portion of the Upper Ohio River Basin.

3.2.1 Geographic Scope

Our geographic scope of analysis for cumulatively affected resources is defined by the physical limits or boundaries of the proposed actions' effect on the resources, and contributing effects from other hydropower and non-hydropower activities within the Upper Ohio River Basin.

The geographic scope for aquatic resources includes a portion of the Upper Ohio River Basin; specifically, the most upstream 33 miles of the Ohio River, the most

downstream 17 miles of the Allegheny River, and the entire 128 miles of the Monongahela River. We chose this geographic scope because effects of the proposed projects in combination with other activities including proposed hydropower development in the basin would be limited to these areas. Any project-related effects on aquatic resources would not be discernable upstream or downstream of the defined geographic scope because potential effects would attenuate with increasing distance from the existing dams and any contribution to cumulative effects would be immeasurable.

3.2.2 Temporal Scope

The temporal scope of our cumulative effects analysis in the EA will include a discussion of past, present, and reasonably foreseeable future actions and their effects on each resource that could be cumulatively affected. Based on the potential term of original licenses issued at federal dams, the temporal scope will look 50 years into the future, concentrating on the effect on the resources from reasonably foreseeable future actions. The historical discussion will, by necessity, be limited to the amount of available information for each resource. The quality and quantity of information, however, diminishes as we analyze resources further away in time from the present.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

In this section, we discuss the effect of the project alternatives on environmental resources. For each resource, we first describe the affected environment, which is the existing condition and baseline against which we measure effects. We then discuss and analyze the site-specific and cumulative environmental issues.

Only the resources that would be affected, or about which comments have been received, are addressed in detail in this EA. We present our recommendations in section 5.1, *Comprehensive Development and Recommended Alternative.*

3.3.1 Geology and Soil Resources

3.3.1.1 Affected Environment

Geology

The Ohio River flows through the Appalachian Plateau Physiographic Province, a region that stretches from Alabama to New York. The Ohio River Projects would be located in the unglaciated regions of Pennsylvania, specifically, in the Pittsburgh Low Plateau Section of the province. This section is characterized by smooth hills and steep-sloped, narrow valleys. Within the narrow valleys, gradients of 45 degrees are common, and some may be as high as 600 feet between valley bottoms and upland surfaces. Elevations range from 660 feet to 1,700 feet.

Bedrock in the project areas consists of Upper Paleozoic (Pennsylvanian and Permian) sedimentary rocks (sandstone, siltstone, shale, claystone, and limestone). Sedimentary beds deposited during the Pennsylvanian age contain large bituminous coal seams in the western half of Pennsylvania, which includes the project areas. Deep mining is prevalent throughout the area, while strip mining is concentrated in areas south and west of the projects. Rock and gravel are also mined in the area.

The seismic hazard in the area is very low, with a peak horizontal ground acceleration of 2 percent g (percent of gravitational acceleration with a 10 percent probability of exceedance in 50 years).

Soils

Surface soils found at all three project sites consist of silt loams and urban lands (table 3-1). The urban land soils are highly disturbed from past industrial practices including mining, agriculture, and commercial industry. The surface soils are underlain predominantly by colluvium of Holocene and late and middle Pleistocene age. In addition, there are limited channel and floodplain alluvium and pre-Illinoian age deposits bordering the Ohio River. In general, soils in the vicinity of the projects are moderately to well-drained, but are susceptible to erosion and exhibit a high incidence of landslides. However, the riverbanks in most areas are protected by riprap and varying amounts of vegetation. Bank steepness varies among projects, with slopes ranging from 0 to 8 percent.

Table 3-1. Primary soil types found at each proposed project (Source: CDM Smith, 2014a).

	Project Name			
Soil Type	**Emsworth**	**Emsworth Back Channel**	**Montgomery**	**Soil Description**
Conotton Gravelly Loam			X	Very deep, well drained; 8 to 15 percent slopes.
Urban Land	X	X		Well drained; 0 to 8 percent slopes
Urban Land-Conotton Complex			X	Well drained; 0 to 8 percent slopes.
Urban Land-Culleoka Complex	X	X		Well drained; 0 to 8 percent slopes

	Project Name			
Soil Type	**Emsworth**	**Emsworth Back Channel**	**Montgomery**	**Soil Description**
Urban Land-Rainsboro Complex	X	X		Moderately well drained; 0 to 8 percent slopes
Weikert-Rock Outcrop Complex			X	Somewhat excessively drained; 25 to 80 percent slopes.
Conotton Gravelly Loam			X	Very deep, well drained; 8 to 15 percent slopes.
Urban Land	X	X		Well drained; 0 to 8 percent slopes

Sediment

Instream sediment types vary depending on streambed location. Main channel instream sediments predominantly consist of poorly graded gravel with sand, poorly graded gravel with silt and sand, and well graded gravel with sand. Scour and deposition occur immediately upstream and downstream of the Corps' dams during intermittent peak flow events.

In its January 9, 2014, comments on the draft license applications for the Ohio River Projects, the Corps states that fine-grained sediments upstream and downstream of its dams are likely to contain heavy metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds. The applicants collected and analyzed sediment core samples in 2013 from the proposed construction locations upstream and downstream of the existing dams at each project site. Instream sediments in the vicinity of the proposed intake channel, powerhouse, and tailrace predominantly consist of gravel mixed with fine sediments (clay and silt) (table 3-2). Samples taken at all three project sites contained PAHs at a concentration above the respective U.S. Environmental Protection Agency (EPA) sediment screening criteria (table 3-3).

Table 3-2. Grain size of instream sediments from core samples at proposed project sites (Source: CDM Smith, 2014a).

		Grain Size (in percent)							
		Gravel		Sand			Fines		
Project	**Location**	**Coarse**	**Fine**	**Coarse**	**Medium**	**Sand**	**Silt**	**Clay**	**Total**
Emsworth Back Channel[a]	US	-	-	-	-	-	-	-	-
	DS	37.1	29.3	12.1	12.6	6.7	2.2		100
Emsworth	US	31.0	30.6	5.2	7.1	15.5	7.7	2.9	100
	DS	0.0	33.5	20.5	26.7	17.0	2.3		100
Montgomery	US	16.0	37.7	10.2	22.6	7.9	5.6		100
	DS	28.9	19.3	10.3	20.7	13.7	5.4	1.7	100

Notes: US – upstream of Corps dam; DS – downstream of Corps dam

[a] Grain size data from samples collected upstream at Emsworth Back Channel were not provided in the source report.

Table 3-3. Contaminants in sediments in exceedance of EPA screening criteria (Source: CDM Smith, 2014a).

Project Location	**Contaminants in Exceedance of EPA Screening Criteria**
Emsworth Back Channel	PAHs: Phenanthrene
Emsworth	PAHs: Acenaphthene, fluoranthene, phenanthrene
Montgomery	PAHs: Phenanthrene

3.3.1.2 Environmental Effects

Construction Effects on Geology and Soils

Construction activities at each of the three Ohio River Projects would generally consist of constructing an intake channel, powerhouse, tailrace, substation, access road/parking lot, and transmission line. Construction of the projects would require excavation and disturbance of instream sediment and upland soils and would likely cause localized soil erosion, sedimentation, and streambed material transport. Sediment from the river bottom and upland construction sites could adversely affect water quality, resident aquatic species, and instream habitats and is discussed in section 3.3.2.2, *Aquatic Resources, Construction Effects on Water Quality*.

To reduce potential erosion and sedimentation impacts, the applicants propose to develop an erosion and sedimentation control plan for each project, in consultation with the Corps and Pennsylvania DEP, that includes procedures and BMPs to address sediment and erosion control during construction and final stabilization. The plan would include placement of turbidity curtains upstream and downstream of cofferdams, silt fencing, protection of temporarily disturbed ground, final stabilization, and measures to address the prevention and cleanup of spills of hazardous substances.

Our Analysis

Table 3-4 shows the estimated volume of material that would be excavated during construction of the intake channel and structure, powerhouse, and tailrace at each of the Ohio River Projects. Excavation of the riverbed, disturbance to shorelines, and installation/removal of cofferdams would likely cause erosion, resulting in a temporary increase in suspended sediment and turbidity in the Ohio River. High-flow events during construction could result in additional scour and suspended sediment in and downstream of the construction area. In addition, construction of the parking lots, access roads, substations, and transmission lines would disturb upland areas and potentially lead to erosion and additional sediment inputs to the river. Potential effects of suspended sediment and turbidity on aquatic resources and measures to address the prevention and cleanup of spills of hazardous substances are discussed in section 3.3.2.2, *Construction Effects on Water Quality*.

Table 3-4. Volume of excavated material at proposed project features (Source: applications; staff).

	Volume of Excavated Material Required for Proposed Project Facilities (estimate) (cubic yards)		
Project Location	**Intake Channel/Structure**	**Powerhouse**	**Tailrace**
Emsworth	34,700	19,600	44,780
Emsworth Back Channel	21,640	24,500	12,000
Montgomery	67,120	40,340	50,000

Installation of cofferdams and turbidity curtains would greatly reduce turbidity and sediment transport caused by in-river excavation activities. These structures would isolate the construction area from the river and minimize sediment and turbidity impacts throughout the construction phase. In upland areas, the applicants' proposed project designs incorporate the use of existing access roads and transmission line corridors to the extent possible. As described previously, much of the area that would be affected by

construction consists of previously disturbed areas with urban soil types. However, some land-clearing and disturbance of upland soils would occur during construction of the parking lots, access roads, substations, and transmission line corridors. Developing and implementing an erosion and sedimentation control plan in consultation with the Corps and Pennsylvania DEP, as the applicants propose, would minimize erosion and sedimentation during in-water and upland construction activities.

Operational Effects on Geology and Soils

Under existing conditions, the inflow to each of the Corps' facilities is released over the dam or through the locks. Flows over the dams are controlled by spillway gates that are repositioned on a daily basis to regulate discharge and maintain the desired pool elevation and corresponding navigational channel depth. In general, flow is released through gates in the center of the river first with additional gate openings as river flow increases in accordance with the Corps' operating schedule at each dam. Under the proposed operation at each project, water would be diverted through the powerhouse located downstream of the dam at the end opposite the existing locks. These proposed project operations would modify discharge patterns and hydrodynamics of the Ohio River upstream and downstream of each dam. Operation of the proposed projects could cause scour in the streambed immediately upstream of the intake and downstream from the proposed tailrace, change existing sediment patterns by redistributing lateral water velocities both upstream and downstream of the dam, and redistribute streambed materials to new locations.

Our Analysis

Based on data developed from the applicants' hydraulic modeling (CDM Smith, 2014b) and channel substrate surveys (CDM Smith, 2014a), project operation would result in increased water velocities within the immediate vicinities of the project intakes and tailraces, potentially increasing bed scour in these areas. The greatest change in water velocities, relative to existing conditions, would occur when most or all river flow is discharged through the powerhouse (i.e., when river flow matches hydraulic capacity of the projects). This effect would be attenuated as river flow increases beyond the hydraulic capacities of the projects as more flow would be released through the Corps' gates and discharge patterns similar to existing conditions would be restored. Overall, scour in the tailraces would occur primarily during initial operation of the powerhouses, and would diminish after the powerhouses have operated at their maximum hydraulic capacity for a short period.

Bed scour could also increase in the main channel during peak flow events because the proposed projects (i.e., powerhouses constructed in the river channel) would reduce channel width. Channel width would decrease by about 18 percent (180 feet) at the Emsworth Project, 12 percent (90 feet) at the Emsworth Back Channel Project, and

15 percent (205 feet) at the Montgomery Project immediately downstream of each dam, not considering the channel width for the locks at the respective projects. The proposed spill gates at each project would be designed to pass flow equal to the capacity of any obstructed Corps' gates, but scour could increase because of the decreased channel width, which would increase flow velocity, especially downstream of the gates that are immediately adjacent to the proposed spillway gates. The maximum scour of the existing streambed sediments would occur during the largest peak flow event. Once the riverbed has equilibrated to the new flow regime, scour of existing sediment would no longer occur, although scoured areas may temporarily fill in again with sediment during low-flow periods. Overall, changes to the existing sedimentation patterns associated with operation of the projects are expected to be minor. Sediments scoured in the immediate vicinities of the project intakes and tailraces, as well as in the main channel during a peak flow event, are not expected to be transported for long distances in the river considering that the existing river bottom consists primarily of gravel with larger substrate (cobble and boulder) near the dams as described in section 3.3.2.1, *Aquatic Resources, Affected Environment*. As such, the effect of resuspended sediment on turbidity levels in the river would be minor and short in duration.

Sediments near all projects contained PAHs at concentrations slightly above EPA sediment screening criteria. Potential impacts of project operation on the river sediment quality, however, are expected to be minimal because: (1) the river is expected to contain similar contaminants throughout its bed given the long industrial history of the area, (2) scoured sediment would generally be expected to resettle rapidly as described above, and (3) scour of existing sediments would be limited to the startup phase of a project (intake and tailrace scour) or to a peak flow event (main channel scour).

3.3.2 Aquatic Resources

3.3.2.1 Affected Environment

Water Quantity

The Ohio River is 981 miles long. It is formed by the confluence of the Allegheny and the Monongahela Rivers in Pittsburgh, Pennsylvania, and ends in Cairo, Illinois, where it flows into the Mississippi River. The Ohio River flows through or along the borders of Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia. The river has a drainage area of 203,940 square miles, encompassing the easternmost regions of the Mississippi River Basin. The majority of the Ohio River is controlled and maintained for navigation by a series of 21 locks and dams owned and operated by the Corps.

Table 3-5 shows the river miles of the existing locks and dams at or adjacent to the proposed projects on the Ohio River.

Table 3-5. Existing locks and dams at or adjacent to the Ohio River Projects (Source: staff).

Name	River	River Mile
Emsworth Locks and Dam	Ohio	6.2
Emsworth Back Channel Dam	Ohio	6.8
Dashields Locks and Dam	Ohio	13.3
Montgomery Locks and Dam	Ohio	31.7
New Cumberland Locks and Dam	Ohio	54.3

Table 3-6 shows the drainage area and daily flow (minimum, mean, and maximum) at each of the proposed project sites, table 3-7 shows 10-, 50-, and 90-percentile flows for the proposed project locations, and table 3-8 shows the monthly flow (mean) for each proposed project. Flow data are prorated based upon drainage areas and data obtained from nearby U.S. Geological Survey (USGS) stream gages.

Table 3-6. Drainage area and minimum, mean, and maximum daily flows at each of the proposed projects based on prorated stream gages (Source: FFP 5 LLC, 2014; FFP 6 LLC, 2014; and Solia 6 LLC, 2014).

Project Location	Drainage Area (square miles)	Lowest Daily Mean Flow (cfs)	Mean Daily Flow (cfs)	Highest Daily Mean Flow (cfs)	Period of Record
Emsworth[a]	19,428	2,229	23,636	241,903	(1995–2011)
Emsworth Back Channel[a]	19,428	1,061	11,246	115,097	(1995–2011)
Montgomery[b]	22,969	3,111	38,468	407,846	(1957–2011)

[a] Flow data developed using USGS gage 03086000, Ohio River at Sewickley, Pennsylvania (RM 13.3), and prorated based on drainage area difference between project and USGS gage.

[b] Flow data developed using USGS gages 03086000, Ohio River at Sewickley, Pennsylvania (RM 13.3), and 03107500, Beaver River at Beaver Falls, Pennsylvania (RM 5.5), and prorated based upon drainage area difference between project and the two USGS gages.

The Corps' operation of the Emsworth, Emsworth Back Channel, and Montgomery Dams is integrated with its operation of the other locks and dams on the river to maintain a minimum navigation channel depth of 9 feet. At each dam, gates are repositioned on a daily basis to regulate discharge and maintain the desired pool elevation and corresponding navigational channel depth. Factors that influence gate selection include controlling detrimental scour and shoaling, avoiding adverse effects on navigation, and managing debris passage. Under existing conditions, the inflow to each of the Corps' facilities is released over the dam or through the locks. In general, flow is released through gates in the center of the river first with additional gate openings as river flow increases in accordance with the Corps' operating schedule at each dam. Information describing lock flows is described in section 2.2.5, *Proposed Project Operation* (see table 2-1). Table 3-9 summarizes the existing median water surface elevation, surface area, and volume of the pools upstream of the Emsworth, Emsworth Back Channel, and Montgomery Dams.

Table 3-7. 10-, 50-, and 90-percentile flows (cfs) at each of the proposed projects (Source: CDM Smith, 2014b).

Project Location	**10-Percentile**	**50-Percentile**	**90-Percentile**
Emsworth	3,252	15,310	39,443
Emsworth Back Channel	3,252	9,756	34,518
Montgomery	8,028	28,155	80,665

Note: The percentile flows are defined as follows: (1) 10-percentile flow (low flow—the flow that is equaled or exceeded 90 percent of the time); (2) 50-percentile flow (moderate flow—the flow that is equaled or exceeded 50 percent of the time); and (3) 90-percentile flow (high flow—the flow that is equaled or exceeded 10 percent of the time).

Table 3-8. Mean monthly flow data (in cfs) for the proposed projects based on prorated stream gage data (Source: FFP 5 LLC, 2014; FFP 6 LLC, 2014; and Solia 6 LLC, 2014).

Project Location	Period of Record	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Emsworth	(1995-2011)	33,361	31,699	43,088	34,858	29,392	16,714	11,025	9,409	11,550	12,261	20,542	30,129
Emsworth Back Channel	(1995-2011)	15,934	15,083	20,501	16,586	13,984	7,952	5,246	4,626	5,496	5,834	9,774	14,335
Montgomery	(1995-2012)	57,638	52,638	71,269	56,272	49,354	28,375	18,797	16,599	19,816	20,683	33,966	51,440

Table 3-9. Upstream pool characteristics of the Emsworth, Emsworth Back Channel, and Montgomery Dams (Source: FFP 5 LLC, 2014; FFP 6 LLC, 2014; Solia 6 LLC, 2014).

Project Location	Existing Normal Water Surface Elevation (feet NGVD29)	Surface Area of Upstream Pool at Normal Elevation (acres)	Volume of Upstream Pool at Normal Elevation (acre-feet)
Emsworth	710	2,870	42,700
Emsworth Back Channel	710	2,870	42,700
Montgomery	682	2,990	57,500

Water Quality

By the early 1900s, the Upper Ohio River Basin was experiencing widespread habitat devastation and water quality degradation. Up until the 1970s, the convenience of using the Monongahela, Allegheny, and Ohio Rivers as a sink for decades of municipal and industrial wastes trumped requirements for potable water in western Pennsylvania. Mining has been identified as having the single greatest impact on surface water quality of any land use in the Monongahela, Allegheny, and Ohio Rivers (Pennsylvania FBC, 2011; Anderson et al., 2000). Concerted state and federal efforts since the 1970s, including reductions in industrial discharge, improvements in wastewater treatment, improvements in mine drainage treatment and low-flow augmentation, eventually led to tremendous improvement in river water quality (Anderson et al., 2000). Improved river water quality culminated in recoveries of fisheries, expressed as range expansions of native species, increases in fish population abundances, and a revival of angling opportunities within historically affected river reaches (Pennsylvania FBC, 2011).

Tables 3-10 and 3-11 present water quality standards and maximum allowable water temperature standards for the project areas, and table 3-12 lists the Pennsylvania-designated uses for the Ohio River in the vicinity of the projects.

The lower Allegheny River is listed as impaired for potable water supply because of pathogens and currently has a fish consumption advisory for PCB contamination that extends from the Allegheny Lock and Dam 2 downstream to the Montgomery Locks and Dam on the Ohio River (Pennsylvania DEP, 2016; 2014). The Ohio River within Pennsylvania is listed as impaired for fish consumption because of dioxins, for aquatic life because of siltation from road runoff, and for recreation because of pathogens (Pennsylvania DEP, 2014). Pennsylvania DEP has a water quality non-degradation policy that requires water quality be sufficient to maintain and protect the existing uses of all surface waters (Commonwealth of Pennsylvania, 2016).

Table 3-10. Pennsylvania water quality standards applicable to the waters within the vicinity of the proposed Ohio River Projects (Source: Commonwealth of Pennsylvania, 2016).

Parameter	Pennsylvania Criteria
Water temperature	See table 3-11
Dissolved oxygen	7-day average 5.5 mg/L; minimum 5.0 mg/L
Suspended solids and floating debris	Floating materials and substances that produce turbidity should be controlled
pH	From 6.0 to 9.0 inclusive

Table 3-11. Pennsylvania maximum allowable water temperature standards applicable to project waters (Source: Commonwealth of Pennsylvania, 2016).

	Maximum Allowable Temperature			Maximum Allowable Temperature	
Period	**°F**	**°C**	**Period**	**°F**	**°C**
January 1–31	40	4.4	Aug 1–15	87	30.5
February 1–29	40	4.4	Aug 16–31	87	30.5
March 1–31	46	7.8	Sept 1–15	84	28.9
April 1–15	52	11.1	Sept 16–30	78	25.6
April 16–30	58	14.4	Oct 1–15	72	22.2
May 1–15	64	17.8	Oct 16–31	66	18.9
May 16–31	72	22.2	Nov 1–15	58	14.4
June 1–15	80	26.7	Nov 16–30	50	10.0
June 16–30	84	28.9	Dec 1–31	42	5.6
July 1–31	87	30.5			

Table 3-12. Beneficial uses designated for the Ohio River near the proposed projects (Source: Commonwealth of Pennsylvania, 2016).

Category	**Use Designation**
Aquatic Life	Warmwater fishes
Water Supply	Potable water supply, industrial water supply, livestock water supply, wildlife water supply, irrigation
Recreation and Fish Consumption	Boating, fishing, water contact sports, aesthetics
Other	Navigation

The applicants conducted a water quality monitoring study that included collection of continuous temperature, DO concentration, and conductivity data at constant depths in the pools and tailraces and in an upstream background site from May to October 2013. The background site was located about 5 miles upstream of the Emsworth Project. In each pool, continuous meters were deployed at shallow (about 6 feet deep) and deep (about 11 to 26 feet deep) locations, with the exception of the Emsworth Back Channel pool, where a meter was deployed only in a shallow-water location. A suitable deep-water location, within 1 mile of the back channel dam, could not be accessed. In

addition, a meter was not deployed downstream of Emsworth Back Channel Dam because heavy commercial, construction, and recreational traffic created unsafe field conditions for field crews and monitoring equipment. The applicants collected monthly nutrient samples at the water surface upstream (in the pools) and downstream of each dam, and at the river background site from April to October 2013.

In addition to continuous water quality monitoring, the applicants collected depth profile data (temperature, DO concentration and percent saturation, and specific conductivity) biweekly in the pools upstream of each dam, and biweekly instantaneous water quality sampling (temperature, DO concentration and percent saturation, pH, specific conductivity, and turbidity) immediately upstream and downstream of each dam, throughout the study season. Downstream of Emsworth Back Channel Dam, field crews recorded weekly instantaneous measurements of temperature, DO, and specific conductivity to compensate for the lack of continuous monitoring data.

The applicants also modeled water quality (temperature and DO concentration) upstream and downstream of each dam with and without operation of the proposed projects for three different water years based on analysis of USGS flow data from 1939 to 2013: (1) dry year (1999); (2) average year (2009); and (3) wet year (2013). The modeling effort examined the proposed projects' effects on water quality, including cumulative effects, and the effects of various bypass flows[12] on DO concentrations downstream of each dam.

Dissolved Oxygen

Average DO concentrations at the Ohio River Projects ranged from 8.9 to 10.1 milligrams per liter (mg/L) during the monitoring period; the lowest concentration was 6.7 mg/L in the Emsworth pool. An aeration effect was observed downstream of the Corps' dams at all of the proposed project locations in 2013, with downstream DO levels 0.4 to 1.1 mg/L higher than upstream levels. Minor diel patterns were observed from June through August only at the Emsworth Project, with DO levels fluctuating 0.5 to 1 mg/L between night and day. Seasonal DO concentration patterns were indicative of typical conditions observed in temperate North American rivers with lower DO concentrations occurring during the warm summer months and higher DO concentrations occurring when water temperatures are cooler in the spring and fall. None of the pools stratified during the 2013 monitoring study.

[12] Bypass flow refers to water that would normally be used by the proposed hydroelectric project, but is instead passed through the Corps' gates or the applicants' proposed spill gates.

DO data collected by Pennsylvania DEP from October 2010 to March 2015 at locations near the Emsworth and Emsworth Back Channel Dams are available in the EPA STORET database (EPA, 2016). Samples were collected about 6 miles downstream of the Emsworth Locks and Dam in the middle of the river channel, and measured DO concentrations at this location were always above the minimum state standard of 5.0 mg/L.

The Ohio River Valley Water Sanitation Commission (ORSANCO)[13] has routinely collected DO data from May through October at the Montgomery Locks and Dam since 1998. A review of the database maintained by ORSANCO (2016a) indicates that DO concentrations at the Montgomery Locks and Dam have occasionally decreased below the state standard of 5.0 mg/L in May through October from 1998 through 2015. Minimum DO concentrations were lower than the state standard on 4 percent of the reported dates. However, on most of those dates the average and maximum concentrations exceeded the state standard.

The applicants' water quality modeling, discussed in more detail in section 3.3.2.2, *Operational Effects on Water Quality*, reflects the above field collection results. The modeled DO concentrations under existing conditions always met state standards at the Ohio River Projects. DO concentrations were typically lower in the average flow year than in the wet year, and lowest in the dry flow year.

Water Temperature

In the Ohio River, recorded water temperatures were almost always below the maximum state standards (table 3-11), with the exception of a 2-day period in early May at the location downstream of the Emsworth Locks and Dam that were slightly above the 64°F standard. The pools at Emsworth, Emsworth Back Channel, and Montgomery Locks and Dams did not stratify during 2013.

Nutrients

In general, nitrate+nitrite concentrations ranged from 0.47 to 0.93 mg/L. Total Kjeldahl nitrogen concentrations ranged from below the detection limit of 0.42 mg/L to 0.66 mg/L. Total phosphorus concentrations typically ranged between the detection limit of 0.014 and 0.130 mg/L. Chlorophyll-*a* concentrations overall were low in the spring and increased throughout the summer, ranging between 0.7 to 13 micrograms per liter.

---

[13] The Commonwealth of Pennsylvania is a member of ORSANCO, which is an interstate commission that was congressionally established in 1948 to coordinate the control and abatement of pollution in the Ohio River Basin.

Total suspended solids concentrations were highest in April, July, and September, ranging between the detection limit of 4 and 113 mg/L. Turbidity levels at the Corps' Emsworth, Emsworth Back Channel, and Montgomery Locks and Dams, based on biweekly field measurements, were typically below regulatory standards with the exception of occasional elevated levels above 50 nephelometric turbidity units during the summer, conceivably a result of rainfall events.

pH

The pH values measured near the proposed projects were always within state standards during the 2013 monitoring period, ranging from 6.4 to 8.3 during biweekly field measurements. Pennsylvania DEP measured similar values (range of 6.1 to 8.6) near the Emsworth Locks and Dam between 1998 and 2015 (EPA, 2016).

Aquatic Habitat

The Ohio River in the vicinity of the proposed projects is a low-gradient river impounded by a series of locks and dams. Short stretches of fast-moving water occur immediately below the dam spillways and near obstructions such as channel islands. Shallow water habitats include river shorelines, tributary mouths, and embayments, typically containing sand, gravel, and some cobble substrates. In addition to the locks and dams, other manmade structures in the rivers include bridges, piers, and other hardened shoreline features (e.g., riprap). Substrate composition in the vicinity of the proposed projects is variable within and across the sites. Table 3-13 lists the predominant substrates upstream and downstream of the Ohio River dams.

Table 3-13. Predominant substrates, listed in order of abundance, upstream and downstream of the proposed projects on the Ohio River (Source: Ecological Specialists, Inc., 2015).

Project Location	Upstream	Downstream
Emsworth	Boulder, cobble, sand	Boulder, cobble, sand
Emsworth Back Channel	Cobble, silt	Cobble, sand, gravel
Montgomery	Clay, sand	Cobble, boulder, gravel, sand

Substrate and fish habitat farther downstream of the Corps' dams is more uniform relative to tailwater habitat[14] at the dams. The Corps gate operations affect where water is released, thus water velocity and the location of suitable fish habitat in and near the tailwaters change with gate adjustments. Habitat in the vicinity of the tailwaters is primarily deep water of varying velocities, with some shallow, low-velocity habitat along the river banks and the shorelines of islands.[15] Shallow-fast habitat is primarily located immediately below the dams, but often consists of habitat with excessive turbulence and high velocities, which is not suitable for most fish. However, riverine fish are generally attracted to areas near the turbulent habitat downstream of the dams, because much of the adjacent area still provides suitable velocities and depths for these species. As such, many fish species, including important game fish such as walleye and smallmouth bass, often utilize the deep-water habitat near the proposed projects.

Fish Community

Decades of mining, agricultural, commercial, and industrial practices have affected the aquatic resources in the Ohio River, with a nearly total loss of fish and invertebrate communities by the mid-twentieth century (Pennsylvania FBC, 2011; Anderson et al., 2000). Substantial water quality improvement over the past 50 years, however, has improved aquatic community composition such that the Ohio River now supports a diverse, warmwater fish community. Lock chamber and nighttime pool electrofishing surveys, as well as other fishery sampling conducted by the Pennsylvania Fish and Boat Commission (Pennsylvania FBC), and available data in the ORSANCO database from 1967 to 2010 show a steady recovery of fish assemblages (ORSANCO, 2016b; Pennsylvania FBC, 2011).

The Ohio River currently supports at least 89 species of fish in Pennsylvania, including five state-listed as endangered (river shiner, black bullhead, bigmouth buffalo, warmouth, and longear sunfish) and one state-listed as threatened (spotted sucker) (Pennsylvania FBC, 2011). According to the electrofishing data collected by ORSANCO and Pennsylvania FBC, and provided by the applicants, gizzard shad, emerald shiner, smallmouth bass, bluegill, sauger, and freshwater drum are the most abundant species observed in the vicinity of the proposed projects. Gizzard shad appear to be the most

---

[14] Tailwater habitat refers to the reach and full width of the river immediately downstream of a dam, and not the more defined hydroelectric term of "tailrace," which refers to the channel (usually excavated) that receives discharges from the powerhouse.

[15] Shallow habitat refers to water depths less than 9 feet, and slow habitat refers to water velocities less than 1 fps. Similarly, deep habitat refers to water depths greater than 9 feet, and fast habitat refers to water velocities at or greater than 1 fps.

abundant fish in the area. High diversity (greater than 10 species) of minnows, suckers, sunfishes, and darters were observed in these reaches. Eighty-two species occur in the Emsworth and Montgomery pool areas (HDR, 2013), including three state-listed species (river shiner, redfin shiner, and longear sunfish), one candidate species (bowfin), and 17 remarkable species[16] (longnose gar, mooneye, skipjack herring, mimic shiner, silver chub, river carpsucker, smallmouth buffalo, smallmouth redhorse, brook silverside, largemouth bass, smallmouth bass, spotted bass, sauger, saugeye, walleye, logperch, and channel darter).

Pennsylvania FBC manages the popular sport fishery in the Upper Ohio River Basin, which includes targeted fish species such as smallmouth bass, walleye, and catfish. Pennsylvania FBC stocks hybrid striped bass, tiger muskellunge and muskellunge, and paddlefish in the basin. There are no anadromous or catadromous fish present in the Upper Ohio River Basin. Some resident freshwater fish may migrate between pools and between the river and tributaries or lakes for spawning, foraging, or overwintering. Movement of fish is partially restricted by the lock and dam structures on the Ohio River, but fish movement between pools can occur via the locks and gate releases.

Mussels

Mussels, like fish species, have historically suffered from degraded water quality and habitat in the Ohio River. In the early 1900s, freshwater mussels were rare or absent, and these conditions persisted up to the 1960s, with some improvements in the 1970s and 1980s, and significant improvements over the past two decades (Anderson et al., 2000).

A series of mussel surveys throughout the Upper Ohio River Basin from 1980 to 1989 identified 33 species (Taylor, 1989). Taylor (1989) noted that, occasionally, healthy populations could be found, but much of the Upper Ohio River was devoid of mussel life. However, little information is available for the last 25 years on mussels in the immediate project areas of the Ohio River.

The applicants conducted semi-quantitative mussel surveys in the summer of 2013 upstream and downstream of the proposed projects (Ecological Specialists, Inc., 2015). Specifically, biologists conducted surveys by scuba diving along transects in a sampling area, generally 656 feet upstream of the dams to 2,500 feet downstream, although actual

[16] Pennsylvania FBC considers remarkable species to be fish species that are: (1) previously or currently protected under 58 Pennsylvania Code Chapter 75; (2) sport fish species maintained by natural reproduction; (3) species classified as pollution intolerant by ORSANCO; or (4) collected for the first time in Pennsylvania or not typically collected with any regularity (Pennsylvania FBC, 2011).

sampling areas spanned a greater area at some projects. Seven transects were placed downstream of each dam and typically spanned the length of the river, except near the dam where hydraulic conditions precluded bank-to-bank transects. Two 100-meter-long transects, perpendicular to the bank, were placed upstream of each dam and the proposed project facilities.

Table 3-14 shows the abundance of live mussel species collected during these surveys. Where mussels were observed, distribution was generally patchy, except for a mussel bed about one-third of a mile downstream of the Emsworth Locks and Dam, along the north shoreline of Neville Island. In general, species abundance and diversity was higher downstream of the locks and dams than upstream. The invasive zebra mussel was observed at every site. No federally listed or Pennsylvania state-listed species were collected.

Table 3-14. Native mussel species collected in the vicinity of the proposed Ohio River Projects during mussel surveys conducted in 2013 (Source: Ecological Specialists, Inc., 2015, as modified by staff).

Species	Emsworth	Emsworth Back Channel	Montgomery
Lampsilinae			
Pink heelsplitter	46	12	91
Pocketbook	-	-	1
Fragile papershell	3	-	-
Plain pocketbook	-	1	-
Threehorn wartyback	58	3	49
Black sandshell	3	3	12
Ambleminae			
Mapleleaf	102	10	107
Pimpleback	-	1	-
Anodontinae			
White heelsplitter	1	-	8
Giant floater	1	-	-
Flat floater	-	-	5
Total abundance	214	30	273
Total species	7	6	7
No. per 10 m^2	0.49	0.23	0.93

Species	Emsworth	Emsworth Back Channel	Montgomery
Percent ≥5 years old	12	2	8

Macroinvertebrates

Benthic macroinvertebrates are a diverse and typically abundant group of organisms with very specific habitat preferences. Many species are sensitive to environmental conditions and stresses and intolerant of specific pollution sources. Therefore, benthic communities are excellent indicators of both water quality and biological integrity. ORSANCO has routinely collected macroinvertebrate samples from the Ohio River since the mid-1960s using a variety of methods (ORSANCO, 2016c).

In 2007, ORSANCO began a study to determine which method or combination of methods is the most appropriate for characterizing Ohio River macroinvertebrate communities (Argo, 2014). This study allowed for the creation of multi-metric macroinvertebrate indices to assess water quality in the Ohio River. Multi-metric indices typically consist of evaluating biological data (i.e., species diversity, richness, and abundance) based on defined gradients or categories (i.e., percent pollutant-tolerant, percent herbivore), and are used by federal, state, and local agencies and groups to assess the overall ecological health of a system in terms of its ability to support aquatic wildlife. Overall condition ratings were based on a calculated Ohio River macroinvertebrate index score and include: "excellent" (50–60), "very good" (40–50), "good" (30–40), "fair" (20–30), "poor" (10–20), and "very poor" (0–10).

ORSANCO sampled the Montgomery pool area of the Ohio River in 2010 using Hester-Dendy samplers[17] deployed in shallow (3-foot contour) and deep (10-foot contour) water, and multi-habitat sweeps that consisted of 10 one-meter (3.28 feet) D-net samples.[18] Investigators collected 18 species in the shallow samples, where midge species were dominant; 12 species in the deep samples, where midge species again were dominant; and 25 species by the multi-habitat sweep samples, where mayflies were dominant. In 2012, investigators used similar methods, with the exception of shallow

[17] A Hester-Dendy sampler consists of several thin (typically 1/8-inch thick) square or round plates secured onto an eyebolt and individually separated by spacers. Multiple samplers are secured to a weighted block and deployed in the water, to provide a substrate for colonization by resident macroinvertebrates.

[18] A D-shaped net is manually swept through or dipped into habitat areas while substrate is suspended via kicking motions.

Hester-Dendy sampling, to survey the Emsworth pool. Deep Hester-Dendy samples accounted for 47 species, where midges were dominant, and multi-habitat sweep samples collected 46 species, where *Gyraulus* snails were dominant.

The condition of the Montgomery and Emsworth pools was assessed using the same methods in 2010 and 2012, respectively; however, shallow Hester-Dendy samples were not used, and only an assessment based on the combination of deep Hester-Dendy and multi-habitat sweeps was completed (Rye Development, 2015a; Argo, 2014). Based on this assessment, the Montgomery pool, from 1.0 RM upstream of the Montgomery Locks and Dam to 1.5 RM downstream from the Dashields Locks and Dam, received a condition rating of "good." The Emsworth pool extending downstream 1.8 RM from the confluence of the Allegheny and Monongahela Rivers received a condition rating of "poor." The Emsworth pool extending 5.2 RM upstream into the Allegheny River received a condition rating of "fair." The Emsworth pool extending 8.7 RM upstream into the Monongahela River received a condition rating of "good."

3.3.2.2 Environmental Effects

Water Quantity

Construction Effects on Water Quantity

Construction would involve temporary placement of cofferdams around each intake channel and proposed powerhouse downstream of the dams. Cofferdams would obstruct discharges from some Corps' gates and temporarily alter hydraulic conditions (e.g., discharge location, water surface elevation, and flow velocity and direction) upstream and downstream of the dams. Specifically, operation and flow through the Corps' gates immediately adjacent to and upstream of the proposed intake channel and new spill gates would be restricted during construction, and other, unobstructed, gates would require larger openings to pass river flows. During construction of the powerhouse, all of the Corps' spillway gates and the projects' new spill gates would be available to pass flows.

The applicants propose to sequence construction times to minimize construction-related hydraulic effects during seasons when spawning fish and other aquatic resources may be particularly sensitive. In addition, at the scoping meeting on October 10, 2014, Rye Development indicated that the applicants would defer to the Corps regarding gate operation during project construction.

The Corps, in its November 6, 2014, scoping comments, indicates that gate schedules during construction would be site-specific, and suggests that flows could be directed through the center of the remaining unobstructed gates. The Corps also states that all gates may be opened to pass high flows and that the applicants' construction plans should consider forecasted river conditions.

Our Analysis

At each proposed project, under all flow conditions, the gate closest to the existing lock would typically be opened last. Use of the gate(s) farthest from the locks would be restricted during construction, increasing the flow volume passing through the remaining spillway gates and likely shifting flow towards the middle of the river and the lock side of the Corps' facility. The use of fewer gates would cause the average water velocities upstream and downstream of the unobstructed portion of each dam to increase slightly, relative to existing flow releases, and would alter fish habitat and river conditions for navigation (i.e., velocities near the locks). The slight increase in velocity, however, would only occur near the Corps' gates and would quickly dissipate downstream. Therefore, velocity near the locks and throughout a majority of the dams' tailwaters would not likely exceed existing conditions (0 to about 5 fps depending on river flow and gate openings) currently experienced by aquatic species, barges, or recreational vessels. Table 3-15 shows the proposed gate restrictions during construction at the dams.

Table 3-15. Spillway gate schedules and discharge capacities at Emsworth, Emsworth Back Channel, and Montgomery Dams under existing conditions and during the project construction period when cofferdams are in place (Source: staff).

Project	Existing Gate Schedule[a]	Maximum Existing Gate Discharge Capacity	Proposed Gate Restriction during Construction[b]	Gate Discharge Capacity during Construction
Emsworth	8, 5, 4, 6, 3, 7, 2, 1	97,648	6, 7	73,425
Emsworth Back Channel	14, 9, 12, 11, 13, 10	55,254	9, 10	36,667
Montgomery	6, 5, 7, 4, 8, 3, 9, 2, 10, 1	177,000	9, 10	140,800

[a] Gate numbering starts adjacent to lock, and gates are opened in the order shown.
[b] Gate restriction would occur during cofferdam installation, intake channel and spill gate construction, and cofferdam removal.

Proposed gate restrictions and obstructions caused by cofferdams during project construction could reduce spillway capacity at all dams. A reduction in spillway capacity would raise pool elevations when flows exceed the gate discharge capacity during construction (table 3-15). River flows would rarely approach spillway capacity at the dams, however, even if some gates were completely obstructed and unavailable during construction (table 3-16). At all three projects, river flows would have no more than a 1 percent chance of approaching the available spillway capacity from June through

October. Ultimately, the Corps would determine both the timing of construction and gate schedules during construction of the proposed projects.

Table 3-16. Percent of time river flow equals or exceeds the maximum spillway capacity that would be available during construction when cofferdams are in place (Source: staff).

	Percent of Time that Available Spillway Capacity would be Exceeded during construction		
Month	**Emsworth**	**Emsworth Back Channel**	**Montgomery**
January	8	6	3
February	3	3	4
March	12	8	6
April	5	4	4
May	4	4	2
June	< 1	< 1	1
July	< 1	< 1	< 1
August	< 1	< 1	< 1
September	1	< 1	< 1
October	< 1	< 1	< 1
November	2	1	< 1
December	4	2	1

Operational Effects on Water Quantity

Operation of the projects in run-of-release mode[19] as proposed would not alter water levels or the quantity or timing of flows that pass each dam, but project operation would alter hydraulic conditions (e.g., flow distribution) in some areas close to the dams. To maintain the existing hydraulic capacity at each dam, the applicants propose to install spill gates in the intake channel (forebay) of each proposed powerhouse. These gates would discharge flow at a 45 degree downstream angle at the Emsworth and Emsworth

[19] Although the applicants describe their proposed operating mode as run-of-river, it is better defined as run-of-release because the Corps would determine how much water is made available to the projects.

Back Channel Projects and perpendicular to the shoreline at the Montgomery Project. The gates would be designed to pass the full hydraulic capacity of any gates obstructed by the proposed powerhouse. When river flow is less than the minimum hydraulic capacity required to operate one unit or when high water levels preclude project operation, the powerhouse would be shut down, and all flows would be passed through the Corps' gates and the proposed spill gates, as directed by the Corps.[20]

In its comments filed on March 4, 2016, the Corps states that the proposed project operation must not impact the navigation channel, pool elevations, or operation of the locks and dams. In addition, Interior (10(j) recommendation 1) recommends that the projects operate in a run-of-river mode, and provide minimum bypass flows through the dam gates or over dam spillways during all months of the year. Pennsylvania FBC also recommends the proposed projects operate in run-of-river mode to avoid impacts on water levels and protect fish and wildlife habitat.

Our Analysis

At the Emsworth and Emsworth Back Channel Locks and Dams, under existing low and moderate flow conditions (table 3-7 defines low, moderate, and high flow conditions for each dam), the Corps generally releases most flow from a gate on the opposite side of the river from the locks and distributes flow releases more evenly across the width of the spillways under higher flow conditions. At the Montgomery Lock and Dam, the Corps releases most flow from a gate in the center of the river and distributes flow releases more evenly across the width of the spillway under higher flow conditions. Under the proposed operation, when river flows are within the hydraulic capacity of the proposed projects (450 to 18,000 cubic feet per second [cfs] at the Emsworth Project, 450 to 9,000 cfs at Emsworth Back Channel Project, and 1,000 to 30,000 cfs at Montgomery Project), most or all of the flow would typically pass through the powerhouses, all of which would be located on the opposite side of the river from the locks. The powerhouse tailraces at the Ohio River Projects would discharge flow approximately parallel to the shoreline. When the spill gates installed in the project intake channels at the three Ohio River Projects are in use, they would discharge flow towards the center of the river.

[20] A detailed description of each project's proposed operation is provided in section 2.2.5, *Proposed Project Operation*.

A two-dimensional hydraulic modeling software, ADH,[21] which was developed by the Corps' Coastal and Hydraulics Laboratory, was used to simulate the effects of project operation on the velocity distribution upstream and downstream of the dams (CDM Smith, 2014b). Under existing conditions, water velocities upstream of each dam typically range between 0.5 and 1.0 fps, with higher velocities up to 5.0 fps in localized areas near the open gates. Existing velocities are between 0.5 and 3.0 fps downstream of the dams, with higher velocities up to 7.0 fps immediately downstream of the open gates. When the proposed projects are operating, areas of localized high velocities would form upstream of the proposed intakes, in and downstream of the proposed tailraces, and upstream and downstream of the proposed spill gates. Velocities in these areas are predicted to increase by 2.0 to 4.0 fps during moderate to high flow conditions (25,000 to 74,000 cfs at the Emsworth and Emsworth Back Channel Projects and 32,000 to 81,000 cfs at the Montgomery Project). Model results indicate that velocity changes in excess of 0.1 fps caused by project operation would extend no more than 1,410 feet upstream of the dams and no more than 9,000 feet downstream of the dams. In addition, velocities in the vicinity of the locks at Emsworth and Montgomery Dams would remain relatively unchanged or decrease under all flow conditions whether or not the projects are operating. Therefore, commercial navigation and recreational boat traffic should not be affected by the operation of the proposed Emsworth and Montgomery Projects. Effects of the proposed projects' operations on aquatic organisms and habitat are discussed below in *Operational Effects on Aquatic Organisms and Habitat*.

The applicants state that project operations would not alter water levels upstream of any of the Corps' dams. However, the applicants' hydraulic modeling (CDM Smith, 2014b) indicates that the maximum hydraulic capacity of the Emsworth Back Channel Dam would be slightly lowered (by about 2,700 cfs) by the current design of the proposed spill gates,[22] which could have an effect on upstream water levels when flow exceeds the maximum capacity of the dam and proposed project (52,531 cfs or greater). The applicants' hydraulic modeling also showed that project operation could result in small increases in water surface elevations downstream of the Corps' gate closest to the proposed powerhouse at all dams. Table 3-17 presents modeled upstream and

---

[21] ADH is a state-of-the-art adaptive hydraulic modeling system capable of handling both saturated and unsaturated groundwater, overland flow, and two- or three-dimensional shallow water problems. ADH uses adaptive numerical meshes that can be employed to improve model accuracy without sacrificing efficiency.

[22] *See* pages 4-28 to 4-32 of the Water Quality, Hydraulics, and Aquatic Habitat study report (appendix c-1 of the final license application – volume II) filed on March 14, 2014. The results indicate that the proposed Emsworth Back Channel Project would reduce capacity of the Emsworth Back Channel Dam from 55,254 to 52,531 cfs.

downstream pool elevations for existing and proposed conditions under moderate flow conditions (i.e., 50-percentile flows).

Table 3-17. Modeled upstream and downstream pool elevations for existing and proposed conditions under moderate (50-percentile) flow conditions (Source: FFP 5 LLC, 2014; FFP 6 LLC, 2014; and Solia 6 LLC, 2014, as modified by staff).

	Pool Elevation (feet)		
Condition	**Emsworth**	**Emsworth Back Channel**	**Montgomery**
Upstream for existing condition	710.1	710.1	682.0
Upstream for proposed condition	710.1	710.1	682.0
Downstream for existing condition	704.1	705.5	679.8
Downstream for proposed condition-turbines on	704.6	705.7	679.7
Downstream for proposed condition-turbines off	704.7	705.8	679.9

Any changes in water surface elevation downstream of the dams would be limited to an area immediately downstream of the dam and would be minor. In addition, upstream water surface elevations should not be affected by the Montgomery and Emsworth Projects. At the Emsworth Back Channel Project, modeling indicates that the existing configuration of the proposed spill gates may increase upstream water surface elevations when flows exceed 52,531 cfs. The applicants' hydraulic modeling study suggests that the proposed spill gates may need to be resized to ensure that the Corps' capacity and upstream water surface elevations would not be affected. In addition, the modeling suggests the proposed spill gates would impede the hydraulic capacity of the Corps' adjacent gate (i.e., gate 10 next to the proposed spill gates). We find that extending the proposed length of the intake channel length could minimize effects on the maximum hydraulic capacity of the Emsworth Back Channel Dam.

Regardless of the modeling results, the applicants propose to operate in run-of-release mode, which would not manipulate total river flow or pool elevations. If run-of-release operation was included in any licenses issued by the Commission, the applicants would be required to modify project designs to accommodate run-of-release operation, as needed. Under this mode of operation, the projects would only be able to generate off of flows made available to them by the Corps and any releases through existing or newly

constructed gates would be at the sole discretion of the Corps. In addition, Commission licenses for non-federal projects at Corps dams require the Corps' final written approval before construction may begin, as well as an operating MOA between the licensee and the Corps. The operating MOA for each project describes the mode of hydropower operation, pool flow diversion, and regulation requirements for the Corps' project, and integration of operation of the hydroelectric facility into the Corps' emergency action plan. The MOA would describe the detailed operation of the project acceptable to the Corps and any restrictions needed to protect the purposes of the Corps' project for navigation. Developing an operation compliance monitoring plan would help to ensure compliance with the operating requirements, including the MOA, of any licenses issued for the projects by including provisions for documenting compliance with any of the Corps' operating requirements included in a license, and establishing a schedule for reporting project compliance/non-compliance with the operating requirements during normal operation and emergencies. Operation of the Ohio River Projects in accordance with MOAs between the applicants and the Corps and developing operation compliance monitoring plans would ensure run-of-release operation and minimize impacts on pool elevations, navigation, water quality, and aquatic resources.

Water Quality

Construction Effects on Water Quality

Proposed project facilities would require in-water construction (cofferdam installation and removal, excavation of intake channels and tailraces, and powerhouse construction), and some land disturbance (construction of the project access roads, parking lots, substations, and transmission lines). Both in-water and on-land construction activities may increase turbidity levels near the proposed projects, depending on the effectiveness of proposed erosion and sedimentation control measures.

Installation and removal of the temporary cofferdams and dredging activities at each of the proposed projects could result in disturbance of contaminated sediment, including suspending sediment and redistributing contaminants to downstream locations. River sediment samples collected by the applicants in the vicinity of the proposed projects contained PAHs at concentrations that exceeded EPA sediment screening criteria.[23] As such, construction activities may result in redistribution of contaminated river sediment during cofferdam installation, excavation, or spoil disposal.

Construction of the proposed projects would also require the use of an assortment of heavy equipment (e.g., bulldozers, dump trucks, and tractors). This equipment would

[23] Table 3-3, section 3.3.1.1, *Geology and Soils, Affected Environment*.

require fuel (diesel and gasoline), motor oil, hydraulic fluid, and other lubricants. The construction contractor(s) may also wish to store fuels and other hydrocarbons on site and may elect to perform some routine maintenance in the general project area. On-site fuel storage facilities for a project of this type are commonly in the range of several hundred to several thousand gallons of fuel, along with the lesser amounts of motor oil, hydraulic fluid, and lubricants. The presence of these materials would create a risk of accidental release of hydrocarbons, with the potential for contamination of area waterways. In addition, the turbine units and transformers used at the project may contain petroleum-based oils or other substances that could be released into the river in the event of catastrophic equipment failure. All types of freshwater organisms as well as mammals, insects, microorganisms, and vegetation are susceptible to the effects of spilled hydrocarbons. In addition, the effects of spilled hydrocarbons on freshwater microorganisms, invertebrates, and algae tend to move up the food chain and affect other organisms. Depending on the nature of a spill, the potential contaminant may also be toxic to the water supply of local communities.

The applicants propose several measures as part of an erosion and sedimentation control plan to be developed at each project in consultation with the Corps and the Pennsylvania DEP that include procedures and BMPs to prevent pollution, minimize erosion, contain sediments, minimize the potential for spills of hazardous substances, and stabilize soils after construction is complete. In addition, the applicants propose to develop a detailed soil disposal plan and dispose of excavated sediment at a designated disposal site.

In its comments filed on March 4, 2016, the Corps states that it would require continuously recorded water quality monitoring downstream and possibly upstream of each hydropower project during construction and operation. The Corps also states that all water quality monitoring data would be required to be available in real-time on the same website and web server, to ensure continual, real-time compliance with non-degradation criteria.

Our Analysis

During project construction, all river flow would continue to be passed through the existing gates of each dam that are not affected by construction activities. Although some gate use would be precluded or restricted during construction, the volume or depth of withdrawal of flows released over each dam would not change. Therefore, construction of the proposed projects should not affect existing upstream or downstream DO concentrations or water temperatures.

Construction would likely temporarily increase turbidity because of cofferdam installation and removal. These effects, however, would be minimized by turbidity curtains, and would be minor and limited to the period and area of construction.

Disturbance to adjacent lands along the shorelines, including road and parking lot construction, could also result in increased runoff and sedimentation. BMPs and measures such as silt fencing and final site stabilization, as proposed in the applicants' erosion and sedimentation control plans, would minimize these effects. If barges are used during construction, sediment could be disturbed and suspended, particularly at the Emsworth Back Channel and Montgomery Projects, each of which have areas of sand near the proposed tailrace area. Existing barge traffic through the Corps' locks routinely causes sediment resuspension and temporary increases in turbidity, so aquatic organisms in the Ohio River near the lock and dams would be accustomed to these short-term effects.

As described above in section 3.3.1.2, *Construction Effects on Geology and Soils.* An erosion and sedimentation control plan at each project, developed in consultation with the agencies, as the applicants propose, would minimize construction-related effects on water quality. In addition, implementing a water quality monitoring plan during construction would allow for immediate identification of water quality deviations, such as turbidity level increases within the immediate area, and would inform any actions needed to minimize erosion and sedimentation impacts. Appropriate monitoring parameters would include turbidity, water temperature, and DO. While temperature and DO would unlikely be affected by construction activities, additional collection of temperature and DO data would provide additional baseline data for comparison to data collected during project operation.

Construction and operation of the proposed projects could result in the release of lubricants or other toxic substances into the Ohio River, adversely affecting water quality and aquatic and terrestrial resources. Use of commonly accepted BMPs during construction and operation would likely minimize this risk because they would require contractors to comply with current regulations applicable to the use of construction equipment near flowing waters.

For example, these specifications could include: (1) intercepting and controlling accidental oil, gas, or electrical component releases through daily inspections and placing barriers around all mechanical and electrical equipment when not mobile; (2) removing and disposing of any spilled material in accordance with appropriate regulations; (3) storing fuel and other hydrocarbons in areas away from waterways; (4) appropriate primary and secondary containment for all fuel and hydrocarbons stored on site to reduce the likelihood of accidental releases that would directly or indirectly contaminate drainage ways; (5) treatment and infiltration of construction-associated wastewater back into the Ohio River only if adequate pretreatment results in water quality consistent with existing state water quality standards; and (6) provisions for emergency response, agency notification procedures, and the availability of onsite equipment to contain spills.

While there still would be some risk for accidental introduction of hydrocarbons into the Ohio River during the construction and operation of the proposed project, the potential adverse effects that spills could have on water quality would be greatly reduced by implementing an appropriate plan, independent of the proposed erosion and sedimentation control plan, for handling hazardous substances. The plan could also serve as a reference for procedures to be followed in the event of a hazardous materials spill, further minimizing the effects on water quality.

Disposing of contaminated sediment at a designated site, as the applicants propose, should limit potential effects of contaminated sediment; however, the applicants indicated that some excavated material may be used on site during construction.[24] In addition, the applicants did not indicate how a designated disposal site would be chosen, whether temporary on-site storage is needed, or how contaminated sediments would be identified. Developing a contaminated sediment testing and disposal plan for each project, in consultation with the Corps and Pennsylvania DEP, which includes the applicants' soil disposal plan measures as well as a requirement for testing sediment from the river bed, would ensure proper handling and disposal of contaminated excavated materials. The contaminated sediment testing and soil disposal plan should include: (1) a description of proposed sampling sites and sampling frequency; (2) a description of sampling methodologies and the types of contaminants to be tested for; (3) a description of the measures to be implemented to minimize suspension of contaminated sediments; (4) a description of the process for removing, handling, and disposing of contaminated soils/sediments; (5) a provision to provide all testing results to Pennsylvania DEP; and (6) an implementation schedule. Sediment testing should be representative of the excavation area, excavation depth, and contaminants observed in the watershed during sampling for the projects' final license applications.

Operational Effects on Water Quality

The applicants propose to divert a portion of the river flow currently passing over the spillways of the Corps' dams through the proposed powerhouses. Current spillage provides some aeration, and redirecting flow into the powerhouses would reduce the amount of aeration that occurs at each dam, potentially reducing downstream DO concentrations. Decreased DO concentrations could, in turn, adversely affect aquatic species, including fish and freshwater mussels (e.g., mortality, reduced growth, and spawning success).

[24] *See* page 17 of the applicants' letter in response to the Commission's request for additional information filed on September 18, 2015.

The applicants propose to conduct 3 years of post-construction water quality monitoring from June through September to monitor for project effects on water quality.

Interior (10(j) recommendation 1) recommends year-round bypass flows to protect fish and wildlife habitat. In addition, Interior recommends post-construction water quality monitoring at all three projects, but does not specify how many years the monitoring should be performed. Pennsylvania FBC also recommends water quality monitoring at the three projects and that the projects adhere to a non-degradation standard determined by the Corps. Pennsylvania FBC also includes a condition that, if the DO standard recommended by the Corps is not met, measures to increase DO (such as increasing bypass flows) must be implemented immediately. Ecosophic Strategies, LLC, recommends a DO non-degradation standard of 6.5 mg/L or higher if the agencies recommend a higher standard.

The Corps states that continuously recorded, water quality monitoring would be required downstream and possibly upstream of each hydropower project during construction and operation. The Corps states that it would require monitoring throughout the term of the license, year-round during the first 3 years of operation, and possibly reduced to a May through November period afterwards based on monitoring results. The Corps also states that all water quality monitoring data would be required to be available in real-time on the same website and web server, to ensure continual, real-time compliance with non-degradation criteria. Finally, the Corps states that an adaptive management approach to maintaining existing water quality and aquatic life conditions would be required, which would include compliance with non-degradation water quality and aquatic life criteria and higher bypass flows if/when criteria are not being met.

Our Analysis

To evaluate the effects of the proposed Ohio River Projects on water quality downstream of the Corps' dams, the applicants conducted water quality modeling as part of their *Water Quality, Hydraulics, and Aquatic Habitat Study* (CDM Smith, 2014b). The study used a two-dimensional (longitudinal-vertical) CE-QUAL-W2 model[25] to simulate DO concentrations downstream of each proposed project from March 1 through October, with focus on the June 15 to October 15 period, during a wet year (2013), average year (2009), and a dry year (1999). The model did not include the period of November through February because DO concentrations are typically near saturation in

[25] The CE-QUAL-W2 model is commonly used by the Corps, EPA, and USGS to simulate hydrodynamics, water temperature, and water quality constituents including DO, nutrients, organic matter and suspended solids in rivers, lakes, reservoirs, estuaries and combinations thereof.

rivers of temperate climates during the winter period. The results indicate that proposed project operations would generally result in small decreases in the minimum DO concentrations downstream of the Ohio River Projects (0.37 to 0.92 mg/L in a wet year, 0.29 to 0.50 mg/L in an average year, with a range of a decrease of 0.90 to an increase of 0.39 mg/L in a dry year) relative to simulated baseline conditions (table 3-18).[26] While these results indicate that the reduction in DO would be similar in wet, average, and dry years, the pre-project (starting) DO concentrations are high, so modeled DO levels with the projects operating always would remain above state standards. The lowest modeled DO concentration occurred during a wet year (7.87 mg/L) at the Emsworth Project, and the model predicts that minimum DO levels would also not fall below state standards in an average or dry water year at any of the projects.

Table 3-18. Modeled DO concentrations (mg/L) downstream of the proposed Ohio River Projects for a wet year (2013), average year (2009), and dry year (1999) under existing and proposed operating conditions, from June 15 to October 15 (Source: Rye Development, 2015a, 2014, as modified by staff).

		Minimum Instantaneous DO Concentration (mg/L)	
Hydrology	**Project**	**Pre-project**	**Post-project**
Wet year (2013)	Emsworth	8.24	7.87
	Emsworth Back Channel	8.15	7.91
	Montgomery	9.13	8.21
Average year (2009)	Emsworth	8.49	8.12
	Emsworth Back Channel	8.42	8.13
	Montgomery	9.35	8.85
Dry year (1999)	Emsworth	8.34	8.67
	Emsworth Back Channel	8.26	8.65
	Montgomery	9.05	8.15

[26] The Corps expressed concern regarding the applicant's water quality model results and indicated that it would conduct a separate study to describe potential effects of hydropower operation on DO concentrations in the Ohio River. However, the Corps has not provided additional water quality modeling results at this time.

However, review of a database maintained by ORSANCO (2016a) indicates that DO concentrations at the Montgomery Locks and Dam have occasionally decreased below the state standard of 5.0 mg/L in May through October from 1998 through 2015. Our analysis of those data indicates that minimum DO concentrations were lower than the state standard on only 4 percent of the reported dates, and on most of those dates the average and maximum concentrations exceeded the state standard. Therefore, the ORSANCO data generally verify the modeling results, with the exception of the 4 percent of the reported days when the minimum DO concentration fell below the state standard. Monitoring results indicate that the pools upstream of the dams did not stratify during the summer of 2013 (a wet year), based on vertical temperature and DO profiles. Although, we note that stratification and lower DO concentrations in the Corps' pools would likely occur, if at all, during hot, dry summers when river flow is below normal.

According to the applicants' DO monitoring and modeling results, DO concentrations are currently higher than state standards, including during dry years, and operation of the proposed Emsworth and Emsworth Back Channel Projects would have a negligible effect, while the proposed Montgomery Project would have a minor effect on DO concentration in the Ohio River. Figures 3-1, 3-2, and 3-3 show the modeled change in DO conditions between the pre- and post-project scenarios. The figures are given for the dry and average hydrologic conditions to show the impact of the turbines during times when DO conditions are more likely to be low for a significant portion of the summer months, because of high temperatures and low streamflow. The applicants' 2013 monitoring study (CDM Smith, 2014b) indicates that diel DO patterns could occur at the Emsworth Project during the summer, resulting in lower DO concentrations at night. However, diel changes in concentrations were typically minor (no more than 0.5 mg/L), and nighttime DO concentrations are not expected to decrease much below 8.0 mg/L under most flow conditions. Nevertheless, monitoring water temperature and DO concentrations from June 1 to September 30 for 3 years, as the applicants propose, should be sufficient to verify that project operation affects DO concentrations as predicted by the modeling and provide feedback to the Corps so that it could make any necessary decisions regarding the flows it makes available to the project. Based on 3 years of seasonal operational water quality monitoring, additional monitoring could be required if needed (e.g., if dry hydrologic summer conditions do not occur during the first 3 years of operations). Also, making real-time monitoring data available on a website would provide stakeholders with a means to access and review the data. Developing water quality monitoring plans in consultation with the Corps, FWS, Pennsylvania FBC, and Pennsylvania DEP also would help to ensure that the plans include appropriate monitoring locations, sampling frequency and duration, and reporting requirements to verify that water quality is consistent with state and other applicable standards.

Because the projects would have a minimal effect on downstream DO concentrations, the applicants do not propose to release bypass flows while the project is operating. However, Interior recommends year-round bypass flows at each project, and

Pennsylvania FBC recommends implementing measures to increase DO concentrations immediately if the DO standard recommended by the Corps is not met. Modeling without bypass flows, however, did not indicate any periods when DO concentrations would be substantially affected by project operations downstream of the projects, indicating there would be no need for bypass flows to protect water quality. The applicants modeled downstream DO concentrations with different bypass flows (300, 600, and 1,500 cfs at the Emsworth and Emsworth Back Channel Projects, and 600, 1,200, and 3,000 cfs at the Montgomery Project) under various hydrologic conditions that confirmed that bypass flows would increase downstream DO concentration by less than 0.1 mg/L on average for all bypass flows and hydrologic conditions evaluated.[27] However, the DO data collected by ORSANCO downstream of Montgomery Dam indicate that bypass flows may be needed to provide DO concentration consistent with state or other water quality standards on occasion. As such, developing water quality monitoring plans and operation compliance monitoring plans, as described previously, would help identify adverse water quality effects and inform any necessary actions, such as release of bypass flows by the Corps prior to the Corps making flows available to the applicants for generation, that could be needed to provide water quality consistent with water quality standards in certain conditions (i.e., hot, dry summers).

Pennsylvania FBC recommends the projects meet a non-degradation standard for DO to support riverine water quality and the aquatic community. However, it does not specify a standard, nor does it provide data to indicate that a non-degradation standard would provide greater protection to water quality and the aquatic community than post-operation DO conditions or existing state standards. The Corps also indicates that an adaptive management approach to project operations would be required to meet a non-degradation DO standard. Based on available data, project effects on DO concentrations would be minor, and DO concentrations would continue to exceed state standards during operation under most conditions. The existing state minimum water quality standard was determined adequate to protect fish and wildlife species, particularly the warmwater fish community in the Ohio River. It is unclear how adherence to an undefined non-degradation standard would benefit aquatic resources relative to state standards. However, the operation compliance monitoring plan, described above, would include provisions to monitor compliance with the operational requirements of any licenses issued for the projects, and would provide information to adapt operations as needed.

[27] *See* bypass flow modeling results filed on January 20, 2015.

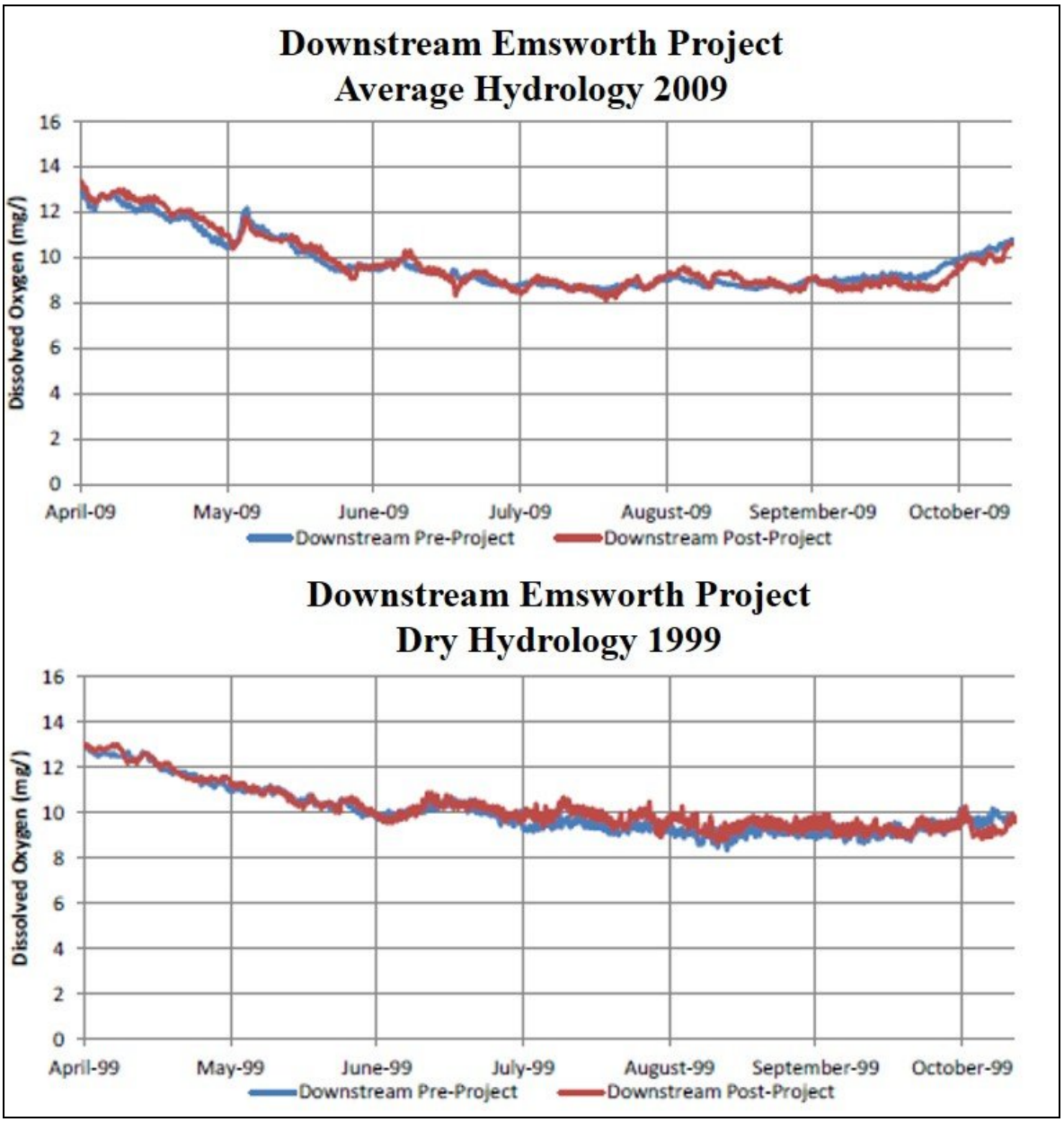

Figure 3-1. Modeled DO concentrations downstream of the Emsworth Project during an average year (2009) and dry year (1999) (Source: CDM Smith, 2014b).

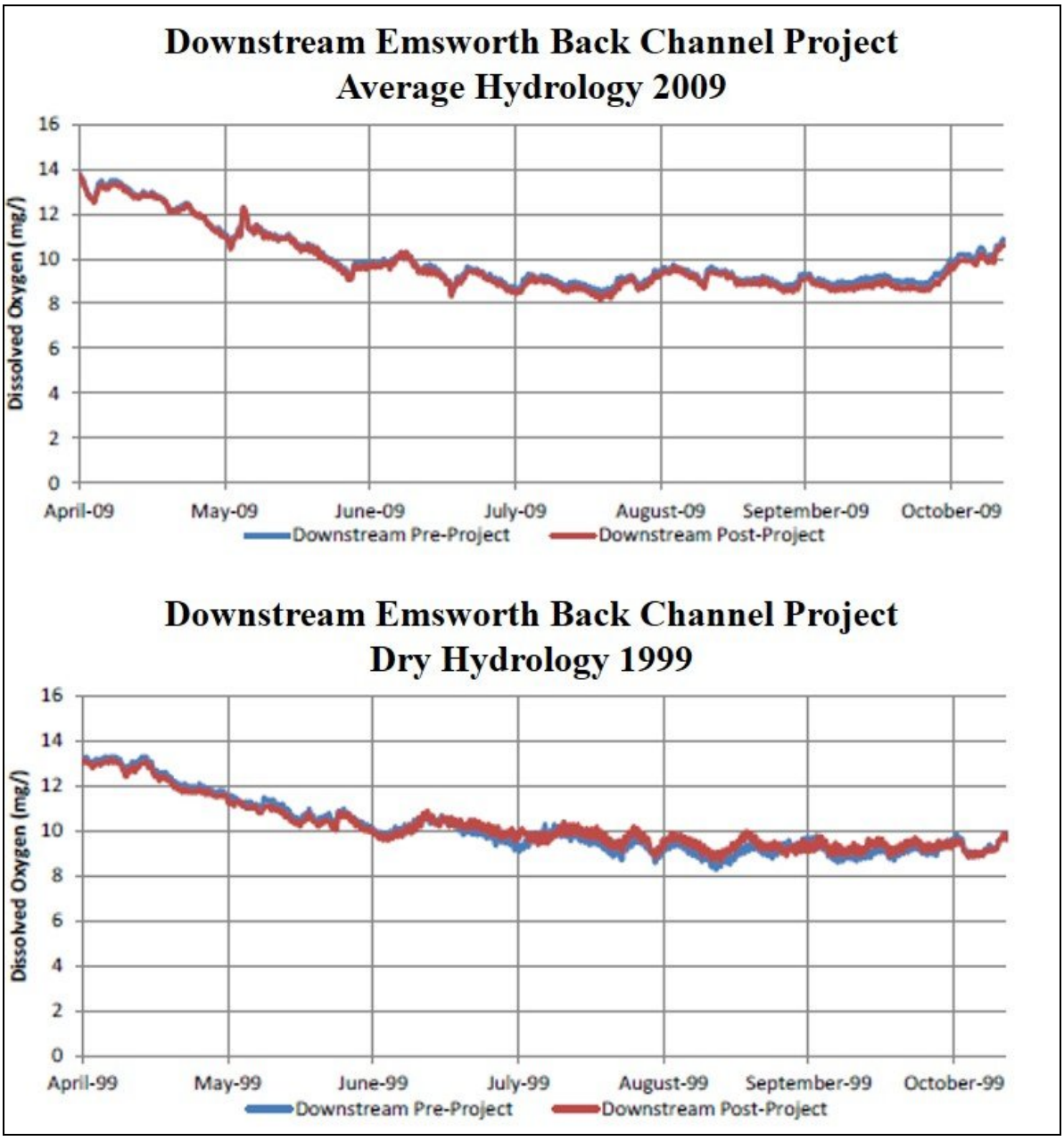

Figure 3-2. Modeled DO concentrations downstream of the Emsworth Back Channel Project during an average year (2009) and dry year (1999) (Source: CDM Smith, 2015b).

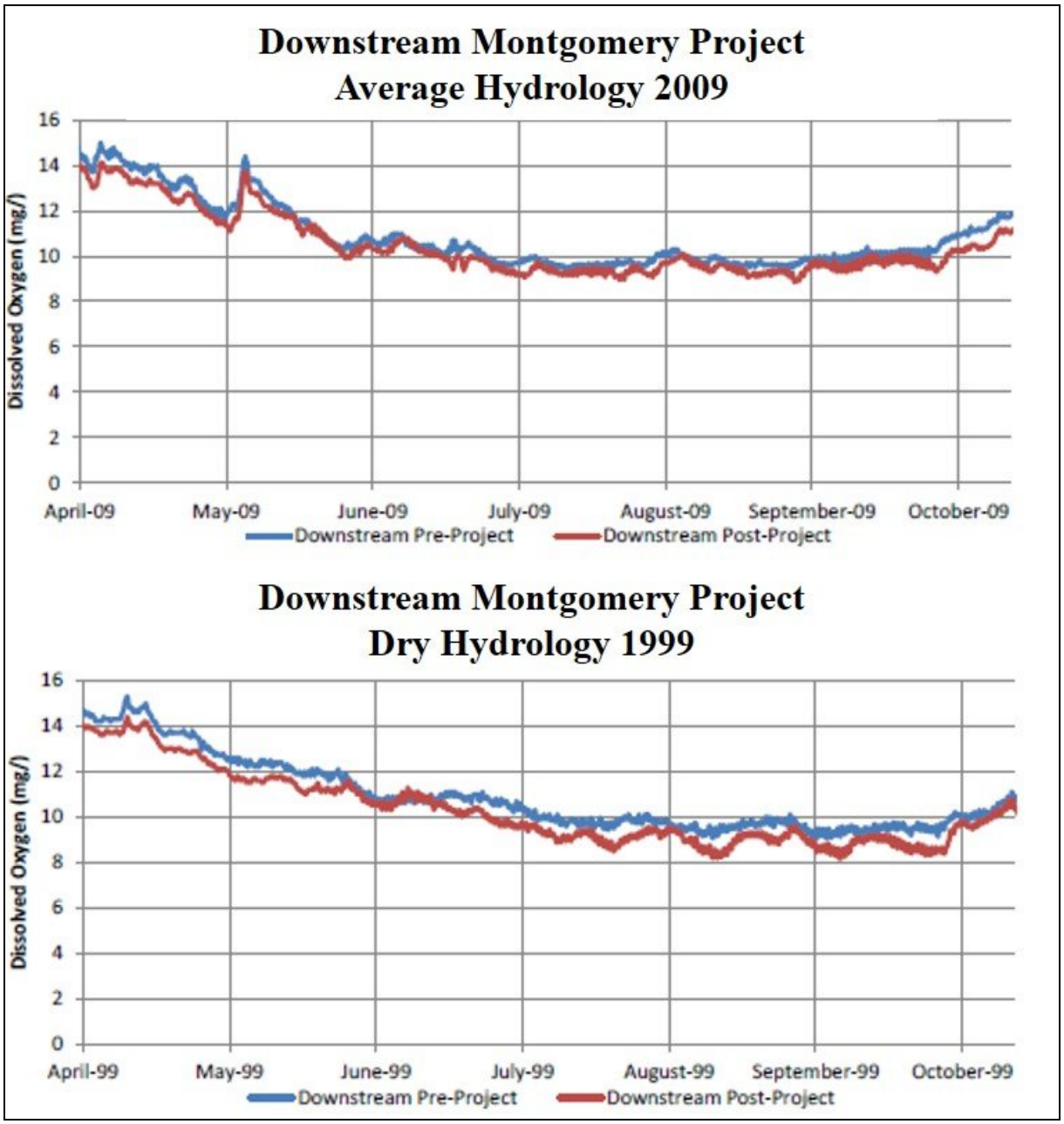

Figure 3-3. Modeled DO concentrations downstream of the Montgomery Project during an average year (2009) and dry year (1999) (Source: CDM Smith, 2014b).

Construction Effects on Aquatic Organisms and Habitat

Cofferdam Construction and Excavation

Construction activities could adversely affect resident fish, mussels, and macroinvertebrates through temporary displacement and mortality associated with cofferdam construction and dewatering, excavation and dredging in the river channel, and erosion and runoff from adjacent disturbed areas. Increases in suspended sediment can reduce aquatic habitat suitability downstream of the construction area, bury juvenile mussels and fish eggs, and clog the gills of freshwater mussels and macroinvertebrates.

As described in detail in section 3.3.1.2, *Construction Effects on Geology and Soils*, the applicants propose to develop an erosion and sedimentation control plan to minimize effects of in-water excavation and runoff from adjacent lands.

Our Analysis

Based on the applicants' substrate data from the mussel survey (Ecological Specialists, Inc., 2015), substrate within the construction footprints for the Ohio River Projects is almost entirely boulder and cobble. This suggests that existing flow releases from the dams scour away fine sediments, leaving larger, more stable substrate behind. Construction footprints would be close to the dam, within a few hundred feet downstream, where minimal fine substrate is expected to occur. As such, in-river construction activities are unlikely to suspend and redistribute large amounts of sediment downstream. Furthermore, cofferdams and turbidity curtains would isolate and dewater the in-river areas where intake channels, powerhouses, and tailraces would be constructed. Therefore, while some sediment may be suspended during cofferdam installation and removal, the cofferdams themselves and turbidity curtains would isolate much of the excavation activity and potentially contaminated sediment from the river. As discussed previously in *Construction Effects on Water Quality*, implementing a water quality monitoring plan during construction would allow for immediate identification of any turbidity level increases within the immediate area, and implementation of any actions needed to minimize erosion and sedimentation impacts.

One area of sand substrate does occur adjacent to the proposed Montgomery tailrace. This area could be disturbed and sediment suspended because of cofferdam installation/removal at the Montgomery Project, but any resultant increases in suspended sediment or turbidity would be temporary, and effects on aquatic habitat would be minor because much of the nearby area is already dominated by sand. Substrate immediately upstream of the dams appears to be dominated by silt and/or clay, but these areas would not be disturbed during construction of the proposed projects.

Fish species in the construction areas may be displaced by cofferdam construction; boat and barge traffic associated with construction; and/or increased turbidity associated

with cofferdam installation and removal, dewatering of the construction area, and excavation of the riverbed. However, any displacement would be temporary and unlikely to have long-term effects on fish populations. Some fish stranding and mortality within the cofferdam construction areas is possible, but would be minimal because most fish would likely avoid the affected area during installation of the cofferdams, prior to cofferdam closure, because of the disturbance to the river bottom and water column.

The applicants did not collect any mussels during surveys within the construction footprints at the Emsworth and Montgomery Projects. While no survey transects were placed within the construction footprint at the Emsworth Back Channel Project, survey transects immediately downstream of the construction footprint did not collect any mussels. In addition, the surveyors noted that habitat at Emsworth Back Channel is mostly unsuitable for mussels, presumably due to the lack of suitable substrate. In general, mussels require habitats that remain suitable under all flow conditions. Under existing conditions, variation in flow and bed scouring from changes in gate operation and high flows would likely preclude most mussels from surviving directly below the dams where most construction activities would occur. Thus, the mussel survey results show limited potential for cofferdam placement and excavation to adversely affect mussel populations at the Ohio River Projects because mussels likely do not inhabit the construction footprint of these proposed projects.

Some macroinvertebrate habitat would be permanently lost within the construction footprint, but, given the small amount of area and the availability of similar substrate outside of the construction footprint, it is unlikely that this small loss of macroinvertebrate habitat would adversely affect the macroinvertebrate community.

Overall, implementing erosion and sedimentation control plans, including the use of turbidity curtains, as described in section 3.3.1.2, *Construction Effects on Geology and Soils,* would minimize any potential effects of erosion and suspended sediment on aquatic organisms and their habitat during construction of the projects.

Flow Distribution during Construction

Installation of cofferdams and restrictions on the use of some of the Corps' gates during construction could cause some hydraulic changes downstream of the dams including a change in flow patterns and increases in velocity because of the use of fewer gates. Restricting the flow to fewer gates would cause higher flow velocities relative to the same quantity of flow passed under existing conditions. The applicants propose to coordinate the timing of construction to avoid impacts on spawning fish and other aquatic organisms, when warranted and to the extent feasible.

The applicants also stated, during the scoping meeting on October 10, 2014, that they would defer to the Corps regarding gate schedules during construction. The Corps, in its November 6, 2014, scoping comments, indicates that gate schedules during

construction would be site specific and suggests that flows could be directed primarily through the gates located in the middle portion of its spillways, to the extent feasible.

Our Analysis

In the hydraulics study report (CDM Smith, 2014b), the applicants estimate that, during construction of the Ohio River Projects, water surface elevations could increase up to 1 foot, and velocities could increase up to 4 fps in some isolated areas immediately below the dams. Upstream of the dams, in the vicinity of the gates remaining open to release water, velocities would increase slightly relative to existing conditions. Potential elevation and velocity changes estimated for the projects are based on maximum gate flow during construction, which is a "worst-case" scenario hydraulically. Actual hydraulic changes during construction would likely be less pronounced than described above because maximum gate flow would occur infrequently (no more than 1 percent of the time from June through October), and most construction activity would likely occur during typical moderate or low-flow periods when high-flow events would be rare. Additionally, any temporary changes in flow patterns and velocities immediately upstream and downstream of the dams would not be unusual; current flow patterns at each dam change depending on changes in river flow and the sequence of Corps gate operations. Furthermore, the applicants' hydraulic modeling suggests that any changes in velocities and flow patterns would rapidly attenuate downstream. Effects on flow during operation, discussed below, would have a greater effect on hydraulic conditions than construction effects, yet any hydraulic changes during operation would occur within 5,725 (Emsworth Back Channel) to 9,000 feet (Montgomery) downstream of the dams.

While hydraulic changes during construction could reduce the suitability of habitat for certain life stages of some fish in some locations, most fish would be able to move to more preferred habitat. Fish habitat conditions below the dams are dynamic under current gate operation conditions, so temporary changes in hydraulic conditions should not affect fish populations. If fish spawning habitat occurs downstream of the proposed cofferdams, spawning adults or incubating eggs could be disturbed by a reduction or change in flow velocity. If the applicants commence construction after the spring spawning and incubation period is complete for most species, this would minimize effects on any spawning habitat that is currently present downstream of the dams.

During the applicants' mussel survey, higher numbers of mussels were collected in the vicinity of the Emsworth and Montgomery Projects relative to the Emsworth Back Channel Project, with more mussels collected downstream of all dams. However, as discussed previously, the majority of mussels are present in areas farther downstream from the proposed projects and not in the proposed construction footprints. Because no mussels were observed in surveys within the downstream construction footprints at any of the proposed projects, changes in gate operations during construction have little potential to affect mussels near the dams. Most mussels that occur farther downstream

would not be affected by gate operations during construction, because flow patterns in downstream areas where mussels occur are not expected to be substantially different than current Corps' operations.

Any mussels present downstream of the proposed cofferdams could be affected by changes in flow distribution while cofferdams are in place. Low velocities in these areas may lead to unsuitable conditions for mussels downstream of cofferdams, as sediment may settle out of suspension, smothering any mussels that are present. In addition, success of spawning or release of glochidia could be affected by decreases in velocity and increases in sedimentation. However, these effects would likely be limited to a small area directly downstream of the cofferdams, where few, if any, mussels occur and would attenuate downstream as flow patterns normalize. Mussels typically spawn and release glochidia in spring through early-summer; therefore, limiting in-river construction activities during this period could protect mussels and provide some benefits to the mussel community.

Some macroinvertebrate habitat outside of the construction footprint could be affected by increased velocities during project construction. However, affected areas would likely be relatively small, and similar macroinvertebrate habitat would not be affected in other locations. Therefore, hydraulic changes during project construction are not likely to cause a measurable effect on the overall macroinvertebrate population.

In summary, expected hydraulic changes due to changes in gate operation during construction and flow obstruction by cofferdams would likely have a minor and temporary effect on individual fish and mussels, but would not likely have a discernable effect on species composition or abundance. Coordinating the timing of construction to minimize impacts on spawning fish and other organisms, as the applicants propose, would likely provide some benefit to aquatic species. We note that coordination with Corps would be required per the standard special articles described in the 2011 MOU between the Commission and the Corps. As such, the Corps would ultimately determine construction timing and the gate schedules at each dam to facilitate project construction.

Operational Effects on Aquatic Organisms and Habitat

Modification of river flows by hydropower operations can negatively affect aquatic organisms and their habitats. Diverting water through the project powerhouses, instead of through the Corps' gates, would alter the existing discharge patterns and the hydrodynamics upstream and downstream of each dam. These changes may affect existing aquatic habitat by changing the existing hydraulic conditions, associated scour and deposition patterns, and DO concentrations.

Fish Habitat

To avoid impacts on water levels in the pools and maintain existing river flows, the applicants propose run-of-release operation for the Ohio River Projects. Interior (10(j) recommendation 1) recommends that the projects operate in a run-of-river mode and provide minimum bypass flows through dam gates or over dam spillways during all months of the year, at all projects. Pennsylvania FBC also recommends run-of-river operations to protect and enhance fish and wildlife habitat and prevent undesirable river fluctuations.

In addition, the Corps expresses concern regarding operational impacts on tailwater habitat because these areas provide riverine habitat features that support higher productivity and greater diversity than other habitats in the Ohio River.

Our Analysis

Because the applicants propose to operate each project in a run-of-release mode, there would be no change to upstream or downstream water surface elevations with the exception of some minor changes immediately upstream and downstream of the Corps' gates. While there would be no changes in the volume of downstream flow releases, project operations would cause flow patterns to change immediately downstream of the Corps' dams because more flow would be discharged through the proposed powerhouses instead of through the Corps' gates.

The applicants assessed the effects of operation of the proposed Ohio River Projects on fish habitat in the upstream and downstream potentially affected areas, by modeling and comparing the weighted useable area (WUA)[28] for multiple life stages of target species under existing and proposed conditions during different flow regimes (CDM Smith, 2014b). Each project's potentially affected area was defined through the study as the area where the change in simulated river velocities from turbine operations would be greater than 0.1 fps. The target species used in this assessment were gizzard shad and white bass (to represent species that use deep-slow habitat, i.e., deep-slow guild), flathead catfish (shallow-slow guild), and walleye (deep-fast guild). These species were selected based on their abundance in the project areas, availability of habitat suitability index curves, ecological importance (act as fish hosts for mussels), and recreational importance (game species). A species representative of the shallow-fast guild was not included because such habitat is not common near the proposed projects, and, if present, would only occur directly below the locks and dams. These areas are turbulent, and while they may present temporary foraging opportunities, they are largely

[28] WUA is an index that describes overall habitat quality within a study area.

unsuitable for most fish species. Changes in velocity, depth, and substrate that would be caused by project operation at different flows were considered in the assessments. The three flow regimes used in this assessment included low (10-percentile), moderate (50-percentile), and high (90-percentile) flows as described above in table 3-7.

Changes in WUA with operation of the Emsworth Project ranged from an 8 percent decrease for spawning gizzard shad during moderate flow conditions, to a 20 percent increase for spawning gizzard shad at high flow conditions. During low flows, habitat suitability for adult walleye would remain unchanged between the existing and proposed operating condition. During moderate flows, habitat suitability for adult walleye would be reduced immediately downstream of the proposed tailrace for about 2,500 feet. However, habitat suitability upstream of the dam would increase slightly. At high flows, walleye habitat would remain unchanged upstream of the dam and would decrease downstream of the proposed tailrace for about 3,500 feet. Habitat for flathead catfish and white bass would remain relatively unchanged and stable under most conditions.

Changes in WUA at the Emsworth Back Channel Project ranged from an 11 percent decrease for juvenile flathead catfish, to a 26 percent increase for gizzard shad fry, both during moderate flow conditions. Decreases in WUA for the remaining target species at the Emsworth Back Channel Project were approximately 3 percent or less. During low flows, habitat suitability for adult walleye would remain unchanged upstream of the dam, would increase downstream of the dam along the left descending bank[29] opposite of the proposed powerhouse, and decrease immediately downstream of the proposed tailrace for approximately 1,000 feet. During moderate flows, habitat suitability for adult walleye would decrease immediately upstream of the dam on the right descending bank and immediately downstream of the proposed tailrace for approximately 2,500 feet. During high flows, habitat suitability would increase in a small area on the riverward side of the powerhouse and tailrace immediately downstream of the proposed spill gates.

At the Montgomery Project, the applicant reported notable decreases in WUA for spawning and fry life stages of white bass and juvenile walleye during high flows (11 to 15 percent), and spawning gizzard shad and juvenile walleye during moderate flows (13 percent). The modeling also showed a 29 percent increase in WUA for spawning gizzard shad at high flows and a 15 percent increase in WUA for juvenile gizzard shad at moderate flows. During low flows, habitat suitability for adult walleye would remain

[29] Left descending bank refers to the river bank on the left side of the river channel when looking downstream. Similarly, the right descending bank refers to the river bank on the right side of the river channel when looking downstream.

unchanged upstream of the dam, and would decrease downstream in the proposed project tailrace. During moderate flows, habitat suitability for adult walleye would decrease immediately upstream of the dam along the right descending bank as well as downstream of the proposed powerhouse location for approximately 6,000 feet, extending into the mid-channel. During high flows, walleye habitat suitability would decrease immediately upstream of the dam, also along the right descending bank, and downstream of the proposed powerhouse for approximately 5,000 feet along the right descending bank. However, habitat suitability for adult walleye would generally increase in the mid-channel downstream of the dam for approximately 4,000 feet.

Results from the habitat suitability analysis at each project indicate that decreases in WUA would be minor (10 percent or less) for most fish species and life stages under all flow conditions. Most of the decreases in habitat suitability would occur within and downstream of the proposed project tailraces because these areas would be exposed to higher velocities than under current conditions. However, the mid channels, opposite banks from the proposed powerhouses, and the upstream pools show either no change or a small increase in WUA for most species and flow conditions.

Changes in flow release patterns and velocities could also affect fish habitat conditions through changes in benthic scour and depositional patterns. Based on hydraulic modeling during high-flow conditions (90-percentile flow) conducted by the applicants (CDM Smith, 2014b), changes to the location and total area of potential stream bed scouring after project operation commences would be minor. Most bed scour would occur during high-flow conditions, similar to existing conditions. While scour and deposition patterns would change slightly at the Emsworth and Montgomery Projects, very little if any measurable changes are predicted to occur at the Emsworth Back Channel Project.

At the Emsworth Project, an area of less than 0.5 acre of potential scour located approximately 1,000 feet downstream of the existing locks would be lost. A total area of approximately 4 acres of potential scour would be lost at the Montgomery Project in the mid channel below the dam (see figure 4-26 in CDM Smith 2014b). At low and moderate flows, when all water is proposed to be routed through the proposed projects, staff expect that fine sediment deposition would likely increase downstream of the Corps' gates at each project. In addition, we note that while some areas would experience a reduction in scour, other areas, generally downstream of the proposed powerhouses would likely experience initial increases in scour when the projects begin operations. During extremely high flow events, flows that equal or exceed the Corps' spillway capacity, the projects would be shut down, and all flow would be directed through the Corps' gates and the projects' spill gates. Under these conditions, where flow patterns are very similar to existing conditions, we expect existing scour and deposition patterns to be maintained. Some deposition could occur immediately downstream of the

powerhouse, but any sediments deposited here would be transported downstream once project operation resumes.

Based on our analysis, some changes to scour, depositional patterns, and benthic fish habitat would occur because of project operations, but these changes would be minor. High flows (90-percentile or greater) would continue to have the largest effect on patterns of bed scour and deposition, which would result in a similar substrate and habitat distribution compared to existing conditions. Considering that overall changes in fish habitat suitability would be limited, and that substantial scour is unlikely, the proposed run-of-release operations would only lead to minor changes in fish habitat downstream of the dams.

Although the overall quantity of water releases would remain the same as current operations, the proposed projects may influence water quality as described previously in *Operational Effects on Water Quality*. In general, reduced DO concentrations could occur downstream of the proposed projects because little or no aeration would occur when water is routed through the powerhouse that may result in the episodic displacement of species that are sensitive to reduced DO concentrations. These events would most likely occur in the summer months during periods of low flow in dry water years.

The applicants' water quality study (CDM Smith, 2014b) indicated that operation of the Ohio River Projects would not result in DO concentrations lower than about 8.0 mg/L downstream of the projects. Post-project DO concentrations at the Ohio River Projects would remain above state standards and would be within or greater than the optimal growth range for target fish species such as channel catfish, smallmouth bass, and walleye (5 to 7 mg/L). However, DO data collected by ORSANCO indicate that DO concentrations often drop below 8.0 mg/L and occasionally drop below the state minimum standard of 5.0 mg/L during the summer and early fall in some years. This occurred on about 4 percent of the days sampled, but on most of those days the average DO concentrations for the day exceeded 5.0 mg/L. Thus, both the applicants' modeling and ORSANCO's DO data indicate that throughout most of the summer period (May to October), DO concentrations are much higher than the resident fish community requires.

Interior's recommendation for year-round minimum bypass flows at all proposed projects would generally increase aeration and DO concentrations downstream of the dams. However, during the winter and spring months when DO is already high, bypass flows would not likely provide a benefit to water quality. Furthermore, it would be at the Corps' discretion whether it releases any flows prior to making flows available to the projects for generation. As such, the Corps would determine the timing, amount, and location for any bypass flows it deems necessary. Bypass flows may provide additional habitat diversity relative to proposed operating conditions because bypass flows would provide some turbulent and fast-moving water downstream of the Corps gates or the

proposed spill gates during low and moderate river flows. However, the applicants' habitat modeling suggests that there would be ample habitat diversity, including areas of fast-moving water, under the proposed operating conditions.

Overall, run-of-release operation as proposed by the applicants may alter fish habitat conditions through changes in velocity and scour patterns downstream of each dam, but only small changes in available suitable habitat for most species and life stages would occur. Fish would likely move into areas with suitable depths, flows, and substrate during project operation. In addition, implementation of a water quality monitoring plan, discussed above in *Operational Effects on Water Quality*, would provide information to the Corps so that it can make decisions on how much flow to make available to the project and how much flow must be released through its and the proposed projects' spill gates to protect fish from any adverse project effects on DO concentrations.

Mussels and Macroinvertebrates

Similar to our previous discussion, mussels, macroinvertebrates, and their habitat may be affected by project-related changes in hydraulic conditions, scour and deposition patterns, and DO concentrations.

Our Analysis

During mussel surveys conducted near the proposed Ohio River Projects (see Ecological Specialists, Inc., 2015), mussels were collected from transects upstream and downstream of the dams. Only six to seven mussel species were collected at each of the three proposed project locations, and the species composition was dominated by common species including mapleleaf, pink heelsplitter, and threehorn wartyback (83 to 93 percent, depending on project). In general, mussels were found near the riverbanks (within 50 to 100 meters) and/or where substrate was diverse and included some silt, sand, and small gravel. Mussels were more abundant along the same river bank as the proposed powerhouse at the Emsworth Project (north side of Neville Island), with a mussel bed located about 0.33 mile downstream of the dam. At the proposed Emsworth Back Channel Project, existing habitat is mostly unsuitable for mussels (lack of fine substrate), and only 30 individual mussels were collected, most of which were collected along the opposite bank relative to the proposed powerhouse location, approximately 0.25 mile downstream of the dam. At the proposed Montgomery Project, mussels were collected along most downstream transects, but most commonly along the left descending bank, opposite the proposed powerhouse location and approximately 0.5 mile downstream from the dam. However, some mussels were found downstream of the proposed tailrace, extending from the bank to mid-channel.

At the Emsworth and Montgomery Projects, some mussels occur downstream of the proposed powerhouses and may be subjected to higher water velocities and possibly

scouring flows once project operations begin. Increases in velocity could displace some individuals and reduce habitat suitability by scouring out fine substrate such as silt, sand, and small gravel. Some displaced mussels could settle into suitable habitat farther downstream, but some mortality could occur if mussels settle into unsuitable habitat. Velocity changes and potential effects on mussel habitat would be greatest at the Montgomery Project because of higher velocities in the discharge plume downstream of the powerhouse and lower velocities elsewhere. At the Emsworth Back Channel Project, effects on existing mussels and mussel habitat would be minimal because of the lack of suitable conditions for mussels.

Flow patterns downstream of all proposed powerhouses would likely be more stable than existing flow patterns, which are affected by variations in river flows and gate operations. Under proposed conditions all water would be routed through the powerhouses during low and moderate flows, up to the capacity of each powerhouse, which should create areas where velocity is consistent under most flow conditions. Increased stability in velocity patterns downstream of the powerhouses would improve habitat conditions in those areas and benefit mussels that either currently occur in or that colonize these areas. Downstream of the Corps' gates, a decrease in velocity would occur under low and moderate flow conditions; however, these areas are currently unsuitable for mussels because the existing substrate consists of mostly boulder and cobble substrate. Overall, some mussel habitat may be lost while additional habitat is created because of the change in flow patterns associated with the operation of the proposed projects.

Changes in velocity and scour patterns could also affect other benthic macroinvertebrates, which are important prey items for many fish species. Macroinvertebrates at each project generally consist of common species such as midges, mayflies, and *Gyraulus* snails, which reflects the pooled habitat conditions found in the Ohio River. Project operations would likely affect some macroinvertebrate habitat, especially near the proposed tailrace areas. For example, consistent discharge from the proposed powerhouses could increase habitat suitability for certain species of mayflies, caddisflies, and other groups that are adapted to live in swift-water while habitat for other species decreases. However, any changes in macroinvertebrate habitat would be small and localized to the project-affected areas. Considering the availability of macroinvertebrate habitat elsewhere in the project areas, it is unlikely that any change or loss of macroinvertebrate habitat would adversely affect the macroinvertebrate community.

The DO thresholds for mussels are not well known, but monitoring water quality and adhering to state standards, or any additional, more restrictive standards determined by the Corps, would minimize effects of the proposed projects on DO concentrations and any associated effects on mussels. As discussed previously for fish, seasonal bypass flows could provide some additional aeration and protect mussels from low DO

conditions during the summer in hot and/or dry years. However, year-round bypass flows, as Interior recommends, would not be needed because DO concentrations are typically high throughout the year. Additionally, it is unlikely that bypass flows would provide any substantial benefit to physical habitat for mussels because any bypass flows would likely discharge in the mid-channel (to avoid impacts on navigation), away from the near-shore habitat where mussels typically persist.

In summary, run-of-release operations, as proposed by the applicants may alter mussel and macroinvertebrate habitat conditions through changes in velocity and scour patterns downstream of each dam, but some habitat would be improved by the steady flow releases from the powerhouses. In addition, implementation of water quality monitoring plans, discussed previously in *Operational Effects on Water Quality*, would provide information to the Corps so that it can make decisions on how much flow to make available to the projects and how much flow must be released through its and the proposed projects' spill gates to protect aquatic life from any adverse project-related effects on DO concentrations.

Fish Stranding Surveys

Interior recommends the applicants design and implement post-construction fish stranding studies for the dam tailraces at all projects, extending downstream to the point where turbine discharges enter the river.

Our Analysis

Although project operations would result in some changes in flow and velocity patterns downstream of the dams, the projects would not dewater any aquatic habitat. On the Ohio River, each Corps dam creates a pool that backwaters to the base of the next upstream dam. As pool levels fluctuate because of changes in flow or the Corps' operations, only small strips of habitat along the river bank would be subject to dewatering. The tailraces of the proposed projects would be excavated into the bed of the existing river channel and would be continuously submerged whether the projects were operating or not. As such, fish stranding studies would not benefit fish or fish habitat in the vicinity of the projects.

Fish Impingement, Entrainment, and Passage

Operation of the proposed projects could result in some fish losses from impingement on the proposed trash racks and injuries caused by entrainment through the proposed turbines. To minimize fish mortality related to project operation, the applicants propose to: (1) design the projects so that the intakes have maximum approach velocities of less than 2 fps; (2) install trash racks with 5-inch clear bar spacing; and (3) use "fish friendly" Kaplan turbines.

Pennsylvania FBC and Interior recommend that the applicants design and implement post-project construction fish impingement and entrainment studies at all projects. Based on the results of these studies, Interior may then recommend the licensee consult with the resource agencies to determine appropriate trash rack vertical bar spacing and approach velocities at all projects, and make project modifications where necessary to ensure protection of all fish species and life stages in project areas. Pennsylvania FBC recommends mitigation of fish impingement and entrainment losses.

Our Analysis

At the existing dams, fish can pass downstream through the Corps' gates and over the spillway or through the lock chambers, and fish can pass upstream through the lock chambers only. Diadromous species (includes both anadromous and catadromous species) do not occur in the Upper Ohio River Basin, so no species that require passage to complete their life history requirements occur here. Some resident species, such as walleye and gizzard shad, may exhibit some migratory characteristics during the spawning (move upstream to spawn) and post-spawning periods, but there is no information to indicate that sufficient spawning areas are not available between the dams.

Entrainment would occur when fish are unable to overcome the approach velocity at the trash racks and pass through the turbines during project operation, or volitionally pass downstream through the trash racks. The proposed 5-inch trash rack bar spacing would allow all but the largest fish to pass through the trash racks, limiting the potential for fish to become impinged on the trash racks. Table 3-19 summarizes the site-specific trash rack and turbine features.

Table 3-19. Trash rack and turbine characteristics at the proposed Ohio River Projects (Source: HDR, 2013).

	Trash Rack Characteristics		**Turbine Characteristics**			
Project	**Trash Rack Bar Spacing (inches)**	**Modeled Maximum Approach Velocity (fps)**	**Number of Units**	**Runner Diameter (feet)**	**Rated Speed (revolutions per minute)**	**Rated Head (feet)**
Emsworth	5	1.77	4	15.8	81.8	17.1
Emsworth Back Channel	5	1.50	4	17.0	65.5	17.1
Montgomery	5	1.86	3	26.0	44.4	17.5

To evaluate the effects of the proposed projects on downstream fish passage, the applicants conducted a desktop entrainment and turbine survival study (HDR, 2013) to estimate the number of fish that would be entrained and suffer mortality during project operations. The calculated maximum intake velocity at the projects' trash racks would be about 1.5 to 1.9 fps, depending on the project (table 3-19). Burst swim speed data for seven of the target species and nine surrogate species[30] show that almost all species in their adult life stage and many in their juvenile life stage can swim faster than the maximum intake velocity, and could avoid being swept into the trash racks (table 3-20). Therefore, we expect that impingement of fish on the trash racks would only occur rarely.

Table 3-20. Average burst swim speeds and fish sizes for representative species (Source: HDR, 2013).

Species	Life Stage	Total Length (inches)[a]	Burst Swim Speed (feet per second)
American shad[b]	Juvenile	1.0–3.0	1.75–2.5
Emerald shiner	Adult	2.5	4
	Juvenile	2.01–2.13	1.84
Bluegill	Adult	3.94–5.91	2.44
	Adult	6.02	4.3
Blue sucker[b]	Adult	26.2	19.51
Herring[b]	Fry	0.4–0.8	0.0–1.0
	Juvenile/Adult	6.0–11.0	5.0–7.0
Hybrid catfish[b]	Juvenile	6.30–9.06	7.88
Ghost shiner[b]	Adult	1.39	2.93
Greenside darter[b]	Adult	4.0–6.8	1.02–2.64
	Fry	0.79–0.87	1.56–2.04
Largemouth bass[b]	Juvenile	2.05–5.04	1.84–3.28
	Juvenile	5.91–10.63	3.02–4.34
Longnose sucker[b]	Juvenile/Adult	3.9–16.0	4.0–8.0

[30] Surrogate species are species that are similar in body shape and size (may be of the same genus or family) to target species in the Ohio River, and that have better data available than for the target species in the Ohio River. Surrogate species are assumed to have the same swimming ability as the target species.

Species	Life Stage	Total Length (inches)[a]	Burst Swim Speed (feet per second)
Mimic shiner	Adult	1.39	2.86
Paddlefish	Juvenile	3.54	1.87–2.46
	Adult	47.2	32.8
Smallmouth bass	Fry	0.55–0.98	<1.78
	Juvenile	3.58–3.66	2.6–3.6
	Adult	10.3–14.9	3.2–7.8
Striped bass[b]	Fry	0.5–1.0	0.4–1.0
	Juvenile	2.0–5.0	1.0–5.0
Walleye[b]	Juvenile	3.15–6.30 (F)	2.48–6.02
	Adult	13.78–22.44 (F)	5.48–8.57
White crappie	Juvenile	3.03	0.36–1.04

[a] (F) equals fork length; otherwise, length measurements are total length.

[b] Surrogate species used to represent target species in the Ohio River. Some target species such as walleye and largemouth bass, representative of sauger and spotted bass respectively, were also used as surrogate species.

The applicants estimated entrainment rates based on seasonal entrainment densities measured at 43 hydroelectric projects in the Electric Power Research Institute's (EPRI's) database (EPRI, 1997). Entrainment estimates for each target species and project were then adjusted by their percent relative composition in the vicinity of the projects, based on specific fish survey data from Pennsylvania FBC and ORSANCO databases. The estimated annual entrainment at the proposed projects ranged from 438,184 fish at the Emsworth Back Channel Project to 4,344,442 fish at the Montgomery Project, with gizzard shad accounting for about 75 to 96 percent of the total annual entrainment (table 3-21). Emerald shiner, channel catfish, and bluegill accounted for the majority of the remainder of the entrainment. Seasonally, the summer/fall period was estimated to have the greatest entrainment, with the winter/spring period (December through May) having the lowest entrainment. The majority of entrained fish would be small fish less than 6 inches in length, with gizzard shad representing the majority of entrainment at all the projects. Larger game species represented a small percentage of the projected entrainment, with both smallmouth bass and walleye entrainment estimated at less than 0.01 percent of the total annual entrainment.

Table 3-21. Annual entrainment estimates (number of individuals) for the Ohio River Projects, based on a 1995 to 2011 period of record (Source: HDR, 2013, as modified by staff).

	Project		
Species	**Emsworth**	**Emsworth Back Channel**	**Montgomery**
Bluegill	120,909	59,502	23,475
Brook silverside	17	9	5
Channel catfish	22,937	11,342	40,364
Channel darter	858	419	1,437
Emerald shiner	10,216	5,026	10,711
Flathead catfish	5,871	2,903	6,795
Freshwater drum	4,598	2,277	8,491
Gizzard shad	672,328	332,845	4,198,382
Logperch	2,869	1,415	937
Mimic shiner	1,933	951	7,417
Mooneye	4,828	2,388	2,169
Paddlefish	0	0	0
River shiner	23	11	33
Rock bass	7,060	3,472	1,173
Silver chub	696	340	855
Skipjack herring	2,656	1,313	27,625
Smallmouth bass	9,740	4,820	2,503
Smallmouth redhorse	2,012	985	674
Spotted bass	5,268	2,604	542
Walleye	5,931	2,929	2,929
White bass	5,077	2,484	7,783
Black crappie	303	149	143
Total	886,128	438,184	4,344,442

The applicants' desktop study (HDR, 2013) also estimated the number of entrained fish that would be killed during turbine passage using the blade strike

probability equation developed by Franke et al. (1997). Mortality estimates by species reflected the entrainment estimates, with gizzard shad comprising most of the fish killed. Larger fish were estimated to suffer the highest mortality, but few large fish were projected to be entrained. Average survival rates for fish entrained through turbines at the Ohio River Projects were estimated to be 95.3 percent at the Montgomery Project and 94.5 percent at the Emsworth and Emsworth Back Channel Projects. These are consistent estimates with the results of turbine passage survival tests conducted at other projects with similar types of turbines, as summarized in EPRI (1997). Slow-speed, large diameter Kaplan turbines, similar to those proposed by the applicants, also typically showed the highest survival rates.

Based on the applicants' calculated intake velocities, trash rack bar spacing, and results of the desktop entrainment mortality study, it appears that potential effects of impingement and entrainment would be minor (i.e., no impingement mortality and approximately 5 percent entrainment mortality rate). While only a desktop study was conducted, the applicants relied on well-known field studies (EPRI, 1997) and information on blade strike probability (Franke et al., 1997) for Kaplan turbines. Considering the expected low rates of impingement and entrainment mortality, and the relatively high fecundity of most warmwater fish species that would be entrained (e.g., gizzard shad, minnows, sunfish), the projects would not likely affect the composition of the existing fish community or fish species populations. As such, entrainment studies at each project would likely only confirm that large Kaplan turbines at relatively low-head projects achieve low entrainment mortality rates. In addition, given the known information on the relationship between trash rack bar spacing, intake velocities, entrainment, and mortality at hydroelectric projects, entrainment studies are not needed to inform trash rack design or determine appropriate intake velocities. However, verifying intake velocities at a range of flows, as part of the operation compliance monitoring plan discussed previously in *Operational Effects on Water Quantity*, would ensure that intake velocities are sufficiently low to protect fish from impingement on the trash racks and to minimize fish entrainment.

In addition to its recommendation to quantify fish losses through entrainment studies discussed previously, Pennsylvania FBC recommends that fish impingement and entrainment losses should be mitigated. However, it does not specifically describe any mitigation measures and, therefore, we cannot fully evaluate Pennsylvania FBC's request. Based on the applicants' fish entrainment study, measurable population-level effects on fish are not anticipated; thus, it is unlikely that any mitigation would be needed to protect the existing fish community in the vicinity of the projects.

In summary, the applicants' desktop entrainment study (HDR, 2013) and other published entrainment studies suggest the applicants' proposed trash rack spacing, intake velocities, and turbine type would adequately protect fish passing downstream through

the projects; therefore, we do not expect any measurable impacts on the large fish populations in the vicinity of the Ohio River Projects.

Special Status Fish

Aquatic state-listed and species of concern would be vulnerable to the same potential construction and operation-related effects as non-listed species discussed previously. Pennsylvania FBC notes that paddlefish, a species once extirpated from Pennsylvania, occurs near the Emsworth Back Channel Dam and recommends maintenance of a deep hole with circulating flow that provides unique habitat for the reintroduced paddlefish.

Our Analysis

State-listed fish reported from the project area since 1990 include bowfin, redfin shiner, river shiner, and longear sunfish. Although construction and operation could change the habitat suitability for some state-listed species, there would be limited loss of suitable habitat near the proposed projects. The applicants' desktop entrainment study estimates that from 11 to 33 river shiners may be entrained at the three projects (table 3-21). However, with an overall anticipated survival rate of about 95 percent, entrainment mortality could range from 1 to 2 river shiners at the three projects. As such, the projects would not likely affect the river shiner population in the Ohio River.

The paddlefish is not a Pennsylvania state-listed species (58 Pennsylvania Code § 75), but Pennsylvania FBC has stocked paddlefish in the lower 30 miles of the Allegheny River and the upper 40 miles of the Ohio River since 1991 (Argent et al., n.d.). While some paddlefish may occur in the Upper Ohio River, most paddlefish should be able to avoid the proposed intake velocity of less than 2 fps at all the Ohio River Projects, and there is little potential for individual paddlefish to be entrained. According to the applicants' entrainment study discussed above, no paddlefish entrainment was anticipated. While some paddlefish may occur in the Upper Ohio River, these fish seem to be uncommon based on available information. Pennsylvania FBC recommends maintenance of a deep hole with circulating flow at the Emsworth Back Channel Project that provides unique habitat for reintroduced paddlefish. However, Pennsylvania FBC did not describe the location of this habitat feature in relation to the proposed project. On April 18, 2016, Pennsylvania FBC informed FERC staff[31] that the paddlefish habitat was downstream of the Emsworth Back Channel Dam, but could not recall the specific

[31] Personal communication between Peter Foote (FERC contractor) and Rick Lorson (Pennsylvania FBC). See telephone record filed on April 30, 2016, for the Emsworth Back Channel Project (FERC Project No. 13761).

location. Based on the applicants' bathymetric data and depth data collected during the applicants' mussel surveys, this habitat feature may occur in the project-affected area. However, this project would be operated in a run-of-release mode, which would maintain existing water elevations downstream of the dam, and no change in areas of potential sediment scour and deposition are expected. A deep hole would also be less likely to be affected by any changes in velocity patterns downstream of the dam, particularly at the river bottom. As such, it is unlikely that the Emsworth Back Channel Project operation would affect this unique habitat feature.

Aquatic Organism Monitoring

The Corps indicates that it would require a variety of post-construction biotic monitoring at regular intervals to document any project-related changes to aquatic habitat and communities. Specifically, the Corps would require: (1) multi-method fish surveys to document any project-related changes in the fish community, (2) fish impingement, entrainment, and mortality surveys to assess impacts to all species and sizes of fish; (3) macroinvertebrate surveys; (4) mussel surveys; (5) an assessment of biological integrity for macroinvertebrate and fish assemblages, and (6) tracking of mussel bed and tailwater habitat during construction and operation throughout the term of the license. In addition, the Corps specifically expressed concern regarding potential project effects on darters (small benthic-dwelling fish) and their habitat in the dam tailwaters as these fish can serve important ecological functions, such as serving as a host fish for mussels.

Our Analysis

As described above, construction and operation of the projects would have some effects on aquatic species and their habitats. In general, effects of construction could temporarily displace organisms or decrease habitat suitability near the construction area. Once operation begins, some habitat would become less suitable for fish and other organisms, while other areas would see an increase in habitat suitability. Overall, a small reduction in suitable habitat for most aquatic species would occur at low and moderate flows while conditions at high flows would remain relatively unchanged. In addition, fish entrained through the project may suffer turbine-induced mortality, but the entrainment mortality rate would be low.

Under existing conditions, changes in gate operations alter flow distribution and habitat suitability downstream of the spillways on a regular basis, and water depth in the Ohio River pools varies by approximately 10 feet or more with normal variations in river flow.[32] As such, the existing aquatic community is adapted to variation in flows and

[32] Based on gage height data from 2000 through 2016 recorded by USGS gage 03086000, Ohio River at Sewickley, Pennsylvania (RM 13.3).

habitat suitability within and near the dam tailwaters. Some entrainment mortality would occur, but it would not likely have an effect on the existing fish communities. Therefore, fish, mussel, and macroinvertebrate surveys, entrainment surveys, and habitat surveys are not likely needed to document project effects.

As for darters, these species are small benthic-dwelling species with short home ranges that are often found in tailwater habitats. The swift current and cobble substrate found in tailwaters can provide protection for darter species because most predatory fish generally do not tolerate this habitat (Pennsylvania FBC, 2016). Because darters typically utilize tailwater habitat and do not exhibit migratory behavior, we expect that darters would not be at high risk of entrainment. Of those that are entrained, few would be killed (probably less than 5 percent) because these small fish would attain higher survival rates than other, larger species. Furthermore, as described above for other species, the availability of suitable habitat for darters is unlikely to change significantly and darters would seek out suitable habitat in the tailwaters with or without operation of the proposed projects.

3.3.2.3 Cumulative Effects

Water Quality

By the early 1900s, the Upper Ohio River Basin was experiencing widespread habitat alteration and water quality degradation. Up until the 1970s, the convenience of using the Monongahela, Allegheny, and Ohio Rivers as a sink for decades of municipal and industrial wastes trumped requirements for potable water in western Pennsylvania. Mining has been identified as having the single greatest impact on surface water quality of any single land use in the Monongahela, Allegheny, and Ohio Rivers (Pennsylvania FBC, 2011; Anderson et al., 2000). Concerted state and federal efforts since the 1970s, including reductions in industrial discharge, improvements in wastewater treatment, improvements in mine drainage treatment and low-flow augmentation, eventually led to substantial improvement in river water quality (Anderson et al., 2000).

Construction and operation of the proposed projects on the Upper Ohio River could cumulatively affect water quality downstream of the projects,[33] both in the short-

[33] Rye Development's other related projects that could contribute to cumulative effects throughout the Upper Ohio Basin include, Opekiska Lock and Dam (P-13753), Morgantown Lock and Dam (P-13762), Point Marion Lock and Dam (P-13771), Grays Landing Lock and Dam (P-13763), Maxwell Locks and Dam (P-13766), and Charleroi Locks and Dam (P-13767) on the Monongahela River; and Allegheny Lock and Dam 2 (P-13755) on the Allegheny River.

term (construction effects) and long-term (operational effects). Construction of the proposed projects may disturb and suspend sediments, potentially resulting in increased turbidity levels within the affected reaches of the each river. However, developing an erosion and sedimentation control plan at each project and monitoring water quality during construction would limit project construction contributions to cumulative effects on turbidity levels. During operation, reduced DO concentrations downstream from each project could contribute to cumulative effects on DO concentrations because the three rivers are already affected by urban and industrial development, navigation, and other uses, and have experienced low DO concentrations, particularly during the summer and early fall when flows are generally low.

On the Monongahela River, operation of the six proposed Monongahela River Projects could reduce DO concentrations downstream of each project, compared to existing conditions. The applicants analyzed the cumulative effect of operating multiple sequential hydropower facilities on DO concentrations on the Monongahela River under different flow conditions. Figures 3-4 and 3-5 show the modeled minimum DO concentrations along the Monongahela River from June 15 to September 30 during average and dry water years during project operations. During these operations, modeling predicts that DO concentrations would be lower immediately below each dam than above the dam, often below state standards, likely because (1) less water is spilled over the dam as more water is drawn through the turbines, so less aeration occurs at the dam, and (2) the powerhouses would withdraw water from the entire upstream water column, including deeper water that may contain lower DO concentrations because of pool stratification in the summer. However, DO concentrations are predicted to recover relatively quickly below each dam and return to levels well above state standards. In addition, DO concentrations in the lower river are predicted to generally increase to well above state standards at the confluence with the tributary Youghiogheny River, upstream of the Braddock Locks and Dam, and at the confluence with the Ohio River. This modeling was conducted for worst-case conditions (without any bypass flows). Other modeling conducted by the applicants showed that implementing bypass flows[34] at the projects could improve DO concentrations below each dam during operations. Although modeling predicts some reductions in DO concentrations at worst-case conditions below some of the dams, overall cumulative effects on DO concentrations in the Monongahela River would be minimal if bypass flows were utilized to reduce project-related impacts on DO concentrations.

---

[34] Because the projects would only be able to operate off of flows made available to them by the Corps (run-of-release), any flows released through dam gates or newly constructed spill gates (bypass flows) would be at the sole discretion of the Corps. The Commission has no authority to require the release of these flows.

The Braddock Project (FERC Project no. 13739-002) is about 30 miles downstream of Charleroi Locks and Dam and about 11 miles upstream of the confluence of the Monongahela and Allegheny Rivers in Pittsburgh, Pennsylvania. The recently licensed Braddock Project will operate in a run-of-release mode similarly to the currently proposed projects on the Monongahela River (FERC, 2014). DO concentrations entering the Braddock pool during operation of all proposed Monongahela River Projects are predicted to be similar to existing conditions regardless of water year. Operation of the Braddock Project was predicted to result in only small decreases in DO concentrations downstream of the Corps' gates (0.07 to 0.32 mg/L) and in the turbine discharge (0.14 to 0.35 mg/L) relative to simulated baseline conditions, based on hydrodynamic and water quality models (FERC, 2014). Lock+ Hydro Friends Fund XLII, LLC, the licensee for the Braddock Project, will also conduct DO monitoring for 5 years following the construction of the hydroelectric project, and for an additional 5 years at such time as the normal elevation of the Braddock pool increases during the term of the license as a result of the Corps' Lower Mon Project.[35] As such, cumulative effects on DO concentrations in the Monongahela River as a result of the proposed projects, in conjunction with the recently licensed Braddock Project, would be minimal.

The Allegheny River and Monongahela River join to form the Ohio River in Pittsburgh, Pennsylvania. The Allegheny Project would be the downstream-most hydroelectric facility on the Allegheny River, only 6.7 miles upstream of the river's confluence with the Monongahela River. Therefore, any effects of the proposed project on water quality could affect the downstream facilities on the Ohio River. However, the applicant's DO modeling indicated that DO concentrations within 1,600 feet upstream and 4,700 feet downstream of the proposed Allegheny Project are not predicted to decrease below 7.74 mg/L at any time. In addition, the applicant proposes a minimum bypass flow of 250 cfs during most of the year and a 900-cfs bypass flow June through September, when background DO concentration is usually lowest. Thus, DO concentrations should remain above state standards in the lower Allegheny River to its confluence with the Monongahela River.

The Upper Ohio River could be cumulatively affected by any changes in DO concentrations in both the Monongahela and Allegheny Rivers during operation of the

---

[35] The Corps' Lower Monongahela Locks and Dams 2, 3, & 4 Project (Lower Mon Project) was authorized by Congress in 1992 to address conditions at the Corps' three navigation facilities on the Lower Monongahela River. The remaining work includes: (1) removal of Locks and Dam 3; (2) replacement of Locks and Dam 4; (3) pool level changes; (4) substantial dredging; and (5) relocation of multiple shore-side facilities. Although the project was initially scheduled for completion in 2004, the Corps' current estimate for completion of the project is 2030.

proposed projects on those rivers. However, modeling potential cumulative effects on the Monongahela River shows that effects on DO concentrations would be limited to that basin. In addition, modeling showed that operations at the proposed Allegheny River Project would have minimal effects on DO concentrations. The applicants also modeled the potential cumulative effects of project operations, without bypass flows, on the Monongahela and Allegheny Rivers on DO concentrations on the Upper Ohio River, and found that those effects would be minimal. If bypass flows were released by the Corps before making flows available to the Monongahela and Allegheny Projects, any potential effects on DO in the Ohio River would be reduced further. Figure 3-6 shows the predicted differences in DO concentrations on the Ohio River upstream of the Ohio River Projects for water years with and without the operation of the Monongahela and Allegheny Projects. The maximum decrease in DO concentration when all upstream projects are operating would be 0.6 mg/L during a dry year, with most predicted decreases generally between 0.0 and 0.4 mg/L. Thus, a maximum predicted decrease of 0.6 mg/L from the combination of the Monongahela and Allegheny Projects would still maintain DO concentrations that are above the state standard at the Ohio River Projects. We previously described that the modeled DO concentrations at the three Ohio River Projects would be above 8 mg/L and nearly identical to existing conditions during operations (see figures 3-1 to 3-3). As such, overall cumulative effects on DO concentrations in the Ohio River would be minimal.

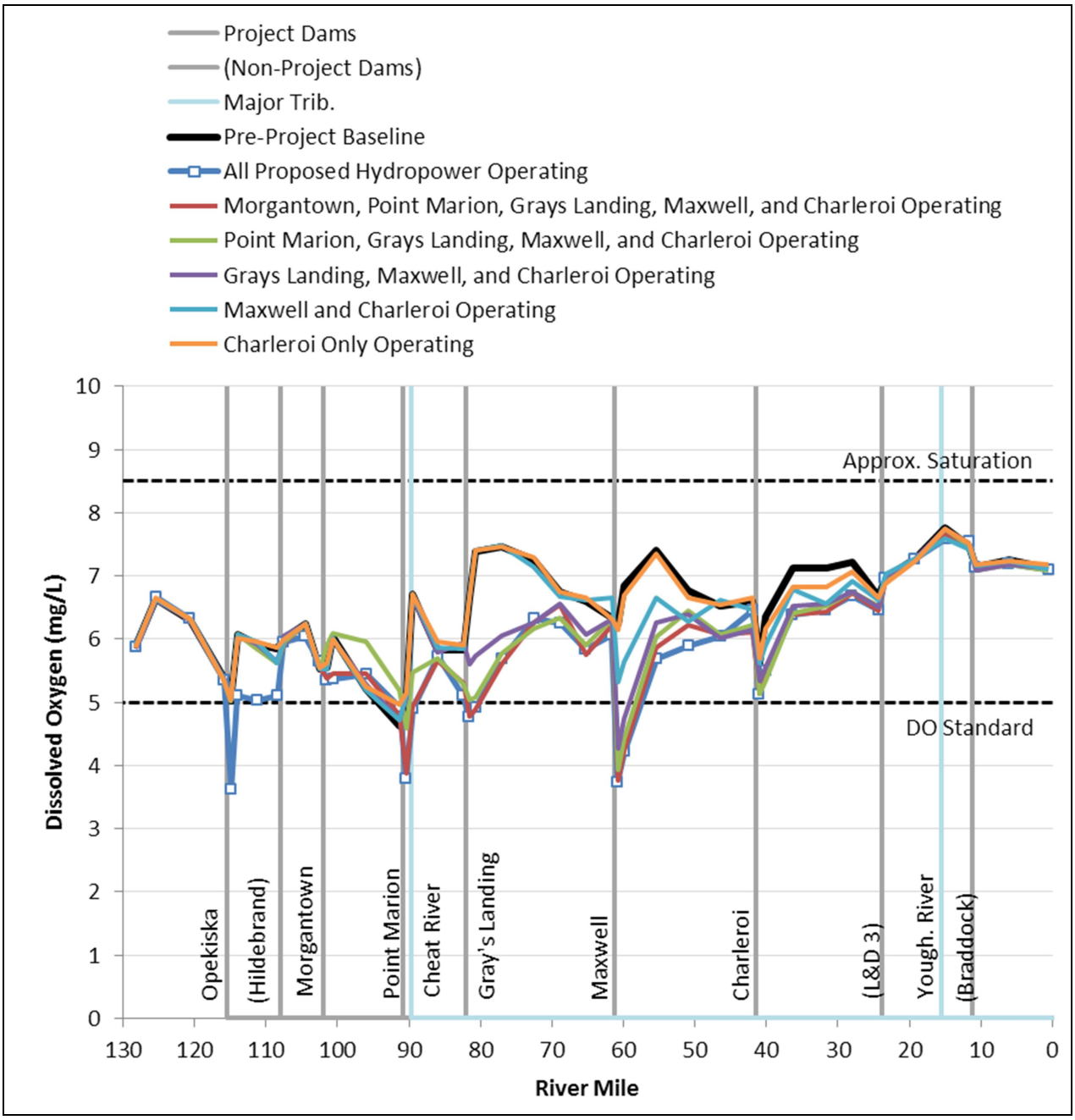

Figure 3-4. Modeled minimum DO concentrations along the Monongahela River between June 15 to September 30, 2009 (average year) (Source: Rye Development, 2014).

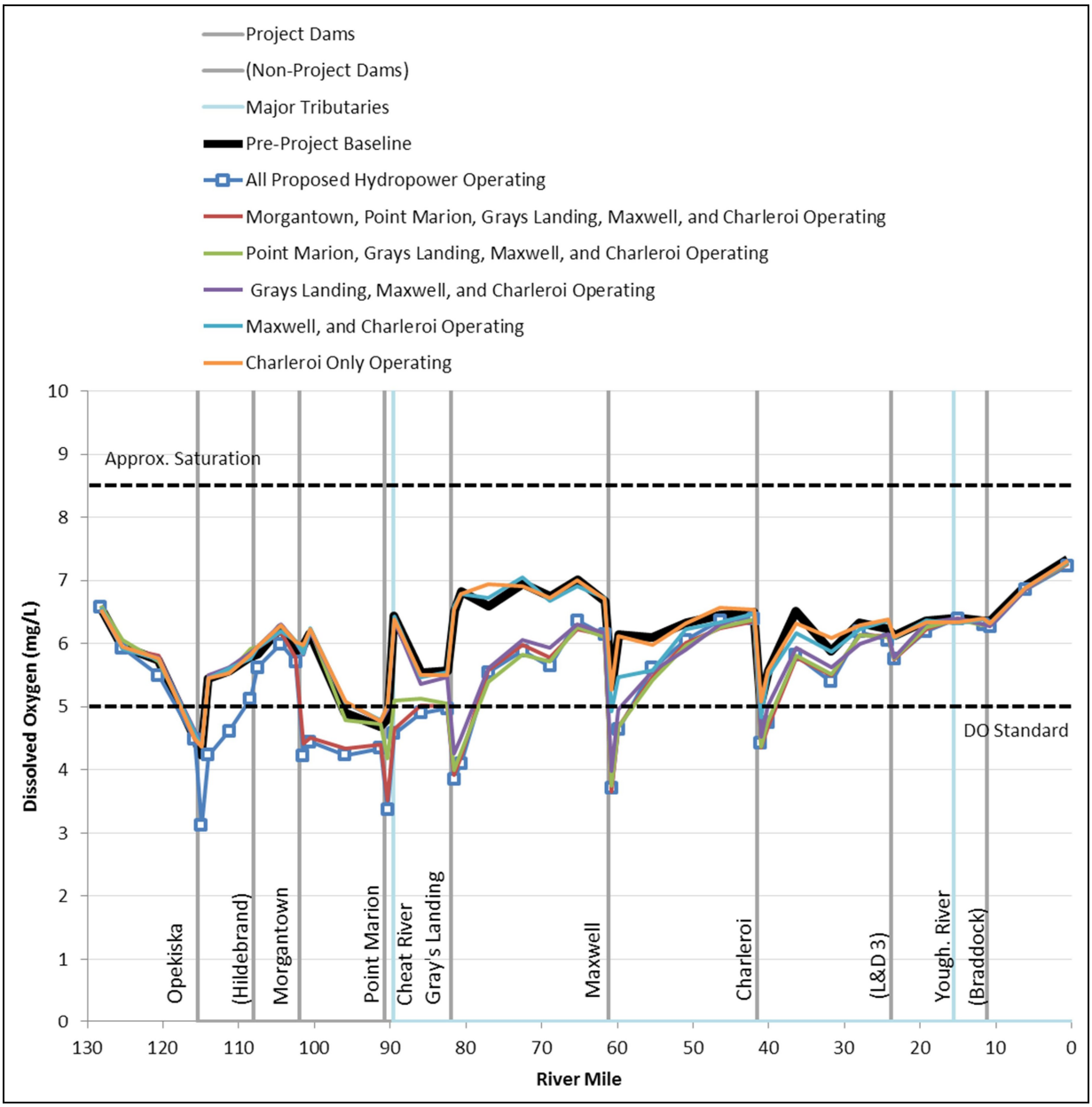

Figure 3-5. Modeled minimum DO concentrations along the Monongahela River between June 15 to September 30, 1999 (dry year) (Source: Rye Development, 2014).

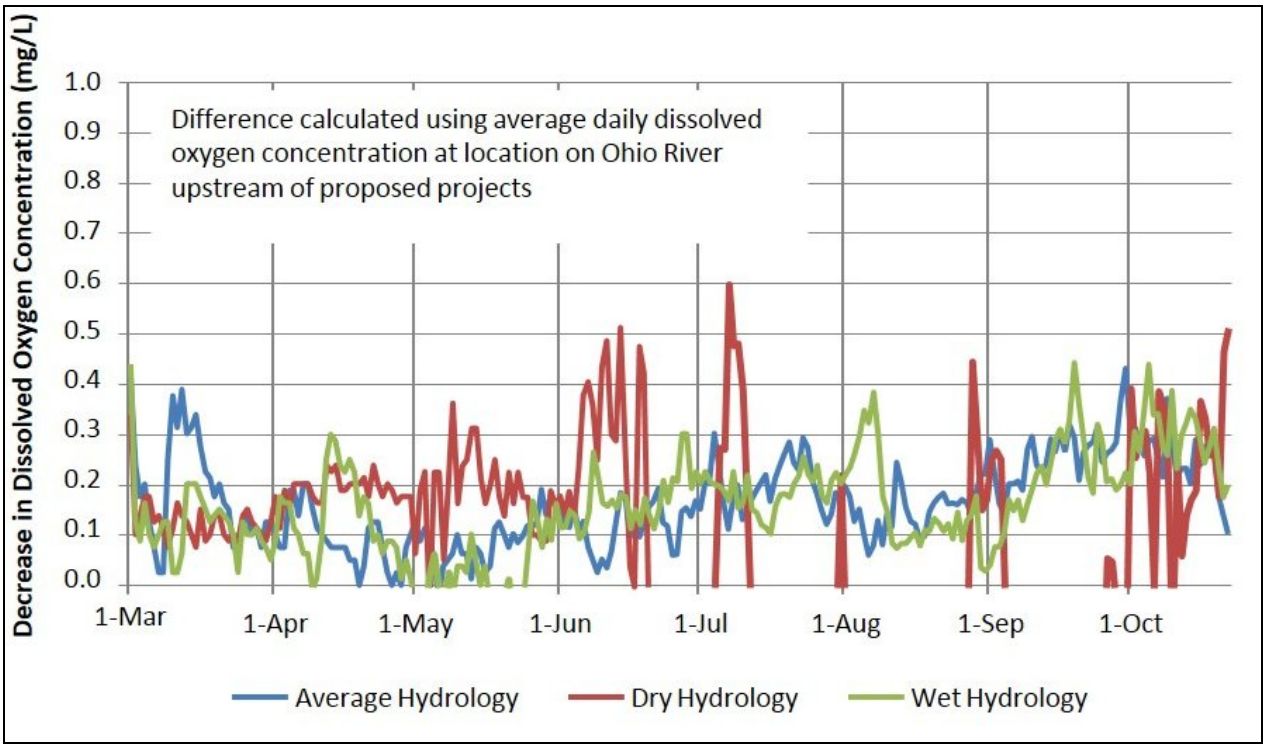

Figure 3-6. Difference in DO concentrations upstream of the Ohio River Projects, with and without the Monongahela and Allegheny Projects (Source: CDM Smith, 2014b).

Fisheries

The flow distribution in aquatic habitat downstream of the proposed projects would be altered by project construction and operation, and some decreases in habitat suitability could contribute to cumulative effects on fishery resources. However, under existing conditions the flow pattern downstream of each gated dam can change dramatically when gate openings are adjusted with changes in river flow, or when the Corps uses different gates to pass flows. Therefore, aquatic organisms are likely adapted to different and variable flow patterns downstream of the Corps' dams, and any effects of project-related modified flow patterns would be limited. While some fish species may lose some suitable habitat in certain areas of the proposed projects, losses would be relatively small, and the majority of suitable habitat would still be available. Because the proposed projects would have minimal effects on fish passage throughout the Upper Ohio River Basin, resident fish populations would maintain their current distribution, with some upstream passage available through the Corps' boat locks, and downstream passage available via spillage over the dams, through the locks, or through the proposed project turbines. Freshwater mussels would still have fish hosts available to complete their life cycle. Additionally, the projects would have minimal effects on mussel habitat, because suitable habitat for mussels is typically found outside of the proposed tailrace and intake areas, which are expected to experience the greatest habitat change. Mussel habitat

downstream of the proposed tailrace areas and dams would be affected by changes in velocity patterns, but these changes would increase suitability in some areas while decreasing suitability in other areas. Therefore, any individual mussels affected by project-related habitat modifications would not likely contribute to a cumulative adverse effect on the Upper Ohio River Basin mussel populations because there would be little net change in suitable mussel habitat.

Turbine-related injuries and mortality because of the operation of the proposed projects could contribute to cumulative effects on fishery resources. While some fish entrainment would occur, most fish entrained would be juvenile or smaller fish of the most common species that occur in the Upper Ohio River Basin. In addition, because of the fish-friendly characteristics of the proposed turbines (large, low-speed Kaplan turbines with low head), entrainment-related mortality rates at the projects would be relatively low. The high fecundities of most of the warmwater fish species that would be subject to entrainment would compensate for any mortality, reducing any population-level effects on resident species. The applicants' proposals to install trash racks with 3-inch clear bar spacing at the Monongahela River Projects and 5-inch clear bar spacing at the Allegheny and Ohio River Projects, with intake approach velocities of less than 2.0 fps, would also limit entrainment and impingement on project trash racks. Most fish would be able to avoid being drawn into the trash racks, and those that are drawn in would likely pass through the racks, with high survival rates through the turbines. Overall effects of any entrainment and impingement of resident fishes that may occur would not likely contribute to a cumulative adverse effect on the Upper Ohio River Basin fish populations.

3.3.3 Terrestrial Resources

3.3.3.1 Affected Environment

Botanical Resources

Emsworth and Emsworth Back Channel Projects

The proposed Emsworth and Emsworth Back Channel Projects are surrounded by existing development and industrial land use, and vegetation is limited to species common to disturbed areas. Opportunistic upland species, including Japanese knotweed and staghorn sumac, are dominant species within the proposed project boundaries. Some riparian forest is also present in the project vicinity, although it is constricted by adjacent development. Where present, the riparian forest is about 80 to 100 feet wide. At the Emsworth Project, the proposed 1,891-foot-long transmission line would follow existing road ROWs, crossing mowed lawns and concrete roadways associated with commercial and industrial development. At the Emsworth Back Channel Project, the 3,758-foot-long transmission line parallels Neville Road through an industrial area.

Montgomery Project

The Montgomery Project area has a steeply sloping, southern-facing aspect, and includes a narrow segment of riparian forest that is about 80 feet wide before it is bisected by a railroad line and is bound on the landward side by urban development. In some places along the downstream shoreline, the embankment becomes about 50 feet wide and consists of mainly rock. The proposed 392-foot-long transmission line, which spans from the powerhouse's substation to an interconnection point with a local utility on the north side of the proposed project, would travel along an existing road and cross a small residential area.

Invasive Species

The applicants consulted the U.S. Department of Agriculture plant database map of recorded occurrences of invasive species to identify invasive populations near the proposed projects. Additionally, site visits for biological studies in 2013 noted occurrences of invasive species in the vicinity of the proposed projects with potential to colonize disturbed areas. Table 3-22 lists the invasive species either encountered during these surveys, or known to occur in the vicinity, the projects.

Table 3-22. Invasive species occurring in the vicinity of the proposed Ohio River Projects (Source: Rye Development, 2015b).

Project	Invasive Species
Emsworth	Autumn olive, beefsteak plant, border privet, Canada thistle, cheatgrass, common buckthorn, common privet, common reed, dame's rocket, garlic-mustard, giant hogweed, glossy buckthorn, goutweed, Guelder rose, Japanese barberry, Japanese honeysuckle, Japanese knotweed, kudzu, lesser celandine, multiflora rose, Norway maple, Oriental bittersweet, porcelain-berry, princess-tree, purple loosestrife, Russian olive, Siberian elm, star-of-Bethlehem, Sycamore maple, tree-of-heaven, wild parsnip, and wineberry
Emsworth Back Channel	Autumn olive, beefsteak plant, border privet, Canada thistle, cheatgrass, common buckthorn, common privet, common reed, dame's rocket, garlic-mustard, giant hogweed, glossy buckthorn, goutweed, Guelder rose, Japanese barberry, Japanese honeysuckle, Japanese knotweed, kudzu, lesser celandine, multiflora rose, Norway maple, Oriental bittersweet, porcelain-berry, princess-tree, purple loosestrife, Russian olive, Siberian elm, star-of-Bethlehem, Sycamore maple, tree-of-heaven, wild parsnip, wineberry, and winged euonymus

Project	Invasive Species
Montgomery	Autumn olive, Canada thistle, cheatgrass, common reed, dame's rocket, garlic-mustard, Japanese barberry, Japanese honeysuckle, Japanese knotweed, Morrow's honeysuckle, Norway maple, purple loosestrife, star-of-Bethlehem, tatarian honeysuckle, tree-of-heaven, wild parsnip, and wineberry

Sensitive Plant Species and Communities

The applicants used the PNDI Environmental Review Tool[36] to identify sensitive species potentially occurring in the project areas. In Pennsylvania, sensitive species are managed by several agencies. The Pennsylvania Game Commission manages state-listed birds and mammals; Pennsylvania FBC manages state-listed fish and aquatic organisms (discussed in section 3.3.2, *Aquatic Resources*), reptiles, and amphibians; Pennsylvania Department of Conservation and Natural Resources (Pennsylvania DCNR) manages state-listed plants, natural communities, and terrestrial invertebrates; and FWS manages federally listed species (discussed in section 3.3.4, *Threatened and Endangered Species*).

The PNDI system coordinates the review of these agencies for specific projects and identifies species that could be affected by the proposed projects. As part of the review process, each agency determines whether further review or species-specific surveys are warranted. At the Montgomery Project, the PNDI results indicated the potential for effects on Silver Maple floodplain forest. This community typically exists along large rivers with well-developed floodplains. The applicant did not identify any silver maples in the Montgomery Project vicinity in its September 2015 survey. The PNDI results did not identify any potential for sensitive plants to occur at either the Emsworth or Emsworth Back Channel Projects.

The applicants found no wetlands during their wetland delineation surveys of the proposed project boundaries conducted in July 2013.

Wildlife and Species of Special Concern

Birds within the project areas are characteristic of deciduous forests of the south central and eastern region of the United States. The proposed project sites provide

[36] The PNDI is a web-mapping tool used to determine the location of sensitive plants, animals, and their habitats, including state and federally listed threatened and endangered species.

nesting and feeding habitat for common avian species including the American robin, mourning dove, northern mockingbird, red-winged blackbird, northern cardinal, tufted titmouse, warblers, eastern towhee, sparrows, Carolina and black-capped chickadee, vireo, flycatchers, and swallows. Waterfowl and shorebirds common to the project areas include American black duck, mallard duck, green-winged teal, merganser, grebe, heron, gulls, and pipers. Birds of prey such as osprey, owls, turkey vultures, kestrel, hawks (e.g., buteos, accipiters, and harriers), and bald eagle may also be present.

Other wildlife species expected to use the edge habitat available within the immediate project areas would be those tolerant of human development and activity (e.g., common raccoon, Virginia opossum, eastern gray squirrel, eastern chipmunk, and small rodents) and those that would use aquatic habitat within the rivers (e.g., muskrat, beaver, reptiles, and amphibians). Larger mammals such as red fox, coyote, striped skunk, and white-tailed deer may also occur in the project areas.

Prothonotary Warbler

The applicant used the PNDI Environmental Review Tool to identify sensitive wildlife species potentially occurring in the project areas. The PNDI results identified the Montgomery Project as having the potential to affect the prothonotary warbler (*Protonotaria citrea*), a state species of concern, and its preferred habitat, the silver maple floodplain forest.

The applicant performed a prothonotary warbler survey at the Montgomery Project on August 20, 2013. No prothonotary warblers were observed or heard within the proposed project area, and its preferred habitat, the silver maple floodplain forest, was not observed in the project area.

Osprey

The applicants' PNDI results for Emsworth and Emsworth Back Channel Projects required consultation with the Pennsylvania Game Commission to determine potential project-related impacts on osprey (*Pandion haliaetus*) and the need for surveys. The Pennsylvania Game Commission determined that no surveys were needed, but indicated that ospreys have been documented in the area of the proposed transmission line for both projects.

Osprey are federally protected under the Migratory Bird Treaty Act of 1918 and are listed as a threatened species in Pennsylvania. The osprey tolerates a wide variety of habitats, nesting in any location near a body of water, coastal or inland, that provides an adequate food supply. Fish are the primary prey for osprey, although they also feed on small waterfowl, mammals, and carrion. Osprey typically inhabit salt marshes, large inland rivers, lakes, ponds, and wetlands bordered by mature trees. Nests are usually built near water in large, often dead, trees but nests have also been found on channel

markers, telephone and transmission line poles, chimneys, and artificial platforms built specifically for birds' use. Preferred foraging habitat of local osprey populations was reported to be shallow water with low turbidity. Osprey pairs typically return in late March to early April to nest and depart by the end of September.

Bald Eagle

Bald eagles (*Haliaeetus leucocephalus*) were removed from the federal list of threatened and endangered species in 2007. This species, however, is still protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act, which prohibit the "take" of bald eagle eggs, nests, and offspring, except as permitted by regulation. Bald eagles migrate throughout North America and nest near large open bodies of water where tall trees and cliffs are available. The diet of bald eagles consists of dying or dead fish, birds, and mammal carcasses, including large herbivores such as livestock and deer. Bald eagles will also scavenge food from other fish-eating birds such as osprey, mergansers, herons, or other eagles.

In Pennsylvania, the bald eagle is generally a year-round resident, though immature birds may migrate in the spring and fall. Typically, these eagles stop over and forage along reservoirs and rivers, especially where shallow water is present. The status of Pennsylvania bald eagles is unknown, as the population is not marked by leg bands or other markings. It is assumed that most pairs remain close to their nesting territories throughout the year. In Pennsylvania, nesting and fledging activities occur from December through August (FWS, 2007). Some immature bald eagles can be nomadic for several years while others demonstrate natal fidelity in their second year (Buehler, 2000).

Bald eagles have been observed around the project areas (eBird, 2015). While no bald eagle nests have been observed at the projects, potential nesting and roosting habitat is likely available in trees located near open water in the project vicinities.

3.3.3.2 Environmental Effects

Effects of Project Construction, Operation, and Maintenance on Botanical Resources

At each of the projects, the applicants would construct a powerhouse, access road, parking lot, substation, and transmission line. The areas surrounding the proposed powerhouses, substations, and transmission lines would be temporarily disturbed by the staging of materials and equipment, as well as from construction activities such as excavation and road construction. These construction activities would involve removal of existing vegetation which could allow invasive plant species to spread or become introduced in disturbed areas. Project operation and maintenance would include mowing and trimming of tree branches to keep vegetation clear from the transmission lines.

To mitigate effects on existing plant communities, the applicants propose to develop transmission line corridor management plans that would: (1) include a protocol for trimming and removing vegetation in accordance with timing restrictions to protect sensitive wildlife species; (2) establish practices to prevent the establishment and spread of noxious or invasive weeds; (3) establish guidelines for revegetation activities in temporarily disturbed areas using native seeds; and (4) develop a protocol to train utility personnel about potential avian, terrestrial, and sensitive wildlife issues. The applicants propose to develop these plans after construction of the transmission lines are complete.

Our Analysis

Construction of generation facilities at the Emsworth and Emsworth Back Channel Projects would largely occur in areas currently inundated by the Ohio River, although the substation, access road, and shoreline stabilization measures would disturb 2.19 and 3.5 acres of land, respectively, most of which is currently disturbed areas or mowed grass. Construction of the transmission line would occur along an existing road in an industrialized landscape.

Construction of generation facilities at the Montgomery Project would largely occur in areas currently inundated by the Ohio River, although the substation, access road, and shoreline stabilization measures would disturb 0.96 acre of land, most of which is in low quality riparian forest. Construction of the transmission line would occur along an existing road in an urban landscape.

Tables 3-23 through 3-25 summarize the dimensions of proposed facilities and the area of expected vegetation disturbance.

Table 3-23. Areas of vegetation disturbance at Emsworth Locks and Dam (Source: Rye Development, 2015b, staff).

Facility	Acres (length x width)	Riparian Forest	Grass	Disturbed	Water
Transmission line	1.52 acres (1,893 feet x 35 feet)	0.12	0.37	1.03	0.00
Access road	0.27acre (420 feet x 28 feet)	0.19	0.00	0.08	0.00
Parking area	0.17	0.13	0.04	0.00	0.00
Riprap	0.44	0.16	0.00	0.00	0.28
Substation	0.07	0.05	0.02	0.00	0.00
Powerhouse	0.74	0.00	0.00	0.00	0.74
Total	3.17	0.65	0.43	1.11	1.02

Table 3-24. Areas of vegetation disturbance at Emsworth Back Channel (Source: Rye Development, 2015b, staff).

Facility	Acres (length x width)	Riparian Forest	Grass	Disturbed	Water
Transmission line	3.02 acres (3,758 feet x 35 feet)	0.00	0.00	3.02	0.00
Access road	0.05 (78 feet x 28 feet)	0.00	0.00	0.05	0.00
Parking area	0.52	0.18	0.00	0.19	0.15
Riprap	NA	0.00	0.00	0.00	0.00
Substation	0.06	0.00	0.00	0.06	0.00
Powerhouse	0.33	0.00	0.00	0.00	0.33
Total	3.93	0.18	0.00	3.32	0.48

Table 3-25. Areas of vegetation disturbance at Montgomery Locks and Dam (Source: Rye Development, 2015b, staff).

Facility	Acres (length x width)	Riparian Forest	Grass	Disturbed	Water
Transmission line	0.31 acre (392 feet x 35 feet)	0.05	0.00	0.26	0.00
Access road	0.25 acre (383 feet x 28 feet)	0.17	0.00	0.08	0.00
Parking area	0.44	0.31	0.00	0.00	0.13
Riprap	0.16	0.05	0.00	0.00	0.11
Substation	0.07	0.04	0.00	0.00	0.03
Powerhouse	1.44	0.00	0.00	0.00	1.44
Total	2.67	0.62	0.00	0.34	1.71

The establishment of early successional native vegetation, as part of the applicants' proposed transmission line corridor management plans, would aid in the reintroduction of native herbaceous forage and cover. Additionally, the applicants' proposal to incorporate BMPs to prevent the spread of invasive species into the

transmission line corridor management plans would reduce effects of invasive plants in the corridors.

However, the areas surrounding the proposed powerhouses, substations, and access roads would also be temporarily disturbed by the staging of materials and equipment, as well as from construction activities such as excavation and road construction. Vegetation removal could allow invasive or noxious plant species to become established in all areas where construction activities occur. The applicants' plans would be more effective at minimizing impacts to botanical resources if they were expanded to include the entire project areas rather than just the transmission line corridors. Additionally, development of the plans prior to construction of the projects would allow implementation of preventive measures to reduce impacts to botanical resources.

The applicants' proposals do not include a mechanism to monitor the effectiveness of the plans, or what actions to take if the plans are not successful. Further, the applicants' proposals do not include a schedule for reporting monitoring results to Pennsylvania DCNR, Pennsylvania Game Commission, FWS, the Corps, and the Commission, or a schedule for implementing the plans. To further reduce potential effects on botanical resources, effective plans would include, a monitoring program to evaluate the success of revegetation and invasive plant control efforts, including criteria that define when the measures are successful, a reporting schedule for filing monitoring results and progress reports with Pennsylvania DCNR, Pennsylvania Game Commission, FWS, the Corps, and the Commission, and an implementation schedule.

The applicants' proposed measures to revegetate the transmission line corridors and control invasive plants, expanded into project-wide vegetation management plans, developed prior to construction of the projects, with the inclusion of a monitoring program to evaluate the success of revegetation and invasive plant control efforts, including criteria that define when the measures are successful and a reporting and implementation schedule, would reduce impacts to botanical resources, including the spread or introduction of invasive plants.

Effects of Project Construction, Operation, and Maintenance on Wildlife and Species of Special Concern

Construction of the proposed project facilities would primarily occur in previously disturbed areas, thereby limiting construction-related effects on terrestrial habitat. Land uses in proximity to the proposed projects, including the transmission lines, are medium-density urban residential and industrial, and the proposed powerhouses would be established on lands managed and maintained by the Corps.

Our Analysis

The applicants would use heavy machinery to clear existing vegetation in preparation for construction of the powerhouse and other project-related facilities. Construction would also result in increased human presence within the projects' boundaries as well as increased levels of noise and artificial lighting. The increase of activity in each project area could disturb local wildlife, resulting in an increased risk of nest and den abandonment for birds and small mammals depending on the season and interference with foraging. However, most of the habitat in the project areas has previously been disturbed or is currently developed, and much of the existing wildlife is tolerant of disturbance. Further, disturbance to most terrestrial habitats during operation of the proposed projects would likely be minimal.

Avian Protection Plan

There are currently no known bald eagle nests in the proposed construction areas; however, there are suitable trees for bald eagles or osprey to use while foraging or roosting at all three Ohio River Projects. The proposed projects would require some clearing of riparian trees along the Ohio River, which could impact bald eagle and osprey habitat. Additionally, bald eagle, osprey, and other raptors can come into contact with transmission lines and associated electrical structures during flight, foraging, roosting, and nesting. Mortality due to interaction with transmission lines and electrical structures has been noted since the 1900s. Raptors and other large-bodied birds may be at higher risk for collision or electrocution due to their large size, hunting strategies, and nesting preferences (APLIC, 2006).

To protect raptors from electrocution and collision with project power lines, the applicants propose to develop avian protection plans in consultation with the Pennsylvania Game Commission and FWS. Specifically, the applicants' proposed plans would be developed in accordance with the APLIC and FWS guidelines.[37] Measures to address future transmission facility maintenance activities would also be addressed in the plan. The avian protection plans would include the following provisions: (1) if a bald eagle or other target species is discovered within the project boundary, the applicants would notify the Pennsylvania Game Commission and FWS within 30 days of discovery; and (2) prior to any tree clearing within the project boundary or areas immediately adjacent to the project boundary, the area to be cleared would be surveyed for target species nests by project staff. If any such nests are discovered, the Pennsylvania Game Commission and FWS would be consulted prior to tree-clearing activities.

---

[37] Staff assumes that the applicants are referring to the FWS' *National Bald Eagle Management Guidelines* (FWS, 2007).

The Pennsylvania Game Commission, in its letter dated March 18, 2015,[38] indicates that osprey have been documented nesting in the vicinity of the transmission line portion of the proposed Emsworth and Emsworth Back Channel Projects. The Pennsylvania Game Commission recommends specific measures to avoid and protect osprey at the projects during nesting, including: (1) no activities related to the transmission line portion of this project should be completed during the osprey nesting season, March 25 to July 31; and (2) complete all activities related to the transmission line outside the nesting season, between August 1 and March 24, to avoid potential impacts on nesting ospreys. The seasonal restriction is only requested on the transmission line portion of the projects and does not apply to work on the intake channels, spillway gates, crest gates, powerhouses, tailraces, substations, or access roads. In their September 18, 2015 letter, the applicants propose to comply with the construction restrictions during the osprey nesting season.

Our Analysis

The applicants' proposals to develop avian protection plans following APLIC and FWS' National Bald Eagle Management guidelines would reduce potential effects on species of special concern such as bald eagles, osprey, and other raptors during construction and operation of the proposed projects.

Preparing the plans in accordance with the guidelines would also help to protect raptors from switchyard equipment interactions by ensuring: (a) adequate separation of energized conductors, ground wires, and other metal hardware; and (b) adequate insulation. In accordance with the guidelines, the plans would include a mechanism to monitor the effectiveness of the plans, or what actions to take if the plans are not successful; a schedule for reporting monitoring results to the Pennsylvania Game Commission, FWS, the Corps, and the Commission; and a schedule for implementing the plans.

According to the Pennsylvania Game Commission, osprey are known to use the Emsworth and Emsworth Back Channel transmission line areas for nesting. The applicants propose to comply with the Pennsylvania Game Commission recommended construction restrictions during the osprey nesting season at the Emsworth and Emsworth Back Channel Projects. Specifically, no activities related to the transmission line portion of these projects should be completed during the osprey nesting season, March 25 to July 31, to avoid potential impacts on nesting osprey. Staff assumes that the applicants intend to include this measure in the avian protection plans for those projects.

---

[38] The March 18, 2015, letter was included with a PNDI report filed by the applicant on September 18, 2015.

Implementation of the proposed avian protection plans, and the osprey measures described above, would ensure that adverse effects on bald eagles, osprey, and other raptors would be avoided or minimized during construction, operation, and maintenance of the projects.

3.3.4 Threatened and Endangered Species

3.3.4.1 Affected Environment

Aquatic Species

In its letter filed February 11, 2016, FWS indicates that the Allegheny River is inhabited by four federally listed as endangered mussel species—the northern riffleshell (*Epioblasma torulosa rangiana)*, the clubshell (*Pleurobema clava)*, the rayed bean (*Villosa fabalis),* and the snuffbox (*Epioblasma triquetra*)—and one federally listed as threatened species, the rabbitsfoot (*Quadrula cylindrica cylindrica*).

Mussel surveys in the vicinity of each of the three proposed Ohio River Projects did not document any threatened or endangered species (Ecological Specialists, Inc., 2015). Furthermore, the results of PNDI reviews filed by the applicants on March 14, 2014 (Montgomery Project), and September 18, 2015 (Emsworth and Emsworth Back Channel Projects), for the three proposed projects indicated that no impacts on federally listed as threatened or endangered aquatic species are anticipated, and no further review was required. Although no listed aquatic species are known to occur in the vicinity of the projects, we provide information on the above-listed species' habitat and occurrence, including in the Upper Ohio River Basin.

Northern Riffleshell

Northern riffleshell was federally listed as endangered wherever found on January 22, 1993, and FWS finalized a recovery plan on September 21, 1994 (Watters, 1994). No critical habitat has been designated for this species. Habitat requirements include packed sand and gravel in riffles and runs. The historical range of northern riffleshell included a more widespread distribution throughout the Ohio River drainage, and farther north in Michigan and Ontario, Canada, in the tributaries of Lake Erie, Lake St. Clair, and the Detroit and St. Clair Rivers (Watters, 1994). Known hosts include brown trout, mottled sculpin, banded darter, and bluebreast darter (FWS, 2008).

Clubshell

Clubshell was federally listed as endangered on January 22, 1993, and FWS finalized a recovery plan on September 21, 1994 (Watters, 1994). No critical habitat has been designated for this species. Habitat requirements include clean, coarse sand and gravel in runs, often just downstream of riffles. The species does not tolerate mud or

slackwater and is very susceptible to siltation. Clubshell were historically common throughout the Ohio and Maumee River valleys, but now are reduced to 21 streams and 7 reproducing populations (Roley, 2012). Host fish species include the central stoneroller, striped shiner, blackside darter, and logperch.

Rayed Bean

Rayed bean was federally listed as endangered wherever found on March 15, 2012. No recovery plan has been finalized or critical habitat designated for this species. Rayed bean are usually found in or near shoal or riffle areas, and in the shallow, wave-washed areas of glacial lakes, including Lake Erie (FWS, 2012a). Rayed bean were historically distributed in more than 100 rivers, lakes, and streams across 10 states and Ontario, Canada. The range of rayed bean has been reduced to 31 streams and 1 lake across 7 states and Ontario. Potential fish hosts may include greenside darter, rainbow darter, mottled sculpin, and largemouth bass (FWS, 2012a).

Snuffbox

Snuffbox was federally listed as endangered wherever found on March 15, 2012. No recovery plan has been finalized or critical habitat designated for this species. Snuffbox was historically distributed across 210 streams and lakes in 18 states and Ontario, Canada. Current distribution is reduced to 79 streams in 14 states and Ontario, Canada. The species occurs in swift currents of riffles and shoals and wave-washed shores of lakes over gravel and sand with occasional cobble and boulders (FWS, 2012a). Juvenile snuffbox have successfully transformed on logperch, blackside darter, rainbow darter, Iowa darter, blackspotted topminnow, mottled sculpin, banded sculpin, Ozark sculpin, largemouth bass, and brook stickleback in laboratory tests (FWS, 2012a).

Rabbitsfoot

Rabbitsfoot was federally listed as threatened wherever found on October 17, 2013. No recovery plan has been published yet. FWS proposed critical habitat that includes a portion of the Allegheny River from the Interstate-80 bridge in Emlenton, Pennsylvania, upstream to the mouth of the French Creek tributary, on October 16, 2012 (FWS, 2012b); this habitat was finalized on April 30, 2015 (FWS, 2015). This designated critical habitat in the Allegheny River is about 93 RM upstream of the proposed Ohio River Projects. The historic range of rabbitsfoot included 140 streams within the lower Great Lakes Subbasin and the Mississippi River Basin. Rabbitsfoot primarily inhabit small to medium sized streams and some larger rivers. It usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity. Specimens also may occupy deep water runs, having been reported in 2.7 to 3.7 meters (9 to 12 feet) of water. FWS estimates that the species has been extirpated from 64 percent of its historic range and that only 22 percent of the extant population is viable (FWS, 2012b). Blacktail shiner, cardinal shiner, red shiner, spotfin shiner,

bluntface shiner, rosyface shiner, striped shiner, emerald shiner, and rainbow darter are host species for rabbitsfoot (Fobian, 2007; FWS, 2013a).

Terrestrial Species

FWS' Species Search website indicated that Indiana bats (*Myotis sodalis*) and northern long-eared bats (*Myotis septentrionalis*) are known to occur in the counties where the projects are located. Neither bat species was observed during general habitat surveys at the projects.

Indiana Bat

The Indiana bat is a migratory species found throughout much of the midwestern United States, hibernating colonially in caves, mines, and other underground areas (hibernacula) through the winter. The non-hibernation season (April 1 through November 15) includes spring emergence and migration, summer reproduction in maternity roosts, and fall migration, swarming, and mating. Summer foraging habitats are generally defined as riparian, bottomland or upland forest, and old fields or pastures with scattered trees, and small ponds or streams. Roosting/maternity habitat consists primarily of live or dead hardwood tree species that have exfoliating bark that provides space for bats to roost between the bark and the bole of the tree. Tree cavities, crevices, splits, or hollow portions of tree boles and limbs also provide roost sites for this species.

The Indiana bat was listed as federally endangered in 1967. Threats to Indiana bats include human disturbance in hibernacula, such as gates or other structures that exclude people from caves and mines, and summer habitat loss and degradation (FWS, 2013b). FWS designated critical habitat for the Indiana bat on September 24, 1976, consisting of 11 caves and 2 mines in 6 states: Illinois, Indiana, Kentucky, Missouri, Tennessee, and West Virginia. There is no designated critical habitat for the Indiana bat in Pennsylvania.

Northern Long-Eared Bat

The northern long-eared bat was listed as federally threatened on April 2, 2015. It is distinguished by its long ears and is a medium-sized nocturnal bat ranging from 3 to 3.7 inches in length and possessing shades of brown fur. Traditional ranges include most of the central and eastern United States, as well as the southern and central provinces of Canada, coinciding with the greatest abundance of forested areas. Similar to the Indiana bat, northern long-eared bat foraging habitat includes forested hillsides and ridges and small ponds or streams and it typically feeds on moths, flies, and other insects. Northern long-eared bats are typically associated with large tracts of mature, upland forests with more canopy cover than is preferred by Indiana bats. Northern long-eared bats seem to be flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices, and this species is known to use a wider variety of roost

types than the Indiana bat. Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat has also occasionally been found roosting in structures like barns and sheds.

As with Indiana bats, northern long-eared bats use caves or mine portals for winter hibernation between November 15 and March 31. These species also use the hibernacula and the areas around them for fall-swarming and spring-staging (August 15 to November 14 and April 1 to May 14, respectively). Some males have been known to stay close to the hibernacula during the summer and may use the hibernacula as summer roosts. There may be other landscape features bats use during the winter that have yet to be documented. No critical habitat has been designated for the northern long-eared bat.

The northern long-eared bat incurs a process of delayed fertilization. Reproduction is limited to one pup a year in late-spring, and as such, bat populations can be slow to rebound from anthropogenic and naturally occurring mortality events. Historically, some bat populations have been negatively affected by degradation or loss of habitat, and exclusion from caves and related human disturbance affecting hibernacula. More recently, white-nose syndrome has become the largest threat, causing the dramatic decline of the northern long-eared bat population with death rates for infected bats reaching 90 to 100 percent (FWS, 2016, 2014).[39]

White-nose syndrome was first observed in New York in 2006 and has since spread throughout the Northeast to the Midwest. Within the past several years, federal and state wildlife agencies have taken measures to protect hibernacula through signage, closures, and other means. FWS most recently finalized 4(d) rules for this species in January 2016, focusing on preventing effects on bats in hibernacula associated with the spread of white-nose syndrome and effects of tree removal on roosting bats or maternity colonies (FWS, 2016). In the recent rule, FWS proposes that take incidental to certain activities conducted in accordance with the following habitat conservation measures, as applicable, would not be prohibited (i.e., excepted from the prohibitions): (1) occurs more than 0.25 mile (0.4 kilometer) from a known, occupied hibernacula; (2) avoids cutting or destroying known, occupied maternity roost trees during the pup season (June 1–July 31); and (3) avoids clearcuts within 0.25 mile (0.4 kilometer) of known, occupied maternity roost trees during the pup season (June 1–July 31).

[39] White-nose syndrome is a fungal infection that agitates hibernating bats, causing them to rouse prematurely and burn fat supplies. Mortality results from starvation or, in some cases, exposure.

3.3.4.2 Environmental Effects

Freshwater Mussels

Currently, no populations of listed mussel species are known to occur in any of the project areas. As with the non-listed mussels, potential construction-related effects include direct mortality during cofferdam placement and excavation, elevated turbidity from erosion and sedimentation, and modified substrates from the construction of new discharge points for project tailraces. Potential operational effects include changes to the cross-sectional flow pattern, which could redistribute substrate and decrease habitat suitability. Also, change in flow distribution from the spillway gates to the turbines could reduce DO concentrations immediately downstream of each project during operation.

The applicants do not propose any specific measures to mitigate potential effects on federally listed mussel species. The Corps states that, prior to any construction or drawdown activities, the footprint of the powerhouses and any dewatered areas in the cofferdam footprints should be surveyed to determine presence/absence of federally listed species. The Corps also states that a contingency plan to either relocate or avoid federally listed mussel species would be necessary to avoid impacts, if any are identified. In Interior's letter filed February 11, 2016, FWS recommends consultation regarding potential impacts on federally listed threatened and/or endangered freshwater mussel species at any of the projects where such species are documented as occurring within the project's potentially affected area. In the same letter, FWS also recommends consultation regarding potential impacts on species that are under review for potential listing under the ESA, including the long solid, pyramid pigote, green floater, and round hickorynut mussels.

Our Analysis

The applicants surveyed the construction footprints at the Emsworth and Montgomery Projects in 2013 (Ecological Specialists, Inc., 2015), and did not find any federally listed species or any of the four species that are under review for listing. Surveys at the Emsworth Back Channel Project were just outside of the construction footprint, but also did not find any federally listed species. In addition, PNDI reports and agency consultation records filed by the applicants on March 14, 2014, and September 18, 2015, show that the proposed projects would have no effect on any threatened or endangered species of mussels, and no further coordination with the agencies is required for these species. As such, it would be unnecessary to conduct additional mussel surveys or to prepare a contingency plan, as recommended by the Corps, because no federally listed species have been documented in the vicinity of the proposed projects. Based on the above, we conclude that construction and operation of the projects would have no effect on federally endangered or threatened mussel species.

Indiana and Northern Long-Eared Bats

Project construction and operation could affect the Indiana and northern long-eared bats if the authorized actions resulted in the removal of suitable roosting and foraging habitat or the disturbance of bat hibernacula.

Our Analysis

Neither bat species was observed during general habitat surveys at the projects. Further, the PNDI report correspondence from FWS does not identify any known effects for either bat species and indicates that no further review is required.

Each project would disturb less than 1 acre of poor quality riparian forest. However, because the project sites are highly industrialized and disturbed, the riparian forest adjacent to the projects is unlikely to support roosting or foraging habitat for either species. All of the projects are also more than 10 miles from known hibernaculum and not near any known maternity roosts or summer detection sites. Therefore, construction and operation of the projects would have no effect on the Indiana bat or northern long-eared bat or their habitat.

3.3.5 Recreation and Land Use Resources

3.3.5.1 Affected Environment

Regional Recreation

Recreational opportunities in the region include powered and non-powered boating, fishing, camping, hiking, biking, hunting, and viewing wildlife. Tributaries and nearby lakes provide water-based opportunities in addition to those available on the Ohio River. Land-based opportunities exist at the 24 state parks, 2 state forests, 2 state game lands, and 3 wildlife areas located in the southwestern Pennsylvania region (Google Earth, 2015). Bradys Run County Park also provides many recreational amenities nearby within its 2,000-acre expanse.

There are four water trails and three major walking and biking trails in the southwestern Pennsylvania region (Pennsylvania FBC, 2011). Water trails include: Ohio River Water Trail from Pittsburgh, Pennsylvania, to East Liverpool, Ohio; Kiski-Conemaugh River Water Trail from Johnstown, Pennsylvania, to Freeport, Pennsylvania; Three Rivers Water Trail from Freeport, Pennsylvania, to Pittsburgh, Pennsylvania; and Youghiogheny River Water Trail from Connellsville, Pennsylvania, to McKeesport, Pennsylvania. Multi-use trails include: Three Rivers Heritage Trail, Bicycle PA Route A, and Montour Trail. Federal lands in the region include Allegheny National Forest, approximately 90 miles northeast of the projects in Pennsylvania; Friendship Hill National Historic Site, approximately 55 miles south of the projects in Pennsylvania; and

Ohio River Islands National Wildlife Refuge, approximately 60 miles southwest of the projects in West Virginia.

The numerous locks and dams of the Ohio River ensure navigability from Pittsburgh to its confluence with the Mississippi. Locks along the Ohio River are designed and operated for year-round commercial navigation, and recreational boaters may lock through each of its locks; however, there are some seasonal restrictions. The Ohio River provides opportunities for recreational boating without the horsepower restrictions that occur on sections of its tributaries (e.g., speed limits that limit opportunities such as water skiing). The Ohio River is also recognized for its recreational fishing opportunities. Anglers are drawn to the areas immediately downstream of the spillways opposite the locks.

Recreation at the Projects

Although many recreational opportunities exist in the region to meet both on-water and off-water recreation demand, within the proposed project boundaries for the Ohio River Projects, there is little recreation use. The Ohio River shoreline is highly industrialized, and access is limited by security restrictions and private property. In the less developed shoreline areas, steep topography and railroad tracks limit access. Both the Emsworth Locks and Dam and Emsworth Back Channel Projects would be constructed along the north and south shoreline of Neville Island, respectively, where angling is prohibited.[40] The Montgomery Project would be constructed on the north side of the dam, where some informal shoreline fishing occurs.

Emsworth Locks and Dam

The Emsworth Locks and Dam is located at RM 6.2 on the Ohio River in Emsworth, Pennsylvania (see figure 1-2), and is bisected by the Three Rivers Water Trail. A section of the mixed-use (hiking, biking, etc.) Three Rivers Heritage Trail (Chateau Trail) runs along the north shoreline of the Ohio River (locks side of dam). The Corps operates the two Emsworth locks on the north side of the dam, and recreational boaters may lock through either of the locks year round. The Corps reports an average of 470 commercial lockages every month, plus another 350-400 lockages a year for recreational purposes (Corps, n.d. (1)). There are no formal recreation facilities at the project; however, informal angling does occur both onshore and by boat in proximity to the locks and dam, with the greatest amount of use occurring during the summer. Shore-based fishing access on Neville Island is limited; however, anglers informally use the

[40] In its comments on Scoping Document 1 filed November 7, 2014, Pennsylvania FBC indicated that Neville Island is closed to anglers.

north bank of the river downstream of the lock facilities. Informal parking exists near the industrial buildings immediately adjacent to the north shore and also near the Emsworth Locks and Dam maintenance building. The nearest formal public parking area is located 1.6 miles downstream at the Kilbuck Access, which includes barrier-free parking. There is a free-access boat ramp, dock, and shoreline fishing area at the Kilbuck Access. Boat angling is popular downstream of the spillway.

Emsworth Back Channel

The Emsworth Back Channel is located at RM 6.8 on the Ohio River near Coraopolis, Pennsylvania (see figure 1-3). The dam holds the navigation pool on the south side of Neville Island and there are no locks at this dam. There are no formal recreation facilities or shoreline fishing access sites at this dam because of steep banks and railroad tracks that limit access along the south shore (opposite Neville Island). In addition, Corps security restrictions on Neville Island prevent shoreline access near the Emsworth Back Channel Dam; however, the area downstream of the spillway is popular with boat anglers. There are two private and fee-accessed boat ramps and docks downstream of the Emsworth Back Channel Dam (Groveton Boat Club and B&L Marina) on the south shore of the Ohio River (opposite Neville Island). The closest public fishing access point is located at the Kilbuck Access, described in detail previously.

Montgomery Locks and Dam

The Montgomery Locks and Dam is located at RM 31.7 on the Ohio River near Beaver, Pennsylvania (see figure 1-4). The Corps operates the two locks on the south side of the dam, and recreational boaters may lock through either of the locks year round. The Corps reports an average of 300 commercial lockages every month, plus another 150 lockages a year for recreational purposes (Corps, n.d. (2)). The primary recreational use in the immediate vicinity of the locks and dam is fishing, which is most popular during summer. Fishing access to the river on the lock side is restricted for security purposes; however, an informal fishing access point exists on the north bank. Anglers interested in fishing the north bank can park their vehicles on River Road, walk about 500 feet, cross the double railroad tracks, and fish upstream and downstream of the dam abutment. Shoreline fishing downstream of the dam occurs along about 300 feet of shoreline adjacent to an informal angler path, which is visible in aerial photographs. Both public and private recreational facilities exist 7 miles farther downstream at Monaca Access, Rochester Access, and Captain's Quarters Marina. Recreational boating does occur in the vicinity of the locks and dam; however, boater use is restricted within 300 feet downstream of the dam.

Regional Land Use

Land use in the Upper Ohio River Basin is predominantly non-urban, with forests representing the dominant land cover. Forests comprise 63 percent of the land use, followed by pasture/grasslands at 14 percent, row crops at 9 percent, bare land at 5 percent, residential at 4 percent, commercial and industrial developments at 3 percent, wetlands at 1 percent, and open water at less than 1 percent. The dominant land uses in proximity to the proposed projects, including the transmission lines, are medium-density urban residential and industrial. Developed land is largely concentrated along the Ohio River shoreline, where industrial infrastructure is prominent. The proposed powerhouses would be established on lands managed and maintained by the Corps.

No portion of the Upper Ohio River Basin is included in the list of wild and scenic rivers. However, Interior named the Three Rivers Water Trail a National Recreation Trail in 2010, and the Ohio River is part of the Federal Marine Highway Corridor M-70, which begins in Pittsburgh and connects to the M-55 Corridor in St. Louis, Missouri (Port of Pittsburgh Commission, n.d.).

3.3.5.2 Environmental Effects

Effects of Project Construction and Operation on Recreation

The applicants filed a recreation resource management plan for the Ohio River Projects on September 18, 2015, that characterizes recreation opportunities in the vicinity of the dams (Rye Development, 2015c). The plan contains provisions to minimize or mitigate project-related construction effects on recreation resources at the Montgomery Project during construction and over the term of a future license. At the Montgomery Project, the applicant proposed to install an accessible/barrier-free fishing platform in the project tailrace with a walkway from the project parking area and provide eight vehicle parking spaces once construction is complete. The plan indicates that there were no recreation activities or anticipated project-related effects on recreation at the Emsworth and Emsworth Back Channel Projects. As such, the plan does not include any recreation measures for those projects.

In its letter filed March 4, 2016, the Corps states that the applicants do not adequately address the effects on recreation and do not provide sufficient mitigation measures. The Corps requests that the applicant assess recreational effects and propose mitigation measures that include alternatives for boating, hiking, and fishing. In its letter filed February 19, 2016, Pennsylvania FBC expresses concern for the lack of angler access and requests additional study to identify potential loss of angler access at the Emsworth Back Channel and Montgomery Projects and recommends mitigation measures if loss of angler use occurs. Pennsylvania FBC also comments that one of the best large walleye fishing spots for the entire Ohio River is located at the proposed

location of the Montgomery Project and recommends the addition of angler access as close to the dam and tailrace as possible as mitigation for loss of access.

Our Analysis

Emsworth Project

Because of the industrialized nature, private property, and angling restrictions within the area that greatly limit recreation access, construction effects on recreation resources are not anticipated at the Emsworth Project. Boaters using the Three Rivers Water Trail would continue to have unrestricted access to lock through the dam during project construction. Access to the Three Rivers Water Trail by way of Pennsylvania FBC's Kilbuck Access would remain unchanged because this access point is located 1.6 miles downstream. Use along the Three Rivers Heritage Trail (Chateau Trail), including hiking, biking, and other uses, would not be affected by project construction because this trail is located on the north side of the river, opposite the proposed project location. During project construction and operation, fishing from boats downstream of the dam would continue to be allowed; however, the flow patterns and distribution of sportfish may change within about 2,500 to 3,500 feet downstream of the dam as discussed previously in section 3.3.2.2, *Operational Effects on Aquatic Organisms and Habitat.*

During project operation, a portion of the water that previously passed through the dam gates would now pass through the project turbines in the powerhouse. The change in hydraulic flow patterns is not likely to have a significant effect on recreational boating immediately downstream of the dam because the next downstream lock and dam holds the reservoir elevation stable for navigation. Although flow patterns immediately downstream of the dam and powerhouse would change, these changes would be modest and boaters would not experience changes in river depth.

Emsworth Back Channel Project

The proposed Emsworth Back Channel Project would be located on the north side of the dam (south side of Neville Island). The proposed project would be within a highly industrialized area on Neville Island, which is closed to shoreline angling for security purposes.[41]

Because there are no recreation activities or facilities in proximity to the Emsworth Back Channel Dam, no construction effects on recreation resources are

[41] *See* page 11 of the recreation resource management plan filed on September 18, 2015.

anticipated, and no further study of recreation access is needed. Access to the Three Rivers Water Trail would remain unchanged, because the water trail only passes through the main channel at Emsworth Locks and Dam and would not be affected by construction at Emsworth Back Channel Dam. During project construction and operation, fishing from boats would continue to be allowed; however, the pattern and distribution of sportfish may change within about 1,000 to 2,500 feet downstream of the dam as discussed in section 3.3.2.2, *Operational Effects on Aquatic Organisms and Habitat.*

During project operation, a portion of the water that previously passed through the dam gates would now pass through the project turbines in the powerhouse. The change in hydraulic flow patterns is not likely to have a significant effect on recreational boating immediately downstream of the dam because the next downstream lock and dam holds the reservoir elevation stable for navigation. Although flow patterns immediately downstream of the dam and powerhouse would change, these changes would be modest, and boaters would not experience changes in river depth.

Montgomery Project

The proposed Montgomery Project would be located on the north river bank near the informal angler access. Access to informal shoreline fishing downstream of the dam, as well as to the path used to access the north side of the river, would be restricted during project construction. Access restrictions during construction could last up to 36 months. After construction is complete, the informal shoreline angling area downstream of the dam would be permanently lost. The informal shoreline angling area upstream of the dam could remain accessible during construction; however, it is not clear from the applicant's proposed recreation management plan if public access to that area would remain open during construction. After construction is complete, access to the upstream shoreline angling area should not be affected. Placement of signs and fencing during construction would ensure public safety during construction activity.

The applicant's proposed barrier-free fishing platform would mitigate for the loss of existing informal angler access while addressing the needs of the disabled. Providing formal parking facilities would encourage recreation at the site while accommodating existing users. These proposed measures would enhance the existing recreation opportunities by providing a formal fishing area at the Montgomery Project.

To continue providing access to a well-known and regularly used fishing location during construction, the applicant could provide temporary angling access downstream of the construction site such as a staircase and fishing pier. It would be a reasonable accommodation for the loss of angling during the construction period. Continued access during and improved access after construction would eliminate the need for further studies to identify the potential loss of angler access.

Recreational boating should not be disrupted during construction, because boating use is already restricted within 300 feet of the dam, and most boaters would likely only use the lock side of the river to pass upstream or downstream when locking through. During project construction and operation, fishing from boats in the vicinity of Montgomery Dam would continue; however, the pattern and distribution of sportfish may change within about 4,000 to 6,000 feet downstream of the dam as discussed previously in section 3.3.2.2, *Operational Effects on Aquatic Organisms and Habitat.* There are no recreational resources along the south side of the Ohio River that would be directly affected by construction or operation of the Montgomery Project.

During project operation, a portion of the water that previously passed through the dam gates would now pass through the project turbines in the powerhouse. The change in hydraulic flow patterns is not likely to have a significant effect on recreational boating immediately downstream of the dam. Flow patterns immediately downstream of the dam and powerhouse would change from general flow through the gates to one of moving water concentrated along the tailrace side of the river; however, these changes are likely to be modest, and boaters would not experience changes in river depth because the next downstream lock and dam holds the reservoir elevation stable for navigation (New Cumberland pool). The change in flow patterns would likely improve the quality of angling in this area because fish tend to be attracted to the moving water from hydropower tailraces and could concentrate fish along the tailrace side in proximity to the proposed fishing platform.

Land Use

Each project would require construction of a new powerhouse and transmission line that connects the proposed substations to the local utility distribution lines. Construction could cause a temporary, localized disruption of existing land use in the immediate vicinity of the projects.

The applicants propose to incorporate measures to minimize disruptions to existing land use into their final construction plans, but have not specifically described any protection, mitigation, or enhancement measures related to land use.

No entities filed comments or recommendations regarding land use at the three Ohio River Projects.

Our Analysis

Because the proposed powerhouses at the Emsworth and the Emsworth Back Channel Projects would be located on Neville Island where industrial warehouses are prominent, they would be consistent with the surrounding land uses.

Construction and operation of the Montgomery powerhouse at the north shore dam abutment would be consistent with the nature of the infrastructure in the immediate area (dam and railroad tracks). However, because the Montgomery Project would be located within 170 feet of a residential area, it would stand out from the existing adjacent land use. In addition, the active rail line adjacent to the Montgomery Project operated by Norfolk Southern Railway would require the applicant to consider the railroad schedule during construction so as not to affect use of the railroad or endanger construction employees. Given the presence of the railroad tracks and the proximity to the dam, there would be no change in land use outside the proposed project boundary.

Heavy machinery and materials could block access to the informal recreational resources in the immediate area of the Montgomery Locks and Dam. Access to shoreline fishing locations near the Montgomery Dam would require temporary restriction during specific construction phases. Recreation activities such as nature observation and fishing from shore would be disrupted during project construction. However, these effects would be temporary. The proposed fishing platform and parking area would be a beneficial change from informal to formal recreation sites. Operation of the powerhouse would not have any noticeable changes to any land uses adjacent to the project boundary.

The project boundaries shown in the Exhibit G drawings filed with the license applications incorporate more land and Corps' facilities than needed to operate and maintain the projects, thereby potentially affecting land use in an area that is larger than necessary. The Exhibit G drawings should include only the principal project works necessary for operation and maintenance of each project, including any recreational facilities.

3.3.6 Aesthetic Resources

3.3.6.1 Affected Environment

The proposed projects would be established in the Ohio River and on lands owned and maintained by the Corps. The main features within the vicinity of the proposed projects are the existing locks and dams and neighboring industrial developments. The Ohio River has a rich history of industrial development along its course, and the visual landscape in the project areas is dominated by stretches of riverfront industrial properties that receive and send goods up and down the river. The river is used for shipment of goods and services, and both shorelines support multiple sets of railroad tracks further crowding the views with evidence of industry and development. Both the Emsworth Locks and Dam and the Emsworth Back Channel Dam are located on Neville Island, which is developed with warehouses, light industry, shipping and distribution terminals, transmission and distribution lines, and large chemical production and storage facilities visible throughout the area. Public access to the areas in proximity to the dam abutments where the proposed powerhouses would be built is restricted. Unobstructed views of the

Emsworth and Emsworth Back Channel sites are difficult to find and are limited to views from public roadways in the vicinity.

The Montgomery Locks and Dam is located near the small community of Industry, Pennsylvania, which sits atop a bluff overlooking the Ohio River. The proposed dam abutment where the powerhouse would be constructed is separated from the community by a double set of railroad tracks that run parallel with the river at the toe of the bluff. Hillslopes between the residential development and the railroad tracks, as well as the shorelines between the railroad tracks and the river, are covered in deciduous vegetation. Because of the topography between the residential developments and the proposed powerhouse location, there are few unobstructed views. The south bank is void of development and is lined by deciduous vegetation upstream and downstream of the locks, which limits opportunities to view the river or the proposed project location from the south side of the river.

Because of the industrial and residential land uses adjacent to the Ohio River, some trash enters the river along with typical organic debris such as dead trees. This debris can build up behind the Corps' dams but is eventually passed downstream in accordance with the Corps' existing management practices.

3.3.6.2 Environmental Effects

Following project construction, facilities, including the powerhouses and transmission conveyance systems, would be visible to recreational boaters and shore-based recreationists, as well as to residents in the neighborhoods adjacent to the Montgomery Locks and Dam. The applicants propose to conduct post-construction site restoration at each project site, so as to preserve the current aesthetics at those areas temporarily affected by construction.

Both man-made trash and organic debris would continue to pass through the Corps' dams during construction. However, when the proposed projects are operating, water would be drawn through the powerhouse, and debris would concentrate and build up against the trash racks. Therefore, the applicants propose to remove and properly dispose of any non-organic debris or trash that is collected during trash rack cleaning.

No agencies or other entities made recommendations regarding project aesthetics.

Our Analysis

Project construction would require the use of machinery and equipment and increase vehicular traffic at each site. Increased truck traffic and construction activities would produce dust that would create visible nuisances for people in proximity to the sites. Proposed construction equipment would produce noise levels between 84 and 90 decibels within 50 feet. Construction may temporarily disrupt both audio and visual

resources in the vicinity, although these effects would be temporary and minimal because project-related construction activities would be comparable to ongoing industrial activities in the vicinity of the projects. Restoring the landscape after construction is complete, as the applicants propose, would ensure that the existing visual character is maintained and/or improved.

Operation of the proposed projects would not meaningfully alter water levels as discussed previously in section 3.3.3.2, *Operational Effects on Water Quantity*. As such, operations would not affect shoreline conditions or waterfront views in the area. The powerhouse itself, new power lines, substations, and roads may have a small effect on the existing visual conditions, but these facilities would be located in an industrialized setting and are not expected to contrast significantly from the existing utility facilities, buildings, and other structures near the sites.

In addition, in their HPMPs, the applicants propose to design project facilities with low profiles and to blend any new facilities with their surroundings to the extent possible (as discussed in the following section); however, the applicants have not provided details on how this would be accomplished. Revising the HPMPs, in consultation with the Corps and the Pennsylvania SHPO, as the applicants propose, would likely ensure that effects on the surrounding landscape are minimized and reduce the visual effect of project facilities on aesthetic values. Consulting with the Pennsylvania SHPO would ensure the powerhouses and additional structures would have a compatible appearance, to the greatest extent possible, with the existing landscape and dam features and ensure that native species are used for any vegetative screening. Also, constructing the proposed powerhouses and other project facilities with materials that blend with the existing architecture and colors would make the project structures less visually and aesthetically disruptive to viewers. Furthermore, the applicants' proposal to restore the landscape after construction would ensure effects on aesthetics and historic properties are minimized and could be included in the HPMPs.

The presence of trash and other debris, especially when concentrated behind dams, can affect the visual character of the river. Disposing of trash collected during trash rack cleaning would improve the existing visual conditions. However, it is unclear what specific kinds of debris would be passed downstream or removed from the river, whether the applicants intend to temporarily store trash on-site, or how often debris would be removed from the projects. Therefore, development of a debris management plan, in consultation with the Corps and Pennsylvania FBC, which includes the applicants' proposed measure to separate and remove trash from the river would ensure that debris is sorted, stored, and disposed of appropriately. A debris management plan could include, but not be limited to, the following provisions: (1) procedures for separation of organic and inorganic trash; (2) procedures for any storage and off-site disposal of inorganic material; (3) procedures for reintroducing organic debris collected on the trash rack to the Ohio River downstream of the dam, as appropriate; and (4) an implementation schedule.

3.3.7 Cultural Resources

3.3.7.1 Affected Environment

Section 106 of the NHPA requires the Commission to evaluate potential effects on properties listed or eligible for listing in the National Register prior to an undertaking. In this case, the undertaking is the issuance of original licenses for each of the proposed projects. Project-related effects could be associated with the construction, operation, and maintenance of the proposed projects.

Historic properties are defined as any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. Traditional cultural properties are a type of historic property eligible for the National Register because of their association with cultural practices or beliefs of a living community that are: (1) rooted in that community's history or (2) important in maintaining the continuing cultural identity of the community. In this EA, we also use the term cultural resources to include properties that have not been evaluated for eligibility for listing in the National Register. In most cases, cultural resources less than 50 years old are not considered eligible for the National Register.

Section 106 also requires that the Commission seek concurrence with the Pennsylvania SHPO on any finding involving effects or no effects on historic properties and allow the Advisory Council on Historic Preservation (Advisory Council) an opportunity to comment on any finding of effects on historic properties. If Native American properties have been identified, section 106 requires that the Commission consult with interested Native American tribes that might attach religious or cultural significance to such properties.

On October 11, 2012, the Commission designated the applicants as the non-federal representatives for carrying out day-to-day consultation regarding the licensing efforts pursuant to section 106 of the NHPA. However, the Commission remains largely responsible for all findings and determinations regarding the effects of the proposed projects on any historic property, pursuant to section 106.

Areas of Potential Effects

Pursuant to section 106, the Commission must take into account whether any historic property could be affected by the issuance of licenses for the proposed Ohio River Projects within each project's APE. According to the Advisory Council's regulations, an APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist" (36 CFR § 800.16(d)) (2014).

The APE for each project include: (1) all lands within the proposed project boundary (as described in section 2.2.3, *Proposed Project Facilities*, and depicted in figures 1-2 through 1-4; and (2) lands outside the project boundary where project construction and/or operation may affect historic properties. Each of the HPMPs filed on October 6, 2015, contains a brief description and map of the project APE. In each description, two APEs are identified: one for above-ground structures and one for archaeological resources where project-related ground disturbance would occur. In all of the HPMPs, the APE for above-ground structures extends beyond the proposed project boundary, while the APE for archaeological resources is described or depicted as contained within the project boundary. In a letter attached to the HPMPs,[42] the Pennsylvania SHPO concurs with the definition of the APEs for the Emsworth, Emsworth Back Channel, and Montgomery Projects.

Cultural History Overview

The following discussion of the cultural context of the projects is adapted from the HPMPs for the three proposed projects (Barrett et al., 2015a,b,c).

Prehistoric occupation of the Ohio River Basin is generally divided into four temporal periods: (1) the Paleoindian period (prior to 8,000 B.C.); (2) the Archaic period (8,000-1,000 B.C.); (3) the Woodland period (1,000-1,600 A.D.); and the Protohistoric period (1,600-contact). The Archaic and Woodland periods are commonly subdivided into early, middle, and late periods. The Paleoindian period is characterized by highly mobile bands of hunter-gatherers traversing the landscape in search of food and high-quality stone tool material. Paleoindian archaeological sites are often identified by the presence of distinctive fluted projectile points, called Clovis points. In the Upper Ohio Valley, the Paleoindian period begins with Clovis points, but projectile points change over the period. Archaeological sites from this period are generally rare because of their age and ephemeral nature. The Meadowcroft Rockshelter, in Washington County, Pennsylvania, not only dates to the Paleoindian period but may be the earliest documented occupation of North America.

The Archaic period is characterized by a change in subsistence strategy as people began relying on smaller game and increased their reliance on plant materials. This shift is often considered a response to changes in climate and environmental conditions. Changes in subsistence sources required different tool technologies; projectile points became smaller and tools associated with plant collection and processing begin to appear in the archaeological record. Although the Archaic period is not well understood in this

[42] The May 18, 2015, correspondence was included in the HPMPs filed on October 6, 2015.

region, archaeological sites dating to this period have been found in the Ohio River Basin. Archaeological evidence indicates that population increased as people moved to exploit different resources.

The shift to the Woodland period is commonly marked by the development of horticulture and appearance of ceramics. Woodland peoples used uplands and smaller streams more frequently than their Archaic ancestors, and their habitation sites, commonly located along floodplains, tended to be more permanent. Increasing sedentism went hand in hand with the adoption of horticulture, which required people to tend their growing plants. However, hunting and gathering subsistence activities continued, and in some areas may have increased. By the end of the Woodland period, people were predominantly relying on agriculture, including maize cultivation, supplemented by hunting and gathering. Changes in burial patterns, the construction of mounds, and material culture suggest changes in ceremonialism and social complexity during this period.

Little is known about the Protohistoric period (seventeenth century) in southwestern Pennsylvania. Captain Henry Fleet commanded an expedition to the headwaters of the Potomac and encountered indigenous settlements, but the expedition did not enter the area of the proposed projects. Archaeological evidence indicates that much of the area was abandoned during this time, and it appears that the indigenous peoples were displaced into the Ohio River Valley and adjacent Susquehanna and Allegheny River valleys. Populations in these areas were mixed, and included people affiliated with the Delaware, Shawnee, Iroquois, Seneca, and other tribes. Glass trade beads have been recovered from several villages, indicating that these communities persisted into the seventeenth century and had contact, probably indirectly, with Europeans.

The French and British began to settle along the rivers west of the Allegheny Mountains around 1730. This settlement led to increased tension among the British, French, and Native Americans as they sought control over land and economic opportunities. The tensions in the Ohio River area and northeastern North America in general led to the French and Indian War in the 1750s. The Ohio River and its tributaries were again a pivotal battle location during the Revolutionary War as the Americans held this position and used it to launch an offensive against the British and their Native American allies for control of the western extent of the Ohio River.

After the Revolutionary War, settlement increased in western Pennsylvania. The Ohio River was integral to transporting resources throughout the area. Although coal was the most common resource moved along the river, crops and other commercial products were also transported. Railroads were constructed along the river during the nineteenth century, but the river continued to be important for transporting commercial products.

Problems such as snags and sandbars created some difficulties in navigating the river, and, beginning in the nineteenth century, Congress appropriated funds to address safe navigation along the Ohio River. By the mid-nineteenth century, the Corps decided to construct a lock and dam on the Ohio River to aid navigation. Davis Island Lock and Dam was completed in 1885 and led to the construction of additional locks and dams. Increased river traffic in the early twentieth century led the Corps to complete a series of improvements to the Ohio River locks and dams. The recent reduction in coal production in the area has impacted the amount of traffic on the river. Table 3-26 details the history of construction and modification of the locks and dams considered in this EA.

Table 3-26. Corps locks and dams: Construction/alteration history (Source: staff).

Project	Period(s) of Construction/Alterations
Emsworth Locks and Dam	1919–1922: Initial construction
	1935–1938: Reconstructed
Emsworth Back Channel Dam	1919–1921: Initial construction
	1935–1938: Reconstructed
Montgomery Locks and Dam	1932–1936: Initial construction
	1960s: Lock gate walls extended
	1989: Lock turbines replaced, lock guard walls resurfaced and raised (1 foot), lock gates upgraded, service building constructed

Prehistoric and Historic Resources

The applicants completed Phase I cultural resource surveys in 2013 for the three proposed projects. The surveys for archaeological resources were initiated with a background search to identify previously documented resources within the APEs. Additionally, a pedestrian field reconnaissance of the portion of each APE that could be affected by direct ground disturbance was completed to confirm areas of prior disturbance and to identify any additional archaeological resources. Portions of the Emsworth and Emsworth Back Channel APEs that would not be subject to project-related ground disturbance were not surveyed. All surveys were documented on a Pennsylvania record of disturbance form (Schumer and Gundy, 2014a,b).

A survey of above-ground resources was also completed for each proposed project (Kuncio and Ricketts, 2014a,b). These surveys documented all of the architectural structures located within the APE for each project, regardless of the age of the structure. A portion of the APEs for the proposed Emsworth and Emsworth Back Channel Projects was not surveyed for architectural resources for unknown reasons.

The Ohio River Navigation System has been documented as a multiple property, National Register-eligible resource. The system consists of 53 locks and dams located between Pittsburgh and the Ohio River/Mississippi River confluence. The first lock and dam (Davis Island) was completed in 1885, and the remaining dams were completed in the early twentieth century (Barrett et al., 2015a). Many of these dams have been determined eligible for the National Register including the Emsworth Locks and Dam, Emsworth Back Channel Dam, and the Montgomery Locks and Dam. The Emsworth Locks and Dam, Emsworth Back Channel Dam, and the Montgomery Locks and Dam are eligible under Criterion A for their association with New Deal relief and public works program and for their contribution to the history of navigation in the Ohio Valley. They are also eligible under Criterion C for their engineering significance. All three locks and dams are contributing elements to the Ohio River Navigation System.

In addition to the Ohio River Navigation System and the existing locks and dams, 18 additional cultural resources were identified within the APEs for the Ohio River Projects. Eight of these resources were previously recorded, including three railroad segments and the Ben Avon Historic District, all of which have been determined eligible for the National Register. One resource, Ohio Plan No. 1, which is a pre-1958 residential subdivision, has not been evaluated. Additionally, three prehistoric archaeological sites are located within the proposed Montgomery Project APE. Site 36BV306 is a pre-contact period open habitation site, site 36BV357 is a lithic reduction site, and site 36BV131 contains both prehistoric and historic components. The prehistoric sites have not been evaluated for listing in the National Register.

The remaining resources identified in the three Ohio River APEs include nine industrial or commercial complexes and one historic cabin, all of which the applicants have recommended as not eligible for listing in the National Register. The Pennsylvania SHPO has not yet concurred with these recommendations. Table 3-27 lists all known cultural resources identified at the Ohio River Projects. Resources identified in italics are those that are identified in the applicants' cultural resource reports as located within a project's APE but are not discussed within the same project's HPMP.

Table 3-27. Cultural resources at the proposed Ohio River Projects (Sources: Barrett et al., 2015a,b,c).

Resource Name	National Register Eligibility	Project-Related Effects	Determination/ Recommendation
Ohio River Navigation System	Recommended eligible	Construction of the proposed projects on the Ohio River would alter character defining features of the Ohio River Navigation System that contribute to its National Register eligibility	Direct adverse effect; mitigation proposed
Emsworth Locks and Dams			
Emsworth Locks and Dam	Eligible (2000 and 2002)	Alterations to the historic locks and dam. Potential inadvertent damage during construction.	Direct adverse effect; mitigation proposed
Pennsylvania Railroad Fort Wayne Line	Eligible (1993 and 2009)	Limited visual impacts	Recommended no adverse effect; consult with the Pennsylvania SHPO if changes occur that would result in other effects

Resource Name	National Register Eligibility	Project-Related Effects	Determination/ Recommendation
Ben Avon Historic District	Eligible (2000)	A few properties within the district would be indirectly affected by visual changes to the dam but the effects would not be adverse	Recommended no adverse effect; consult with the Pennsylvania SHPO if changes occur that would result in other effects
Tejan Coal and Supply Company Buildings	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
Dickson Log House	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
One Herron Ave Industrial Complex	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
Single-Story Building	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
FedEx Building	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
Tank Farm	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
Ohio River Boulevard	*Not eligible*	*Undetermined*	*Undetermined; no measures proposed*
Emsworth Back Channel Dam			

Resource Name	National Register Eligibility	Project-Related Effects	Determination/ Recommendation
Emsworth Back Channel Dam	Eligible (2000 and 2002)	Alterations to the historic locks and dam. Potential inadvertent damage during construction.	Direct adverse effect; mitigation proposed
Pittsburg and Lake Erie Railroad	Eligible (1999)	Limited visual effects	Recommended no adverse effect; consult with the Pennsylvania SHPO if changes occur that would result in other effects
Neville Chemical Company Building	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
Commercial Building #1	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
Commercial Building #2	*Recommended not eligible*	*Undetermined*	*Undetermined; no measures proposed*
Montgomery Locks and Dam			
Montgomery Locks and Dam	Eligible (2013 and 2015)	Alterations to the historic locks and dam. Potential inadvertent damage during construction.	Direct adverse effect; mitigation proposed
Pennsylvania Railroad Fort Wayne Line (Pittsburg to Ohio State Line)	Eligible (1993 and 2009	Limited visual effects	Recommended no adverse effect; consult with the Pennsylvania SHPO if changes occur that would result in other effects
Ohio Plan No. 1	Unevaluated	Undetermined	Undetermined; no measures proposed

Resource Name	National Register Eligibility	Project-Related Effects	Determination/ Recommendation
36BV131	*Undetermined*	*Undetermined*	*Undetermined; no measures proposed*
36BV306	*Undetermined*	*Undetermined*	*Undetermined; no measures proposed*
36BV357	*Undetermined*	*Undetermined*	*Undetermined; no measures proposed*

Traditional Cultural Properties

By letters issued September 18, 2012, the Commission initiated consultation with the Tonawanda Band of Seneca Indians of New York, Seneca Nation of New York, Saint Regis Mohawk Tribe, Oneida Nation of New York, Tuscarora Nation of New York, Onondaga Nation of New York, and Cayuga Nation of New York on the proposed Emsworth, Emsworth Back Channel, and Montgomery Projects.

No responses to these letters were received and no consulted tribes have reported any known traditional cultural properties within the proposed projects' APEs.

3.3.7.2 Environmental Effects

Effects on Historic Properties

Construction, operation, and maintenance of the proposed Emsworth, Emsworth Back Channel, and Montgomery Projects would adversely affect the historic locks and dams and the Ohio River Navigation System. Project maintenance, use, and maintenance of project roads, recreation, vandalism, and mitigation measures associated with other resources could also affect other cultural resources located within the APEs. Project effects are adverse when an activity directly or indirectly alters the characteristics of a historic property that qualifies it for inclusion in the National Register. Any adverse effects must be resolved in consultation with the Pennsylvania SHPO and other parties.

Identified effects for the proposed projects located on the Ohio River are summarized in table 3-27. In letters dated February 7, 2014,[43] the Pennsylvania SHPO

[43] The February 7, 2014, correspondences were included in the HPMPs filed by the applicants on October 6, 2015.

determined that construction of the proposed projects would have an adverse effect on the Corps' three locks and dams by directly affecting the historic transportation and engineering significance that contributes to the eligibility of these resources. The letters did not address potential effects on the Ohio River Navigation System. However, in its HPMPs, the applicants recommend a finding that all of the projects would result in adverse effects to the navigation system.

In its HPMPs for the proposed Emsworth, Emsworth Back Channel, and Montgomery Projects (Barrett et al., 2015a,b,c), the applicants recommend a finding that the construction of these projects would have visual effects on four historic-period structures or districts: two segments of the Pennsylvania Railroad Fort Wayne Line (at the Emsworth and Montgomery Projects), structures within the Ben Avon Historic District, and the Pittsburg and Lake Erie Railroad. While these structures are all eligible for listing in the National Register, the applicants recommend a finding that the visual effects would not be adverse. The Pennsylvania SHPO has not yet concurred with any of the applicants' effect assessments and recommendations for other resources found within the APEs of the proposed Ohio River Projects.

Assessments of effect were not provided for several other resources. These include seven historic resources at the Emsworth Project (Tejan Coal and Supply Company Buildings, Dickson Log House, One Heron Avenue Industrial Project, Single-story Building [SE of dam], Fed-Ex Building, Tank Farm, Ohio River Boulevard) and three structures at the Emsworth Back Channel Project (Neville Chemical Company, Commercial Building #1, Commercial Building #2). Assessments of effects were also not provided for three prehistoric archaeological sites located within the APE of the Montgomery Project (36BV131, 36BV306, 36BV357). While all of these resources were identified in the applicants' survey reports, they were not identified in the projects' HPMPs. Finally, although it was identified in the HPMP for the proposed Montgomery Project, no assessment of effects was provided for the Ohio view Plan No. 1 subdivision.

Management of Historic Properties

To address project-related effects, the applicants propose to implement an HPMP for each project. The applicants filed draft HPMPs on October 6, 2015, that were developed in accordance with the *Guidelines for the Development of Historic Property Management Plans for FERC Hydroelectric Projects* (Advisory Council and FERC, 2002). The HPMPs contain general procedures and requirements for: (1) designation of

a Cultural Resources Coordinator[44]; (2) employee training; (3) internal decision-making; (4) consultation requirements; (5) unanticipated discoveries; (6) procedures for emergency situations; (7) Native American consultation; (8) the discovery of human remains and/or funerary objects; (9) curation of any recovered cultural materials; (10) public interpretation; (11) annual reporting; (12) a plan for review and revisions to the HPMP; and (13) dispute resolution.

In addition to the proposed general procedures and requirements identified above, the HPMPs provide specific procedures and requirements to resolve adverse effects on several eligible properties located within the projects' APEs. For direct adverse effects on the eligible Ohio River Navigation System and affected locks and dams, the applicants propose to: (1) document the lock and dam structures using the Secretary of the Interior's standards for documenting historic engineering resources; (2) design new facilities with low profiles to blend with the surrounding area to the greatest extent practicable and allow the Pennsylvania SHPO and Corps opportunity to comment; (3) consult with the Pennsylvania SHPO and the Corps of any changes or modifications to the projects; and (4) install interpretive signage.

The HPMPs also call for further consultation with the Pennsylvania SHPO regarding: (1) eligibility recommendations for resources where project effects have not been determined; and (2) properties identified with non-adverse visual effects where potential changes in project activities could result in a change to an "adverse" effect recommendation.

In a letter filed November 10, 2015, the Pennsylvania SHPO provides comments on the HPMPs for the proposed Emsworth, Emsworth Back Channel, and Montgomery Projects. The Pennsylvania SHPO states that, in general, it was in agreement with the proposed management and mitigation measures provided in the HPMPs for above-ground structures at these projects (Ohio River Navigation System and existing locks and dams). However, the Pennsylvania SHPO requests a number of revisions to the HPMPs. Although many of these revisions are editorial in nature, additional information on the eligibility of each identified property, including the applicable National Register criteria, and additional discussion of project-related effects were requested. Because the comments were filed subsequent to the filing of the HPMPs, these comments have not yet been addressed by the applicants.

---

[44] The Cultural Resources Coordinator would ensure compliance with the expected PAs and implementation of the HPMPs, including review of project activities, consultation with the Pennsylvania SHPO, coordination of personnel training, maintenance of cultural resources records, and public outreach.

On April 6, 2016, Commission staff initiated a conference call with Rye Development, the Corps, and the Pennsylvania SHPO to discuss issues related to the proposed projects. Several topics were discussed, including but not limited to: (1) the projects' APEs; (2) tribal consultation, and (3) additional consultation with the Pennsylvania SHPO regarding project effects on historic properties and the resolution of those effects. These issues are discussed in detail in the following section. In the call, Rye Development agreed to revise the HPMPs to satisfy the Commission's comments. Meeting notes for the call were submitted to all participants for review and were filed on April 27, 2016.

Our Analysis

The applicants' HPMPs provide measures that are consistent with the Advisory Council and Commission's 2002 guidelines. However, the final HPMPs should include more detail as explained below. Continued consultation with the Pennsylvania SHPO and the Corps is needed to finalize the documents.

Each of the HPMPs contains a brief description and map of the APE. In each description, two APEs are identified: one for above-ground structures and one for archaeological resources where project-related ground disturbance would occur. In each HPMP, the APE for above-ground structures extends beyond the proposed project boundary, while the APE for archaeological resources is contained within the project boundary. Licensing of a hydroelectric project is a single section 106 undertaking, and Commission staff recognizes a single APE that would encompass land both directly and indirectly affected by the project. For each project, the APE would coincide with the larger APE that the applicants identified for structures that would extend beyond the proposed project boundary. However, while each HPMP refers to additional information related to the determination of the APE,[45] no detailed discussion of exactly how the APE was defined for each project was provided (e.g., distance from project boundary, extent of viewshed). Additionally, the APE and resource location maps in each of the HPMPs do not depict the proposed project boundary in relation to the APE. Inclusion in the HPMPs of (1) a discussion related to how the APE beyond the project boundary for each project was defined and (2) revised APE and resource location maps that include the proposed project boundary, would provide clarity regarding the location of resources and project effects, both within and outside of the project boundary.

The HPMPs do not include plans for cultural resources monitoring during construction. To protect the prehistoric archaeological sites that have been identified at the Montgomery Project as well as any unknown sites which may be discovered during

[45] See Chapter II, Section D, subsection 2 of each HPMP.

construction, the HPMPs must include provisions for monitoring cultural resources during ground-disturbing construction activities. Additionally, the Pennsylvania SHPO has stated that unsurveyed portions of the Emsworth, and Emsworth Back Channel APEs contain a high potential for archaeological resources. The Pennsylvania SHPO comments that, if ground disturbance becomes necessary in these areas, additional surveys would be required. If these surveys identify new resources, cultural resources monitoring in these areas by either the Cultural Resources Coordinator or a qualified cultural resources professional would ensure that these resources are protected.

In accordance with the Advisory Council and Commission 2002 guidelines, HPMPs for hydroelectric projects must contain a list of activities that are exempt from further section 106 consultation. In its HPMPs, the applicants' state that a PA with the Pennsylvania SHPO would be established that would specify the types of activities that would be exempt from SHPO review. Including a list of exempted activities in the HPMPs would comply with the Advisory Council and Commission guidelines and would ensure that the listed activities are considered during project planning.

As mentioned above in section 3.3.7.1, *Cultural Resources, Affected Environment,* the Commission initiated consultation with a number of Native American tribes regarding the proposed projects. No tribal organizations responded to the Commission's invitation to consult regarding the proposed projects. In the HPMPs for the proposed projects, the applicants state that any tribal correspondence should be directed to the Seneca Nation and the Tonawanda Band of Seneca. In the initial consultation letters, seven tribes were identified by the Commission; it is not clear why only two of these tribes are identified by the applicants for the purposes of consultation. Therefore, the HPMPs for each of the proposed projects should include a description of Native American consultation efforts undertaken by the applicants to date, a justification for the selection of tribes to be consulted for each project, and the inclusion of appropriate Tribes as consulting parties regarding prehistoric archaeological resources and human remains. These measures would ensure that Native American concerns are appropriately considered in accordance with section 106, the Native American Graves Protection and Repatriation Act, and the Advisory Council's Policy Statement Regarding Treatment of Human Remains and Grave Goods.

We also note that the applicants' HPMPs for the proposed projects only identify the Commission and the Pennsylvania SHPO as consulting parties. Given that the proposed facilities would be located on existing Corps structures, the applicant should include the Corps as a consulting party in the HPMPs. The HPMPs should delineate the roles and responsibilities of each consulting party.

In accordance with section 106 and its implementing regulations found at 36 CFR Part 800, the Pennsylvania SHPO must be consulted regarding any recommendations of National Register eligibility, the assessment of effects, and the resolution of adverse

effects. The Pennsylvania SHPO has determined that the Ohio River Navigation System and the three Corps locks and dams are eligible for listing. The proposed construction would have an adverse effect on these historic resources. The Pennsylvania SHPO has not concurred with the applicant's effect recommendations for other resources identified within the projects' APEs. In its HPMPs, the applicants only propose to consult with the Pennsylvania SHPO in the future if there are changes in project activities that could result in new effects, other than visual effects, to properties that have been recommended as eligible for listing in the National Register. Further, all three of the applicants' cultural resource reports identify specific properties that are located within the project's APE, but these resources are not discussed within the same project's HPMP. These resources are identified in italics in the tables provided in section 3.3.7.1, *Cultural Resources, Affected Environment*. The applicants have recommended that most of these resources are not eligible for listing in the National Register; three prehistoric sites remain unevaluated. All cultural resources identified within a project's APE must be included in the project's HPMP regardless of eligibility. Therefore, additional information regarding the applicants' recommendations of National Register eligibility should be provided in the HPMPs. Further consultation with the Pennsylvania SHPO regarding these recommendations, any recommendations of effect, and the ultimate resolution of effects found to be adverse is needed to complete section 106 consultation.

Finally, inclusion in the HPMPs of a detailed schedule for completion of the activities required under the HPMPs (e.g., further consultation regarding National Register eligibility of identified resources, assessment of effects, and implementation of mitigation measures) would ensure that these activities are completed in a timely manner.

Revision of the HPMPs in consultation with the Pennsylvania SHPO and the Corps to include the following measures would ensure that the HPMPs are compliant with section 106 and with the Advisory Council and FERC (2002) guidelines: (1) a discussion regarding how the APE for each project was defined and revised APE map and resource location maps that delineate both the APE and the project boundary; (2) a monitoring plan for prehistoric resources to be conducted during ground-disturbing activities by either the Cultural Resources Coordinator or by a qualified cultural resources professional; (3) a list of activities that are exempt from further section 106 consultation; (4) a description of Native American consultation efforts undertaken by the applicants to date, justification for the selection of tribes to be consulted for each project, and the inclusion of appropriate Tribes as consulting parties regarding prehistoric archaeological resources and human remains; (5) inclusion of the Corps as a consulting party in the HPMPs; (6) a discussion of all cultural resources identified with the APEs of the proposed projects, their National Register eligibility, project-related effects, and specific management measures to resolve project-related adverse effects (all to be completed in consultation with the Pennsylvania SHPO); and (7) inclusion in the consultation appendix all correspondences and comments related to the HPMP (particularly the Pennsylvania SHPO's November 10, 2015, comments) and a discussion of how those comments are

addressed in the HPMPs. In addition, the HPMPs could include the applicants' proposals to restore the landscape after construction to protect aesthetics as described in section 3.3.6.2, *Aesthetic Resources, Environmental Effects*. Revision of the HPMPs to include these requirements in consultation with the Pennsylvania SHPO and Corps, and submittal to consulting parties (for a minimum of 30 days), for their review and comments, would ensure that project effects on historic properties within each project's APE are appropriately addressed.

To meet the section 106 requirements, the Commission intends to execute PAs with the Pennsylvania SHPO for each proposed project for the protection of historic properties that would be affected by the construction and operation of the projects. The terms of each PA would require the applicants to address all historic properties identified within the projects' APEs through the revision of the existing HPMPs.

3.4 NO-ACTION ALTERNATIVE

The no-action alternative is license denial. Under the no-action alternative, the proposed Ohio River Projects would not be constructed, and the environmental resources in each project area would not be affected. The power that would have been developed from renewable resources would have to be replaced by nonrenewable fuels.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at each project's use of the river for hydropower purposes to see what effect various environmental measures would have on the projects' costs and power generation. Under the Commission's approach to evaluating the economics of hydropower projects, as articulated in *Mead Corp*.,[46] the Commission compares the current project cost to an estimate of the cost of obtaining the same amount of energy and capacity using a likely alternative source of power for the region (cost of alternative power). In keeping with Commission policy as described in *Mead Corp.*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.

For each of the licensing alternatives, our analysis includes an estimate of: (1) the cost of individual environmental measures considered in the EA; (2) the cost of alternative power; (3) the total project cost (i.e., for construction, operation, maintenance, and environmental measures); and (4) the difference between the cost of alternative power and total project cost. If the difference between the cost of alternative power and total project cost is positive, the project produces power for less than the cost of alternative power. If the difference between the cost of alternative power and total project cost is negative, the project produces power for more than the cost of alternative power. This estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

4.1 POWER AND DEVELOPMENTAL BENEFITS OF THE PROJECTS

Table 4-1 summarizes some of the assumptions and economic information we use in our analysis. The table contains information that pertains to all three projects. Tables 4-2 through 4-4 summarize additional assumptions and economic information we use in our analysis, but these tables contain information that is specific to each project.

We find that the values provided by the applicants are reasonable for the purposes of our analyses. For each project, cost items common to all action alternatives except the no-action alternative include: taxes and insurance costs; estimated future capital investment required to maintain and extend the life of plant equipment and facilities;

---

[46] See *Mead Corporation, Publishing Paper Division*, 72 FERC ¶ 61,027 (July 13, 1995). In most cases, electricity from hydropower would displace some form of fossil-fueled generation, in which fuel cost is the largest component of the cost of electricity production.

costs to prepare the license application; normal operation and maintenance cost; and Commission fees. The no-action alternative only includes the cost to prepare the license application. All dollars are year 2016, unless specified otherwise.

Table 4-1. Parameters for the economic analysis common to all of the Ohio River Projects (Source: applicants and staff).

Economic Parameter	Value	Source
Period of economic analysis	30 years	Staff
Term of financing	20 years	Staff
Cost of capital (long-term interest rate)	9 percent[a]	Applicants
Short-term interest rate (during construction)	9 percent[b]	Staff
Discount rate	8 percent	Staff
Federal tax rate	35 percent	Staff
Local tax rate	3 percent	Staff
Energy rate	$56.33/MWh[c]	Staff
Capacity rate	$165/kWh-yr[d]	Staff

[a] All applicants, license applications, page D-2.

[b] Staff assumed the applicants' short-term interest rate was the same as its long-term interest rate.

[c] The applicants provided a 2012 energy rate of $40.86/MWh. Staff used values from the Monitoring Analytics, LLC, 2014 PJM State of the Market Report (Monitoring Analytics, LLC, 2014).

[d] The capacity rate is based on the Energy Information Administration's 2015 Annual Energy Outlook.

Table 4-2. Parameters for the economic analysis for FFP 5 LLC's Emsworth Project (Source: FFP 5 LLC and staff).

Economic Parameter	Value	Source
Proposed capacity	24.0 MW[a]	FFP 5 LLC
Proposed average annual generation	101,300 MWh[b]	FFP 5 LLC
Construction cost	$52,854,290[c]	FFP 5 LLC
Annual operating and maintenance cost	$1,265,420/year[d]	FFP 5 LLC
Cost to prepare license application	$1,318,940[e]	FFP5 LLC

Economic Parameter	Value	Source
Insurance	$114,350/year	FFP 5 LLC
Dependable capacity	3.03 MW[f]	FFP 5 LLC

[a] FFP 5 LLC, 2014, pages A-5, B-10.
[b] FFP 5 LLC, 2014, pages A-5, B-10.
[c] FFP 5 LLC, 2014, page D-2, table D.3-1, escalated to 2016 dollars.
[d] FFP 5 LLC, 2014, page D-2, table D.4-1. This value includes operation and maintenance expenses, transmission charges, Corps' electric bill, land lease fees, and headwater benefits fees, escalated to 2016 dollars.
[e] FFP 5 LLC, 2014, page D-4, escalated to 2016 dollars. In addition, this cost includes the estimated capital cost ($10,000) to determine the need for a recreation resource management plan.
[f] FFP 5 LLC, 2014, page B-8.

Table 4-3. Parameters for the economic analysis for FFP 6, LLC's Emsworth Back Channel Project (Source: FFP 6 LLC and staff).

Economic Parameter	Value	Source
Proposed capacity	12.0 MW[a]	FFP 6 LLC
Proposed average annual generation	53,500 MWh[b]	FFP 6 LLC
Construction cost	$31,287,770[c]	FFP 6 LLC
Annual operating and maintenance cost	$708,770/year[d]	FFP 6 LLC
Cost to prepare license application	$689,710[e]	FFP 6 LLC
Insurance	$59,370/year	FFP 6 LLC
Dependable capacity	1.89 MW[f]	FFP 6 LLC

[a] FFP 6 LLC, 2014, pages A-5, B-8.
[b] FFP 6 LLC, 2014, pages A-5, B-8.
[c] FFP 6 LLC, 2014, page D-2, Table D.3-1, escalated to 2016 dollars.
[d] FFP 6 LLC, 2014, page D-2, Table D.4-1. This value includes operation and maintenance expenses, transmission charges, Corps' electric bill, land lease fees, and headwater benefits fees, escalated to 2016 dollars.
[e] FFP 6 LLC, 2014, page D-4, escalated to 2016 dollars. In addition, this cost includes the estimated capital cost ($10,000) to determine the need for a recreation resource management plan.
[f] FFP 6 LLC, 2014, page B-8.

Table 4-4. Parameters for the economic analysis for Solia 6 LLC's Montgomery Project (Source: Solia 6 LLC and staff).

Economic Parameter	Value	Source
Proposed capacity	42.0 MW[a]	Solia 6 LLC
Proposed average annual generation	194,370 MWh[b]	Solia 6 LLC
Construction cost	$128,983,630[c]	Solia 6 LLC
Annual operating and maintenance cost	$2,471,490/year[d]	Solia 6 LLC
Cost to prepare license application	$2,480,580[e]	Solia 6 LLC
Insurance	$215,830/year	Solia 6 LLC
Dependable capacity	5.86 MW[f]	Solia 6 LLC

[a] Solia 6 LLC, 2014, pages A-5, B-8.
[b] Solia 6 LLC, 2014, pages A-5, B-8.
[c] Solia 6 LLC, 2014, page D-2, table D.3-1, escalated to 2016 dollars.
[d] Solia 6 LLC, 2014, page D-2, Table D.4-1. This value includes operation and maintenance expenses, transmission charges, Corps electric bill, land lease fees, and headwater benefits fees, escalated to 2016 dollars.
[e] Solia 6 LLC, 2014, page D-4, escalated to 2016 dollars. In addition, this cost includes the estimated capital cost ($10,000) to determine the need for a recreation resource management plan.
[f] Solia 6 LLC, 2014, page B-8.

4.2 COMPARISON OF ALTERNATIVES

Tables 4-5 through 4-7 compare the installed capacity, annual generation, cost of alternative power, estimated total project cost, and difference between the cost of alternative power and total project cost for each applicant's proposal and staff alternative. In these tables, a number in parentheses denotes that the difference between the cost of alternative power and project cost is negative, thus the project cost is greater than the cost of alternative power.

Table 4-5. Summary of the annual cost of alternative power and annual project costs for alternatives for the two alternatives for the Emsworth Project (Source: staff).

	FFP 5 LLC's Proposal[a]	**Staff Alternative**
Installed capacity (MW)	24	24
Annual generation (MWh)	101,300	101,300
Annual cost of alternative power	$6,206,650	$6,206,650
($/MWh)	61.27	61.27
Annual project cost	$7,855,530	$7,869,390
($/MWh)	77.55	77.68
Difference between cost of alternative power and project cost ($/MWh)	($1,648,880)	($1,662,740)
	(16.28)	(16.41)

[a] A number in parentheses means that the annual project cost exceeds the cost of alternative power.

Table 4-6. Summary of the annual cost of alternative power and annual project costs for alternatives for the two alternatives for the Emsworth Back Channel Project (Source: Staff).

	FFP 6 LLC's Proposal[a]	**Staff Alternative**
Installed capacity (MW)	12	12
Annual generation (MWh)	53,500	53,500
Annual cost of alternative power	$3,325,560	$3,325,560
($/MWh)	62.16	62.16
Annual project cost	$4,471,950	$4,485,810
($/MWh)	83.59	83.85
Difference between cost of alternative power and project cost ($/MWh)	($1,146,390)	($1,160,250)
	(21.43)	(21.69)

[a] A number in parentheses means that the annual project cost exceeds the cost of alternative power.

Table 4-7. Summary of the annual cost of alternative power and annual project costs for alternatives for the two alternatives for the Montgomery Project (Source: staff).

	Solia 6 LLC's Proposal[a]	Staff Alternative
Installed capacity (MW)	42	42
Annual generation (MWh)	194,370	194,370
Annual cost of alternative power	$11,914,880	$11,914,880
($/MWh)	61.30	61.30
Annual project cost	$17,491,790	$17,505,650
($/MWh)	89.99	90.06
Difference between cost of alternative power and project cost ($/MWh)	($5,576,910)	($5,590,770)
	(28.69)	(28.76)

[a] A number in parentheses means that the annual project cost exceeds the cost of alternative power.

4.2.1 No-action Alternative

Under the no-action alternative, the three projects would not be constructed and would not produce any electricity. None of the environmental enhancements would be implemented. The only cost associated with this alternative would be the cost to prepare the license application.

4.2.2 Applicants' Proposals

Emsworth Project

Under FFP 5 LLC's proposal, the Emsworth Project would have an installed capacity of 24.0 MW and generate an average of 101,300 MWh of electricity annually. The average annual cost of alternative power would be $6,206,650, or $61.27/MWh. In total, the average annual project cost would be $7,855,530, or about $77.55/MWh. Overall, the project would produce power at a cost that is $1,648,880, or $16.28/MWh, more than the cost of alternative power.

Emsworth Back Channel Project

Under FFP 6 LLC's proposal, the Emsworth Back Channel Project would have an installed capacity of 12.0 MW and generate an average of 53,500 MWh of electricity annually. The average annual cost of alternative power would be $3,325,560, or

$62.16/MWh. In total, the average annual project cost would be $4,471,950, or about $83.59/MWh. Overall, the project would produce power at a cost that is $1,146,390, or $21.43/MWh, more than the cost of alternative power.

Montgomery Project

Under Solia 6 LLC's proposal, the Montgomery Project would have an installed capacity of 42.0 MW and generate an average of 194,370 MWh of electricity annually. The average annual cost of alternative power would be $11,814,880, or $61.30/MWh. In total, the average annual project cost would be $17,491,790, or about $89.99/MWh. Overall, the project would produce power at a cost that is $5,576,910, or $28.69/MWh, more than the cost of alternative power.

4.2.3 Staff Alternative

The staff alternative includes the same power generating features as the applicants' proposals and, therefore, would have the same capacity and energy values described above. For the Ohio River Projects, tables 4-8 through 4-10 show the respective staff-recommended additions, deletions, and modifications to each applicant's proposed environmental protection and enhancement measures, and the estimated cost of each.

Emsworth Project

Under the staff alternative for the Emsworth Project, based on the same capacity and energy attributes as the proposed project, the cost of alternative power would be $6,206,650, or $61.27/MWh. The average annual project cost would be $7,869,390 or about $77.68/MWh. Overall, the project would produce power at a cost which is $1,662,740, or $16.41/MWh, more than the cost of alternative power.

Emsworth Back Channel Project

Under the staff alternative for the Emsworth back Channel Project, based the same capacity and energy attributes as the proposed project, the cost of alternative power would be $3,325,560, or $62.16/MWh. The average annual project cost would be $4,485,810 or about $83.85/MWh. Overall, the project would produce power at a cost which is $1,160.250, or $21.69/MWh, more than the cost of alternative power.

Montgomery Project

Under the staff alternative for the Montgomery Project, based on the same capacity and energy attributes as the proposed project, the cost of alternative power would be $11,914,880, or $61.30/MWh. The average annual project cost would be

$17,505,650 or about $90.06/MWh. Overall, the project would produce power at a cost which is $5,590,770, or $28.76/MWh, more than the cost of alternative power.

4.3 COST OF ENVIRONMENTAL MEASURES

Tables 4-8 through 4-10 give the cost of each of the PM&E measures for each of the three projects considered in our analysis. We convert all costs to equal annual (levelized) values over a 30-year period of analysis to give a uniform basis for comparing the benefits of a measure to its cost. All costs are from the applicants unless otherwise noted. All costs are presented in 2016 dollars.

Table 4-8. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of constructing and operating the Emsworth Project (Source: staff).

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
Geologic and Soil Resources				
1. Develop and implement an erosion and sedimentation control plan.	Applicant, Staff	$10,130[d]	$1,050[d]	$1,550
Aquatic Resources				
2. Develop and implement a soil disposal plan.	Applicant	$0[e]	$0	$0
3. Develop and implement a contaminated sediment testing and disposal plan that adds a provision for testing soils to the applicant's soil disposal plan in measure 2 above.	Staff	$25,000[f]	$0	$2,130
4. Operate the project in a run-of-river mode.	Applicant, Pennsylvania FBC, Staff	$0	$0[g]	$0
5. Develop and implement an operation compliance monitoring plan.	Staff	$10,000[h]	$5,000[h]	$4,100

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
6. Develop and implement a spill prevention, containment, and countermeasures plan independent of the erosion and sedimentation control plan in measure 1 above.	Staff	$10,000[i]	$0	$850
7. Conduct water quality monitoring during the months of June through September for 3 years after the commencement of project operation.	Applicant	$0	$1,620[j]	$1,050
8. Develop and implement a detailed water quality monitoring plan in consultation with the Corps, Pennsylvania DEP, and Pennsylvania FBC that includes the applicant's proposal in measure 8 above and adds water quality monitoring during construction.	Staff	$10,000[k]	$8,860[k]	$6,610
9. Conduct post-project construction DO monitoring.	Pennsylvania FBC, Interior	$0	$18,890[l]	$12,280
10. Conduct continuous water quality monitoring during project construction and operation, for the life of the project.	Corps	$0	$25,190[m]	$16,380

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
11. Operate the project in run-of-river mode and provide minimum bypass flows through dam gates or over the dam spillway during all months of the year to protect and enhance fish and wildlife habitat.	Interior	$0	$0[n]	$0
12. Comply with the Corps' non-degradation standard for DO and implement measures, such as increasing bypass flow, if the standard is not met.	Pennsylvania FBC, Ecosophic Strategies	$0	$0[o]	$0
13. Provide an adaptive management approach to maintain existing water quality and aquatic life, including compliance with non-degradation water quality and aquatic life criteria and higher bypass flows if/when criteria are not being met.	Corps	$0	$0[o]	$0
14. Coordinate the timing of construction-related hydraulic changes to minimize potential effects on spawning fish and other aquatic organisms.	Applicant, Staff	$0[p]	$0	$0

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
15. Install trash racks with a 5-inch clear bar spacing and provide approach velocities of less than 2 fps to reduce impingement or entrainment of fish.	Applicant, Staff	$0[e]	$0	$0
16. Design and implement post-construction fish impingement and entrainment studies, including turbine mortality studies, and if necessary modify the trash rack spacing and approach velocities based on the results.	Interior, Pennsylvania FBC	$250,000[q]	$0	$21,270
17. Design and implement post-construction fish stranding studies for the dam tailrace, extending downstream to the point where the turbine discharge enters the river.	Interior	$10,000[r]	$0	$850
18. Conduct biotic monitoring at regular intervals to document local and cumulative effects on aquatic habitats and communities.	Corps	$10,000[s]	$108,730[s]	$71,530

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
19. Survey for federally listed mussels in the construction footprints and relocate any listed mussels that are found.	Corps	$20,000[t]	$0	$1,720
Terrestrial Resources				
20. Develop and implement an avian protection plan consistent with APLIC and FWS guidelines to protect Bald eagle, osprey and other raptors. Avoid transmission line construction during the osprey nesting season (March 25 to July 31).	Applicant, Pennsylvania Game Commission, Staff	$5,070	$5,070	$3,730
21. Develop and implement a transmission line corridor management plan to protect botanical resources along the transmission line.	Applicant	$5,070	$5,070	$3,730
22. Develop a vegetation management plan, which incorporates the applicant's measures from item 21 above to reestablish native vegetation and to manage invasive plants, expanded to cover all project lands.	Staff	$10,000[u]	$5,000[u]	$4,100

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
Land Use and Aesthetic Resources				
23. Remove and properly dispose of any non-organic debris or trash that is collected during trash rack cleaning.	Applicant	$0	$0[v]	$0
24. Develop and implement a debris management plan, in consultation with the Corps and Pennsylvania FBC that includes the applicant's proposal in measure 23 above and adds provisions to ensure trash is sorted, stored, and disposed of appropriately.	Staff	$5,000[w]	$0	$430
Cultural Resources				
25. Prepare HPMPs in accordance with anticipated PAs between the Commission and the Pennsylvania SHPO.	Applicant, Pennsylvania SHPO,	$15,130	$0	$1,290

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
26. Execute and implement a PA that requires revision of the draft HPMP to address the management of historic properties and unevaluated cultural resources including staff recommendations described in this EA.	Staff	$20,130[x]	$0	$1,710

[a] Costs provided by the applicant unless otherwise noted.
[b] Capital costs typically include equipment, construction, permitting, and contingency costs.
[c] Annual costs typically include operation and maintenance costs and any other costs which occur on a yearly basis.
[d] Proposed cost includes $10,000 for plan development (2013 dollars) and $5,000 (2013 dollars) per year during 3years of project construction.
[e] Cost included in the overall construction cost.
[f] Cost of plan would be the same as for the proposed plan, which is included in the overall construction cost, but staff added $25,000 for specific testing requirements.
[g] There is no cost for "run-of-river" operation, because the project is designed to operate in this manner. Although the applicant and Pennsylvania FBC used the term "run-of-river," we interpret their use of run-of-river to mean "run-of-release." In other words, the project would operate from flows made available (i.e., released) by the Corps.
[h] Staff estimated $10,000 for development of the plan and $5,000 per year for implementation of the plan.
[i] Staff estimated $10,000 for development of the plan.
[j] Cost provided by applicant; $10,000 per year for 3 years in 2013 dollars. Cost was updated to 2016 dollars.
[k] Cost includes $10,000 for plan development, $35,000 per year during 3 years of construction, including turbidity monitoring, and $10,000 per year (2013 dollars) for monitoring June 1 to September 30 during project operation for 3 years.
[l] Cost prorated to year-round water quality monitoring based on the cost of the applicant's proposed monitoring.

[m] Cost assumes year-round water quality monitoring during construction (3 years) and operation. Cost prorated based on the cost of the applicant's proposed monitoring.

[n] Staff would not assign a cost to a bypass flow regardless of the magnitude because the release or spill of any quantity of water prior to it being made available to the project for generation (run-of-release) would be at the sole discretion of the Corps and, therefore, not considered a project cost.

[o] DO concentrations in the Ohio River should remain high and similar to existing conditions after project operation begins based on the applicant's modeling results. As such, generation likely would not need to be curtailed to comply with a non-degradation standard. Nevertheless, compliance with a non-degradation standard through the release of bypass flows would not result in a project cost for the reason stated above in footnote n.

[p] Staff estimated the cost would be negligible.

[q] Staff estimated $250,000 to conduct the studies.

[r] Staff estimated $10,000 to conduct the studies.

[s] Staff estimated $10,000 for plan development, and $300,000 in year 1 and every 3 years thereafter to conduct the studies.

[t] Staff estimated $20,000 to conduct the survey.

[u] Staff estimated $10,000 to develop the plan and $5,000 per year to implement the plan.

[v] Cost would be part of routine operation and maintenance cost.

[w] Staff estimated $5,000 to develop the plan.

[x] Staff estimates that our recommendations would increase the cost of the proposed plan by approximately $5,000. The plan would also include the applicant's proposal to restore areas temporarily affected by construction to protect aesthetic resources. Staff assumes cost for restoring areas after construction is included in the overall construction cost.

Table 4-9. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of constructing and operating the Emsworth Back Channel Project (Source: staff).

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
Geologic and Soil Resources				
1. Develop and implement an erosion and sedimentation control plan.	Applicant, Staff	$10,130[d]	$1,050[d]	$1,550
Aquatic Resources				
2. Develop and implement a soil disposal plan.	Applicant	$0[e]	$0	$0
3. Develop and implement a contaminated sediment testing and disposal plan that adds a provision for testing soils to the applicant's soil disposal plan in measure 2 above.	Staff	$25,000[f]	$0	$2,130
4. Operate the project in a run-of-river mode.	Applicant, Pennsylvania FBC, Staff	$0	$0[g]	$0
5. Develop and implement an operation compliance monitoring plan.	Staff	$10,000[h]	$5,000[h]	$4,100

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
6. Develop and implement a spill prevention, containment, and countermeasures plan independent of the erosion and sediment control plan in measure 1 above.	Staff	$10,000 [i]	$0	$850
7. Conduct water quality monitoring during the months of June through September for 3 years after the commencement of project operations.	Applicant	$0	$1,620[j]	$1,050
8. Develop and implement a detailed water quality monitoring plan in consultation with the Corps, Interior, Pennsylvania DEP, and Pennsylvania FBC that includes the applicant's proposal in measure 7 above and adds water quality monitoring during construction.	Staff	$10,000[k]	$8,860[k]	$6,610
9. Conduct post-project construction DO monitoring.	Pennsylvania FBC, Interior	$0	$18,890[l]	$12,280
10. Conduct continuous water quality monitoring during project construction and operation for the life of the project.	Corps	$0	$25,190[m]	$16,380

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
11. Operate the project in a run-of-river mode, and provide minimum bypass flows through dam gates or over the dam spillway during all months of the year to protect and enhance fish and wildlife habitat.	Interior	$0	$0[n]	$0
12. Comply with the Corps' non-degradation standard for DO and implement measures, such as increasing bypass flow, if the standard is not met.	Pennsylvania FBC, Ecosophic Strategies	$0	$0[o]	$0
13. Provide an adaptive management approach to maintain existing water quality and aquatic life, including compliance with non-degradation water quality and aquatic life criteria and higher bypass flows if/ when criteria are not being met.	Corps	$0	$0[o]	$0
14. Coordinate the timing of construction-related hydraulic changes to minimize potential effects on spawning fish and other aquatic organisms	Applicant, Staff	$0[p]	$0	$0

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
15. Install trash racks with a 5-inch clear bar spacing and provide approach velocities of less than 2 fps to reduce impingement or entrainment of fish.	Applicant, Staff	$0[e]	$0	$0
16. Design and implement post-construction fish impingement and entrainment studies, including turbine mortality studies, and if necessary modify the trash rack spacing and approach velocities based on the results.	Interior, Pennsylvania FBC	$250,000[q]	$0	$21,270
17. Design and implement post-construction fish stranding studies for the dam tailrace, extending downstream to the point where the turbine discharge enters the river.	Interior	$10,000[r]	$0	$850
18. Maintain habitat conditions for paddlefish.	Pennsylvania FBC	$0	$0[s]	$0
19. Conduct biotic monitoring at regular intervals to document local and cumulative effects on aquatic habitats and communities.	Corps	$10,000[t]	$108,730[t]	$71,530

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
20. Survey for federally listed mussels in the construction footprint and relocate any listed mussels that are found.	Corps	$15,000[u]	$0	$1,280
Terrestrial Resources				
21. Develop and implement an avian protection plan consistent with APLIC and FWS guidelines to protect bald eagle, osprey, and raptors. Avoid transmission line construction during the osprey nesting season (March 25 to July 31).	Applicant, Pennsylvania Game Commission, Staff	$5,070	$5,070	$3,730
22. Develop transmission line corridor management plan after the completion of construction.	Applicant	$5,070	$5,070	$3,730
23. Develop a vegetation management plan, which incorporates the applicant's measures from item 22 above to reestablish native vegetation and to manage invasive plants, expanded to cover all project lands.	Staff	$10,000[v]	$5,000[v]	$4,100

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
Recreation Resources				
24. Study the potential loss of angler access and use after the installation of the power facilities and mitigate if a loss of angler use would occur.	Pennsylvania FBC	$10,000[w]	$0	$850
Land Use and Aesthetic Resources				
25. Remove and properly dispose of any non-organic debris or trash that is collected during trash rack cleaning.	Applicant	$0	$0[x]	$0
26. Develop and implement a debris management plan, in consultation with the Corps and Pennsylvania FBC that includes the applicants' proposal in measure 25 above and adds provisions to ensure trash is sorted, stored, and disposed of appropriately.	Staff	$5,000 [y]	$0	$430

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
Cultural Resources				
27. Prepare HPMPs in accordance with anticipated PAs between the Commission and the Pennsylvania SHPO.	Applicant, Pennsylvania SHPO	$15,130	$0	$1,290
28. Execute and implement a PA that requires revision of the draft HPMP to address the management of historic properties and unevaluated cultural resources including staff recommendations described in this EA.	Staff	$20,130[z]	$0	$1,710

[a] Costs provided by the applicant unless otherwise noted.
[b] Capital costs typically include equipment, construction, permitting, and contingency costs.
[c] Annual costs typically include operation and maintenance costs and any other costs which occur on a yearly basis.
[d] Proposed cost includes $10,000 for plan development (2013 dollars) and $5,000 (2013 dollars) per year during 3 years of project construction.
[e] Cost included in the overall construction cost.
[f] Cost of plan would be the same as for the proposed plan, which is included in the overall construction cost, but staff added $25,000 for specific testing requirements.
[g] There is no cost for "run-of-river" operation, because the project is designed to operate in this manner. Although the applicant and Pennsylvania FBC used the term "run-of-river," we interpret their use of run-of-river to mean "run-of-release." In other words, the project would operate from flows made available (i.e., released) by the Corps.
[h] Staff estimated $10,000 for development of the plan and $5,000 per year for implementation of the plan.

[i] Staff estimated $10,000 for development of the plan.

[j] Cost provided by applicant; $10,000 per year for 3 years in 2013 dollars. Cost was updated to 2016 dollars.

[k] Cost includes $10,000 for plan development, $35,000 per year during 3 years of construction, including turbidity monitoring, and $10,000 per year (2013 dollars) for monitoring June 1 to September 30 during project operation for 3 years.

[l] Cost prorated to year-round water quality monitoring based on the cost of the applicant's proposed monitoring.

[m] Cost assumes year-round water quality monitoring during construction (3 years) and operation. Cost prorated based on the cost of the applicant's proposed monitoring.

[n] Staff would not assign a cost to a bypass flow regardless of the magnitude because the release or spill of any quantity of water prior to it being made available to the project for generation (run-of-release) would be at the sole discretion of the Corps and, therefore, not considered a project cost.

[o] DO concentrations in the Ohio River should remain high and similar to existing conditions after project operation begins based on the applicant's modeling results. As such, generation likely would not need to be curtailed to comply with a non-degradation standard. Nevertheless, compliance with a non-degradation standard through the release of bypass flows would not result in a project cost for the reason stated above in footnote n.

[p] Staff estimated the cost would be negligible.

[q] Staff estimated $250,000 to conduct the studies.

[r] Staff estimated $10,000 to conduct the studies.

[s] Based on our analysis, the proposed project would not likely affect paddlefish habitat. Therefore, we do not estimate a cost.

[t] Staff estimated $10,000 for plan development, and $300,000 in year 1 and every 3 years thereafter to conduct the studies.

[u] Staff estimated $15,000 to conduct the survey.

[v] Staff estimated $10,000 to develop the plan and $5,000 per year to implement the plan.

[w] Staff estimated $10,000 to conduct the study.

[x] Cost would be part of routine operation and maintenance cost.

[y] Staff estimated $5,000 to develop the plan.

[z] Staff estimates that our recommendations would increase the cost of the proposed plan by approximately $5,000. The plan would also include the applicant's proposal to restore areas temporarily affected by construction to preserve aesthetic resources. Staff assumes cost for restoring areas after construction is included in the overall construction cost.

Table 4-10. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of constructing and operating the Montgomery Project (Source: staff).

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
Geologic and Soil Resources				
1. Develop and implement an erosion and sedimentation control plan.	Applicant, Staff	$10,130[d]	$1,050[d]	$1,550
Aquatic Resources				
2. Develop and implement a soil disposal plan.	Applicant	$0[e]	$0	$0
3. Develop and implement a contaminated sediment testing and disposal plan that adds a provision for testing soils to the applicant's soil disposal plan in measure 2 above.	Staff	$25,000[f]	$0	$2,130
4. Operate the project in a run-of-river mode.	Applicant, Interior, Pennsylvania FBC, Staff	$0	$0[g]	$0

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
5. Develop and implement an operation compliance monitoring plan.	Staff	$10,000[h]	$5,000[h]	$4,100
6. Develop and implement a spill prevention, containment, and countermeasures plan independent of the erosion and sediment control plan in measure 1 above.	Staff	$10,000[i]	$0	$850
7. Conduct water quality monitoring during the months of June through September for 3 years after the commencement of project operations.	Applicant	$0	$1,620[j]	$1,050
8. Develop and implement a detailed water quality monitoring plan in consultation with the Corps, Interior, Pennsylvania DEP, and Pennsylvania FBC that includes the applicant's proposal in measure 7 above and adds water quality monitoring during construction.	Staff	$10,000[k]	$8,860[k]	$6,610
9. Conduct post-project-construction DO monitoring.	Pennsylvania FBC, Interior	$0	$18,890[l]	$12,280

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
10. Conduct continuous water quality monitoring during project construction and operation for the life of the project.	Corps	$0	$25,190[m]	$16,380
11. Operate the project in a run-of-river mode and provide minimum bypass flows through dam gates or over dam spillway during all months of the year to protect fish and wildlife habitat.	Interior	$0	$0[n]	$0
12. Comply with the Corps' non-degradation standard for DO and implement measures, such as increasing bypass flow, if the standard is not met.	Pennsylvania FBC, Ecosophic Strategies	$0	$0[o]	$0
13. Provide an adaptive management approach to maintain existing water quality and aquatic life, including compliance with non-degradation water quality and aquatic life criteria and higher bypass flows if/ when criteria are not being met.	Corps	$0	$0[o]	$0

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
14. Coordinate the timing of construction-related hydraulic changes to minimize potential effects on spawning fish and other aquatic organisms	Applicant, Staff	$0[p]	$0	$0
15. Install trash racks with a 5-inch clear bar spacing and provide approach velocities of less than 2 fps to reduce impingement or entrainment of fish.	Applicant, Staff	$0[e]	$0	$0
16. Design and implement post-construction fish impingement and entrainment studies, including turbine mortality studies, and if necessary, modify the trash rack spacing and approach velocities based on the results.	Interior, Pennsylvania FBC	$250,000[q]	$0	$21,270
17. Design and implement post-construction fish stranding studies for the dam tailrace, extending downstream to the point where the turbine discharge enters the river.	Interior	$10,000[r]	$0	$850

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
18. Conduct biotic monitoring at regular intervals to document local and cumulative effects on aquatic habitats and communities.	Corps	$10,000[s]	$108,730[s]	$71,530
19. Survey for federally listed mussels in the construction footprint and relocate any listed mussels that are found.	Corps	$30,000[t]	$0	$2,550
Terrestrial Resources				
20. Develop and implement an avian protection plan consistent with APLIC and FWS guidelines to protect bald eagle and other raptors.	Applicant, Staff	$5,070	$5,070	$3,730
21. Develop and implement a transmission line corridor management plan to protect botanical resources along the transmission line.	Applicant	$5,070	$5,070	$3,730

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
22. Develop a vegetation management plan, which incorporates the applicant's measures from item 21 above to reestablish native vegetation and to manage invasive plants, expanded to cover all project lands.	Staff	$10,000[u]	$5,000[u]	$4,100
Recreation Resources				
23. Implement measures described in the recreation resource management plan, including constructing an accessible tailrace fishing platform with a walkway connecting to eight designated parking spaces for recreational users.	Applicant, Staff	$300,000[v]	$3,000[v]	$27,480
24. Provide site access to anglers during site construction by installing a temporary staircase and fishing pier, prior to project construction.	Staff	$30,000[w]	$0	$2,550

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
25. Study the potential loss of angler access and use after the installation of the power facilities and mitigate if a loss of angler use would occur.	Pennsylvania FBC	$10,000[x]	$0	$850
Land Use and Aesthetic Resources				
26. Remove and properly dispose of any non-organic debris or trash that is collected during trash rack cleaning.	Applicant, Staff	$0	$0[y]	$0
27. Develop and implement a debris management plan, in consultation with the Corps and Pennsylvania FBC that includes the applicants' proposal in measure 26 above and adds provisions to ensure trash is sorted, stored, and disposed of appropriately.	Staff	$5,000[z]	$0	$430

Enhancement/Mitigation Measure	Entity	Capital Cost[a,b] (2016$)	Annual Cost[a,c] (2016$)	Levelized Annual Cost (2016$)
Cultural Resources				
28. Prepare HPMPs in accordance with anticipated PAs between the Commission and the Pennsylvania SHPO.	Applicant, Pennsylvania SHPO	$15,130	$0	$1,290
29. Execute and implement a PA that requires revision of the draft HPMP to address the management of historic properties and unevaluated cultural resources including staff recommendations described in this EA.	Staff	$20,130[aa]	$0	$1,710

[a] Costs provided by the applicant unless otherwise noted.
[b] Capital costs typically include equipment, construction, permitting, and contingency costs.
[c] Annual costs typically include operation and maintenance costs and any other costs which occur on a yearly basis.
[d] Proposed cost includes $10,000 for plan development (2013 dollars) and $5,000 (2013 dollars) per year during 3 years of project construction.
[e] Cost included in the overall construction cost.
[f] Cost of plan would be the same as for the proposed plan, which is included in the overall construction cost, but staff added $25,000 for specific testing requirements.
[g] There is no cost for "run-of-river" operation, because the project is designed to operate in this manner. Although the applicant and Pennsylvania FBC used the term "run-of-river," we interpret their use of run-of-river to mean "run-of-release." In other words, the project would operate from flows made available (i.e., released) by the Corps.

[h] Staff estimated $10,000 for development of the plan and $5,000 per year for implementation of the plan.
[i] Staff estimated $10,000 for development of the plan.
[j] Cost provided by applicant; $10,000 per year for 3 years in 2013 dollars. Cost was updated to 2016 dollars.
[k] Cost includes $10,000 for plan development, $35,000 per year during 3 years of construction, including turbidity monitoring, and $10,000 per year (2013 dollars) for monitoring June 1 to September 30 during project operation for 3 years.
[l] Cost prorated to year-round water quality monitoring based on the cost of the applicant's proposed monitoring.
[m] Cost assumes year-round water quality monitoring during construction (3 years) and operation. Cost prorated based on the cost of the applicant's proposed monitoring.
[n] Staff would not assign a cost to a bypass flow regardless of the magnitude because the release or spill of any quantity of water prior to it being made available to the project for generation (run-of-release) would be at the sole discretion of the Corps and, therefore, not considered a project cost.
[o] DO concentrations in the Ohio River should remain high and similar to existing conditions after project operation begins based on the applicant's modeling results. As such, generation likely would not need to be curtailed to comply with a non-degradation standard. Nevertheless, compliance with a non-degradation standard through the release of bypass flows would not result in a project cost for the reason stated above in footnote n.
[p] Staff estimated the cost would be negligible.
[q] Staff estimated $250,000 to conduct the studies.
[r] Staff estimated $10,000 to conduct the studies.
[s] Staff estimated $10,000 for plan development, and $300,000 in year 1 and every 3 years thereafter to conduct the studies.
[t] Staff estimated $30,000 to conduct the survey.
[u] Staff estimated $10,000 to develop the plan and $5,000 per year to implement the plan.
[v] The cost to prepare the plan is included in the cost to develop the license application. The applicant estimated $300,000 to construct the proposed recreational facilities and $3,000 per year for routine maintenance.
[w] Staff estimated $30,000 to construct temporary access facilities.
[x] Staff estimated $10,000 to conduct the study.
[y] Cost would be part of routine operation and maintenance cost.
[z] Staff estimated $5,000 to develop the plan.

[aa] Staff estimates that our recommendations would increase the cost of the proposed plan by approximately $5,000. The plan would also include the applicant's proposal to restore areas temporarily affected by construction to preserve aesthetic resources. Staff assumes cost for restoring areas after construction is included in the overall construction cost.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a) of the FPA require the Commission to give equal consideration to the power development purposes and to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Any licenses issued shall be such as in the Commission's judgment will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses. This section contains the basis for, and a summary of, our recommendations for licensing the three Ohio River Projects. We weigh the costs and benefits of our recommended alternative against other proposed or recommended measures.

Based on our independent review of the agency and public comments filed on these projects and our review of the environmental and economic effects of the proposed projects, we have developed a staff alternative as the preferred alternative for each of the Ohio River Projects. The staff alternative includes elements of the applicants' proposals with some additional staff-recommended measures. We recommend this alternative because: (1) issuing an original license for each project would authorize the applicants to construct and operate the projects as economically beneficial and dependable sources of electrical energy; (2) the combined 78 MW of electric capacity would come from a renewable resource that does not contribute to atmospheric pollution; (3) the public benefits of this alternative in all three cases would exceed those of the no-action alternative; and (4) the recommended measures would protect and enhance environmental resources affected by the proposed projects.

In the following section, we make recommendations as to which environmental measures proposed by FFP 5 LLC, FFP 6 LLC, and Solia 6 LLC or recommended by agencies or other entities should be included in any licenses issued for the projects. In addition to the applicants' proposed environmental measures listed below, we recommend additional staff-recommended environmental measures to be included in any licenses issued for the projects.

5.1.1 Measures Proposed by the Applicants

Based on our environmental analysis of the applicants' proposals in section 3, and the costs presented in section 4, we recommend the following environmental measures proposed by the applicants to protect and enhance environmental resources and believe these measures would be worth their cost. Unless otherwise noted, each measure applies to all three projects.

- Develop an erosion and sedimentation control plan in consultation with the Corps and Pennsylvania DEP that includes procedures and BMPs to reduce runoff and sedimentation during construction and final stabilization.

- Develop a detailed soil disposal plan to ensure excavated sediment is handled and disposed of appropriately.

- Operate the project in run-of-release mode to avoid project-related impacts on water levels and river flows.

- Conduct 3 years of post-construction water quality monitoring from June through September to monitor for any project-related effects on water quality.

- Install trash racks at the project intake with a 5-inch clear bar spacing, and an approach velocity of less than 2 fps to mitigate for the entrainment and impingement of fish.

- When warranted and to the extent feasible, coordinate the timing of any construction-related hydraulic changes, such as changes in flow direction, to minimize effects on spawning fish and other aquatic organisms downstream of the project.

- Develop an avian protection plan consistent with APLIC and FWS guidelines that include provisions for protecting bald eagles, osprey, and other raptors.

- Develop a transmission line corridor management plan that includes provisions for protecting botanical resources and controlling invasive species along the transmission line.

- Implement the recreation resource management plan at the Montgomery Project for installing a fishing platform downstream of the project's tailrace, designated parking, and an accessible walkway that leads from the parking spaces to the fishing platform.

- Restore areas temporarily affected by construction activities to protect the sites' aesthetics.

- Remove and properly dispose of any non-organic debris or trash that is collected during trash rack cleaning.

- Prepare an HPMP in accordance with an anticipated PA between the Commission and the Pennsylvania SHPO.

5.1.2 Additional Staff-recommended Measures

The additional staff-recommended measures are described below. As noted in section 5.1.1, unless otherwise noted, each measure applies to all three projects.

- A contaminated sediment testing and disposal plan that includes the applicants' soil disposal plan, as well as provisions for testing sediment from the river bed to ensure sediment is handled and disposed consistent with state standards and to ensure minimal impacts of contaminated sediment on aquatic species and their habitat.

- An operation compliance monitoring plan to document compliance with the operating requirements of any licenses issued for the projects.

- A stand-alone spill prevention, containment, and countermeasures plan to guide the handling of hazardous substances and protect water quality and aquatic biota during project construction and operation.

- A water quality monitoring plan that includes the applicants' proposal to monitor water quality for 3 years post-construction and an additional provision to monitor water quality during construction.

- A vegetation management plan for each project that would apply the measures included in the applicants' transmission line corridor management plans to all project lands.

- A temporary staircase and fishing pier at the Montgomery Project that would provide access to anglers and minimize construction-related effects on angler use.

- A debris management plan that includes the applicants' proposed measures to remove and dispose of trash that accumulates upstream of the proposed projects' trash racks, as well as procedures that describe how debris would be sorted, stored, and disposed to minimize the effect of floating debris on local recreation and aesthetics.

- Execution and implementation of a PA that requires revision of the draft HPMP to address the management of historic properties and unevaluated cultural resources.

We discuss the rationale for the measures we are recommending or not recommending below.

Erosion and Sedimentation Control Plan

Construction of the proposed projects would require shoreline and riverbed disturbance, which could result in sediment (including potentially contaminated sediment) reaching or suspending within the Ohio River. The applicants propose to develop an erosion and sedimentation control plan for each project, in consultation with the Corps and Pennsylvania DEP, which would include placement of turbidity curtains, siltation fencing, stabilization of temporarily disturbed soil, final site stabilization, and, to the extent necessary, measures to prevent spills and guide cleanup of hazardous substances. Implementing erosion and sedimentation control measures would help to minimize erosion and sedimentation which would help protect water quality in the river and protect fish and other aquatic life, and we recommend these measures. We estimate that the levelized annual cost of developing a sedimentation and erosion control plan would be $1,550 for each project, and conclude that the benefits of the measures outweigh the cost.

Contaminated Sediment Testing and Disposal Plan

In-water construction activities would include the construction of temporary cofferdams and localized dredging. These activities would disturb river sediments, potentially suspending contaminated sediments into the water column, which could lead to bioaccumulation of toxic substances in aquatic and terrestrial organisms. The applicants collected and analyzed sediment core samples in 2013 from the proposed construction locations and confirmed the sites contained PAH concentrations exceeding the EPA sediment screening criteria. The applicants propose to develop a detailed soil disposal plan to ensure excavated sediment is handled and disposed of appropriately.

Depending on the type and level of contamination, disposal methods could vary. As such, some sediment sampling within the construction area prior to the start of construction would determine if measures are needed to ensure proper disposal of any contaminated sediment and to minimize suspension and transport of contaminated sediments into the Ohio River. To ensure that contaminated sediment is identified and handled properly, we recommend that the applicants modify the proposed plans to include sediment testing. A contaminated sediment testing and disposal plan should describe the specific locations and frequency for testing river-bottom sediments; a description of the sampling and testing methodologies; a description of measures that would minimize suspension of contaminated sediments; a description of how to remove, handle, and dispose of any contaminated sediments; and an implementation schedule. The plan should be developed in consultation with the Corps and Pennsylvania DEP to ensure appropriate measures are implemented to dispose of contaminated sediments. We estimate that the levelized annual cost of developing a contaminated sediment testing and disposal plan would be $2,130 for each project, and conclude that the benefits of the measure outweigh the cost.

Spill Prevention, Containment, and Countermeasures Plan

As discussed in section 3.3.2.2, *Aquatic Resources*, *Environmental Effects*, construction, operation, and maintenance of the proposed Ohio River Projects would require the use of equipment in and adjacent to the Ohio River. Therefore, there is the potential for accidental spills of oil, gasoline, and other hazardous materials, which could degrade water quality and negatively affect aquatic resources in the project areas. The applicants state that their proposed erosion and sedimentation control plans would include measures "to the extent necessary" to address the prevention and cleanup of spills of hazardous substances. However, we recommend that the applicants develop a separate spill prevention, containment, and countermeasures plan for each project.

Developing separate plans would facilitate plan review during development, and specifying emergency procedures in separate plans would simplify prompt access to the information needed to address any hazardous materials spills that may occur. To maximize the effectiveness of each spill prevention, containment, and countermeasures plan, we recommend that each plan be developed in consultation with the Corps and Pennsylvania DEP, and contain, at a minimum: (1) a detailed description of how to transport, store, handle and dispose of oil, fuels, lubricant products, and other hazardous liquid substances in a safe and environmentally acceptable manner; (2) procedures that would be implemented in the event of a spill to ensure the proper containment and cleanup of any hazardous substances to minimize adverse effects on water quality and aquatic resources in the project areas; (3) a provision to provide immediate notification to the Commission, Corps, and Pennsylvania DEP upon discovering an accidental spill of hazardous substances; and (4) a provision to file a report with the Commission within 10 days of a hazardous substance spill that identifies: (a) the location of the spill; (b) the type and quantity of hazardous material spilled; (c) any corrective actions that have been undertaken to clean up the spill; and (d) any measures taken to ensure similar spills do not occur in the future. These notification procedures would provide the Commission, Corps, and appropriate resource agencies an opportunity to visit the site, assess the effects of any hazardous material spills, and quickly recommend an appropriate response action(s) in consultation with the applicants.

We estimate that the levelized annual cost of developing a spill prevention, containment, and countermeasures plan would be $850 for each project and conclude that the benefits of the measure outweigh the cost.

Run-of-release Operation

The applicants propose to operate the projects in run-of-release mode,[47] meaning that the projects would operate using flows established by and made available by the Corps. Interior recommends that the applicants operate the projects in run-of-release mode and provide year-round minimum bypass flows through the Corps' gates or over dam spillways. Pennsylvania FBC also recommends run-of-release operation for all projects. In addition, the Corps noted that the projects must not impact the navigation channel, pool elevations, or operation of the locks and dams.

Operating the projects in run-of-release mode would limit effects on pool elevations and protect fish and mussel habitat upstream and downstream of the dams. Only small (0.5 foot change or less), localized effects immediately upstream or downstream of the dam would likely occur with run-of-release operation. No changes to the quantity of flow releases would occur, and navigation should not be affected. Although, the applicant's hydraulic model for the Emsworth Back Channel Project indicates the design of the proposed spill gates could limit the hydraulic capacity of the existing Corps' dam that could increase pool elevations upstream of the dam during high flows (i.e., more than 52,531 cfs in the back channel).

Regardless of the modeling results, the applicants' proposal to operate in run-of-release mode should not change total river flow or pool elevations in the navigation channel. If run-of-release operation was included in any licenses issued by the Commission, the applicants would be required to modify project designs to accommodate run-of-release operation, as needed. Therefore, staff recommends run-of-release operation. Under this mode of operation, the projects would only be able to generate using flows made available by the Corps and any bypass flow releases through the Corps' existing gates or proposed spill gates would be at the sole discretion of the Corps. There would be no additional cost associated with operating the projects in run-of-release mode because the applicants consider this operation mode in their proposals.

Operation Compliance Monitoring Plan

As described above, the applicants propose to operate the projects in run-of-release mode. The applicants' proposal, however, does not specify how it would document compliance with the run-of-release operation or how they would coordinate their operations with the Corps.

---

[47] Although the applicants, Interior, and Pennsylvania FBC used the term "run-of-river," we interpret their use of run-of-river to mean "run-of-release" because the Corps would determine how much flow to make available (release) to the proposed projects.

Generally, Commission licenses for non-federal projects at Corps' dams require the licensee to develop an operating plan and an MOA with the Corps.[48] The operating MOA describes the mode of hydropower operation, pool flow diversion, and regulation requirements for the Corps' project, and integration of operation of the hydroelectric facility in the Corps' emergency action plan. The MOA describes the detailed operation of the project acceptable to the Corps and any restrictions needed to protect the purposes of the Corps' project.

Therefore, we recommend that any licenses issued for the projects require the applicants to develop an operation compliance monitoring plan in consultation with the Corps, and enter into an operating MOA with the Corps for each project. Such plans should include provisions for documenting compliance with the Corps' operating requirements and establish a schedule for reporting project compliance/non-compliance during normal operation and emergencies. The plans should also include provisions for measuring intake velocities at a range of flows to ensure that intake velocities are sufficiently low to protect fish from impingement on the trash racks and to minimize fish entrainment. Operation compliance monitoring plans would also ensure run-of-release operation and minimization of impacts on aquatic resources that could otherwise occur due to changes in flow, pool elevations, or water quality caused by project operations. We estimate that the levelized annual cost of developing an operation compliance monitoring plan would be $4,100 for each project and conclude that the benefits of this measure outweigh the costs.

Water Quality Monitoring Plan

Project operations could alter existing DO concentrations in the Ohio River downstream of each proposed project because water that passes through the projects' turbines would not be subject to the turbulence and aeration that currently occurs when water passes over the existing dams. Also, construction of the proposed projects would likely result in moderate, short-term increases in turbidity levels within the Ohio River.

The applicants propose to conduct post-construction water quality monitoring to assess project-related effects on water quality. Monitoring is proposed for June through September for 3 years after project operation begins. However, the applicants do not provide specific details about what parameters would be monitored, the locations where monitoring would occur, or what parties, if any, would be consulted to develop a monitoring strategy.

---

[48] *See* Memorandum of Understanding between the Commission and the Corps of Engineers on Non-federal Hydropower Projects, dated March 2011.

The Corps states that real-time, continuously recorded, water quality monitoring would be required downstream and possibly upstream of each hydropower project during construction and operation. The Corps also states that it would require monitoring throughout the term of the licenses, year-round during the first 3 years of operation, with the potential to reduce the duration of monitoring to May through November after 3 years. In addition, the Corps states that an adaptive management approach to maintaining existing water quality and aquatic life conditions would be required, which would include compliance with non-degradation water quality and aquatic life criteria and higher bypass flows if/when criteria are not being met.

Pennsylvania FBC recommends post-construction continuous DO monitoring at all three projects, that the projects adhere to a non-degradation standard, and that measures be implemented to increase DO concentrations immediately if any DO standard recommended by the Corps is not met. In addition, Interior recommends post-construction DO monitoring at all projects. Ecosophic Strategies, LLC, recommends a DO non-degradation standard of 6.5 mg/L or higher if the agencies recommend a higher standard.

The applicants' water quality modeling study and our analysis in section 3.3.2.2, *Operational Effects on Water Quality,* indicates that operation of the proposed projects may have some small effects on DO concentrations downstream of the dams. DO concentration, the primary parameter of concern to the Corps, agencies, and Ecosophic Strategies, is typically much higher from October through May than during the summer months in temperate climates, and the applicants' DO modeling suggests DO concentration during the summer months would consistently be much higher than the state standard (5 mg/L). Thus, year-round continuous monitoring would not be worth the cost. Furthermore, monitoring for the life of the license may not be necessary if monitoring during the first 3 years of project operation demonstrates that the project is not affecting downstream DO concentrations and the 3 years include a range of environmental conditions, including a hot, dry summer. As such, a requirement to monitor throughout the life of the license is premature and not justified. However, monitoring water quality during construction, as recommended by the Corps, and implementing any needed corrective measures would protect water quality during project construction and would provide additional baseline data. Therefore, we recommend the applicants monitor water quality, including turbidity, temperature, and DO concentration during construction.

The existing state minimum water quality standard was determined by Pennsylvania DEP as adequate to protect aquatic life in the Ohio River. At this time, it is unclear how adherence to an undefined non-degradation standard would benefit aquatic resources relative to the state standard. Nevertheless, because the project could only be licensed to operate off of flows made available to it by the Corps, i.e., run-of-release, the Corps could choose to spill or release through its gates any quantity of water it decides

would be necessary to meet its water quality standards. The project could not be licensed to provide bypass flows because the decision to release flows downstream of the Corps' dam prior to being made available for generation at the project lies solely with the Corps. As for any adaptive management measures aimed at addressing the Corps' non-degradation requirements, we note that the Corps would enter into an operating MOA with each applicant that would specify any restrictions needed to protect the primary purposes of the Corps' project, including water quality.

Overall, developing a water quality monitoring plan for each project would allow for adverse effects on water quality during construction and operation of the proposed projects to be quickly identified and allow the Corps or the applicants to change operations, if necessary. Accordingly, we recommend that the applicants develop, in consultation with the Corps, FWS, Pennsylvania FBC, and Pennsylvania DEP, a water quality monitoring plan for each project that contains, at a minimum, the following provisions: (1) identifying the exact locations of monitoring sites; (2) the type of instruments that would be used to monitor water quality; (2) a schedule for monitoring turbidity levels, water temperature, and DO concentrations during project construction; (3) continuous, real-time monitoring of water temperature and DO concentration downstream of the projects from June 1 through September 30 each year for 3 years following the commencement of project operation; (4) the filing of annual summary reports for each year that monitoring is conducted; and (5) if the monitoring indicates deviations from the water quality requirements of any license issued for the project occur during project construction or operation, filing a report with the Commission within 10 days describing the deviation and implementation of any corrective actions.

Development of a water quality monitoring plan with our recommended measures would result in a levelized annual cost of $6,610 for each project and would be a reasonable cost to ensure that construction and operation of the proposed projects do not adversely affect water quality and aquatic resources downstream of the Ohio River Projects.

Vegetation Management Plan

Construction and maintenance of the proposed projects would disturb some existing vegetation, potentially leading to the introduction or spread of invasive plants. Land surrounding the three projects likely has numerous invasive plant species that could spread along transmission line corridors and access roads and potentially to construction sites. The applicants propose to develop transmission line corridor management plans, after construction of the transmission lines, to limit impacts from project construction and maintenance on plant communities within project transmission line ROWs. The proposed plans would include measures to revegetate disturbed areas and BMPs to prevent the spread of invasive species into the transmission line corridor.

However, the areas surrounding the proposed powerhouses, substations, and access roads would require vegetation removal that could allow invasive or noxious plant species to become established in all areas where construction activities occur. Therefore, staff recommends that the applicants' prepare vegetation management plans for each project that would incorporate the revegetation and invasive species control measures specified in their transmission line corridor management plans but apply the measures to the entire project areas rather than just the transmission line corridors. Additionally, development of the plans prior to construction of the projects would allow implementation of preventive measures to reduce impacts to botanical resources. To further reduce potential effects on botanical resources, staff recommends that the plans include a monitoring program to evaluate the success of revegetation and invasive plant control efforts, including criteria that define when the measures are successful, a reporting schedule for filing monitoring results and progress reports with Pennsylvania DCNR, Pennsylvania Game Commission, FWS, the Corps, and the Commission, and an implementation schedule.

Vegetation management plans that apply to the entire project area, with measures for monitoring revegetation and invasive species control, would reduce impacts to native vegetation, including the spread or introduction of invasive plants. We estimate that the levelized annual cost of developing a vegetation management plan would be $4,100 for each project and conclude that the benefits of this measure outweigh the costs.

Avian Protection Plan

Bald eagles, osprey, and other raptors may collide with and be electrocuted by transmission lines or other electrical equipment. Further, construction of the project transmission lines could disturb or remove bald eagle and osprey roosting or nesting habitat. To protect bald eagles, osprey, and other raptors from potential habitat disturbance or electrocution and collision with project power lines, the applicants propose to develop avian protection plans in consultation with the Pennsylvania Game Commission and FWS. Specifically, the applicants' proposed plans would be developed in accordance with the APLIC and FWS' National Bald Eagle Management guidelines. Measures to address future transmission facility maintenance activities would also be addressed in the plan. The avian protection plan would include the following provisions: (1) if a bald eagle or other target species is discovered within the project boundary, the applicants would notify the Pennsylvania Game Commission and FWS within 30 days of discovery; and (2) prior to any tree clearing within the project boundary or areas immediately adjacent to the project boundary, the area to be cleared would be surveyed for target species nests by project staff. If any such nests are discovered, the Pennsylvania Game Commission and FWS would be consulted prior to tree-clearing activities.

Preparing the plans in accordance with the guidelines would also help to protect raptors from switchyard equipment interactions by ensuring: (a) adequate separation of

energized conductors, ground wires, and other metal hardware; and (b) adequate insulation. In accordance with the guidelines, the plans would include a mechanism to monitor the effectiveness of the plans, or what actions to take if the plans are not successful; a schedule for reporting monitoring results to the Pennsylvania Game Commission, FWS, the Corps, and the Commission; and a schedule for implementing the plans. As such, staff recommends the proposed avian protection plans.

According to the Pennsylvania Game Commission, osprey are known to use the Emsworth and Emsworth Back Channel transmission line areas for nesting. The applicants propose to comply with the Pennsylvania Game Commission recommended construction restrictions during the osprey nesting season at the Emsworth and Emsworth Back Channel Projects. Specifically, no activities related to the transmission line portion of these projects should be completed during the osprey nesting season, March 25 to July 31, to avoid potential impacts on nesting osprey. Staff assumes that the applicants intend to include this measure in the avian protection plans for those projects.

We estimate that developing avian protection plans in accordance with the above specified guidelines and osprey measures would have an annualized cost of $3,730 for each project and would be a reasonable cost to minimize the risk to bald eagle, osprey, and other raptors from electrocution, collision, and nest disturbance at the projects' facilities.

Recreation Amenities

The applicant filed a recreation resource management plan for all three projects that evaluates access and amenities during project construction and operation. As discussed in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effect*s, because of the restriction of public access at the Emsworth and Emsworth Back Channel Projects, the recreation resource management plan only proposes recreation measures for the Montgomery Project. The applicant proposes to construct an accessible/barrier-free tailrace fishing platform with an accessible walkway that connects to eight designated parking spaces for recreational users. In addition to the applicants' proposals, Pennsylvania FBC recommends a study of the potential loss of angler access and use after the installation of the power facilities at the Emsworth Back Channel and Montgomery Projects and mitigation should a loss of angler use occur.

The scale of the proposed recreation amenities does not perpetuate the need for a revised recreation resource management plan. Implementing the parking area, walkway, and barrier-free fishing platform measures proposed at the Montgomery Project would contribute to the enhancement of recreation facilities and would mitigate for the loss of recreation access while addressing the needs of the disabled. We recommend these proposed measures because they would enhance the existing recreation opportunities available at the Montgomery Project.

In contrast, the applicant does not address provisions for site access during project construction. Therefore, we recommend that the applicant provide temporary site access to anglers during construction at the Montgomery Project by installing a temporary staircase and fishing pier. The proposed measures, in combination with our recommendation for temporary site access during construction, would satisfy recreational access needs at the Montgomery Project, and no further studies would be needed. Use of the recreational facilities would be monitored through reporting requirements of the FERC Form 80.

Furthermore, angler use at the Emsworth Back Channel Dam is not sufficient to warrant the cost of angler access studies as recommended by Pennsylvania FBC; therefore, we do not recommend an additional study at this project.

We estimate that constructing, operating, and maintaining the applicants' proposed facilities at the Montgomery Project would have a levelized annual cost of $27,480, and providing temporary site access to anglers during construction would have a levelized annual cost of $2,550. We conclude that the benefits justify these costs.

Debris Management Plan

The presence of trash and other debris, especially when concentrated behind dams, can affect the visual character of the river. The applicants propose to remove and properly dispose of any non-organic debris or trash that is collected during trash rack cleaning.

Disposing of trash collected during trash rack cleaning would improve the existing visual conditions. However, it is unclear what specific kinds of debris would be passed downstream or removed from the river, whether the applicants intend to temporarily store trash on-site, or how often debris would be removed from the projects. Therefore, we recommend the applicants develop debris management plans in consultation with the Corps and Pennsylvania FBC, which includes the applicants' proposed measure to separate and remove trash from the river and ensure that debris is sorted, stored, and disposed of appropriately. A debris management plan should include, but not be limited to, the following provisions: (1) procedures for separation of organic and inorganic trash; (2) procedures for any storage and off-site disposal of inorganic material; (3) procedures for reintroducing organic debris collected on the trash rack to the Ohio River downstream of the dam, as appropriate; and (4) an implementation schedule. We estimate that the levelized annual cost of developing a debris management plan would be $430 for each project and conclude that the benefits of this measure outweigh the costs.

Historic Properties Management Plan

Construction of the proposed Emsworth, Emsworth Back Channel, and Montgomery Projects would result in adverse effects on the existing Corps' locks and

dams. The applicants recommend a finding that the Ohio River Navigation System would also be adversely affected. All of these structures are eligible for listing in the National Register. The proposed projects could also adversely affect other cultural resources located within each project's APE, including three historic railroads, the Ben Avon Historic District, as well as a 1958 residential subdivision, 10 structures, and three prehistoric archaeological sites that are located within the APEs but have not been addressed in the HPMPs. Therefore, we recommend the applicants revise the HPMPs to contain additional staff-recommended measures, listed in section 3.3.7.2, *Cultural Resources, Environmental Effects,* in consultation with the Pennsylvania SHPO and the Corps to avoid, lessen, or mitigate the adverse effects on these historic properties. In addition, the HPMPs should include the applicants' proposals to conduct post-construction site restoration at each of the project sites to ensure the landscape is cleared of construction debris and restored to a managed landscape because these measures would protect aesthetics and historic properties.

To satisfy the requirements of section 106, the Commission intends to execute PAs for each project that would include stipulations for the protection of historic resources, including revision of the HPMPs in consultation with the Pennsylvania SHPO and the Corps. The revised HPMPs would describe the treatment measures necessary for managing properties included in, or eligible for inclusion in, the National Register that could be affected by issuance of a license for the proposed projects. Specifically, the revised HPMPs would include, but not be limited to, a discussion of all cultural resources identified within the APEs of the proposed projects, their National Register eligibility status, project-related effects, and specific management measures to resolve project-related adverse effects (all to be completed in consultation with the Pennsylvania SHPO). We conclude that the benefits are worth the levelized annual cost of $1,710 for each project to revise and implement final HPMPs.

5.1.3 Measures Not Recommended by Staff

Fish Stranding Surveys

Interior recommends the applicants design and implement post-construction fish stranding studies for the dam tailraces at all projects, extending downstream to the point where turbine discharges enter the river.

Although project operation would result in some changes in flow and velocity patterns downstream of the dams, the projects would not dewater any aquatic habitat. On the Ohio River, each Corps dam creates a pool that backwaters to the base of the next upstream dam. Project operation should not strand fish in the project tailraces, or in any other area of the river, because the tailraces would be excavated into the bed of the existing river channel and would be continuously submerged whether the projects were operating or not. Therefore, we do not recommend fish stranding surveys and conclude that the cost of this measure is not justified.

Post-Construction Fish Impingement and Entrainment Studies

Project operation has the potential to result in some fish impingement on the project trash racks and entrainment-related mortality of fish that are entrained through the turbines. To minimize fish mortality related to project operations, the applicants propose to design the projects so that the intakes have maximum approach velocities of less than 2 fps and install trash racks with 5-inch clear bar spacing. Pennsylvania FBC and Interior recommend that the applicants design and implement post-project construction fish impingement and entrainment studies at the projects. Based on the results of the post-project construction studies, Interior may then recommend the applicants consult with the resource agencies to determine appropriate trash rack vertical bar spacing and approach velocities at all projects, and make project modifications where necessary to ensure protection of all fish species and life stages in project areas. Pennsylvania FBC recommends that fish impingement and entrainment losses should be mitigated, but does not specifically describe any mitigation measures.

As discussed in section 3.3.2.2, *Aquatic Resources*, *Environmental Effects*, the applicants conducted a desktop entrainment and turbine survival study to evaluate the risk of impingement and to estimate the number and survival rates of fish that would be entrained through the project turbines during project operation. Analysis of burst swim speeds for representative species indicates that the low approach velocity and relatively wide bar spacing of the trash racks would pose a very low risk of impingement. The study also indicates that most entrained fish would be less than 6 inches in length, with gizzard shad accounting for about 75 to 96 percent of the total entrainment. Average survival rates for fish entrained through the turbines were estimated to be 95.3 percent at the Montgomery Project and 94.5 percent at the Emsworth and Emsworth Back Channel Projects. We conclude that there is little basis for recommending additional field entrainment and impingement studies because it is likely that any such studies would show results similar to the studies that have already been conducted at other projects, which have consistently shown that most of the fish entrained and killed during turbine passage are young fish of highly prolific species, whose populations can compensate for such losses. Accordingly, we do not recommend that the applicants be required to conduct post-construction fish impingement and entrainment studies, because the benefits would not justify the levelized annual cost of $21,270 at each project.

Corps' Biotic Monitoring Requirements

As described in section 3.3.2.2, *Aquatic Resources, Environmental Effects,* construction and operation of the projects would have some effects on aquatic species and their habitats. In general, effects of construction could temporarily displace organisms or decrease habitat suitability near the construction area. Once operation begins, some habitat would become less suitable for fish and other organisms, while other areas would see an increase in habitat suitability. Overall, a small reduction in suitable

habitat for most aquatic species would occur at low and moderate flows, while conditions at high flows would remain relatively unchanged. In addition, fish entrained through the project may suffer turbine-induced mortality, but the entrainment mortality rate would be low.

The Corps indicates that it would require the applicants to conduct post-construction monitoring studies at regular intervals to document local and cumulative effects on aquatic habitats and communities at each project. Specifically, the Corps indicates that it would require: (1) multi-method fish surveys to document any project-related changes in the fish community, (2) fish impingement, entrainment, and mortality surveys to address impacts on all species and sizes of fish; (3) macroinvertebrate surveys; (4) mussel surveys; (5) an assessment of biological integrity for macroinvertebrate and fish assemblages, and (6) tracking of mussel bed and tailwater habitat during construction and operation throughout the term of the licenses.

Under existing conditions, changes in river flow alter and shift aquatic habitat suitability on a regular basis (e.g., daily, weekly, or annually, depending on river flow and gate operations). We note that based on the Corps' rating curves, water depth in the Ohio River pools can vary by more than 10 feet as a result of changes in river flow under existing conditions. As such, the existing aquatic community would be adapted to variation in the flows and habitat suitability within and near the dam tailwaters and project-related changes in habitat suitability would be minor. Some project-related entrainment mortality would occur, but it would not likely have an effect on the existing fish communities. Therefore, fish, mussel, and macroinvertebrate surveys, entrainment surveys, and habitat surveys are not likely needed to document project effects, and we do not recommend these surveys. We estimate that the biotic monitoring studies recommended by the Corps would have a levelized annual cost of $71,530 for each project, and conclude that the benefits of the studies would not justify the cost.

Pre-Construction Federally Listed Mussel Surveys

The Corps recommends that prior to any construction or drawdown activities, the footprint of the powerhouse and any dewatered areas in the cofferdam footprint at each project should be surveyed to determine the presence/absence of federally listed mussel species. The Corps also states that a contingency plan to either relocate or avoid federally listed mussels would be necessary to avoid impacts if such species are found.

Conducting surveys within the proposed dewatered areas, as recommended by the Corps, would provide further assurance on the presence/absence of federally listed mussels within the construction footprint of each project. However, the applicants' PNDI results indicate that no individuals or populations of listed mussels are known to currently occur in these areas. Furthermore, as discussed in section 3.3.2.1, *Aquatic Resources, Affected Environment,* the applicants' 2013 mussel survey did not document any federally

listed mussels in the vicinity of the proposed projects. The applicants surveyed the construction footprints at the Emsworth and Montgomery Projects as well as immediately downstream of the construction footprint at the Emsworth Back Channel Project in 2013 (Ecological Specialists, Inc., 2015). No mussels were found within or immediately downstream of the construction footprints at the Emsworth and Montgomery Projects. While the construction footprint was not surveyed at the Emsworth Back Channel Project, no mussels were found immediately downstream of the construction footprint. In addition, the surveyors noted that habitat at Emsworth Back Channel is mostly unsuitable for mussels. The boulder and cobble substrate and changing hydraulic conditions downstream of the dams, as a result of the Corps' gate operations, likely make the construction footprints at these projects unsuitable for mussels, which generally require stable hydraulic conditions and finer substrates. As such, it would be unnecessary to conduct additional mussel surveys because surveys already conducted within or just outside the construction footprints did not document any federally listed mussel species.

Similarly, a contingency plan as recommended by the Corps, would not be necessary because additional mussel surveys would not be required. Therefore, we do not recommend that the applicants conduct pre-construction surveys for federally listed mussel species, which we estimate would have levelized annual costs ranging from $1,280 to $2,550, depending on the project, because the benefits would not justify the costs.

5.2 UNAVOIDABLE ADVERSE EFFECTS

Construction and initial operation of the three Ohio River Projects may cause unavoidable short-term increases in erosion and sedimentation within the Ohio River in locations immediately upstream and downstream of the respective projects. Construction of the proposed projects also has the potential to result in the suspension and downstream distribution of contaminated sediments present within the Ohio River. However, implementation of an erosion and sedimentation control plan at each project, as proposed by the applicants, would minimize the potential for negative effects, and no long-term effects from erosion are expected. Implementing a soil disposal plan at each project with staff-recommended measures would minimize the potential for suspending and distributing contaminated sediments by ensuring proper procedures are in place during contaminated sediment removal and disposal activities. Lastly, implementing a spill prevention, containment and countermeasures plan at each project with staff-recommended measures would further protect water quality in the Ohio River.

A temporary loss of aquatic habitat would occur within portions of the river enclosed by cofferdams. Construction activities such as cofferdam placement and removal, excavation, and boat traffic in the immediate project areas could displace aquatic organisms, representing a minor, short-term effect during construction. Any mussels currently present within or near the proposed construction footprints could be permanently impacted, but because no mussels were found within the construction

footprints, the overall effects of the projects' construction on the mussel community should be minor.

Operation of the proposed projects may result in lower DO concentrations downstream of the respective projects under some critical river flow conditions, compared to existing conditions. However, monitoring DO concentrations upstream and downstream of each proposed project from June through September for the first 3 years of project operations would help to determine to what extent project operations are affecting DO concentrations downstream of the projects, and what adaptive measures, if any, would be needed.

Operation of the projects would result in some unavoidable fish entrainment-related mortality as fish pass through the turbines. However, the applicants' proposal to install trash racks at the powerhouse intakes with a 5-inch clear bar spacing and limit maximum intake velocity to no more than 2 fps would help to limit any entrainment- and impingement-related fish mortality. Most of the fish entrained by the projects would be juveniles and with expected high survival rates during turbine passage, and any resulting mortality is not likely to result in any measurable impact on resident fish populations in the Ohio River.

Construction of the proposed facilities would permanently disturb shoreline vegetation and some vegetation along transmission line corridors and access roads. Some trees that could serve as potential bald eagle or osprey roosting or nesting habitat would be cleared. Vegetation clearing may also reset plant succession, consequently removing saplings that may develop into the types of mature forest essential for these avian species. However, loss of vegetation would be mitigated by implementing the staff-recommended vegetation management plan at each project. Lastly, implementing the applicants' proposed avian protection plan with staff modifications would minimize project impacts on the avian community.

Construction of the proposed Montgomery Project would result in the loss of some public recreational fishing areas. Additionally, some debris would periodically accumulate near the three proposed Ohio River Projects during construction and operation. This debris could decrease the recreational value of the Ohio River in the vicinity of the proposed projects. However, implementation of a debris management plan and incorporation of the staff modifications for the Montgomery recreational resource management plan would minimize the effects on recreational use.

The construction of the Ohio River Projects would result in a short-term degradation of the visual qualities and noise levels in the vicinity of the dams. The disturbances would be localized, with the surrounding commercial and residential areas being most affected by the visual effects of construction, along with noise and dust. The

decreased visual quality and increased noise levels are unavoidable, but temporary, adverse effects of project construction.

Construction of the proposed Emsworth, Emsworth Back Channel, and Montgomery Projects would result in adverse effects to the existing Corps' locks and dams and also the Ohio River Navigation System, all of which are eligible for listing in the National Register. The proposed projects could also adversely affect other cultural resources located within each project's APE. Revision of the HPMPs to contain additional staff-recommended measures in consultation with the Pennsylvania SHPO and the Corps would avoid or mitigate the adverse effects on these historic properties.

5.3 FISH AND WILDLIFE AGENCY RECOMMENDATIONS

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission believes that any fish and wildlife agency recommendation is inconsistent with the purposes and the requirements of the FPA or other applicable law, the Commission and the agency will attempt to resolve any such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

In response to the Commission's Ready for Environmental Analysis notice, two fish and wildlife agencies submitted recommendations for the projects: Interior (timely filed letter on February 11, 2016) and Pennsylvania FBC (untimely filed letter on February 19, 2016).[49] Table 5-1 lists Interior's recommendation and whether it is adopted under the staff alternative. Environmental recommendations that we consider outside the scope of section 10(j) are considered under section 10(a) and addressed in the specific resource sections of this document and the previous section.

[49] Pennsylvania FBC filed recommendations, but did not specify if the recommendations were submitted under section 10(a) or 10(j). Therefore, these recommendations are considered under section 10(a) and are discussed by resource area in section 3 of this EA.

Table 5-1. Fish and wildlife agency recommendation for all three of the Ohio River Projects (Source: staff).

Recommendation	Agency	Within the Scope of Section 10(j)	Annual Cost	Adopted?
Operate the projects in a run-of-river mode, and provide minimum bypass flows through dam gates or over dam spillways during all months of the year	Interior	No[a]	$0	Not adopted.

[a] The measure is outside the scope of section 10(j) because it is not within the Commission's authority to enforce. The applicants would only be able to operate off of flows made available to them by the Corps. Flow releases through dam gates or over spillways are at the sole discretion of the Corps.

5.4 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2)(A) of the FPA, 16 U.S.C. § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed seven qualifying comprehensive plans that are applicable to the three Ohio River Projects. No inconsistencies were found.

The following is a list of qualifying comprehensive plans relevant to the Ohio River Projects:

Ohio River Basin Commission. 1978. Upper Ohio main stem comprehensive coordinated joint plan. Cincinnati, Ohio. January 1978.

Pennsylvania Department of Environmental Resources. 1983. Pennsylvania State water plan. Harrisburg, Pennsylvania. January 1983. 20 volumes.

Pennsylvania Department of Environmental Resources. 1986. Pennsylvania's recreation plan, 1986-1990. Harrisburg, Pennsylvania.

Pennsylvania Department of Environmental Resources. 1988. Pennsylvania 1988 water quality assessment. Harrisburg, Pennsylvania. April 1988. Three volumes.

Pennsylvania Department of Environmental Resources. 1990. The Pennsylvania scenic rivers program scenic rivers inventory. Harrisburg, Pennsylvania. April 1990.

U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

U.S. Fish and Wildlife Service. Undated. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

6.0 FINDING OF NO SIGNIFICANT IMPACT

If the three Ohio River Projects are licensed as proposed with the additional staff-recommended measures, the projects would operate while providing protective measures for aquatic, terrestrial, recreation, aesthetic, and cultural resources in the project areas.

Based on our independent analysis, issuance of licenses for the Ohio River Projects, as proposed with additional staff-recommended measures, would not constitute a major federal action significantly affecting the quality of the human environment.

7.0 LITERATURE CITED

Advisory Council and FERC (Advisory Council on Historic Preservation and Federal Energy Regulatory Commission). 2002. Guidelines for the development of historic properties management plans for FERC hydroelectric projects. Advisory Council on Historic Preservation and Federal Energy Regulatory Commission, Washington, DC.

Anderson, R.M., K.M. Beer, T.F. Buckwalter, M.E. Clark, S.D. McAuley, J.I. Sams, III, and D.R. Williams. 2000. Water quality in the Allegheny and Monongahela River Basins, Pennsylvania, West Virginia, New York, and Maryland, 1996-98. U.S. Geological Survey Circular 1202, 41 pp.

APLIC (Avian Power Line Interaction Committee). 2006. Suggested practices for avian protection on power lines: the state of the art in 2006. Edison Electric Institute, Avian Power Line Interaction Committee, and the California Energy Commission. Washington, DC, and Sacramento, CA.

Argent, D., R. Lorson, and B. Ventorini. (n.d.). Allegheny and Ohio River Paddlefish. Western Pennsylvania. 2011-2013 Evaluation of our paddlefish restoration program. Pennsylvania Fish and Boat Commission Biologist Report. Available at: https://www.riversofsteel.com/_uploads/files/Allegheny-Ohio%20and%20Paddlefish.pdf. Accessed March 4, 2016.

Argo, R.D. 2014. Creation of a multi-metric macroinvertebrate index: Implications for annual Ohio River assessment. Presentation. Presented at National Monitoring Conference, Cincinnati, OH. April 30, 2014. Available at: http://acwi.gov/monitoring/conference/2014/2ConcurrentSessions/H1/H1Argo.pdf . Accessed February 11, 2016.

Barrett, J., J. Burr, K. Kirchen, and M. Bruckse Bury. 2015a. Emsworth Locks and Dam Hydroelectric Project Historic Properties Management Plan, TRC Environmental Corporation, Inc. Report submitted to FFP, Boston, MA, and Chester Engineers, Moon Township, PA.

Barrett, J., J. Burr, K. Kirchen, and M. Bruckse Bury. 2015b. Emsworth Back Channel Dam Hydroelectric Project Historic Properties Management Plan, TRC Environmental Corporation, Inc. Report submitted to FFP, Boston, MA, and Chester Engineers, Moon Township, PA.

Barrett, J., J. Burr, K. Kirchen, and M. Bruckse Bury. 2015c. Montgomery Lock and Dam Hydroelectric Project Historic Properties Management Plan, TRC Environmental Corporation, Inc. Report submitted to FFP, Boston, MA, and Chester Engineers, Moon Township, PA.

Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: http://bna.birds.cornell.edu/bna/species/506. Accessed February 23, 2016.

CDM Smith. 2015. Water quality, hydraulics, and aquatic habitat study report. Monongahela River Projects. (Appendix c-1, final license application volume – II). Prepared by CDM Smith, Inc., Boston, MA. Prepared for FFP New Hydro, LLC, Boston, MA. Updated October 15, 2015.

CDM Smith. 2014a. Sediment survey study. Monongahela, Allegheny and Ohio River Projects. (Appendix C-7, final license application volume – II). Prepared by CDM Smith, Inc. Boston, MA. Prepared for FFP New Hydro, LLC, Boston, MA. January, 2014.

CDM Smith. 2014b. Water quality, hydraulics, and aquatic habitat study report. Ohio River Projects. (Appendix c-1, final license application volume – II). Prepared by CDM Smith, Inc., Boston, MA. Prepared for FFP New Hydro, LLC, Boston, MA. March, 2014.

Commonwealth of Pennsylvania. 2016. § 93.7. Specific Water Quality Criteria. *The Pennsylvania Code Online*. Fry Communications, Inc., 9 Jan. 2016. Available at: http://www.pacode.com/secure/data/025/chapter93/s93.7.html. Accessed February 1, 2016.

Corps (U.S. Army Corps of Engineers). (n.d. (1)). Pittsburgh District: Emsworth Locks & Dams. Available at: http://www.lrp.usace.army.mil/Missions/Navigation/LocksandDams/EmsworthLocksDams.aspx. Accessed February 25, 2016.

Corps. (n.d. (2)). Pittsburgh District: Montgomery Locks and Dam. Available at: http://www.lrp.usace.army.mil/Missions/Navigation/LocksandDams/MontgomeryLocksDam.aspx. Accessed February 25, 2016.

eBird. 2015. eBird: An online database of bird distribution and abundance [Bald Eagles Range Map]. eBird, Ithaca, New York. Available at: http://ebird.org/ebird/map/baleag?neg=true&env.minX=&env.minY=&env.maxX=&env.maxY=&zh=false&gp=false&ev=Z&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2016. Accessed March 10, 2016.

Ecological Specialists, Inc. 2015. Unionid survey at ten dams on the Monongahela, Ohio, and Allegheny Rivers. Final Revised Report. Prepared by Ecological Specialists, Inc., O'Fallon, MI. Under contract to CDM Smith, Pittsburgh, PA. Prepared for FFP, Boston, MA. October 15, 2015.

EPA (U.S. Environmental Protection Agency). 2016. My Waters Mapper. Available at: http://watersgeo.epa.gov/mwm/. Accessed February 5, 2015.

EPRI (Electric Power Research Institute). 1997. Turbine Entrainment and Survival Database – Field Tests. EPRI Report No. TR-108630. Prepared by: Alden Research Laboratory, Inc. Holden, MA.

FERC (Federal Energy Regulatory Commission). 2014. Final environmental assessment for original hydropower license Braddock Locks and Dam Hydroelectric Project, FERC Project No. 13739-002, Pennsylvania. Federal Energy Regulatory Commission, Washington, DC. June 2014.

FFP 5 LLC (FFP Missouri 5, LLC). 2014. Emsworth Locks and Dam Hydroelectric Project, FERC No. 13757. Final license application for initial license – Major project – Existing dam. Prepared by: FFP, Boston, MA. Volumes I through IV. March 14.

FFP 6 LLC (FFP Missouri 6, LLC). 2014. Emsworth Back Channel Dam Hydroelectric Project, FERC No. 13761. Final license application for initial license – Major Project – Existing dam. Prepared by: FFP, Boston, MA. Volumes I through IV. March 14.

Fobian, T.B. 2007. Reproductive biology of the rabbitsfoot mussel (Quadrula cylindrica) (Say, 1817) in the Upper Arkansas River System, White River System, and the Red River System. Unpublished M.S. thesis. Missouri State University, Springfield, MO. 104 pp.

Franke, G.F., D.R. Webb, R.K. Fisher, Jr., D. Mathur, P.N. Hopping, P.A. March, M.R. Headrick, I.T. Laczo, Y. Ventikos, and F. Sotiropoulos. 1997. Development of environmentally advanced hydropower turbine system design concepts. Prepared for U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID.

FWS (U.S. Fish and Wildlife Service). 2016. Endangered and threatened wildlife and plants; 4(d) rule for the northern long-eared bat. Federal Register 81(9). January 14, 2016. Available at: https://www.fws.gov/Midwest/endangered/mammals/nleb/pdf/FRnlebFinal4dRule14Jan2016.pdf. Accessed March 18, 2016.

FWS. 2015. Endangered status for the neosho mucket, threatened status for the rabbitsfoot, and designation of critical habitat for both species, 80 FR 24691: final rule. U.S. Fish and Wildlife Service. April 30, 2015. Available at: http://www.gpo.gov/fdsys/pkg/FR-2015-04-30/pdf/2015-09200.pdf. Accessed February 24, 2015.

FWS. 2013a. Endangered status for the neosho mucket and threatened status for the rabbitsfoot. U.S. Fish and Wildlife Service, Interior. September 17, 2013. Available at: http://www.gpo.gov/fdsys/pkg/FR-2013-09-17/pdf/2013-22245.pdf. Accessed February 24, 2015.

FWS. 2013b. Indiana Bat Fact Sheet. Available at: http://www.fws.gov/midwest/endangered/mammals/inba/inbafctsht.html. Accessed February 20, 2016.

FWS. 2012a. Endangered and threatened wildlife and plants; determination of endangered status for the rayed bean and snuffbox mussels throughout their ranges. U.S. Fish and Wildlife Service, Interior. February 14, 2012. Available at: http://www.gpo.gov/fdsys/pkg/FR-2012-02-14/pdf/2012-2940.pdf. Accessed February 24, 2015.

FWS. 2012b. Proposed endangered status for the neosho mucket, threatened status for the rabbitsfoot, and designation of critical habitat for both species: Proposed rule. U.S. Fish and Wildlife Service, Interior. October 16, 2012. Available at: http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24151.pdf. Accessed February 24, 2015.

FWS. 2008. Northern riffleshell (*Epioblasma torulosa rangiana*) 5-year review: Summary and evaluation. U.S. Fish and Wildlife Service, Interior. Fall 2008. Available at: http://ecos.fws.gov/docs/five_year_review/doc3284.pdf. Accessed February 25, 2016.

FWS. 2007. National Bald Eagle Management Guidelines. U.S. Department of the Interior, Fish and Wildlife Service. May 2007.

Google Earth. 2015. Google Earth 7.1.5.1557: West Pennsylvania. Viewed February 3, 2016.

HDR. 2013. Ohio River Projects fish entrainment and passage study. HDR, Syracuse, NY. Prepared for FFP, Boston, MA. October 2013.

Kuncio, G.M. and L.C. Ricketts. 2014a. Emsworth Locks and Dams Hydroelectric Project, Ben Avon and Emsworth Boroughs, Kennedy and Neville Townships, Allegheny County, Pennsylvania: Phase I reconnaissance level above-ground structures investigation, Skelly and Loy, Inc., Pittsburg, Pennsylvania. Report submitted to FFP, Boston, MA, and Chester Engineers, Moon Township, PA.

Kuncio, G.M. and L.C. Ricketts. 2014b. Montgomery Locks and Dams Hydroelectric Project, Ben Avon and Emsworth Boroughs, Potter and Raccoon Townships, Beaver County, Pennsylvania: Phase I reconnaissance level above-ground

structures investigation, Skelly and Loy, Inc., Pittsburg, Pennsylvania. Report submitted to FFP, Boston, MA, and Chester Engineers, Moon Township, PA.

NERC (North American Electric Reliability Corporation). 2015. 2015 Long-term reliability assessment. North American Electric Reliability Corporation, Atlanta, GA. December 2015.

Monitoring Analytics, LLC. 2014. PJM (Pennsylvania-New Jersey-Maryland) State of the market report for 2014, volume 2, appendix c, table c-5. March 12, 2015. Available at: http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2014/2014-som-pjm-volume2-appendix.pdf. Accessed April 25, 2016.

ORSANCO (Ohio River Valley Water Sanitation Commission). 2016a. Dissolved oxygen and temperature database. Available at: http://www.orsanco.org/dissolved-oxygen-and-temperature. Accessed February 27, 2016.

ORSANCO. 2016b. Fish population database. Available at: http://www.orsanco.org/fish-population. Accessed February 5, 2016.

ORSANCO. 2016c. Macroinvertebrate database. Available at: http://www.orsanco.org/macroinvertebrate. Accessed February 11, 2016.

Pennsylvania DEP (Pennsylvania Department of Environmental Protection). 2016. Commonwealth of Pennsylvania 2016 fish consumption public health advisory. Pennsylvania DEP, Harrisburg, PA. Available at: http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/FishConsumption/FishAdvisory/FishConsAdvTables2016-Final.pdf. Accessed February 8, 2016.

Pennsylvania DEP. 2014. 2014 Pennsylvania integrated water quality monitoring and assessment report clean water act section 305(b) report and 303(d) list. Pennsylvania DEP. Harrisburg, PA. Available at: http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/2014%20Integrated%20List/2014_Pennsylvania_Integrated_Water_Quality_Monitoring_and_Assessment_Report.pdf. Accessed February 2, 2016.

Pennsylvania FBC (Pennsylvania Fish and Boat Commission). 2016. Pennsylvania's dynamic darters. Available at: http://fishandboat.com/education/catalog/darters.html. Accessed April 25, 2016.

Pennsylvania FBC. 2011. Three rivers management plan: A strategy for managing fisheries resources of the Allegheny, Monongahela and Ohio Rivers. Pennsylvania Fish and Boat Commission. Bureau of Fisheries. Fisheries Management Division Area 8, Somerset, PA. Available at: http://fishandboat.com/water/rivers/threerivers/ThreeRiversMgmtPlan.pdf Accessed February 1, 2016.

Port of Pittsburgh Commission. (n.d.). Federal Marine Highway Corridor M-70. Available at: http://www.port.pittsburgh.pa.us/index.aspx?page=241. Accessed February 26, 2016.

Roley, S.S. 2012. The influence of floodplain restoration on stream ecosystem function in an agricultural landscape. Dissertation. November 2012. University of Notre Dame. 305 pp.

Rye Development. 2015a. Supplemental Information of Rye Development under P-13757, et al. Response to request for additional information. Rye Development, LLC, Boston, MA. Filed September 18, 2015.

Rye Development. 2015b. Supplemental Information of Rye Development under P-13757, et al. Response to Request for Additional information. Response 1 of 2. September 18, 2015. Available at: http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=13990710. Accessed February 26, 2016.

Rye Development. 2015c. Recreation resource management plan. September 18, 2015. Available at: http://elibrary.ferc.gov/idmws/File_list.asp?document_id=14378292. Accessed March 29, 2016.

Rye Development. 2014. Responses to supplemental information by Rye Development under P-13755, et al. Rye Development, LLC, Boston, MA. Filed October 20, 2014.

Schumer, J.L. and B.J. Gundy. 2014a. Emsworth Locks and Dams Hydroelectric Project,[50] Ben Avon and Emsworth Boroughs, Kennedy and Neville Townships, Allegheny County, Pennsylvania. Pennsylvania Historical and Museum Commission Record of Disturbance Form. Report submitted to FFP, Boston, MA, and Chester Engineers, Moon Township, PA.

[50] This document also includes information pertaining to Emsworth Back Channel.

Schumer, J.L. and B.J. Gundy. 2014b. Montgomery Locks and Dams Hydroelectric Project, Industry Borough, Potter and Raccoon Townships, Beaver County, Pennsylvania. Pennsylvania Historical and Museum Commission Record of Disturbance Form. Report submitted to FFP, Boston, MA, and Chester Engineers, Moon Township, PA.

Solia 6 LLC (Solia 6 Hydroelectric, LLC). 2014. Montgomery Locks and Dam Hydroelectric Project, FERC No. 13768. Final license application for initial license – Major project – Existing dam. Prepared by FFP, Boston, MA. Volumes I through IV. March 14.

Taylor, R.W. 1989. Changes in freshwater mussel populations of the Ohio River: 1,000 BP to recent times. The Ohio Journal of Science 89(5):188–191.

Watters, G.T. 1994. Ohio Department of Natural Resources, Division of Wildlife. Clubshell (*Pleurobema clava*) and northern riffleshell (*Epioblasma torulosa rangiana*) recovery plan. Prepared for Region 5 U.S. Fish and Wildlife Service, Hadley, MA. September 1994. Available at: http://ecos.fws.gov/docs/recovery_plan/940921.pdf. Accessed February 24, 2015.

8.0 LIST OF PREPARERS

Federal Energy Regulatory Commission

Nicholas Ettema—Project Coordinator, Water Quality, Aquatic Resources (Fisheries Biologist; M.S., Aquatic Ecology)

Woohee Choi—Engineering, Aquatic Resources (Water Quantity/Water Quality), and Developmental Analysis (Environmental Engineer; Ph.D., M.S., and B.S., Civil and Environmental Engineering)

Allyson Conner—Recreation and Land Use, Aesthetic Resources, Cultural Resources. (Outdoor Recreation Planner; M.S., Recreation Management)

Gaylord Hoisington—Geology and Soil Resources (Soil Conservationist; B.S., Recreation)

Brandi Sangunett—Terrestrial Resources, Threatened and Endangered Species (Ecologist; M.S., Natural Resources and Environmental Sciences, B.S., Zoology, B.A., Geography)

Louis Berger

Fred Winchell—Project Manager, Aquatic Resources (Fisheries Biologist; M.S., Fisheries Biology, B.S., Fisheries Biology)

Alison Macdougall—Deputy Project Manager; Cultural Resources Senior Review (Senior Environmental Manager; B.A., Anthropology)

Megan Blue-Sky—Terrestrial Resources (Environmental Scientist; B.A., Geography)

Stephen Byrne—Water Quality, Aquatic Resources, and Threatened and Endangered Species (Fisheries Biologist; M.S. Marine and Environmental Biology)

Peter Foote—Aquatic Resources (Senior Fisheries Biologist; M.S., Fisheries Biology; B.S., Wildlife Biology)

Alynda Foreman—Terrestrial Resources and Threatened and Endangered Species (Ecologist; M.S., Multidisciplinary Studies; B.A., Biology)

Nick Funk—Water Quantity, Developmental Analysis, and Geology and Soils Resources Support (Hydrologist; M.S. Water Resources Management and Hydrologic Science)

Bernward Hay—Water Resources (Principal Environmental Scientist; Ph.D., Oceanography (Marine Geology); M.S., Geological Sciences and Remote Sensing)

Kenneth Hodge—Developmental Analysis, Project Description, and Geology and Soils Resources (Senior Engineer; B.S., Civil Engineering)

Erin Hudson—Cultural Resources (Senior Archaeologist; M.A., Anthropology)

Coreen Johnson—Editorial Review (Technical Editor; B.A., English/Education)

Emily Johnson—Editorial Support (Editor; B.A., English)

Ann Koch—Quality Assurance/Quality Control (Fisheries Biologist; B.S., Biological Science, B.S. Civil Engineering)

Tyler Rychener—Terrestrial Resources, Threatened and Endangered Species, and Graphics (Environmental Scientist/GIS; M.S., Plant Biology; B.S., Biology)

Lela Shepherd—Recreation Resources, Land Use and Aesthetics Support (M.U.P., Land Use and Environmental Planning; B.A., International Development and German)

Denise Short—Editorial Review (Technical Editor; M.S., Agriculture, Food, and the Environment; B.A., English)

Jot Splenda—Recreation Resources (Environmental Planner; M.E.S.M, Water Resource Management; B.S., Ecology and Evolution)

Document Content(s)