BRADDOCK LOCKS AND DAM HYDROELECTRIC PROJECT (FERC NO. 13739)

APPLICATION FOR ORIGINAL LICENSE
MAJOR PROJECT – EXISTING DAM

Prepared for:
LOCK+ HYDRO FRIENDS FUND XLII, LLC
Westmont, Illinois

Prepared by:
HDR ENGINEERING, INC.
Portland, Maine

SEPTEMBER 2012

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LIST OF ABBREVIATIONS AND ACRONYMS

°C	degrees Celsius
°F	degrees Fahrenheit
3R2N	Three Rivers – Second Nature Program
ACED	Allegheny County Economic Development
B.P.	before present
CEII	Critical Energy Infrastructure Information
CFR	Code of Federal Regulations
cfs	cubic feet per second
DO	dissolved oxygen
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
FERC or Commission	Federal Energy Regulatory Commission
GISCP	Governor's Invasive Species Council of Pennsylvania
Hydro Friends Fund	Lock+ Hydro Friends Fund XLII, LLC
LFM	Large Frame Module
MBTs	Modular Bulb Turbines
mg/L	milligrams per liter
MNC	Monongahela Navigation Company
MW	megawatt
MWh	megawatt hour
National Register	National Register of Historic Places
NAWQA	National Water-Quality Assessment
NGVD	National Geodetic Vertical Datum
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NWI	National Wetlands Inventory
ODNR	Ohio Department of Natural Resources
ORSANCO	Ohio River Valley Water Sanitation Commission
PAD	Pre-Application Document
PADCNR	Pennsylvania Department of Conservation and Natural Resources
PADEP	Pennsylvania Department of Environmental Protection
PennDOT	Pennsylvania Department of Transportation
PFBC	Pennsylvania Fish and Boat Commission
PM&E	Protection, Mitigation, and Enhancement
PNDI	Pennsylvania Natural Diversity Inventory

PNHP ....Pennsylvania Natural Heritage Program
POR ....period of record
RC ....relative composition
RM ....river mile
RPM ....revolutions per minute
SHPO ....State Historic Preservation Office
TMDL ....total maximum daily loads
USACE .................................U.S. Army Corps of Engineers
USBM ...................................U.S. Bureau of Mines
USEPA ..................................U.S. Environmental Protection Agency
USFWS .................................U.S. Fish and Wildlife Service
USGS ....................................U.S. Geological Survey
WVDEP ....West Virginia Department of Environmental Protection

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

LOCK+™ HYDRO FRIENDS FUND XLII | **BRADDOCK LOCKS AND DAM PROJECT FERC NO. 13739**

APPLICATION FOR ORIGINAL LICENSE
FOR A MAJOR WATER POWER PROJECT - EXISTING DAM

INITIAL STATEMENT

Application for License for a Major Water Power Project – Existing Dam

1. Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund) applies to the Federal Energy Regulatory Commission for an original license for the proposed Braddock Locks and Dam Project (FERC No. 13739), as described in the attached Exhibits.

2. The location of the proposed Project is:

   State: Pennsylvania
   County: Allegheny
   Township or Nearby Towns: Borough of Braddock and Borough of West Mifflin
   Body of Water: Monongahela River

3. The exact name and business address of applicant is:

   Lock+™ Hydro Friends Fund XLII
   900 Oakmont Lane, Suite 310
   Westmont, IL 60559
   Telephone: (877) 556-6566

4. The exact name and business address of each person authorized to act as agent for the applicant in this application is:

   Mr. Mark R. Stover
   Vice President of Corporate Affairs
   Lock+™ Hydro Friends Fund XLII
   Hydro Green Energy, LLC
   900 Oakmont Lane, Suite 310
   Westmont, IL 60559
   Telephone: (877) 556-6566 ext. 711
   Email: mark@hgenergy.com

Mr. Wayne F. Krouse
Managing Partner
Lock+™ Hydro Friends Fund XLII
Hydro Green Energy, LLC
900 Oakmont Lane, Suite 310
Westmont, IL 60559
Telephone: (877) 556-6566 ext. 709
Email: wayne@hgenergy.com

5. The applicant is a domestic corporation and is not claiming preference under Section 7(a) of the Federal Power Act.

6.(i) The statutory or regulatory requirements of the state in which the Project would be located that affect the Project as proposed, with respect to bed and banks, and to the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power, and any other business necessary to accomplish the purposes of the license under the Federal Power Act, are:

- A water quality certificate pursuant to Section 401 of the Clean Water Act is required from the Commonwealth of Pennsylvania. In Pennsylvania, the Certification Program is administered by the Pennsylvania Department of Environmental Protection (PADEP).

- To the extent not preempted by the Federal Power Act, the proposed Project is subject to the provisions of the Limited Water and Power Act of June 14, 1923 (P.L. 704, 32 P.S. §591-601), which is currently administered by PADEP.

- Permits are required from the U.S. Army Corps of Engineers (USACE) to assure compliance with the River and Harbor Act of 1899 (Section 404 of P.L. 92-500, and Section 103 of P.L. 92-532).

6.(ii) The steps which the applicant has taken or plans to take to comply with each of the laws cited above are:

- Hydro Friends Fund will apply to the PADEP for a water quality certificate pursuant to Section 401 of the Clean Water Act and additional permits administered by the PADEP following submittal of the license application.

- Hydro Friends Fund will apply to the USACE for approval under Section 408 of the River and Harbors Act and Section 404 of the Clean Water Act.

7. The Braddock Locks and Dam was built from 1902 to 1906 and underwent a reconstruction that was completed in 1953. Between 2002 and 2004, the fixed crest dam was demolished and replaced with a floated-in gated dam positioned on reinforced

concrete caissons. The approximate 1,007-foot-long locks and dam is currently comprised of:

- An approximately 504-foot-long gated section (four 110-foot-long gated bays);
- An 84-foot-long fixed crest weir;
- 230 feet of locks (a land-side lock that is 110 feet wide by 720 feet long, and a river side lock that is 56 feet wide by 360 feet long);
- An approximately 55-foot-long right abutment; and
- A left closure weir, constructed of cellular sheeting and tremie concrete (founded on rock at Elevation 670.0 ± feet NVGD29[1]), that is approximately 133 feet long and 52 feet wide.

These locks provide an 8.7-foot vertical lift (Port of Pittsburgh Commission undated).

The proposed Project consists of a new powerhouse with five turbine-generators, a switchyard and control room, and an approximately 3,450-foot-long electric transmission line. More specifically, the proposed Project will deploy hydropower turbines within a patented "Large Frame Module" (LFM) that will be deployed on the south (river left) side of the dam, opposite the location of the existing navigational locks and at the upstream face of the existing left closure weir. The proposed modular, low environmental impact powerhouse will be approximately 60.4 feet long, 16.6 feet wide, and 40 feet high, and constructed of structural-grade steel. The powerhouse will bear on a concrete foundation on rock that is anchored to the existing left closure weir. A trash rack with 6-inch openings will be placed at the powerhouse intake to increase safety and protect the turbines from large debris.

(i) The installed capacity of the proposed Project is 3.75 MW.

(ii) The classification of the proposed Project is "Existing Dam."

8. The proposed Project does not occupy any lands of the United States.

9. Construction of the proposed Project is planned to start within three months, and is planned to be completed within six months, from the date of license issuance.

<u>Additional Information Required by 18 CFR §4.32(a)</u>

In accordance with 18 CFR §4.32(a) of FERC's regulations, the Applicant provides the following information.

[1] All elevations in this license application are referenced to FT NGVD29.

Proprietary Rights Necessary to Construct, Operate, and Maintain the proposed Project:

> Hydro Friends Fund presently holds, or intends to obtain, all proprietary rights necessary to construct, operate, and maintain the proposed Project.

The proposed Project would be located in the following State of Pennsylvania county:

> Allegheny County
> 501 County Office Building
> 542 Forbes Ave.
> Pittsburgh, PA 15219

The proposed Project would use the following Federal facilities:

> Braddock Locks and Dam
> U.S. Army Corps of Engineers
> 11th Street
> Braddock, PA 15104

The proposed Project, and the Federal facilities that would be used by the Project, are located within the boundaries of the following towns:

> Borough of West Mifflin
> 3000 Lebanon Church Road
> West Mifflin, PA 15112

> Borough of Braddock
> 600 Anderson Street
> Braddock, PA 15104

Consistent with the list presented in the Pre-Application Document (PAD), Table IS-1 presents the cities, towns, or similar local political subdivisions that have populations greater than 5,000 and are located within 15 miles of the proposed Project.

Table IS-1 Municipalities within 15 miles of the proposed Project with populations greater than 5,000.

Municipality and Address	
Borough of Avalon 640 California Avenue Pittsburgh, PA 15202	Borough of Baldwin 10 Community Park Drive Pittsburgh, PA 15234
Borough of Brentwood 3624 Brownsville Road Pittsburgh, PA 15227	Borough of Bridgeville 425 Bower Hill Road Bridgeville, PA 15017
Borough of Carnegie 1 Glass Street Carnegie, PA 15106	Borough of Castle Shannon 310 McRoberts Road Castle Shannon, PA 15234
Borough of Crafton 100 Stotz Avenue Pittsburgh, PA 15205	Borough of Forest Hills 2071 Ardmore Blvd. Pittsburgh, PA 15221
Borough of Plum 4575 New Texas Road Plum, PA 15239	Borough of Swissvale 7560 Roslyn Street Swissvale, PA 15218
Borough of Turtle Creek 125 Monroeville Avenue Turtle Creek, PA 15145	Borough of West View 441 Perry Highway West View, PA 15229
Borough of Wilkinsburg 605 Ross Ave Wilkinsburg, PA 15221	City of Clairton 551 Ravensburg Boulevard Clairton, PA 15025
City of Duquesne 125 2nd Street Duquesne, PA 15110	Borough of West Mifflin 3000 Lebanon Church Road West Mifflin, PA 15122
City of McKeesport 201 Lysle Blvd McKeesport, PA	City of Pittsburgh 414 Grant St. City - County Building Suite 510 Pittsburgh, PA 15219
Kennedy Township 340 Forest Grove Rd. Coraopolis, PA 15108	Township of O'Hara Township 325 Fox Chapel Road O'Hara Township, PA 15238
Township of North Versailles 1401 Greensburg Avenue North Versailles, PA 15137	Township of Shaler Township 300 Wetzel Road Glenshaw, PA 15116

The proposed Project, and the Federal facilities that would be used by the Project, are located within the following irrigation districts, drainage districts, and similar special purpose political subdivisions:

None

The proposed Project, and the Federal facilities that would be used by the Project, are owned, operated, maintained or used by the following irrigation districts, drainage districts, and similar special purpose political subdivisions:

None

Other political subdivisions in the general area of the proposed Project that there is reason to believe would likely be interested in, or affected by, the application include:

None

Indian Tribes that may be affected by the proposed Project include:

Oneida Tribe of Indians of Wisconsin
P.O. Box 365
Oneida, WI 54155-0365

St. Regis Mohawk Tribe
412 State Route 37
Akwesasne, NY 13655

Stockbridge-Munsee Community of Wisconsin
N8476 Mo He Con Nuck Road
Bowler, WI 54416

Oneida Nation of New York
5218 Patrick Road
Verona, NY 13478

Shawnee Tribe
P.O. Box 189
Miami OK 74355

Seneca-Cayuga Tribe of Oklahoma
23701 South 655 Road
Grove, OK 74344

Onondaga Nation of New York
P.O. Box 319-B
102 W. Conklin Avenue
Nedrow, NY 13120

Seneca Nation of Indians
P.O. Box 231
Salamanca, NY 14479

Cayuga Nation of New York
2540 State Route 89
P.O. Box 803
Seneca Falls, NY 13148

Eastern Shawnee Tribe of Oklahoma
P.O. Box 350
Seneca, MO 64865

Tonawanda Band of Seneca Indians
P.O. Box 795
7027 Meadville Road
Basom, NY 14013

Tuscarora Nation of New York
2006 Mount Hope Road
Lewiston, NY 14092

VERIFICATION

The undersigned being duly sworn, deposes and says that the contents of the Application are true to the best of his knowledge or belief. The undersigned applicant has signed this application this 12 day of September 2012.

Mark R. Stover
Vice President of Corporate Affairs
Hydro Green Energy, LLC
Designated Representative of Lock+™ Hydro Friends Fund XLII (license applicant, which is a wholly-owned subsidiary of Hydro Green Energy, LLC)

Subscribed and sworn to before me this
12 day of September, 2012.

Notary Public

OFFICIAL SEAL
RUE A FARCAS
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 6-30-2013

BRADDOCK LOCKS AND DAM HYDROELECTRIC PROJECT

FERC NO. 13739

LICENSE APPLICATION

EXHIBIT A - PROJECT DESCRIPTION

A.1 GENERAL PROJECT DESCRIPTION

A.1.1 Project Overview and Location

Lock+™ Hydro Friends Fund XLII, LLC (Hydro Friends Fund), a wholly owned project development entity of Hydro Green Energy, LLC of Westmont, Illinois, is proposing to develop a hydroelectric facility at the U.S. Army Corps of Engineers (USACE) Braddock Locks and Dam, which is located in an industrial area on the Monongahela River in the Borough of Braddock, Pennsylvania. Braddock Locks and Dam is one of nine navigational structures, collectively known as the USACE Monongahela River Locks and Dams system, which provide year-round navigation on the Monongahela River between Pittsburgh, Pennsylvania, and Fairmont, West Virginia. A pool is maintained for 12.6 miles upstream to Locks and Dam 3 at Elizabeth, Pennsylvania. Located at river mile (RM) 11.2 at the City of Braddock, Pennsylvania, the lock chambers and operations buildings are situated along the right bank of the river adjacent to a major steel-making plant (Figure A.1.1-1 and A.1.1-2). Road access to the USACE Braddock Locks and Dam is from 11th Street in Braddock (USACE 2011a, 2011b). Figure A.1.1-3 shows the location of the dams and diversions along the Monongahela River and the larger Ohio River Basin operated by the USACE Pittsburgh District, and Figure A.1.1-4 depicts the existing Monongahela River profile for the Monongahela River Locks and Dams system.

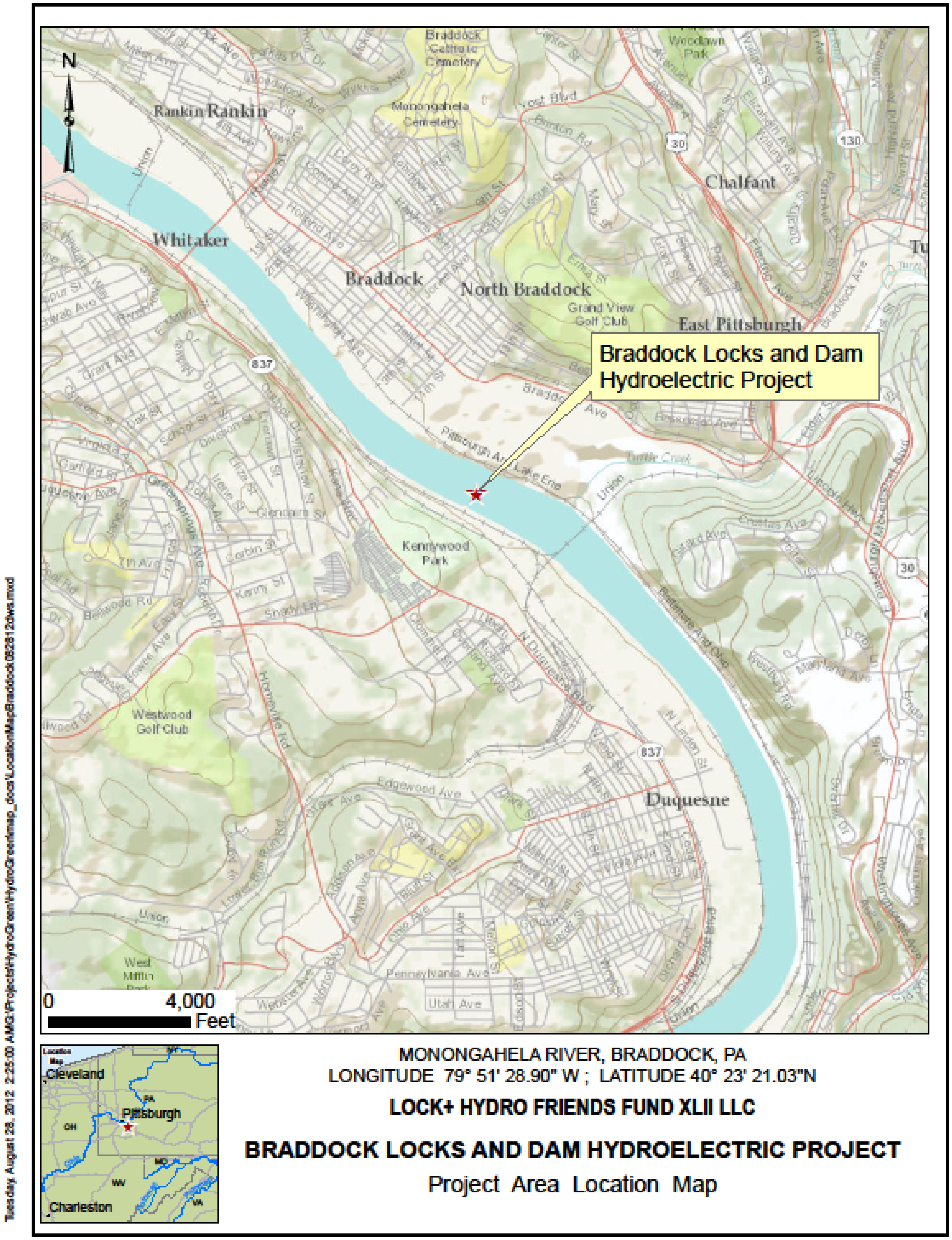


Figure A.1.1-1 Project vicinity map.

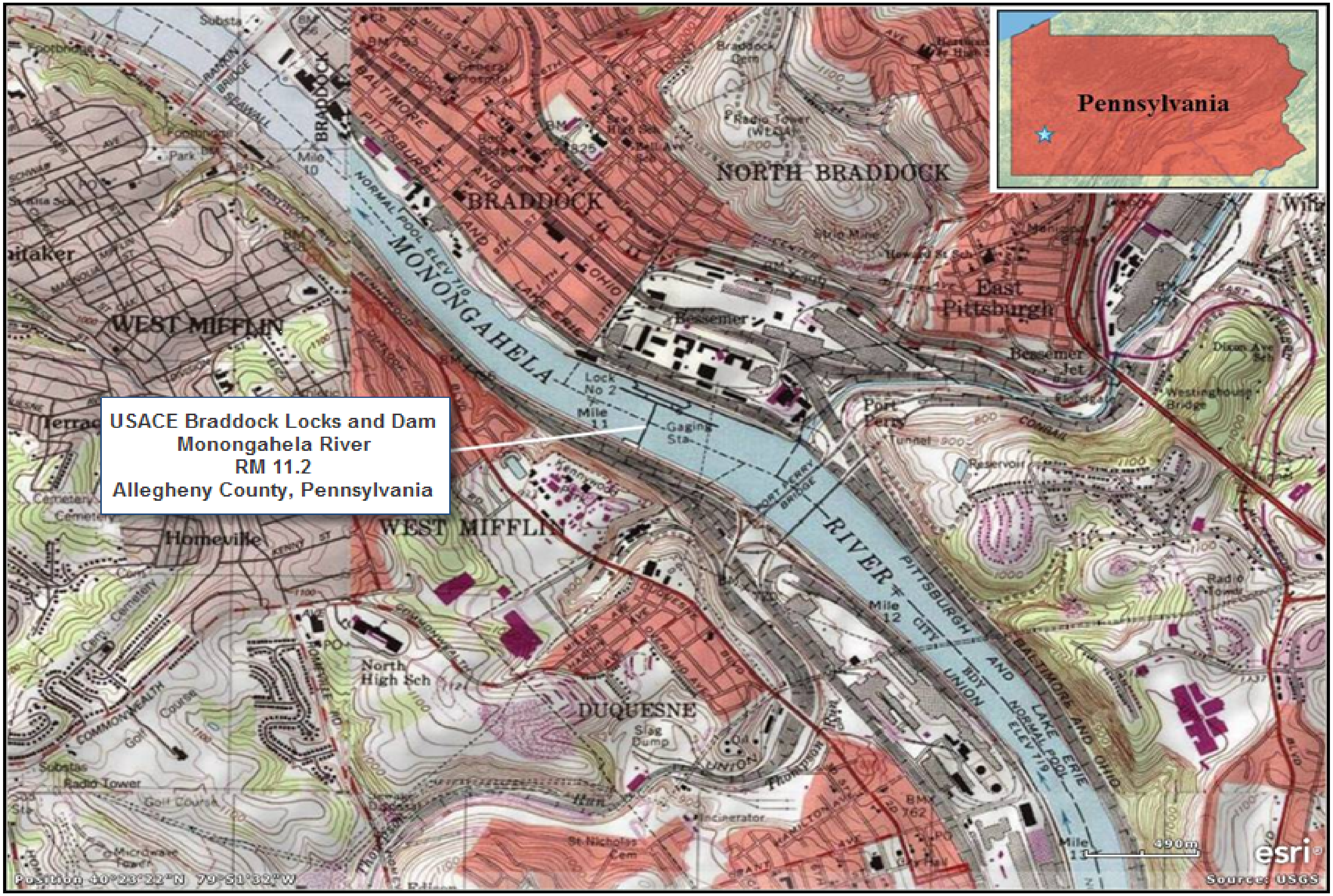


Figure A.1.1-2 Project location map.

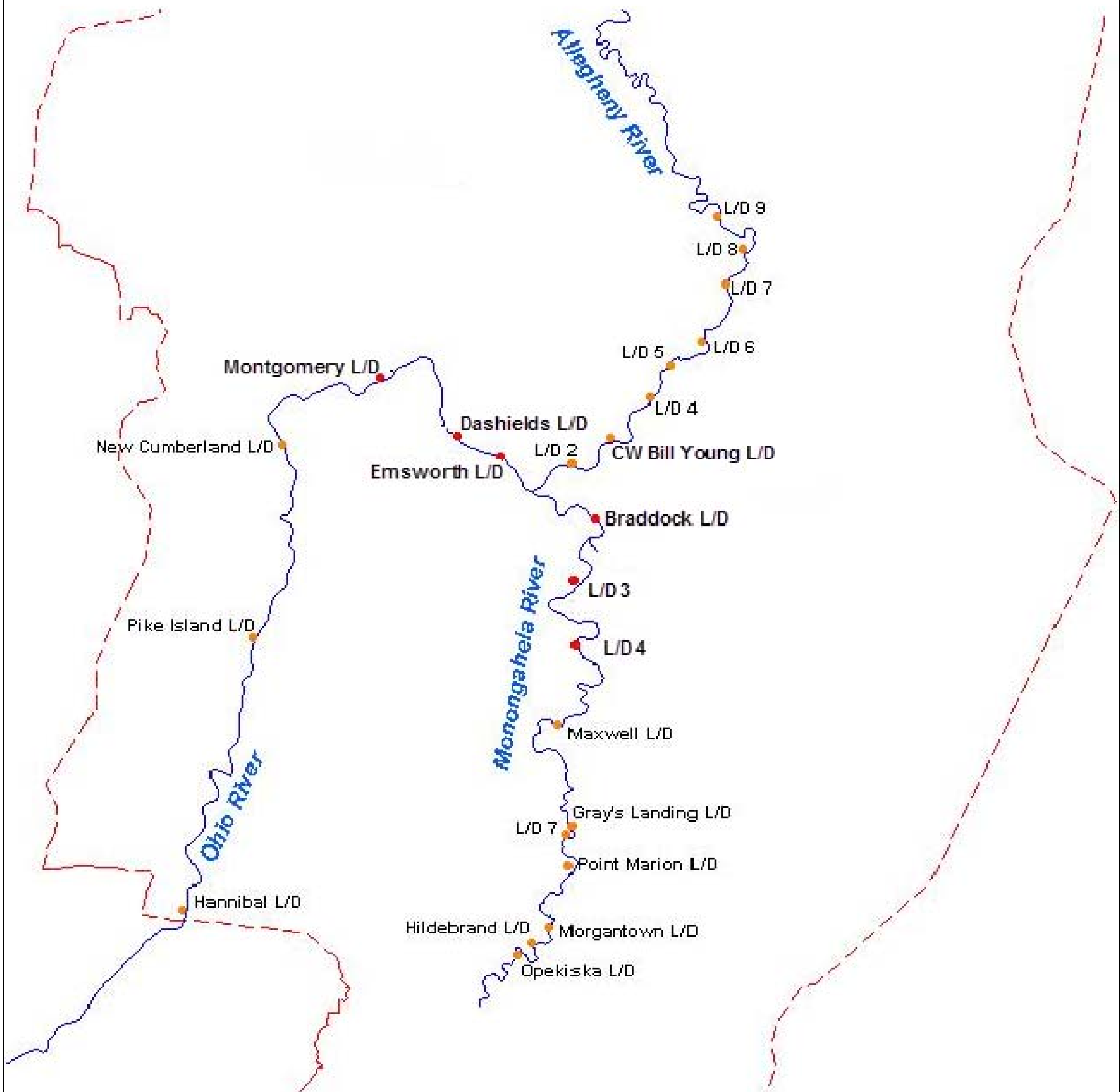
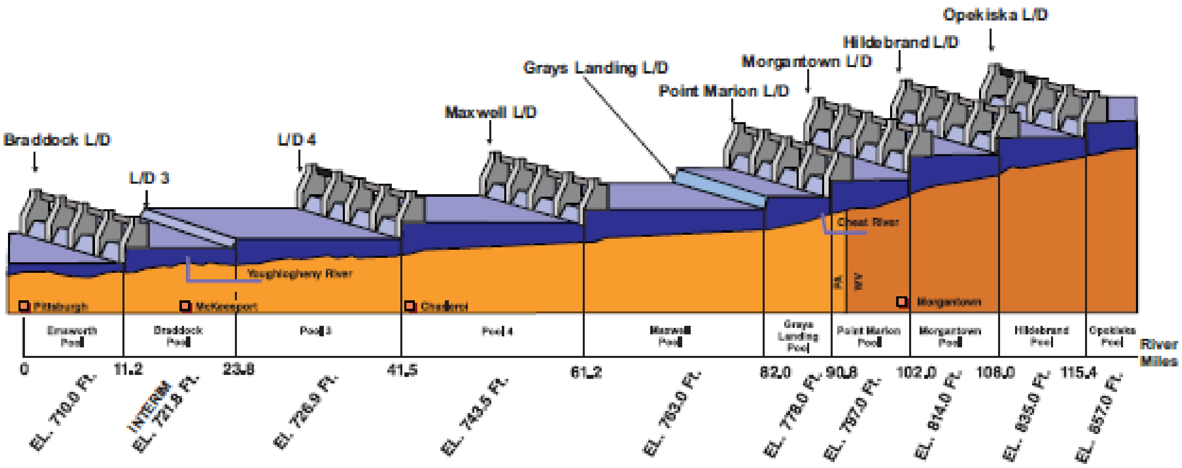


Figure Source: Pittsburgh District, U.S. Army Corps of Engineers (http://outreach.lrh.usace.army.mil/Locks/lrp.htm)
* Figure has been modified to include the full names of the Braddock Locks and Dam (Braddock L/D) and CW Bill Young Lock and Dam (CW BillYoung L/D).

Figure A.1.1-3 USACE Pittsburgh District dams and diversions along the Monongahela River and the larger Ohio River Basin.



Source: Exhibit E, USACE 2004

Figure A.1.1-4 Existing Monongahela River profile.

A.2 DESCRIPTION OF PRIMARY PROJECT FACILITIES

A.2.1 Existing USACE Facilities

With the exception of minor infrastructure to deliver power to the local electric grid, and the integration of the LFM into the weir, the proposed Project will have limited effect on any structures or facilities currently at the Braddock Locks and Dam. The following is a description of the USACE Braddock Locks and Dam facilities, which are operated by the USACE - Pittsburgh District.

The original Braddock Locks and Dam was built from 1902 to 1906 of unreinforced concrete founded on timber piles and rock-filled timber cribbing. Between 1949 and 1953, the Dam underwent reconstruction in which it was shortened and sheetpile cells were driven at the left abutment (for erosion protection). Between 2002 to 2004 the fixed-crest dam was demolished and replaced with a floated-in gated dam founded on reinforced concrete caissons. The approximate 1,007-foot-long locks and dam is currently comprised of an approximate 504-foot-long gated section (four 110-foot-long gated bays), a 84-foot-long fixed crest weir, 230 feet of locks (a land-side lock that is 110 feet wide by 720 feet long, and a river side lock that is 56 feet wide by 360 feet long), an approximate 55-foot-long right abutment, and a left closure weir, constructed of cellular sheeting and tremie concrete (founded on rock at Elevation 670.0 ± feet

NGVD29[2]), that is approximately 133 feet long and 52 feet wide. The sill of the spillway varies from elevation 704.7 in gate bays 2 through 4, elevation 714.0 at gate bay 1, and elevation 723.7 at the fixed weir. The crest of the left closure weir is at elevation 725.0.

A.2.2 Existing Project Operations at the Braddock Locks and Dam

The Braddock Locks and Dam is operated as a run-of-release facility in order to maintain a near-constant upper pool, and is operated for navigational purposes on the Monongahela River. The facility is operated by the USACE and is manned 24 hours a day. The normal pool elevation for the Braddock Pool was originally at 718.7 feet (USACE 2011a). Braddock Dam currently holds an interim pool at Elevation 721.8, which it has held since 2004. The authorized pool for Braddock Dam is Elevation 723.7, which will be established sometime in the future as part of the completion of the Lower Mon Project concurrent with the removal of Lock and Dam 3. Typical elevation at the downstream Emsworth Pool is 710 feet.

A.2.3 Proposed New Project Facilities and Integrated Operations

A.2.3.1 Proposed Project Facilities

The proposed Project's current design concept consists of a new steel frame powerhouse with five turbine generators, a switchyard and control room, and an approximately 3,450-foot-long electric transmission line. As shown in Figure A.1.1-2, the Exhibit G proposed Project Boundary maps, and the preliminary design drawings included in Exhibit F[3], the powerhouse would be located at the upstream face of the left closure weir, opposite the location of the existing navigational locks. A trashrack will be integrated into the powerhouse intake structure and flow will exit the powerhouse through five draft tubes, which will be constructed through the existing left closure weir, and discharge into the river. A small switchyard, containing a new transformer for station service, will be situated on an elevated platform located immediately west of the dam axis along the river left abutment. The Large Frame Module will be manufactured and assembled off-site. Once the project is licensed and the installation process is underway, the LFM will be delivered to the site via barge for installation. The majority of site preparations will be conducted from a barge just upstream from the weir. There may be the need for a local staging and lay-

[2] All elevations in this license application are referenced to FT NGVD29.

[3] The Exhibit F preliminary design drawings are classified as Critical Energy Infrastructure Information (CEII) and have only been filed with FERC in conformance with CEII regulations at Title 18, Part 388, Section 112 of the Code of Federal Regulations (18 CFR 388.112).

down areas, which will be limited to existing paved or gravel areas immediately adjacent to the dam in an industrial/disturbed area of approximately 115 feet x 65 feet. Storage of equipment, if necessary, could also take place on the weir or across the river at a USACE storage area. The Applicant will ensure that any use of USACE property for storage will be conducted in a manner suitable to USACE and which will not interfere with USACE operations. Table A.2.3.1-1 provides a summary of the engineering features proposed for the Project that are described in more detail in the following sections.

For the powerhouse, Hydro Friends Fund proposes to utilize a patented technology developed and provided by Hydro Green Energy, LLC. More specifically, the proposed Project will deploy hydropower turbines within a patented "Large Frame Module" (LFM) that will be deployed on the south (river left) side of the dam, opposite the location of the existing navigational locks and at the upstream face of the existing left closure weir. The proposed modular, low environmental impact powerhouse will be approximately 60.4 feet long, 16.6 feet wide and 40 feet high and constructed of structural grade steel. The powerhouse will bear on a concrete foundation on rock that is anchored to the existing left closure weir. A waterway barrier (e.g. Tuff Boom) will be installed upstream from the project to prevent most debris (and all boats) from interacting with the project. USACE opens its gates periodically to move debris downstream, and it is not anticipated that the installation of the hydropower project will impact such operations. A trashrack with 6-inch openings will be placed at the powerhouse intake to increase safety and protect the turbine from large debris. The top of the trashrack will be approximately 17 feet below the water surface. The proposed trashrack will be designed to be easily removed for rare circumstances and will be cleaned by an automated or manual rake, or combination of both.

Exhibit F of this application contains early design phase images of the proposed Project facilities. **Exhibit F preliminary design drawings are classified as Critical Energy Infrastructure Information (CEII) and have only been filed with FERC in conformance with CEII regulations at Title 18, Part 388, Section 112 of the Code of Federal Regulations (18 CFR 388.112).**

Table A.2.3.1-1 Engineering features of the proposed Project.

Civil/Structural Feature	Description
Existing USACE Dam and Reservoir	
Length of Existing Braddock Locks and Dam	1,007 feet
Existing Spillways	Four 110-foot-long gated bays
Sill Elevation of Spillway Sections of Dam	El. 714 feet for Gate Bay 1[4] El. 704 feet for Gate Bays 2-4
Length of Fixed Spill Weir	Approximately 118 feet at the axis
Elevation of Fixed Spill Weir	El. 723.7 feet
Dimensions of Land Side Lock	110 feet wide by 720 feet long
Dimensions of River Side Lock	56 feet wide by 360 feet long
Left Closure Weir – Material of Construction	Cellular sheeting and tremie concrete founded on rock at ~El. 670.0
Left Closure Weir – Crest Elevation	El. 725.0
Reservoir Surface Area at El.721.8 feet	1,191 acres
Reservoir Gross Storage Capacity at El. 721.8 feet	18,937 acre-feet
Reservoir Net Storage Capacity	0 (Run-of-Release Facility)
Reservoir Pool Length	12.6 miles
Proposed Project Features	
Large Frame Module Powerhouse Dimensions	60.4 feet long by 16.6 feet wide by 40 feet high
Large Frame Module Powerhouse Construction Materials	Structural grade steel mounted on a concrete foundation on rock
Type of Turbine Units	Horizontal Propeller Type Modular Bulb (proprietary)
Number of Turbine Units	5
Turbine Unit – Hydraulic Design Capacity per Unit	1,250 cfs
Turbine Unit – Maximum Hydraulic Capacity per Unit	1,500 cfs
Turbine Unit – Minimum Hydraulic Capacity per Unit	500 cfs
Operating Efficiency at Design Flow	83%
Installed Capacity per Unit	750 kW
Proposed Authorized Installed Capacity for Project	3.75 MW
Runner Diameter	7.7 feet
Runner Speed	110 rpm
Number of Turbine Blades	4
Rated Gross Head	10 feet
Maximum Operating Flow (all 5 units)	7,500 cfs
Minimum Operating Flow (1 unit)	500 cfs
Trashrack Clear Spacing Between Bars	6 inches
Maximum Intake Velocities at Trashrack	2.0 feet per second
Concrete Draft Tube Dimensions	52 feet long, 8-foot by 8-foot at the turbine, and 10-foot-wide by 17-foot-high at the tailrace
Centerline Elevations of Draft Tubes	El. 700.5 feet
Generators	1,200 rpm induction
Switchyard Dimensions	25 feet by 50 feet

[4] All elevations shown in this table are in FT NGVD29.

A.2.3.1.2 Reservoir Gross Storage Capacity and Normal Maximum Water Surface Area and Elevation

The existing facilities at the Braddock Locks and Dam will be used to facilitate hydro generation, and the proposed Project will operate in run-of-release fashion using the regulated release that occurs under current USACE guidelines for the locks and dam. Therefore, the proposed Project will not impound additional water or result in additional storage capacity, and the USACE will continue to control reservoir levels. Since 2004, the USACE has operated Braddock Dam with an interim pool elevation of 721.8 feet. The authorized pool for Braddock Dam is Elevation 723.7, which will be established sometime in the future as part of the Lower Mon Project when Lock and Dam 3 is removed. The gross storage capacity of the Braddock Locks and Dam at Elevation 721.8 feet is 18,937 acre-feet and since the project is operated as a run-of-release facility, there is no net or active storage at this dam. The normal maximum water surface area of the Braddock Locks and Dam impoundment at Elevation 721.8 feet is approximately 1,191 acres. Typical elevation of the downstream Emsworth Pool, which will serve as the proposed Project's tailrace, is 710 feet.

The drainage area of the basin above the Braddock Locks and Dam is 7,337 square miles (U.S. Geological Survey [USGS] 2011a) and the average annual flow at the Project is 12,692 cubic feet per second (cfs) (1943-2004). Data from USGS Gage No. 03085000 was used to calculate the minimum, mean, and maximum monthly flows associated with the Locks and Dam presented in Table A.2.3.1-2.

Table A.2.3.1-2 USGS Braddock Locks and Dam hydrologic data based on POR (1943-2004).

Month	Average Flow (cfs)	Minimum Flow (cfs)	Maximum Flow (cfs)	10% Exceedance (cfs)	90% Exceedance (cfs)
January	17,552	1,290	188,000	35,500	4,209
February	20,691	1,300	135,000	39,600	5,554
March	24,266	2,170	171,000	44,810	8,427
April	18,642	2,650	140,000	33,800	6,169
May	14,770	1,710	121,000	32,310	3,929
June	9,216	1,340	158,000	20,810	2,310
July	6,296	1,180	88,100	13,200	1,880
August	5,747	1,040	144,000	11,810	1,820
September	4,980	703	117,000	9,396	1,710
October	5,390	828	162,000	10,600	1,750
November	9,569	720	154,000	19,700	2,229
December	15,496	1,000	112,000	30,520	3,834
Annual	12,692	703	188,000	29,500	2,300

Appendix A-1 contains two sets of flow duration curves for the period of record (1943–2004), and for the period from 2004 to 2012. Between 2002 and 2004, the fixed crest dam was demolished and replaced by the USACE with a floated-in, gated dam founded on reinforced concrete caissons. The two sets of flow duration curves located in Appendix A-1 help demonstrate that operation of this project has not changed since the dam was replaced in 2004.

A.2.3.1.2 Number, Type, and Hydraulic Capacities of Turbines and Generators, and Installed (Rated) Capacity of Proposed Turbines or Generators

The powerhouse will contain generator equipment, backup battery power systems, an operating console, five low-head, horizontal Modular Bulb Turbines (MBTs), and associated control equipment. The turbines will be installed in a single row, along with flow-control door assemblies that can open and close off flow to the units during an event that would require suspension of generation. Each turbine will have an installed capacity of approximately 750 kilowatts (kW) based on a design head of 10 feet and an approximate diameter of 7.7 feet, for a total authorized installed capacity of 3.75 MW. The design flow of each unit will be 1,250 cfs with an operating range from a minimum of 500 cfs to a maximum of 1,500 cfs.

The turbine discharge will be directed through five concrete draft tubes constructed within the existing left closure weir. The draft tubes will be approximately 52 feet long, 8-foot by 8-foot at the turbine, and 10-foot-wide by 17-foot-high at the tailrace. The flow will be directed into the existing channel to avoid erosion of the riprap-lined riverbanks and to not impede USACE operations of the locks and dam.

Each turbine will drive a 3-phase, 60-cycle, horizontally orientated, induction generator. Each of the five generators will have a nameplate rating of 800 kW, 4,160 volts, and 1,200 rpm.

A.2.3.1.3 Number, Length, Voltage, and Interconnections of Any Primary Transmission Lines Proposed to be Included as Part of the Project

The proposed Project is expected to produce approximately 3.75 MW from generator to grid. Project power will be delivered to the electric grid with the installation of a new transformer in a small, new switchyard and a new power line to an existing substation. A low-voltage, 36.7-kilovolt distribution line will run above ground from the hydropower station to the new switchyard located approximately 20 feet from the powerhouse.

A.2.3.2 Energy Production

The proposed Project will consist of five low-head, horizontal MBTs embedded into a patented and patented-pending LFM. Total proposed Project output is estimated at 25,020 megawatt hours (MWh) per year. The estimated average monthly generation is provided below in Table A.2.3.2-1. Project power will be delivered to the electric grid and sold to a local utility, local large power user, or to PJM under a merchant power plant mode of operation. Since the proposed Project will be operated as a run-of-release facility, the requirement to provide on-peak and off-peak power values and their basis is not applicable.

Table A.2.3.2-1 Estimated average monthly generation.

Month	Estimated Average per Month (MWh)
January	2,268
February	2,196
March	2,410
April	2,395
May	2,409
June	2,183
July	2,030
August	1,656
September	1,348
October	1,784
November	2,018
December	2,323
Total	25,020

A.2.3.3 Proposed Project Operation

The proposed Project would operate in run-of-release fashion, using the regulated release that occurs under current USACE guidelines for the locks and dam. As proposed, the Project would not impound additional water, result in additional storage capacity, or affect USACE operations. A computerized operating system will assure a consistent run-of-release operation, staff will be on site daily, and Hydro Friends Fund proposes to provide USACE with operational override capabilities in the event of emergency scenarios.

A.2.3.4 New Facilities or Components to be Constructed, Plans for Future Development or Rehabilitation of the Project, and Changes in Project Operation

As described in Sections A.2.3.1 through A.2.3.3, the proposed Project will include the LFM and appurtenant transmission and substation facilities.

Hydro Friends Fund has no plans for future development or installation at the Braddock Locks and Dam at this time, beyond that associated with the proposed development described above.

A.2.4 Project Boundary

The proposed Project Boundary will encompass the footprint of the LFM, which consists of an area immediately downstream and upstream from the dam, as well as the proposed new transmission line. The proposed Project Boundary also encompasses certain land for a proposed new switchyard (containing a new transformer) and control room. The proposed Project Boundary is depicted in Exhibit G of this application. The proposed Project will be developed in close coordination with the USACE, which controls the access to and the facilities of the Braddock Locks and Dam. The proposed Project will interact physically with the weir portion of Braddock Dam. The USACE is presently reviewing an engineering analysis provided by Hydro Friends Fund regarding the proposed installation method and additional consultation will occur with USACE as part of the Section 408 review process. Hydro Friends Fund anticipates entering into a Memorandum of Agreement with the USACE in which Hydro Friends Fund will lease lands from the USACE to obtain sufficient rights to construct the proposed Project and to maintain Project structures and facilities for Project operation. Hydro Friends Fund may need to lease land at the south abutment from a railroad company for access during installation and/or for site operations access. These conversations are ongoing.

A.2.5 Estimated Costs

Tables A.2.5-1 and A.2.5-2 provide the estimated costs required for licensing, project development, and proposed protection, mitigation, and enhancement (PM&E) measures.

Table A.2.5-1 Estimated licensing and project development costs.

Description	Estimated Costs (2012 $)
Estimated Cost of Constructing the Project	$11,200,000
Estimated Cost of Developing the License Application	$475,000

Table A.2.5-2 Estimated costs of proposed PM&E measures.

Description	Capital Costs / O&M Costs	PM&E
Three benches, two bike racks, and two public signs to be installed along the Great Allegheny Passage Trail	$10,500 (Capital) $500 (Annual O&M)	Recreational Enhancements

A.2.6 On-Peak and Off-Peak Power Values

Since the proposed Project will operate in run-of-release mode, this information is not applicable.

A.2.7 Increase or Decrease in Power Resulting from Proposed PM&E Measures

Since this is an original license application for a proposed, unconstructed project, this information is not applicable.

A.2.8 Remaining Undepreciated Net Investment

Since this is an original license application for a proposed, unconstructed project, this information is not applicable.

A.2.9 Annual Operation and Maintenance Expenses

At this time, it is estimated that the operation and maintenance costs for the proposed project will be $237,000 per year. In addition, insurance costs are estimated to be $53,000 per year.

A.2.10 One-Line Drawing

Since this is an original license application for an unconstructed project, a detailed one-line drawing does not yet exist and is not applicable to original license applications.

A.2.11 Measures to Ensure Safe Management, Operation, and Maintenance

The proposed Project will be developed in close coordination with the USACE, which controls the access to and the facilities of the Braddock Locks and Dam, and will not affect USACE's operation of existing facilities during the term of the license. A computerized operating system will assure a consistent run-of-release operation, staff will be on site daily, and Hydro Friends Fund proposes to provide USACE with operational override capabilities in the event of emergency scenarios. As previously discussed, a waterway barrier will be installed upstream to prevent boat interaction with the project. Any portion of the project that is downstream from the dam, such as the tailrace, will be contained in the USACE security zone, which is off limits to the public. Land access to the project from the south side of the dam will be prevented through the installation of security gates or fencing, consistent with USACE specifications.

BRADDOCK LOCKS AND DAM HYDROELECTRIC PROJECT

FERC NO. 13739

LICENSE APPLICATION

EXHIBIT E – ENVIRONMENTAL EXHIBIT

E.1 INTRODUCTION

This exhibit addresses environmental resources in the vicinity of the proposed Braddock Locks and Dam Project (Project). It consists of several sections and is organized according to the Federal Energy Regulatory Commission (FERC) licensing regulations of 18 Code of Federal Regulations (CFR) §4.61, which govern the content of applications for major water power projects less than 5 megawatts (MW). Although not required by these regulations for this class of hydro projects, Lock+™ Hydro Friends Fund XLII, LLC (Hydro Friends Fund) has included a separate Socioeconomic Resources section (E.6), which describes existing demographic and economic conditions in the Project vicinity as well as potential economic benefits associated with the development and operation of the proposed Project. This section was added to address interest in this resource area that was expressed at the Joint Agency Meetings held on March 7, 2012 in Pittsburg, Pennsylvania.

Each section describes the environmental resources in the Project area to frame the existing environmental baseline conditions; describes any studies conducted or in process to develop additional information; identifies potential environmental impacts associated with the proposed Project; and describes measures proposed to protect, mitigate, or enhance potentially impacted environmental resources.

E.1.1 Overview of Proposed Project

Hydro Friends Fund is proposing to develop a hydroelectric facility at the U.S. Army Corps of Engineers (USACE) Braddock Locks and Dam, which is located on the Monongahela River at River Mile (RM) 11.2 in the Borough of Braddock, Pennsylvania. Braddock Locks and Dam is one of nine navigational structures collectively known as the USACE Monongahela River Locks and Dams system that provide year-round navigation on the Monongahela River between Pittsburgh, Pennsylvania, and Fairmont, West Virginia.

The proposed Project will include five low-head, horizontal Modular Bulb Turbines (MBTs), generator equipment, backup battery power systems, an operating console, and associated control equipment within a patented Large Frame Module (LFM) that will be deployed on the south (river left) side of the dam, opposite the location of the existing navigational locks and at the upstream face of the existing left closure weir. The turbines will be installed in a single row, along with flow-control door assemblies that can open and close off flow to the units during an event that would require suspension of generation of the hydropower turbines. The proposed modular, low environmental impact powerhouse will be approximately 60.4 feet long, 16.6 feet wide, and 40 feet high and constructed of structural grade steel. The powerhouse will bear on a concrete foundation on rock that is anchored to the existing left closure weir. A trashrack with 6-inch spacing will be integrated into the powerhouse intake structure and flow will exit the powerhouse through five draft tubes, which would be constructed through the existing left closure weir and discharge into the river. The proposed Project includes a small 25-foot-by-50-foot switchyard and an electric interconnection line approximately 3,450 feet long that will connect the proposed Project to the electric grid.

The proposed Project is unique in that it has been designed to minimize impacts to the USACE facilities and to minimize environmental effects during construction and operation. The LFM, which makes up the majority of the powerhouse and contains all the generating and control systems, allows a great deal of flexibility during maintenance or high water events. From an environmental perspective, the effects of constructing (including off-site manufacturing and assembly) and operating the proposed Project will similarly be minimized due to the method of construction that minimizes impacts to the USACE dam, the small footprint of the proposed Project, the relatively short timeframe that construction is needed, as well as by using areas of prior disturbance. The following sections document the low-impact nature of the proposed Project.

E.1.2 Organization of Exhibit E

This Exhibit E follows the content and format requirements of 18 CFR §4.61(d) with minor format modifications for enhanced readability.

Exhibit E is organized as follows:

- E.1 – Introduction
- E.2 – General Setting
- E.3 – Report on Water Quantity and Quality
- E.4 – Report on Fish, Wildlife, and Botanical Resources
- E.5 – Report on Cultural, Historic, and Archaeological Resources
- E.6 – Report on Socioeconomic Resources
- E.7 – Report on Geological and Soil Resources
- E.8 – Report on Recreational Resources
- E.9 – Report on Aesthetic Resources
- E.10 – Report on Land Use
- E.11 – Conformance with Comprehensive Plans
- E.12 – Alternative Locations, Designs, and Energy Sources
- E.13 – Consultation and Proposed Protection, Mitigation and Enhancement (PM&E) Measures
- E-14 – List of Literature
- Appendix E-1a – Water Quality Study Report
- Appendix E-1b – Water Quality Modeling
- Appendix E-2 – Fish Entrainment and Survival Assessment Report
- Appendix E-3 – Consultation Record

E.2 GENERAL SETTING

E.2.1 Monongahela River Watershed

The Monongahela River is within the Upper Ohio River basin and originates in the Allegheny Plateau in Marion County, West Virginia, where it is formed by the confluence of the Tygart Valley and West Fork rivers at an elevation of approximately 2,359 feet (National Geodetic Vertical Datum [NGVD] 29) near Fairmont, West Virginia. The river flows north for 128 miles through Marion and Monongalia counties in West Virginia, and to the confluence with the Allegheny River in Pittsburgh, Pennsylvania, forming the Ohio River at an elevation of 694.23 feet (NGVD29). Here the Monongahela River is classified as a low-gradient, seventh-order stream, and a U.S. Environmental Protection Agency (USEPA) classified “large river,” draining an area of 7,340 square miles of Maryland, Pennsylvania, and West Virginia (Pennsylvania Fish and Boat Commission [PFBC] 2011; U.S. Geological Survey [USGS] 2011a).

The USACE maintains nine locks and dams on the river. The river channel is generally entrenched within confined banks and steep banks in the river valley. The 100- and 500-year floodplains are also relatively narrow and confined within the steeply sloped fringes of the river valley (PFBC 2011). Based on the period of record (POR) between 1943 and 2004, the average monthly flows at the Project range between 3,020 cubic feet per second (cfs) in September to 20,400 cfs in March (USGS 2011a). The main stem of the river has an average stream gradient of 1.15 feet per mile, and is about 750 feet wide at the Pennsylvania/West Virginia border, and 900 feet wide at the confluence with the Allegheny River, during normal pool river stage. The widest section of the river is 1,150 feet upstream of Braddock Locks and Dam near the mouth of Turtle Creek (PFBC 2011).

The proposed Project is located at RM 11.2 of the Monongahela River within the Lower Monongahela River watershed (Hydrologic Unit Code 5020005) of the Monongahela River sub basin (Figure E.2.1-1) (USGS 2011a). The Braddock Pool is maintained above the Project for 12.6 miles upstream to Locks and Dam 3 at Elizabeth, Pennsylvania. Emsworth Pool begins immediately downstream of the Project and extends for approximately 11.2 miles downstream to the City of Pittsburgh, where the Allegheny River and Monongahela River merge to form the Ohio River, and continues downstream to the Emsworth Locks and Dam Project on the Ohio River.

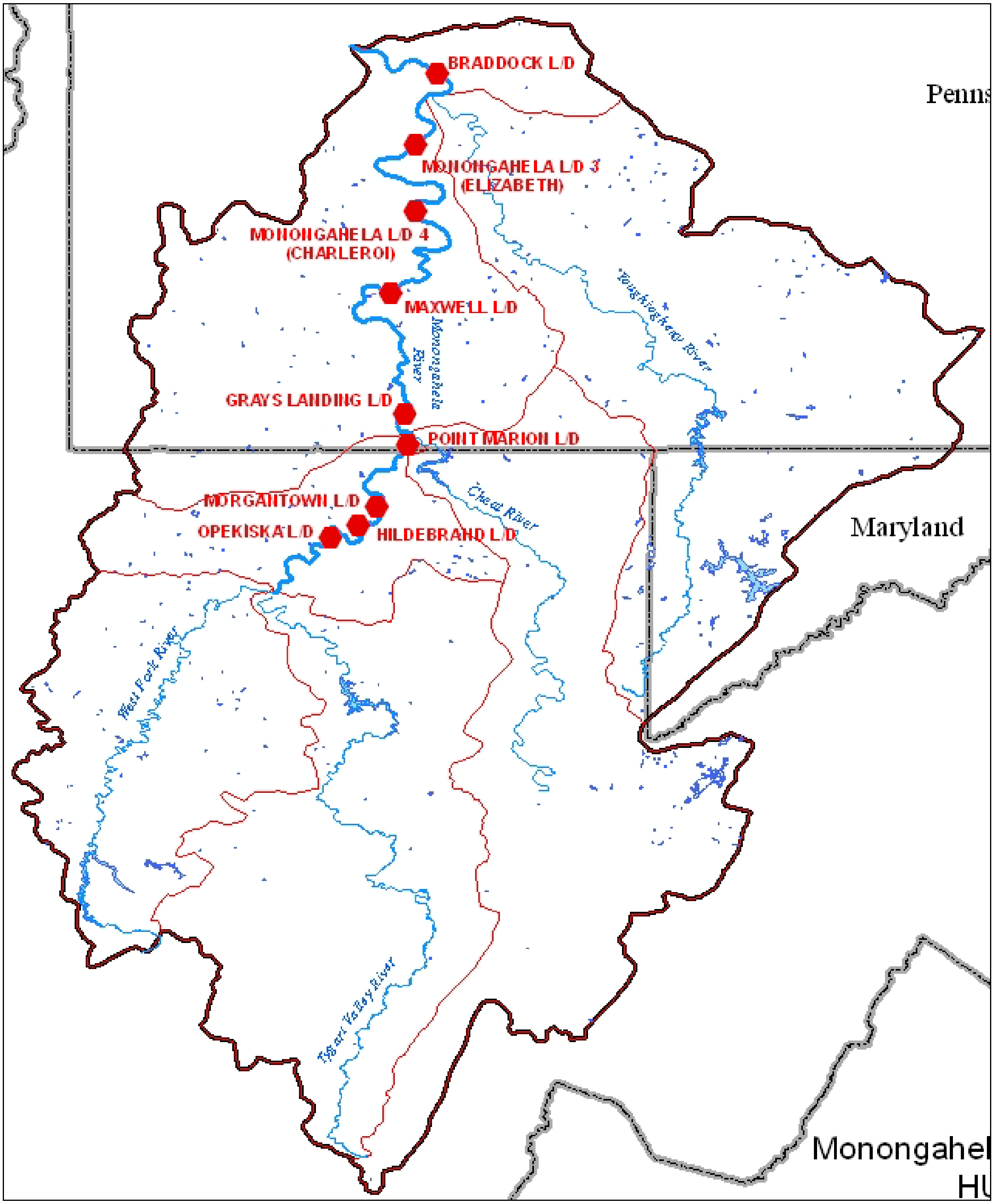


Figure E.2.1-1 Monongahela River lock and dam facilities locations (USACE 2011a).

E.2.2 Monongahela River Basin Geography and Climate

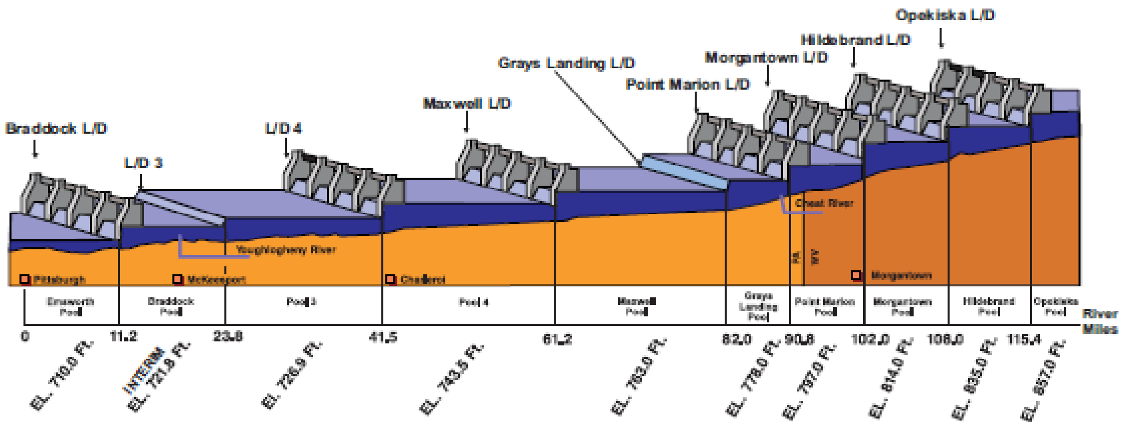
The Monongahela River is located within the Appalachian Plateau physiographic province. In Pennsylvania, the Monongahela River flows through the Waynesburg Hills and into the Pittsburgh Low Plateau sections of the Appalachian Plateau province, where the Project is located. Flood events are common in the rivers of the Appalachian Plateau due to 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 dentric pattern (PFBC 2011).

The temperate climate in the upper Ohio River basin has a mean minimum temperate range from 9°F to 19°F, while the maximum mean temperature ranges from 75°F to 84°F. The average annual rainfall ranges from 34 to 53 inches a year, where the southwestern area receives the most precipitation and the northeastern areas the least. June and July are the wettest time of the year, while November is the driest (PFBC 2011).

E.2.3 Dams and Diversions within the Basin

In addition to the Braddock Locks and Dam, there are eight other navigation dams along the Monongahela River, all located upstream of Braddock Locks and Dam. Six are gated locks and dams, while the other two (USACE's Locks and Dam 3 at Elizabeth, and Gray's Landing Locks and Dam) are fixed-crest dams. Locks and Dam 3 is located 12.6 miles upstream of the Braddock Locks and Dam (PFBC 2011). Five of these dams are located in Pennsylvania and three are located in West Virginia. The most upstream lock is Opekiska Lock and Dam (RM 115.4). Refer to Figure E.2.3-1 for a river profile and existing locks and dams within the basin.

There are no known water diversion sites located within the proposed Project's vicinity or immediately upstream of the proposed Project. Table E.2.3-1 provides information on the existing locks and dams along the Monongahela River that are owned and operated by the USACE. There are currently no hydropower dams on the Monongahela River.



Source: USACE 2004

Figure E.2.3-1 Monongahela River profile and existing locks and dams.

Table E.2.3-1 Existing locks and dams on the Monongahela River that are owned and operated by the USACE.

Locks and Dams	River	River Mile
Braddock	Monongahela	11.2
Locks & Dam 3	Monongahela	23.8
Locks & Dam 4	Monongahela	41.5
Maxwell	Monongahela	61.2
Grays Landing	Monongahela	82.0
Point Marion	Monongahela	90.8
Morgantown	Monongahela	102.0
Hildebrand Lock	Monongahela	108.0
Opekiska Lock	Monongahela	115.4

E.2.4 Monongahela River Tributaries

The Monongahela River is a large watershed comprising six sub-watersheds. Moving upstream, the major sub-watersheds are the Youghiogheny River, Lower Monongahela River, Upper Monongahela River, Cheat River, Tygart Valley River, and West Fork River. The largest tributaries on the Monongahela River are the Cheat and Youghiogheny rivers (West Virginia Department of Environmental Protection [WVDEP] 2000). Additionally, there are many smaller tributaries including Turtle Creek, Thompson Run, Streets Run, Homestead Run, and Peters Creek.

E.2.5 General Land and Water Use

The land within the Monongahela Watershed is predominantly forested or used for agricultural purposes (about 80%, or 5,909 square miles). The remaining land uses are industrial and urban development (about 20%, or 1,477 square miles). Due to rough terrain and poor soils in the area, most agricultural lands extend east and west from the Monongahela River, with dairy farming and livestock-rearing being the dominant agricultural use (Pennsylvania Department of Environmental Protection [PADEP] 2003).

Industrial and urban development is commonly located along the river valley. Mining of coal, sand, and limestone, and extraction of oil and natural gas are the major industries within the Monongahela River Basin. The proposed Project is located in the Pittsburgh metropolitan area, which is characterized by urban and industrial development and has a history of extractive mining (PFBC 2011). Further detail regarding land use of the area is provided in Section E.10.

The major consumptive water use for the Monongahela River is for industrial and commercial activities. Public water supply is a secondary consumptive source for the river, particularly in the Pittsburgh area. Non-consumptive uses of the Monongahela River include navigation and recreation. Nine navigation locks and dams owned and operated by the USACE are located along the 128 miles of the river and aid with the commercial shipping of products such as coal (PFBC 2011; USACE 2011a). Recreational activities include boating, fishing, and some whitewater sports in the river's upper reaches (Anderson et al. 2000). Non-consumptive water uses also include water quality enhancements and/or aquatic life protection uses, such as the environmental gate (i.e., Gate 1) controlled by the USACE at the Braddock Locks and Dam.

There are no known water withdrawal sites located within the proposed Project's vicinity or immediately upstream of the proposed Project. Eight National Pollutant Discharge Elimination System (NPDES) permit sites have previously been authorized as point discharge sources in the vicinity of the proposed Project (Table E.2.5-1).

The Monongahela River is used for navigation and recreational activities. Other than the mainstem of the Monongahela River, there are no anticipated impacts to streams associated with the proposed Project. The proposed Project is not anticipated to affect other existing water rights or uses.

Table E.2.5-1 NPDES permitted discharges to the Monongahela River adjacent to the proposed Project.

NPDES ID	Facility Name	Site Description	Status of Permit
PAG066102	Braddock Borough	Sewerage Systems	Expired
PA0217387	Braddock Plant	Industrial Gases	Expired
PAR806127	Braddock Terminal	General Warehousing and Storage	Expired
PA0094510	Edgar Thomson Plant	Steel Works	Expired
PAR606124	Josh Steel Company	Scrap and Waste Materials	Expired
PAR606125	Josh Steel Company	Scrap and Waste Materials	Expired
PAG066114	North Braddock Borough	Sewerage Systems	Expired
PAG066105	Rankin Borough	Sewerage Systems	Expired

Source: USEPA 2011

The Braddock Locks and Dam is currently operated as a run-of-release facility in order to maintain a near-constant headwater elevation for upstream navigation purposes. It is currently maintained as part of the larger USACE Monongahela River Locks and Dams system, which provides slack water navigation on the entire length of the river from Pittsburgh, Pennsylvania, to above Fairmont, West Virginia. Hydro Friends Fund's proposed run-of-release operations for hydroelectric generation capability will not affect current USACE operation and use of the Braddock Locks and Dams.

E.3 REPORT ON WATER QUANTITY AND QUALITY

E.3.1 Existing Environment – Water Resources

The Braddock Locks and Dam is a USACE navigation facility located at river mile (RM) 11.2 on the lower Monongahela River. It is the first of nine navigational structures that provide year-round navigation on the river between Pittsburgh, Pennsylvania, and Fairmont, West Virginia. Braddock Locks and Dam was one of the oldest navigation facilities on the Monongahela River (USACE 2011b). As part of the Lower Mon Project, the fixed-crest dam at Braddock was replaced with a gated spillway structure in 2004. The Project currently comprises a 721-foot-long gated spillway, a land-side lock that is 110 feet wide and 720 feet long, and a river-side lock that is 56 feet wide by 360 feet long.

The Braddock Pool is maintained above the Project for 12.6 miles upstream to Locks and Dam 3 at Elizabeth, Pennsylvania. Prior to the replacement of the Braddock fixed-crest dam, the pool elevation was maintained at 718.7 feet. The pool elevation rose 3.1 feet to an elevation of 721.8 feet after the dam was replaced in the gated spillway. The Lower Mon Project will also result in the removal of Locks and Dam 3 at Elizabeth (RM 23.8) and construction of two new larger locks at Locks and Dam in Charleroi (RM 41.3). Removal of Locks and Dam 3 at Elizabeth will create a single pool between Braddock and Charleroi, which will result in an additional rise in pool level of 1.9 feet (721.8 feet to 723.7 feet). The total 5-foot increase in pool elevation associated with the initial replacement of the Braddock fixed-crest dam and removal of the Locks and Dam 3 at Elizabeth will be offset by a 3.2-foot drop in pool elevation upstream of Locks and Dam 3 to maintain the historic pool elevation. Currently, the Braddock Pool is approximately 12.6 miles long with a normal maximum water surface area of approximately 1,191 square feet and a gross storage capacity of 18,937 acre-feet.

Emsworth Pool begins immediately downstream of Braddock Locks and Dam and extends for approximately 11.2 miles downstream to the city of Pittsburgh, where the Allegheny River and Monongahela River merge to form the Ohio River, and continues downstream to the Emsworth Locks and Dam. The lock chambers and operations buildings at Braddock Locks and Dam are situated along the right bank of the river adjacent to a major steel-making plant. The Braddock Locks and Dam is operated by the USACE and utilizes lockage schedules. It is operated as a run-of-release facility in order to maintain a near-constant upper pool and for navigational purposes on the Monongahela River.

E.3.1.1 Water Quantity

E.3.1.1.1 Existing Water Uses

As described in Section E.2, the major consumptive water use for the Monongahela River is for industrial and commercial activities. Public water supply is a secondary consumptive source for the river, particularly in the Pittsburgh area. Non-consumptive uses of the Monongahela River include navigation and recreation. Nine navigation locks and dams owned and operated by the USACE are located along the 128 miles of the river and aid with the commercial shipping of products such as coal (PFBC 2011; USACE 2011a). Recreational activities include boating, fishing, and some whitewater sports in the river's upper reaches (Anderson et al. 2000).

Instream flow uses at the project primarily include fishing, navigation, and resource protection, which are controlled at Braddock by the USACE. An environmental gate (i.e., Gate 1) is maintained by the USACE with constant flows on the Braddock Locks and Dam to provide water quality enhancements and protection for aquatic resources, such as increasing dissolved oxygen (DO) levels during low flow periods. The proposed Project is not anticipated to affect other existing water rights or uses.

E.3.1.1.2 Existing Project Flows

The U.S. Geological Survey (USGS) has 13 stations on the mainstem of the Monongahela River (Table E.3.1.1-1). Gage 03085000 at Braddock is located on the right bank guide wall of the USACE facility approximately 300 feet upstream from the Braddock Locks and Dam. Gage 03075070 at Elizabeth is located on the right bank of the river, approximately 1,050 feet upstream from the locks and dam at RM 24.0. Appendix A-1 contains flow duration curves for the POR from 1943 to 2004, and for the period from 2004 to 2012 using stage data and a rating curve provided by the USACE. Between 2002 and 2004, the fixed-crest dam at Braddock was demolished and was replaced by the USACE with a floated-in gated dam founded on reinforced concrete caissons. The two sets of flow duration curves show that the operation of the Project has not changed since the dam was replaced in 2004.

Table E.3.1.1-1 USGS gages on the mainstem of the Monongahela River, Pennsylvania.

Number	Name
03062998	Monongahela River L&D 8 (Upper Pool) at Point Marion
03063000	Monongahela River L&D 8 (Lower Pool) at Point Marion
03072655	Monongahela River (Upper Stage) near Masontown
03072656	Monongahela River (Lower Stage) near Masontown
03073750	Monongahela River at Maxwell L&D (Upper Pool) at Maxwell
03073751	Monongahela River at Maxwell L&D (Lower Pool) at Maxwell
03074988	Monongahela River at L&D 4 (Upper Pool) at Charleroi
03075000	Monongahela River at L&D 4 (Lower Pool) at Charleroi
03075070	Monongahela River at Elizabeth
03075071	Monongahela River below L&D 3 at Elizabeth
03085000	Monongahela River at Braddock (Upper Stage)
03085002	Monongahela River below L&D 2 Lower Pool (Lower Stage) at Braddock
03085152	Monongahela River at Point State Park at Pittsburgh

Table E.3.1.1-2 provides the monthly minimum, maximum, and average flows recorded at USGS Gage 03085000 at Braddock based on the POR between 1943 and 2004. The average monthly flows range from 4,980 cfs in September to 24,266 cfs in March. The annual average flow is 12,692 cfs.

Table E.3.1.1-2 USACE Braddock Locks and Dam hydrologic data based on POR (1943-2004).

Month	Average Flow (cfs)	Minimum Flow (cfs)	Maximum Flow (cfs)	10% Exceedance (cfs)	90% Exceedance (cfs)
January	17,552	1,290	188,000	35,500	4,209
February	20,691	1,300	135,000	39,600	5,554
March	24,266	2,170	171,000	44,810	8,427
April	18,642	2,650	140,000	33,800	6,169
May	14,770	1,710	121,000	32,310	3,929
June	9,216	1,340	158,000	20,810	2,310
July	6,296	1,180	88,100	13,200	1,880
August	5,747	1,040	144,000	11,810	1,820
September	4,980	703	117,000	9,396	1,710
October	5,390	828	162,000	10,600	1,750
November	9,569	720	154,000	19,700	2,229
December	15,496	1,000	112,000	30,520	3,834
Annual	12,692	703	188,000	29,500	2,300

Currently flows are actively passed at four major locations at the Braddock Locks and Dam:

1. Locks
2. Gates 2, 3, and 4
3. Environmental Gate (Gate 1)
4. Overflow Weir/Spillway

Table E.3.1.1-3 contains the existing average monthly flow distributions at the Braddock Locks and Dam based on the POR between 1943 and 2004. The USACE maintains a flow up to 9,440 cfs through the environmental gate (Gate 1) closest to the lock. This environmental gate is fully open at 7,360 cfs, but will pass flows up to 9,440 cfs before the next gate is open. A locking flow of 250 cfs is assumed on a constant basis, and any other flow is released through the other spillway gates (Gates 2-4) and/or the overflow weir.

Table E.3.1.1-3 Existing Braddock Locks and Dam average monthly flow distribution data based on POR (1943-2004) and existing USACE operations.

Month	Average Flow (cfs)	Lock Flow (cfs)	Environmental Gate Flow (cfs)	Gates 2-4 and/or Overflow Weir Flow (cfs)
January	17,552	250	9,440	7,862
February	20,691	250	9,440	11,001
March	24,266	250	9,440	14,576
April	18,642	250	9,440	8,952
May	14,770	250	9,440	5,080
June	9,216	250	8,966	0
July	6,296	250	6,046	0
August	5,747	250	5,497	0
September	4,980	250	4,730	0
October	5,390	250	5,140	0
November	9,569	250	9,319	0
December	15,496	250	9,440	5,806

E.3.1.1.3 Proposed Project Flows

The proposed Project will operate in run-of-release mode, generating power using the head differential of the USACE's dam without affecting the USACE run-of-release mode operations. A computerized operating system will assure a consistent run-of-release operation at the Project, and it is anticipated that Hydro Friends Fund staff will be on site daily. Hydro Friends Fund intends to provide the USACE with operational override capabilities in the event of emergencies or flow-control issues. Hydro Friends Fund has no plans for future development or installations at the Braddock Locks and Dam at this time, beyond that associated with the proposed development described in this application.

Concern has been expressed by the USACE over the installation and resulting operation of the proposed Project affecting existing flow distributions. The primary concern deals with maintaining water availability for flows released through the environmental gate (Gate 1) to maintain water quality standards below the Project. Various hydraulic scenarios have been analyzed to address this concern in an attempt to maintain the feasibility of the Project, lock flow requirements, and the USACE water quality flow requirements. The scenario selected by Hydro Friends Fund involves the use of the Tennant Method (Tennant 1976) to distribute flow through the proposed Project. The Tennant Method is used as a default bypass flow setting methodology in some states (e.g., South Carolina and others) in lieu of a site-specific instream flow study or hydraulic modeling. This method recognizes the importance of keeping a minimum base flow in the river (20%), while incorporating the same or greater seasonal/monthly bypass flow percentages to replicate natural seasonal flow variations (Table E.3.1.1-4). This does not apply directly to the proposed Project, as the same quantity of flow will continue to pass through the facility as before, with some flows redistributed across the river to the proposed turbine location at the overflow weir.

For the purposes of applying the Tennant Method to the Braddock structure, the recommended percentage of flow to a ‘bypass’ refers to the environmental gate. Hydro Friends Fund proposes an enhanced flow regime that recognizes the pending removal of Lock and Dam 3. Therefore, as compared to a 20% flow in August and September, as would be consistent with the standard methodology, Hydro Friends Fund is recommending that 25% of the flow be diverted through the environmental gate during these two months. The proposed flow regime also provides the USACE with flexibility in certain months to maximize non-hydro flow through the environmental gate, or distribute the flow more evenly through Gates 1-4.

Table E.3.1.1-4 displays the average monthly flow distributions around the proposed Project. A total of 250 cfs is allocated to the locking structure on a constant basis, while a flow up to 9,440 cfs is released from the environmental gate. The design maximum operating flow of the proposed Project is 6,250 cfs, with a minimum operating flow of 500 cfs for a single unit. A modification of the Tennant Method was used as the basis for allocating seasonal bypass flows for use in the environmental gate. River flow was first allocated to the locking structures (250 cfs), which was considered as unavailable for power generation or passing through the spillway gates. Once this was subtracted, the remaining flow was distributed between the proposed Project, the environmental gate, and the remaining spillway gates based on seasonal Tennant flow percentages. The environmental gate (up to 9,440 cfs) maintained priority for bypass flow, with any bypass flow remaining passing through the additional gates and/or the overflow weir.

Table E.3.1.1-4 Proposed average monthly flows distribution based on POR (1943-2004) at the Project using the Tennant Method.

Month	Average Flow (cfs)	Lock Flow (cfs)	Proposed Flows			
			Environmental Gate Flow (cfs)	Environmental Gate Flow (%)[1]	Gates 2-4 (cfs)	Turbine Flow (cfs)
January	17,552	250	9,440	Maximum	1,612	6,250
February	20,691	250	9,440	Maximum	4,751	6,250
March	24,266	250	9,440	Maximum	8,326	6,250
April	18,642	250	9,440	Maximum	2,702	6,250
May	14,770	250	8,270	57	0	6,250
June	9,216	250	2,716	30	0	6,250
July	6,296	250	1,209	20	0	4,837
August	5,747	250	1,374	25	0	4,123
September	4,980	250	1,183	25	0	3,548
October	5,390	250	1,028	20	0	4,112
November	9,569	250	3,069	33	0	6,250
December	15,496	250	8,996	59	0	6,250

[1] Environmental Gate Flow (%) presents the percentage of water available to be passed through the structure's environmental gate. Where indicated, "Maximum" represents the USACE's current operating practice of limiting the maximum flow through the environmental gate to 9,440 cfs. Hydro Friends Fund understands that redistributing excess flow (i.e., flow not dedicated to energy production) between the environmental gate and Gates 2-4 would be at the discretion of the USACE. Lock flow was subtracted from the average flow before allocating flows to the gates and turbines.

E.3.1.2 Water Quality

This section summarizes the existing information on water quality on the Lower Monongahela River in order to evaluate potential Project effects and compare data to Pennsylvania's state water quality standards, as well as the existing DO concentration recognized by the USACE (USACE 2012). Pennsylvania's water quality standards are found in the PADEP's regulations in 25 Pa. Code §93. Five protected designated use categories have been established and include

Aquatic Life, Water Supply, Recreation and Fish Consumption, Special Protection, and Other (25 Pa. Code §93.3). Minimum use designations that apply to all Pennsylvania surface waters include Warm Water Fisheries, Potable/Industrial/Livestock/Wildlife Water Supply, Irrigation, Boating, Fishing, Water Contact Sports, and Aesthetics. The water quality standards include instream water quality criteria to protect designated uses, which were promulgated pursuant to Pennsylvania's Clean Streams Law (35 P.S. §691.1 et seq.) and Section 303 of the federal Clean Water Act (33 U.S.C.A. §1313). Protected water uses in the proposed Project area include warm water fisheries and navigation (25 Pa. Code §93.9(v)).

Numerical water quality criteria specify that minimum daily average DO levels should not be less than 5.0 milligrams per liter (mg/L) and instantaneous DO levels should not be less than 4.0 mg/L. The pH should be between 6.0 and 9.0 units, inclusively. Water temperature criteria for warm water fishery streams vary based on the period (Table E.3.1.2-1). Water quality conditions are expected to meet these criteria at least 99% of the time under Pennsylvania Code §96.3(c). When this is not achieved due to natural quality, as determined by the PADEP, the natural quality that is achieved at least 99% of the time shall be the applicable water quality criterion for protection of fish and aquatic life, according to Pennsylvania Code §96.3(e).

Table E.3.1.2-1 Maximum allowable water temperature criteria in the Project area.

Period	Maximum Allowable Temperature		Period	Maximum Allowable Temperature	
	°F	°C		°F	°C
Jan 1-31	40	4	Aug 1-15	87	31
Feb 1-29	40	4	Aug 16-30	87	31
Mar 1-31	46	8	Sept 1-15	84	29
Apr 1-15	52	11	Sept 16-30	78	26
Apr 16-30	58	14	Oct 1-15	72	22
May 1-15	64	18	Oct 16-31	66	19
May 16-30	72	22	Nov 1-15	58	14
June 1-15	80	27	Nov 16-30	50	10
June 16-30	84	29	Dec 1-31	42	6
July 1-31	87	31			

Source: 25 Pa. Code §93.7, 93.9(u)-(v)

E.3.1.2.1 Antidegradation

Antidegradation is a policy created by the U.S. Department of Interior and included in the USEPA's first water quality standards regulations in 1975. The federal basis for the program is set forth in the federal Clean Water Act in regulations under 40 CFR §131.32. Under these regulations, states are required to adopt an antidegradation policy meeting minimum requirements and must include this policy as a required element of surface water quality standards programs in order to gain federal approval of the standards. Under Pennsylvania's antidegradation rules, existing instream water uses and the level of water quality necessary to protect such existing uses "shall be maintained and protected" (25 Pa. Code §93.4a(d)). Higher levels of protection are accorded to special protection waters, including those designated as high quality or exceptional value waters (25 Pa. Code §93.4a(b)-(c)). In this case, the reaches of the lower Monongahela River above and below the proposed Project area are not classified as special protection, and the applicable water quality criteria are those for maintaining existing uses as set forth in 25 Pa. Code §93.6-93.7.

However, the USACE maintains their own antidegradation policy, which is applicable to the proposed Project, as defined in applicable regulations, manuals, and pamphlets including:

- Water Quality and Water Control Considerations for Non-Federal Hydropower Development at Corps of Engineers Projects (ER 110-2-1462)
- Water Quality and Environmental Management for Corps Civil Works Projects (ER 110-2-8154)
- Project Operations – Environmental Stewardship Operations and Maintenance Policies (ER 1130-2-540)
- The Federal Responsibility in Water Resources (EP 1165-2-1)
- Hydrologic Engineering Requirements for Reservoirs (EM 1110-2-1420)
- Prevention Control and Abatement of Environmental Pollution at Federal Facilities (ER 1130-2-344)
- Engineering and Design Reservoir Water Quality Analysis Proponent (EM 1110-2-1201)

According to applicable regulations, "any physical or operational modification to a project…shall not degrade water quality in the reservoir (pool) or project discharges" (EP 1165-2-1, EM 1110-2-1201, , ER 110-2-8154). The USACE has identified the current minimum DO concentration downstream of the Braddock Locks and Dam under current pool conditions since the environmental gate was installed in 2004 as 7.5 mg/L (USACE 2012).

E.3.1.2.2 Existing Water Quality Information

This section does not attempt to summarize water quality in the Monongahela River in entirety, but aims to provide information useful for evaluating the potential effects of the proposed Project on downstream water quality. In doing so, the potential for the proposed Project to meet state water quality standards as well as the existing DO concentration downstream of the Braddock Locks and Dam after 2004 that has been identified by the USACE (USACE 2012) are assessed.

The Monongahela River has been the focus of numerous water quality and environmental studies (FERC 1988; Anderson et al. 2000) that have largely focused on toxic components of water quality, due to the historically industrialized characteristics of the basin. Municipal and industrial activities have polluted the Monongahela River and have resulted in the introduction of pathogens, various organic contaminants (detergents, petroleum hydrocarbons, volatile organic compounds) from urban runoff and inadequate wastewater treatment, inorganic contaminants (acidity and heavy metals), and thermal pollution (USACE 2011a).

Coal mining activities have also occurred in the Monongahela and Allegheny River basins for more than 200 years. Collectively, these basins contain the greatest concentration of abandoned mine sites in the nation (Anderson et al. 2000). These activities have had a significant influence on water quality and aquatic resources in the Monongahela River. In fact, mining has been identified as having the greatest influence on surface water quality of any single land use in the Monongahela and Allegheny River basins (Anderson et al. 2000). Surface and subsurface water affected by mine drainage can have high metal concentrations (iron, manganese, aluminum, zinc, arsenic, barium, cadmium, cobalt, copper, and silver) and have unnaturally low pH levels (USEPA 2002).

In the 1960s, the Monongahela River was occasionally too acidic to support a diverse aquatic community (Finni 1988 as cited in Anderson et al. 2000), but has improved since then (Anderson et al. 2000). Water quality improvements have been attributed to reductions in industrial discharges, improvements in wastewater treatment (FERC 1988), improvements in mine drainage treatment (Anderson et al. 2000; USACE 2011a), and low flow augmentation (USACE 2011a). Regardless of the recent improvements, acid- and/or mineral-laden mine drainage from abandoned coal mines is still one of the most serious and persistent water quality issues in the Monongahela and Allegheny River basins (Anderson et al. 2000). Table E.3.1.2-2 lists impaired waters in the Project vicinity according to Section 303(d) of the Clean Water Act.

Table E.3.1.2-2 Clean Water Act 303(D) impaired waters near the proposed Project.

Water Body Name	STORET Water Body ID	State Basin Name	Cause of Impairment	Cycles Listed	Latest TMDL* Date
Turtle Creek	PA10C18694_20011017-1130-GGM	White Deer-Buffalo Creeks	Siltation	2004	--
Turtle Creek	PA19A37204_4705	Turtle Creek	Metals (other than Mercury)	1996, 1998, 2002, 2004	Jul-07-2009
Turtle Creek	PA19A37204_990102-1010-TVP	Turtle Creek	Metals (other than Mercury)	1996, 1998, 2002, 2004	Jul-07-2009
Turtle Creek	PA19A37204_990102-1010-TVP	Turtle Creek	pH	2002, 2004	Jul-07-2009
Turtle Creek	PA19A37204_990102-1011-TVP	Turtle Creek	Metals (other than Mercury)	2002, 2004	Jul-07-2009
Turtle Creek	PA19A37204_990102-1011-TVP	Turtle Creek	pH	2002, 2004	Jul-07-2009
Turtle Creek	PA19A37204_990301-0905-ALF	Turtle Creek	Metals (other than Mercury)	1996, 1998, 2002, 2004	Jul-07-2009
Turtle Creek	PA19A37204_990301-0905-ALF	Turtle Creek	Nutrients	2002, 2004	--
Turtle Creek	PA19A37204_990301-0905-ALF	Turtle Creek	Siltation	2002, 2004	--
Turtle Creek	PA19A37204_990301-1230-ALF	Turtle Creek	Nutrients	2002, 2004	--
Turtle Creek	PA19A37204_990301-1230-ALF	Turtle Creek	Siltation	2002, 2004	--
Turtle Creek	PA19A37204_990302-1000-ALF	Turtle Creek	Metals (other than Mercury)	1996, 1998, 2002, 2004	--
Turtle Creek	PA19A37204_990302-1000-ALF	Turtle Creek	Nutrients	2002, 2004	--
Turtle Creek	PA19A37204_990302-1000-ALF	Turtle Creek	Siltation	2002, 2004	--
Turtle Creek	PA19A37204_990302-1200-ALF	Turtle Creek	Metals (other than Mercury)	1996, 1998, 2002, 2004	--
Turtle Creek	PA19A37204_990302-1200-ALF	Turtle Creek	Suspended Solids	2002, 2004	--
Ninemile Run	PA19A37201_9962	Turtle Creek	Ammonia, Un-ionized	2002, 2004	--
Ninemile Run	PA19A37201_9962	Turtle Creek	Nonpriority Organics	2002, 2004	--
Ninemile Run	PA19A37201_9962	Turtle Creek	Taste and Odor	2002, 2004	--

* TMDL = Total Maximum Daily Loads
Source: USEPA 2004

To assess existing water quality conditions in the lower Monongahela River, water quality data relevant to hydropower projects including DO, water temperature, pH, specific conductance, and turbidity were compiled from 1990 to the present from Emsworth Locks and Dam (RM -6.2) to Charleroi Locks and Dam (RM 41.5) from the USGS, Three Rivers – Second Nature (3R2N), PADEP, Ohio River Valley Water Sanitation Commission (ORSANCO), and the USACE in a Water Quality Desktop Study Report (Appendix E-1a). These data were used to calculate minimum, maximum, and mean values as suitable, as well as identify any apparent trends that were compared to applicable water quality standards (USACE 2012).

Of these data, water temperature and DO data are presented in this section with particular focus on comparable data collected upstream and downstream of the Braddock Locks and Dam during critical low-flow periods to characterize existing conditions and analyze potential Project effects. These data collected on the lower Monongahela River are presented to assess the quality of water flowing into and out of the proposed Project. Please refer to the Water Quality Desktop Study Report in Appendix E-1a for additional detail on each of the sampling efforts and additional parameters.

Water temperature and DO data presented below are separated into three distinct sections including:

- **Discrete Spatial Data –** A compilation of data collected by a variety of entities along the Lower Monongahela River. Unfortunately, these data were typically not collected at sites along the reach of the river on similar days or times and the ability to make direct comparisons between sites is limited. Data were available from 1990 to present.
- **Discrete Vertical Profile Data –** Annual grab water quality sampling data collected by the USACE on the mainstem of the river. Often these data were collected at different sites on the lower Monongahela River at similar times, including upstream of the Braddock Locks and Dam, which will be analyzed further. Data were available from 1990 to present.
- **Continuous Water Quality Data –** Seasonal, continuous 15-minute water quality data collected at the USGS gage at Elizabeth approximately 30 feet upstream of the end of the

guide wall and 1,050 feet upstream from the locks and dam at RM 23.8. These data were only available from 2002 to 2012 and recent data is considered provisional.

Water Temperature

Discrete Spatial Water Temperature Data

During the summer months, water temperatures ranged from 15.0°C (59.0°F) to 31.3°C (88.3°F), with the exception of a few outliers. During the summer, approximately 3.4% of the water temperature data exceeded the state maximum criteria, but did not exceed criteria by more than 1.2°C. There did not appear to be any strong lateral gradients in water temperature along the study reach and water temperatures pre-2004 and post-2003 appeared to be relatively similar (Figure E.3.1.2-1). Data collected upstream and downstream of the Braddock Locks and Dam were not collected on similar dates or time, which limits the ability to analyze these data further.

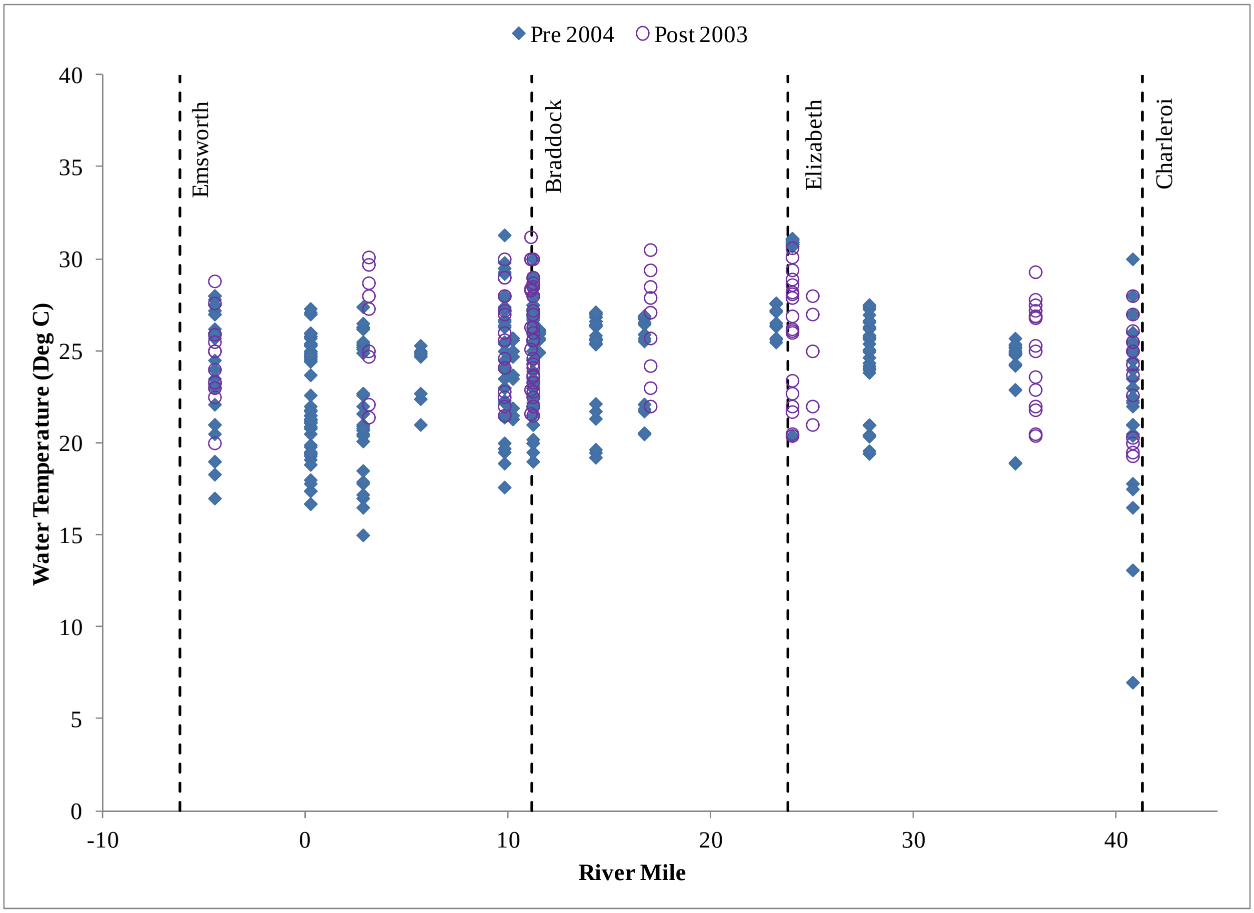


Figure E.3.1.2-1 Water temperature data collected from Emsworth Locks and Dam (RM -6.2) to Charleroi Locks and Dam (RM 41.5) during the summer from 1990 to 2011.

Discrete Vertical Profile Water Temperature Data

Summer water temperatures at sites in the study reach ranged from 19.6°C (67.3°F) to 33.9°C (93.0°F). Water temperature data collected on similar dates at mid-channel from a site located 0.1 mile upstream (Site BDP1002) and 0.2 mile downstream (Site BDP1201) of the Braddock Locks and Dam were compared and are included in Appendix E of the Desktop Water Quality Study (Appendix E-1a). It should be noted that all of these data were collected before the Braddock Dam was replaced. Following dam replacement, the Braddock Pool elevation rose 3.1 feet in 2004; therefore, these data may not be representative of current conditions. Water temperatures at the site upstream of the Braddock Locks and Dam were either slightly higher or similar to the site just downstream of the structure. Typically water temperature was relatively consistent throughout the water column upstream and downstream of the Braddock Locks and Dam, indicating the water column was well mixed. Exceptions were noted on two monitoring events: August 1991 and July 1995. On both dates, the water temperatures declined more drastically towards the deeper portion of the water column than observed in other years.

Continuous Water Temperature Data

Summer water temperatures at the Locks and Dam 3 at Elizabeth ranged from 17.2°C (63.0°F) to 35.9°C (96.6°F) and mimicked ambient air temperatures (Appendix F of the Desktop Water Quality Study [Appendix E-1a]). Approximately 18.1% of the water temperature data exceeded state criteria, which occurred most frequently in August. Temperatures exceeded criteria by up to 6.3°C, but typically only exceeded criteria by approximately 2°C. Water temperatures displayed diurnal patterns, but were typically not substantial.

Dissolved Oxygen

Discrete Spatial DO Data

Summer DO concentrations ranged from 4.4 mg/L to 10.25 mg/L and all data were above the minimum instantaneous state criteria of 4.0 mg/L (Figure E.3.1.2-2). Only one datum was below 5.0 mg/L in 1993; otherwise, DO concentrations were typically above 6.0 mg/L. There did not appear to be strong lateral gradients in DO along the study reach. DO concentrations were occasionally below the USACE proposed minimum DO concentration of 7.5 mg/L established for the reach downstream the Braddock Locks and Dam after 2003 (Figure E.3.1.2-2). Data collected upstream and downstream of the Braddock Locks and Dam were not collected on similar dates or time, which limits the ability to analyze these data further.

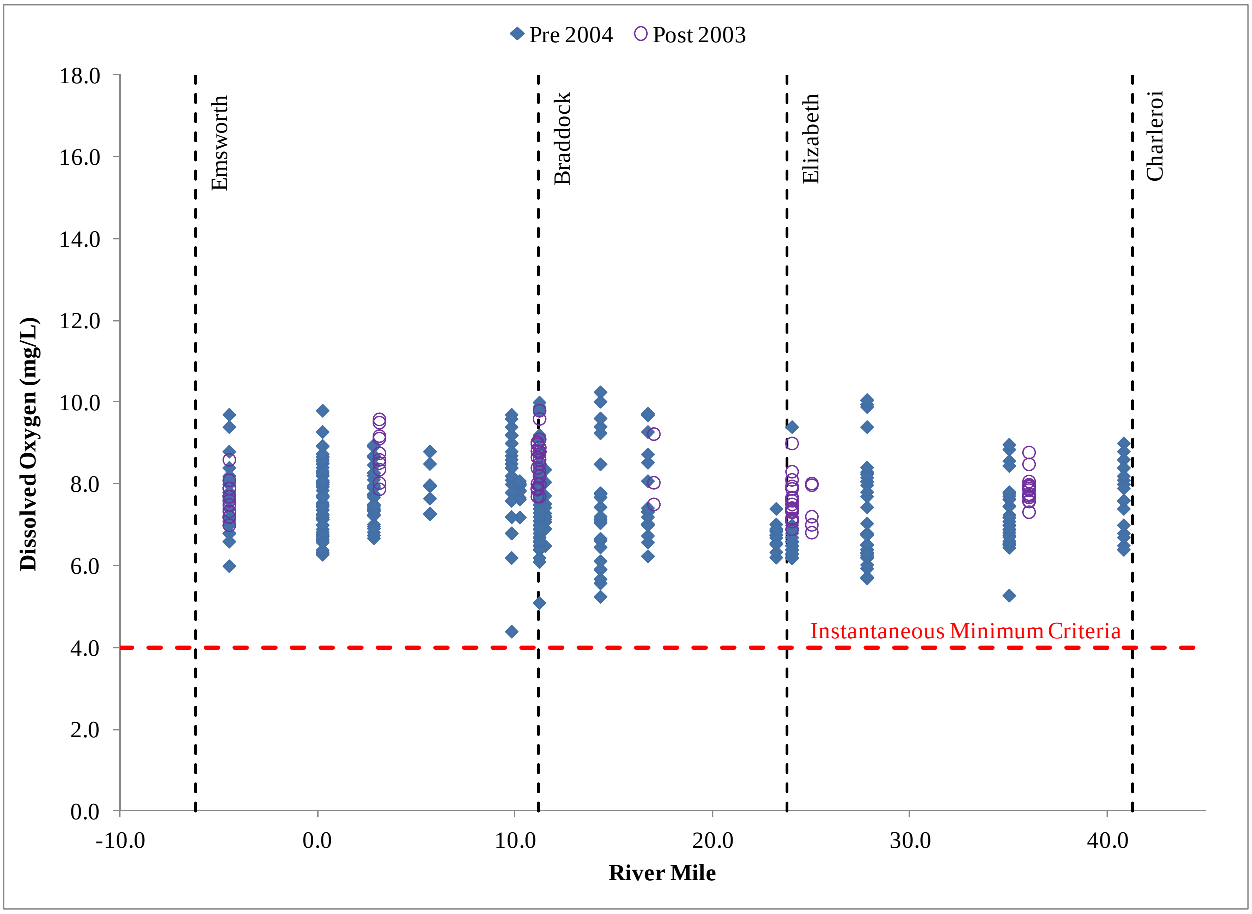


Figure E.3.1.2-2 DO concentration data collected from Emsworth Locks and Dam (RM -6.2) to Charleroi Locks and Dam (RM 41.5) during the summer from 1990 to 2011.

Typically, during the summer, sample sites were relatively saturated with percent saturation ranging from 80 to 120%. No strong lateral gradients in DO concentration were apparent along the study reach during the summer months (Figure E.3.1.2-3).

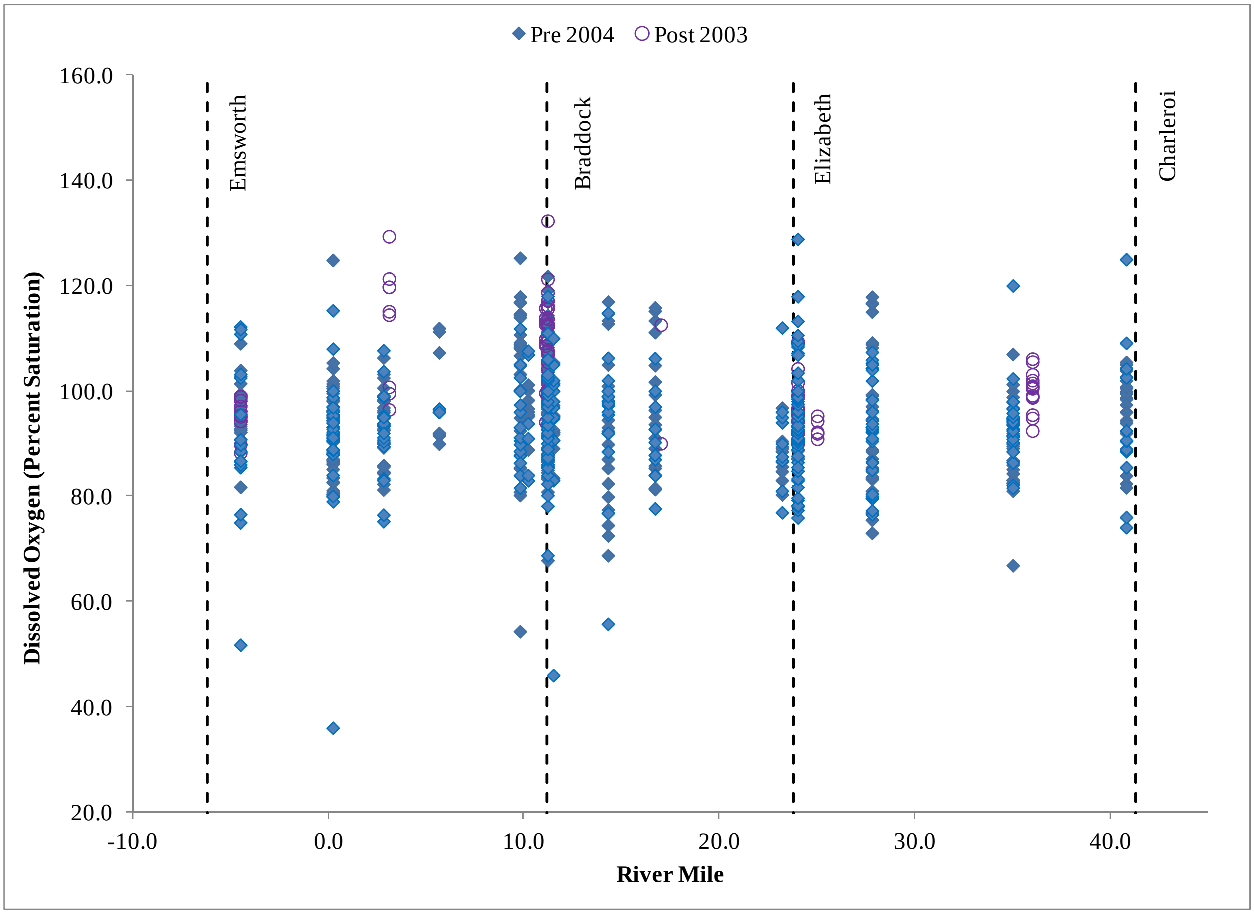


Figure E.3.1.2-3 Percent saturation data from Emsworth Locks and Dam (RM -6.2) to Charleroi Locks and Dam (RM 41.5) from 1999 to 2011 during the summer.

Discrete Vertical Profile DO Data

DO and water temperature data collected on similar dates at mid-channel from a site located 0.1 mile upstream (Site BDP1002) and 0.2 mile downstream (Site BDP1201) of the Braddock Locks and Dam were compared. It should be noted that all of these data were collected before the Braddock Dam was replaced. Following dam replacement, the Braddock Pool elevation rose 3.1 feet in 2004; therefore, these data may not be representative of current conditions. These figures are provided in Appendix C and D of the Desktop Water Quality Study (Appendix E-1a). DO concentrations were all above the state minimum instantaneous criteria of 4.0 mg/L. Typically, DO concentrations were relatively consistent throughout the water column upstream and downstream of the Braddock Locks and Dam, indicating the water column was well mixed. Exceptions were noted on two monitoring events: August 1991 and July 1995. On both dates the

DO concentration was higher upstream of the Braddock Locks and Dam and declined abruptly towards the deeper portion of the water column than observed in other years (Appendix C, D, E of the Desktop Water Quality Study [Appendix E-1a]). These are likely associated with lower flows and warmer water temperatures. For example, the in 1995 air temperatures exceeded 32°C (90°F) on 17 days, which was the most recorded from 1990 through 2012. Collectively, these data may suggest intermittent periods of weak stratification may occur during seasonably warm water temperatures and low flows, but it is difficult to determine the extent of stratification based on the infrequency of data collection.

Continuous DO Data

DO levels at Elizabeth ranged from 6.0 mg/L to 10.0 mg/L and were relatively high throughout the summer (Appendix G of the Desktop Water Quality Study [Appendix E-1a]). Instantaneous DO concentrations were well above the state minimum water quality criteria. DO concentration was recorded below state criteria during three different periods in late August 2002 and late September 2004, but these appear to be outliers. The daily averages ranged from 3.5 to 10.5 mg/L and were only below the state minimum daily average criteria during the same period, which again were likely outliers. Otherwise, the daily average DO generally exceeded 6.0 mg/L. Typically, sample sites were relatively saturated and occasionally supersaturated; saturation generally ranged from 80 to 120% during the summer (Appendix H of the Desktop Water Quality Study [Appendix E-1a]). Diurnal patterns were observed, but were relatively minimal and appeared to correspond with water temperature data.

Water Quality Modeling

Water quality modeling was also conducted to analyze the potential effects of the proposed Project on DO concentration during summer low-flow conditions. The following presents the salient results with more detailed discussion of the model development in the Water Quality Modeling Report in Appendix E-1b. The hydrodynamic model ECOM and water quality model RCA were used to quantify the potential changes in DO associated with the proposed Project for baseline and proposed project operational conditions (Scenario 1). Flows for baseline and Scenario 1 were 7,250 cfs, but the former assumed all flows passed over the environmental gate (Gate 1), whereas the latter assumed a minimum of 1,000 cfs at the environmental gate and 6,250 cfs at the five turbines operating at a capacity of 1,250 cfs. Under Scenario 1 it was assumed that the turbines were at a depth of 12 to 16 feet and discharged into the top 3 feet of water below the Braddock Locks and Dam based on the elevation differential between the Braddock and Emsworth pools (721.8 feet Braddock Pool elevation – 710.9 feet Emsworth Pool elevation = 10.9 feet). USGS water quality data at gage 03075070 at the Lock and Dam 2 at Elizabeth, gage 03085000 at the Braddock Locks and Dam, and gage 03083500 from the Youghiogheny River at Suttersville were used to characterize the study area. Only data collected after the Braddock Locks and Dam were replaced in 2004 and during the low flow periods (June through October) were used.

DO data were consistent seasonally and concentrations were generally above 7.0 mg/L since 2004. Therefore, an upstream concentration of 7.0 mg/L was used in the model. Results indicated that during baseline conditions, surface and bottom increases in DO over Gate 1 and at the location of the proposed turbines increase approximately 0.2 mg/L (Figure 8 in Appendix E-1b). Under Scenario 1, operation of the turbines resulted in a 0.11 increase in surface DO over Gate 1 and no increase in bottom DO at Gate 1 or in surface or bottom DO where the turbines would be placed. These results reflect all of the model sources and sinks for DO.

A unit response model run was also conducted that did not include DO sources and sinks and only included reaeration associated with the environmental gate. Results indicated that baseline DO increased by 0.13 mg/L due to the environmental gate alone. Although no data has been provided from the USACE regarding actual affects of the environmental gate on DO, recent samples taken by HDR above and below the environmental gate and the Metcalf and Eddy weir reaeration calculation support this assertion. One set of DO measurements collected on July 11, 2012 upstream (8.54 mg/L) and downstream (8.31 mg/L) of the environmental gate showed no increase in DO. Application of the reaeration equation using defined coefficients for reaeration at Gate 1 resulted in a 48% oxygen transfer efficiency and an increase in DO of 0.07 mg/L to 6.92 from an assigned upstream concentration of 6.85 mg/L and DO saturation.

To test a conservative estimate of the weir reaeration oxygen transfer efficiency, the oxygen transfer efficiency was set at 80% based on recent work of Witt and Gulliver 2012, where a maximum oxygen transfer efficiency of 80% was observed for unsubmerged hydraulic jumps at low-head dams. Both 48% and 80% transfer efficiency runs were completed for cases where all of the DO sources and sinks were applied and where only the reaeration over Gate 1 was applied. Table 3 in Appendix E-1b presents calculated reductions in DO at these locations due to the proposed project for these model runs. When considering only the DO changes due to Gate 1 and at the likely oxygen transfer efficiency of 48%, the model indicates that there is a modest reduction in the increase in DO under Scenario #1 ranging from 0.05 mg/L to 0.13 mg/L. A conservative calculation using 80% oxygen transfer efficiency and considering DO changes due to the Gate 1 weir also indicates a modest reduction in the increase in DO under Scenario #1 ranging from 0.14 mg/L to 0.35 mg/L.

Small changes in DO due to the weir at Gate 1 are not unexpected for this analysis, given that the DO saturation at 35C is approximately 7.0 mg/l and the upstream DO is set at 7.0 mg/L. It should be noted that the data support river DOs at 7.0 mg/L or higher, and the above analyses were done using worse case conditions. None of the predicted changes cause DO to approach violating standards or having biological significance. Potentially lower DOs in bottom waters of the Braddock Pool may occur, as evidenced by the depth profile data.

E.3.2 Project Effects

Construction of the proposed Project, which is expected to take less than 12 weeks, will involve temporary placement of a coffer dam in close proximity to the existing dam, which will result in temporary disturbance to bottom substrates at the Braddock Locks and Dam. The dimensions of the cofferdam upstream from the existing weir are 15 feet x 60 feet x 15 feet. Once the cofferdam is in place, the area may be dewatered before being excavated for the installation of the concrete pedestal and LFM. It is expected that no more than 220 cubic yards of material will be removed from this location before the concrete pedestal is poured. A downstream coffer dam of similar size will be installed for draft tube work on the weir. This area will be dewatered but excavation is not required. This activity will result in temporary disturbance to river bottom substrates and flow distribution across the dam spillway that may temporarily increase turbidity. Relevant best management practices will be utilized to minimize effects to water quality.

The proposed Project will operate in a run-of-release manner, and the USACE will continue to operate the Braddock Locks and Dam in a run-of-release manner. These operations will not affect the current surface water elevations of the lower Monongahela River, but will result in minor changes to flow distribution across the Project with the addition of the five proposed bulb turbines within the overflow section of the existing dam on the river left side. This additional flow may benefit water quality on this side of the river by providing flow to this area at all times of the year. Currently the left bank does not receive flow directly, but is likely affected by flow through the spill gates.

These proposed Project operations would maintain flow through the environmental gate at a distribution level consistent with the Tennant Method developed for instream and bypass flow recommendations, whereby a minimum of 20% of available flow (1,209 cfs based on the average flow for July) and up to the maximum flow of 9,440 cfs would be passed through the environmental gate, with the balance through the proposed turbines or other gates/overflow weir (Table E.3.1.1-4). River flow that would otherwise be used in the environmental gate will be utilized for power generation, while maintaining adequate flows through the environmental gate for resource protection measures during low flow periods.

As a result, this new flow regime (Table E. 3.1.1-4) presents a potential improvement to current environmental conditions by balancing the discharge on both sides of the river rather than focusing the discharge to the environmental gate on river right (when looking downstream). No negative effects are anticipated with these newly proposed flows. However, continuous water quality data (DO, temperature, pH, and conductivity) is being collected just upstream and downstream of the Braddock Locks and Dam during the critical summer period (June-September 2012) to enhance the available existing information and will be provided when available.
The environmental basis (and potential benefits) of Hydro Friends Fund's proposed flow regime relevant to water quality are:

- It preserves at all times 250 cfs for lock operations and a minimum of 1,000 cfs through the environmental gate;
- It distributes flow out over the entire length of the project;;

- It replicates a natural seasonal flow pattern;
- It will increase flow mixing in the immediate tailrace area; and
- It will not diminish, and may in fact enhance, DO concentrations in the immediate tailrace area.

The results from the desktop water quality study indicate that existing water quality conditions meet state standards during summer low flow, critical conditions (Appendix E-1). Water temperature exceeded criteria occasionally throughout the lower Monongahela River and closely mimicked ambient air temperatures. Regardless of warmer water temperatures during the summer months, DO data were above the instantaneous (4.0 mg/L) and daily average (5.0 mg/L) state criteria, even during critical, low flow summer conditions. DO concentrations downstream of the Braddock Locks and Dam were occasionally lower than the existing condition identified by the USACE of 7.5 mg/L.

Certain hydroelectric facilities can have substantial storage capacity that largely influences instream flow conditions, and can have a variety of associated water quantity and quality effects. The proposed Project would be operated as a low head, run-of-release facility that allocates required flow amounts to the locks and environmental gate, while utilizing access hydraulic capacity to produce approximately 3.75 MW of renewable energy. As such, the Project is not anticipated to have substantial effects on water quantity or quality. The proposed Project may result in improvements to downstream and upstream cross-sectional flow patterns and water quality, due to the addition of flows to the river right side that is otherwise a slower backwater area during low flow periods, when the Braddock and Emsworth pools may become weakly stratified. Therefore, no protection, mitigation, or enhancement measures are proposed at this time.

E.4 REPORT ON FISH, WILDLIFE, AND BOTANICAL RESOURCES

E.4.1 Fish and Aquatic Resources

Decades of mining, agricultural, commercial, and industrial practices have impacted the aquatic resources in the Monongahela River, with a near loss of fish and invertebrate communities by the mid-20th century (PFBC 2011; Anderson et al. 2000; Hart 2012). Improvements to water quality have led to substantial improvements to aquatic communities over the past several decades such that the Monongahela River now supports a diverse array of fish and macroinvertebrate resources. These resources and the potential Project effects on these resources are discussed in the following subsections.

E.4.1.1 Aquatic Habitat

The Three Rivers Management Plan (PFBC 2011) provides a comprehensive description of aquatic habitat within the Allegheny, Monongahela, and Ohio rivers. The following paragraphs summarize the information contained in that report.

As with the Allegheny and Ohio rivers, construction of the navigation system of locks and dams has substantially changed the Monongahela River habitat since the first locks and dams were constructed in 1841. The nine locks and dam along the Monongahela River result in a series of pool habitats that are deeper and provide less habitat complexity than unregulated rivers; however, the Monongahela River maintains a high degree of sinuosity for a large, regulated river. The river channel is generally entrenched within confined banks and steep banks in the river valley. The 100- and 500-year floodplains are also relatively narrow and confined within the steeply sloped fringes of river valley.

The lower Monongahela River near Pittsburgh is a low-gradient, seventh-order large river with a normal wetted width of approximately 900 feet at its confluence with the Allegheny River in Pittsburgh. The river is widest (1,150 feet from bank to bank) near the mouth of Turtle Creek located just upstream of the Braddock Locks and Dam at RM 11.6. Information on water depths for the Monongahela River is limited, but recent observations suggest a mean depth of about 20 feet. The navigation channel is dredged to maintain a minimum depth of 9 feet. This activity primarily occurs just downstream of the locks where the rivers are typically the shallowest. The pools above each of the locks and dams, which impound waters, typically result in deeper waters.

The general macrohabitats of the navigation pools consist of tailwaters, main channel habitat, and back channel habitat. Shallow water habitats include river shorelines, tributary mouths, and embayments typically containing sand, gravel, and some cobble substrates. In addition to locks and dams, several other manmade habitats exist within this highly industrialized region, including bridges, piers, and other hardened shoreline features (e.g., rip rap). Due to the developed nature of this river, few riparian habitats (i.e., wetlands, littoral zones, riparian forests, and floodplains) are present. Lock and dam structures also provide some complex habitats with altered flow patterns. The river is typically more stream-like at the tailwaters of a dam, but flow patterns are also affected by structures resulting in areas of turbulence directly below the dam (e.g., backwash, boil line, and outwash) and eddies adjacent to shorelines or behind obstructions.

The USACE primarily operates the lock and dam facilities in a run-of-release mode to replicate natural flows and maintain suitable aquatic habitat conditions. The USACE also operates one of the spillway gates at Braddock Locks and Dam to enhance water quality (i.e., environmental gate) and sustain suitable environmental conditions for many species, especially during low flow periods. The lock chambers also pass fish and other aquatic organisms upstream and downstream of the dams during USACE-scheduled lockages that have been conducted since 2009 specifically for allowing fish passage during the spring spawning period.

The aquatic habitat of the Monongahela River watershed has historically suffered from urban development and industrialization, coal mining, and wastewater discharges, but has significantly improved in recent years. Navigation dams reduce the natural velocity immediately upriver from their locations, trapping sediments that would otherwise flow downstream. Coal fines and steel mill slag became a substantial component of fluvial sediment (as bedload) of the lower Monongahela River. Fine-grained fluvial sediments are known to adsorb and carry a variety of nutrients and contaminants.

E.4.1.2 Fish Community

Prior to 1970, poor water quality conditions led to significant declines and eradication of many fish communities of the Monongahela River. However, lock chamber and nighttime pool electrofishing surveys and other fishery sampling events conducted by the PFBC and available data in the ORSANCO (2009) database from 1967 to 2010 have shown a steady recovery of fish assemblages as a result of concerted federal and state efforts to improve water quality (PFBC 2009, 2010) (Figure E.4.1.2-1). Conservation efforts appear to have led to several fish species that were previously listed in the state of Pennsylvania being delisted, a few of which have shown up in the more recent surveys in the Monongahela River (PFBC 2010). Tables E.4.1.2-1 and E.4.1.2-2 display a dramatic increase in the biomass of forage species at several locks in the Monongahela River from 2003 to 2010. Overall, the fish population in the Monongahela River at Braddock Locks and Dam has greatly improved in health, diversity, and abundance (PFBC 2010).

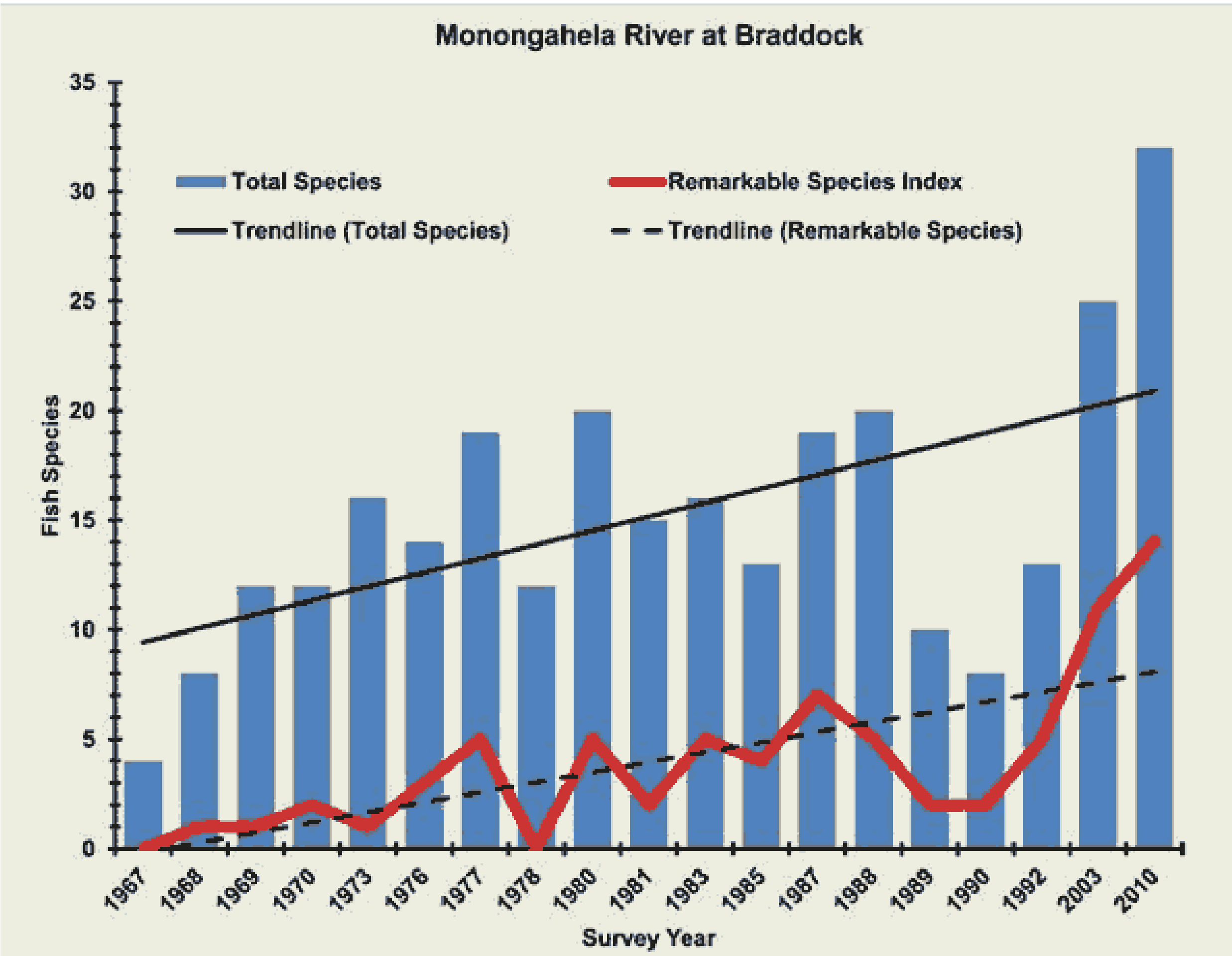


Figure E.4.1.2-1 Fish species collected at Braddock Locks and Dam during lock chamber surveys from 1967 to 2010 (PFBC 2010).

Table E.4.1.2-1 Forage biomass comparison at Monongahela River Locks from 2003 to 2010.

Lock Chamber	2003 Forage Biomass (pounds per acre)	2010 Forage Biomass (pounds per acre)
Grays Landing	10	127
Maxwell	5	46
Braddock	63	162

Source: PFBC 2010

Table E.4.1.2-2 Summary of 2003 and 2010 results of lock chamber surveys at Braddock Locks and Dam.

Common Name	Scientific Name	9/15/2003 N	10/1/2010 N	Total Collected
Bluegill	*Lepomis macrochirus*	5	408	413
Bluntnose minnow	*Pimephales notatus*	0	1,437	1,437
Brook silverside*	*Labidesthes sicculus*	0	6	6
Channel catfish	*Ictalurus punctatus*	68	113	181
Channel darter*	*Percina copelandi*	0	6	6
Channel shiner	*Notropis wickliffi*	96	2,507	2,603
Common carp	*Cyprinus carpio*	79	6	85
Emerald shiner	*Notropis atherinoides*	344	4,535	4,879
Flathead catfish	*Pylodictis olivaris*	21	6	27
Freshwater drum	*Aplodinotus grunniens*	181	196	377
Ghost shiner*	*Notropis buchanani*	81	465	546
Gizzard shad	*Dorosoma cepedianum*	60	13,294	13,354
Green sunfish	*Lepomis cyanellus*	0	9	9
Largemouth bass*	*Micropterus salmoides*	0	2	2
Logperch*	*Percina caprodes*	0	11	11
Longnose gar*	*Lepisosteus osseus*	0	1	1
Mimic shiner*	*Notropis volucellus*	119	0	119
Mooneye	*Hiodon tergisus*	1	0	1
Pumpkinseed	*Lepomis gibbosus*	0	32	32
Quillback	*Carpiodes cyprinus*	0	1	1
Redear sunfish	*Lepomis microlophus*	1	0	1
River carpsucker*	*Carpiodes carpio*	1	0	1
Rock bass	*Ambloplites rupestris*	1	3	4
Sauger*	*Sander canadense*	6	8	14
Saugeye*	*Sander vitreus x Sander canadense*	1	0	1
Silver chub*	*Macrhybopsis storeriana*	0	6	6
Silver redhorse	*Moxostoma anisurum*	1	3	4
Skipjack herring*	*Alosa chrysochloris*	1	38	39
Smallmouth bass*	*Micropterus dolomieu*	1	3	4
Smallmouth buffalo*	*Ictiobus bubalus*	18	3	21
Smallmouth redhorse*	*Moxostoma breviceps*	2	3	5
Spotfin shiner	*Cyprinella spiloptera*	1	66	67
Spotted bass*	*Micropterus punctulatus*	0	94	94
Walleye*	*Sander vitreus*	9	7	16
White bass	*Morone chrysops*	27	98	125
White crappie	*Pomoxis annularis*	0	2	2
White perch	*Morone americana*	2	0	2
Yellow perch	*Perca flavascens*	0	1	1
	Total N	**1,127**	**23,370**	**24,497**
	Species Richness	**25**	**32**	**38**
	Remarkable Species Richness	**11**	**14**	**17**

*PFBC "Remarkable Species" – includes species either previously or currently protected under 58 PA Code Chapter 75, sport fish species maintained by natural production, species classified as pollution intolerant by ORSANCO, and other rare species in PA (PFBC 2011).

Source: PFBC 2003, 2010

The fish community in the Monongahela River is dominated by gizzard shad and species in the carp and minnow family (Cyprinidae). Except for the common carp, these are typically very small individuals and tend to inhabit sandbars or riffle areas within a riverine environment. Night electrofishing surveys conducted in 2003, 2009, and 2011 in the Braddock tailwaters documented smallmouth bass as the most abundant game fish species. In 2009, smallmouth bass ranged in size from 3 to 14 inches (Table E.4.1.2-3). A 2012 nighttime electrofishing survey was conducted in the Braddock Pool at approximately RM 23 in the tailwaters of the Locks and Dam 3 at Elizabeth, where smallmouth bass also dominated the game species composition. Common forage species observed in Braddock Pool surveys included emerald shiners and mimic shiners (Table E.4.1.2-4) (PFBC 2009; PFBC 2012b).

Fish surveys conducted between 1990 and 1992 in the Braddock Pool (RM 12.45) documented a total of 620 fish representing 28 species (ORSANCO 2009). Unlike the 2003 and 2010 lock chambers where the relative composition (RC) of gizzard shad, channel shiner, and emerald shiner combined was approximately 85%, these species only represented 7% of the RC in the pool in 1990-1992. Smallmouth bass, channel catfish, and freshwater drum dominated compositions in 1990-1992 with a combined RC of 44% (ORSANCO 2009) (Table E.4.1.2-5). Complete fish species lists and RC from fisheries surveys conducted throughout the Monongahela River since 1990, including those mentioned above are provided in Table E.4.1.2-5.

Table E.4.1.2-3 Summary of game fish and panfish species, sizes, and numbers collected from the Braddock Locks and Dam tailwater in 2009.

Common Name	Number Collected	Size Range (inches)
Sauger	33	7-13
Walleye	4	8-12
Saugeye	2	11
Smallmouth bass	57	3-14
Largemouth bass	1	9
Hybrid striped bass	-	-
White bass	-	-
Rock bass	6	7-8
Bluegill	4	7-8
Black crappie	-	-
Muskellunge	-	-
Channel catfish	8	14-19

Source: PFBC 2009

Table E.4.1.2-4 Summary of 2012 results of nighttime electrofishing survey in Braddock Pool/Elizabeth Lock and Dam tailwaters.

Common Name	Number Collected
Black redhorse	4
Bluegill	102
Bluntnose minnow	38
Brook silverside	2
Chain pickerel	1
Channel catfish	12
Channel darter	1
Channel shiner	69
Common carp	4
Emerald shiner	295
Flathead catfish	5
Freshwater drum	45
Gizzard shad	3
Golden redhorse	80
Green sunfish	7
Greenside darter	6
Largemouth bass	29
Lepomis hybrids	1
Logperch	12
Longnose gar	8
Mimic shiner	355
Northern hog sucker	8
Pumpkinseed	25
Quillback	6
River redhorse	5
Rock bass	98
Sand shiner	11
Sauger	4
Silver redhorse	31
Smallmouth bass	71
Smallmouth buffalo	3
Smallmouth redhorse	15
Spotfin shiner	75
Spotted bass	45
Striped bass hybrid	8
Tiger muskellunge	1
Walleye	4
White bass	8
Yellow perch	2

Table E.4.1.2-5 Monongahela River fish species list and relative compositions (RC) from surveys conducted between 1990 and 2012.

		Morgantown Pool (9/21/99)[c]		Grays Landing Pool (10/7/03-10/21/03)[b]		Grays Landing Lock Chamber (9/17/03 and 9/29/10)[a]		Maxwell Pool (10/7/03-10/20/03)[b] & (2003, 2009, 2011)[d]		Maxwell Lock Chamber (9/16/03 and 9/30/10)[a]		Pool #4 (10/21/03)[b] & (2003, 2008, 2009, 2011)[d]		Braddock Pool (9/5/90-9/24/92)[b] & (2012)[d]		Braddock Lock Chamber (9/15/03 and 10/01/10)[a]		Emsworth Pool (9/17/07-9/18/07)[b] & (2003, 2009, 2011)[d]		Emsworth Pool/Pool #1 (9/5/90-9/24/92)[b]		Average Monongahela River Composition
Scientific Name	**Common Name**	**N**	**RC %**	**N**	**RC %**	**N**	**RC %**	**N**	**RC %**	**N**	**RC %**	**N**	**RC %**	**N**	**RC %**	**N**	**RC %**	**N**	**RC %**	**N**	**RC %**	
Atherinidae	**Silversides**																					
Labidesthes sicculus	Brook silverside*	5	0.09	12	1.32	52	0.08	13	0.48	99	0.27	3	0.12	2	0.09	6	0.02	4	0.13	0	0.00	0.26
Catostomidae	**Suckers**																					
Hypentelium nigricans	Northern hog sucker	0	0.00	0	0.00	0	0.00	8	0.29	0	0.00	21	0.84	8	0.38	0	0.00	4	0.13	1	0.13	0.18
Carpiodes carpio	River carpsucker*	0	0.00	0	0.00	10	0.02	4	0.15	1	0.00	5	0.20	0	0.00	1	0.00	19	0.62	0	0.00	0.10
Carpiodes velifer	Highfin carpsucker	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.04	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Carpiodes cyprinus	Quillback	0	0.00	4	0.44	10	0.02	7	0.26	10	0.03	62	2.48	6	0.28	1	0.00	17	0.56	0	0.00	0.41
Ictiobus niger	Black buffalo	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.03	0	0.00	0.00
Ictiobus bubalus	Smallmouth buffalo*	0	0.00	0	0.00	9	0.01	0	0.00	1	0.00	15	0.60	3	0.14	21	0.09	126	4.14	9	1.20	0.62
Moxostoma duquesnei	Black redhorse	0	0.00	3	0.33	1	0.00	14	0.51	0	0.00	9	0.36	12	0.57	0	0.00	11	0.36	9	1.20	0.33
Moxostoma carinatum	River redhorse	0	0.00	1	0.11	0	0.00	1	0.04	0	0.00	3	0.12	5	0.24	0	0.00	26	0.85	0	0.00	0.14
Moxostoma erythrurum	Golden redhorse	0	0.00	137	15.04	2	0.00	167	6.14	1	0.00	88	3.52	83	3.92	0	0.00	61	2.00	3	0.40	3.10
Moxostoma anisurum	Silver redhorse	0	0.00	25	2.74	13	0.02	35	1.29	3	0.01	69	2.76	52	2.45	4	0.02	178	5.84	8	1.07	1.62
Moxostoma breviceps	Smallmouth redhorse*	0	0.00	0	0.00	0	0.00	12	0.44	0	0.00	27	1.08	29	1.37	5	0.02	51	1.67	91	12.18	1.68
Centrarchidae	**Sunfish**																					
Ambloplites rupestris	Rock bass	10	0.19	15	1.65	31	0.05	138	5.07	71	0.19	117	4.69	141	6.65	4	0.02	27	0.89	56	7.50	2.69
Lepomis cyanellus	Green sunfish	9	0.17	9	0.99	228	0.35	44	1.62	16	0.04	5	0.20	11	0.52	9	0.04	9	0.30	6	0.80	0.50
Lepomis gibbosus	Pumpkinseed	7	0.13	3	0.33	25	0.04	8	0.29	14	0.04	11	0.44	33	1.56	32	0.13	0	0.00	3	0.40	0.34
Lepomis macrochirus	Bluegill	292	5.50	38	4.17	1,423	2.19	144	5.29	403	1.09	46	1.84	112	5.29	413	1.69	117	3.84	4	0.54	3.14
Lepomis hybrid	Hybrid sunfish	0	0.00	0	0.00	0	0.00	4	0.15	0	0.00	0	0.00	1	0.05	0	0.00	0	0.00	0	0.00	0.02
Lepomis auritus	Redbreast sunfish	0	0.00	1	0.11	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.01
Lepomis megalotis	Longear sunfish	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Lepomis gulosus	Warmouth	7	0.13	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.01
Lepomis microlophus	Redear sunfish	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.00	0	0.00	0	0.00	0.00
Micropterus dolomieu	Smallmouth bass*	0	0.00	35	3.84	19	0.03	404	14.85	16	0.04	255	10.21	196	9.25	4	0.02	347	11.39	266	35.61	8.52
Micropterus punctulatus	Spotted bass*	5	0.09	1	0.11	29	0.04	52	1.91	124	0.34	44	1.76	46	2.17	94	0.38	76	2.49	5	0.67	1.00
Micropterus salmoides	Largemouth bass*	0	0.00	5	0.55	3	0.00	45	1.65	0	0.00	37	1.48	29	1.37	2	0.01	14	0.46	0	0.00	0.55
Pomoxis annularis	White crappie	0	0.00	0	0.00	5	0.01	7	0.26	0	0.00	0	0.00	0	0.00	2	0.01	1	0.03	0	0.00	0.03
Pomoxis nigromaculatus	Black crappie	1	0.02	3	0.33	4	0.01	7	0.26	1	0.00	11	0.44	0	0.00	0	0.00	2	0.07	0	0.00	0.11
Clupeidae	**Herrings**																					
Alosa chrysochloris	Skipjack herring*	0	0.00	0	0.00	2	0.00	0	0.00	5	0.01	0	0.00	0	0.00	39	0.16	7	0.23	0	0.00	0.04
Dorosoma cepedianum	Gizzard shad	50	0.94	2	0.22	24,216	37.20	15	0.55	11,004	29.74	17	0.68	46	2.17	13,354	54.51	103	3.38	41	5.49	13.49
Cyprinidae	**Carps and Minnows**																					
Carassius auratus	Goldfish	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.09	0	0.00	0	0.00	0	0.00	0.01
Notemigonus chrysoleucas	Golden shiner	0	0.00	0	0.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.03	0	0.00	0.00
Cyprinella spiloptera	Spotfin shiner	0	0.00	0	0.00	0	0.00	11	0.40	7	0.02	33	1.32	75	3.54	67	0.27	34	1.12	0	0.00	0.67
Cyprinus carpio	Common carp	0	0.00	14	1.54	123	0.19	29	1.07	50	0.14	111	4.45	57	2.69	85	0.35	198	6.50	55	7.36	2.43
Macrhybopsis storeriana	Silver chub*	0	0.00	9	0.99	0	0.00	15	0.55	23	0.06	10	0.40	0	0.00	6	0.02	26	0.85	1	0.13	0.30
Rhinichthys obtusus	Western blacknose dace	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.05	0	0.00	0	0.00	0	0.00	0.00
Notropis wickliffi	Channel shiner	3	0.06	0	0.00	924	1.42	40	1.47	2,992	8.09	120	4.81	69	3.26	2,603	10.63	106	3.48	0	0.00	3.32
Notropis blennius	River shiner	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.03	0	0.00	0.00
Notropis atherinoides	Emerald shiner	4,087	76.92	388	42.59	34,322	52.72	792	29.11	15,100	40.81	285	11.41	295	13.92	4,879	19.92	264	8.66	1	0.13	29.62
Notropis buchanani	Ghost shiner*	750	14.12	0	0.00	608	0.93	6	0.22	4,443	12.01	2	0.08	0	0.00	546	2.23	8	0.26	0	0.00	2.99
Notropis photogenis	Silver shiner	0	0.00	0	0.00	401	0.62	1	0.04	294	0.79	1	0.04	0	0.00	0	0.00	0	0.00	0	0.00	0.15
Notropis hudsonius	Spottail shiner	0	0.00	0	0.00	0	0.00	11	0.40	0	0.00	54	2.16	1	0.05	0	0.00	118	3.87	0	0.00	0.65
Notropis stramineus	Sand shiner	0	0.00	0	0.00	0	0.00	1	0.04	294	0.79	8	0.32	11	0.52	0	0.00	13	0.43	0	0.00	0.21
Notropis volucellus	Mimic shiner*	0	0.00	126	13.83	952	1.46	288	10.58	677	1.83	430	17.22	415	19.58	119	0.49	294	9.65	17	2.28	7.69
Nocomis micropogon	River chub	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.04	0	0.00	0	0.00	1	0.03	0	0.00	0.01
Pimephales promelas	Fathead minnow	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.04	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Pimephales notatus	Bluntnose minnow	45	0.85	21	2.31	424	0.65	61	2.24	77	0.21	49	1.96	38	1.79	1,437	5.87	6	0.20	0	0.00	1.61
Esocidae	**Pikes**																					
Esox niger	Chain pickerel	0	0.00	5	0.55	0	0.00	3	0.11	0	0.00	1	0.04	1	0.05	0	0.00	0	0.00	0	0.00	0.07
Esox masquinongy	Muskellunge	0	0.00	0	0.00	0	0.00	3	0.11	0	0.00	1	0.04	0	0.00	0	0.00	0	0.00	0	0.00	0.02
Esox masquinongy x E. lucius	Tiger muskellunge	0	0.00	0	0.00	1	0.00	0	0.00	0	0.00	2	0.08	1	0.05	0	0.00	0	0.00	1	0.13	0.03
Hiodontidae	**Mooneyes**																					
Hiodon tergisus	Mooneye*	0	0.00	0	0.00	6	0.01	0	0.00	1	0.00	2	0.08	1	0.05	1	0.00	7	0.23	0	0.00	0.04
Ictaluridae	**North American Catfishes**																					
Icatlurus puntatus	Channel catfish	9	0.17	8	0.88	538	0.83	19	0.70	274	0.74	40	1.60	81	3.82	181	0.74	46	1.51	8	1.07	1.21
Pylodictis olivaris	Flathead catfish	13	0.24	2	0.22	33	0.05	0	0.00	21	0.06	6	0.24	11	0.52	27	0.11	12	0.39	2	0.27	0.21
Ameiurus natalis	Yellow bullhead	0	0.00	0	0.00	1	0.00	0	0.00	3	0.01	1	0.04	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Lepisosteidae	**Gars**																					
Lepisosteus osseus	Longnose gar*	0	0.00	2	0.22	29	0.04	10	0.37	3	0.01	63	2.52	8	0.38	1	0.00	48	1.58	0	0.00	0.51
Moronidae	**Temperate Bass**																					
Morone sp.	Unidentified temperate bass	0	0.00	4	0.44	0	0.00	2	0.07	0	0.00	0	0.00	0	0.00	0	0.00	18	0.59	0	0.00	0.11
Morone chrysops	White bass	8	0.15	0	0.00	49	0.08	17	0.62	124	0.34	35	1.40	36	1.70	125	0.51	45	1.48	25	3.35	0.96
Morone chrysops × M. saxatilis	Hybrid striped bass	0	0.00	1	0.11	14	0.02	4	0.15	4	0.01	2	0.08	8	0.38	0	0.00	2	0.07	0	0.00	0.08
Morone americana	White perch	0	0.00	0	0.00	0	0.00	0	0.00	1	0.00	0	0.00	0	0.00	2	0.01	3	0.10	0	0.00	0.01
Percidae	**Perch**																					
Etheostoma nigrum	Johnny darter	2	0.04	4	0.44	4	0.01	0	0.00	0	0.00	3	0.12	1	0.05	0	0.00	1	0.03	1	0.13	0.08
Etheostoma blennioides	Greenside darter	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.04	7	0.33	0	0.00	3	0.10	0	0.00	0.05
Etheostoma caeruleum	Rainbow darter	0	0.00	0	0.00	1	0.00	0	0.00	0	0.00	1	0.04	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Perca flavascens	Yellow perch	0	0.00	0	0.00	19	0.03	12	0.44	3	0.01	5	0.20	2	0.09	1	0.00	0	0.00	0	0.00	0.08
Percina copelandi	Channel darter*	0	0.00	20	2.20	0	0.00	0	0.00	0	0.00	29	1.16	1	0.05	6	0.02	14	0.46	4	0.54	0.44
Percina caprodes	Logperch*	5	0.09	0	0.00	12	0.02	12	0.44	36	0.10	33	1.32	27	1.27	11	0.04	56	1.84	59	7.90	1.30
Sander spp.	Unidentified *Sander* species	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.05	0	0.00	0	0.00	0	0.00	0.00
Sander canadense	Sauger*	0	0.00	0	0.00	14	0.02	168	6.17	5	0.01	213	8.53	18	0.85	14	0.06	269	8.83	13	1.74	2.62
Sander vitreus x Sander canadense	Saugeye*	0	0.00	0	0.00	0	0.00	11	0.40	0	0.00	14	0.56	7	0.33	1	0.00	14	0.46	36	4.82	0.66
Sander vitreus	Walleye*	0	0.00	0	0.00	28	0.04	39	1.43	32	0.09	44	1.76	5	0.24	16	0.07	50	1.64	5	0.67	0.59
Polyodontidae	**Paddlefishes**																					
Polyodon spathula	Paddlefish	0	0.00	0	0.00	0	0.00	0	0.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Salmonidae	**Trouts**																					
Salmo trutta	Brown trout	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.03	0	0.00	0.00
Sciaenidae	**Drums**																					
Aplodinotus grunniens	Freshwater drum	4	0.08	13	1.43	517	0.79	37	1.36	766	2.07	50	2.00	124	5.85	377	1.54	187	6.14	17	2.28	2.35
	Total	**5,313**	**100**	**911**	**100**	**65,103**	**100**	**2,721**	**100**	**37,000**	**100**	**2,497**	**100**	**2,119**	**100**	**24,497**	**100**	**3,047**	**100**	**747**	**100**	**100**

[a]Source data from PFBC website (2010 Monongahela Biological Monitoring Study: (http://www.fish.state.pa.us/images/reports/2011bio/8x04_01mon.htm)

[b]Souce data from 2009FishPopDB_PA_ORSANCO.mdb; Note - only used data from 1990 to present

[c]Souce data from MonRiverStreamSurveys_WV_WVDNR.mdb; Note - only used data from 1990 to present

[d]Souce data from Robert Ventorini (PFBC) on July 23, 2012 of nighttime electrofishing surveys

*PFBC "Remarkable Species"

E.4.1.3 Temporal and Spatial Distribution of Fish Communities

Fish are typically distributed according to habitat preferences, which often change seasonally. In addition to Cyprinids (i.e., minnows and shiners), a very large component of the Monongahela River fish community includes species of the sunfish family (Centrarchidae). This includes popular sport fish like largemouth, spotted, and smallmouth bass and members of the *Lepomis* genus like bluegill and pumpkinseed. Members of the sunfish family tend to inhabit shoreline areas throughout most of their life history, although they may orient themselves seasonally according to depth, temperature, woody debris, or other structural habitat features available in the pools at the Braddock Locks and Dam. The large piscine predators (walleye, hybrid striped bass, and muskellunge) are also popular game fish and tend to inhabit the deeper reaches during daylight hours and make crepuscular movements into shallows to feed. Several shiner and minnow species (Cyprinids) are also common is the deep and shallow water habitats above and below the Project, and provide the forage base for the large predatory game species. Life histories of the most notable species present in the Project vicinity is provided below, and further describes their temporal and spatial distribution, as well as their RCs observed in the Monongahela River and Braddock Pool during surveys conducted between 1990 and 2012, as shown Table E.4.1.2-5 and Table E.4.1.3-1, respectively.

Table E.4.1.3-1 Relative compositions (RC) of notable species in the Braddock Pool from surveys conducted between 1990 and 2012.

Common Name	Braddock Pool (RM 12.45) 8/12/1992[a]		Braddock Pool (RM 12.45) 9/24/1992[a]		Braddock Pool (RM 12.6) 1990[a]		Braddock Pool (RM 23) 2012[b]		Average Braddock Pool RC%
	N	RC%	N	RC%	N	RC%	N	RC%	
Bluegill	3	3.57	7	5.22	0	0.00	102	6.80	3.90
Brook silverside	0	0.00	0	0.00	0	0.00	2	0.13	0.03
Channel catfish	7	8.33	0	0.00	0	0.00	12	0.80	2.28
Channel darter	0	0.00	0	0.00	0	0.00	1	0.07	0.02
Emerald shiner	0	0.00	0	0.00	0	0.00	295	19.68	4.92
Flathead catfish	0	0.00	0	0.00	0	0.00	5	0.33	0.08
Freshwater drum	0	0.00	1	0.75	28	26.42	45	3.00	7.54
Ghost shiner[E]	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Gizzard shad	1	1.19	2	1.49	3	2.83	3	0.20	1.43
Logperch	7	8.33	8	5.97	0	0.00	12	0.80	3.78
Mimic shiner	0	0.00	0	0.00	0	0.00	355	23.68	5.92
Mooneye	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Paddlefish	0	0.00	0	0.00	0	0.00	0	0.00	0.00
River darter	0	0.00	0	0.00	0	0.00	0	0.00	0.00
River shiner[E]	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Rock bass	7	8.33	31	23.13	5	4.72	98	6.54	10.68
Silver chub	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Skipjack herring	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Smallmouth bass	24	28.57	61	45.52	40	37.74	71	4.74	29.14
Smallmouth redhorse	1	1.19	4	2.99	1	0.94	15	1.00	1.53
Spotted bass	0	0.00	1	0.75	0	0.00	45	3.00	0.94
Walleye	0	0.00	0	0.00	0	0.00	4	0.27	0.07
White bass	9	10.71	0	0.00	0	0.00	8	0.53	2.81
White crappie	0	0.00	0	0.00	0	0.00	0	0.00	0.00

[E] State endangered species according to Chapter 75 of the Pennsylvania Code
[a] Source: ORSANCO 2009 (note only used data from 1990 to present)
[b] Source: PFBC 2012b

Bluegill (Lepomis macrochirus)

The bluegill is a common type of sunfish in the Centrarchidae family and a popular game fish. They are a widespread species, originally found in a region that extended from the St. Lawrence River south to Georgia and then west to Texas and Minnesota, but has since been introduced to areas beyond this range (Smith 1985). Bluegills have the typical deep and laterally compressed body type represented in most *Lepomis* species. They have several sharp dorsal fin spines, and are often greenish-blue to brown in color with vertical bars sometimes present along the sides of the body with an orange breast. A black spot located on the posterior base of the soft dorsal fin is a useful identification characteristic (Smith 1985).

Bluegill are colonial and tend to occupy more open habitat near vegetative cover, while building nests, spawning, and rearing in littoral zones. Males construct and defend the nest in shallow areas with sand and gravel substrates, often within inches of neighboring nests. Spawning occurs in late fall and into the summer (Smith 1985; Jenkins and Burkhead 1993).

Bluegills are generalists and opportunistic feeders. Fry leave the nest to open area to feed on zooplankton when they are 1/4 to 1/3 inches in length. At approximately 1 inch in length, young bluegill return to the littoral habitats to feed on zooplankton, and begin to feed on insects, invertebrates, and occasionally on small fish as they further develop. Throughout their lives, juveniles and adults will often make forays to deep water habitats during the day to feed on zooplankton, returning to littoral zone habitats at night to rest or feed on insects. In rivers, they are found in low velocity, marginal, and backwater habitats (Smith 1985; Jenkins and Burkhead 1993).

The species is often fairly abundant where it occurs due to high reproductive and growth rates, represents an important forage fish for black bass and other piscivorous species, and can live as long as 11 years (Smith 1985). Average bluegill RC from all Monongahela River surveys is 3.14% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 3.9% (Table E.4.1.3-1). Bluegill provide recreational and economic value to the region, having the highest RC of *Lepomis* species in the Braddock Pool. Similar *Lepomis* species found in the Project vicinity, but at much lower RCs, include green sunfish, pumpkinseed, and redear sunfish.

Brook Silverside (Labidesthes sicculus)

Brook silversides are found from the St. Lawrence River to the Great Lakes, and south to Texas and the Florida gulf coast. Brook silversides are a distinctively slender and transparent fish with fine scales and elongate “beak-like” jaws. This species can reach up to about 4 inches in length (Smith 1985). Average brook silverside RC from all Monongahela River surveys is 0.26% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 0.03% (Table E.4.1.3-1).

Brook silversides are an important forage fish for several game species, and are a pollution-intolerant species (Thomas et al. 2005).

Brook silversides are most commonly seen in vegetated areas of streams and lakes, and are vulnerable in turbid water. Spawning occurs from May to August, and has been documented in Michigan within shallow areas with current over gravel substrates. Males chase females until spawning occurs near the surface. Fertilized eggs sink to the bottom and are attached to an excreted filament that adheres to the substrate. This species develops rapidly and spawns during the first summer, and dies before their second winter. Young brook silversides have been observed in open water, while adults prefer shallow areas in the mid-water column or surface, and are most active during the day (Smith 1985; Jenkins and Burkhead 1993).

Channel Catfish (Ictalurus punctatus)

Channel catfish support recreational and commercial fisheries throughout their range. This species was originally found throughout the central part of the United States from Florida to Canada and along the western slopes of the Appalachians to Montana. The species has since been introduced east of the Appalachians and westward to California (Smith 1985). Channel catfish can range in color from a blue gray when young to darker shades as they mature. Average channel catfish RC from all Monongahela River surveys is 1.21% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 2.28% (Table E.4.1.3-1).

Channel catfish have been found to make extensive migrations up freshwater rivers and streams in the spring and downstream migrations in the fall (Ross et al. 2001). Whether these are related to spawning events is unknown. Adult channel catfish typically associate with deep pools in rivers, while juveniles often inhabit shallow, moderately flowing pools and riffles (Smith 1985; Jenkins and Burkhead 1993). They most always have randomly scattered spots on the sides of the body, a moderately forked tail, and a rounded outer margin of the anal fin (Smith 1985).

Spawning may occur during spring and summer months, typically in dark, secluded cavities/holes in banks, rubble/boulder piles, rocky ledges, logs/woody debris, and even rip rap. Both the male and female will construct the “cavity” nest but usually only the male provides parental care of eggs and larvae (Smith 1985; Jenkins and Burkhead 1993). Channel catfish live in large streams, lakes, or rivers with sandy or rocky bottoms. They are not normally associated with heavily vegetated areas and they feed at night on all types of aquatic organisms (Smith 1985).

After hatching, yolk-sac fry remain in the nest for up to 7 days, after which they become free-swimming and form schools often herded by the male (7 to 8 days). These fry associate with aquatic vegetation, woody debris, rock crevices, and other underwater structures for cover. Juveniles typically stay within littoral zones to moderately deeper pelagic areas in association with submerged structure. Ross et al. (2001) reported that young channel catfish aggregate along the bottom during the day during their first 4 to 10 months, often dispersing at night to feed. Channel catfish feed along or near the bottom by taste and smell, ingesting a variety of items including organic detritus, insects, zooplankton, fish, mollusks, and algae. Larval catfish may feed on midge larvae, pupae, and zooplankton in the water column (Ross et al. 2001).

Channel Darter (Percina copelandi)

Channel darters are distributed widely, but in several disconnected populations within the Great Lakes, St. Lawrence, Ohio, and Mississippi river basins. Typical of other darters found near the Project, the channel darter is a small (35 to 50 mm) bottom-dwelling fish, with a long and slender body and a moderate to blunt snout. This species prefers warm and low to moderate gradient rivers, and associates with riffles and runs with gravel and other medium sized substrates. Spawning occurs in April and May in currents between small rocks, or in gravel behind large rocks between 20°C and 21°C (Smith 1985).

Average channel darter RC from all Monongahela River surveys is 0.44% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 0.02% (Table E.4.1.3-1). Channel darters are rare in the region and pollution intolerant (Thomas et al. 2005). They were delisted from threatened species status by the state of Pennsylvania in 2010 (Ohio Department of Natural Resources [ODNR] 2012).

Emerald Shiner (Notropis atherinoides)

The emerald shiner is a very common minnow, belonging to the *Notropis* genera in the Cyprinidae family. Emerald shiners have one of the largest distributions for minnows, occurring throughout the Mississippi River basin and up into Canada. The emerald shiner's body is elongate and compressed with a pointed snout and an eye diameter that exceeds snout length. It has a large, terminal mouth that lacks a corner barbel and a dorsal fin origin that is posterior to the pelvic fin insertion (Smith 1985). Silvery in color, the emerald shiner possesses an iridescent, blue-green mid-lateral stripe that is diffuse anteriorly. They often constitute the primary forage fish base for certain systems (Smith 1985; Jenkins and Burkhead 1993), including for important game species within the Monongahela River, such as smallmouth bass (PFBC 2010). Average emerald shiner RC from all Monongahela River surveys is 29.62% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 4.92% (Table E.4.1.3-1). Emerald shiner is highly abundant in the Monongahela River and Braddock Pool, and important as forage for game species.

Emerald shiners primarily feed in the mid to upper water column where they select for zooplankton and drifting terrestrial and aquatic insects (Smith 1985; Jenkins and Burkhead 1993). Some benthic foraging likely occurs as well. This species forms large schools and is tolerant of low DO, but becomes susceptible to disease and mortality at high water temperatures. Emerald shiners are broadcast spawners, which occurs at night in late spring to summer months. Large aggregations of emerald shiners form just under the water surface in shallow habitats over sand and hard mud to spawn (Smith 1985; Jenkins and Burkhead 1993). Fertilized, non-adhesive eggs sink to the bottom and hatch in 2 to 3 days, where fry will remain for several days before swimming to the surface and forming schools. Larvae feed on smaller zooplankton. Emerald shiners grow rapidly and may live up to 5 years. Typical adult size is about 3 inches (Smith 1985; Jenkins and Burkhead 1993).

Flathead Catfish (Pylodictis olivaris)

The native flathead catfish belongs to a monotypic genus, *Pylodictis*, within the Ictaluridae family. Important recreational and commercial fisheries exist for the species throughout most of its range. Flatheads are dorso-ventrally compressed with a large, flat head (hence the name), projecting lower jaw, slightly rounded caudal fin, large adipose fin, and brownish-yellow mottled body (Smith 1985; Jenkins and Burkhead 1993; Ross et al. 2001). Average flathead catfish RC from all Monongahela River surveys is 0.21% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 0.08% (Table E.4.1.3-1). Flathead catfish are a recreationally and economically important game species in the region.

Spawning begins in spring and lasts into the summer months. Flathead catfish will often construct nests on cleared areas near substantial cover, but not necessarily in a cavity (Lee and Terrell 1987). They have also been found to use riprap for spawning, as noted in Daugherty and Sutton (2005). Some large female flathead catfish may lay as many as 100,000 eggs (mass) in one nest (Jenkins and Burkhead 1993). After spawning, males typically chase females from the nest, which they will then relentlessly defend even after the eggs hatch. Like many other fish species, males will aerate the nest with their fins, often turning the egg mass several times a day (Boschung and Mayden 2004). Juvenile flatheads may associate with cover in shallow, swift riffles, but are more widely distributed and more common in deeper habitats as they mature (Ross et al. 2001; Jenkins and Burkhead 1993). Adult flatheads are usually solitary and almost always associate with deeper habitats. Distinct home ranges and varying movement patterns have been identified for flatheads, which often increase with increasing river flow. Flatheads may reach lengths greater than 3 feet and live as long as 20 years (Ross et al. 2001; Jenkins and Burkhead 1993).

Young flathead catfish begin feeding on insect larvae, switching to fish, crayfish, and mollusks as they develop (Boschung and Mayden 2004; Jenkins and Burkhead 1993). Adult flatheads are large, voracious predators that have been attributed to declines in other catfish species (e.g., bullheads, madtoms) where they are introduced. Feeding activity is greatest at night and in the morning, but may continue throughout the day. Seasonally, feeding may stop during the winter and peak in the spring and summer months (Ross et al. 2001; Jenkins and Burkhead 1993).

Freshwater Drum (Aplodinotus grunniens)

Freshwater drum belong to the Sciaenidae family, or drum family. The family is represented by 245 species worldwide in primarily marine and brackish water habitats (Jenkins and Burkhead

1993). Only a few of these reside in freshwater ecosystems, and the freshwater drum is the only representative of the group in the region, and the only member of this group that resides in freshwater for its entire life (Smith 1985; Jenkins and Burkhead 1993). It is a well sought-after game fish in the Monongahela River and throughout its wide range, which includes the gulf coast and north to Montana, and east to the Hudson Bay and St. Lawrence River drainage (Smith 1985). Freshwater drum are an abundant species that is important to the region recreationally and economically as a game species. Average freshwater drum RC from all Monongahela River surveys is 2.35% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 7.54% (Table E.4.1.3-1).

Freshwater drum possess a steep and somewhat bulging nape, short head, subterminal mouth, long dorsal fin, and a deep, silvery body (Smith 1985). They also attain relatively large sizes (up to at least 50 pounds). The species is very vocal, where muscles are used to vibrate the swim bladder to "croak" or "grunt" primarily during the spawning season. They can be found in a variety of habitats within river systems, from slow-moving deep pools to relatively swift sections (Smith 1985; Ross et al. 2001).

Spawning begins in late spring and early summer months in open water habitats of a given river channel. The resonant "drumming" sound produced by the fish may initiate congregation of individuals at spawning sites where fertilized eggs and newly hatched larvae will float near the surface (Smith 1985; Jenkins and Burkhead 1993). These planktonic early life stages are rare for most freshwater fish species, which tend to release demersal and/or adhesive eggs that remain at the spawning site. Muth and Schmulbach (1984) found freshwater drum larvae to be a primary component of the larval drift in a South Dakota river from June through July. Predation of larvae is likely high; however, female freshwater drum are extremely fecund and may produce an average of 132,000 eggs per kilogram of body weight (Boschung and Mayden 2004). Larvae drift for about 2 weeks until they begin to actively swim, and typically reside in the benthos during the juvenile stage and for most of their adult life. Freshwater drum begin feeding on zooplankton and insect larvae during early life stages and shift to mollusks and fish as adults. Snails, mussels, and young fish have often been found to dominate diet compositions. Freshwater drum may live as long as 17 years (Smith 1985; Jenkins and Burkhead 1993).

Ghost Shiner (Notropis buchanani)

The ghost shiner is listed as an endangered species by the state of Pennsylvania (Pa. Code §75). This member of the *Notropis* genera has a pale coloration, relatively deep bodied, with large eyes and small oblique mouth. Ghost shiners are small minnows, and adults are most commonly 1.5 to 2 inches longs. Females are typically larger than males. This species is distributed within the Missouri and Mississippi River drainages and within Prairie streams in the southwest to the Salt and Fabius rivers in the northeast (Pflieger 1997). Average ghost shiner RC from all Monongahela River surveys is 2.99% (Table E.4.1.2-5). Ghost shiners have not been found in the Braddock Pool surveys (Table E.4.1.3-1).

The ghost shiner prefers backwaters and large pools protected from swift currents within low-gradient sections of large moderately clear water streams. This species is commonly found in mid-water column schools associated with other shiners, commonly mimic shiners. Ghost shiners also likely have similar feeding habitats of mimic shiners, whose diets consist of insects and other small invertebrates. Spawning takes place in spring and early summer in slow riffles with sand or fine gravel substrates. Ghost shiners reach sexual maturity by their second summer, and their life span does not exceed 3 years (Pflieger 1997).

Gizzard Shad (Dorosoma cepedianum)

The gizzard shad is a member of the herring family (Clupeidae) and is considered an important forage fish throughout its range in all life stages, especially for valued game species. This range includes throughout the Mississippi River basin, Atlantic Slope, and further west into the Gulf of Mexico drainages of Texas and Mexico. They are also highly sought after as bait by catfish anglers. Gizzard shad are silvery blue-green in color with a round, black humeral spot, elongate last dorsal fin ray that does not reach near the caudal fin base, yellow iris, and short subterminal mouth (Boschung and Mayden 2004). They rarely exceed 1.5 feet in length and 5 pounds in weight. Gizzard shad, along with other herring species resemble members of the Hiodontidae, or mooneye family, but lack a distinct lateral line, teeth on the tongue, and short last dorsal fin ray. Gizzard shad are often very abundant where they occur (Smith 1985; Boschung and Mayden 2004). Average gizzard shad RC from all Monongahela River surveys is 13.49% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 1.43% (Table E.4.1.3-1).

Gizzard shad spawn in the early spring to summer months at night. They may often ascend smaller tributaries where schools of males and females will congregate near the surface to splash and roll while emitting eggs and sperm (Boschung and Mayden 2004; Ross et al. 2001). Fertilized eggs sink to the bottom where they attach to the substrate and hatch in 2 to 5 days. Newly hatched fry initially form schools in shallow littoral zone areas, and often make up a majority of the ichthyoplankton from June to July in the Mississippi River (Ross et al. 2001). Juvenile shad often remain in shallow littoral zone areas and move into more mid-channel or lentic habitats as they mature. Larvae are carnivorous predators, feeding on zooplankton and insect larvae, while juveniles and adults are planktivorous. They have also been found to feed abundantly on organic detritus (Ross et al. 2001).

Rapid growth rates of gizzard shad and their planktivorous diets have led to discussions about their use of stocked forage in certain systems. Abundant gizzard shad populations have been shown to shift plankton dynamics and reduce game fish abundance in certain closed/reservoir systems (Bonds 2000; Ross et al. 2001). Large shad cannot be preyed upon effectively by most game fish like largemouth bass, and therefore population levels can be difficult to manage.

Logperch (Percina caprods)

The logperch is found within the Mississippi River drainage and east to the Great Lakes and Lake Champlain (Smith 1985). This species is a distinctively shaped and colored member of the darter genera (i.e., Percina). Logperch have elongated bodies, small scales, and a snout overhanging the mouth. Common lengths reach 6 inches, which is large for a darter species (Smith 1985). Logperch are found in relatively high abundance among darter species in this region, and are considered pollution intolerant (Thomas et al. 2005). Average logperch RC from all Monongahela River surveys is 1.3% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 3.78% (Table E.4.1.3-1).

Logperch prefer slow water areas within streams and lakes. Spawning habitats of logperch vary. They have been observed spawning in swift stream outlets of lakes and over slow water sand shoals. In lacustral habitats, males move into spawning grounds in early summer, schooling in shallow water, followed by individual females entering the schools to spawn during daylight over fine substrates. In riverine habitats, males congregate in swift currents over boulders and gravel, while females move into the group to pair with a male to spawn in nearby gravel beds. Logperch feed on insects and entomostracans, and have been documented up to approximately 5 inches long at 4 years old (Smith 1985).

Mimic Shiner (Notropis volucellus)

This shiner is often confused with other shiners, mostly with sand and bigmouth shiners, but is most easily identified by their seven anal rays. Like many shiners, this species has a silvery color, elongated body, and a snout overhanging mouth. This species reached up to 3 inches in length. The species is widely distributed in central North America to the St. Lawrence and Red rivers, and to the Gulf Coast (Smith 1985). Mimic shiners are an important forage fish for game species, and considered a pollution-intolerant species (Thomas et al. 2005). Average mimic shiner RC from all Monongahela River surveys is 7.69% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 5.92% (Table E.4.1.3-1).

Mimic shiners inhabit lakes and protected slow waters within rivers, associated with vegetative cover. Studies in Indiana found that spawning takes place in summer months, and likely at night in moderately deep water, and in aquatic vegetation. Spawning adults are between 1 and 3 years old, and feed mostly on insects, insect larvae, algae, and entomostracans (Smith 1985).

Mooneye (Hiodon tergisus)

Mooneye are native to the Monongahela River watershed, and exhibit a wide distribution range including the Mississippi River, the Great Lakes, and St. Lawrence River drainages (Smith 1985). The mooneye is one of two species from the family Hiodontidae that occurs in North America, the other being goldeneye. Mooneye are mostly found in large rivers and lakes where clear water is available. Their range and population has been reduced by siltation of preferred habitat. Mooneye are generally surface feeders and stomach analysis has included both aquatic and terrestrial macroinvertebrates and small fish (Smith 1985).

Mooneye have been caught and aged over 7 years and have reached lengths of 13 to 17.5 inches. Although information is limited, spawning is believed to occur in April through June and is thought to be dependent on water temperatures. The female is capable of laying between 10,000 and 20,000 eggs in a gelatinous mass (Smith 1985; Pflieger 1997).

Average mooneye RC from all Monongahela River surveys is 0.04% (Table E.4.1.2-5). No mooneyes have been collected in recent Braddock Pool surveys (Table E.4.1.3-1). Mooneye are a rare species to the region and considered as pollution intolerant (Thomas et al. 2005). This species was delisted from threatened species status by the state of Pennsylvania in 2010 (ODNR 2012).

Paddlefish (Polydon spathula)

The paddlefish is a member of an ancient order (Acipenseriformes) and family (Polyodontidae) of fishes. The only other living polyodontid is the Chinese swordfish (*Psephurus gladius*), which occurs in the Yangtze River basin in China (Smith 1985). Paddlefish have historically been and continue to be harvested both commercially and recreationally throughout their native range in the Mississippi River drainage. Over-exploitation, poor water quality, and river alterations/obstructions have chiefly been the causes of their decline in the last 100 years, leading to the consideration of the species as rare throughout its range (Smith 1985; Ross et al. 2001; Boschung and Mayden 2004).

Paddlefish retain a unique physique that includes a large rostrum or paddle-like snout that, according to one theory, aids in drag reduction while feeding (Boschung and Mayden 2004). Paddlefish are planktivorous, and feed by swimming with their mouth agape to strain plankton (primarily crustacean zooplankton) out of the water. Having their large mouth open for extended periods of time is thought to create excessive drag on the fish's ability to swim and successfully feed. It is possible that over time, this selective pressure led to an adaptation to reduce drag by extending the snout into a large, paddle-like shape that is evident today; however, other theories exist on the paddle's use. Along with the unique snout, paddlefish possess other unique characteristics for freshwater fish, including a heterocercal tail, robust body, long and pointed opercula, and very few small ganoid scales (Smith 1985; Boschung and Mayden 2004).

Coloration ranges from pale blue to a slate gray with whitish sides and belly. Paddlefish can also grow fairly large, with reported weights up to 140 pounds (Boschung and Mayden 2004).

Paddlefish are highly migratory species. Henley et al. (2001) tracked paddlefish movement through five locks and dams (both upstream and downstream) on the Ohio River, representing a total distance of 290 river miles. Paddlefish typically display upstream spawning movements to swift, rocky riffle habitats from late winter into spring (Jenkins and Burkhead 1993). These movements are triggered simultaneously by a rise in water temperature and water flow. Spawning occurs at night, when eggs and sperm are likely broadcasted over the spawning substrate during a series of splashing and rolling behaviors (Boschung and Mayden 2004). Fertilized eggs sink to the bottom and are adhesive, sticking to the first substrate particles they encounter. Substrate must be free of silt for successful hatching, as no parental care is provided during the egg incubation period or fry stage. Larvae hatch in about one week and live off their yolk-sac for a few days thereafter in downstream, backwater water habitats. They actively feed on zooplankton and insect larvae just after yolk-sac absorption and quickly become planktivorous when they reach greater than 3 inches in length. Paddlefish are long-lived, with reported ages as old as 30 years (Smith 1985; Jenkins and Burkhead 1993; Boschung and Mayden 2004).

Paddlefish were extirpated from Pennsylvania; however, a few juvenile paddlefish have been sampled at the Maxwell Locks and Dam in recent years, which is about 50 miles upstream of Braddock Locks and Dam. One juvenile paddlefish was sampled in the Project area in 2003, while another was sampled in 2009. Both individuals were the only paddlefish sampled on record in the state in recent years, and are were determined as the result of stocking efforts upstream in West Virginia (PFBC 2003, 2009).

Average paddlefish RC from all Monongahela River surveys is <0.01% (Table E.4.1.2-5), and no paddlefish have been observed at the proposed Project. Paddlefish are not currently protected by the Endangered Species Act (ESA), although several states have listed it a threatened or species of concern (not including Pennsylvania), and it is considered a pollution-intolerant species by ORSANCO (Thomas et al. 2004). This species is currently being stocked in the upper Monongahela River in West Virginia for reintroduction/restoration purposes.

River Shiner (Notropis blennius)

The river shiner is listed as a Pennsylvania endangered species (Pa. Code §75). These fish are a common minnow in large rivers (ODNR 2012). River shiners are typically 3 to 4 inches, and can reach up to 5 inches in length (ODNR 2012). They have a silver side, dark back, and a distinct stripe down the center of the back that surrounds dorsal fin base. River shiners have transparent fins, a relatively large terminal mouth, and small eyes. They prey on various aquatic invertebrates and terrestrial insects on the water surface. River shiners prefer habitats in large rivers over sand and gravel bars where they spawn throughout the summer months (ODNR 2012).

This species has not recently been documented in the Braddock Pool, but records of two specimens collected via electrofishing are available in the ORSANCO database; one downstream of the Project in Emsworth pool in 2007, and the other in the Braddock Pool in 1977 (ORSANCO 2009).

River Darter (Percina shumardi)

The species has historically been found in some of the larger Lake Erie tributaries, the Ohio River, and in other larger tributaries like the Scioto, Hocking, and Muskingum rivers; however, recent records of this species in the Lake Erie drainage do not exist (ODNR 2012). The river darter inhabits large, swift rivers with gravel or rock substrates, and in depths of 3 feet or more (ODNR 2012).

This species is typically 2 to 3 inches long, and can reach 4 inches in length, feeding on similar prey as other darters, including snails, crustaceans, and other aquatic invertebrates (ODNR 2012). River darters are dark brown with a light cream-colored belly, with 10 to 15 dark vertical bars on their side that fuse together near the caudal fin, and six to 12 dark blotches along the center their backs. The river darter also has a pronounced tear drop under the eye, and speckles on their fins and along their backs. Males and females are similarly colored but males do have an elongated anal fin. River darters are known to spawn in April or May, when they lay eggs in swift currents at depths between 1 and 3 feet, burying them in gravel. The species provides no parental care for eggs or young (ODNR 2012). River darter has not reported in any of the collections obtained for this report; however, this species has been added through consultation with PFBC, which indicated that this species may be present in the Project vicinity (PFBC 2012a).

Rock Bass (Ambloplites rupestris)

Rock bass are mostly found in rivers and lakes where abundant rocky substrate exists. They prefer moderate to fast currents, but do well along gravelly and rocky shores in lakes and reservoirs. Average rock bass RC from all Monongahela River surveys is 2.69% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 10.68% (Table E.4.1.3-1). Rock bass are an economically and recreationally important game species in the Monongahela River, and are relatively abundant in the Braddock Pool.

Young rock bass are usually abundant in aquatic vegetation where the species is present. Rock bass are also opportunistic feeders and generally feed during daylight hours on aquatic invertebrates, crustaceans, and small fish but have been observed feeding during darkness as well (Smith 1985; Jenkins and Burkhead 1993).

Rock bass may reach sexual maturity within 1 year. Spawning usually occurs in late spring/early summer between mid-May and mid-June when water temperatures reach 60°F to 70°F. Spawning occurs in shallow water over any substrate, although silt-free substrate is preferred. Males build and maintain a nest that is plate-like in size using their pectoral fins, unlike the largemouth and smallmouth bass, which use caudal fins. Multiple females may visit a rock bass nest. Eggs hatch between 3 and 5 days, depending on the water temperature (Smith 1985; Jenkins and Burkhead 1993).

Silver Chub (Macrhybopsis storeriana)

Silver chub are large minnow species found in large rivers and tributaries throughout the Missouri and Mississippi River drainages (Jenkins and Burkhead 1993). This species is typically 4 to 7 inches long, but can reach up to 9 inches in length, and has a typical silver minnow body type and a small barbel at each corner of the mouth. Silver chub feed on mayfly larvae and other macroinvertebrates, and are common over sand and gravel substrates and various depths of up to 60 feet. Little is known about this species' spawning habitats, but spawning has been observed during June and July in the Ohio River drainage, where eggs are scattered along the bottom and drift until hatching. Silver chubs are an important forage species for many species, particularly walleye and sauger (ODNR 2012).

Average silver chub RC from all Monongahela River surveys is 0.3% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is <0.01% (Table E.4.1.3-1). This species was delisted from endangered species status by the state of Pennsylvania in 2010 (ODNR 2012).

Skipjack Herring (Alosa chrysochloris)

Skipjack herring are members of the Clupeidae family and are considered important forage, bait, and sport fish in some areas. Recent declines in skipjack herring abundance have primarily been attributed to river obstructions and increased silt loads (Boschung and Mayden 2004; Ross et al. 2001). The species has been found to be an important glochidial host for the ebonyshell mussel (*Fusconaia ebena*), which has also declined throughout its range. The ebonyshell has not been reported in the Monongahela River, but occurs in the Ohio River system outside of Pennsylvania. The slender-bodied skipjack herring is silvery-blue in color, lacks a humeral spot and elongate last dorsal fin ray like the other Alosa species, and possesses a large terminal mouth with projecting lower jaw (Ross et al. 2001). Although it has occasionally been found in salt water and can be highly migratory, skipjacks are not considered diadromous. They are often collected in deep, swift sections of rivers and do not tolerate areas with high turbidity.

Spawning likely takes place in the spring and summer months over gravel and sand bars in the main river channel (Boschung and Mayden 2004). Little is known about much of the species' life history, but it is thought that the fish do not congregate during spawning. Zooplankton and insect larvae make up the majority of younger fish diets, while adults are strictly piscivorous, feeding on minnows, shad, silversides, and mullets (Boschung and Mayden 2004). Skipjack herring may grow up to 20 inches in length and weigh as much as 4 pounds. Life expectancy is likely similar to other alosids (5 to 8 years).

Average skipjack herring RC from all Monongahela River surveys is 0.04% (Table E.4.1.2-5). No skipjack herring have been collected in recent surveys of the Braddock pool (Table E.4.1.3-1). This species was delisted from threatened species status by the state of Pennsylvania in 2010 (ODNR 2012).

Smallmouth Bass (Micropterus dolomieu)

Smallmouth bass are similar in appearance to largemouth bass, but is differentiated by their smaller mouth and browner coloration with dark vertical lines. Other distinctive characteristics include the jaw ending below the middle of the eye, and juveniles with orange and black bands on the base of their tails. This species is common in the north-central United States and southern Canada from Minnesota and Dakotas to the St. Lawrence River drainage, and south to the Mississippi Valley, the Ozarks, and northern Alabama (Smith 1985).

Smallmouth bass can be found in almost all manner of aquatic habitat but are most abundant in cool, large rivers and lakes. They prefer slow to moderate current and select areas of rocky shorelines. Like the yellow perch, smallmouth bass are opportunistic feeders and generally feed during daylight hours on aquatic invertebrates, crustaceans, and small fish (Smith 1985).

Smallmouth bass are sexually mature between the age of 3 to 6 years. Spawning usually occurs in late spring/early summer when water temperatures reach 62°F to 65°F. Spawning occurs in 2 to 20 feet of water but average spawning depth is approximately 3 feet. Males build and maintain a nest in gravelly substrate until the fry emerge and disperse. Multiple females may visit a nest over a 30- to 36-hour period. Eggs hatch between 7 and 21 days, depending on the water temperature (Smith 1985).

Average smallmouth bass RC from all Monongahela River surveys is 8.52% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 29.14% (Table E.4.1.3-1). Smallmouth bass are an economical and recreational important game species, as well as a pollution-intolerant species (Thomas et al. 2005).

Smallmouth Redhorse (Moxostoma breviceps)

The smallmouth redhorse is only found in the Ohio River and its tributaries. It is a relatively rare species to the region and is considered a pollution-intolerant species (Thomas et al. 2005). Average smallmouth redhorse RC from all Monongahela River surveys is 1.68% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 1.53% (Table E.4.1.3-1).

Smallmouth redhorse have a small head and a relatively long slender body. They have a deeply concave (curves in toward body) dorsal fin and a bright red tail. Their body is gold to silver on the sides with a darker olive-brown back. They differ from the very similar shorthead redhorse in having a shorter and more deeply concave dorsal fin. Adults are typically 12 to 16 inches long, but can reach 20 inches in length (ODNR 2012).

Smallmouth redhorse prefer relatively swift currents in shallow waters, and are common in areas with clean sand or gravel substrates that are absent of finer clay or silt substrates. Smallmouth redhorse migrate into smaller streams and spawn at night at the top and bottom ends of shallow riffles in April and May. Two males will press a single female between them to release eggs and sperm that get buried in fine gravel by their tails (ODNR 2012).

Spotted Bass (Micropterus punctulatus)

Spotted bass are very similar to largemouth bass, and a recreationally valuable game species to the region. Differences include the spotted bass having a dark spot on the gill cover and spots and/or streaks along the ventral portion of the body. Additionally, spotted bass have a roughened mid-tongue patch that the largemouth bass does not, as well as a somewhat well-connected first and second dorsal fin. Spotted bass are distributed throughout the Ohio River basin as well as the central and lower Mississippi River basin. The species may be found in Gulf Coast states from Texas east to Florida. Spotted bass are native to portions of East Texas from the Guadalupe River to the Red River, exclusive of the Edwards Plateau region. Average spotted bass RC from all Monongahela River surveys is 1.0% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 0.94% (Table E.4.1.3-1).

Spawning generally occurs from mid-April to mid-June and like the largemouth bass, the male constructs a nest near cover over a gravelly to rocky substrate, and protects the young for a short period after hatching. The female can lay between 1,000 and 47,000 eggs and will generally spawn at water temperatures of 57-74°F. Spotted bass are opportunistic feeders with a large portion of their diet consisting of insects, crayfish, and small fishes. Spotted bass usually grow to approximately 1 pound; however they can grow larger under optimal conditions.

The natural habitat of spotted bass is clear, gravelly, flowing pools and runs of creeks and small to medium rivers; and they also tolerate the slower, warmer, and more turbid sections that are unlikely to host smallmouth bass. They are seldom found in natural lakes but have adapted well to deep impoundments, which were created by damming some of their natural rivers and streams. In reservoirs they prefer water temperatures in the mid-70°F temperatures and are especially suited to deep, clear impoundments. Typical habitat is similar to that of the largemouth bass although the spotted bass prefers rocky areas and is much more likely to inhabit and suspend in open waters; it may hold in deep depths (between 60 and more than 100 feet) in some waters. Rocky bluffs, deep rockpiles, and submerged humps are among its preferred habitats. Like largemouth bass, they likely occupy a variety of habitats in the Monongahela River, from shallow littoral zones to deep water areas.

Walleye (Sander vitreus)

Walleye usually occur in large rivers and lakes and prefer a bottom of loose aggregates. They are generally found in deeper waters during the day and tend to move into shallower areas during heavy cloud cover and at night for feeding. Walleye are an economically and recreationally important game species in the Monongahela River. They can be sensitive to low pH levels (Carlson 1992). Walleye are opportunistic predators, eating crustaceans and aquatic invertebrates as juveniles and then fish and other larger vertebrates and invertebrates as they mature (Smith 1985). Average walleye RC from all Monongahela River surveys is 0.59% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 0.07% (Table E.4.1.3-1).

Male walleye mature at age 2 to 3, while females mature at age 4 to 5. They spawn in the spring following ice-out when water temperatures reach 35°F to 44°F. Walleye are known to spawn over substrates ranging in size from sand to boulders, but preferably select cobble to rock-size substrate in water generally 2 to 4 feet deep. Walleye are not nest builders; instead, they broadcast their eggs along the substrate. Eggs hatch between 7 and 26 days, depending on the water temperature. Generally, less than 20% of the eggs survive to hatching, and more commonly only 5% survive under natural conditions. While males tend to remain in the area following spawning, no parental care is undertaken (Smith 1985; Jenkins and Burkhead 1993).

White Bass (Morone chrysops)

White bass are native to the central United States west of the Appalachians, including the Great Lakes, as well as river systems in the Ohio and Mississippi River valleys. As with other true basses, the dorsal fin is clearly double, separated into spiny and soft-rayed portions. White bass are silvery shading from dark-gray or black on the back to white on the belly. Several incomplete lines or stripes run horizontally on each side of the body. Adults resemble young striped bass, and the two are often confused. However, striped bass have two distinct tooth patches on the back of the tongue, and white bass have one tooth patch (Smith 1985; Jenkins and Burkhead 1993).

White bass are active early spring spawners. Schools of males migrate upstream to spawning areas as much as a month before females. There is no nest preparation. Spawning occurs either near the surface, or in midwater. Running water with a gravel or rock substrate is preferred. Females rise to the surface and several males crowd around as the eggs and sperm are released. Large females sometimes release nearly a million small eggs during the spawning season. After release, eggs sink to the bottom and become attached to rocks, hatching in 2 to 3 days. Fry grow rapidly, feeding on small invertebrates. White bass may grow 8 or 9 inches during the first year. Adults are usually found in schools. Feeding occurs near the surface where fish, crustaceans, and emerging insects are found in abundance. Gizzard and threadfin shad are the preferred food items. White bass more than 4 years of age are rare (Smith 1985; Jenkins and Burkhead 1993). Average white bass RC from all Monongahela River surveys is 0.96% (Table E.4.1.2-5). Average RC from the Braddock Pool surveys is 2.81% (Table E.4.1.3-1).

White Crappie (Pomoxis annularis)

The native range of white crappie included the area west of the Appalachian Mountains north to southern Ontario and south to the Gulf of Mexico. The white crappie is deep-bodied and silvery in color, ranging from silvery-white on the belly to a silvery-green or even dark green on the back. There are several vertical bars on the sides. The dorsal fin has a maximum of six spines. Males may develop dark coloration in the throat region during the spring spawning season (Jenkins and Burkhead 1993; Smith 1985). White crappie are a very popular game species in the region but their numbers are low in the Monongahela River. Average white crappie RC from all Monongahela River surveys is 0.03% (Table E.4.1.2-5). No white crappie have been collected in recent Braddock pool surveys (Table E.4.1.3-1).

Like bluegill and other sunfish species, crappie construct nests in shallow littoral zones with sand, gravel, clay, and/or mud substrates for spawning in the early spring to late summer (Boschung and Mayden 2004; Jenkins and Burkhead 1993). Nests are constructed in colonies, with a few feet typically separating one nest from another and almost always in proximity to cover (e.g., vegetation and undercut banks). Males guard the eggs and newly hatched fry. After yolk-sac absorption, crappie fry leave the nest for limnetic habitats to feed on zooplankton during dawn and dusk hours (Boschung and Mayden 2004). They may remain in these open water habitats for up to 8 weeks or until they are about 1 inch in length and then return to the littoral zone. Crappie are opportunistic when feeding, primarily ingesting insects when young and fishes (e.g., minnows and sunfish) as adults. They typically occur in mid-water column habitats in slower sections of rivers (e.g., backwater/oxbow), and associate with vegetative cover in littoral zones. Crappie can reach weights of 4 pounds or more in reservoirs and live up to 10 years (Jenkins and Burkhead 1993; Smith 1985).

E.4.1.4 Project Effects

The proposed Project consists of the installation of five bulb turbines within the spillway of an existing Braddock Locks and Dam operated by the USACE. The draft tubes are fully integrated inside the existing weir. As no permanent in-water structures separate from the existing structures are proposed, Hydro Friends Fund anticipates minimal Project-related effects to fish and aquatic resources. The primary effects discussed below include the effect of turbine impingement, entrainment, and survival of fish that encounter these new turbines. Potential effects related to habitat alterations are also discussed.

Turbine Impingement, Entrainment, and Survival Effects

Consistent with industry practice, Hydro Friends Fund has conducted a desktop analysis of fish impingement, entrainment, and survival at the proposed Project to evaluate potential effects on the fish community (Appendix E-2). Operation of hydroelectric projects can result in the sporadic/episodic impingement and entrainment of fish. Impingement refers to the potential for fish to become trapped against the intake racks due to velocity conditions at the intake. Entrainment at hydroelectric projects refers to the passage of fish (or other aquatic organisms) into the powerhouse intakes and through the turbine units. Fish passing through the turbines can be subject to the risk of injury or mortality. The potential of these effects on fish at the proposed Project are discussed below.

Proposed operations will require passage of large volumes of water from the Monongahela River through hydropower bulb turbines within an LFM that will be deployed on the left (looking downstream) side of the dam, opposite the location of the existing navigational locks. This creates the potential for fish to be impinged on trashracks and/or entrained through turbines. This potential will vary spatially and temporally by species and life stage. Although the existing locks, spillway, and environmental flow gate (Gate 1) will provide other options for passage (and possible mortality), potential entrainment and survival rates of fish that occupy various habitats in the Braddock Pool during different times of the year was considered important in the evaluation of potential Project effects. This aspect of the study involved the selection of target fish species (important managed species, rare species, and migratory species, as well as non-game and forage) for such an analysis, and was created in consultation with the PFBC (PFBC 2012a).

The potential for impingement and entrainment typically increases for intake structures located on rivers, while avoidance of intakes by fish may be possible due to relatively low river flow conditions. The proposed Project is expected to create some degree of entrainment that will vary with river flow, species, season, and fish size/life stage. The majority of entrained fishes will likely be clupeids, sunfish, and young life stages of all species, including eggs, fry, juveniles, and some young adults incapable of intake avoidance or exclusion by the trashracks. Larval and juvenile fish abundances and adult fish movements typically increase in the spring and summer months. Most larval (yolk-sac) fish can only adjust their vertical position in the water column and drift with river flow (Jenkins and Burkhead 1993). Fry (no yolk-sac) and juvenile fish possess escape or burst swim speeds capable of avoidance; however, adults are more successful in avoiding intake structures, and thus make up the minority of entrained fish at a given system.

The proposed 6-inch trashrack spacing at the Project will allow most sizes of the target species to physically pass through the racks, although some larger juvenile and adult fish will likely avoid and escape intake velocities, while others may volitionally follow the attractant flow through the turbines. The majority of entrained fish will be small in size and incapable of avoidance due to swim speeds slower than the less than 2 feet/second intake velocities or dependence on flow for movement during the larval stages.

Table E.4.1.3-1 lists target species used in this impingement, entrainment, and survival analysis. The table includes species RC from various collections made in Braddock Pool, and average RC from these collections that were used to adjust entrainment and survival rate estimates specific to the Braddock Pool fish community (see Section E.4.1.2). Two of the target species are state listed species (ghost shiner and river shiner). There are no federally listed species known to occur in the proposed Project area. Target Monongahela River fish characteristics, along with the proposed hydropower facility design, current USACE operations, projected hydropower operations, and hydrology were compared to databases of findings from various field entrainment studies (Electric Power Research Institute [EPRI] 1992, 1997a, 1997b; FERC 1995a, 1995b; Franke et al. 1997) to determine entrainment and mortality potential at the proposed Project. This approach is consistent with current industry practice.

Direct correlation for each of these species to the impingement data and hydropower entrainment databases was not always possible due to lack of swim speed data and/or absence of those species in the databases. When possible, surrogate species were used to account for these deficiencies. The entrainment rates derived for the target species were related to each species' RCs to estimate total numbers of fish entrained through the proposed Project annually. It is important to note that entrainment through the turbines does not equate to mortality as most fish are known to survive passage. Therefore, a separate analysis of estimated mortality was conducted and is discussed below.

The quantitative entrainment estimates provided in this study utilized target species' empirical entrainment rate data collected at various hydroelectric projects, hydraulic data, species spawning and development periodicities, and their average RC in the Braddock Pool (Appendix E-2). Analysis of 60-year Monongahela River flow data (Appendix A-1) and proposed operating regime/flow distributions (Tennant Method) were used to calculate monthly total flow amounts (1,000 cfs-hours) based from median flows that would have gone through the proposed Project's turbines for an average (POR), dry (1954), and wet (2004) year. This enabled the prediction of future flows through the proposed Project's turbines.

Flow amounts were determined by fitting custom lines to monthly flow duration curves, and calculating the area under that curve that would have been available for generation. The custom curves are provided as Appendix A-1. The total, annual flow amount estimated to have passed through the Project on an average year (POR) was 28,427 (1,000 cfs-hours), with a range of 23,067 to 38,756 based on the dry and wet years, respectively (Table E.4.1.4-1). Monthly flow amounts were summed to determine seasonal flow amounts, which were then multiplied by the seasonal entrainment rates for each target species seen in Table E.4.1.4-2. This resulted in seasonal/annual entrainment estimates in "number of fish" estimated to be entrained (Table E.4.1.4-3 through Table E.4.1.4-5). These values represent entrainment estimates which have been multiplied by the target species' average RC in the Braddock Pool (Table E.4.1.3-1).

According to this assessment, the annual average number (rounded to the nearest hundred thousandth) of target species expected to become entrained at the proposed Project is approximately 54,800 fish per year. Based on water year, this number could range from approximately 43,700 to 78,700 fish. Entrainment densities will likely be the highest in the summer and fall months when fish are most mobile. Rock bass showed the highest entrainment estimates, followed by bluegill and gizzard shad, respectively.

Because of low or zero RC of certain species collected in the Braddock Pool, their resulting entrainment estimates were zero, even during a wet year. These results do not suggest that these species will never be entrained at the proposed Project, but instead suggest that their presence in entrainment samples would be extremely low and often absent relative to other target species with greater RC. Although entrainment numbers may appear high, these numbers do not equate to low survival, as presented in the next section. It should also be noted that entrainment avoidance (burst swim speeds or physical exclusion) of the target species, particularly that of larger juvenile and adult fish was not factored into these estimates, but should be taken into consideration when assessing entrainment potential. However, physical exclusion was factored into the survival estimates as discussed below.

Table E.4.1.4-1 Flow amounts (1,000 cfs-hours) predicted for generation based on median monthly flows for average (POR), dry, and wet years at the proposed Project .

	Month	Monthly	Seasonal
PERIOD OF RECORD (1943-2004)	December	2,416	
	January	2,506	7,584
	February	2,662	
	March	3,403	
	April	2,751	8,539
	May	2,385	
	June	2,260	
	July	2,191	6,366
	August	1,915	
	September	1,619	
	October	1,914	5,939
	November	2,406	
	Annual	**28,428**	
DRY YEAR (1954)	December	704	
	January	2,287	4,873
	February	1,882	
	March	4,225	
	April	2,563	8,718
	May	1,930	
	June	2,155	
	July	2,015	7,307
	August	3,137	
	September	1,941	
	October	192	2,168
	November	35	
	Annual	**23,066**	
WET YEAR (2004)	December	3,878	
	January	2,747	9,762
	February	3,137	
	March	3,797	
	April	3,727	10,128
	May	2,604	
	June	3,439	
	July	2,387	8,168
	August	2,342	
	September	3,016	
	October	3,991	10,699
	November	3,692	
	Annual	**38,757**	

Table E.4.1.4-2 Seasonal and annual estimated entrainment rates for target/surrogate species determined from projects in the EPRI database (1997a).

Target/Surrogate Species	Seasonal Entrainment Rates (Number of Fish/Hour/1,000 cfs of Unit Capacity)				
	Winter	Spring	Summer	Fall	Annual
Bluegill	0.22	9.06	7.58	16.39	33.25
Brook silverside	0.32	0.29	0.44	0.33	1.38
Channel catfish[1]	1.33	1.15	32.13	3.06	37.68
Channel darter[2]	0.27	3.95	0.49	0.27	4.98
Emerald shiner	0.67	2.67	2.68	3.81	9.83
Flathead catfish[1]	1.33	1.15	32.13	3.06	37.68
Freshwater drum	0.00	0.05	0.55	1.81	2.41
Ghost shiner[E, 3]	0.64	0.37	1.27	0.16	2.44
Gizzard shad[4]	19.80	9.78	27.33	27.89	84.80
Logperch	0.09	0.57	2.16	0.42	3.24
Mimic shiner	0.64	0.37	1.27	0.16	2.44
Mooneye[4]	19.80	9.78	27.33	27.89	84.80
Paddlefish[5]	0.00	0.03	0.01	0.03	0.08
River darter[2]	0.27	3.95	0.49	0.27	4.98
River shiner[E, 3]	0.64	0.37	1.27	0.16	2.44
Rock bass	3.86	5.39	3.94	11.73	24.92
Silver chub[6]	2.79	0.24	0.20	0.41	3.64
Skipjack herring[4]	19.80	9.78	27.33	27.89	84.80
Smallmouth bass	0.13	0.14	2.02	1.17	3.45
Smallmouth redhorse [7]	1.84	0.28	0.32	0.57	3.00
Spotted bass[8]	0.40	0.34	3.54	1.27	5.55
Walleye[9]	0.30	0.49	3.19	0.65	4.64
White bass[10]	0.20	1.58	0.40	0.24	2.43
White crappie[11]	1.81	1.43	6.25	4.50	13.99

[1] Combined channel and flathead catfish entrainment rates to represent both species.
[2] Combined entrainment rates of several *Etheostoma* and *Percina* (excluding logperch) species to represent channel darter and river darter.
[3] Entrainment rate of mimic shiner to represent ghost shiner and river shiner.
[4] Combined entrainment rates of several *Alosa* species and mooneye to represent mooneye, gizzard shad, and skipjack herring.
[5] Used entrainment rate of lake sturgeon to represent paddlefish.
[6] Combined entrainment rates of several chub species to represent silver chub.
[7] Combined entrainment rates of several *Moxostoma* species to represent smallmouth redhorse.
[8] Combined entrainment rates of spotted bass and largemouth bass to represent spotted bass.
[9] Combined entrainment rates of sauger and walleye to represent saugeye.
[10] Combined entrainment rates of several *Moronid* species to represent white bass.
[11] Combined entrainment rates of white and black crappie to represent white crappie.
[E] PFBC State Endangered

Table E.4.1.4-3 Seasonal and annual estimated entrainment estimates based on the POR.

Target/Surrogate Species	Seasonal Entrainment Estimates (Number of Fish)				
	Winter	Spring	Summer	Fall	Annual
Bluegill	66	3,017	1,882	3,795	8,760
Brook silverside	1	1	1	1	4
Channel catfish	231	224	4,671	415	5,541
Channel darter	0	6	1	0	7
Emerald shiner	250	1,121	838	1,114	3,323
Flathead catfish	8	8	171	15	202
Freshwater drum	0	34	265	809	1,108
Ghost shiner[E]	0	0	0	0	0
Gizzard shad	2,145	1,193	2,485	2,365	8,188
Logperch	25	225	520	95	865
Mimic shiner	288	189	478	56	1,011
Mooneye	0	0	0	0	0
Paddlefish	0	0	0	0	0
River darter	0	0	0	0	0
River shiner[E]	0	0	0	0	0
Rock bass	3,127	4,920	2,679	7,439	18,165
Silver chub	0	0	0	0	0
Skipjack herring	0	0	0	0	0
Smallmouth bass	277	344	3,749	2,021	6,391
Smallmouth redhorse	213	36	31	52	332
Spotted bass	28	27	211	70	336
Walleye	2	3	14	3	22
White bass	44	380	71	40	535
White crappie	0	0	0	0	0
Total	**6,705**	**11,728**	**18,067**	**18,290**	**54,790**

[E] PFBC State Endangered

Table E.4.1.4-4 Seasonal and annual estimated entrainment estimates based on a dry year (1954).

Target/Surrogate Species	Seasonal Entrainment Estimates (Number of Fish)				
	Winter	Spring	Summer	Fall	Annual
Bluegill	43	3,080	2,161	1,386	6,670
Brook silverside	1	1	1	0	3
Channel catfish	148	229	5,362	152	5,891
Channel darter	0	6	1	0	7
Emerald shiner	160	1,144	963	407	2,674
Flathead catfish	5	8	196	6	215
Freshwater drum	0	35	304	295	634
Ghost shiner[E]	0	0	0	0	0
Gizzard shad	1,378	1,218	2,853	864	6,313
Logperch	16	230	596	35	877
Mimic shiner	185	193	549	20	947
Mooneye	0	0	0	0	0
Paddlefish	0	0	0	0	0
River darter	0	0	0	0	0
River shiner[E]	0	0	0	0	0
Rock bass	2,009	5,023	3,076	2,716	12,824
Silver chub	0	0	0	0	0
Skipjack herring	0	0	0	0	0
Smallmouth bass	178	352	4,304	738	5,572
Smallmouth redhorse	137	37	35	19	228
Spotted bass	18	28	242	26	314
Walleye	1	3	16	1	21
White bass	28	388	81	15	512
White crappie	0	0	0	0	0
Total	**4,307**	**11,977**	**20,740**	**6,680**	**43,702**

[E] PFBC State Endangered

Table E.4.1.4-5 Seasonal and annual estimated entrainment estimates based on a wet year (2004).

Target/Surrogate Species	Seasonal Entrainment Estimates (Number of Fish)				
	Winter	Spring	Summer	Fall	Annual
Bluegill	85	3,578	2,415	6,837	12,915
Brook silverside	1	1	1	1	4
Channel catfish	297	266	5,993	748	7,304
Channel darter	0	7	1	0	8
Emerald shiner	321	1,329	1,076	2,006	4,732
Flathead catfish	11	10	219	27	267
Freshwater drum	0	40	340	1,457	1,837
Ghost shiner[E]	0	0	0	0	0
Gizzard shad	2,760	1,415	3,189	4,261	11,625
Logperch	32	267	667	171	1,137
Mimic shiner	370	224	614	101	1,309
Mooneye	0	0	0	0	0
Paddlefish	0	0	0	0	0
River darter	0	0	0	0	0
River shiner[E]	0	0	0	0	0
Rock bass	4,025	5,835	3,438	13,402	26,700
Silver chub	0	0	0	0	0
Skipjack herring	0	0	0	0	0
Smallmouth bass	357	409	4,810	3,641	9,217
Smallmouth redhorse	274	43	39	93	449
Spotted bass	37	33	271	127	468
Walleye	2	3	17	5	27
White bass	56	451	91	72	670
White crappie	0	0	0	0	0
Total	**8,628**	**13,911**	**23,181**	**32,949**	**78,669**

[*E] PFBC State Endangered

To evaluate survival rates of entrained fish, a total of 540 blade strike probability/survival estimates were calculated for the proposed Project resulting from running the equations referenced in Section 5.4.1 of Appendix E-2. The maximum length used (52 inches) represents the largest sized fish of the target species (paddlefish) that may be expected to approach the 6-inch trashrack spacing, and become susceptible to blade strike (Table E.4.1.4-6). The averages were based on the blade strike survival estimates in relation to the size ranges of fish for each species expected to be entrained. For example, the expected average survival rate of all combined length groups of gizzard shad is 94.8%. Because all size classes of gizzard shad are expected to be able to pass through the 6-inch spacing, and the maximum reported size of gizzard shad is 20 inches, the survival rate of 94.8% was calculated by averaging the individual survival rates (seen in Appendix H of the Fish Entrainment and Survival Assessment provided in Appendix E-2) for fish from 1 to 20 inches and all possible passage routes (edge of hub, mid-blade, and blade tip) or position in the plane of revolution (correlation factor 0.1, 0.15, and 0.2).

Table E.4.1.4-6 Target species average survival rates (%) for combined length classes expected to be entrained based on the minimum size excluded and blade strike survival results.

Target Species	Minimum Size (in) Excluded by a Trashrack Clear Spacing of 6 in	Maximum Size (in) Reported	Average Survival Rate (%)
Bluegill	NE*	12	96.8
Brook silverside	NE	4	98.8
Channel catfish	38.5	40	90.0
Channel darter	NE	3	99.0
Emerald shiner	NE	4	98.8
Flathead catfish	35.0	60	91.0
Freshwater drum	NE	37	90.5
Ghost shiner[E]	NE	3	99.0
Gizzard shad	NE	20	94.8
Logperch	NE	7	98.0
Mimic shiner	NE	3	99.0
Mooneye	NE	18	95.3
Paddlefish	51.7	60	86.8
River darter	NE	4	98.8
River shiner [E]	NE	5	98.5
Rock bass	NE	15	96.0
Silver chub	NE	9	97.5
Skipjack herring	NE	21	94.5
Smallmouth bass	NE	24	93.8
Smallmouth redhorse	NE	20	94.8
Spotted bass	NE	21	94.5
Walleye	NE	36	90.8
White bass	NE	17	95.5
White crappie	NE	20	94.8

* NE = not excluded, all sizes could physically pass through the trashrack based on the maximum reported sizes.
[E] PFBC State Endangered

As noted previously, entrainment does not equate to mortality. Fish survival rates through modular-bulb turbine units are also high, particularly for small fish that make up the vast majority of all entrained fish. Average blade strike survival rates were multiplied by target species seasonal entrainment estimates provided above to determine turbine mortality estimates of the target species (Table E.4.1.4-7 through Table E.4.1.4-9). According to this assessment, the annual average number (rounded to the nearest ten thousandth) of target species expected to experience turbine-related mortality at the proposed Project is approximately 2,600 fish based on the POR. Based on water year, this number could range from approximately 2,200 to 3,800 fish. This represents an annual mortality rate of approximately 5% (survival rate of 95%) based on the number of fish estimated to become entrained. Entrainment mortalities will likely be the highest in the summer and fall months when fish are most mobile. Rock bass showed the highest mortality estimates, followed by channel catfish and gizzard shad, respectively.

Table E.4.1.4-7 Seasonal and annual turbine mortality estimates based on the POR.

Target/Surrogate Species	Seasonal Mortality Estimates (Number of Fish)				
	Winter	Spring	Summer	Fall	Annual
Bluegill	2	98	61	123	284
Brook silverside	0	0	0	0	0
Channel catfish	23	22	467	41	553
Channel darter	0	0	0	0	0
Emerald shiner	3	14	10	14	41
Flathead catfish	1	1	15	1	18
Freshwater drum	0	3	25	77	105
Ghost shiner[E]	0	0	0	0	0
Gizzard shad	113	63	130	124	430
Logperch	0	4	10	2	16
Mimic shiner	3	2	5	1	11
Mooneye	0	0	0	0	0
Paddlefish	0	0	0	0	0
River darter	0	0	0	0	0
River shiner[E]	0	0	0	0	0
Rock bass	125	197	107	297	726
Silver chub	0	0	0	0	0
Skipjack herring	0	0	0	0	0
Smallmouth bass	17	22	234	126	399
Smallmouth redhorse	11	2	2	3	18
Spotted bass	2	2	12	4	20
Walleye	0	0	1	0	1
White bass	2	17	3	2	24
White crappie	0	0	0	0	0
Total	**302**	**447**	**1,082**	**815**	**2,646**

[E] PFBC State Endangered

Table E.4.1.4-8 Seasonal and annual turbine mortality estimates based on a dry year (1954).

Target/Surrogate Species	Seasonal Mortality Estimates (Number of Fish)				
	Winter	Spring	Summer	Fall	Annual
Bluegill	1	100	70	45	216
Brook silverside	0	0	0	0	0
Channel catfish	15	23	536	15	589
Channel darter	0	0	0	0	0
Emerald shiner	2	14	12	5	33
Flathead catfish	0	1	18	0	19
Freshwater drum	0	3	29	28	60
Ghost shiner[E]	0	0	0	0	0
Gizzard shad	72	64	150	45	331
Logperch	0	5	12	1	18
Mimic shiner	2	2	5	0	9
Mooneye	0	0	0	0	0
Paddlefish	0	0	0	0	0
River darter	0	0	0	0	0
River shiner[E]	0	0	0	0	0
Rock bass	80	201	123	109	513
Silver chub	0	0	0	0	0
Skipjack herring	0	0	0	0	0
Smallmouth bass	11	22	269	46	348
Smallmouth redhorse	7	2	2	1	12
Spotted bass	1	2	13	1	17
Walleye	0	0	1	0	1
White bass	1	17	4	1	23
White crappie	0	0	0	0	0
Total	**192**	**456**	**1,244**	**297**	**2,189**

[E] PFBC State Endangered

Table E.4.1.4-9 Seasonal and annual turbine mortality estimates based on a wet year (2004).

Target/Surrogate Species	Seasonal Mortality Estimates (Number of Fish)				
	Winter	Spring	Summer	Fall	Annual
Bluegill	3	116	78	222	419
Brook silverside	0	0	0	0	0
Channel catfish	30	27	599	75	731
Channel darter	0	0	0	0	0
Emerald shiner	4	17	13	25	59
Flathead catfish	1	1	20	2	24
Freshwater drum	0	4	32	138	174
Ghost shiner[E]	0	0	0	0	0
Gizzard shad	145	74	167	224	610
Logperch	1	5	13	3	22
Mimic shiner	4	2	6	1	13
Mooneye	0	0	0	0	0
Paddlefish	0	0	0	0	0
River darter	0	0	0	0	0
River shiner[E]	0	0	0	0	0
Rock bass	161	233	137	536	1,067
Silver chub	0	0	0	0	0
Skipjack herring	0	0	0	0	0
Smallmouth bass	22	26	301	227	576
Smallmouth redhorse	14	2	2	5	23
Spotted bass	2	2	15	7	26
Walleye	0	0	2	0	2
White bass	3	20	4	3	30
White crappie	0	0	0	0	0
Total	**390**	**529**	**1,389**	**1,468**	**3,776**

[E] PFBC State Endangered

In general, survival of the target species through the proposed Project is expected to be high based on this analysis (95% survival). This is further supported with empirical data from survival studies conducted at the USACE's Lock and Dam 2 in Hastings, Minnesota. A similar modular turbine unit that was tested found 99% average survival for both small and large fish after pre-installation modeling suggested 97% survival (Normandeau Associates, Inc. 2009). The units at Hastings Lock and Dam are larger (diameter of 12 feet) and slower (21 rotations per minute [rpm]) than those proposed for Braddock; however, the Braddock modular-bulb (propeller-type) turbines are still considered some of the more "fish friendly" designs available, particularly at a head of 10 feet.

Duke Energy (2008) estimated average survival for first year (2-24 inches), sub-adult (25-46 inches), and adult (47-65 inches) paddlefish at the Markland Hydroelectric Project, located in Indiana, based on blade strike probabilities by a Kaplan turbine at an operating head of 30 feet. Their findings resulted in survival estimates of 98.4%, 96.0%, and 92.7% for these three life stages, respectively. It should be noted that the average survival rate of paddlefish (86.8%) presented in Table E.4.1.4-6 was derived for all size groups (1-52 inches) not excluded by the trashracks. Using a similar subset of size groups used by Duke Energy (2008) and the Braddock blade strike results, average survival estimates of first year (2-24 inches), sub-adult (25-46 inches), and adult (47-52 inches) paddlefish would be 93.5%, 82.3%, and 75.3%, respectively. Similar to Hastings Lock and Dam, the Markland Project turbines are larger (diameter of 22.5 feet) and slower (64.3 rpm) than those proposed for Braddock, to which these comparatively lower survival rates correspond.

Habitat Alteration Effects

No new in-water structures are proposed for this Project, as the turbines will be installed within the existing spillway. Construction of the proposed Project will involve temporary placement of coffer dams in close proximity to the dam, which will result in temporary disturbance to bottom substrates at the Braddock Locks and Dam. This activity will result in temporary disturbance to river bottom substrates. Fish habitat that occurs within the disturbance area may be exposed or buried; however, this is expected to be minor and temporary. Best management practices will be utilized to minimize effects to in-water habitat. Other potential effects on habitat could result from altered flow patterns below the spillway where some species, such as walleye, potentially spawn (PFBC 2012a).

During spring, high flows and associated changes in water temperature trigger the spawning season of walleye, which allows for potentially suitable spawning grounds over medium to large substrates (large gravel, cobble, and boulders) found below the spillway (Smith 1985; Jenkins and Burkhead 1993). With the presence of the new turbines installed in the overflow weir, flow that would otherwise be directed over this weir will be utilized for power generation through the new turbine units, which poses little to no changes on the existing flows below the overflow weir.

When little to no spill usually occurs during low flow periods (e.g., summer months), the flow through the turbines (proposed for installation in the overflow weir) will potentially enhance fish habitat directly below the overflow weir by providing flow that would not otherwise exist in this specific location. The lack of flow over the weir in summer months may create low DO and high temperatures directly below the overflow weir, so increased flow from the turbines into this area would likely negate any previous backwater effects and enhance fish habitat.

Additionally, the relatively minimal flow distribution alterations from the environmental flow gate to the turbines are not anticipated to negatively affect water quality, as detailed in Section E.3. A water quality survey is being conducted in 2012 to evaluate this further. The reports will be provided as they become available. The proposed Project will serve to maintain potential spawning habitat during high flows, and potentially enhance fish habitat during critical low flow months directly downstream of the overflow weir. In addition, tailwater elevations are not expected to change, so no appreciable effects to potential fish habitat are anticipated as a result of the proposed Project.

Summary of Effects on Fish Resources

Entrainment rates in run-of-release intake systems like the proposed Project are typically higher than in reservoir intake systems; however, alternate routes of passage are available at Braddock Locks and Dam on a consistent basis, such as through locks, spill gates, and the environmental flow gate, which will have continuous flow throughout the year as required by the USACE. Entrainment survival is expected to be high (95%) based on the turbine entrainment and survival study conducted for the proposed Project (Appendix E-2). These are conservative estimates derived from extrapolating the total fish entrained per year from entrainment rates estimated at other facilities into relative compositions of fish species in the Braddock Pool. Additionally, empirical evidence suggests that the majority of fish family entrainment compositions are comprised of clupeids and sunfishes. Species representing both of these families in the Monongahela River, such as gizzard shad, rock bass, and bluegill, typically possess rapid growth and maturation rates, high fecundity, and rapid recruitment (Jenkins and Burkhead 1993). Such characteristics may potentially offset effects from entrainment turbine mortality losses.

Hydro Friends Fund will utilize best management practices during installation and operations to avoid potential effects from impingement, turbine entrainment and mortality, or habitat alterations. As the Project is currently proposed, little to no effect is anticipated on fish resources.

E.4.1.5 Macroinvertebrate Resources

Benthic macroinvertebrates are often used to evaluate water quality and aquatic life conditions within streams and rivers, and are often incorporated into federal and state water quality assessment efforts (Barbour et al. 1999; USGS 2009; PADEP 2012). However, there is limited information available on the composition of macroinvertebrate communities of the Monongahela River, especially within the proposed Project vicinity. Studies have shown that the aquatic invertebrate populations (insects, worms, crustaceans, and mollusks) in the Monongahela River have mirrored the decline and rebound of the fish communities and improvements in water quality (PFBC 2011; Anderson et al. 2000).

As part of the National Water Quality Assessment (NAWQA) Program, the USGS conducted an assessment of the Allegheny and Monongahela River basins from 1996 to 1998 (Anderson et al. 2000). The assessment included collections of intensive and comprehensive water quality parameters, as well as aquatic communities (fish, invertebrates, and algae) and instream habitat at numerous locations, including a study site at Braddock[5] (Anderson et al. 2000). In general, the assessment determined that urban development and coal-mining activities through much of the basin had a significant effect on water quality and aquatic life, but that recent data indicated significant improvements had been achieved. The Anderson et al. (2000) report also reviewed historical information and described crayfish and freshwater mussel occurrence as rare or absent in the early 1900s in the lower Monongahela River and these conditions persisted up to the 1960s, with some improvements in the 1970s and 1980s, and significant improvements based on their 1998 assessment.

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[5] Anderson et al. (2000) is a summary report and does not provide specific sample data.

Further discussion of macroinvertebrates is divided into two major groups, benthic macroinvertebrates and freshwater mussels, as aquatic survey methodologies differ for these invertebrates groups that influences the availability of data. Further, the life history characteristics for these different groups vary significantly. General life history characteristics of macroinvertebrates found within Pennsylvania is also provided in this section.

Benthic Macroinvertebrates

Benthic macroinvertebrate collections were conducted in the Monongahela River at Pittsburgh (RM 4.5 to 11.5) from 1963 to 1967 as part of the National Water Quality Network monitoring effort (Mason et al. 1971). The report stated, "Industrial and acid mine drainage pollution eliminated most benthic organisms from the lower reach of the Monongahela River." Mason et al. (1971) also described the river bottom in the lower reach as covered in oil and tar-like deposits. Repeated sampling using dredges and rock baskets collected very few aquatic invertebrates. Specific to the Braddock Locks and Dam, Mason et al. (1971) noted that organisms were coated with iron deposits. The 1966 collection from basket samplers contained damselflies and pollutant-tolerant midges. The 1967 samples contained only four taxa, including unidentified worms, sewage fly (*Psychoda*), and the dragonfly nymph (*Plathemia*).

Several other river monitoring programs have collected more recent macroinvertebrate data in the Monongahela River. These include the 3R2N, ORSANCO, and the PADEP. These programs typically consist of additional partners such as the USEPA, USGS, USACE, and other entities. The 3R2N program consisted of a biological assessment of aquatic invertebrate communities sampled at small tributaries near the confluence with the lower Monongahela River in 2001 and 2002 (Koryak and Stafford 2002). While samples were collected at two tributaries in close proximity to the Braddock Locks and Dam, details on the macroinvertebrate community were not provided. However, the assessment ranked these tributaries as severely to moderately impaired based on the macroinvertebrate data (Koryak and Stafford 2002). All of the 33 tributaries to the lower Monongahela River (Emsworth pool to Locks and Dam 3) that were assessed were ranked as impaired to some level. Reasons for the impairments were listed as high alkalinity from mill slag leachates, highway deicing salts, sewage contamination, and at some locations, acid mine drainage (Koryak and Stafford 2002).

A limited amount of aquatic macroinvertebrate data is available for Emsworth pool at RM -6.2 (ORSANCO) and RM 9.8 (PADEP – retrieved from STORET) downstream of the Braddock Locks and Dam and is presented in Table E.4.1.5-1.

The PADEP collected additional aquatic macroinvertebrate data at 20 sites on the Monongahela from RM 0 to 23 in 2008 and 2009; however, that data was not available for this License Application.

Table E.4.1.5-1 Aquatic macroinvertebrates collected in the Emsworth and Braddock Pools.

Phylum	Class	Order	Family	Genus	Species	Total Count: Emsworth Pool at ~RM -6.2[1]	WQN701 Braddock at RM9.8[2] 1999	2005	2007
Annelida	Clitellata	Hirudinea (leeches)				17			
	Oligochaeta	(worms)							4
		Haplotaxida	Naididae			79	1	60	
				Dero		16			
				Nais	*communis*	777			
Anthropoda	Insecta	Diptera (midges)	Chironomidae			38	88	81	132
				Ablabesmyia	*rhamphe*	10			
				Conchapelopia		5			
				Cricotopus		45			
				Cricotopus	*bicinctus*	30			
				Dicrotendipes		140			
				Dicrotendipes	*lucifer*	200			
				Dicrotendipes	*neomodestus*	190			
				Glyptotendipes		1,318			
				Rheocricotopus	*robacki*	5			
				Nanocladius		30			
				Nanocladius	*distinctus*	252			
				Polypedilum	*flavum*	25			
				Polypedilum	*illinoense*	15			
				Tanytarsus		48			
		Ephemeroptera (mayflies)	Heptageniidae	*Stenacron*			2	6	14
				Stenacron	*interpunctatum*	79			
			Tricorythidae	*Tricorythodes*		17			
		Odonata (damselflies)	Coenagrionidae	*Argia*		1	4		
		Trichoptera (caddisflies)	Hydropsychidae	*Cheumatopsyche*		53			
				Hydropsyche		1			
				Hydropsyche	*oris*	30			
				Potamyia	*flava*	1			
			Hydroptilidae				1		
				Hydroptila		58			14
			Leptoceridae	*Nectopsyche*				1	
			Philopotamidae	*Chimarra*					1
			Polycentropodidae	*Cyrnellus*			1	6	
				Cyrnellus	*fraternus*	90			
				Neureclipsis					4
	Crustacea	Amphipoda	Gammaridae	*Gammarus*		284	4	14	6
		Arguloidea	Argulidae	*Argulus*		5			
		Cladocera (waterfleas)							7
		Cladocera	Sidaidae	*Sida*	*crystillina*	1,830			
		Ostracoda				8			
Cnidaria		Hydroida	Hydridae	*Hydra*					5
				Hydra	*americana*	563			
Mollusca	Bivalvia		Corbiculidae (Asian clam)	*Corbicula*				1	
				Corbicula	*fluminea*	3			
			Dreissenidae (zebra mussel)	*Dreissena*	*polymorpha*	138			
		Veneroida	Sphaeriidae (peaclam)						1
	Gastropoda (snails)	Basommatophora	Ancylidae	*Ferrissia*	*rivularis*	15			
			Physidae						6
				Physa				2	
				Physella		1	10		
			Planorboidea	*Menetus*					12
		Neotaenioglossa	Hydrobiidae	*Amnicola*		4	9		
Platyhelminthes	Turbellaria (flatworms)								3
		Tricladida	Planariidae					5	
				Dugesia	*tigrina*	206			
					TOTAL	**6,627**	**120**	**176**	**209**

[1] ORSANCO macroinvetebrate data collected using rock baskets.
[2] PADEP macroinvertebrate data collected within Monongahela River at Braddock.

Life History

Benthic Macroinvertebrates

Benthic macroinvertebrate communities in nearly all of Pennsylvania's waters are primarily composed of insects from five different insect orders: *Plecoptera* (stoneflies), *Ephemeroptera* (mayflies), *Trichoptera* (caddisflies), *Diptera* (true flies), and *Coleoptera* (beetles). In addition, populations of *Odonata* (dragonflies and damsel flies), as well as *Hemiptera* (surface bugs), are common in the proposed Project vicinity, due to the large amount of surface water in the navigational pools. Brief descriptions of the life history of key benthic macroinvertebrate orders known to occur within the proposed Project boundaries are provided below.

Stoneflies (Plecoptera)

Nearly all species of stoneflies are found exclusively in cold, running water. They tend to have specific water temperatures, substrate type, and stream size requirements reflected in their distribution. Stoneflies range in size from a few millimeters to 5 centimeters and most are herbivores, either scraping algae from surfaces or shredding leaf litter (Merritt and Cummins 1984).

Mayflies (Ephemeroptera)

Mayflies occur in a wide variety of habitats in both standing and flowing water habitats. The greatest diversity generally resides in rocky-bottomed headwater streams (Merritt and Cummins 1984). Most mayfly nymphs are herbivore collector-gatherers or scrapers. Mayflies spend most of their 1-year life cycle as nymphs. Emergence from nymphs to adults is weather- and species-dependent and can occur from late spring through early fall (Ward and Kondratieff 1992).

Caddisflies (Trichoptera)

Caddisflies reside in a variety of aquatic habitats, with the majority of species being found in cool, running water or still water. Larvae have a wide range of feeding mechanisms and commonly feed on algae, decaying plant material, and microorganisms. There are several predaceous species as well (Merritt and Cummins 1984). Generally, larvae show little selectivity in food preferences but can show highly specialized food-capture methods with nets constructed of silk. Caddisflies may construct and reside in cases made of silk, sand, woody debris, shells, or leaf fragments during their changes in life stages (Ward and Kondratieff 1992).

True Flies (Diptera)

The adults of aquatic dipterans are terrestrial and the larvae are aquatic. Diptera larvae occur in almost every type of aquatic habitat. They are found freely swimming, suspended from structure, or burrowing in substrate (Merritt and Cummins 1984). Some species produce several generations per year, whereas other species require several years to complete a single generation. Some dipterans are used as indicators of water pollution and eutrophication (Ward and Kondratieff 1992).

Beetles (Coleoptera)

Beetles occupy a broad spectrum of aquatic habitats, ranging from cold, headwater streams to stagnant wetland areas along lake shores. The majority of aquatic beetle species within the proposed Project boundary likely inhabit the various adjacent wetland areas. Some beetle larvae have gills or obtain oxygen through their body’s surface, but others must sometimes travel to the water’s surface to obtain air (Ward and Kondratieff 1992). Many adult aquatic beetles carry an air bubble with them. This air bubble must be periodically replenished with oxygen at the water’s surface. Feeding habits are diverse, but the majority of larvae are predaceous, with prey ranging from daphnia or other insect larvae to small fish (Ward and Kondratieff 1992).

Dragonflies and Damselflies (Odonata)

Dragonflies are found in slower river sections and navigational pools within the proposed Project vicinity. Larvae and adults are primarily predaceous, with larvae stalking underwater prey and adults capturing prey on the wing. Dragonfly nymphs respire by means of gills lining the rectal chamber (Ward and Kondratieff 1992).

True Bugs (Hemiptera)

Members of Hemiptera are largely terrestrial, but one species is aquatic in both the immature and the adult stages. Most aquatic hemipterans are found in well-vegetated, stagnant, or slow-flowing habitats (Ward and Kondratieff 1992). Within the proposed Project vicinity, hemipterans would most likely be found within the embayment, upstream of Braddock Locks and Dam.

Scuds (Amphipoda)

Scuds tend to prefer darker environments with abundant structure in slow-moving waters, although they are frequently found in fast water. They are scavengers, feeding on decomposing plant and animal detritus. Most species breed between February and October, and the eggs hatch 1 to 3 weeks after breeding (Newman 2008).

Additional macroinvertebrate orders that have been documented within the proposed Project vicinity include Lepidoptera, Megaloptera, Neuroptera, Tubificida, Basommatophora, Enchytraeida, Hemiptera, Hoplonemertea, and Isopoda (USGS 2011b).

Crayfish (Decapoda)

There is very little specific information available about the current spatial distribution of crayfish in the proposed Project vicinity. Though nine crayfish species have been documented in Pennsylvania, little is known about their life histories, feeding habits, and habitat use throughout the year (NatureServe 2008). Crayfish can be found in a variety of habitats, including riffles and pools with cobble and boulder/rubble substrates, undercut banks, debris piles, and moist depressions under rocks. Larger adults tend to be found under cobbles in deeper water, while younger crayfish live along the water margins (Nuttall 2008). Crayfish species are opportunistic omnivores, feeding on plants, animals, worms, insects, fish eggs, and detritus. They will often scavenge, as well as prey on live food items, such as fish, mollusks, and insects. Typical breeding periods for all crayfish species occur from spring through summer months. Juveniles and adults molt during summer months, with juveniles molting as many as three times in a given year (Jezerinac et al. 1995).

Impoundments of lotic habitat can impact crayfish by increasing concentrations of major fish predators, such as bass and sunfish. Loss of physical habitat structure, including gravel and boulder substrate, woody debris, and aquatic vegetation, can markedly increase their susceptibility to predation (Stein 1977).

Freshwater Mollusks

Freshwater mussels have recently become widely recognized as important components of stream ecosystems; however, there is a general lack of data regarding their abundance, life history characteristics, and distribution. Freshwater mussels are one of the most diverse groups of aquatic organisms and nearly 300 species have been reported in North America (Williams et al. 1993; Turgeon et al. 1998). However, mussels have declined over the past century or more. Declines have been attributed to many factors, but are primarily related to habitat degradation resulting from land use practices (deforestation, farming, livestock, construction); stream channelization; dredging; pollution; invasive species; commercial harvesting; loss of host fish; and construction of impoundments (Bogan 1993a; Watters 2000). Freshwater mussels are particularly sensitive to physical and chemical habitat alterations, which can result from impoundment dredging and channelization (Williams et al. 1993).

The USACE conducted a mussel survey at selected locations in association with the Lower Mon Project, which will involve removal of the Locks and Dam 3 in Elizabeth (Mainstream Commercial Divers, Inc. and Tetra Tech Inc. 2006). Divers searched for mussels downstream of Locks and Dam 3 (RM 23.2-23.7) in October 2005 but only found two live mussels (both pink heelsplitter [*Potamalis alatus*]). Relict shell material of the pink heelsplitter and three other species was also found; longsolid (*Fusconaia subrotunda*), round pigtoe (*Pleurobema sintoxia*), and the pimpleback (*Quadrula pustulosa*).

The most comprehensive source of information regarding freshwater mussels in the Monongahela River was found in Hart (2012). Hart (2012) conducted a review of historical information in addition to a comprehensive field survey in 2008, covering 31 locations over 91 river miles. Historically, the Monongahela River supported as many as 25 different species of mussels based on live specimens, plus an additional three species based on shell material

(Ortmann 1919 as cited in Hart 2012). However, nine of these species are presumed extirpated from Pennsylvania (Bogan 1993b). Water quality and aquatic habitat continued to degrade such that two other surveys conducted on the mainstem Monongahela River in the late 1980s and early 1990s found no evidence of freshwater mussels (Bogan 1993b).

Only data collected by Hart (2012) in the Emsworth and Braddock pool are presented here. Five sites were surveyed for mussels in the Emsworth pool in 2008, resulting in the collection of 19 live mussels representing six species (Hart 2012). A total of 14 pink heelsplitter were collected along with a single individual of each on the following species; fluted shell (*Lasmigona costata*), fragile papershell (*Leptodea fragilis*), giant floater (*Pyganodon grandis*), maple leaf (*Quadrula quadrula*), and the fatmucket (*Lampsilis siliquioidia*). Habitat was described as dominated by fine substrate (mud/silt/sand) with variable amounts of gravel, cobble, and occasional boulder/bedrock, and depths averaged 8 to 16 feet.

Six sites were surveyed in the Braddock Pool in 2008, resulting in the collection of 71 live mussels of the pink heelsplitter and a single specimen of maple leaf (Hart 2012). The greatest abundance within this pool was found in the upper reach of the Braddock Pool (Table E.4.1.5-2). Overall, estimated densities based on visual searches were low throughout the river with the greatest density found in the two lower pools: Emsworth and Braddock (Hart 2012). Habitat was similar to the Emsworth pool with substrate dominated by fines with variable amounts of gravel, cobble, and occasional boulder/bedrock, with depths ranging from 10 to 20 feet. The lower reach of the pool near Braddock Locks and Dam contained higher amounts of cobble and boulder substrates. In addition to freshwater mussels, the invasive zebra mussel (*Dreissena polymorpha*) was found in very low numbers in both pools.

Table E.4.1.5-2 Results of the 2008 Monongahela River mussel survey in Emsworth and Braddock Pools.

Survey Site (RM)	Abundance (count)	Species Diversity	Search Area (m^2)	Density ($mussels/m^2$)
0.28	1	1	247	0.004
3.42	4	2	286	0.014
4.00	7	1	303	0.023
5.42	5	3	364	0.014
7.49	2	2	265	0.008
12.17	3	1	305	0.010
12.50	4	1	350	0.011
15.74	7	1	390	0.018
18.03	22	1	355	0.062
20.27	23	1	366	0.063
21.66	13	1	479	0.027

Source: Hart 2012

Life History

Freshwater mussels exhibit a unique life history in that the larvae have a parasitic lifestage. The typical life cycle consists of males discharging sperm into the surrounding water, which are then dispersed by water currents. The females draw in sperm through their incurrent siphon during feeding and respiration activities. The eggs in the outer gills of the females are fertilized internally and develop into larval forms referred to as glochidia. There are reports for a few species or portions of a population that are hermaphroditic. The glochidia are released generally in spring or summer although a few species are known to release in winter. The glochidia need to attach to a suitable host fish, either on the fish gills or on the fins. Many mussel species have developed highly specialized adaptations to attract potential host fish, including modified mantle flaps and glochidial packets that resemble fish prey items. Some mussel species are host specific while others can use a wide variety of fishes as hosts. The host species for many mussels is still unknown or only based on some limited laboratory testing.

These encysted larvae are essentially parasites, which grow and develop into juvenile mussels while on the host fish. After metamorphosis, juvenile mussels drop from the host and settle to the stream or lake bottom, burying themselves in the substrate to continue their life cycle. Metamorphosis usually takes a few weeks, depending primarily on species and water temperature. Juveniles need to settle on substrate suitable for the adult life stage as they have limited mobility, although there has been some suggestion that they may not recruit to the adult bed itself but nearby and then move into the adult bed (O'Brien and Brim Box 1999).

Though there are many variations, freshwater mussel reproductive strategy is typically categorized as either short-term brooder (tachytictic) or long-term brooder (bradytictic). Short-term brooders typically spawn in the spring and brood larvae only until they are mature glochidia, which are then released to parasitize a host fish and complete metamorphosis to the juvenile stage. Long-term brooders generally spawn and fertilize eggs in late summer or early fall, and females brood the glochidia over the winter and release them the following spring or early summer to complete the life-cycle.

Mussels are primarily filter feeders but may also ingest sediment particles, particularly juveniles. Important food items include detrital material, bacteria, algae, very small protozoans, particulate and dissolved organic materials (Coker et al. 1921; Fuller 1974; Yeager et al. 1994; Gatenby et al. 1996; Nichols and Garling 2000).

The pink heelsplitter was the most common mussel species found upstream and downstream of the Braddock Locks and Dam. This species, common to medium-sized streams to large river systems, is typically found in fine substrates (sand, silt, and mud). Freshwater drum (*Aplodinotus grunniens*) has been identified as the host fish species (Spoo 2008) and is known to occur within the lower Monongahela River (PFBC 2010).

E.4.1.5.1 Project Effects on Macroinvertebrate Resources

Construction of the proposed Project will involve temporary placement of coffer dams in close proximity to the dam, which will result in temporary disturbance to bottom substrates at the Braddock Locks and Dam. This activity will result in temporary disturbance to river bottom substrates and flow distribution across the dam spillway. Benthic species that occur within the disturbance area may be exposed or buried.

Benthic macroinvertebrate diversity and abundance are typically low in the Monongahela River as a result of decades of pollution and habitat degradation through channelization, dredging for navigation, and habitat alterations through the original construction on the Braddock Locks and

Dam system. While water quality conditions have been steadily improving, the river is still regularly maintained as a major navigation corridor through dredging activities which further disturb benthic habitats. Temporary disturbance to the bottom substrates resulting from the Project construction may affect macroinvertebrates by burial or exposure; however, this is expected to be minor and temporary. Best management practices will be utilized to minimize effects to in-water habitat.

The proposed Project will operate in a run-of-release manner, and the USACE will continue to operate the Braddock Locks and Dam in a run-of-release manner. These operations will not affect the current surface water elevations of the lower Monongahela River, but will result in minor changes to flow distribution across the Project with the addition of the five proposed bulb turbines within the overflow section of the existing dam on the river left side. This additional flow may benefit aquatic species by providing flow to this area at all times of the year. Currently the left bank does not receive flow directly, but is likely affected by flow through the spill gates. These proposed Project operations are not expected to modify benthic habitat or species that inhabit it.

E.4.2 Wildlife and Botanical Resources

The following discussion describes existing wildlife and botanical resources on lands surrounding the Project area and along the lower Monongahela River within the Project boundary. Floodplains, wetlands, riparian, and littoral habitats are discussed in Section E.4.3. Federal and state listed (endangered and threatened) aquatic and terrestrial species are discussed in Sections E.4.4 and E.4.5, respectively.

The information provided in this section is the result of consultation with federal and state natural resource agencies (Appendix E-3), limited background data collection and analyses, and a site visit conducted in the Project area in June 2012.

E.4.2.1 Existing Environment

The land use and land cover in the Project vicinity is a mosaic of forests, urban-suburban-industrial activity, dairy and livestock farms, pastures, coal mines, and oil-gas fields. Urban and industrial activity is common in the valleys along the Monongahela River watershed. These land use activities are widespread and have reduced wildlife and botanical species diversity (Woods et al. 1999; USACE 2011a).

The potential natural vegetation in the Project vicinity are mostly Mixed Mesophytic Forest, which is primarily Appalachian Oak Forest (dominant species include white and red oaks [*Quercus alba* and *Q. rubra*], respectively). Today, forests are not as extensive, while urban, suburban, and industrial activities are very common in the river valleys that also serve as main transportation corridors. Streams in the Project area typically have cobble, gravel and sand substrates, and moderate gradients. Bituminous coal mining is common and some oil production occurs. There is also some general farming, although it is less prevalent (Woods et al. 1999). These land use types have replaced a significant amount of preferred wildlife and botanical habitats in the Project vicinity (PFBC 2011).

E.4.2.1.1 Botanical Resources

Major Vegetation Types within the Project Vicinity

As a whole, Allegheny County has a diversity of vegetation across its landscape, due in part to the physiographic characteristics and the varied bedrock and soils of the region, as well as human activities. Land clearing for industrial, commercial, and residential development has permanently altered the land, and the vegetation is reflective of these activities. The proposed Project boundaries consist of previously disturbed areas made up of grassy field areas and early successional vegetation.

Allegheny County is located in a White Oak - Black Oak (*Q. velutina*) - Northern Red Oak forest cover type. These three species of oak are dominant in the forests, but other tree species are reported as common in forests located in southern Pennsylvania, including chestnut oak (*Q. prinus*), tulip tree (*Liriodendron tulipifera*), blackgum (*Nyssa sylvatica*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), white ash (*Fraxinus americana*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), red elm (*Ulmus rubra*), basswood (*Tilia americana*), cucumber tree (*Magnolia accuminata*), sweet gum (*Liquidambar styraciflua*), shortleaf pine (*Pinus echinata*), pitch pine (*P. rigida*), Virginia pine (*P. virginiana*), and loblolly pine (*P. taeda*). Black walnut (*Juglans nigra*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), and eastern hemlock (*Tsuga Canadensis*) may also be present (Western Pennsylvania Conservancy 1994).

White oak, black oak, and northern red oak comprise the majority of the species in this dominant vegetation cover type. In general, oaks grow best on north- and east-facing, gently sloping, lower slopes; in coves and deep ravines; and on well-drained valley floors where soils are at least 36 inches deep. Medium-quality sites consist of moderately deep soils (20 to 36 inches) on upper and middle slopes facing north and east. Narrow ridgetops or south- and west-facing steep, upper slopes where soil is less than 20 inches deep are locations in which oaks survive but grow poorly (Woodland Stewardship 2011). Common reproduction of oaks is through acorns. Beginning at approximately 50 years old, red oaks produce good acorn crops on a 2- to 5-year interval, which drop in the fall. Soon after falling, white oak acorns germinate; however, red oak acorns germinate the following spring (Woodland Stewardship 2011).

Invasive Botanical Species

Invasive species are defined as non-indigenous plant or animal species that aggressively compete with native species. These species often out-compete local native species, impacting biodiversity, recreation, and human health. Invasive plants tend to appear on disturbed ground, and the most aggressive have the ability to invade existing ecosystems (Pennsylvania Department of Conservation and Natural Resources [PADCNR] undated a). The PADCNR and other governmental and non-governmental agencies maintain lists of invasive species for the state. Non-native species are not specifically regulated by federal or state law. However, non-native invasive species can be further classified as noxious weeds, which are regulated at the federal level and by the state.

Non-native invasive species and noxious weeds are typically prolific pioneering species that have the ability to quickly outcompete native vegetation. They grow rapidly, mature early, and effectively spread seeds that can survive for significant periods in the soil until site conditions are favorable for growth. Invasive plants often form vast single-species communities that are less suitable to birds and wildlife than native communities and can compromise native ecosystems by altering soil and water resources on a site. The introduction of non-indigenous invasive aquatic plant species to the United States has been escalating with widespread destructive consequences.

The impacts of the spread of invasive aquatic plants are well known, including habitat disruption, loss of native plant and animal communities, reduced property values, impaired fishing and degraded recreational experiences, as well as enormous and ongoing control costs (Maine Center for Invasive Aquatic Plants 2007). Invasive species readily inhabit disturbed sites such as residential/commercial developments, roads, trails, recreational areas, and along rivers and streams, particularly those that are periodically disturbed. Even if not present on a site, disturbance can result in conditions that are favorable for the establishment of non-native invasive species.

The majority of the most common weeds in Pennsylvania are non-native invasive plants that date back to colonial times and are considered widespread across the state. Certain weed species such as garlic mustard (*Alliaria petiolata*) are more recent invaders that quickly spread across the state (Governor's Invasive Species Council of Pennsylvania [GISCP] undated). Other well known or common non-native invasive plants, such as kudzu (*Pueraria lobata*), giant hogweed (*Heracleum mantegazzianum*), and goatsrue (*Galega officinalis*), in Pennsylvania are limited in the state or in regions of the state. Species such as Japanese knotweed (*Fallopia japonica*), Japanese hops (*Humulus japonicus*), and tree of heaven (*Ailanthus altissima*) are limited across the state but widespread in certain counties or regions (GISCP undated).

No directed surveys of invasive or noxious species were performed during the field visit conducted as part of relicensing. However, Table E.4.2.1-1 contains non-native invasive plants with limited or widespread occurrences throughout Pennsylvania (GISCP undated). The proposed Project is not expected to facilitate the spread of invasive species.

Table E.4.2.1-1 Non-native invasive plants with potential of occurring in the Project vicinity.

Common Name	Scientific Name
Widespread Pennsylvania Occurrences	
Multiflora rose	*Rosa multiflora*
Johnsongrass	*Sorghum halepense*
Garlic mustard	*Alliaria petiolata*
Mile-a-minute	*Persicaria perfoliata*
Canada thistle	*Cirsium arvense*
Asiatic bittersweet	*Celastrus orbiculatus*
Japanese knotweed	*Fallopia japonica*
Tree of heaven	*Ailanthus altissima*
Purple loosestrife	*Lythrum salicaria* L.
Japanese hops	*Humulus japonicus*
Common reed	*Phragmites australis*
Limited Pennsylvania Occurrences	
Kudzu	*Pueraria lobata*
Giant hogweed	*Heracleum mantegazzianum*
Goatsrue	*Galega officinalis*

Source: GISCP undated

E.4.2.1.2 Wildlife Resources

A variety of wildlife species occur in the habitats surrounding the Project. For purposes of describing the existing condition of these resources, this discussion has been divided into the following categories: mammals, avians, and reptiles and amphibians.

Mammals

Table E.4.2.1-2 provides mammal species that exist in western Pennsylvania, and may be present in the proposed Project vicinity. Wetlands and riparian habitat is important to wildlife, although this habitat is minimal in the Project vicinity (refer to Section E.4.3 for a discussion of floodplains, wetlands, riparian, and littoral habitats occurring in the Project vicinity). Some of the furbearing animals that are known to inhabit western Pennsylvania are beaver (*Castor Canadensis*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), muskrat (*Ondatra zibethicus*), Virginia opossum (*Didelphis virginiana*), river otter (*Lontra canadensis*), striped skunk (*Mephitis mephitis*), and long-tailed weasel (*Mustela frenata*). These wildlife species reside in many different habitat types such as woodland, wetland, scrub-shrub or early successional areas, and grassland areas. Use of these areas may shift during different life stages and/or times or year (DeGraaf and Yamasaki 2001; Doutt et al. 1977).

Mammal species typically found within wetlands include white-tailed deer (*Odocoileus virginianus*), star-nosed mole (*Condylura cristata*), water shrew (*Sorex palustris*), masked shrew (*Sorex cinereus*), and southern bog lemming (*Synaptomys cooperi*) (Whitaker and Hamilton 1998). Mammal species typically found within riparian areas include raccoon (*Procyon lotor*), eastern chipmunk (*Tamias striatus*), eastern gray squirrel (*Sciurus carolinensis*), gray fox, and all of the known bat species in West Virginia (Whitaker and Hamilton 1998). These species typically use riparian habitats for nesting and cover, venturing out into surrounding habitats to forage.

Beavers, muskrats, and river otters are a few notable common mammals that may utilize the limited wetland and riparian habitat in the Project vicinity. Beavers generally require small to large, slowly flowing brooks, streams, or rivers that are usually bordered by woodlands. Wetlands that provide an adequate food supply and sufficient water depths are beaver habitat requirements. Muskrats inhabit marshes and shallow portions of lakes, ponds, swamps, and sluggish streams. Wetlands with dense, emergent vegetation and stable water depths are muskrat habitat requirements. River otters inhabit streambanks, lakeshores, marshes, and other wetlands in forested areas. River otter habitat requirements include adequate den sites and burrows. Beavers and muskrats are herbivorous and rely on riparian vegetation for summer and winter forage. River otters are piscivorous and depend on an adequate, year-round supply of forage fish species. Overall, minimal wildlife use is expected within the Project area.

Table E.4.2.1-2 List of mammals potentially occurring in the Project vicinity.

Common Name	Scientific Name
Beaver	*Castor canadensis*
Big brown bat	*Eptesicus fuscus*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Eastern chipmunk	*Tamias striatus*
Eastern cottontail	*Sylvilagus floridanus*
Eastern pipistrelle	*Pipistrellus subflavus*
Fox squirrel	*Sciurus niger*
Gray fox	*Urocyon cinereoargenteus*
Gray squirrel	*Sciurus carolinensis*
Hairy-tailed mole	*Parascalops breweri*
Hoary bat	*Lasiurus cinereus*
House mouse	*Mus musculus*
Keen's myotis	*Myotis keenii*
Least weasel	*Mustela nivalis*
Little brown myotis	*Myotis lucifugus*
Long-tailed weasel	*Mustela frenata*
Masked shrew	*Sorex cinereus*
Meadow jumping mouse	*Zapus hudsonius*
Meadow vole	*Microtus pennsylvanicus*
Mink	*Mustela vison*
Muskrat	*Ondatra zibethicus*
Northern short-tailed shrew	*Blarina brevicauda*
Norway rat	*Rattus norvegicus*
Raccoon	*Procyon lotor*
Red bat	*Lasiurus borealis*
Red fox	*Vulpes vulpes*
Red squirrel	*Tamiasciurus hudsonicus*
Silver-haired bat	*Lasionycteris noctivagans*
Small-footed myotis	*Myotis leibii*
Smoky shrew	*Sorex fumeus*
Southern bog lemming	*Synaptomys cooperi*
Southern flying squirrel	*Glaucomys volans*
Southern red-backed vole	*Clethrionomys gapperi*
Star-nosed mole	*Condylura cristata*
Striped skunk	*Mephitis mephitis*
Virginia opossum	*Didelphis virginiana*
White-footed mouse	*Peromyscus leucopus*
White-tailed deer	*Odocoileus virginianus*
Woodchuck	*Marmota monax*
Woodland jumping mouse	*Napaeozapus insignis*
Woodland vole	*Microtus pinetorum*

Source: The American Society of Mammalogists 2011

Avian Species

According to the National Audubon Society Christmas Bird Count, the City of Pittsburgh supports a wide variety of birds, including songbirds, blackbirds, and game birds (National Audubon Society 2011) (Table E.4.2.1-3). Pennsylvania is within the Atlantic flyway, one of four major North American flyways used by migrating birds. The flyway encompasses several primary migration routes and many more that are tributaries of the other flyways. This area is important to migratory waterfowl and other birds that winter on the waters and marshes south of the Delaware Bay. The Atlantic flyway extends from the offshore waters of the Atlantic Coast, west to the Allegheny Mountains where it curves northwestward across northern West Virginia and northeastern Ohio, and continues across the prairie provinces of Canada and the Northwest Territories to the Arctic Coast of Alaska (Ohio State University Bird Nature undated). Minimal avian species habitat is available in the Project area.

Common avian species include American goldfinch (*Carduelis tristis*), black-and-white warbler (*Mniotilta varia*), blue-gray gnatcatcher (*Polioptila nigriceps*), white-throated sparrow (*Zonotrichia albicollis*), yellow-throated warbler (*Dendroica dominica*), yellow warbler (*Dendroica petechia*), song sparrow (*Melospiza melodia*), red-winged blackbird (*Agelaius phoeniceus*), eastern phoebe (*Sayornis phoebe*), and common yellowthroat (*Geothlypis trichas*) (Sibley 2003). Avian species associated with aquatic environments include the American black duck (*Anas rubripes*), American coot (*Fulica americana*), lesser scaup (*Aythya affinis*), ring-billed gull (*Larus delawarensis*), and great blue heron (*Ardea herodias*) (Sibley 2003).

Table E.4.2.1-3 National Audubon Society Christmas bird count for the City of Pittsburgh.

Common Name	Count
American crow	15,120
European starling	8,371
American robin	1,068
Mallard	1,044
Canada goose	805
Rock pigeon	743
House sparrow	650
Dark-eyed (slate-colored) junco	599
Northern cardinal	534
Mourning dove	480
Blue jay	408
Tufted titmouse	382
American goldfinch	308
House finch	262
Song sparrow	248
Chickadee sp.	213
Gull sp.	202
Black-capped chickadee	196
Carolina chickadee	163
White-breasted nuthatch	149
Downy woodpecker	139
Wild turkey	128
White-throated sparrow	116
Red-bellied woodpecker	110
Carolina wren	96
Ring-billed gull	68
Cedar waxwing	67
Northern mockingbird	63
Red-tailed hawk	60
American tree sparrow	55
Eastern bluebird	53
Northern flicker	43
Hairy woodpecker	27
Herring gull	18
Golden-crowned kinglet	18
Cooper's hawk	16
Great blue heron (blue form)	15
Double-crested cormorant	14
Pileated woodpecker	14
Brown creeper	12
Belted kingfisher	10
Eastern screech-owl	9

Common Name	Count
Red-breasted nuthatch	9
Hooded merganser	8
Sharp-shinned hawk	6
Swamp sparrow	6
Pied-billed grebe	5
Red-shouldered hawk	5
Peregrine falcon[E]	5
Great horned owl	5
Barred owl	4
Yellow-bellied sapsucker	4
Eastern towhee	3
Field sparrow	3
Common merganser	2
American kestrel	2
Merlin	2
Common raven	2
Winter wren	2
Purple finch	2
Pine siskin	2
Redhead	1
Lesser scaup	1
Bufflehead	1
Red-breasted merganser	1
Accipiter sp.	1
American coot	1
Ruby-crowned kinglet	1
Hermit thrush	1
Brown thrasher	1
Fox sparrow	1
Turkey vulture	0
Bald eagle[T]	0
Common grackle	0

Source: National Audubon Society 2011
[E] PA endangered species
[T] PA threatened species

Reptiles and Amphibians

Pennsylvania is home to a diverse population of amphibians and reptiles. Table E.4.2.1-4 presents a list of reptiles and amphibians that are found in Allegheny County, Pennsylvania. Minimal reptile and amphibian species habitat is available in the Project area.

Many species utilize riparian zones for foraging and shelter, venturing into more aquatic habitats to forage and reproduce. Common reptiles and amphibians include Jefferson spotted salamander (*Ambystoma jeffersonianum*), eastern American toad (*Bufo a. americanus*), wood frog (*Rana sylvatica*), northern coal skink (*Eumeces a. anthracinus*), eastern milksnake (*Lampropeltis t. triangulum*), and eastern ratsnake (*Elaphe obsoleta*) (Conant and Collins 1998). Reptiles and amphibians that may be located in wetlands near the Project area include pickerel frog (*Rana palustris*), northern two-lined salamander (*Eurycea bislineata*), and northern dusky Salamander (*Desmognathus fuscus*) (Conant and Collins 1998). The species that utilize wetlands are relatively wide-ranging generalists that can make use of multiple habitats. They include snapping turtle (*Chelydra s. serpentina*), northern map turtle (*Graptemys geographica*), eastern spiny softshell (*Apalone s. spinifera*), common watersnake (*Nerodia s. sipedon*), and bullfrog (*Rana catesbeiana*) (Conant and Collins 1998). These species utilize open water and littoral habitats primarily for foraging and nesting.

Table E.4.2.1-4 Amphibian and aquatic reptile species known to occur in Allegheny County, Pennsylvania.

Common Name	Scientific Name
American bullfrog	*Lithobates catesbeiana*
American toad	*Anaxyrus americanus*
Dusky salamander	*Desmognathus fuscus*
Eastern box turtle	*Terrapene carolina*
Eastern garter snake	*Thamnophis sirtalis sirtalis*
Eastern milk snake	*Lampropeltis triangulum triangulum*
Eastern painted turtle	*Chrysemys picta picta*
Eastern rat snake	*Pantherophis alleghaniensis*
Green frog	*Lithobates clamitans*
Jefferson spotted salamander	*Ambystoma jeffersonianum*
Kirkland's snake[E]	*Acris crepitans*
Long-tailed salamander	*Eurycea longicauda*
Mountain dusky salamander	*Desmognathus ochrophaeus*
Northern cricket frog[E]	*Clonophis kirklandii*
Northern copperhead	*Agkistrodon contortrix mokasen*
Northern ravine salamander	*Plethodon electromorphus*
Northern ribbon snake	*Thamnophis sauritus septentrionalis*
Northern ringneck snake	*Diadophis punctatus edwardsii*
Northern slimy salamander	*Plethodon glutinosus*
Northern two-lined salamander	*Eurycea bislineata*
Northern water snake	*Nerodia sipedon*
Pickerel frog	*Lithobates palustris*
Queen snake	*Regina septemvittata*
Racer	*Coluber constrictor*
Smooth green snake	*Liochlorophis vernalis*
Snapping turtle	*Chelydra serpentina*
Spiny softshell	*Apalone spinifera*
Spotted salamander	*Ambystoma maculatum*
Spring peeper	*Pseudacris crucifer*
Spring salamander	*Gyrinophilus porphyriticus*
Wood frog	*Lithobates sylvatica*
Yellow-bellied slider	*Trachemys scripta scripta*

Source: Pennsylvania Herp 2010
[E] PA endangered species

Invasive Wildlife Species

As discussed earlier, invasive species are defined as non-indigenous plant or animal species that aggressively compete with native species. These species often out-compete local native species, impacting biodiversity, recreation, and human health. Invasive aquatic species of concern for the Ohio River Watershed include: zebra mussel, Asian carp, and Asiatic clam (Penn State Erie and

Seagrant 2011). There are no known invasive amphibian species and only two invasive reptiles in Pennsylvania. The red-eared slider (*Trachemys scripta elegans*) and the yellow-bellied slider (*Trachemys s. scripta*) turtles have established breeding populations within Pennsylvania. These invasive turtle species are aggressive competitors for basking sites, food, and breeding habitat. Additionally, they are threats to many native Pennsylvania turtle species including the red-bellied turtle (*Pseudemys rubriventris*) that is state listed as threatened (GISCP undated, PFBC 2011a).

The Pennsylvania Biological Survey identified five non-native bird species (rock dove [*Columba livia*] [pigeon], ring-necked pheasant [*Phasianus colchicus*], European starling [*Sturnus vulgaris*], house sparrow [*Passer domesticus*], and mute swan [*Cygnus olor*]) known to reproduce in Pennsylvania. European starling, house sparrow, and pigeons can cause considerable property, agricultural, and ecological damage. Additionally, species such as the mute swan can impact native waterfowl directly through aggressive behavior, and indirectly by consuming large amounts of native vegetation (GISCP undated).

The Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), and thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*) are three non-native, reproducing mammals in Pennsylvania. In addition to the three aforementioned species, feral swine have caused considerable damage following accidental or intentional introductions (GISCP undated).

E.4.2.2 Affected Environment

The proposed Project will operate in a run-of-release manner, and the USACE will continue to operate the Braddock Locks and Dam in a run-of-release manner. These operations will not affect the current surface water elevations of the lower Monongahela River; therefore, no Project effects to any existing adjacent terrestrial communities and the botanical and wildlife resources within them are expected.

Botanical Resources

The current and proposed future operation of the Project has, and is anticipated to have, very little impact on the terrestrial communities that border the Project area. The occurrence and distribution of terrestrial vegetation cover types in the Project area is generally unrelated to Project operations. As previously discussed in this application, the Project will be operated in a run-of-release manner, and the USACE will continue to operate the Braddock Locks and Dam in a run-of-release manner. The only effects to terrestrial resources within the Project area include potential vegetation management along the proposed transmission line, vegetation management and maintenance of Project lands, and the maintenance of Project-related access ways. The occurrence and distribution of terrestrial vegetative cover types in the Project area outside of the Project area is affected by development and other land uses undertaken by other entities (e.g., commercial development and residential areas). Based on a site visit to the Project area, there is no evidence of any on-going adverse effects to botanical resources due to current and/or proposed Project operations.

Wildlife Resources

The proposed Project will have very little, if any, effect on wildlife resources within and bordering the Project area. The occurrence and distribution of wildlife resources in the Project area is generally unrelated to the Project and/or its future operations. As previously discussed in this application, the Project, which will maintain a footprint on the existing dam, will be operated in a run-of-release manner, and the USACE will continue to operate the Braddock Locks and Dam in a run-of-release manner. Based on a site visit to the Project area and an assessment of habitat conditions within the Project area, there is no evidence of any on-going adverse effects to wildlife resources due to current and/or proposed Project operations.

Proposed Protection, Mitigation, and Enhancement Measures

The proposed modifications at the Project are not anticipated to negatively affect terrestrial communities; therefore, no PM&E measures are proposed that specifically address these resources.

E.4.3 Floodplains, Wetlands, Riparian, and Littoral Habitats

E.4.3.1 Existing Environment

E.4.3.1.1 Floodplains, Wetlands, Riparian, and Littoral Habitats

In general, the lower Monongahela River is a large riverine system that flows through a highly separated plateau with deeply eroded stream valleys. The wetlands and floodplains bordering the river in the Project vicinity are seasonally flooded, and most often occur on the islands and embayments, or along the shoreline and tributary mouths. Large wetlands and associated habitats are generally not found in the Monongahela River watershed, as a result of the steep topography and development of the floodplains (USACE 2011a). The majority of this watershed's wetlands are found in the southern portion in West Virginia, except for an area consisting of a significant amount of emergent and submergent wetland vegetation in Pool 3, which is the next pool upstream of the Braddock Pool, between Lock and Dam 3 and Lock and Dam 4. Overall, there are approximately 37 square miles of palustrine, lacustrine, and riverine wetlands, and 60 square miles of open water within the Monongahela River watershed (USACE 2011a).

Wetlands are generally defined as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. Most formal wetland definitions emphasize three primary components that define wetlands: the presence of water, unique soils, and hydrophytic vegetation. The U.S. Fish and Wildlife Service (USFWS) (Cowardin et al. 1979) defines wetlands as follows:

> *Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.*

PADEP’s wetland definition is consistent with that of the USACE. The USACE and the PADEP have jurisdiction over wetlands within Pennsylvania, and within the vicinity of the proposed Project.

Riparian habitats are areas that support vegetation found along waterways such as lakes, reservoirs, rivers, and streams. The boundary of the riparian area and the adjoining uplands is gradual and not always well defined. However, riparian areas differ from the uplands because of their high levels of soil moisture, frequency of flooding, and unique assemblage of plant and animal communities (Virginia State University 2000). These habitats can range from mature forests to areas covered by emergent vegetation and shrubs. Riparian habitats are unique because of their linear form and because they process large fluxes of energy and materials from upstream systems (Mitsch and Gosselink 1993). Riparian areas and the vegetation associated with them provide important habitat for wildlife and often contain a higher number of species, both plant and animal, than surrounding upland areas due to the proximity to water. These areas are also important avian habitats for resident and migratory birds. Riparian habitat also functions as travel corridors for wildlife species.

No specific studies addressing floodplains, wetland, riparian, or littoral habitats were conducted in the Project area. However, wetland habitats occurring in the vicinity of the Project area as shown on Figure E.4.3.1-1 are described below.

According to the USFWS National Wetlands Inventory (NWI), there are limited wetlands present along the Monongahela River near the site of the proposed Project (USFWS 2012a). The total combined acreage of the two wetlands within the inset map on Figure E.4.3.1-1 is 2.58 acres. The wetlands near the proposed Project appear to be very small, isolated wetlands that are considered palustrine and permanently flooded with an unconsolidated bottom (Table E.4.3.1-1). The NWI-mapped riverine habitat present at the proposed Project location is classified as permanently flooded with a lower perennial subsystem and an unconsolidated bottom. Riverine habitats are hydraulically complex and occur in floodplains and riparian corridors in association with stream channels. Dominant water sources for this type of wetland are subsurface hydraulic connections between the stream channel and wetlands or overbank flow from the channel.

Additionally, riverine wetlands typically extend perpendicular from the stream channel to the edge of the stream's floodplain (Brinson et al. 1995).

Table E.4.3.1-1 National Wetlands Inventory classification system.

Wetlands Code	System	Subsystem	Class	Subclass	Regime	Chemistry	Special Modifiers
R2UBH	Riverine	Lower perennial	Unconsolidated bottom	NA	Permanently flooded	–	–
PUBH	Palustrine	NA	Unconsolidated bottom	NA	Permanently flooded	–	–

Source: Cowardin et al. 1979

There are no wetlands located within the proposed Project boundary. In addition, minimal littoral habitat is expected to occur in the immediate Project vicinity, as rather steep banks are present, limiting the amount of wetland, riparian, and littoral habitat.

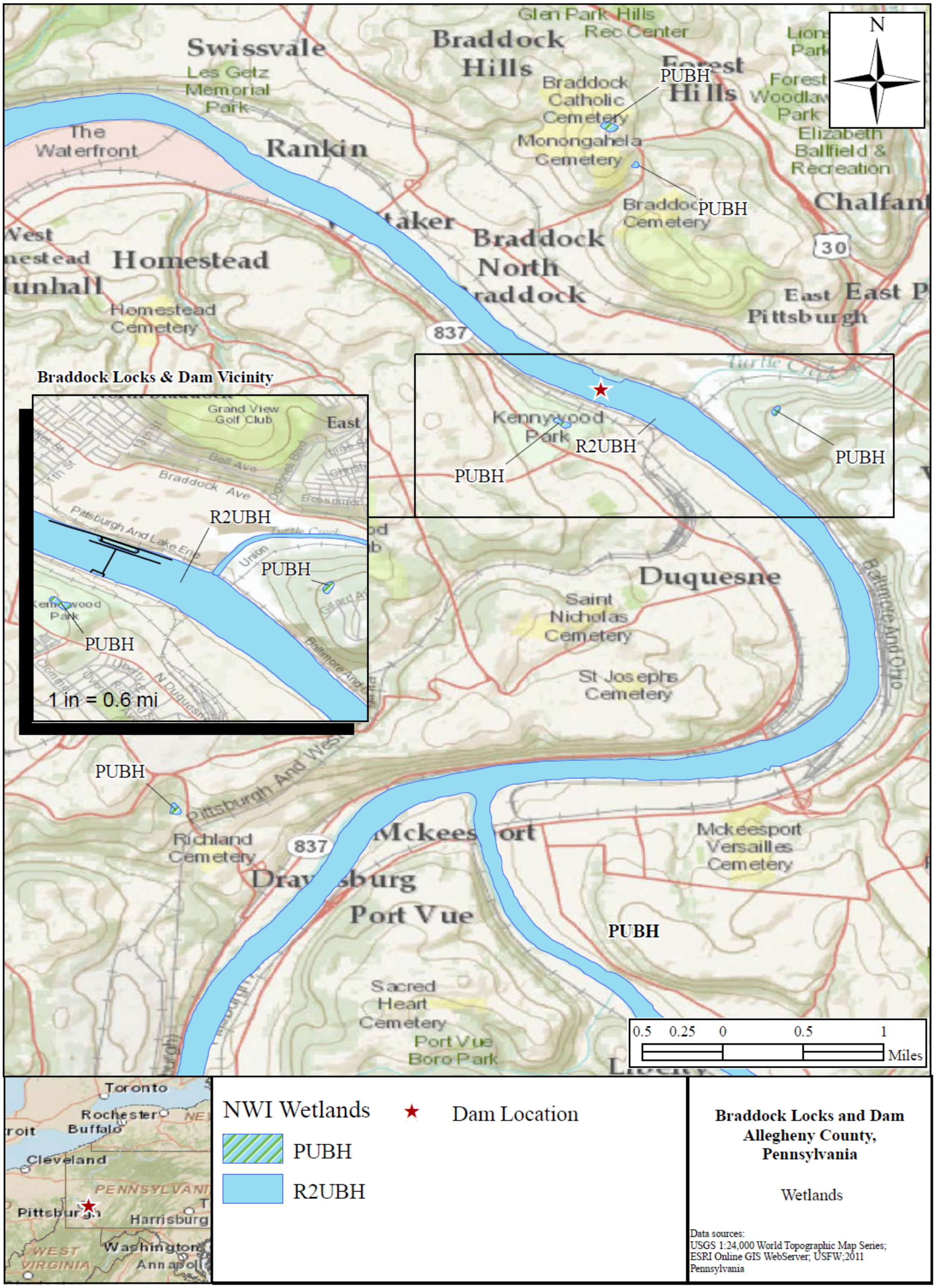


Figure E.4.3.1-1 Wetlands in the vicinity of the Braddock Locks and Dam.

E.4.3.1.2 Wetland Plant and Animal Species

Plants

As noted above, Figure E.4.3.1-1 presents information regarding wetlands in the proposed Project vicinity; however, no formal surveys of wetlands or vegetation have been performed in support of the preparation of this document, as no wetlands are present in the immediate Project area. Additional information on rare, threatened, and endangered wetland plant species is provided in Section E.4.4, and botanical resources in Section E.4.2.

Animals

Lists of wildlife known to occur in wetland and riparian habitats in the proposed Project vicinity are not readily available; however, many of the species likely to occur typically use wetland or riparian habitats at some point in their lives. Additional information on general wildlife resources found in the Project vicinity is provided in Section E.4.2, and information on aquatic and terrestrial rare, threatened, and endangered wildlife species in Section E.4.4 and E.4.5.

E.4.3.2 Affected Environment

The proposed Project will operate in a run-of-release manner, and the USACE will continue to operate the Braddock Locks and Dam in a run-of-release manner. These operations will not affect the current surface water elevations of the lower Monongahela River; therefore, no Project effects to any existing floodplains, wetlands, littoral, and riparian resources are expected.

Best management practices and an upland staging area along the river left bank (adjacent to the existing railroad bed) will be utilized during construction activities to avoid effects to adjacent riparian and open water habitat.

Proposed Protection, Mitigation, and Enhancement Measures

The proposed modifications at the Project will not negatively affect floodplains, wetlands, littoral, and riparian habitats during construction or operation; therefore, no PM&E measures are proposed that specifically address these resources.

E.4.4 Threatened and Endangered Species

Based on information gathered from the USFWS Pennsylvania Field Office, no federally listed (endangered or threatened under the ESA) species occur within the proposed Project area (USFWS 2012b). Based on a review of information available from the Pennsylvania Natural Heritage Program (PNHP) (2012), no federally endangered or threatened fish or terrestrial species have been reported to occur within the lower Monongahela River watershed, including tributaries. However, four freshwater mussels species are listed for this watershed. There are several state listed endangered and threatened species (under PA Code §75) identified to occur in the lower Monongahela River watershed (PNHP 2012). The following sections describe federally and state listed fish, aquatic invertebrates, and terrestrial species.

E.4.4.1 Federal and State Listed Fish Species

There are no federally listed fish species reported to occur in the Project area and only two state listed species potentially occurring in the proposed Project vicinity (Table E.4.4.1-1). A description of the species life history, associated habitat requirements, and distribution within the Project area is provided below. No biological opinions, status reports, or recovery plans directly concerned with aquatic resources of the proposed Project vicinity were identified. According to the USFWS, the proposed Project vicinity does not contain habitat that is currently a designated or proposed critical habitat, in accordance with the provisions of the ESA. Based on the Pennsylvania Natural Diversity Inventory (PNDI) Project screening review and review of the PNHP database, two state listed fish species are known to occur in the Project vicinity: warmouth and ghost shiner (PNDI 2012; PNHP 2012).

Warmouth (Lepomis gulosus)

The warmouth is listed as an endangered species by the state of Pennsylvania (Pa. Code §75). This species occurs naturally throughout the central and southeastern United States. It is distributed throughout Kansas, Iowa, and Missouri; north to southern Wisconsin, lower Michigan, Lake Erie, and western Pennsylvania; south to Florida; and west through the Gulf States to the Rio Grande (Hubbs and Lagler 1947; Larimore 1957). It has been introduced into California (Hubble 1966; Moyle 1976), Arizona (Minckley 1973), and other western states (Smith 1896). No warmouth have been collected in the Braddock Pool during sampling events between 1990 and 2012 (PFBC 2010; ORSANCO 2009). Seven were collected in the Morgantown pool in 1999, located in the upper Monongahela River of West Virginia, approximately 191 river miles upstream of the Braddock Project (PFBC 2010; ORSANCO 2009).

Warmouth are found almost invariably in slow-moving or still waters having a soft substrate and dense beds of submerged, floating, or emergent aquatic vegetation or other dense cover such as stumps, brush, or boulders (Larimore 1957; Cross 1967; Germann et al. 1975; Pflieger 1997; Guillory 1978; Trautman 1981). In Illinois, Ohio, and Missouri, warmouth habitat consists chiefly of weedy, sluggish streams, oxbows, and backwaters adjacent to large rivers and clear to moderately turbid, silt-bottomed ponds with dense cover along the shoreline (Larimore 1957; Pflieger 1997; Smith 1979; Trautman 1981).

Nesting and spawning activity of warmouth commences in April or when temperatures exceed 21°C (Larimore 1957; Germann et al. 1975). Spawning generally peaks in late May to early June, but may extend through August if temperatures are favorable (Larimore 1957; Guillory 1978). Multiple spawning of individual fish has been reported in Texas where one pair of warmouth spawned three times in one season (Toole 1946). Eggs are laid in nests built and guarded by males (Larimore 1957). Nests are built near cover in shallow, protected areas over a variety of substrates (Larimore 1957; Germann et al. 1975). Nests in Georgia swamps were found near stumps, root bases of trees along the shoreline, and in backwater areas having water lilies and emergent vegetation (Germann et al. 1975).

Ghost Shiner (Notropis buchanani)

The ghost shiner is listed as an endangered species by the state of Pennsylvania (Pa. Code §75). This member of the *Notropis* genera has a pale coloration, relatively deep bodied, with large eyes and small oblique mouth. Ghost shiners are small minnows, and adults are most commonly 1.5 to 2 inches longs. Females are typically larger than males. This species is distributed within the Missouri and Mississippi Rivers' drainages and within Prairie streams in the southwest to the Salt and Fabius rivers in the northeast (Pflieger 1997). Two ghost shiners have been found in the Monongahela since 1990, one in the Grays landing lock chamber and the other in Emsworth Pool

(PFBC 2010; ORSANCO 2009). The average RC from these surveys that took place only within the Braddock Pool is 1.5% (PFBC 2010; ORSANCO 2009).

The ghost shiner prefers backwaters and large pools protected from swift currents within low-gradient sections of large moderately clear water streams. This species is commonly found in mid-water column schools associated with other shiners, commonly mimic shiners. Ghost shiners also likely have similar feeding habitats of mimic shiners, whose diets consist of insects and other small invertebrates. Spawning takes place in spring and early summer in slow riffles with sand or fine gravel substrates. Ghost shiners reach sexual maturity by their second summer, and their life span does not exceed 3 years (Pflieger 1997).

Table E.4.4.1-1 Federal and state listed aquatic species occurring in Allegheny County and Lower Monongahela Watershed, Pennsylvania.

Common Name	Scientific Name[a]	Federal Status[b]	State Status[b]	Habitat Requirements[c]
Fish				
Warmouth	*Lepomis gulosus*	-	E	This species occurs in ponds, lakes, swamps, and streams of low gradient with mud or debris over bottom; a pool species in streams where it often is near beds of vegetation or other cover; weedy turbid areas of rivers and backwaters. Tolerant of low oxygen levels of polluted waters. Common in lowlands, uncommon in uplands. Eggs are laid in a bowl-like nest made by male, often in sand or rubble bottom with thin covering of silt or detritus near a rock, stump, clump of vegetation, or similar object, at depths of 15 centimeters to 1.5 meters. Nests usually are separated from one another.
Ghost shiner	*Notropis buchanani*	-	E	Found in low-gradient sections of large creeks and small to large rivers having moderate flow and moderately clear to turbid water. In larger pools and protected backwaters without noticeable current. Bottom may vary from silt/detritus to clean gravel.
Mussels				
Snuffbox	*Epioblasma triquetra*	E	-	Found in riffles of medium and large rivers with stony or sandy bottoms, in swift currents, usually deeply buried. The snuffbox is a long-term brooder and fish host species include the Ozark sculpin (*Cottus hypselarus)*, blackspotted topminnow (*Fundulus olivaceous*), banded sculpin, (*Cottus caroline*), logperch (*Percina caprodes*), blackside darter (*Percina maculata*), and mottled sculpin (*Cottus bairdi*).
Pink mucket	*Lampsilis abrupta*	E	-	This species is tolerant of a variety of aquatic habitats of medium to large rivers. It is found in strong current with coarse gravel and sand substrates at depths up to about 1 meter but can also occur in deeper waters with slower currents. This species is thought to be extirpated in Pennsylvania. It is a long-term brooder with the following identified fish host species; freshwater drum (*Aplodinotus grunniens*), largemouth bass (Mi*cropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), spotted bass (*Micropterus punctulatus*), and walleye (*Stizostedion vitreum*).
Sheepnose	*Plethobasus cyphyus*	E	T	Although it does inhabit medium-sized rivers, this mussel generally has been considered a large-river species. It may be associated with riffles and gravel/cobble substrates but usually has been reported from deep water (>2 meters) with slight to swift currents and mud, sand, or gravel bottoms. It also appears capable of surviving in reservoirs, such as upper Chickamauga Reservoir immediately below Watts Bar Dam, located in Tennessee. Specimens in larger rivers may occur in deep runs. The sheepnose is a short-term brooder with a wide variety of host fish species, primarily minnow/shiner species and possibly the sauger (*Stizostedion canadense*).

Clubshell	*Pleurobema clava*	E	E	This species primarily inhabits small to medium-sized rivers and streams though was historically found in larger rivers such as the Monongahela and Tennessee Rivers. It has been reported found completely buried in clean sand/gravel substrate in riffle/run situations in shallow water and does not tolerate mud or slackwater conditions Limited information is available on the reproductive characteristics but it is thought to be a short-term brooder.
Rabbitsfoot	*Quadrula cylindrica*	C	E	The typical habitat for this species is small to medium rivers with moderate to swift currents, and in smaller streams it inhabits bars or gravel and cobble close to the fast current. It is found in medium to large rivers in sand and gravel. It has been found in depths up to 3 meters. Despite their streamlined appearance, specimens are more often found fully exposed lying on their sides on top of the substrate. This is a short-term brooder that spawns and releases glochidia from May to July. Potential host fish species include whitetail shiner (*Cyprinella galactura*), spotfin shiner (*Cyprinella spiloptera*), and bigeye chub (*Hybopsis amblops*).
Salamander	*Simpsonaias ambigua*		E	This is a small mussel (<2 inches) that prefers sand or silt substrate, often found under large, flat stones in areas of a swift current in medium to large rivers and lakes. Glochidia are suspected to be released in the fall and the confirmed host species is the mudpuppy (*Necturus maculosus*).

[a] Source: Pennsylvania Natural Heritage Program 2012
[b] E – Endangered; T – Threatened; C - Candidate
[c] Habitat requirements as indicated by NatureServe 2012 and Spoo 2008

E.4.4.2 Federal and State Listed Aquatic Invertebrates

The federal and state listed invertebrate species potentially occurring in the proposed Project vicinity, along with habitat and reproductive information, are listed in Table E.4.4.1-1. Federally endangered mussel species include snuffbox (*Epioblasma triquetra*), pink mucket (*Lampsilis abrupta*), sheepnose (*Plethobasus cyphyus*), and clubshell (*Pleurobema clava*). The rabbitsfoot (*Quadrula cylindrica*) is a candidate species that has been determined to be warranted for proposed listing by the USFWS (76 Fed. Reg. 66,404 2011). Pennsylvania state endangered species include the salamander mussel (*Simpsonaias ambigua*).

None of these species have been reported in the vicinity of the Braddock Locks and Dam in recent times. Based on a review of available current and historical survey data by Hart (2012), the snuffbox and clubshell were only reported from tributaries to the Monongahela River and were not found in the mainstem river. The pink mucket, sheepnose, and rabbitsfoot were found in the mainstem river in the early 1900s (Ortmann 1919 as cited in Hart 2012) but have not been found live in the Monongahela River in Pennsylvania since that time. The pink mucket is presumed extirpated from Pennsylvania (Bogan 1993b). The state listed salamander mussel also historically occurred in tributaries to the Monongahela River but was not reported in the mainstem (Hart 2012).

No biological opinions, status reports, or recovery plans directly concerned with aquatic resources of the proposed Project vicinity were identified. Based on the PNDI Project screening review, the USFWS summarized that no effects to federally listed species associated with the proposed Project were anticipated (PNDI 2012).

E.4.4.3 Federal and State Listed Terrestrial Species

Federal and state listed endangered and threatened terrestrial plant and animal species that may occur in habitats within the proposed Project vicinity were identified using existing information. Based on a review of information gathered from the PNHP and USFWS, it was determined that several state listed and no federally listed threatened or endangered terrestrial species potentially occur in the proposed Project vicinity (PNHP 2012, USFWS 2012) (Table E.4.4.3-1 and Table E.4.4.3-2). Urban and industrial activity is common in the valleys along the Monongahela River watershed. These land use activities are widespread, and have resulted in reduced wildlife and botanical species diversity (USACE 2011a).

Based on the PNDI Project screening review, the PFBC indicated that no listed terrestrial species are found near the proposed Project (PNDI 2012), and no other information has been found that documents listed terrestrial species near the Project. In addition, no biological opinions or status reports directly concerned with terrestrial botanical and wildlife resources of the proposed Project area and vicinity were available. Little information exists on the temporal and spatial distributions of listed terrestrial species within, or adjacent to, the proposed Project boundary. It is possible that migratory listed species like the migrant loggerhead shrike could use the proposed Project area for foraging corridors; however, due to the urban/industrial and commercial nature of the proposed Project area, it is unlikely that any terrestrial federal or state listed species use the area and none are known to occur within the Project area. Additional information on wildlife and plant species is provided in Section E.4.2.

Table E.4.4.3-1 Federal and state listed terrestrial wildlife species occurring in Allegheny County and Lower Monongahela Watershed, Pennsylvania.

Common Name	Scientific Name[a]	Federal Status	State Status[b]	Habitat Requirements[c]
Reptiles and Amphibians				
Northern cricket frog	*Acris crepitans*	-	E	This species inhabits the edges of sunny marshes, marshy ponds, and small, slow-moving streams in open country. It may periodically range into adjacent non-wetland habitats in some regions. Eggs and larvae develop in the shallow water of ponds, marshes, ditches, slow streams, springs, or rain pools. Hibernation sites are underground on land near water; may hibernate communally.
Kirtland's snake	*Clonophis kirtlandii*	-	E	Prefers open damp habitats, such as marsh edges, wet fields and pastures, and along creeks, canals, sluggish ponds and ditches. Prominent occurrences of this species are recorded from such habitat types in and around large cities.
Avians				
Peregrine falcon	*Falco peregrinus*	-	E	Various open situations from tundra, moorlands, steppe, and seacoasts, especially where there are suitable nesting cliffs, to mountains, open forested regions, and human population centers (American Ornithologists' Union 1983). When not breeding, occurs in areas where prey concentrate, including farmlands, marshes, lakeshores, river mouths, tidal flats, dunes and beaches, broad river valleys, cities, and airports. Often nests on ledge or hole on face of rocky cliff or crag. River banks, tundra mounds, open bogs, large stick nests of other species, tree hollows, and man-made structures (e.g., ledges of city buildings) are used locally (Cade 1982). Nests typically are situated on ledges of vertical rocky cliffs, commonly with a sheltering overhang (Palmer 1988; Campbell et al. 1990). Tundra populations nests typically on rocky cliffs, bluffs, or dirt banks. Ideal locations include undisturbed areas with a wide view, near water, and close to plentiful prey. Substitute man-made sites include tall buildings, bridges, rock quarries, and raised platforms.
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	-	E	This species prefers open habitat characterized by grasses and forbs of low statue interspersed with bare ground and shrubs or low trees. In Pennsylvania, this species uses pastures with scattered low trees (especially hawthorns, or other thorny shrub species, and crab-apples), farmsteads, mowed right-of-ways, and croplands. Scattered shrubs or trees, particularly thick or thorny species, serve as nesting substrates, hunting perches, and impaling stations. This species is a predator that preys on small songbirds, grasshoppers, and small rodents but does not have talons like raptors. This species will therefore impale the prey on a sharp thorn in a small tree such as a hawthorn.

[a] Source: Pennsylvania Natural Heritage Program 2012
[b] E – Endangered
[c] Habitat requirements as indicated by NatureServe 2012

Table E.4.4.3-2 Federal and state listed plant species occurring in Allegheny County and the Lower Monongahela River Watershed, Pennsylvania.

Common Name	Scientific Name[a]	Federal Status	State Status[b]
Wild hyacinth	*Camassia scilloides*	-	T
Carey's sedge	*Carex careyana*	-	E
Tall larkspur	*Delphinium exaltatum*	-	E
Four-angled spike-rush	*Eleocharis quadrangulata*	-	E
Harbinger-of-spring	*Erigenia bulbosa*	-	T
Cluster fescue	*Festuca paradoxa*	-	E
Purple rocket	*Iodanthus pinnatifidus*	-	E
Crested dwarf iris	*Iris cristata*	-	E
Forked rush	*Juncus dichotomus*	-	E
Torrey's rush	*Juncus torreyi*	-	T
American gromwell	*Lithospermum latifolium*	-	E
Oblique milkvine	*Matelea obliqua*	-	E
False gromwell	*Onosmodium molle var. hispidissimum*	-	E
Passion-flower	*Passiflora lutea*	-	E
Balsam poplar	*Populus balsamifera*	-	E
Common hop-tree	*Ptelea trifoliata*	-	T
Limestone petunia	*Ruellia strepens*	-	T

[a] Source: Pennsylvania Natural Heritage Program 2012
[b] E – Endangered; T – Threatened

E.4.4.4 Project Effects on Federal and State Listed Aquatic and Terrestrial Species

Project Effects on Federal and State Listed Aquatic Species

The use of coffer dams during construction will result in temporary disturbance to river bottom substrates and flow distribution across the dam spillway. However, no federal or state listed species are known or expected to occur within the disturbance area in close proximity to the dam and best management practices will be utilized to minimize effects to in-water habitat.

The proposed Project will operate in a run-of-release manner, and the USACE will continue to operate the Braddock Locks and Dam in a run-of-release manner. These operations will not affect the current surface water elevations of the lower Monongahela River, but will result in minor changes to flow distribution across the Project with the addition of the five proposed bulb turbines within the overflow section of the existing dam on the river left side. This additional flow may benefit aquatic species by providing flow to this area at all time of the year, reducing current effects like backwater effects downstream of the dam or thermal stratification upstream of the dam.

Potential operational effects for listed fish species such as the ghost shiner may be associated with turbine entrainment. However, this is expected to be insignificant considering the potential for the species to occur in the lower Monongahela River and minimal entrainment effects. See Section E.4.1 and Appendix E-2 for a detailed evaluation of this potential Project effect.

Additional correspondence with the PADCNR states that although PNDI records indicate species or natural resources of concern are located in the vicinity of the proposed Project, based on the information submitted to the agency concerning the nature of the proposed Project, immediate location, and detailed resources information, the PADCNR has determined that no Project effects on listed species are likely; therefore, no PM&E measures are proposed.

Project Effects on Federal and State Listed Terrestrial Species

The terrestrial area to be used during construction on the river left side consists of old railroad bed and other previously disturbed/developed urban land that is absent of any suitable plant or wildlife habitat. No operational or construction Project activities are anticipated to affect terrestrial listed species; therefore, no PM&E measures are proposed.

E.5 REPORT ON CULTURAL, HISTORIC, AND ARCHAEOLOGICAL RESOURCES

The archaeological and historical record of Prehistoric and Historic period populations in southwestern Pennsylvania begins over 10,000 years before present (B.P.). This section begins with a brief overview of the cultural setting of the proposed Project, and is intended to provide contextual information regarding the nature and character of cultural resources within the proposed Project vicinity. Section E.5.2 describes the previously reported archaeological and historic resources within the proposed Project’s vicinity; Section E.5.3 provides an overview of existing discovery measures, including previous archaeological and architectural surveys; and Section E.5.4 presents a summary of the Section 106 consultation process completed in support of the proposed Project.

E.5.1 Cultural Context

E.5.1.1 Prehistoric Period

The earliest evidence for human occupation in the Upper Ohio River Valley dates to the Late Pleistocene. At the end of the Pleistocene, continental ice sheets blanketed much of the northeastern United States and extended as far south as New Castle, Pennsylvania. However, archaeological investigations at Meadowcroft Rockshelter in nearby Washington County, Pennsylvania, suggest that Paleoindian hunter-gatherers were occupying areas south of the glacial margin as early as 14,555 B.P. Seasonal changes in resource availability meant that Paleoindian groups developed resource procurement strategies that required seasonal migration. Intact archaeological sites in the Northeast and in the New England-Maritimes suggest that Paleoindian populations favored rich ecological zones associated with swamps, rivers, and postglacial lakes (Pasquariello and Loorya 2006).

A warming climate and a greater ecological diversity following glacial retreat prompted changes in subsistence strategies and technologies (Ritchie 1965). The changing climatic conditions during the Archaic period (10,000 to 3,000 B.P.) saw the emergence of mixed deciduous-coniferous forests and the appearance of essentially modern faunal assemblages in the Northeast (Quinn 1999). Technological developments, such as smaller projectile points, indicate a shift toward locally available fauna, such as white-tailed deer, turkey, waterfowl, and black bear. Seasonal availability of game animals, aquatic resources, and wild plant foods continued to make hunting and foraging successful resource procurement strategies, and allowed for population growth throughout the Northeast (Fagan 2000).

Archaeological evidence from southwestern Pennsylvania reflects a "Pan-Appalachian" stylistic affinity in diagnostic tool types during the Middle Archaic (Adovasio et al. 1998). While the exact nature of this Pan-Appalachian influence is unclear, such a relationship suggests that populations in the vicinity of the proposed Project adopted technologies and cultural patterns radiating from points south (Adovasio et al. 1998). By the Late Archaic, the geographical scope of these relationships had expanded, and the archaeological record indicates similarities in diagnostic tool types that extend into New York State.

Archaeologists have long recognized a Terminal Archaic period that bridges the Archaic and Woodland periods in the Northeast (Ritchie 1965). The Terminal Archaic period saw an expansion in the distribution of sites at different elevations from valley floors to ridgetops. This transitional period is also characterized by a greater typological diversity in lithic tools and projectile points.

The Woodland period (3,000 B.P.–AD 1550) was characterized by widespread and significant changes in cultural patterns across the Northeast (Quinn 1999). The transition from the Archaic to the Early Woodland period is typically defined by the manufacture and use of ceramic vessels. This development occurred in areas of eastern North America during the Late Archaic but became widespread in the Northeast approximately 3,000 B.P. (Quinn 1999; Stewart 2003).

Early Woodland cultural traditions are evidence of the continuation, adaptation, and intensification of Archaic period cultural trends (Fagan 2000). In the Upper Ohio River Valley, these trends culminated in the emergence of the Adena ceremonial complex at the end of the Early Woodland period (Stewart 2003; Fagan 2000). The Adena complex was marked by a focus on mortuary ceremonialism that is exemplified in the estimated 300 to 500 burial mounds that may once have existed across the Ohio River Basin (Fagan 2000). Adena burial mounds reveal the complexity of social, religious, economic, and political relationships at the end of the Early Woodland period.

The Middle Woodland is perhaps best known across the Ohio River Basin for the emergence of the Hopewell Interaction Sphere, a broad cultural pattern that influenced cultural traditions from the American Midwest to the Great Lakes (Quinn 1999). Centered in southern Ohio, the Hopewell culture had antecedents in the Adena complex of the Early Woodland (Cowin 2003). The Middle Woodland also saw an increased reliance on incipient horticulture to augment hunting and gathering subsistence practices. Concomitant with an increase in cultivation, regional populations trended toward more sedentary villages and intensified seasonal foraging. Although these practices set the stage for larger changes during the Late Woodland, there is little evidence of large-scale sedentism or intensive horticulture during the Middle Woodland period in southwestern Pennsylvania.

Maize, bean, and squash horticulture became an increasingly important source of subsistence throughout the region during the Late Woodland period. Major sociopolitical changes accompanied these developments, including increased territorialization and changes in residence patterns. By the Late Woodland period, a distinctive Monongahela culture was present in the Upper Ohio River Valley. The Foley Farm-phase cultural assemblage that emerged toward the end of the Late Woodland period reveals significant changes in Monongahela cultural practices (Grumet 1995). Foley Farm-phase ceramics indicate increased contact with Iroquoian groups living to the north, and Susquehannock communities in the eastern part of the Commonwealth (Grumet 1995). Settlement patterns during the Foley Farm-phase also suggest dramatic shifts towards concentrated and fortified villages. The shifting residential patterns are similar to those of the neighboring Iroquoian and Susquehannock communities during the end of the Late Woodland period, and they suggest amplified hostilities brought about by increased competition for resources (Grumet 1995).

E.5.1.2 Historic Period

While direct contact between Native Americans and Europeans in the Trans-Appalachian region did not occur until the 17th century, European trade items were obtained by indigenous coastal groups from European fishing and whaling fleets and made their way inland through trading intermediaries during the 16th century (Quiggle 2008; Grumet 1995). By the 1680s, William Penn had established a colony in the eastern portion of Pennsylvania on land granted to him by the King of England. Notwithstanding the success of Penn’s colony near Philadelphia, the European presence west of Pennsylvania’s Appalachian Mountains remained ephemeral and transitory throughout most of the 17th century.

In many ways, the European colonial expansion in the 18th century was driven by the fur trade (Grumet 1995; Wolf 1982). By the early 1700s, both the French and English had established trading posts in Pennsylvania, south of Lake Erie. The construction of Fort Niagara in 1726 allowed the French to expand their control over the region, and, by the mid-18th century, they had established a string of fortifications along the Niagara Frontier and along the southern shore of Lake Erie to present-day Erie, Pennsylvania (Quiggle 2008). While the French presence was established in the Great Lakes region, competing interest from the British increased across southwestern Pennsylvania. Both nations struggled to control trade and to win support of the powerful Iroquois Tribes that dominated the region.

The site of the present-day City of Pittsburgh was still a frontier area during the mid-18th century when hostilities erupted between the French and the English. During the French and Indian War, southwestern Pennsylvania became the primary battleground for control of the continent (Commager 1999). The French established Fort Duquesne at the confluence of the Allegheny, Ohio, and Monongahela rivers as part of a string of fortifications designed to protect their access to critical inland waterways. The initial attempts by the British to wrest control of the region from the French and their Indian allies failed dramatically (Commager 1999). However, by the late 1750s, the cost of the conflict and the mounting number of military defeats became more than the French could bear. By the time the British captured Fort Duquesne in 1758 (renaming it Fort Pitt), the conflict was nearing its end, and the British had emerged as the dominant colonial power in the New World (Commager 1999).

Because of its relatively isolated location along the western frontier, southwestern Pennsylvania escaped direct conflict during the American Revolution. With the cessation of hostilities between the British and the Americans in 1783, the Pittsburgh region became the gateway to the American west (Lorant 1999). Goods and cargo flowing through the inland port of Pittsburgh provided the stimulus for economic development throughout the late 1700s and early 1800s.

The natural coal fields of western Pennsylvania spurred the growth of the iron and steel industry. Following the invention of the Bessemer process, the Pittsburgh region became one of the largest steel-producing centers in the world (Handlin 1999). Pittsburgh's industries blossomed during the Civil War, and by the 1900s, steel mills crowded the city's waterfront. One of the largest of these steel mills was the Edgar Thomson Works of the Carnegie Steel Company, located on the shores of the Monongahela River in North Braddock. Coal mines across southwestern Pennsylvania fueled the mills and the industrial growth of the region through the early 1900s. Employment in the steel mills and coal mines attracted waves of immigrants to the Pittsburgh region during this period (Handlin 1999). Despite this economic growth, the poor wages, dangerous working conditions, long hours, and exhausting labor led to bitterly contested labor disputes that rippled through the coal fields and steel mills of southwestern Pennsylvania during the 19th and early-20th centuries (David 1999).

Notwithstanding this labor unrest, the region's proximity to inland waterways, the availability of steel and coal, and the large immigrant workforce made Pittsburgh and southwestern Pennsylvania one of the principal industrial and manufacturing hubs in the country by the mid-20th century. The demand for steel and the industrial growth of the Pittsburgh region continued until after World War II, when production in wartime industries declined.

E.5.2 Known Archaeological and Historic Resources in the Proposed Project's Vicinity

Hydro Friends Fund conducted a search of the Pennsylvania Historic Museum Commission's Cultural Resources Geographic Information System to identify known archaeological historic and archaeological resources within the proposed Project vicinity, including those properties listed in or eligible for the National Register of Historic Places (National Register). While an area of potential effects had not yet been determined for this undertaking, Hydro Friends Fund continues to believe that the proposed Project's footprint within the proposed FERC project boundary depicted in Exhibit G of this application combined with its potential to impact historic properties are limited. Notwithstanding the limited potential impacts associated with the proposed Project, Hydro Friends Fund reviewed Cultural Resources Geographic Information System data to identify archaeological and historic resources within approximately 1,500 feet of the Braddock Locks and Dam. This review was undertaken to better characterize the nature and types of known resources in the proposed Project vicinity.

E.5.2.1 Archaeological Resources

No known archaeological resources listed in or eligible for inclusion in the National Register have been reported within 1,500 feet of the proposed Project. However, one archaeological resource has been identified upstream of the Braddock Locks and Dam. The Monongahela Navigation Company (MNC) Lock and Dam 2 (36AL0542) was constructed by the MNC between 1838 and 1841. The lock and dam was operated by the MNC between 1841 and 1906 when the original structure was replaced by the USACE Braddock Locks and Dam. The submerged archaeological remains of the original MNC Lock and Dam 2 are located more that 2,900 feet upstream from the Braddock Locks and Dam, well outside of the proposed Project boundary.

E.5.2.2 Historic Resources

Known historic resources within the proposed Project vicinity include buildings, structures, and districts listed in or eligible for inclusion in the National Register. The Braddock Locks and Dam, which was completely replaced and returned to service in 2004 (Weiser 2010), is a component of the National Register-listed Monongahela River Navigation System. Table E.5.2.2-1 summarizes other known historic resources within approximately 1,500 feet of the proposed Project. None of the historic properties described in Table E.5.2.2-1 are located within the Project boundary depicted in Exhibit G of this application (the prospective area of potential effects for this undertaking).

As noted Table E.5.2.2-1, a National Historic Landmark district is located within the proposed Project's vicinity. Kennywood Amusement Park is a historic amusement park located near the left shoreline of the Monongahela River. While within the general vicinity of the proposed Project, Kennywood Amusement Park is separated from the Monongahela River by extensive rail lines and associated railway infrastructure. Construction and operation of the proposed Project are not expected to impact this National Historic Landmark.

A map of historic buildings, structures, and districts in Allegheny County that are listed in or eligible for inclusion in the National Register has been included as Figure E.5.2.2-1. Figure E.5.2.2-1 also identifies City of Pittsburgh Designated Historic Landmarks, none of which are located in the proposed Project's vicinity.

Table E.5.2.2-1 Historic resources within approximately 1,500 feet of the proposed Project.

Resource Name	Resource Type	Description	National Register Status	Notes
Braddock Locks and Dam	Historic Structure	Locks and dam	Listed	Component of the National Register-listed Monongahela River Navigation System
Pittsburgh & Lake Erie Railroad (Port Perry to Rankin)	Historic District	Linear resource	Eligible	—
Baltimore & Ohio Railroad: Pittsburgh Division (Maryland Line to City of Pittsburgh)	Historic District	Linear resource	Eligible	—
Union Railroad (Dravosburg Borough to Monroeville Borough)	Historic District	Linear resource	Eligible	—
Pennsylvania Railroad: Monongahela Line	Historic District	Linear resource	Eligible	—
Edgar Thomson Works of the Carnegie Steel Company	NA	Historic manufacturing facility	Eligible	—
Kennywood Amusement Park	District	Historic amusement park	Listed	National Historic Landmark
Union Railroad Trestle	Structure	Railroad bridge	Eligible	—

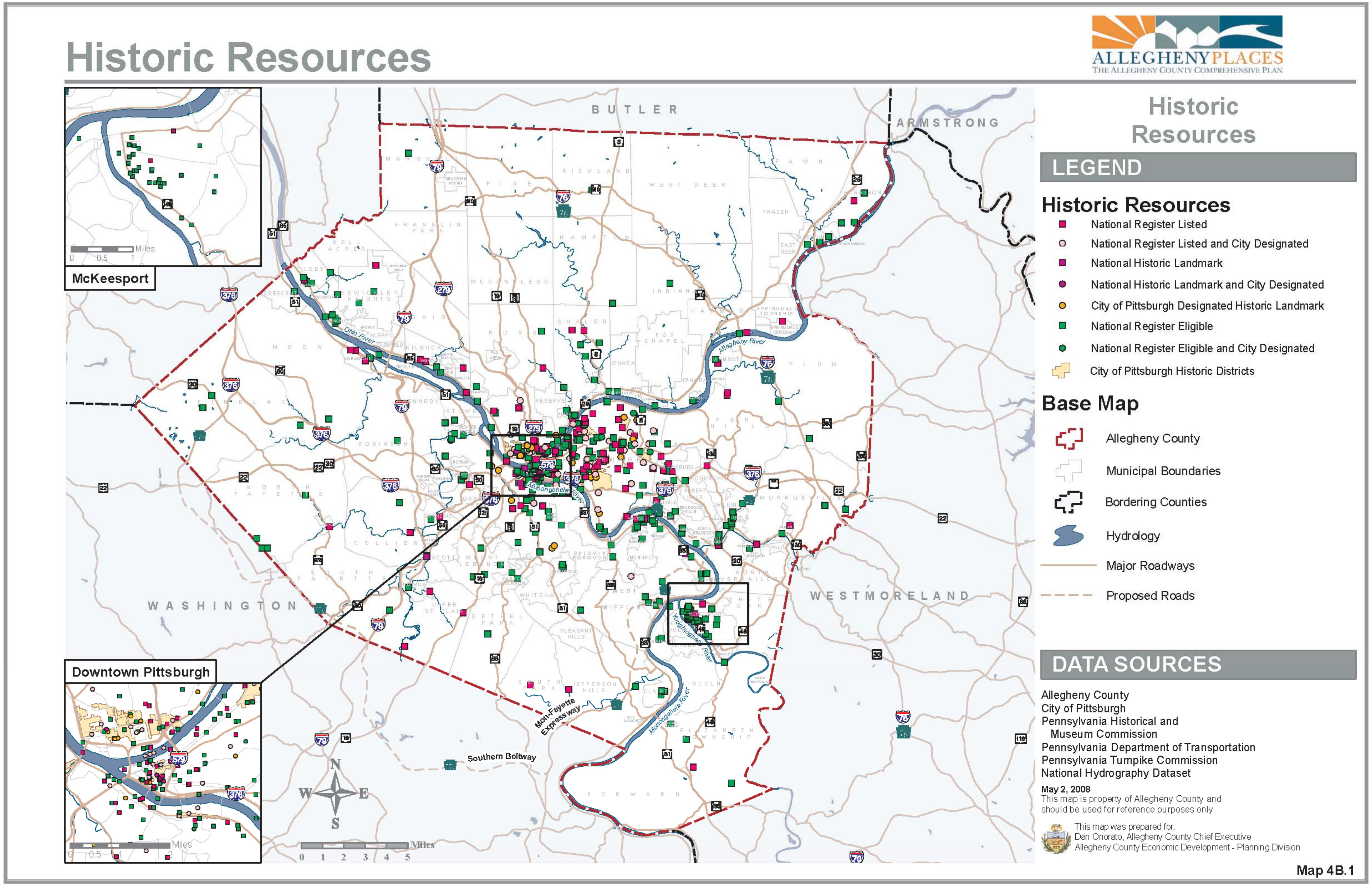


Figure E.5.2.2-1 **Historic resources for Allegheny County, Pennsylvania.**

E.5.3 Existing Discovery Measures

The USACE has undertaken extensive surveys and inventories for the purpose of locating, identifying, and assessing historic and archaeological resources within the vicinity of the proposed Project. These studies were primarily undertaken in association with USACE's Lower Monongahela River Project to modernize Locks and Dams 2, 3, and 4 on the Monongahela River in Allegheny, Washington, and Westmoreland counties, Pennsylvania (Lower Mon Project). Studies conducted within the proposed Project's vicinity include:

- A literature review and preliminary field reconnaissance of the shoreline of Monongahela River Pools No. 2 and 3, upstream from the Braddock Locks and Dam;
- Archaeological investigations of sites selected for the relocation of municipal facilities potentially impacted by the Lower Mon Project;
- A high-resolution, side-scan sonar investigation of Monongahela River Pool 3;
- Documentation of timbers and stones removed from the Monongahela River during 2006 dredging operations;
- Phase I and II submerged cultural resources investigations in Monongahela River Pool 3;
- Geomorphological investigations along the lower Monongahela River;
- A historical engineering evaluation of the Monongahela River Navigation System;
- Historic American Engineering Record documentation of the Braddock Locks and Dam; and
- Development and submission of a National Register Multiple Property thematic nomination for the historic resources of the Monongahela River Navigation System in Pennsylvania and West Virginia, 1838-1960.

In addition to these studies conducted by the USACE, archaeological investigations have been conducted in the proposed Project's vicinity in association with the proposed Mon/Fayette Expressway Project. These investigations included Phase I background research, field testing, and Phase II site evaluations.

E.5.4 Identification of Indian Tribes

Hydro Friends Fund has identified Tribes with a potential interest in the proposed Project through the Pennsylvania Department of Transportation’s (PennDOT) Interim Guidance/Procedures for Tribal Consultation and the associated List of Tribal Contacts (PennDOT undated 2008). In addition to the resources available from PennDOT, Hydro Friends Fund also consulted with the National Park Service's (NPS) Native American Contact Database and the Grand Council of the Haudenosaunee’s 2008 guidance document, entitled *Building Relationships between Federal Agencies and the Haudenosaunee*, to finalize an appropriate contact list (NPS 2009; Grand Council of the Haudenosaunee 2002).

A total of 12 Tribes with a potential interest in the proposed Project have been identified, including: the Oneida Tribe of Indians of Wisconsin, the St. Regis Mohawk Tribe, the Stockbridge-Munsee Community of Wisconsin, the Oneida Nation of New York, the Shawnee Tribe, the Seneca-Cayuga Tribe of Oklahoma, the Onondaga Nation of New York, the Seneca Nation of Indians, the Cayuga Nation of New York, the Eastern Shawnee Tribe of Oklahoma, the Tonawanda Band of Seneca Indians, and the Tuscarora Nation of New York.

E.5.5 Section 106 Consultation

Hydro Friends Fund initiated informal Section 106 consultation with the Pennsylvania State Historic Preservation Office (SHPO) and identified Indian Tribes with the distribution of the Pre-Application Document (PAD) Questionnaire on October 11, 2011 seeking existing information on information on known historic properties in the Project area. The only response related to historic properties was from the SHPO who asked for more information on the proposed Project on November 18, 2011.

On January 6, 2012, FERC sent letters to the identified Indian Tribes notifying them of Hydro Friends Fund’s request to use the Traditional Licensing Process, inviting these Tribes to participate in the licensing process for this Project, and asking whether they intended to participate. Hydro Friends Fund is not aware that any Tribes responded to FERC’s request expressing an interest in this proceeding. On February 10, 2012, FERC issued a public notice of Hydro Friends Fund’s notice of intent to file a license application, noting FERC’s approval of the Traditional Licensing Process on January 30, 2012 and designating Hydro Friends Fund as

FERC's non-federal representative for carrying out consultation pursuant to Section 106 of the National Historic Preservation Act.

On March 20, 2012, Hydro Friends Fund submitted the additional information on the proposed Project requested by the SHPO and on April 17, 2012 the SHPO submitted their determination that although there exists a high probability that archeological resources are located in the Project area, that the proposed Project will have no effects on either archeological sites or on the National Register-listed Monongahela River Navigation System. Copies of the consultation material referenced in this section are included in Appendix E-3.

As noted above, Hydro Friends Fund has not seen any response from the identified potentially interested Indian Tribes but, in a continuing effort to make a reasonable and good faith effort to offer the Tribes an opportunity to participate, is filing a copy of this license application with the Tribes for review and comment.

E.6 REPORT ON SOCIOECONOMIC RESOURCES

Although a report on socioeconomic resources is not a requirement under 18 CFR §4.61 Application for a New License for Minor or Major Water Power Projects 5 Megawatts or Less, Hydro Friends Fund has provided a brief description of socioeconomic information in the Project area. Hydro Friends Fund believes the Project will have a positive local economic impact during the development and construction phase of the proposed Project. Positive economic impacts will continue during operation of the proposed Project through various local and state taxes, employment, and production of renewable energy.

E.6.1 Existing Socioeconomic Conditions

The proposed Project is located in the Pittsburgh metropolitan area, specifically in the Borough of Braddock, Pennsylvania in Allegheny County. The Pittsburgh region as a whole has seen population decline in the central city and the metropolitan area, and between 1970 and 2000 the population of the city fell by 35.7% (from approximately 520,000 to 335,00 people) (Committee on Water Quality Improvement for the Pittsburgh Region, National Research Council 2005). The 2010 census reported that 305,704 people reside in the City of Pittsburgh, which is an 8.6% reduction from the 2000 census population.

The City of Pittsburgh is located in Allegheny County. The 2010 population for Allegheny County was 1,223,348 persons, which is a 4.6% reduction from the 2000 census population (U.S. Census Bureau 2011*)*. Table E.6.1-1 provides socioeconomic statistics for the City of Pittsburgh, Allegheny County, and the Commonwealth of Pennsylvania.

Table E.6.1-1 Statistics for the City of Pittsburgh, Allegheny County, and the Commonwealth of Pennsylvania.

Description	City of Pittsburgh	Allegheny County	Commonwealth of Pennsylvania
Population (2000)	334,563	1,281,666	12,281,054
Population (2010)	305,704	1,223,348	12,702,379
Persons with Bachelor's Degree or Higher (2005-2009) Age 25+	33.20%	33.50%	26.00%
Median Household Income (2005-2009)	$35,732	$46,212	$49,737
Percent of Persons Below Poverty Level (2009)	21.7%*	13.00%	12.50%
Unemployment Rate (September 2011)**	6.80%	7.20%	7.50%
Total Number of Firms (2007)	24,605	95,698	981,501

Source: U.S. Census Bureau 2011

The Allegheny Institute for Public Policy reports that the U.S. Department of Labor statistics in 2010 found that the Pittsburgh metropolitan area has fewer private sector jobs as of 2011 than a decade ago. The area lost on average 32,000 jobs from the same month 2 years prior during the 2008 to 2010 recession. A year or more prior to the recession, the average job growth was moderate at approximately 1% per year, and the post-recovery period has been sluggish due to the total number of private jobs not climbing above levels posted more than a decade before (Allegheny Institute for Public Policy 2011).

The Pittsburgh region has a concentration of jobs in the education and health sector and the professional and business sector. These two sectors have added more than 50,000 workers since 2000 and account for almost all net new jobs in the region. However, manufacturing and retail trades are still experiencing losses and stagnation. Pittsburgh does possess several strong economic attributes such as quality medical facilities and higher education institutions, which help sustain the regional economy but are not entirely sufficient at spurring long-term economic well-being in the private sector (Allegheny Institute for Public Policy 2011).

Coal has been mined across Pennsylvania's main bituminous coal field for more than 200 years, providing the fuel for the steel industry in the Pittsburgh region and beyond (PADCNR 2000; Durant undated). Although bituminous coal mining production has declined in recent years, mining operations in Pennsylvania still produced 63.5 million tons of coal in 2007 (Freme 2008).

There are two active strip mines within Allegheny County, one in South Park Township and one in Findlay Township. There are no active underground mines currently operating in Allegheny County.

In addition to coal production, the most recent minerals yearbook for Pennsylvania lists the Commonwealth as 13th in the nation in total nonfuel mineral production value, with a total value of $1.97 billion. Nonfuel raw minerals and commodities recorded for Allegheny County during 2009 include vermiculite, sulfur (oil), steel, and common clay (USGS 2008).

There are four sites of industrial mineral mining within Allegheny County (Allegheny County Economic Development [ACED] Planning Division 2008):

- McShane Quarry (sandstone) in Collier Township
- Brown Reserve Site (slag) in West Mifflin Borough
- Redland Brick Inc. (shale/clay) in Harmar Township
- Gascola Pit (slag) in the Municipality of Penn Hills

In addition, 4.5 million tons of river aggregate is dredged from the Allegheny and Ohio rivers per year to meet industry needs in Allegheny County (ACED Planning Division 2008). The USACE is currently managing the Lower Mon Project in which approximately 1.2 million cubic yards of river bed material, mostly sands, gravels, and coal fines will be dredged from the river bottom upstream of Elizabeth. These materials will be used to reclaim a former slag dump in Washington County, Pennsylvania (USACE 2011b).

E.6.2 Economic Benefits from Proposed Project

The proposed Project will offer benefits to the region by providing low-cost renewable energy; local county and state tax payments; and employment related to the construction, operation, and maintenance of the Project facilities.

- **Renewable Energy:** The proposed Project will offer efficient, reliable, and cost-effective hydropower. The Project will produce approximately 3.75 MW from generator to the electric grid. This amount of generating capacity is capable of providing the equivalent of approximately 2,800 households with electricity each year, assuming 1 MW of power services an average of 750 households per year.
- **Taxes:** Hydro Friends Fund will be subject to a variety of state and local taxes. The taxes paid by Hydro Friends Fund will positively affect the public as state taxes are deposited into general funds, which are directed, in part, back to the county and city governments.
- **Employment:** The proposed Project will have a positive local economic impact on the area, especially in the development phase of the Project. During the construction and installation of the Project, Hydro Friends Fund predicts approximately 130 jobs will be created during a six- to nine-month window. After construction and installation, one individual will be hired full time to manage the facility. Hydro Friends Fund has pledged to hire local qualified individuals and purchase services and equipment from local companies where possible.

E.7 REPORT ON GEOLOGICAL AND SOIL RESOURCES

E.7.1 Existing Environment

The basin, including the proposed Project area, is included within the Appalachian Plateaus Physiographic Province. Exposed geologic formations in this Province are sedimentary in origin and Pennsylvanian or Permian in age. Quaternary age alluvial deposits are also present along lakes, rivers, and streams in this province. Glacial deposits are absent from the region since the area is beyond the southern limit of Pleistocene glacial advances (West Virginia Geological and Economic Survey 2005). The land surface is underlain by sedimentary rocks (sandstone, shale, coal, and limestone) of Pennsylvanian, Mississippian, and Devonian age that are fractured and have been faulted and folded in many areas. A layer of weathered rock material, and Quaternary glaciofluvial deposits, and alluvium sits on top of the bedrock. The weathered rock material is generally thin (less than 20 feet), the glaciofluvial deposits commonly range in thickness from 20 to 500 feet, and the alluvium is generally less than 100 feet thick (USGS 1995).

Geologic formations in the proposed Project's vicinity are relatively flat-lying, horizontally bedded, Pennsylvanian age, sedimentary deposits. The sedimentary deposits have a slight westward dip and are generally thin gradually from east to west. The Pennsylvanian age sedimentary deposits are part of a relatively thick sequence of interbedded sandstone and shale with occasional calcareous shale, limestone, and coal deposits.

Relief is generally greatest in the southeastern mountainous areas where the valleys are wide with steep sides and the uplands are broad, linear ridges. The relief is lowest and valleys and uplands are wide in the northern areas that have been eroded by glacial activity (USGS 1995). The present topography was formed by regional uplift of the sedimentary deposits during the Appalachian Orogeny in the Permian Period. Following regional uplift, deposition of new material ceased and erosion of exposed sedimentary layers began. The continued erosion of the sedimentary deposits over the remainder of geologic time gradually formed the ridge and valley structures that make up the present topography. The result is a dendritic pattern of relatively steep valleys and high ridges throughout the Appalachian Plateau Province. The ridges and steep valleys are formed by gradual erosion of the sedimentary layers by rivers, streams, and intermittent drainage features of the region (USGS and U.S. Bureau of Mines [USBM] 1968). Figure E7.1-1 presents a topography map of the proposed Project area.

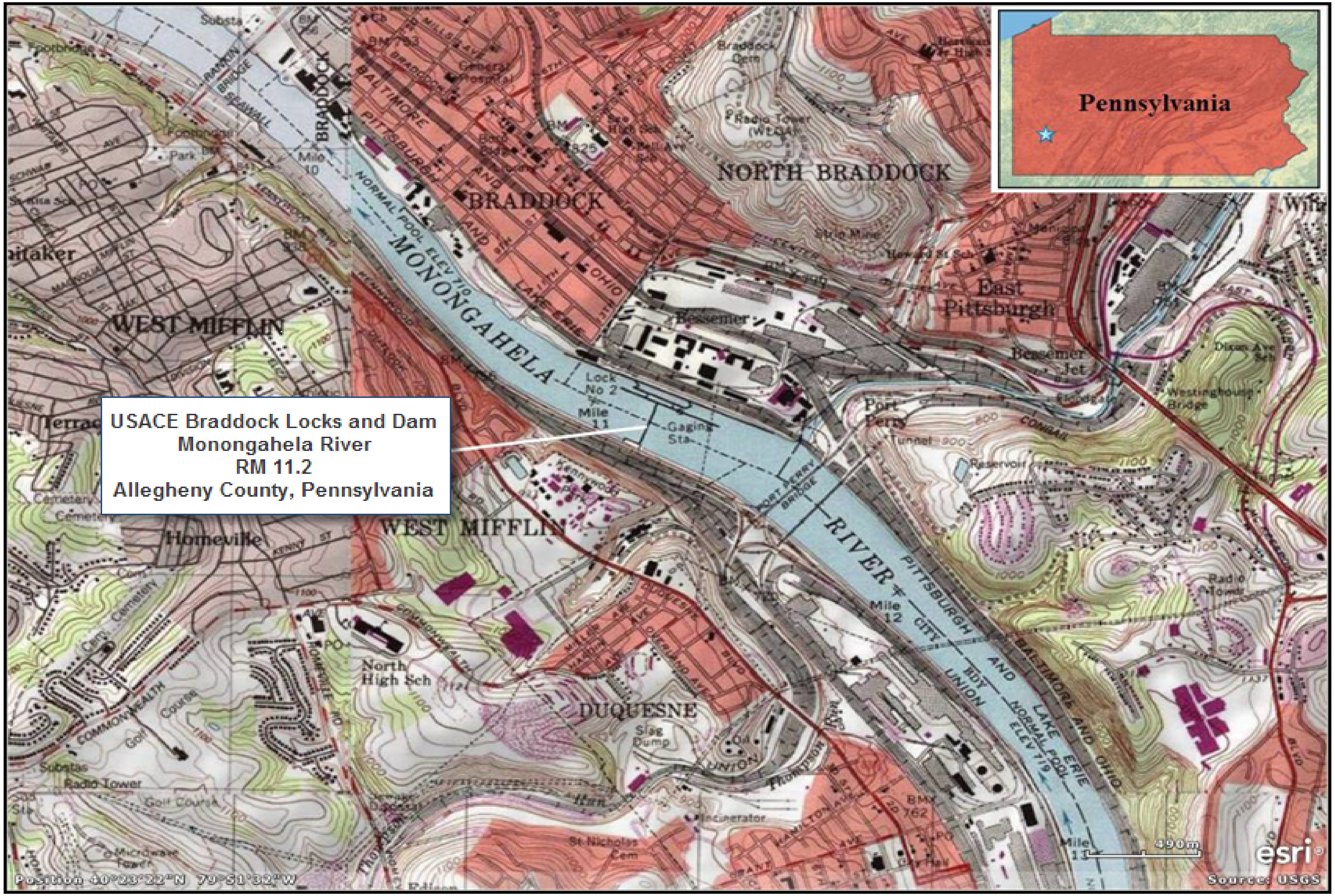


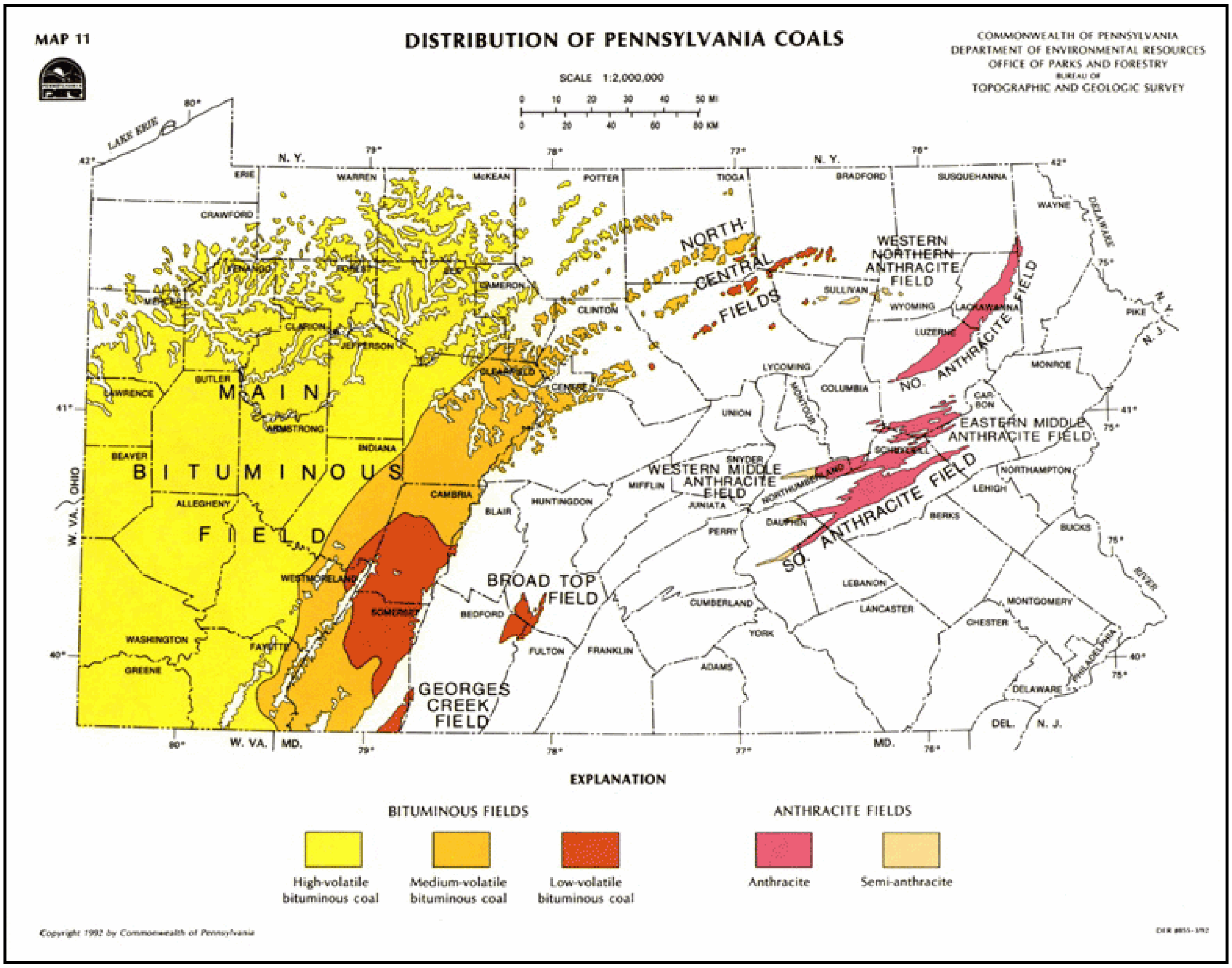
Figure E.7.1-1 Topography surrounding the USACE Braddock Locks and Dam.

Although the geologic formations are relatively flat lying and dip from the east to the west, the presence of several anticlines and synclines can cause this trend to be disrupted in some locations. The anticline and syncline structures are generally broad and flat, but some cause locally steeper dips in the structure. The overall trend of these structures is northeast to southwest, although locally, variations can trend to the north and even northwest (USGS and USBM 1968).

Soils in the region are generally derived in place from physical and chemical weathering of the bedrock materials. Because of the steepness of the landscape and erodibility of the geology, the soil cover along the ridges and valleys in the region tends to be relatively thin. Soil sequences along ridges and valleys are commonly 3 to 4 feet thick overlying the sedimentary bedrock. Thicker soil sequences may be present in benches on valley slopes, or at the base of the valleys, in floodplains, and along stream terraces. Soil sequences in these areas are typically 5 feet or more in thickness overlying the sedimentary bedrock (U.S. Department of Agriculture Soil Conservation Service 1977).

E.7.1.1 Coal Resources

Sedimentary beds deposited during the Pennsylvanian Period contain large bituminous coal seams in the western half of Pennsylvania. The coal beds are of significant economic interest and are mined in many locations where they are of sufficient thickness. Allegheny County is within the Main Bituminous Field of Pennsylvania; specifically within the area of high volatile bituminous coal (ACED Planning Division 2008). See Figure E.7.1.1-1 for the geographic distribution of coal resources in Pennsylvania (PADCNR undated).



Source: PADCNR undated

Figure E.7.1.1-1 Geographic distribution of coal in Pennsylvania.

E.7.1.2 Geological Features

The geology of the proposed Project area consists of sedimentary formations primarily composed of sandstone, siltstone, and shale. In the site vicinity, these deposits are part of the Pennsylvanian age Conemaugh and Monongahela Formations. The Pennsylvanian Washington Formation (i.e., Dunkard Group) is also present near the tops of ridges to the west of the Monongahela River. Occasional limestone or calcareous shale deposits and coal deposits are present within the sandstone and shale of these formations (McColloch and McColloch 2005).

E.7.1.2.1 Structural Geology/Seismicity

The geologic materials are relatively flat-lying with gradual thinning and dipping from east to west. Faulting is generally absent from bedrock exposures visible at the ground surface (Hennen and Reger 1913). Jointing is present in the Pennsylvanian sedimentary deposits. Joints typically have a principal set with strike direction to the north-northeast and a secondary set approximately perpendicular to the primary set (Carlston 1958). The National Seismic Hazard Mapping Project developed by the USGS states that there are no faults within 100 miles of the proposed Project.

E.7.1.2.2 Dam Site Geology

The proposed Project is located within the Casselman Formation. The primary rock type is shale and the secondary rock type is siltstone or limestone (PADCNR undated b) (Figure E.7.1.2-1). Records of specific geologic materials encountered at the dam sites were not available.

E.7.1.3 Soils

Figure E.7.1.3-1 presents a map of the soils located near the proposed Project, and Table E.7.1.3-1 presents definitions for the map unit symbols associated with Figure E.7.1.3-1. The soil map units represent soils or miscellaneous areas in the Project vicinity. Map unit delineation on a soil map represents an area that is dominated by one or more major soil types. Soils in areas of steep slope are commonly shallow, weakly developed, poorly drained, and have low fertility and high erosion potential. Soils on gentler slopes and soils over unconsolidated sediments are commonly deep, well-drained, and fertile (USGS 1995).

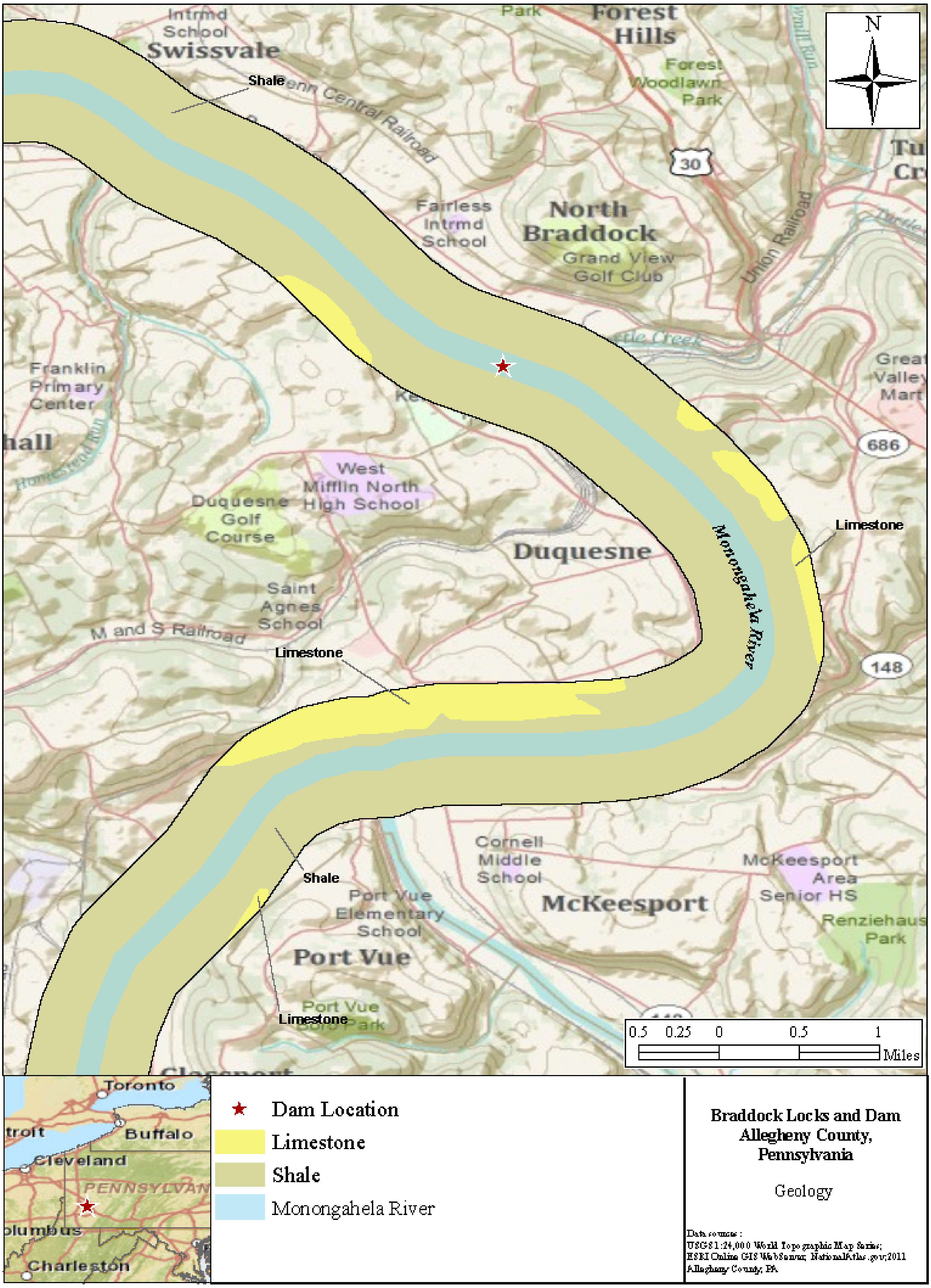


Figure E.7.1.2-1 Geology surrounding the Braddock Locks and Dam.

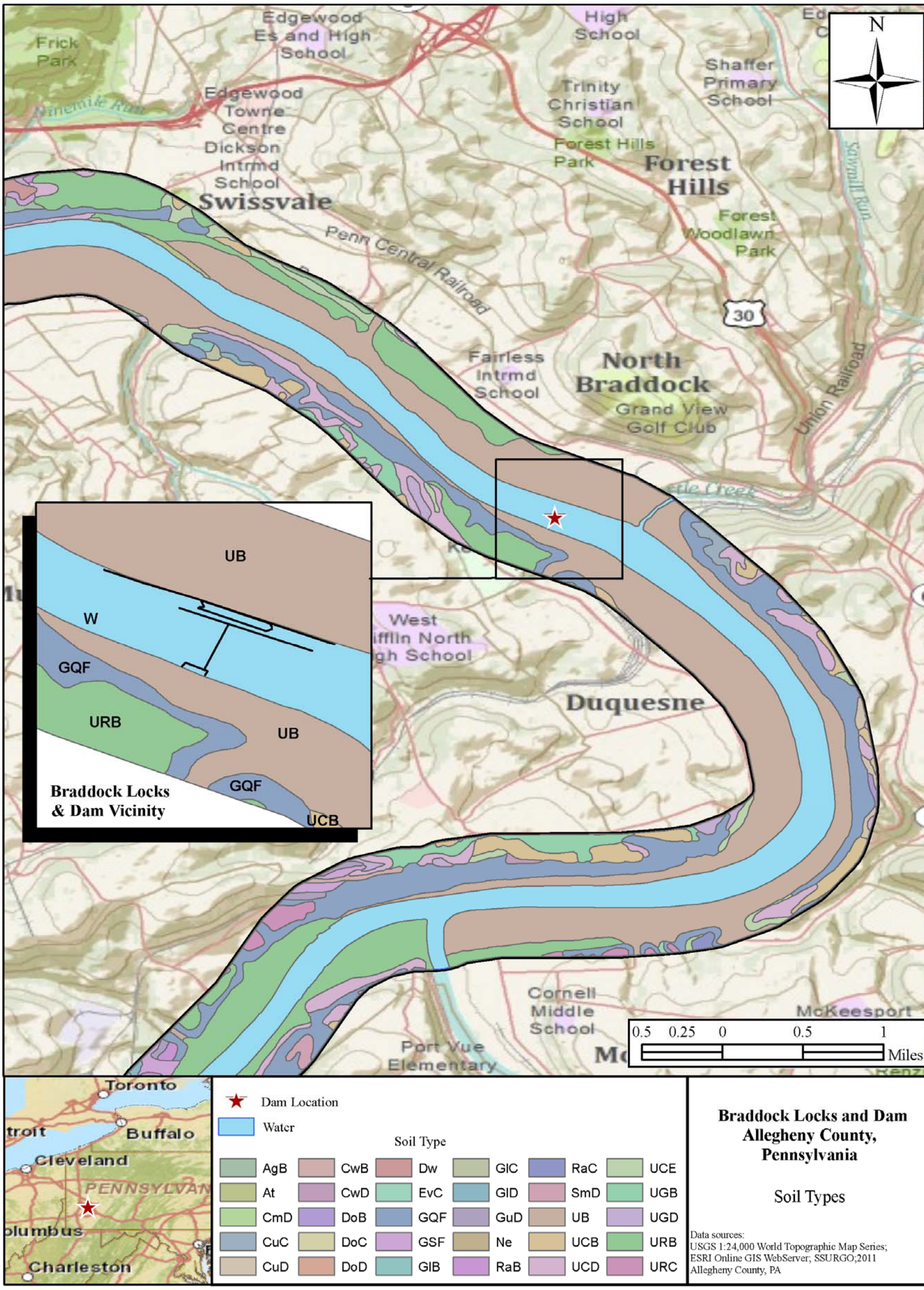


Figure E.7.1.3-1 Soil types surrounding the Braddock Locks and Dam.

Table E.7.1.3-1 Soil types surrounding proposed Project (companion table to Figure E.7.1.3-1).

Map Unit Symbol	Map Unit Name and Slope
GQF	Gilpin-Upshur complex, very steep
UB	Urban land, consociation
URB	Urban land-Rainsboro complex, gently sloping
W	Water

E.7.1.4 Reservoir Shoreline and Streambanks

The proposed Project will not include or create a reservoir, and therefore, will have no effect on current shoreline uses or management. However, it is important to note that based on the mapped soil types, soils in the vicinity of the proposed Project have been significantly modified with urban fill and the existing shoreline consists primarily of gravelly soils formed on outwash deposits. The river-right bank of the Monongahela River at the proposed Project is flanked by a concrete embankment that comprises part of the locks structure, while the remaining shoreline is buffered by rip rap.

E.7.2 Affected Environment

The proposed Project is not expected to affect the geology or soils found in the Project area and vicinity. Project operations will not adjust flows so that shorelines or streambanks will be altered. In addition, no new permanent structures are proposed that will alter the current geology or soils in the project area, and best management practices will be utilized to avoid any effects to these resources during construction.

E.8 REPORT ON RECREATIONAL RESOURCES

E.8.1 Existing Environment –Recreational Resources

Pennsylvania offers a variety of outdoor recreational opportunities through federal, state, and local agencies as well as through the private sector. Public outdoor recreational areas include state parks, scenic rivers, state forests, trails and greenways, local parks, campgrounds, golf courses, and amusement parks.

There are 10 county parks in Allegheny County and three state forests in the southwestern Pennsylvania region. Kennywood Amusement Park, which is a National Historic Landmark, is the closest recreational use area to the proposed Project and is located 0.2 mile southwest of the Braddock Locks and Dam in West Mifflin, Pennsylvania. The park was originally built in 1898 and offers a variety of rides and concessions.

Although the Project area is highly industrialized and there are no recreational facilities located within the Project boundary, a national scenic trail, the Great Allegheny Passage of the Potomac

Heritage National Scenic Trail, passes nearby. The Potomac Heritage National Scenic Trail is a 150-mile trail from Pittsburgh, Pennsylvania, to Cumberland, Maryland, that uses abandoned rail beds and provides primarily hiking and cycling opportunities.

E.8.1.1 Allegheny County Parks

Table E.8.1.1-1 contains information on the 10 Allegheny County parks that are within approximately 25 miles of the proposed Project. The locations of these parks are shown in relation to the proposed Project on Figure E.8.1.1-1 (Allegheny County Pennsylvania undated).

Table E.8.1.1-1 Allegheny County park recreational opportunities.

Recreation Facility	Address	Acreage	Amphi-theater	Cabins	Groves / Shelters	Hiking / Trails	Picnicking	Fishing	Vistas	Swimming	Golf Course	Playground	Ball Fields / Tennis Courts	Other
Kennywood Amusement Park	4800 Kennywood Blvd. West Mifflin, PA 15122	--												Amusement park rides and concession stands
North Park	Pearce Mill Road Allison Park, PA 15101	3,075		X	X	X		X	X	X	X	X	X	Horseshoe pits, ice skating, nature center, wildfowl reserve, dog park
South Park	Buffalo Drive South Park, PA 15129	2,013	X	X	X	X	X			X	X	X	X	Ice skating, theatre, gardens, horse show rink, café, dog park, bike rental, model airplane field, BMX track
Boyce Park	675 Old Frankstown Road Pittsburgh, PA 15239	1,096					X			X			X	Four-season activity center, nature center, action park, skiing and snow tubing, model airplane field, log house tours
Round Hill Park	651 Round Hill Road Elizabeth, PA 15037	1,101			X	X						X		Visitor center, day on the farm program
Deer Lakes Park	1090 Bailey Run Road Tarentum, PA 15084	1,180			X	X					X	X	X	Flying disc society, observatory
Harrison Hills Park	5200 Freeport Road Natrona Heights, PA 15065	500			X	X			X			X		Environmental learning center, wildlife observation blind, birding area, guided walks and nature camps
Hartwood Acres Park	200 Hartwood Acres Pittsburgh, PA 15238	629	X			X								Mansion/stable complex, guided tours
Settlers Cabin Park	1225 Greer Road Oakdale, PA 15071	1,610		X	X	X				X				Log cabin
White Oak Park	3 Muse Lane McKeesport, PA 15131	810			X	X						X		Ash-grove, garden, dog park

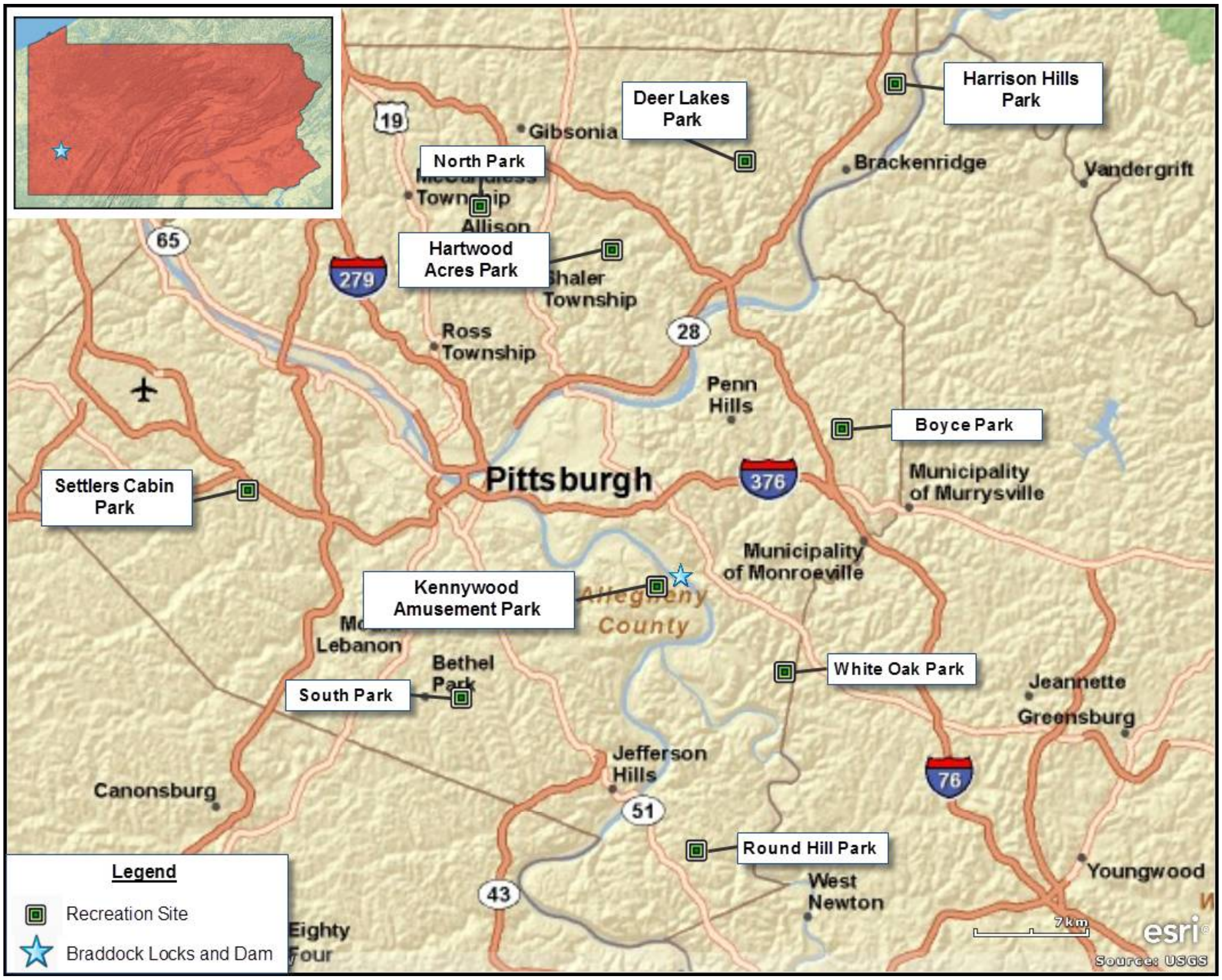


Figure E.8.1.1-1 Allegheny County park recreational facilities.

E.8.1.2 Regional State Forests

There are three state forests regionally located in southwestern Pennsylvania. A summary of the recreational opportunities associated with these resources is provided below.

Gallitzin State Forest

Gallitzin State Forest provides recreation opportunities such as (PADCNR undated b*)*:

- 51 miles of trails and roads suitable for hiking
- One developed state forest picnic area
- Primitive backpack camping
- Six designated campsites

- Hunting and fishing
- Horseback riding
- Mountain biking

Clear Creek State Forest

Clear Creek State Forest provides recreation opportunities such as (PADCNR undated c):

- 35 miles of trails and roads suitable for hiking
- Permitted camping
- Hunting and fishing
- Vistas
- Horseback riding
- Mountain biking

Forbes State Forest

The Forbes State Forest provides numerous recreation opportunities such as (PADCNR undated d):

- 250 miles of trails and roads suitable for hiking
- Two developed state forest picnic areas
- Primitive backpack camping
- Six designated motorized campsites
- Hunting and fishing
- Vistas
- Horseback riding
- Mountain biking

E.8.1.3 The Great Allegheny Passage

The 150-mile Great Allegheny Passage of the Potomac Heritage National Scenic Trail was primarily developed along abandoned rail corridors and runs along the western side of the

Monongahela River past the proposed Project. The trail runs from Pittsburgh, Pennsylvania, to Cumberland, Maryland, and is nearly complete. Figure E.8.1.1-2 presents a map of the trail in the vicinity of the proposed project (adjacent to Kennywood Amusement Park).

The trail predominantly consists of a packed, crushed limestone surface. Bicycling and hiking are the two most popular activities that occur along the trail, and sections of the trail system are open to equestrians. The trail system is accessible between dawn and dusk, and the winter snow allows for cross-country skiing and snowshoeing. Fishermen can take the trail to access fishing locations, and bird watching is another popular activity that occurs along the trail (The Allegheny Trail Alliance 2011). Plans to eventually connect with the 184.5-mile C&O Canal Towpath at Cumberland, Maryland, would create a 334.5-mile, traffic-free, and motorized-vehicle-free route between Pittsburgh and Washington, DC (The Allegheny Trail Alliance 2011).

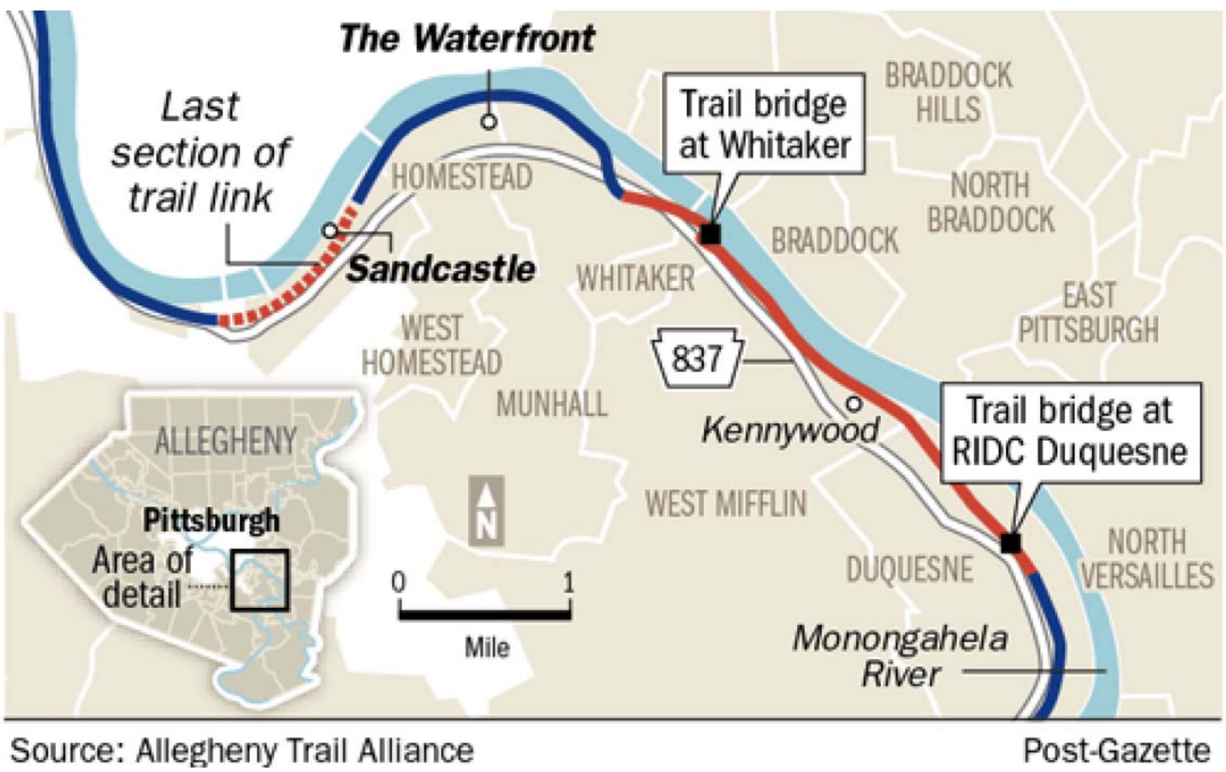


Figure E.8.1.1-2 Great Allegheny Passage Trail in the Project vicinity.

E.8.1.4 Existing Recreation Facilities and Opportunities

There are no developed recreational facilities or opportunities associated with the proposed Project, although fishing opportunities exist downstream of the Braddock Dam and along shoreline areas where accessible.

E.8.1.5 Existing Shoreline Buffer Zones

The proposed Project does not include an impoundment and thus no shoreline buffer zones exist within the proposed Project Boundary.

E.8.2 Recreational Use Needs Identified in Management Plans

As discussed above, no recreational facilities are located within the proposed Project and no focused study of recreational use was conducted in the Project vicinity, given the current industrial landscape and limited recreational resources in the area. The Pennsylvania Outdoor Recreation Plan does not identify any planning issues or related recommendations that would be relevant to the proposed Project lands or the installation or operation of the proposed Project. A summary of the Pennsylvania Outdoor Recreation Plan has been provided below for reference purposes.

E.8.2.1 Pennsylvania Outdoor Recreation Plan

Every five years, Pennsylvania is required to produce a new statewide plan to remain eligible to receive federal Land and Water Conservation Fund. The NPS requires that each plan assesses outdoor recreation resources, identifies the current challenges of recreation providers, analyzes the current recreational needs of residents, and outlines a course of action to improve and enhance the state of outdoor recreation over the next five years (PADCNR 2011).

The Pennsylvania Outdoor Recreation Plan contains 28 programmatic and five funding recommendations to enhance outdoor recreation facilities and services throughout the state. These recommendations are organized under four major goals of the plan: (1) strengthen connections between outdoor recreation, healthy lifestyles, and economic benefits in communities; (2) reconnect people to the outdoors and develop a stewardship ethic through outdoor recreation; (3) develop a statewide land and water trail network to facilitate recreation, transportation, and healthy lifestyles; and (4) enhance outdoor recreation through better state agency cooperation (PADCNR 2011).

Several surveys were conducted for the development of the Plan. The following represents the findings of two of the surveys conducted—the Resident Survey and the Trail Gap Survey (Table E.8.2.1-1).

Table E.8.2.1-1 Resident survey results for the Pennsylvania Outdoor Recreation Plan.

Facilities	Respondents (%)	Number of Facilities Should be Increased (%)	Facility Quality Should be Improved (%)
Bicycle paths	61	55	42
Natural or wild areas	60	54	42
Indoor pools	58	51	38
Environmental education areas	55	56	43
Wildlife viewing areas	54	60	47
Bike lanes	49	69	60
Dog parks	45	64	51
Ice rinks	43	50	36
Rental cabins	42	62	46
Fish viewing areas	38	54	43
Nature inns/lodges	37	60	42
Rifle/handgun ranges	37	50	38
Skateboarding/rollerblading areas	36	51	39
Mountain bike trails	33	51	36
Archery ranges	31	51	36

Source: PADCNR 2011

The Trail Gap Survey found that among geographic issues respondents assigned the highest importance to providing connections between existing trails, closing a gap within an existing trail, and building trails that connect communities to each other (PADCNR 2011).

Additionally, respondents assigned less importance to: building trails that access open space (parks, forests, game lands, etc.); providing trails that connect neighborhoods, shopping areas, and workplaces within communities; providing convenient trailheads and access points; building trails that provide access to remote areas; providing trails within walking distance of users' homes; and connecting neighborhoods to schools (PADCNR 2011).

E.8.3 Protected River Segments on Proposed Project Lands or in Project Area

No designated National Wild and Scenic Rivers are located within or adjacent to the proposed Project area (National Wild and Scenic Rivers 2011).

E.8.4 Proposed Project Lands – National Trails System or Wilderness Area

As previously discussed, the Great Allegheny Passage of the Potomac Heritage National Scenic Trail runs along the western bank of the Monongahela River and is adjacent to the proposed Project boundary. Once completed, the 150-mile Great Allegheny Passage will connect to the 184.5-mile C&O Canal Towpath at Cumberland, Maryland. The joining of these trails will create a 334.5-mile traffic-free and motorized-vehicle-free route between Pittsburgh and Washington, DC (The Allegheny Trail Alliance 2011).

E.8.5 Nationally or Regionally Important Recreation Areas

There are no nationally or regionally important recreation areas within the proposed Project Boundary. However, as mentioned above, the Great Allegheny Passage trail is located just southwest of the proposed Project Boundary along the Monongahela River corridor. As described in more detail in Section E.5, Kennywood Amusement Park is a National Historic Landmark located just southwest of the Project.

E.8.6 Impacts to Recreational Use Associated with the Proposed Project

The proposed Project will not negatively impact any existing recreational resources or opportunities adjacent to the Project or at the regional resources identified in this section. The addition of the powerhouse at the Braddock Dam will generally improve fishing opportunity downstream of the powerhouse in the vicinity of the Project tailrace.

E.8.7 Proposed Protection, Mitigation, and Enhancement Measures related to Recreational Resources

While there is an absence of impacts to existing recreational uses and resources attributed to the proposed Project, Hydro Friends Fund intends to provide a recreational enhancement to the local community. Hydro Friends Fund, based on some feedback from local residents, proposes to install a rest area along the Great Allegheny Passage near the Project site. The rest area is expected to include three benches (possibly with cover), two bike racks, and two interpretive signs (one discussing the project, the existing dam and renewable energy; the other discussing the Great Allegheny Passage). Hydro Friends Fund intends to work closely with the Allegheny Trail Alliance regarding the location and layout of the rest area.

E.9 REPORT ON AESTHETIC RESOURCES

E.9.1 Existing Environment – Aesthetics

The area of the proposed Project and the Braddock Locks and Dam is a mixture of industrial/vacant lands, brownfields, and nearby parks (Figure E.9.1-1 and E.9.1-2). The visual landscape in the vicinity of the Project area is a product of abandoned industrial facilities that once supported a much larger population nearby and the current remnants of those facilities.

Figure E.9.1-1 Aerial view of the Braddock Locks and Dam and surrounding vicinity.

Figure E.9.1-2 Upstream aerial view of the Braddock Locks and Dam and surrounding vicinity.

The Great Allegheny Passage (trail system) runs along the western bank of the Monongahela River adjacent to the proposed Project location. The portion of the Great Allegheny Passage that passes through the vicinity of the proposed Project is called the Steel Valley Trail. The Steel Valley Trail traces the shores of the Monongahela River and runs through historic battlefields and former steel mill sites in Homestead, Braddock, Duquesne, McKeesport, Glassport, and Clairton. These former steel mill sites and interpretive signage add interest to the surrounding area and the retail area called The Waterfront. The Waterfront is now a retail center with offices, restaurants, and entertainment that was rebuilt to reflect characteristics of the early 20th century and the industrial past of the area (Rails to Trails 2011).

The Braddock Locks and Dam directly contribute to the aesthetic resources of the area. As the first of nine navigation facilities on the Monongahela River, the Braddock Locks average 2,122 recreation vessels, 4,406 commercial tows, and 19.4 million tons of cargo, which adds visual interest to the River (Port of Pittsburgh Commission 2005).

Also in the vicinity of the proposed Project is Kennywood Amusement Park. The park was founded in 1898 and has been a designated National Historic Landmark since 1987. The amusement park features "Lost Kennywood," a replica of turn-of-the-century architecture that houses some of the park's most popular rides (Kennywood undated).

E.9.2 Project Environmental Impacts to Aesthetics

The proposed Project facilities will have a minor impact on the visual properties of the existing Braddock Locks and Dam and no impact to the surrounding vicinity. The location of the existing dam will remain unchanged and proposed facilities will be visually integrated into the current locks and dam configuration. The river elevation and shoreline conditions associated with the operation of the Project will not be altered significantly from current conditions and will have no impact on the waterfront views in the area. A short electric power line connecting to a new switchyard adjacent to the dam will not contrast significantly from the existing utility facilities and train tracks that are present at the current site.

E.9.3 Proposed Measures to Protect and Enhance Aesthetic Resources

Hydro Friends Fund is not proposing any specific measures to enhance the existing aesthetic resources associated with the Project area. Post-construction site restoration after Project construction is completed will likely improve the current aesthetics at those temporarily impacted areas.

E.10 REPORT ON LAND USE

E.10.1 Existing Environment – Land Use

The lands surrounding the Braddock Locks and Dam are primarily industrial, vacant, or unclassified. Figure E.10.1-1 shows existing land use in the Project area and the surrounding vicinity (ACED Planning Division 2008). The proposed Project is bordered by railroad corridors parallel to the river on both sides, which transition into industrial or vacant land. The Kennywood Amusement Park, which is addressed in more detail in Sections E.5 and E.8, is located approximately 0.2 mile southwest of the proposed Project in West Mifflin.

In the vicinity of the proposed Project there are several brownfields where industrial facilities once existed, including the Port Perry - North Versailles brownfields, just east of the proposed Project in Braddock; the Duquesne brownfield, approximately 0.7 mile southwest of the proposed Project; and the Carrie Furnace brownfield, approximately 1.2 miles downstream of the proposed Project. None of these three brownfields have been redeveloped. Partially redeveloped brownfields include the Regional Industrial Development Corporation City Center of Duquesne, approximately 1.0 mile upstream of the proposed Project, and the Steel Valley Area - Warehouse sites, approximately 2.5 miles downstream of the proposed Project. Fully redeveloped brownfields in the proposed Project vicinity include the Waterfront site, approximately 3.2 miles downstream of the proposed Project and the Keystone Commons site, approximately 1.5 miles east of the proposed Project in Braddock (ACED Planning Division 2008).

There are several greenways in the vicinity of the proposed Project that are a part of the Allegheny Land Trust GREENPRINT. Allegheny County has proposed additional greenways to be considered for development in the region (ACED Planning Division 2008).

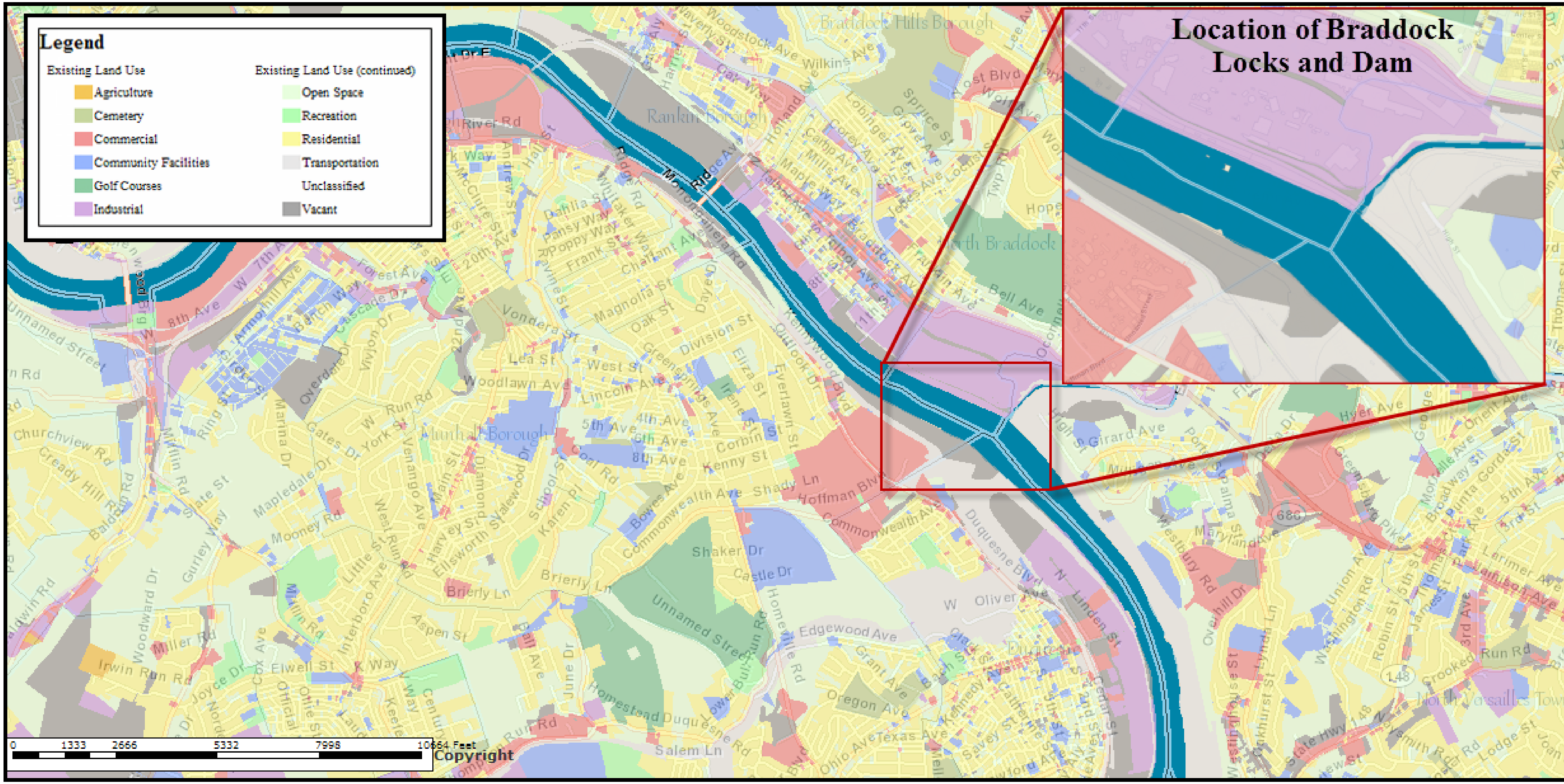


Figure E.10.1-1 Land use classifications of the area surrounding the Braddock Locks and Dam (ACED Planning Division 2008).

E.10.2 Environmental Impacts to Current Land Use

The proposed Project will have no impact on the current land uses at the Project site or land use in the adjacent areas on either side of the Monongahela River. The new facilities associated with the Project development will be integrated into the existing Braddock Locks and Dam and there will be no significant changes to the upstream and downstream shoreline conditions that would alter current land use.

E.10.3 Measures to Protect and Enhance Land Use in the Project Area

Since there is no impact to existing land use attributed to the proposed Project, Hydro Friends Fund does not plan on implementing any specific measures to protect or enhance existing land uses in the vicinity of the Project.

E.11 CONFORMANCE WITH COMPREHENSIVE PLANS RELEVANT TO THE PROPOSED PROJECT

As detailed in FERC's List of Comprehensive Plans (revised April 2012), Section 10(a)(2)(A) of the Federal Power Act requires FERC to consider the extent to which a project is consistent with the federal or state comprehensive plans for improving, developing, or conserving a waterway or the extent to which a waterway is affected by the proposed Project.

On April 27, 1988, FERC issued Order No. 481-A establishing that FERC will accord the Federal Power Act Section 10(a)(2)(A) comprehensive plan status to any federal or state plan that: is a comprehensive study of one or more of the beneficial uses of the waterway or waterways; specifies the standards, the data, and the methodology used; and is filed with the Secretary of FERC.

According to FERC, a comprehensive plan should contain the following:

- A description of the waterway or waterways that are the subject of the plan, including pertinent maps detailing the geographic area of the plan.

- A description of the significant resources of the waterway or waterways.

- A discussion of the goals, objectives, and recommendations for improving, developing, or conserving the waterway or waterways in relation to these resources. The description of the significant resources in the area should contain an examination of how the different uses will promote the overall public interest. Elements of significant resources to be included are:

  - Navigation
  - Power development
  - Energy conservation
  - Fish and wildlife
  - Recreational opportunities
  - Irrigation
  - Flood control
  - Water supply

As of April 2012, FERC lists 31 federal and state comprehensive plans applicable to Pennsylvania. Of these 31 listed plans, five are potentially relevant to the proposed Braddock Locks and Dam Project. Additionally, two state comprehensive plans (not identified by FERC) were identified by Hydro Friends Fund as being relevant to the proposed Project. Each plan is listed separately below, with a brief explanation for its inclusion as a relevant qualifying comprehensive plan. Given that the proposed Project will not alter operation of the USACE Braddock Locks and Dams and generate power using only flows scheduled for release from this facility by the USACE, Hydro Friends Fund has determined that the proposed Project is consistent with the relevant plans listed below.

E.11.1 Qualifying Comprehensive Plans Deemed Applicable

E.11.1.1 United States

- *U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American Waterfowl Management Plan. Department of the Interior. Environment Canada. May 1986.*

This plan provides relevant guidance for waterfowl habitat management. This plan specifies the standards, data, and methodology used.

- *U.S. Fish and Wildlife Service. Undated. Fisheries USA: The Recreational Fisheries Policy of the U.S. Fish and Wildlife Service. Washington D.C.*

The proposed Project is located on the Monongahela River, which is a recreational fishing area for bass, crappie, catfish, and sunfish. This plan addresses the recreational fisheries policy for each state in the United States, and specifies the standards and methodology used.

E.11.1.2 Pennsylvania

- *Pennsylvania Department of Environmental Resources. 1983. Pennsylvania State Water Plan. Harrisburg, Pennsylvania. January 1983. 20 volumes.*

The Pennsylvania State Water Plan is the result of the Water Resources Planning Act, passed in 2002. This Act requires the water plan to have several key components:

- Surface and groundwater inventories;
- Assessments of existing and future withdrawal use demands;
- Identification of potential problems with water availability or conflicts among water uses or users; and
- A review and evaluation of statutes, regulations, policies, institutional arrangements, alternatives, and recommended programs.

- *Pennsylvania Department of Environmental Resources. 1986. Pennsylvania's Recreation Plan, 1986-1990. Harrisburg, Pennsylvania.*

Pennsylvania’s Recreation Plan provides a vision for the future of recreation in the Commonwealth. As a result of extensive research and public participation, it reflects the concerns of its citizens and the strategies for implementation, as detailed by providers of park and recreation services throughout the state.

- *Pennsylvania Department of Environmental Resources. 1988. Pennsylvania 1988 Water Quality Assessment. Harrisburg, Pennsylvania. April 1988. Three volumes.*

This plan summarizes and outlines management strategies for the surface waters in Pennsylvania. It describes water pollution controls and assessment/monitoring programs and reports on the conditions of waters in the Commonwealth. A water quality assessment report is published yearly by the PADEP, as required by the CWA.

E.11.1.3 Additional Comprehensive Plans

- *Pennsylvania Historical and Museum Commission. 2006. Honoring the Past, Planning for the Future: Pennsylvania’s Historic Preservation Plan 2006-2011.*

This plan was developed for the purposes of assisting the Commonwealth of Pennsylvania in identifying, prioritizing, and addressing historic preservation needs over the course of five years.

- *Pennsylvania Fish and Boat Commission. 2011. Three Rivers Management Plan - A Strategy for Managing Fisheries Resources of the Allegheny, Monongahela and Ohio Rivers.*

This plan was developed by the Pennsylvania Fish and Boat Commission’s Bureau of Fisheries and Fisheries Management Division. This plan was developed to function as a comprehensive approach to manage the fisheries resources of Pennsylvania’s large rivers.

E.11.2 Qualifying Comprehensive Plans Deemed Not Applicable

The qualifying plans listed below were deemed not applicable because the proposed Project is not subject to the jurisdiction or scope of the comprehensive plans listed below (i.e., the proposed Project is not geographically located within the listed plans management areas).

Atlantic States Marine Fisheries Commission. 1996. Interstate fishery management plan for weakfish. Report No. 27. May 1996.

Atlantic States Marine Fisheries Commission. 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*). Report No. 31. July 1998.

Atlantic States Marine Fisheries Commission. 1998. Interstate fishery management plan for Atlantic striped bass. Report No. 34. January 1998.

Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. Report No. 35. April 1999.

Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (*Anguilla rostrata*). Report No. 36. April 2000.

Atlantic States Marine Fisheries Commission. 2000. Technical Addendum 1 to Amendment 1 of the Interstate Fishery Management Plan for shad and river herring. February 9, 2000.

Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.

Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010. Atlantic States Marine Fisheries Commission.

Delaware River Basin Commission. 1967. Delaware River Basin compact. Trenton, New Jersey. January 1967. 51 pp.

Delaware River Basin Commission. 1983. Resolution No. 83-13. Criteria for defining drought warning and drought conditions, and to schedule phased reductions in diversions and releases during such periods. West Trenton, New Jersey. June 29, 1983. 9 pp.

Delaware River Basin Commission. 1984. Resolution No. 84-7. Coordinated operation of Delaware River Basin reservoirs during a basinwide drought. West Trenton, New Jersey. April 25, 1984. 6 pp.

National Marine Fisheries Service. 1998. Final Recovery Plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. December 1998.

National Oceanic and Atmospheric Administration. 1980. Pennsylvania coastal zone management program and final environmental impact statement. Department of Commerce, Washington, D.C. August 1980.

National Park Service. 1987. Upper Delaware scenic and recreational river. Department of the Interior, Philadelphia, Pennsylvania. February 1987. 475 pp.

National Park Service. 1993. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.

Ohio River Basin Commission. 1978. Upper Ohio main stem comprehensive coordinated joint plan. Cincinnati, Ohio. January 1978.

Ohio River Basin Commission. 1979. Allegheny River Basin comprehensive coordinated joint plan. Cincinnati, Ohio. October 1979.

Pennsylvania Department of Environmental Resources. 1990. The Pennsylvania scenic rivers program scenic rivers inventory. Harrisburg, Pennsylvania. April 1990.

Susquehanna River Basin Commission. 2011. Comprehensive plan for the water resources of the Susquehanna River Basin. Harrisburg, Pennsylvania. June 2011.

U.S. Fish and Wildlife Service. 1988. The Lower Great Lakes / St. Lawrence Basin: A component of the North American waterfowl management plan. December 29, 1988.

U.S. Fish and Wildlife Service. 1989. Chesapeake Bay Alosid (shad and river herring) management plan. Annapolis, Maryland. July 1989.

U.S. Fish and Wildlife Service. 1989. Chesapeake Bay striped bass management plan. Annapolis, Maryland. December 1989.

U.S. Fish and Wildlife Service. 1992. Chesapeake Bay American eel fishery management plan. Annapolis, Maryland. December 18, 1992.

U.S. Forest Service. 1996. Allegheny National Wild and Scenic River management plan. Department of Agriculture. Warren, Pennsylvania. September 1996. Includes Appendices A (References), B (Glossary), and C (Allegheny Wild and Scenic River Corridor maps).

U.S. Forest Service. 2007. Allegheny National Forest land and resource management plan. Department of Agriculture. Warren, Pennsylvania. March 2007.

E.12 ALTERNATIVE LOCATIONS, DESIGNS, AND ENERGY SOURCES

E.12.1 Alternate Locations and Designs

In developing the proposed Project design, Hydro Friends Fund has studied a range of design options for the proposed Project under the FERC Preliminary Permit. The proposed Project design was selected to minimize impacts to the USACE dam structure and to ensure that the proposed facilities meet FERC dam safety and stability criteria. All assessments for the proposed Project were focused solely on creating options for installing generation at the existing Braddock Locks and Dam, so no other locations were assessed for this Project. The Preliminary Supporting Design Report included with this application in Exhibit F, and filed with FERC as Critical Energy Infrastructure Information demonstrates that the proposed Project meets FERC's dam safety and stability criteria, but additional revisions to the proposed Project design may be implemented to address any comments and concerns expressed by the USACE during final design negotiations.

E.12.2 Alternate Energy Sources

Hydro Friends Fund has not identified additional alternate energy sources that would provide reliable, emission free, renewable energy that can be deployed within the greater Pittsburgh area. Furthermore, Hydro Friends Fund has not identified an alternative energy source that incorporates the existing infrastructure associated with the locks and dam structure or the naturally flowing water that passes over the structure.

E.13 CONSULTATION AND EFFECTS OF PROPOSED PM&E MEASURES

E.13.1 Summary of Consultation

Consistent with 40 CFR Section 18.6 (f), documentation of associated with the consultation performed in support of this license application is included in Appendix E-3.

E.13.2 Proposed Protection, Mitigation, and Enhancement Measures

Although Hydro Friends Fund has not identified any project impacts that require the implementation of PM&E measures at this time, Hydro Friends Fund is proposing the installation and maintenance of three benchs, two bike racks, and two public signs along the Great Allegheny Passage Trail in proximity to the Project (Table E.13.2-1).

Table E.13.2-1 Proposed PM&E measures.

Proposed PM&E Measure	Summary Description	Estimated Capital Cost (2012$)	Estimated O&M Cost (2012$)
Recreational Enhancements	Three benches, two bike racks, and two public signs to be installed along the Great Allegheny Pasage Trail	$10,500	$500

E.14 LIST OF LITERATURE

Adovasio, J. M., R. Fryman, A. G. Quinn, D. C. Dirkmaat, and D. R. Pedler. 1998. The Archaic West of the Allegheny Mountains: A View from the Cross Creek Drainage, Washington County, Pennsylvania. In The Archaic Period in Pennsylvania: Hunter-Gatherers of the Early and Middle Holocene Period. Edited by P.A. Raber, P.E. Miller, and S.M. Neusis. Recent Research in Pennsylvania Archaeology, No. 1, P.A. Raber, series editor. Pennsylvania Historical and Museum Commission, Harrisburg, Pennsylvania.

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BRADDOCK LOCKS AND DAM HYDROELECTRIC PROJECT

FERC NO. 13739

LICENSE APPLICATION

EXHIBIT F – GENERAL DESIGN DRAWING

F.1 CRITICAL ENERGY INFRASTRUCTURE INFORMATION

In accordance with 18 CFR Part 388, Hydro Friends Fund is requesting that the Exhibit F General Design Drawing and Preliminary Supporting Design Report (PSDR) for the proposed Braddock Locks and Dam Project (proposed Project) be given privileged treatment and not be released to the public. This request is due to the Critical Energy Infrastructure Information (CEII) contained in the the design drawing and PSDR. However, these documents are available for review by resource agencies, Tribes, and interested parties. Parties who wish to view these drawings are requested to contact Mark Stover by telephone at (877) 556-6566 ext. 711 or email at mark@hgenergy.com to make an appointment to review these documents.

F.2 DESIGN DRAWING

The General Design Drawing show overall plan views, elevation and sections of the proposed principal Project works of the proposed Braddock Locks and Dam Project. In conjunction with the filing of this Final License Application, Table F.2-1 presents the title of the Exhibit F General Design Drawing that is being filed with the FERC in Appendix F-1, Volume 1 of this application under separate cover in accordance with FERC's regulations for filing CEII classified material. Hydro Friends Fund is filing the following preliminary Exhibit F drawing for the proposed Project.

Table F.2-1 Exhibit F Preliminary General Design Drawing

Drawing Number	Title
Exhibit F - Sheet No. 1	Braddock General Plan and Intake

F.3 SUPPORTING DESIGN REPORT

18 CFR §4.41(g)(3) requires that an applicant for a new license file with the Commission two copies of a Supporting Design Report when the applicant files a license application. The purpose of the Supporting Design Report is to demonstrate that the existing and proposed structures are safe and adequate to fulfill their stated functions.

In conjunction with the filing of this Final License Application, two copies of the Preliminary Supporting Design Report for the proposed Project are being filed with the FERC in Appendix

F-2, Volume 2 of this application under separate cover in accordance with FERC's regulations for filing CEII classified material.

BRADDOCK LOCKS AND DAM HYDROELECTRIC PROJECT
FERC NO. 13739

LICENSE APPLICATION

EXHIBIT G – PROJECT MAP

G.1 PROJECT MAP

This Exhibit contains the map of the proposed Braddock Locks and Dam Project (proposed Project) vicinity and proposed Project Boundary. Table 1.1-1 list presents the title of the Exhibit G map for the proposed Project, which is included in this license application as Appendix G-1.

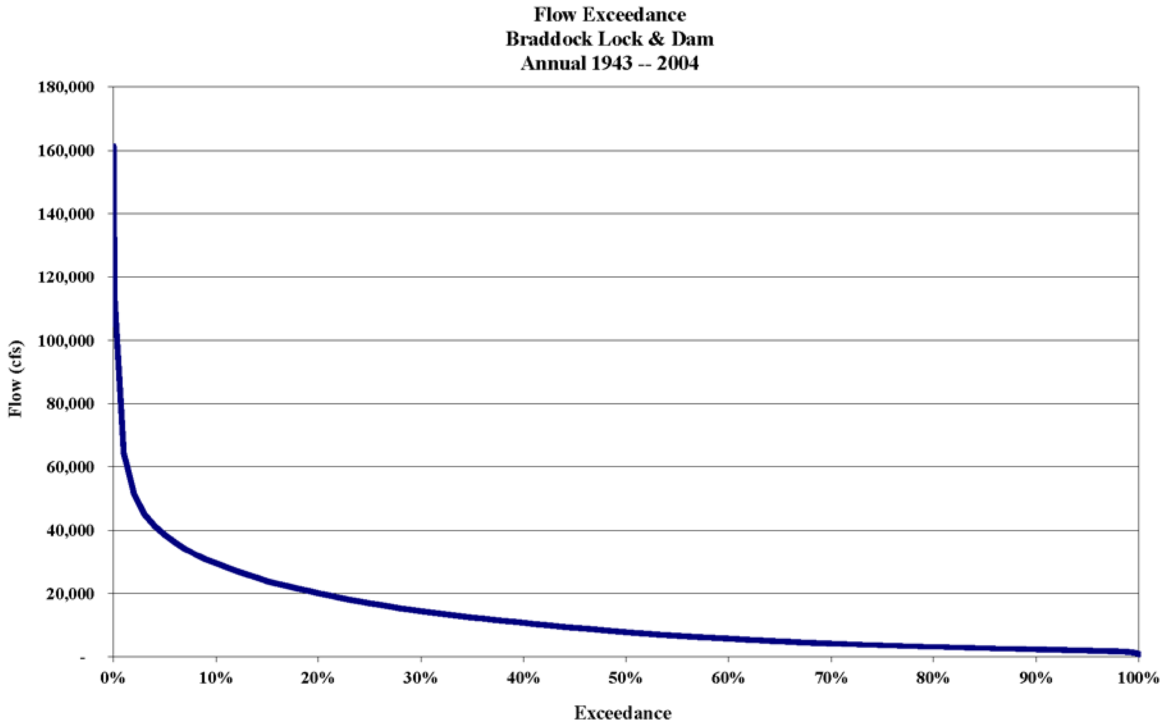
Table G.1.1-1 Proposed Project Boundary map.

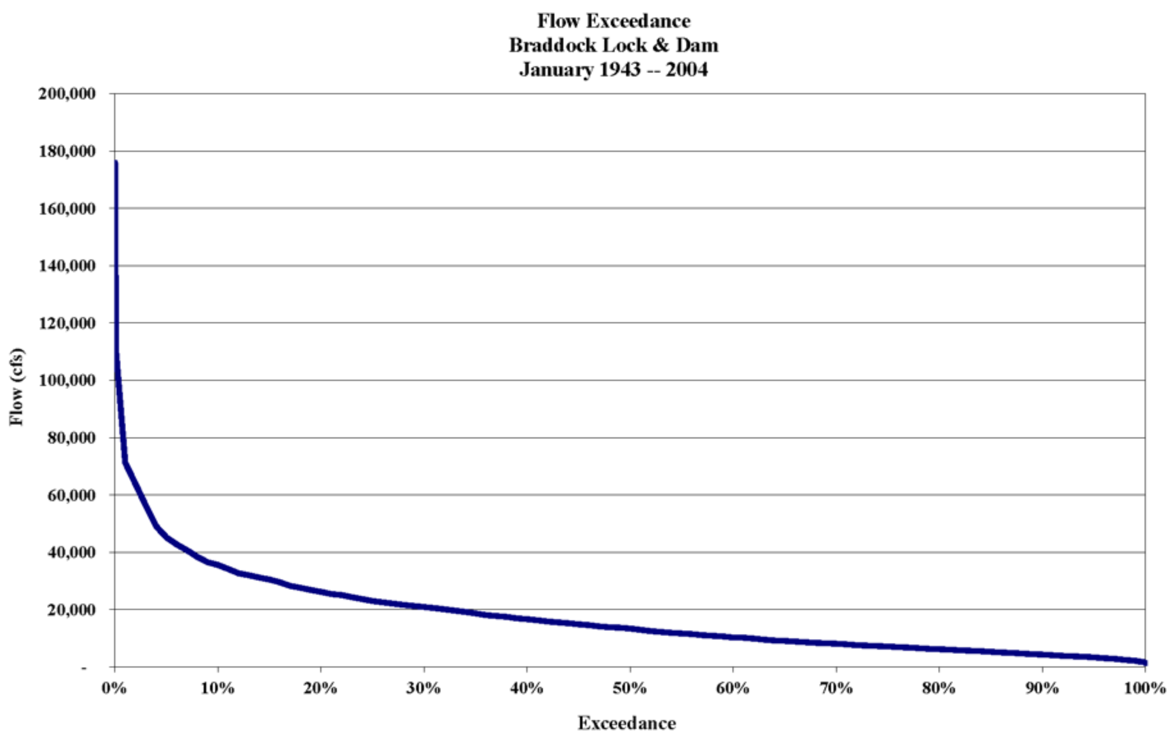
Drawing Number	Title
G-1	Braddock Project Boundary Map and Location Map

Hydro Friends Fund will obtain the necessary easements and rights from the landowners needed for operation and maintenance of the proposed Project.

APPENDIX A-1

FLOW DURATION CURVES


Flow Exceedance
Braddock Lock & Dam
Annual 1943 -- 2004
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Flow Exceedance
Braddock Lock & Dam
January 1943 -- 2004
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Flow (cfs)
0%
10%
20%
30%
40%
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60%
70%
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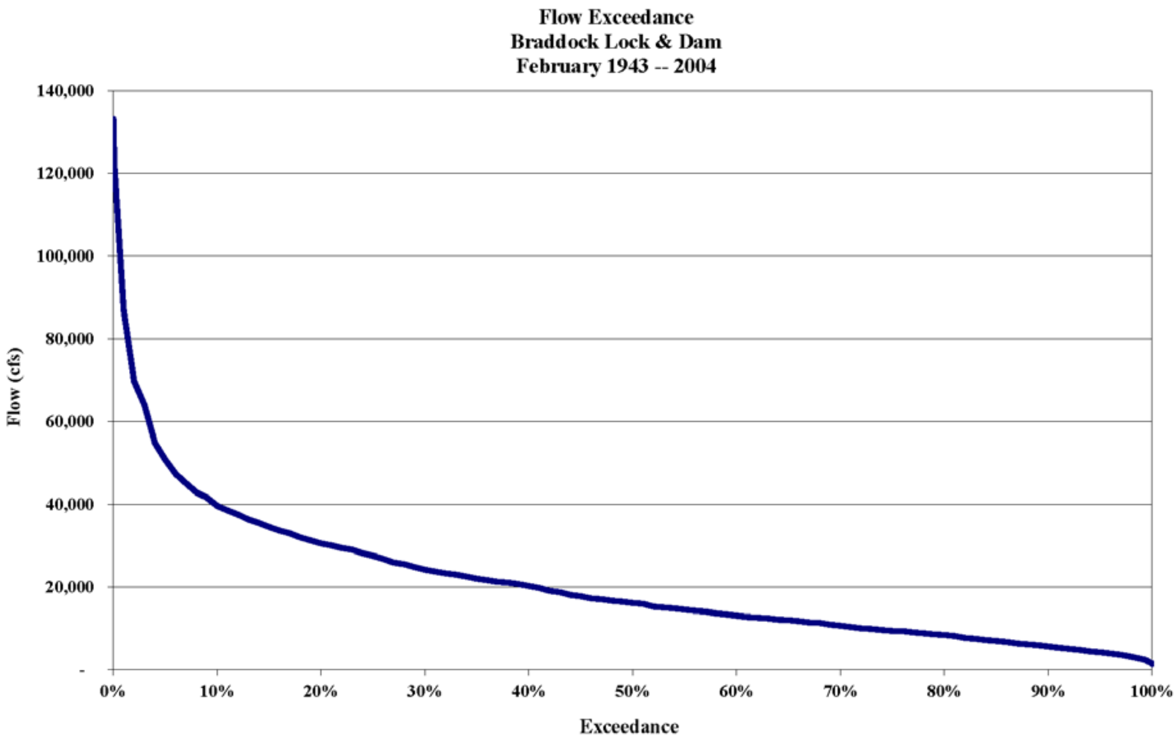
90%
100%
Exceedance


Flow Exceedance
Braddock Lock & Dam
February 1943 -- 2004
140,000
120,000
100,000
80,000
60,000
40,000
20,000
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Flow (cfs)
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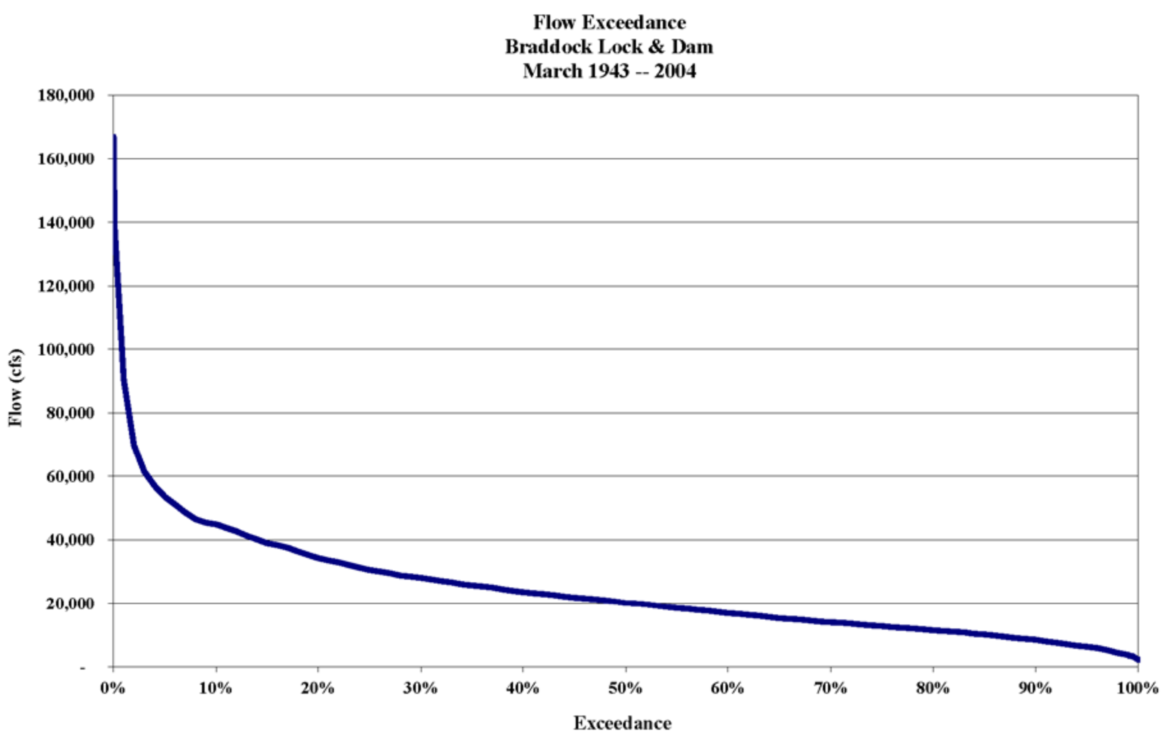
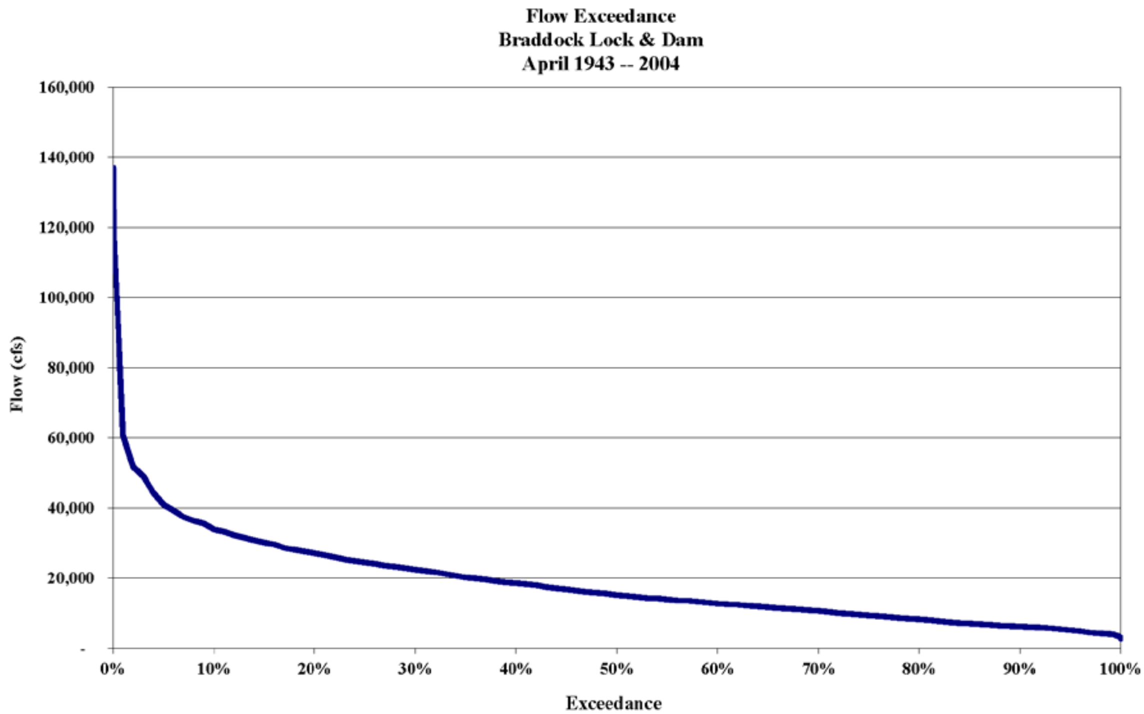
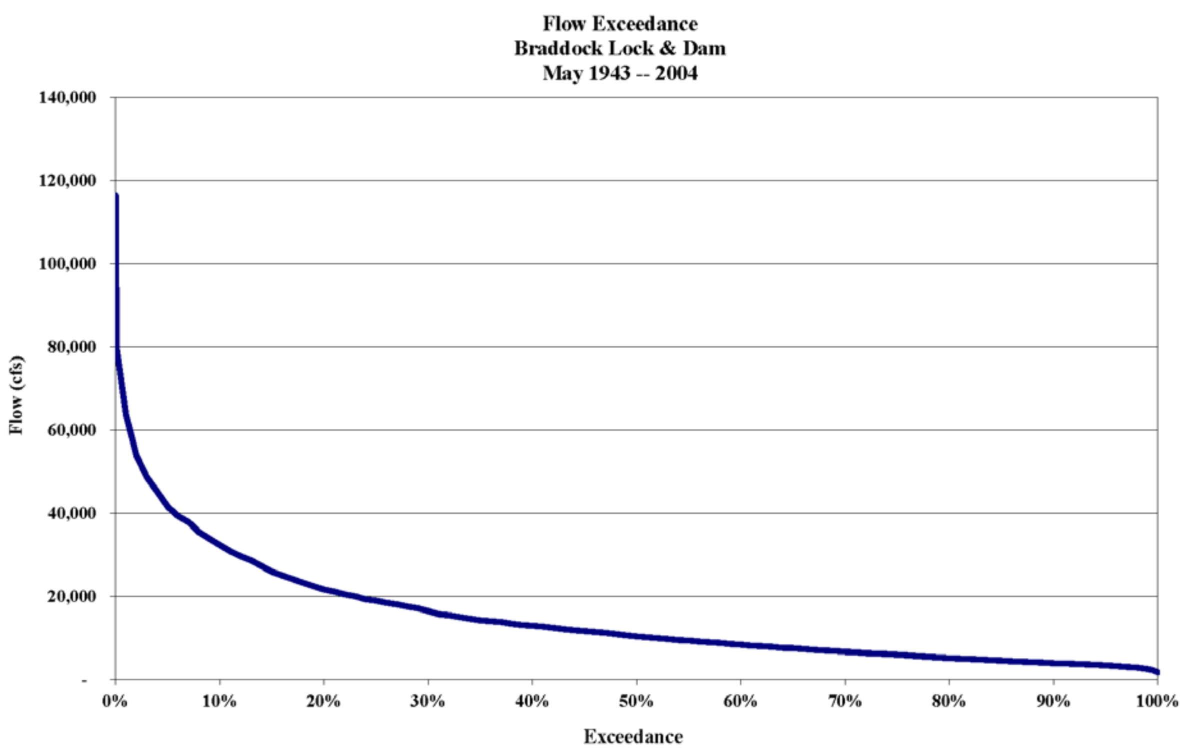
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Flow Exceedance
Braddock Lock & Dam
March 1943 -- 2004
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance



Flow Exceedance
Braddock Lock & Dam
April 1943 -- 2004
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance



Flow Exceedance
Braddock Lock & Dam
May 1943 -- 2004
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Flow (cfs)
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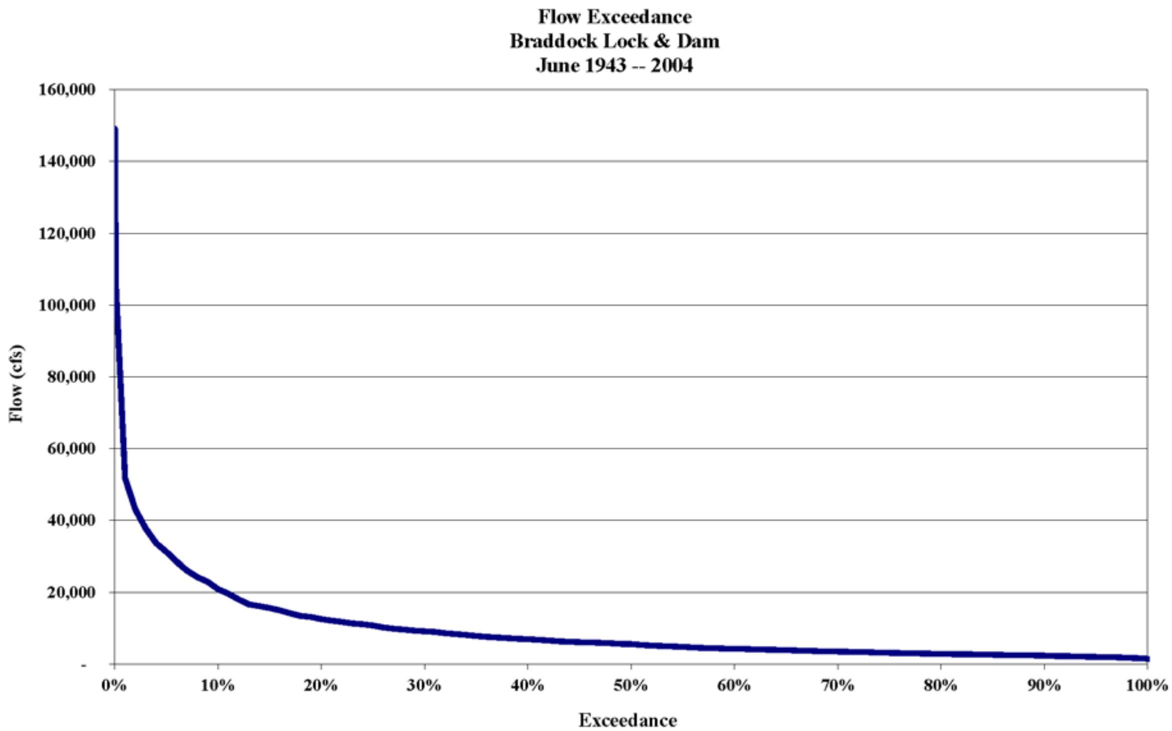
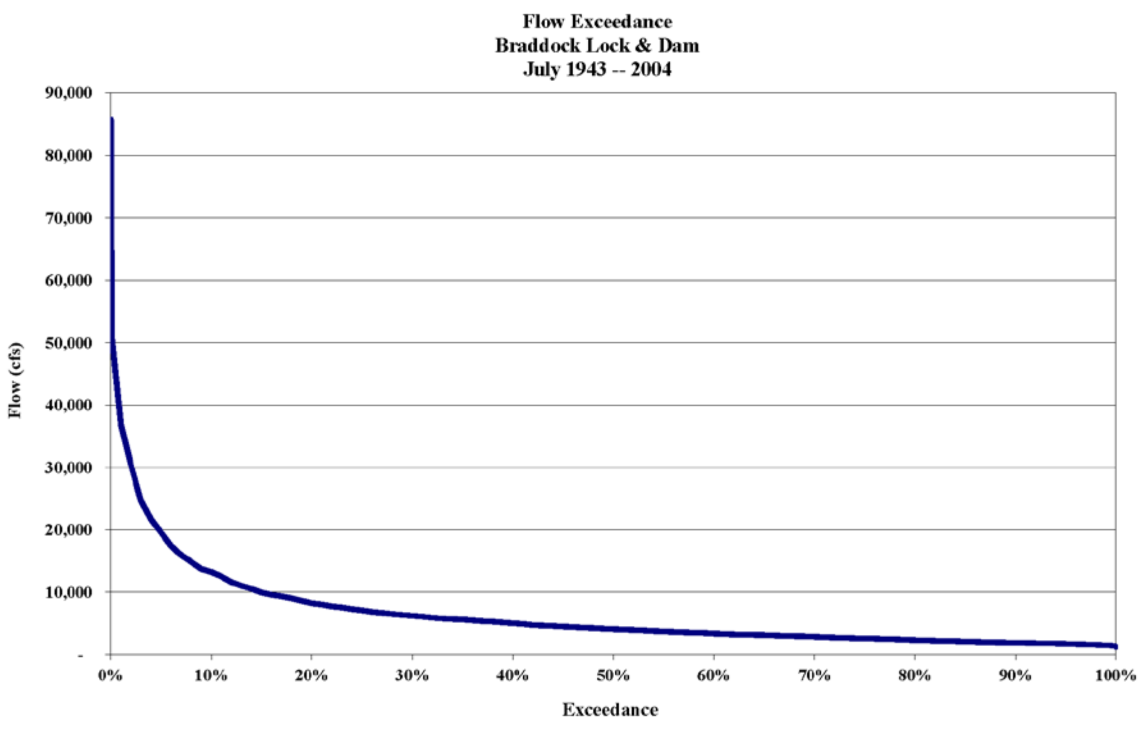
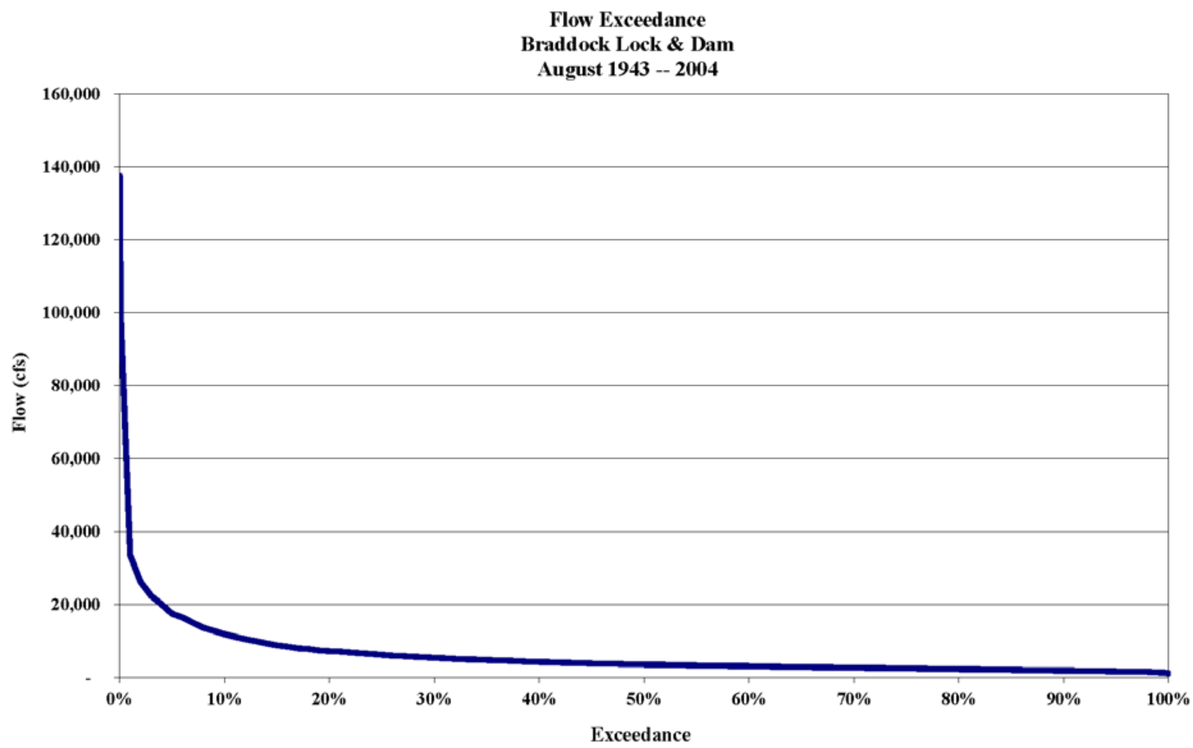
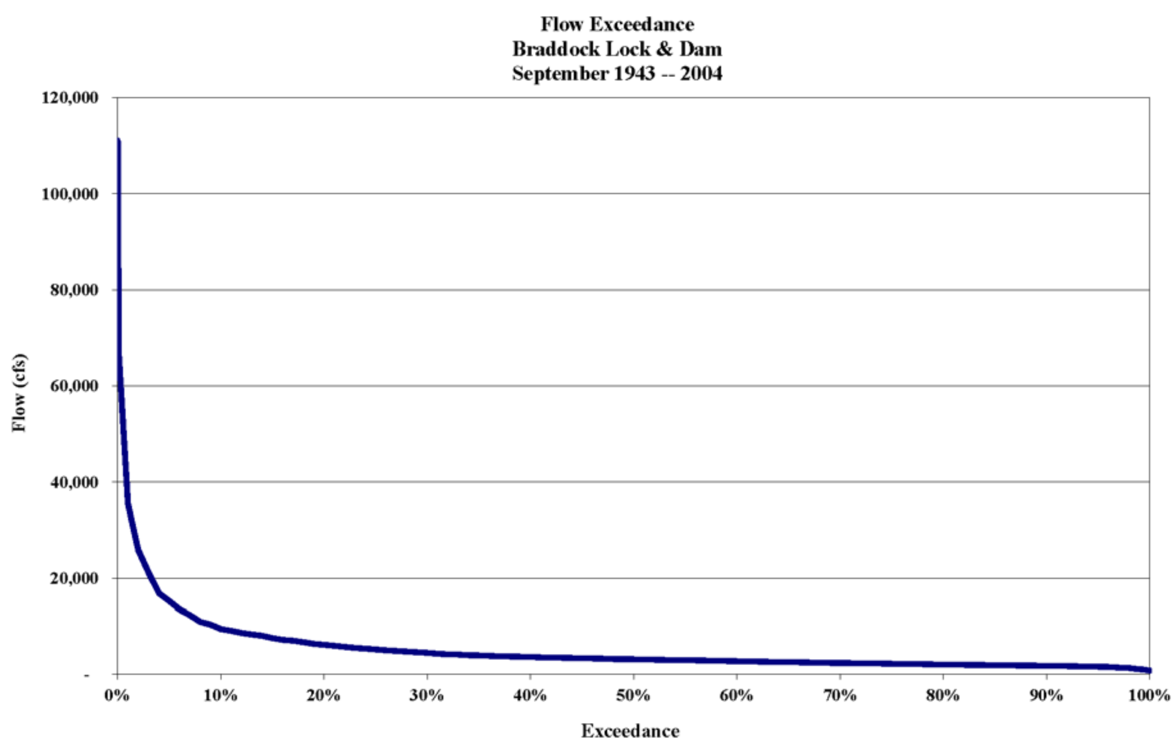
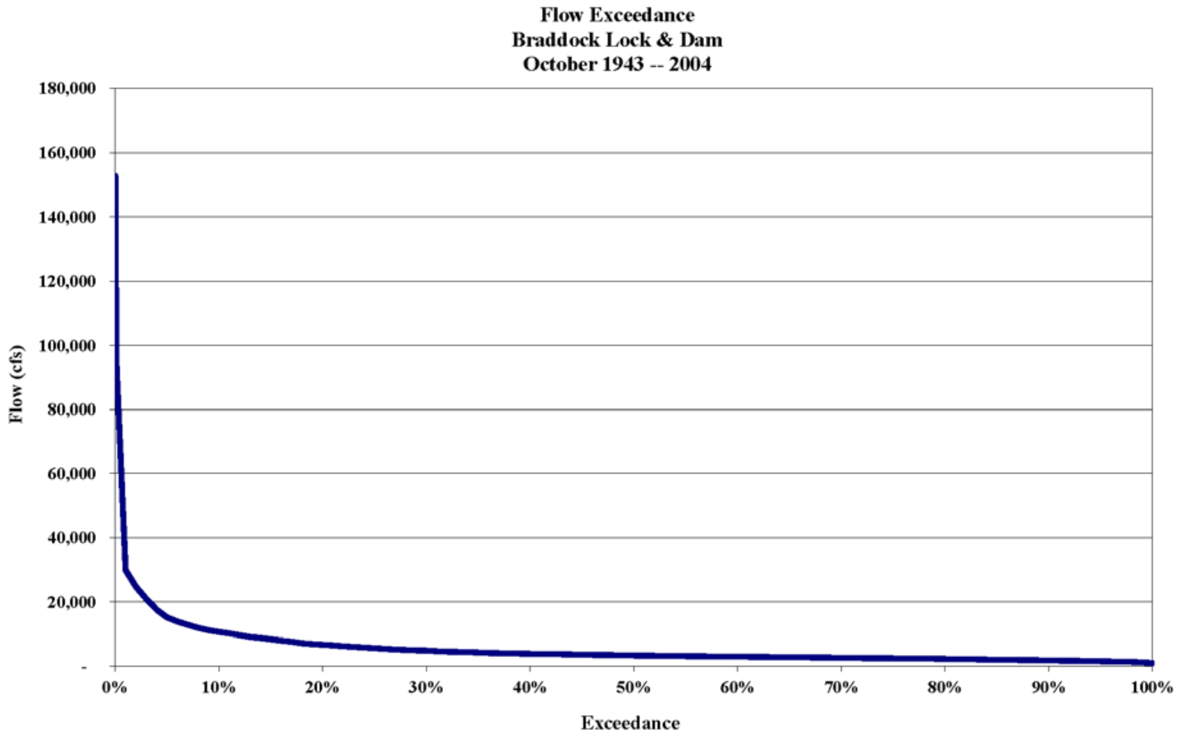
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

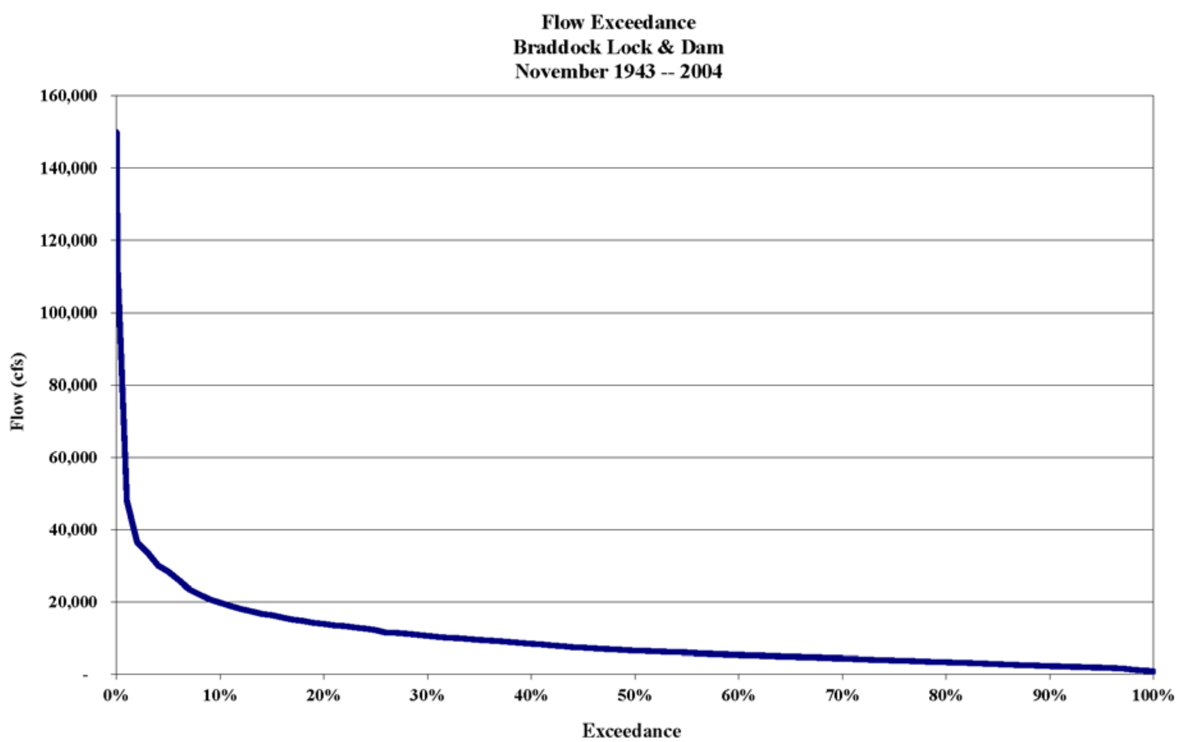

Flow Exceedance
Braddock Lock & Dam
June 1943 -- 2004
Flow (cfs)
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

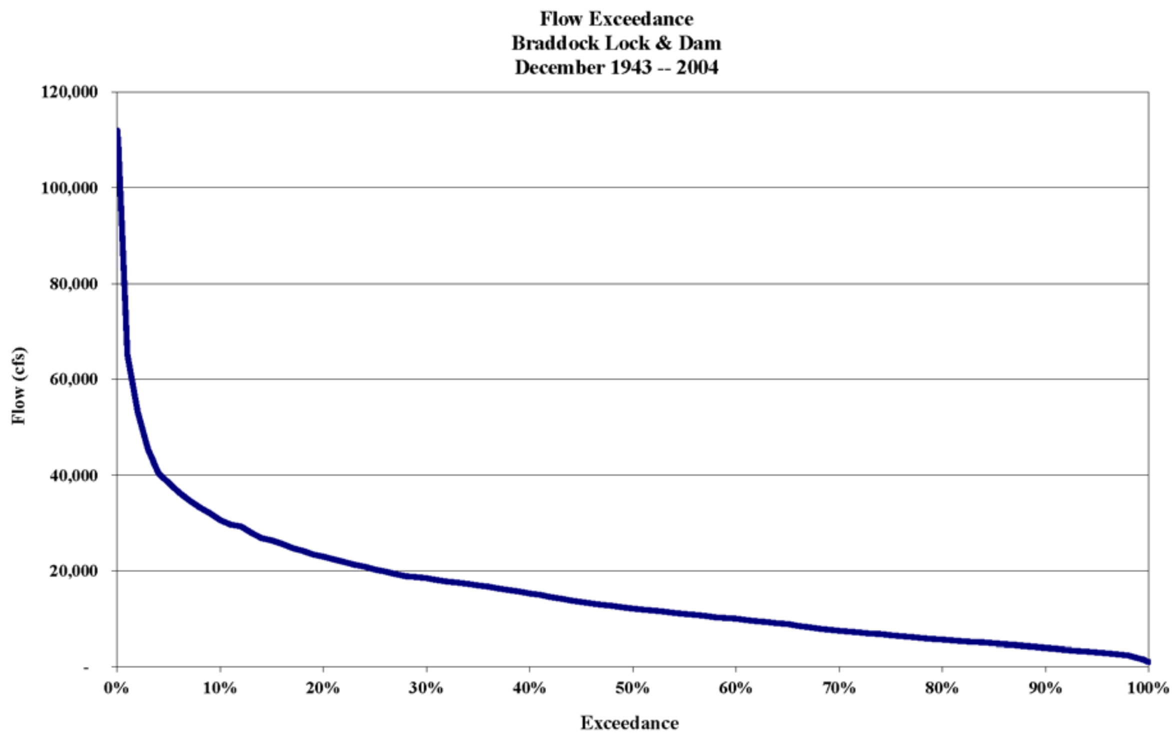

Flow Exceedance
Braddock Lock & Dam
July 1943 -- 2004
Flow (cfs)
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

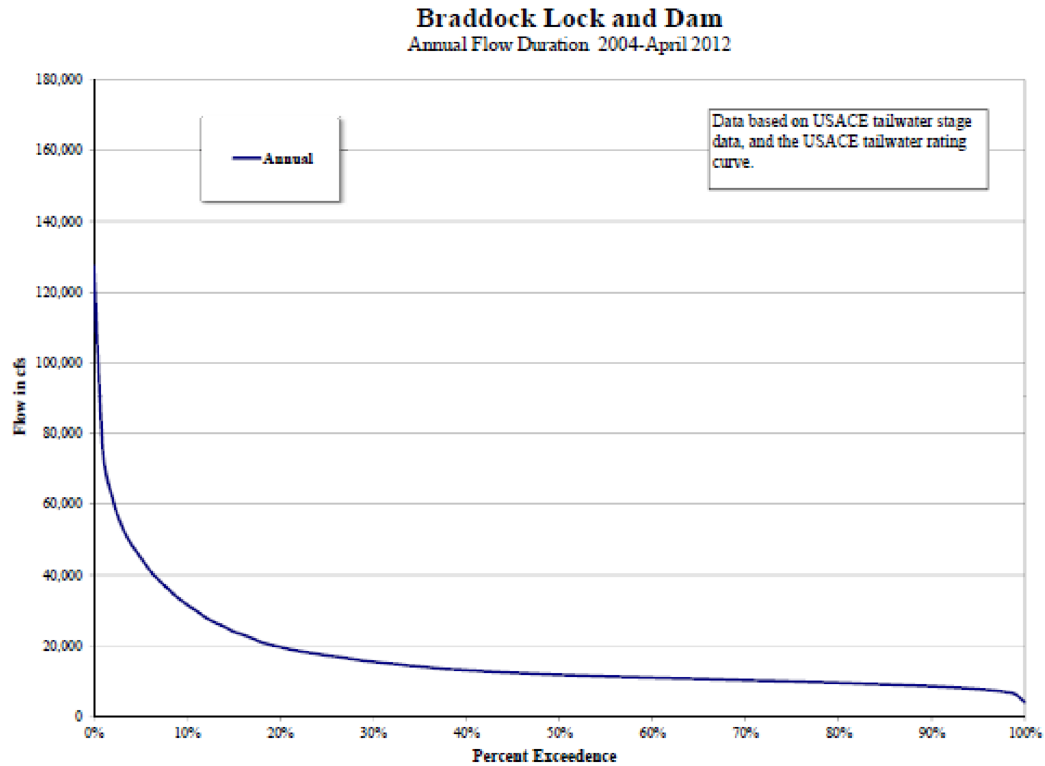

Flow Exceedance
Braddock Lock & Dam
August 1943 -- 2004
Flow (cfs)
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

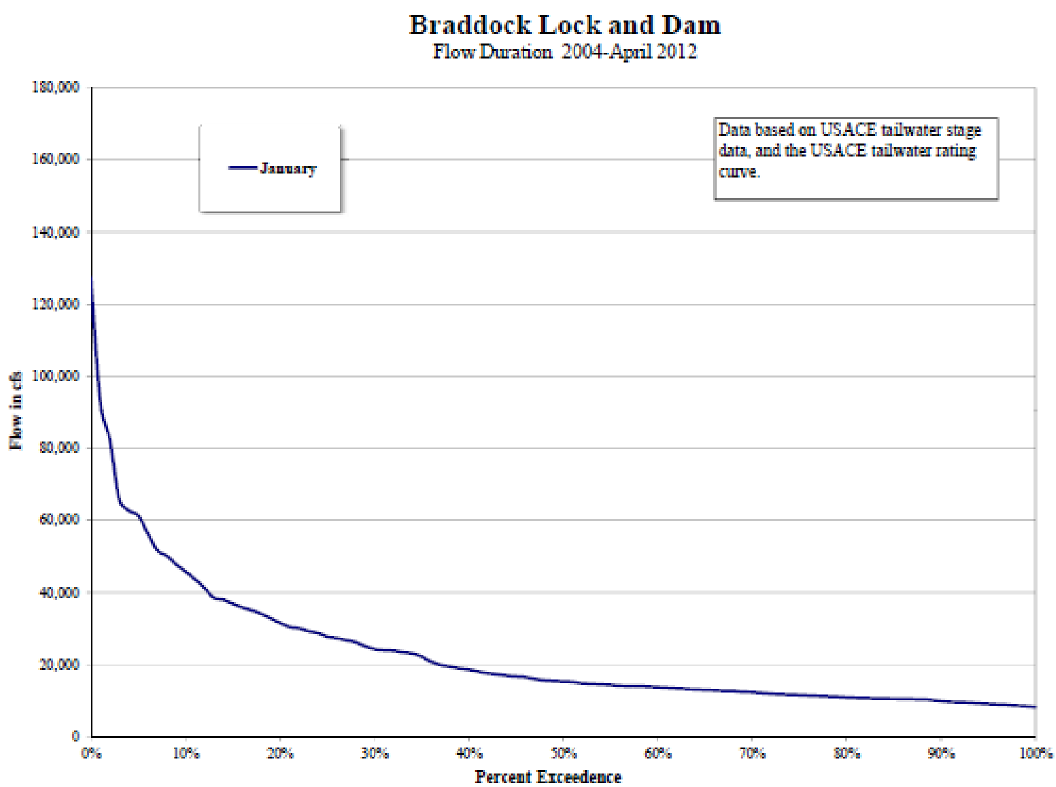

Flow Exceedance
Braddock Lock & Dam
September 1943 -- 2004
Flow (cfs)
120,000
100,000
80,000
60,000
40,000
20,000
-
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

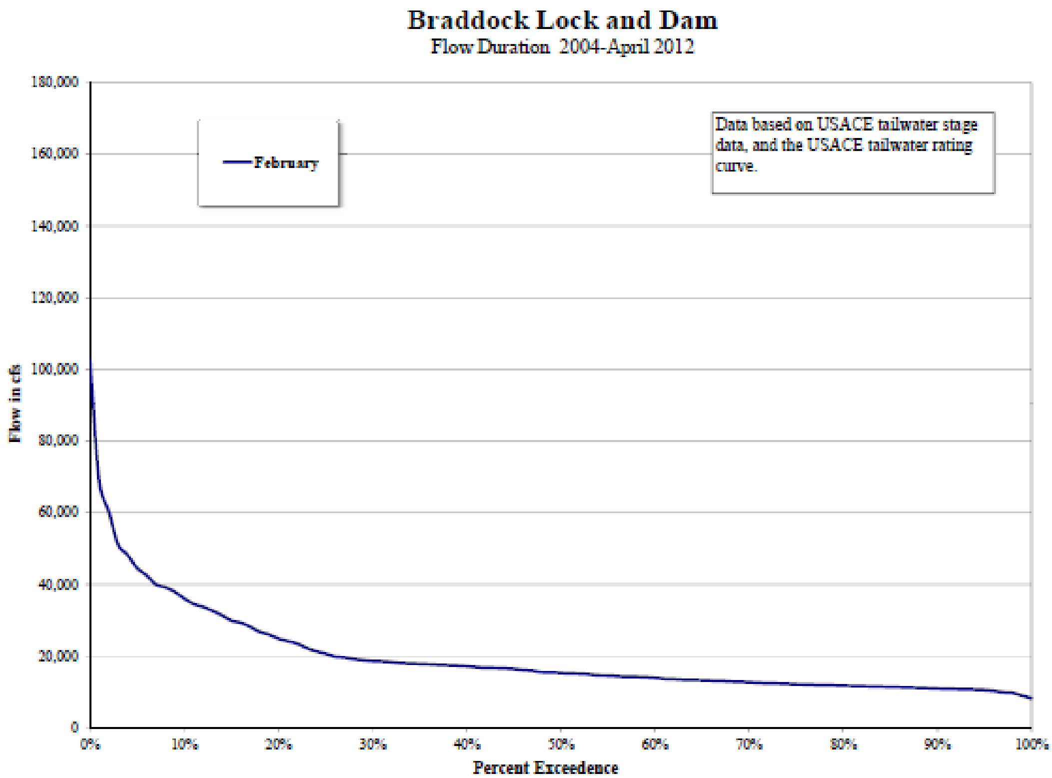

Flow Exceedance
Braddock Lock & Dam
October 1943 -- 2004
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Flow Exceedance
Braddock Lock & Dam
November 1943 -- 2004
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

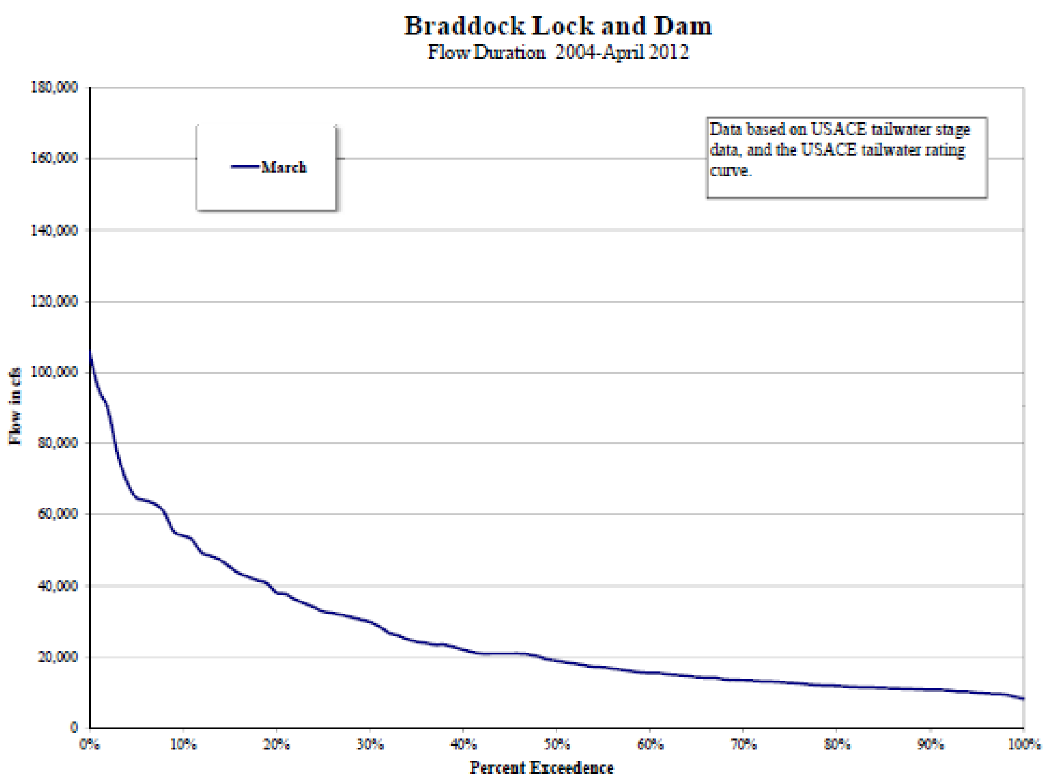

Flow Exceedance
Braddock Lock & Dam
December 1943 -- 2004
120,000
100,000
80,000
60,000
40,000
20,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Braddock Lock and Dam
Annual Flow Duration 2004-April 2012
Annual
Data based on USACE tailwater stage data, and the USACE tailwater rating curve.
Flow in cfs
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence

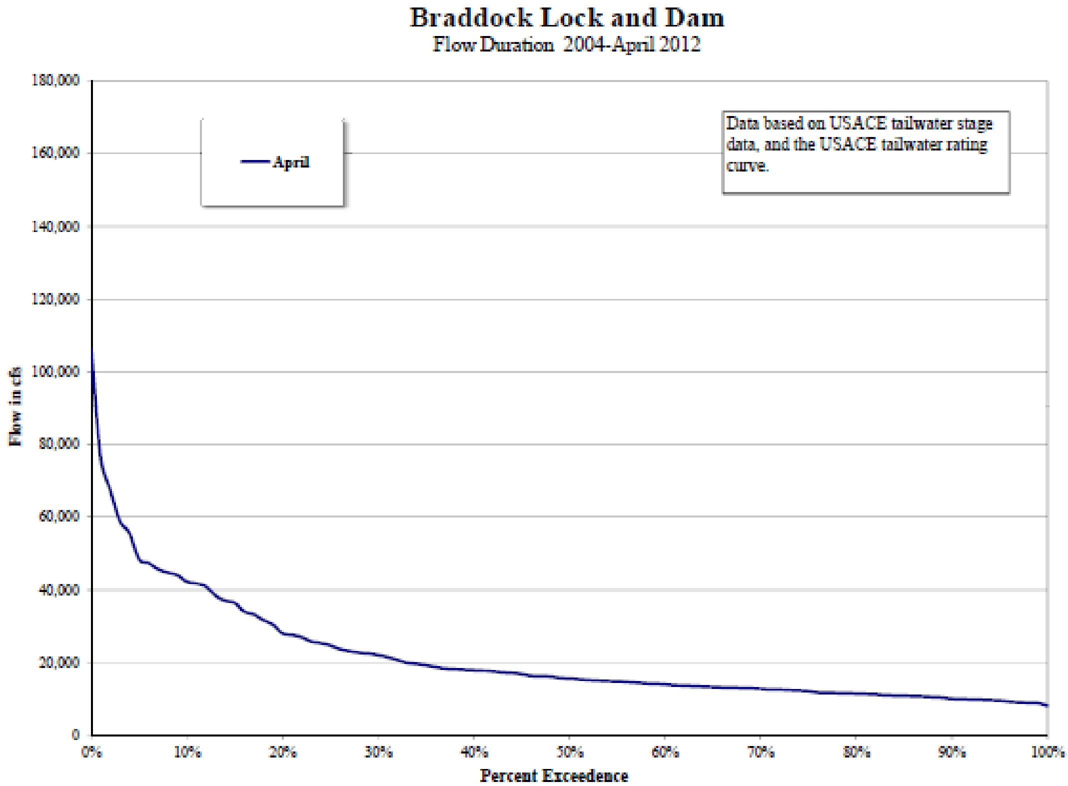

Braddock Lock and Dam
Flow Duration 2004-April 2012
January
Data based on USACE tailwater stage data, and the USACE tailwater rating curve.
Flow in cfs
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence

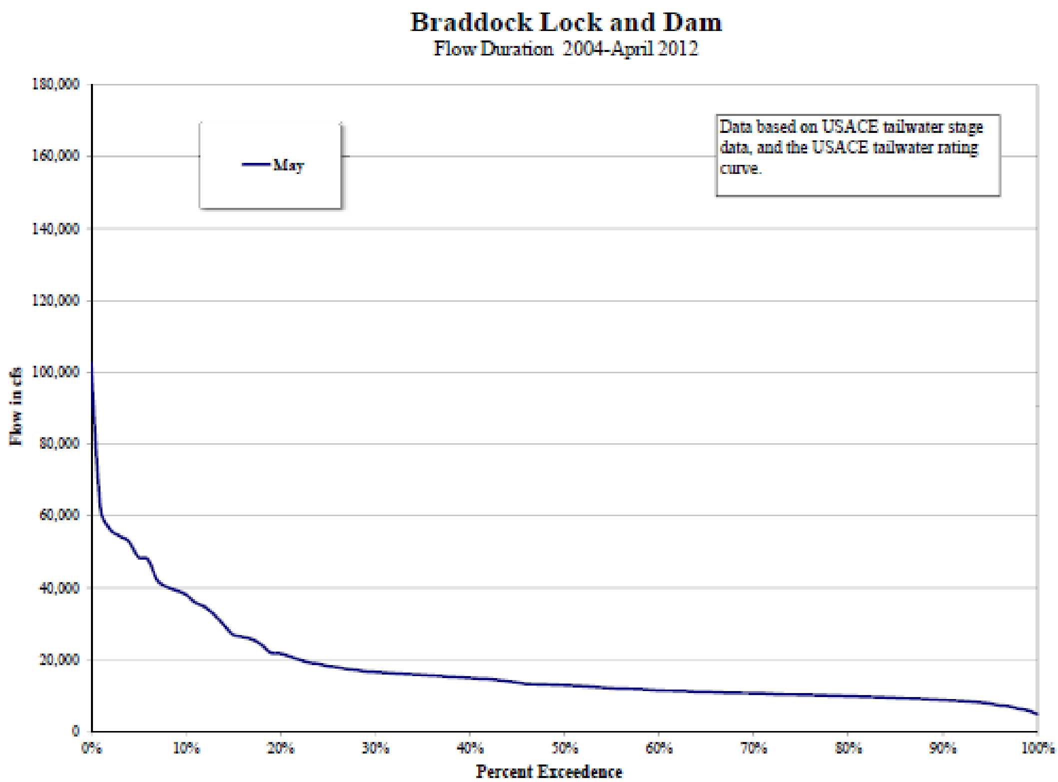


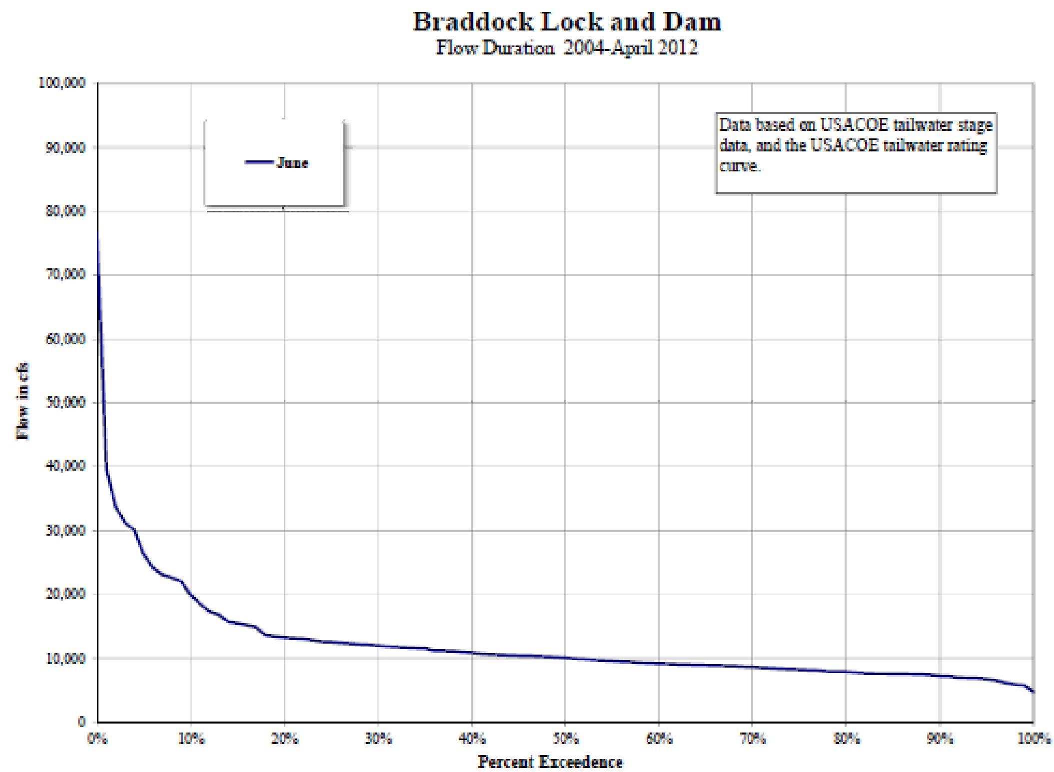
Braddock Lock and Dam
Flow Duration 2004-April 2012
February
Data based on USACE tailwater stage data, and the USACE tailwater rating curve.
Flow in cfs
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence



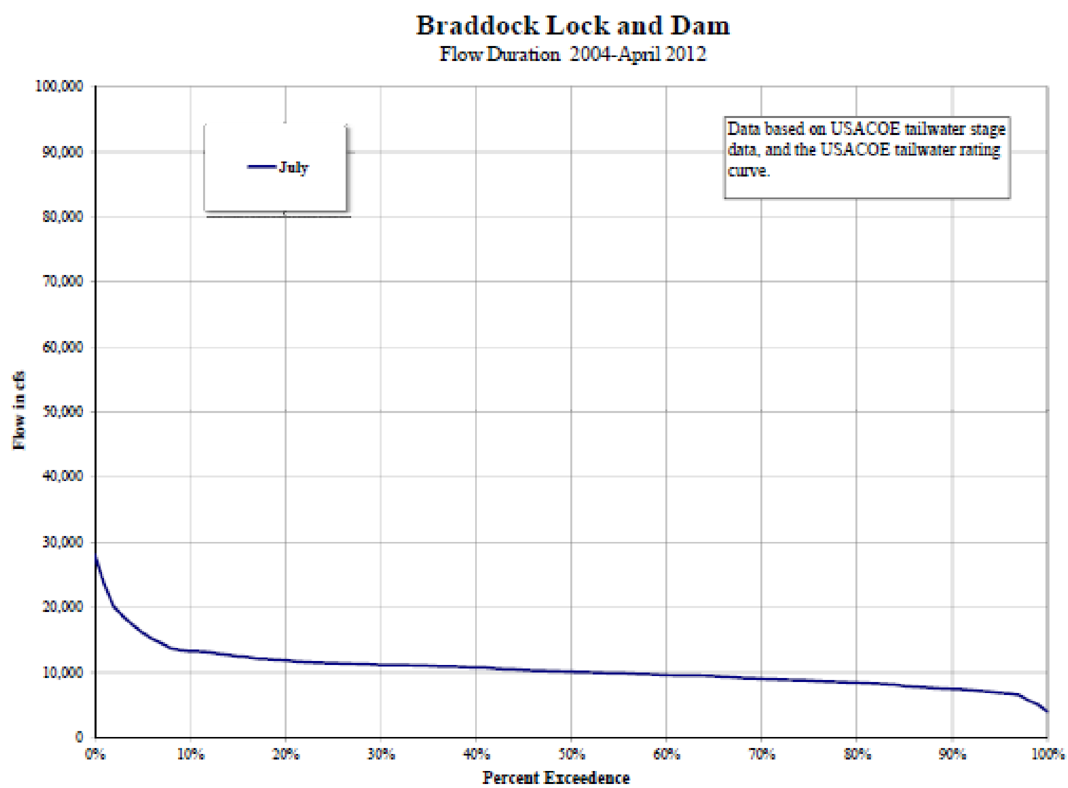
Braddock Lock and Dam
Flow Duration 2004-April 2012
March
Data based on USACE tailwater stage data, and the USACE tailwater rating curve.
Flow in cfs
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence


Braddock Lock and Dam
Flow Duration 2004-April 2012
April
Data based on USACE tailwater stage data, and the USACE tailwater rating curve.
Flow in cfs
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence

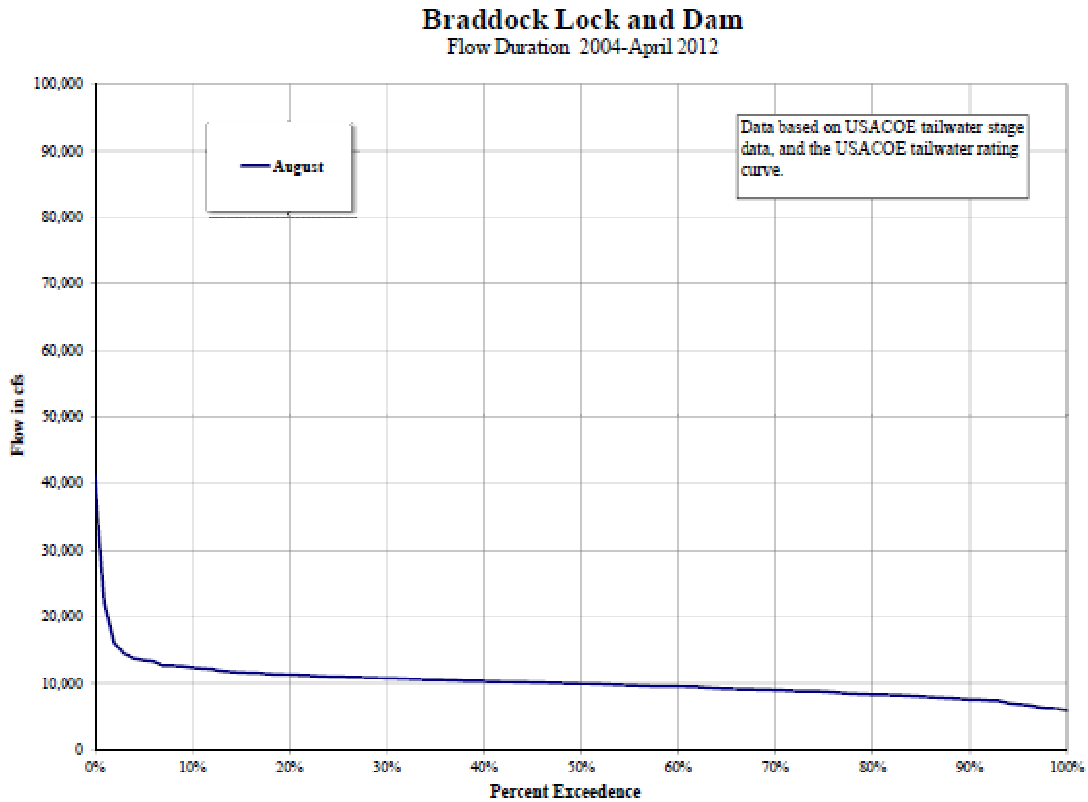

Braddock Lock and Dam
Flow Duration 2004-April 2012
May
Data based on USACE tailwater stage data, and the USACE tailwater rating curve.
Flow in cfs
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence



Braddock Lock and Dam
Flow Duration 2004-April 2012
June
Data based on USACOE tailwater stage data, and the USACOE tailwater rating curve.
Flow in cfs
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence



Braddock Lock and Dam
Flow Duration 2004-April 2012
July
Data based on USACOE tailwater stage data, and the USACOE tailwater rating curve.
Flow in cfs
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence



Braddock Lock and Dam
Flow Duration 2004-April 2012
August
Data based on USACOE tailwater stage data, and the USACOE tailwater rating curve.
Flow in cfs
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
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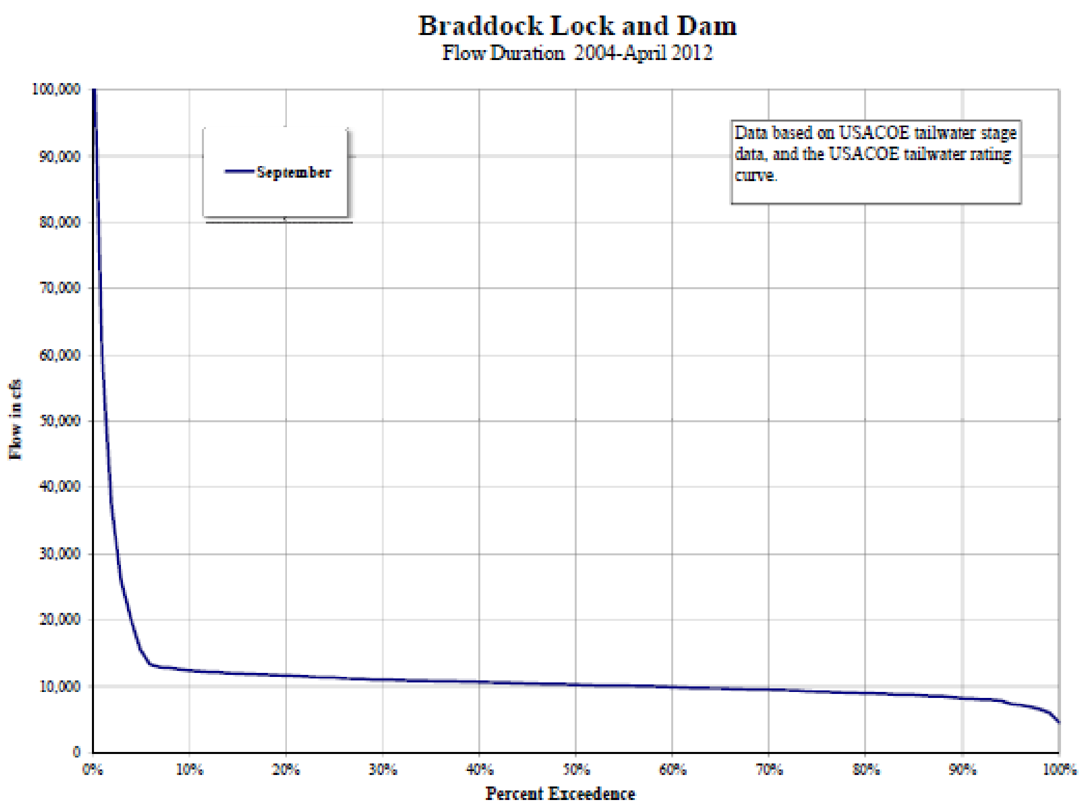
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence



Braddock Lock and Dam
Flow Duration 2004-April 2012
September
Data based on USACOE tailwater stage data, and the USACOE tailwater rating curve.
Flow in cfs
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0%
10%
20%
30%
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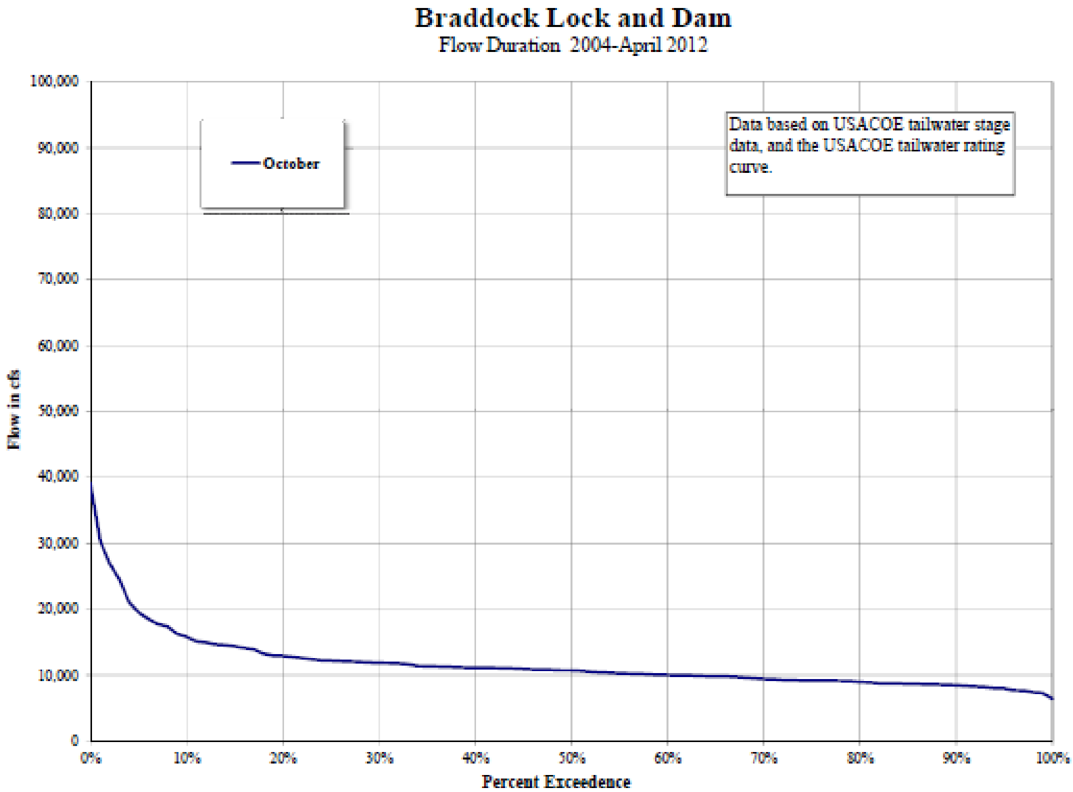
50%
60%
70%
80%
90%
100%
Percent Exceedence



Braddock Lock and Dam
Flow Duration 2004-April 2012
October
Data based on USACOE tailwater stage data, and the USACOE tailwater rating curve.
Flow in cfs
Percent Exceedence
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
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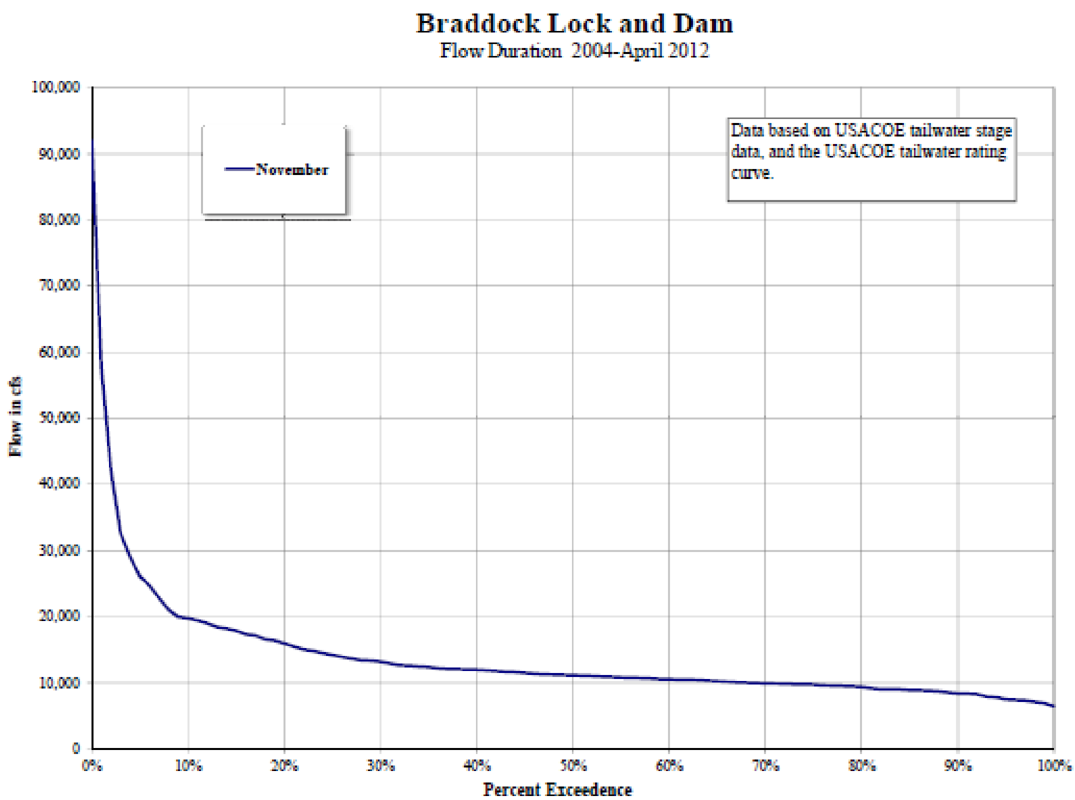
80%
90%
100%



Braddock Lock and Dam
Flow Duration 2004-April 2012
November
Data based on USACOE tailwater stage data, and the USACOE tailwater rating curve.
Flow in cfs
Percent Exceedence
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
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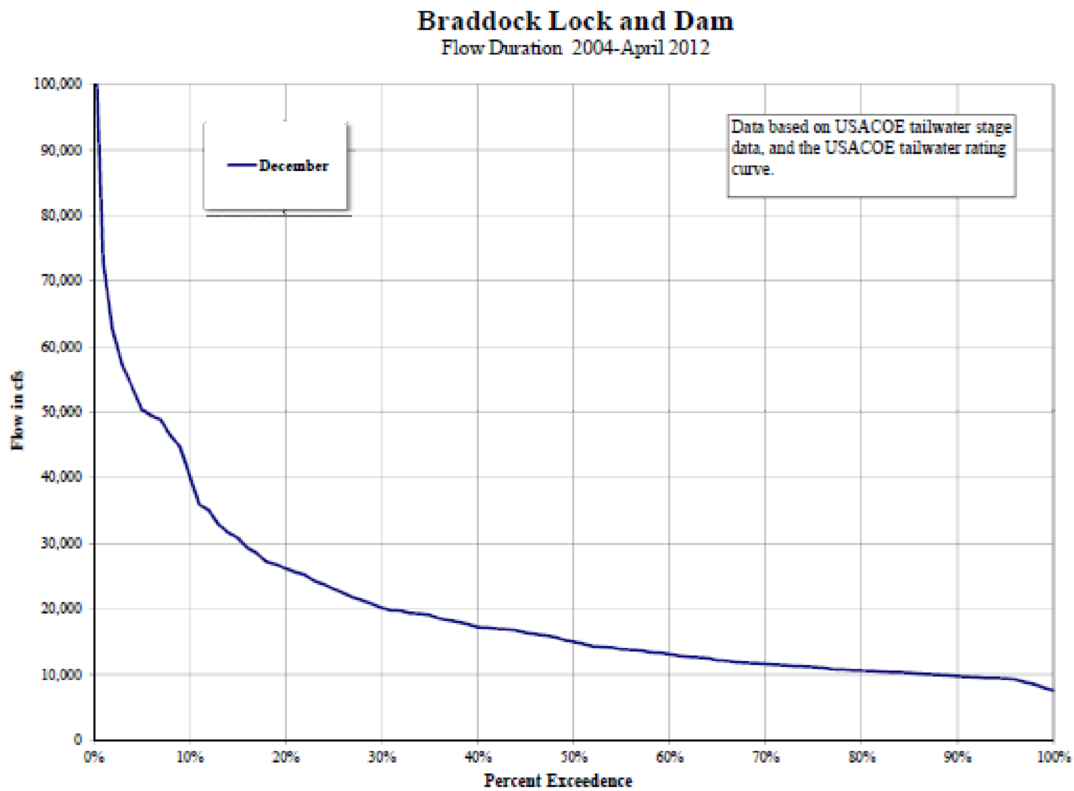
80%
90%
100%


Braddock Lock and Dam
Flow Duration 2004-April 2012
December
Data based on USACOE tailwater stage data, and the USACOE tailwater rating curve.
Flow in cfs
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence

APPENDIX E-1a

WATER QUALITY STUDY REPORT

(Given size of document – filed under separate cover)

APPENDIX E-1b

WATER QUALITY MODELING

BRADDOCK LOCKS & DAM HYDROPOWER PROJECT
WATER QUALITY MODELING
AUGUST 2012

INTRODUCTION

A dissolved oxygen (DO) screening level model of the Monongahela River in Pennsylvania has been developed to provide insight into the potential effects of the Hydro Green Energy (HGE) renewable power generation project at the Braddock Locks and Dam (Braddock L&D) in Braddock, PA. This work is in response to the USACOE's request to assess the potential effects on DO downstream from the Braddock L&D due to the proposed project as part of licensing effort. The coupled ECOM and RCA hydrodynamic and water quality model framework has been developed for the study area. The RCA model is a general purpose water quality modeling computer code that has been developed to interface with the ECOM general circulation model. The model inputs were set up for a summer low-flow condition to capture the potential extent of impacts under a worst case scenario. Baseline and proposed project model simulations will be conducted to quantify changes in dissolved oxygen due to placement of five turbines at the Braddock L&D. The following summarizes model development, data review, and model results.

MODEL FRAMEWORK

The Braddock L&D model consists of two major components: the hydrodynamic model and the water quality model. In general, the ECOM hydrodynamic model can compute the circulation of water due to tides, density variation, wind and freshwater flow. As the Monongahela River in the study area is a nontidal river, only freshwater flows and geometry will drive the computation of transport and mixing processes within the study area. The water quality model, RCA, is an extension to the family of generalized water quality models supported by EPA which include WASP (Water Analysis Simulation Program) which was developed by HDR|HydroQual's predecessor firm, Hydroscience, and provided to EPA. The water quality model is capable of representing the physical, chemical and biological processes that occur in the water and is directly coupled with the hydrodynamic model. The ECOM/RCA model framework has been used extensively in the development of coupled hydrodynamic/water quality models for a number of coastal, estuarine, river and lake settings located in the continental United States as well as abroad. Water quality models for Long Island Sound; Massachusetts Bay; NY/NJ Harbor; Thames River, CT; Perdido Bay, St. Andrew Bay, Fenholloway River, and Escambia/Pensacola Bay, FL; Lake Victoria; San Joaquin River, CA, and Dubai Creek have been developed to model the inter-relationships between nutrients, eutrophication and dissolved oxygen and to address management alternatives using this state-of-the-art modeling framework. The water quality model for this analysis has been specifically designed as a screening level model to simulate limited mechanisms that impact DO in the water column. These mechanisms include nitrification, oxygen demand from water column carbon and the sediment, as well as reaeration from the atmosphere and from river flow passing over Gate 1 (the structure's "environmental gate"). Although this analysis employs a simplified configuration of the framework, the specialized experience gained from the numerous applications of this framework has guided the development of this model.

TRANSPORT MODEL CONFIGURATION

The study area extends approximately four miles both upstream and downstream from the Braddock L&D. The upstream end of the model domain is at the confluence of Youghiogheny River with the Monongahela River and the downstream end is at the Homestead Grays Bridge. The first step in model development was to segment the river study area into a model grid. This involved spatially segmenting the river to provide sufficient resolution for the analysis and then incorporating the river bathymetry (depths) into the model grid. A practical, numerically efficient and accurate approach has been taken in order to discretize the model domain. The model domain extends from river mile 7.5 to river mile 15.4. The Braddock L&D is located at river mile 11.2.

The orthogonal, curvilinear grid system used in the present study is shown in Figure 1 (at the end of this document). A zoomed in view of the model configuration at the Braddock L&D is shown in Figure 2. The grid consists of 11-by-101 segments in the horizontal plane and 10 equally spaced layers in the vertical. Nine grid cells were used to represent lateral direction. The transformed coordinate system in the vertical plane allows the model to have an equal number of vertical segments in all of the computational grid cells. The grid size is approximately 30 x 85 m (100 x 280 ft) in the vicinity of the Braddock L&D structure. Average model depths were computed from recent USACE survey data from the upstream boundary to the Braddock L&D (USACE, 2012). Downstream of the Braddock L&D where the bathymetric survey data were not available, depths were assumed to be 4.6m (15 ft) based on bathymetric maps.

Both the baseline and proposed project conditions are based on a river flow of 7,250 cfs to allow 7,250 cfs over Gate 1 under the baseline condition and a minimum of 1,000 cfs over Gate 1 and 6,250 discharge through the five turbines operating at a capacity of 1,250 cfs each under the proposed project condition. The turbines were placed at 12 to 16 feet depth in the Braddock forebay. Flows from the turbines were discharged below the Braddock L&D into the top 3 feet of water assuming an elevation differential of 10.9 feet (721.8 feet Braddock pool elevation – 710.9 feet Emsworth pool elevation = 10.9 feet). A computational time step of 0.5 seconds produced stable and consistent model results for the entire simulation period. Model parameters were set to reasonable values obtained for similar studies performed in the past. The minimum bottom friction coefficient, CD, representing the characteristics of the bottom roughness was set to 0.003. The horizontal eddy diffusion coefficient based on the Smagorinsky (1963) formulation, CS, was chosen equal to 0.05.

DATA

A review of the available data was made to characterize the water quality in the study area to set model conditions. USGS water quality at the Elizabeth L&D, at the Braddock L&D, and from the Youghiogheny River were downloaded and plotted. Figure 3 presents data at these three locations. The three USGS gages are 1) gage 03085000 at Braddock, 2) gage 03075070 upstream of the Elizabeth L&D and 3) gage 03083500 on the Youghiogheny River at Sutersville, PA, 15 miles upstream of the confluence with the Monongahela River.

The model and data analyses address 2004 to current conditions since the Braddock L&D was replaced in 2004. Also since the analysis addresses impacts under low flow conditions (i.e., considered worst case conditions), the analysis considers data during the summer June to October time period. Figure 3 shows temporal profiles of ammonia, organic carbon, total suspended solids, and DO data. Flows at Braddock calculated from USACE rating curves were also plotted. The data indicates ammonia levels between 0.02 mg/L and 0.19 mg/L in the Monongahela River and similar levels in the Youghiogheny River (0.02 mg/L to 0.11 mg/L). Summer DO data ranges from 7.7 mg/L to 10.3 mg/L at the Braddock gage, 7.3 mg/L to 11.3 mg/L at the Elizabeth gage and 6.9 mg/L to 11.2 mg/L at the Youghiogheny River gage. Temporal DO data shows a consistent seasonal pattern with levels generally remaining above 7.0 mg/L since 2004. Based on the June through October data at Elizabeth in Figure 3, upstream boundary concentrations of 0.04 mg/L for ammonia and 7.0 mg/L for DO were assigned in the model.

Limited total organic carbon data at Braddock is plotted in Figure 3. No organic carbon data was found for the Elizabeth location. Summer average total organic carbon is 2.4 mg/L at Braddock and 1.85 mg/L at the Youghiogheny gage. For modeling purposes, the BOD was estimated as the oxygen consumption needed to oxidize organic carbon, or 2.67 mg oxygen per mg organic carbon. Using the organic carbon at Braddock to represent oxygen exerting material in the system, an upstream BOD boundary of 6.41 mg/L (2.4 mg/L x 2.67) was assigned in the model. TSS concentrations at Braddock average 16.25 mg/L and range from 2 mg/L to 62 mg/L.

Stratification in the system has also been considered. Figures 4 and 5 present temperature and DO vertical profiles along the Monongahela River for June to October 2004 to 2012. Temperature and DO data indicate that there is little if any stratification along the river in the study area. One sample taken during recent water quality sampling efforts indicates that there may be localized stratification near the Braddock L&D (MP 11.2). This may reflect increased depths in the vicinity of the Braddock L&D. Local stratification has all but disappeared by MP 11.0. These figures also show flows when the profiles were collected. These profiles represent a range of flows from 1,342 cfs to 25,900 cfs indicating that even during periods of lower flows, stratification is at a minimum.

Spatial graphs of ammonia in the study area (Figure 6) indicate that ammonia levels are generally low through the study area. Spatial graphs of DO also indicate consistent DO concentrations. Plots of DO with temperature for post 2004 Braddock pool data shown in Figure 7 indicate that in general DO levels are not significantly above saturation, generally less than 2 mg/L above saturation, indicating that primary productivity may contribute to the oxygen balance. However, given the lack of data and the intended purpose of this screening level model to assess impacts from water passing through the turbines, the purpose of the analysis would be better achieved without including productivity in the model.

Analyses of temperature data, indicate maximums of 32C. However the occurrence of temperatures in the 35C range in the summer of 2005, perhaps influenced by upstream industrial discharges, has been documented. Therefore a critical temperature of 35C was assigned in the model.

Several industrial and municipal point sources along the Monongahela and Youghiogheny Rivers upstream of the Braddock L&D were identified. However all discharges except one are upstream of the model segmentation and water quality data would reflect these discharges. One point source, approximately 75 ft above the Braddock L&D from the Edgar Thompson plant, discharges to the river. Average daily flow for this plant was 217 cfs in 2010 and average temperature for 2010 was 26.2C (US EPA, 2012). It is not expected that this discharge is a source of significant BOD and therefore BDO passing over the Braddock L&D would not be influenced by this discharge, so this discharge was not included in the model.

WATER QUALITY MODEL

The Braddock L&D model simulates ammonia (NH3), biochemical oxygen demand (BOD), and dissolved oxygen (DO). Since the intent of the model is to simulate dissolved oxygen impacts for the proposed project, and due to lack of data as discussed above, a more detailed model was not developed. A brief description of the selection of constants appears below. The remainder of this section contains a general description of the model framework employed in this study and selection of model parameters.

Transport of Pollutants

The results of the hydrodynamic model provide the water quality model with the water transport and dispersive information required to simulate the transport of pollutants. The dispersive information includes horizontal, lateral, and vertical mixing. A tracer model run was performed that indicates travel time from the upstream boundary to the downstream boundary is approximately one day.

Dissolved Oxygen

Mechanisms that were considered for this model that can kinetically reduce DO in the river are nitrification, biochemical oxygen demand (BOD), and sediment oxygen demand (SOD). Mechanisms that were considered that can kinetically increase DO in the river are atmospheric reaeration and reaeration over Gate 1. Dissolved oxygen concentrations are also influenced by boundary conditions. As mentioned above, no point source loadings are considered in the model. The following sections summarize selection of conditions to calibrate the model for dissolved oxygen.

Dissolved Oxygen Reaeration

Dissolved oxygen is exchanged at the air-water interface. When the water column dissolved oxygen concentration is less than the naturally occurring dissolved oxygen saturation concentration, oxygen is added to the water column from the atmosphere. The dissolved oxygen saturation concentration is calculated for the surface water in the model as a function of temperature. Oxygen is removed from the water column by reaeration when the water is supersaturated with oxygen. The aeration coefficient is calculated internally in the model as a function of the oxygen transfer coefficient as follows:

$$K_a = K_L/H \qquad (1)$$

Where: K_a is the aeration coefficient [/day],

K_L is the oxygen transfer coefficient [m/day], and

H is the depth of the model surface segment layer [m].

The oxygen transfer coefficient was assigned as 10 m/day based on large scale field observations presented in the literature (O'Connor, 1983) which range from 2 m/day to 20 m/day for a wind speed range of 1 m/s to 10 m/s. The oxygen transfer coefficient is spatially constant in the model. The segment specific aeration coefficient is then calculated within the model.

Nitrification

Nitrification is a biological process in which nitrifying bacteria oxidize ammonia nitrogen present in the water column. Given the low and consistent ammonia levels seen in the data minimal nitrification rates were used in the model. Boundary ammonia was set at 0.04 mg/L. Typical nitrification rates at 20C are 0.05 to 0.10 /day (HydroQual, 2004). A nitrification rate 0.05 was assigned in the model to reflect potential instream ammonia nitrification.

Biochemical Oxygen Demand

The biochemical oxygen demand (BOD) oxidation rate (K_d) is the rate at which microorganisms utilize oxygen dissolved in the water column during the process of consuming organic matter. Organic carbon data has been used as an indicator of BOD in the absence of BOD data for this analysis. Typical oxidation rates for BOD range from 0.007/day to 0.01/day for refractory BOD and 0.10/day to 0.15/day for more reactive labile BOD (HydroQual, 2004). The oxidation rate used for this study was 0.065/day.

Sediment Oxygen Demand

In general, particulate solids can potentially settle to the bottom sediments of waterways, and promote a series of chemical reactions that utilize dissolved oxygen in the aerobic sediment layer and the water column. As oxygen is depleted in the sediment layer, anaerobic reactions begin. Sediment reactions produce hydrogen sulfide, which either oxidizes in the aerobic layer of the sediment or migrates up from the sediment into the water column. The entire process is known as diagenesis. While this model does not calculate settling of solids and resulting SOD, nominal SOD values of 2.0 gm/m2/d immediately upstream and downstream of the Braddock L&D and 0.5 gm/m2/d in the remainder of the river were applied. These values are based on experience as well as the lack of physical indicators that significant reactions are occurring in receiving waters such as strong odors of hydrogen sulfide and low dissolved oxygen in bottom waters. Data indicate that bottom waters immediately upstream and downstream of the Braddock L&D may experience lower DO levels than at the surface. One sample on July 11 resulted in bottom DO of 5.58 mg/L, indicating potential SOD and therefore the above mentioned SOD values were assigned.

Reaeration at Gate 1

According the USACE, Gate 1 has been designed to provide reaeration as flows pass over the gate. An important feature of this modeling effort is to assess potential changes in reaeration that might occur as a result of the flows passing through the turbines rather than over Gate 1. A cascade height equation from Metcalf and Eddy, 2003, used extensively in the waste water industry to design stair-step weirs that provide aeration prior to a WWTP outfall, has been used to estimate reaeration over Gate 1. The Metcalf and Eddy cascade height equation is presented here:

$$H = \frac{R - 1}{0.11 \times a \times b \times (1 + 0.046 \times T)} \qquad (2)$$

Where:

C_S = DO saturation concentration at temperature T (m/L)

C_O = DO concentration of influent (mg/L)

C = Required DO level after post aeration (mg/L)

R = Deficit ratio:

$$R = \frac{C_S - C_O}{C_S - C}$$

a = water quality parameter, = 0.8 for WWTP effluent
b = weir geometry parameter, = 1.0 , = 1.1 for steps, = 1.3 for step weir
T = water temperature (deg. C)
H = height through which water falls (ft)

Replace C_o with C_u, the upstream DO concentration and C with C_d, the downstream DO concentration, yields the flowing equation:

$$C_d = C_u – E (C_s – C_u) \quad (3)$$

Where:

E = oxygen transfer efficiency = 1 – (1/R)

R = 1 + 0.11ab (1 + 0.046T) H

Equation 3 was added to the model code to calculate reaeration over Gate 1. Coefficients were assigned as follows: a=0.8 for WWTP effluent, b=1.0 for weir with no steps, H=4.0 ft., approximate height of the Braddock spillway.

Temperature Effect

Temperature is employed in the model to calculate dissolved oxygen saturation concentrations and to adjust model kinetic coefficients from standard 20C to model temperature of 35C. Temperature correction coefficients for the major kinetic reactions are summarized in Table 1.

Table 1. Temperature Correction Coefficients

Kinetic Reaction	Rate	Temperature Correction Coefficient
Atmospheric Reaeration	K_a	1.024
Nitrification	K_n	1.045
SOD	K_{sod}	1.024
BOD Oxidation	K_d	1.080

MODEL SIMULATIONS

Two model simulations were made representing a baseline condition and the proposed project condition. In this way, changes in DO concentrations can be directly computed and impacts from the proposed project can be assessed. Both the baseline and proposed project conditions are based on a river flow of 7,250 cfs. The baseline run passes all 7,250 cfs over Gate 1. The proposed project scenario allows a minimum of 1,000 cfs over Gate 1 and 6,250 cfs discharge through five turbines operating at a capacity of 1,250 cfs each. Water quality conditions have been defined above and the baseline and scenario #1 conditions are outlined below.

Baseline Condition

- Braddock Pool elevation at 721.8 ft
- Emsworth Pool elevation at 710.9 ft
- Water temperature at summer maximum of 35 deg. C (2005 data)
- Lock operations suspended or very infrequent; therefore, no flow thru locks
- River discharge = 7,250 cfs
- Discharge thru WQ Gate 1 = 7,250 cfs
- Upstream DO = 7.0 mg/L

Scenario #1 - Operational Condition

- Braddock Pool elevation at 721.8 ft
- Emsworth Pool Elevation at 710.9 ft
- Water temperature at summer maximum of 35 deg. C (2005 data)
- Lock operations suspended or very infrequent; therefore, no flow thru locks
- River discharge = 7,250 cfs
- Discharge thru WQ Gate 1 = 1,000 cfs (HGE's operational minimum)
- Discharge thru turbines = 6,250 cfs (five turbines at capacity)
- Upstream DO = 7.0 mg/L

Spatial profiles of surface (red) and bottom (green) model results at Gate 1 (top panel) and at the location of the turbines (bottom panel) are presented in Figure 8. Surface and bottom increases in DO over Gate 1 and at the location of the proposed turbines for the baseline case (solid red and green lines, top and bottom panels) indicate a calculated increase of approximately 0.2 mg/L. This increase reflects all of the model sources and sinks for DO. Scenario 1, with operation of the turbines, results in a 0.11 increase in surface DO over Gate 1 and no increase in bottom DO at Gate 1 or in surface or bottom DO where the turbines would be placed. Figure 9 shows a map view of the model results. Caution in interpreting the map views is warranted as the changes in map colors between light green (6.5 mg/L to 7.0 mg/L) and yellow (7.0 mg/L to 7.5 mg/L) actually reflect changes in DO model results on the order of tenths of mg/L.

Since these model runs include all of the sources and sinks of DO a model run was done where all sources and sinks were turned off and only reaeration due to the Gate 1 weir was calculated. The increase in DO due to the weir at Gate 1 is computed as 0.13 mg/L. Although no data has been provided from the USACE regarding actual impacts on DO at Gate 1, both recent samples taken by HDR above and below Gate 1 and the Metcalf and Eddy weir reaeration calculation confirm this small change in DO. One set of DO measurements collected on July 11, 2012 upstream (8.54 mg/L) and downstream (8.31 mg/L) of Gate 1 shows no increase in DO. The reaeration equation using coefficients defined above for reaeration at Gate 1 resulted in 48% oxygen transfer efficiency and in increase in DO of 0.07 mg/L to 6.92 from an assigned upstream concentration of 6.85 mg/L and DO saturation of 7.0 mg/L at 35C.

To test a conservative estimate of the weir reaeration oxygen transfer efficiency, the oxygen transfer efficiency was set at 80% based on recent work of Witt and Gulliver 2012, where a maximum oxygen transfer efficiency of 80% was observed for unsubmerged hydraulic jumps at low-head dams. Both the 48% and 80% transfer efficiency runs were completed for cases where all of the DO sources and sinks were applied and also where only the reaeration over Gate 1 was applied. Table 2 tabulates the model results for oxygen transfer efficiencies of 48% and 80% below Gate 1 and below the dam at the proposed location of the turbines. Table 2 also shows results for runs including all DO sources and sinks and for only where weir reaeration is applied. Table 3 presents calculated reductions in DO at these locations due to the proposed project for these model runs. When considering only the DO changes due to Gate 1 and at the likely oxygen transfer efficiency of 48%, the model indicates that there is a modest reduction in the increase in DO under Scenario #1 ranging from 0.05 mg/L to 0.13 mg/L. A conservative calculation using 80% oxygen transfer efficiency and considering DO changes due to the Gate 1 weir also indicates a modest reduction in the increase in DO under Scenario #1 ranging from 0.14 mg/L to 0.35 mg/L.

SUMMARY AND RECOMMENDATIONS

Small changes in DO due to the weir at Gate 1 are not unexpected for this analysis, given that the DO saturation at 35C is approximately 7.0 mg/l and the upstream DO is set at 7.0 mg/L. It should be noted that the data support river DOs at 7.0 mg/L or higher, and the above analyses were done using worse case conditions. None of the predicted changes cause DO to approach violating standards or having biological significance. Potentially lower DOs in bottom waters of the Braddock pool, as evidenced by the single depth profile (Figure 5) may be occurring.

Table 2. Dissolved Oxygen Downstream of the Water Quality Gate and Proposed Turbine Location

		Dissolved Oxygen (mg/L)							
		Downstream of Water Qualty Gate				Downstream of Turbines			
		Surface		Bottom		Surface		Bottom	
DO Sources/Sinks	**Transfer Efficiency**	**Baseline**	**Scenario #1**	**Baseline**	**Scenario #1**	**Baseline**	**Scenario #1**	**Baseline**	**Scenario #1**
All	0.48	7.06	6.99	7.05	6.84	7.08	6.84	7.00	6.83
Only WQ Gate	0.48	7.13	7.08	7.13	7.01	7.13	7.00	7.13	7.00
All	0.8	7.20	7.06	7.19	6.85	7.19	6.84	7.14	6.83
Only WQ Gate	0.8	7.22	7.13	7.22	7.02	7.22	7.00	7.22	7.00

Table 3. Dissolved Oxygen Reduction Due to Project Downstream of the Water Quality Gate and Proposed Turbine Location

		Dissolved Oxygen Reduction (mg/L) Under Scenario #1			
		Downstream of Water Qualty Gate		Downstream of Turbines	
DO Sources/Sinks	**Transfer Efficiency**	**Surface**	**Bottom**	**Surface**	**Bottom**
All	0.48	0.07	0.21	0.24	0.17
Only WQ Gate	0.48	0.05	0.12	0.13	0.13
All	0.8	0.14	0.34	0.35	0.31
Only WQ Gate	0.8	0.09	0.20	0.22	0.22

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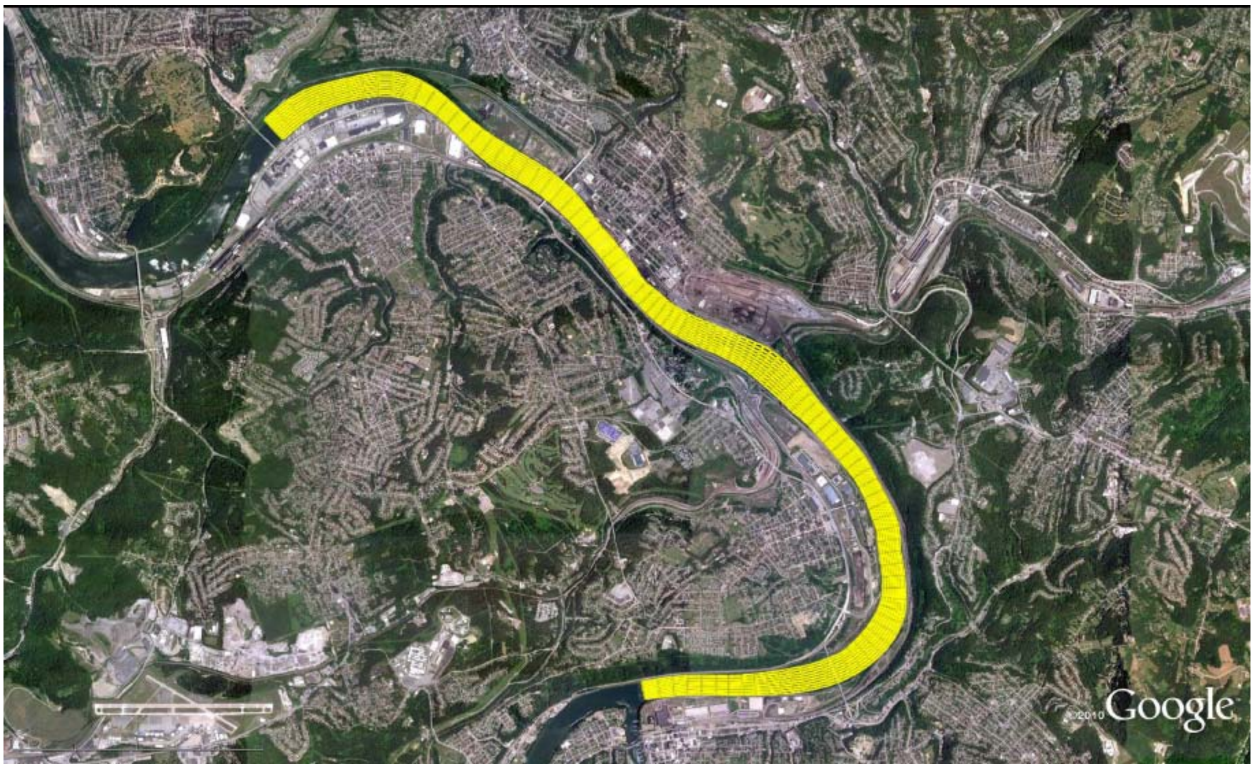


Figure 1. Braddock L&D Study Area and Model Segmentation.

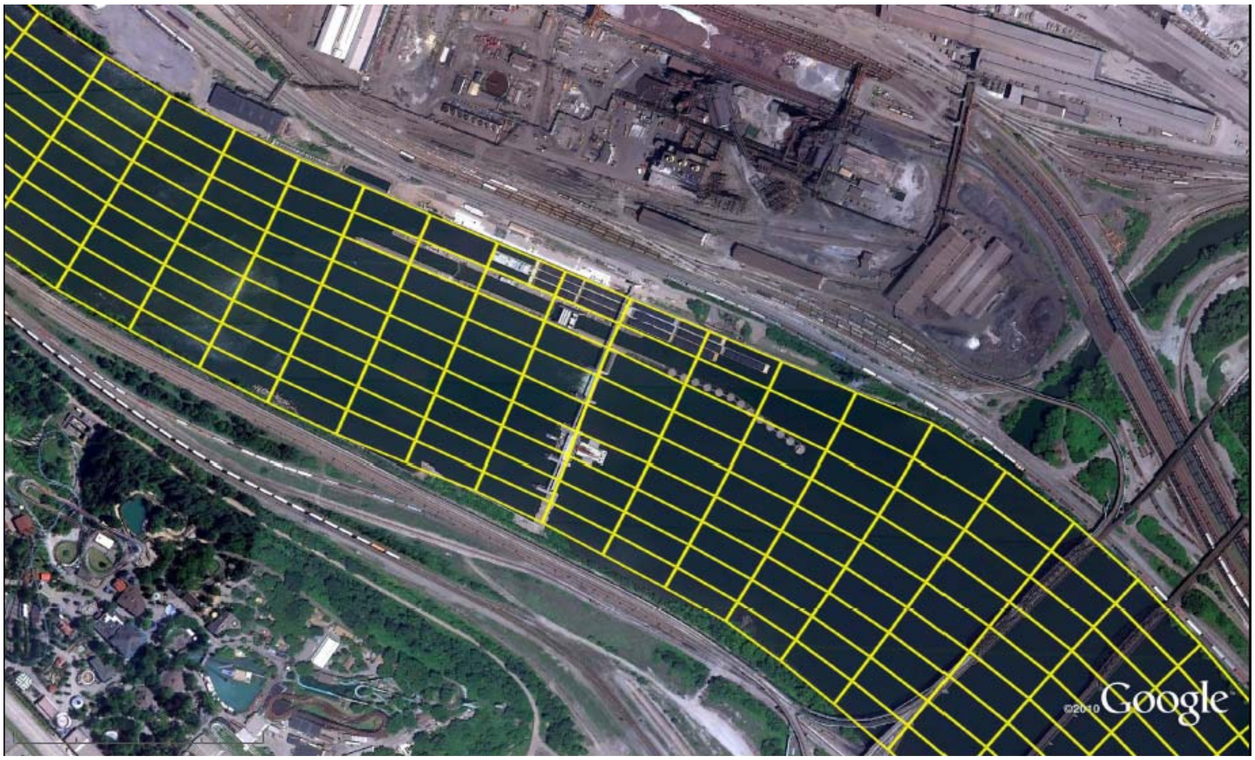


Figure 2. Braddock L&Dam Model Segmentation Zoomed In.

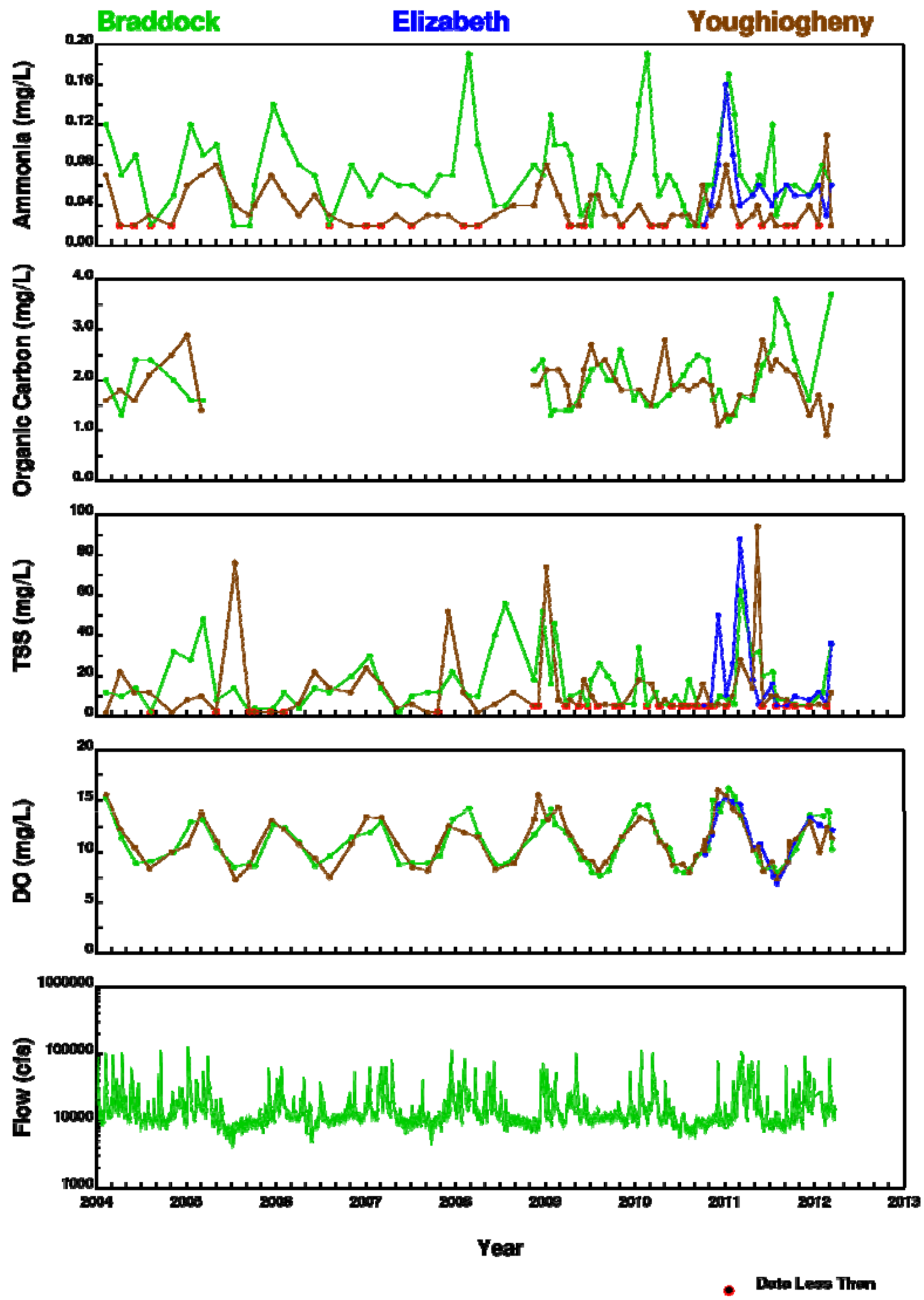


Figure 3. USGS Water Quality Data in the Monongahela and Youghiogheny Rivers, 2004 – 2012.

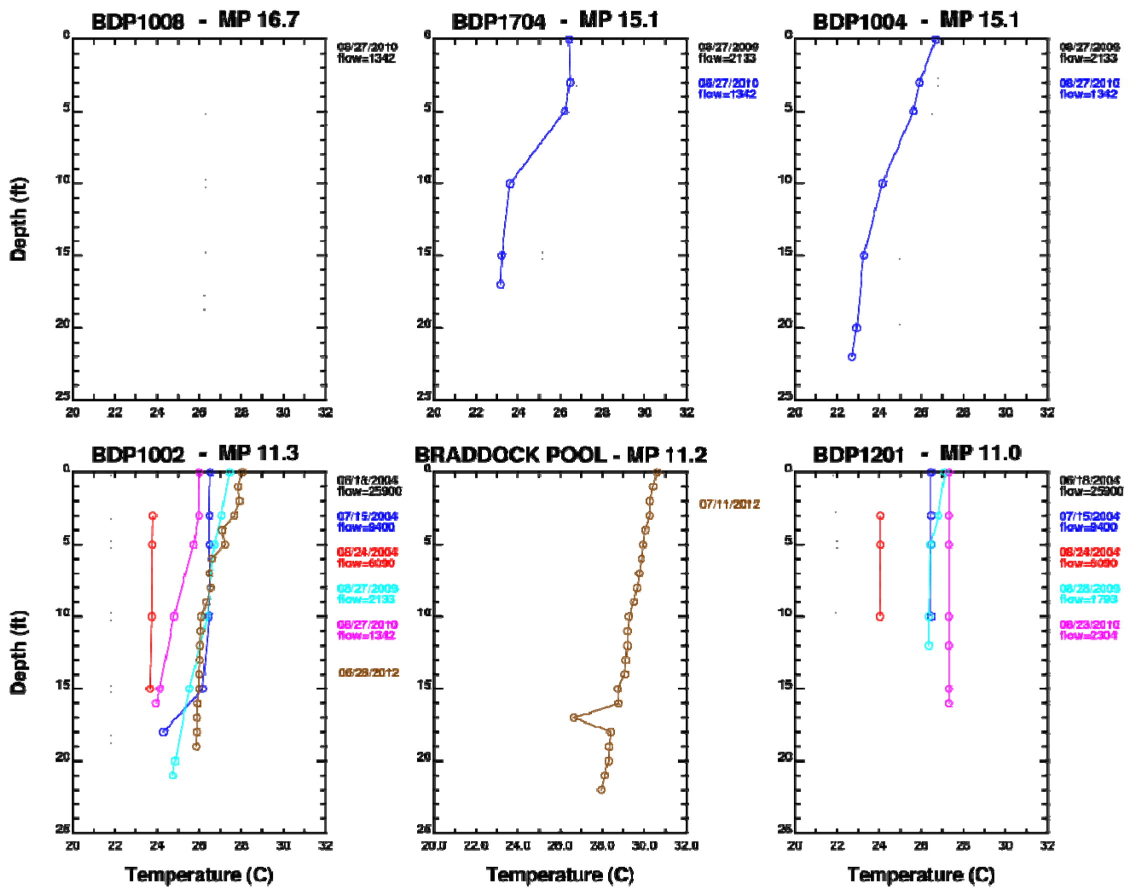


Figure 4. Depth Profiles of Temperature Upstream and Downstream of the Braddock L &D, June – October, 2004 to 2012.

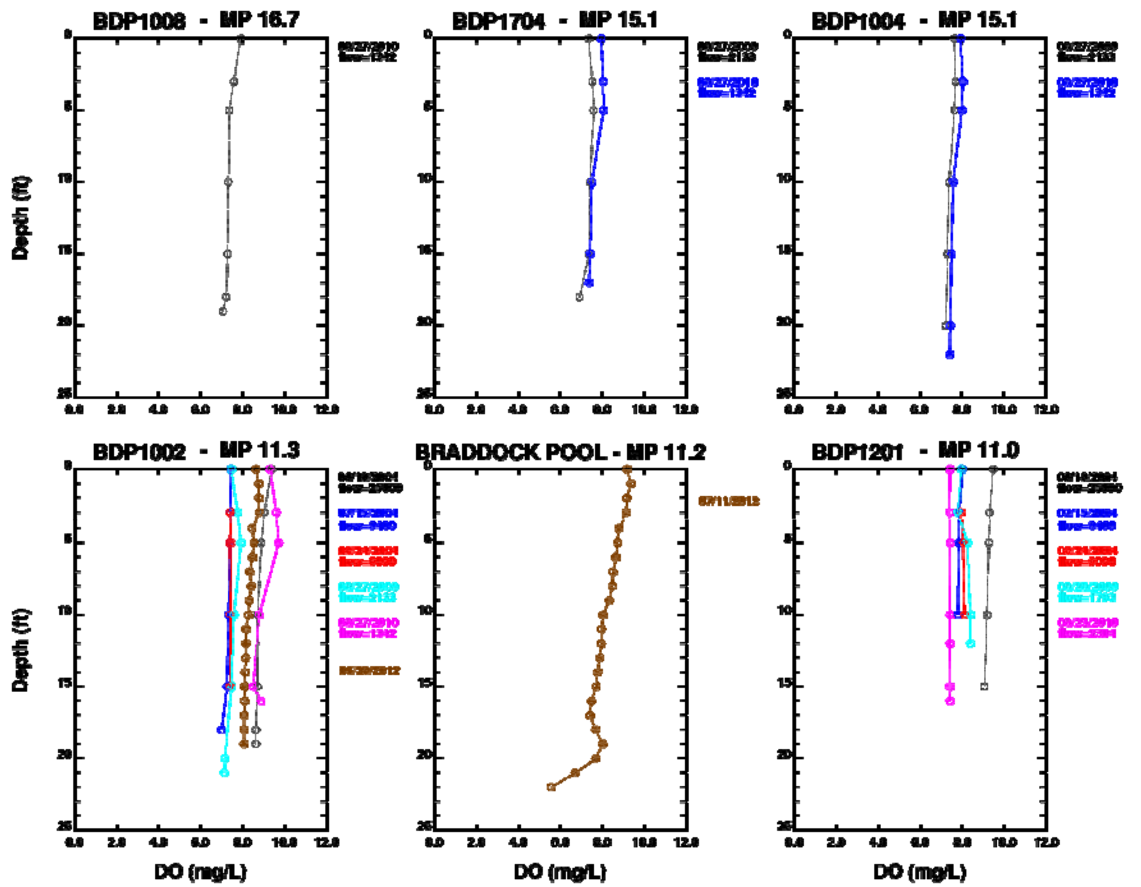


Figure 5. Depth Profiles of DO Upstream and Downstream of the Braddock L &D, June - October, 2004 to 2012.

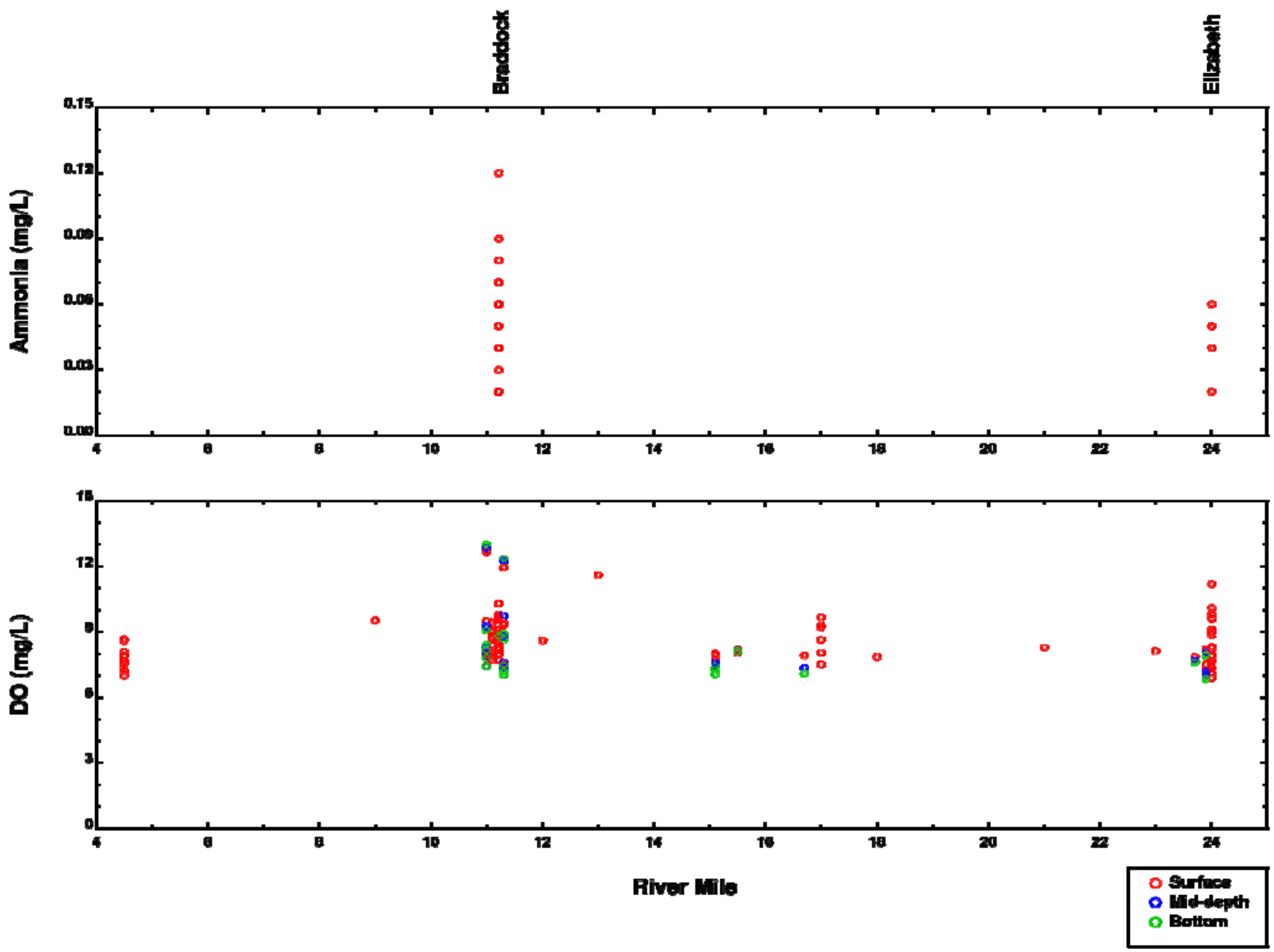


Figure 6. Spatial Profiles of Ammonia and Dissolved Oxygen, June to October, 2004 – 2012.

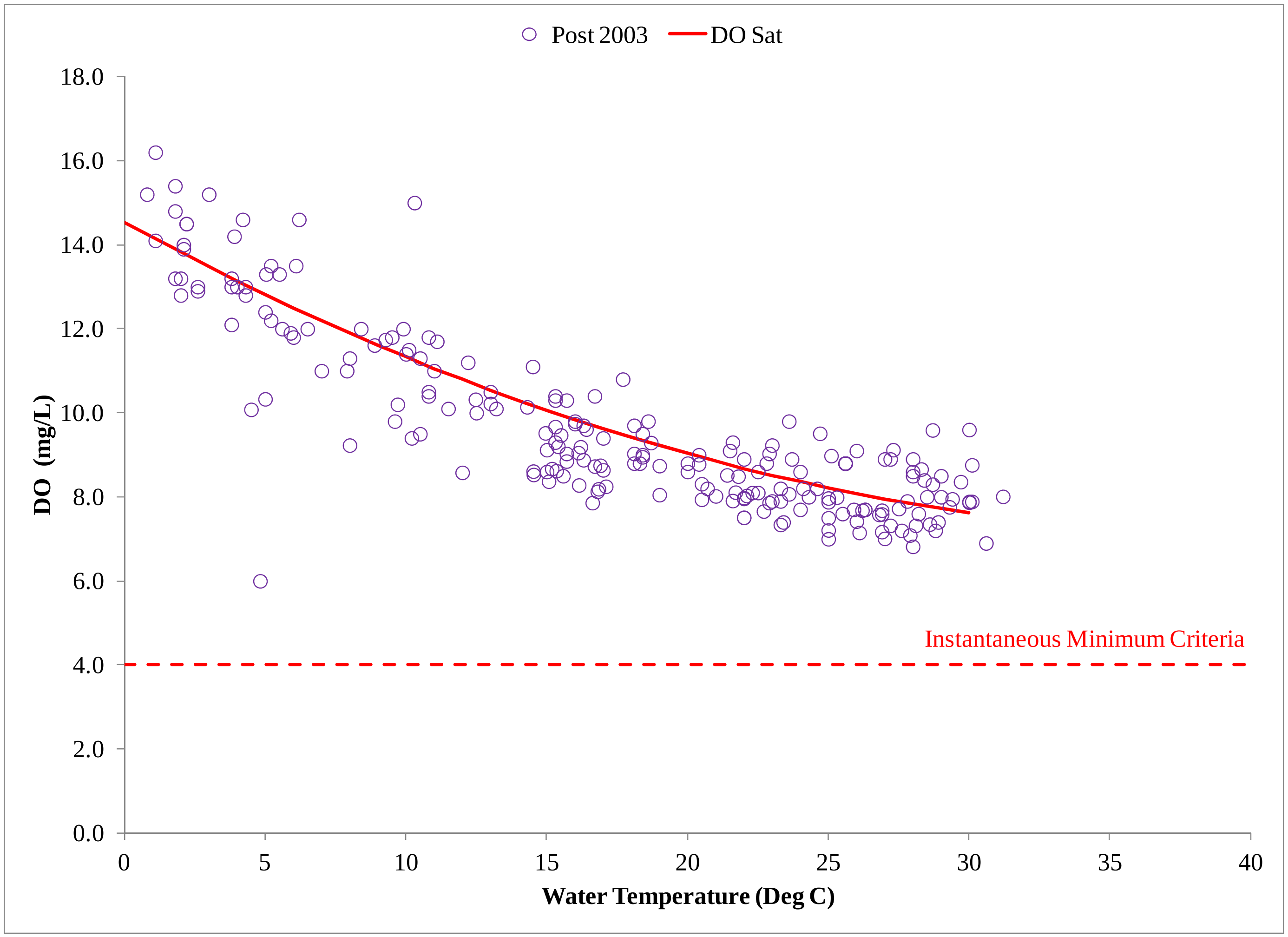


Figure 7. Dissolved Oxygen with Temperature at the Braddock L&D.

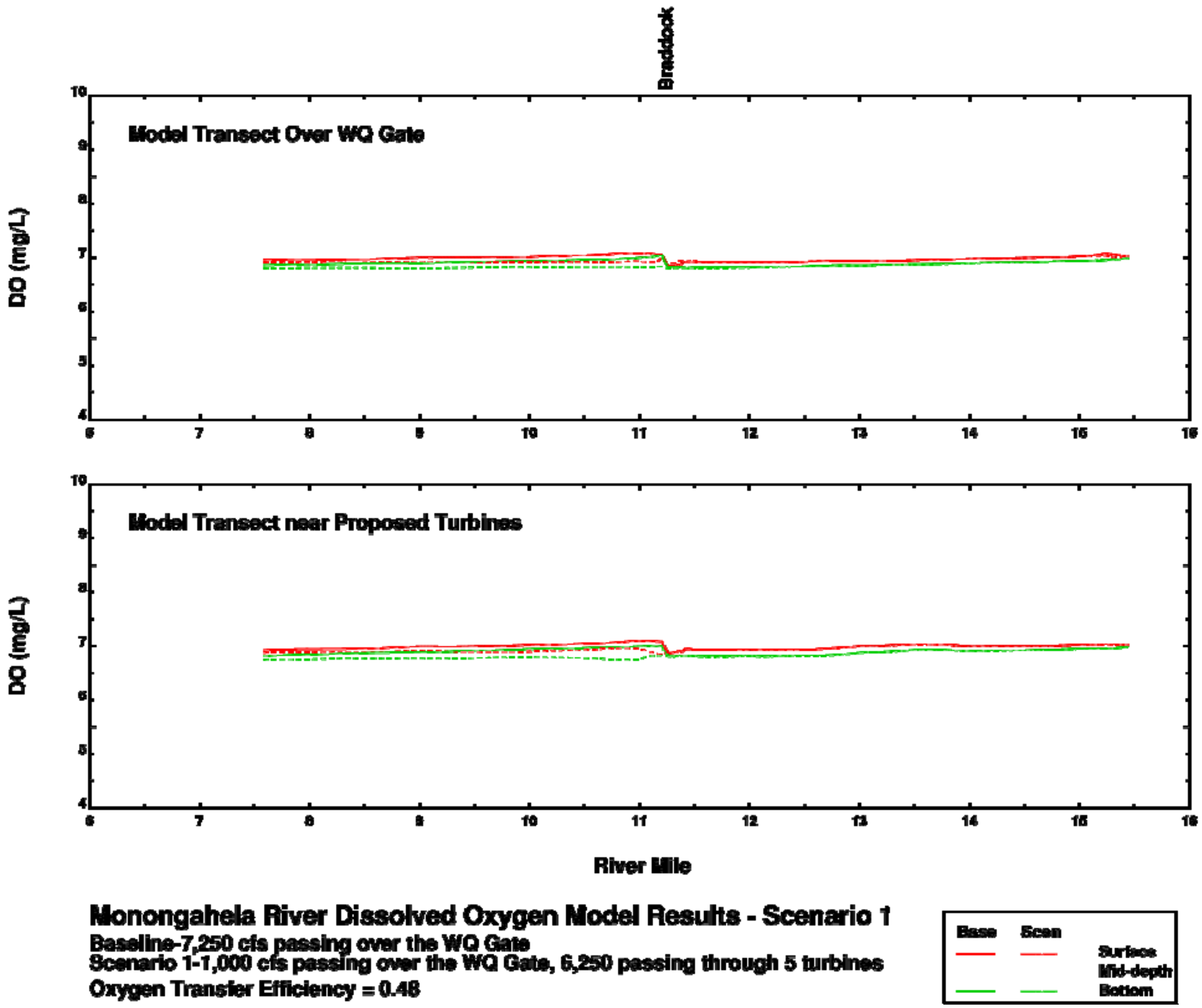


Figure 8. Dissolved Oxygen Model Results for Baseline and Proposed Project Scenario #1.

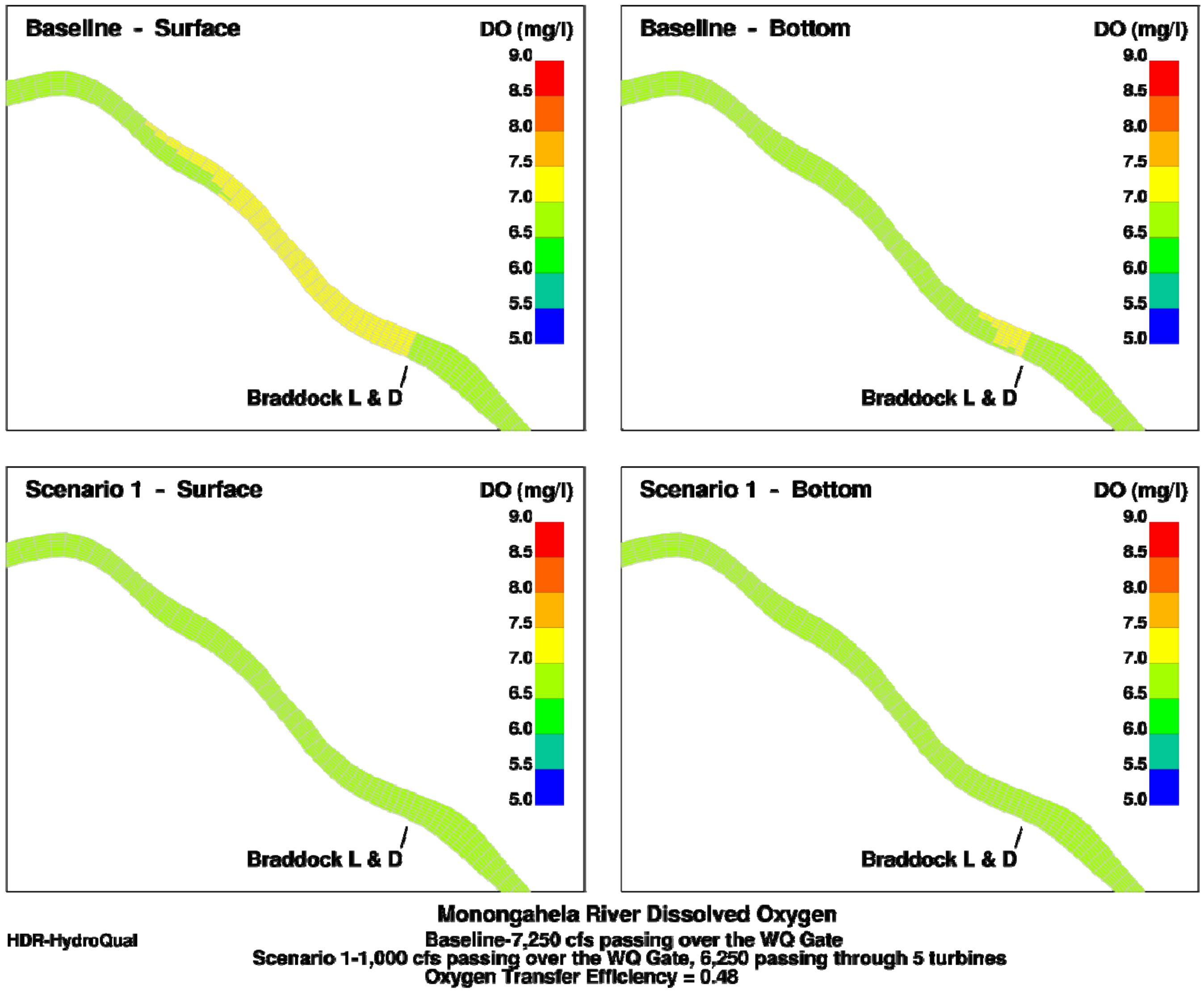


Figure 9. Map View of Dissolved Oxygen Model Results for Baseline and Proposed Project Scenario #1.

APPENDIX E-2

FISH ENTRAINMENT AND SURVIVAL ASSESSMENT REPORT

(Given size of document – filed under separate cover)

APPENDIX E-3

CONSULTATION RECORD

BRADDOCK LOCKS AND DAM HYDROELECTRIC PROJECT
(FERC NO. 13739)

CONSULTATION SUMMARY

The consultation documentation presented in this appendix is a supplement to Exhibit E, which has been prepared in accordance with 18 CFR Section 16.8 (f). This appendix provides a chronological list of consultation, as well as copies of applicable correspondence.

Initial-Stage Consultation

In order to gain a better understanding of the potential resource areas to be addressed through the licensing process, Hydro Friends Fund conducted a series of initial consultation activities with Project stakeholders. In addition to the filing of the preliminary permit application, included in these activities was initial consultation with the US Army Corps of Engineers (USACE), a series of correspondence, a pre-application meeting with the Pennsylvania Department of Environmental Protection (PADEP), meeting with area stakeholders, and the distribution of a Pre-Application Document (PAD) questionnaire. Subsequent to these initial activities, Hydro Friends Fund filed and distributed a Notice of Intent (NOI) and PAD for the Project on December 23, 2011.

Following FERC's granting of Hydro Friends Fund to use the Traditional Licensing Process (TLP) in support of the licensing effort, Hydro Friends Fund conducted two (publically noticed) Joint Agency/Public Meetings and a site visit of the Braddock Locks and Dam on March 7, 2012. Consistent with the information presented in the PAD and during the Joint Agency/Public Meeting, a 60-day comment period was provide to all parties to comment on the information presented in the PAD and during the March 7th meeting, as well as to make study requests. In response to this comment period, comments were filed by the USACE.

Second-Stage Consultation

Environmental Study Efforts – Environmental studies were conducted in consultation with the Project stakeholders including the PADEP, USACE, US Fish and Wildlife Service (USFWS), and the Pennsylvania Fish and Boat Commission (PAFBC). Following the Joint Agency/Public Meetings, Hydro Friends Fund performed a series of conference calls with the USACE to address comments pertaining to the PAD and study requests. In general, the focus of the consultation focused on water quality. As a result of this consultation, in addition to the desktop water quality study proposed by Hydro Friends Fund, a continuous water quality field effort commenced in late June and will continue through the last week of September. During this time period, Hydro Friends Fund has deployed and monitored four continuous water quality monitors at the Braddock Locks and Dam. In addition, Hydro Friends Fund and the USACE have coordinated to modify gate flows associated with the structure to measure water quality under varied flow scenarios. In addition, through consultation with the USACE, Hydro Friends Fund was able to better define the parameters used during the water quality modeling performed in support of the license effort. Hydro Friends Fund was also able to obtain additional water quality and facility information from the USACE through this routine (approximately twice a week) consultation.

In addition to the consultation with the USACE, Hydro Friends Fund coordinated over the summer with the PADEP, USFWS, and PAFBC regarding the scope and methodology of the studies to be performed in support the licensing effort. Based on this consultation, Hydro Friends Fund was able to identify the target fish species applicable to the impingement and entrainment study that was performed. In addition, Hydro Friends Fund was able obtain additional water quality and macroinvertibrate information and was able to better define the parameters applicable to the water quality modeling effort.

Applicable sections of this License Application, including appendices E-1a, E-1b, and E-2, present and address the results of each of these studies. The study results augment the resource information presented in the PAD and help address the data needs that were identified through consultation activities. Collectively, Hydro Friends Fund has used this information to present a comprehensive description of Project-related associated resources and an assessment of Project impacts.

Through consultation with the Pennsylvania Department of Conservation and Natural Resources (DCNR), and the submission of the Pennsylvania Natural Diversity Inventory (PNDI) review request, Hydro Friends Fund was informed that DCNR has determined that the proposed project will likely have no impact to potential species or resources of concern to the DCNR and that no additional coordination with DCNR is required at this time.

Through consultation with the Pennsylvania Historical and Museum Commission – Bureau for Historic Preservation, Hydro Friends Fund was informed that State Historic Preservation Office (SHPO) has determined that the proposed project will have no adverse effect upon the National Registered listed Monongahela River Navigation System or no effect on any archaeological or structural historic resource.

License Application

Through a series of emails and a mailing starting on August 8, 2012, Hydro Friends Fund distributed a draft version of the license application and associated study reports to the parties who indicated interest in the project – USACE, PADEP, USFWS, and PAFBC. Subsequent to this distribution, Hydro Friends Fund met with representatives of the USACE on August 29th to review the project and on August 30th with USACE, USFWS, and PADEP to walk the parties through the content of the application and the study reports. During these meetings, Hydro Friends Fund requested if the parties would concur with the filing of the license application and study reports with the Commission as final in order to initiate the formal comment periods and formal NEPA activities under the TLP. Following the August 30th meeting, Hydro Friends Fund received correspondence from USFWS, PADEP and USACE that these parties are comfortable with the level of consultation to date and are in agreement with filing the license application at this time, as compared to initiating an additional draft application comment period.

Pending Consultation

Based on consultation activities to date, Hydro Friends Fund fully understands that additional consultation in support of developing the project will be occurring with the PADEP and PAFBC regarding the Section 401 Water Quality Certification and additional Commonwealth of Pennsylvania permit requirements. In addition, Hydro Friends Fund will be performing a considerable amount of consultation with the USACE regarding the required Section 408 authorization and Section 404 permit. Hydro Friends Fund will also be consulting with the USFWS and other applicable agencies and parties in support of these required authorizations.

List of Attached Correspondence

Date	Type	From	To	Subject
10/11/11	Letter	Jim Gibson (HDR)	Project Stakeholders	PAD Questionnaire
10/11	Response	East Pittsburgh Borough	HDR	PAD Response
10/11	Response	Allegheny Valley Trails Assoc	HDR	PAD Response
10/11	Response	Appalachian Watershed Corporation	HDR	PAD Response
10/11	Response	Braddock Borough	HDR	PAD Response
10/11	Response	USFWS – Susquehanna	HDR	PAD Response
10/11	Response	PA Game Commission	HDR	PAD Response
10/11	Response	BLM	HDR	PAD Response
10/11	Response	Bureau & Topographic and Geologic Survey	HDR	PAD Response
10/11	Response	Turtle Creek Borough	HDR	PAD Response
10/11	Response	PA Natural Heritage Program/Western PA Conservancy	HDR	PAD Response
10/28/11	Letter	Jim Gibson (HDR)	PADEP	Coastal Zone Consistency Determination
10/28/11	Letter	Jim Gibson (HDR)	PA Historical and Museum Commission	Request for Historical and Cultural Information

Date	Type	From	To	Subject
10/28/11	Letter	Jim Gibson (HDR)	PA Department of Conservation and Natural Resources	Request for Threatened and Endangered Species Information
10/28/11	Letter	Jim Gibson (HDR)	USFWS	Request for Threatened and Endangered Species Information
11/23/11	Letter	PA Department of Conservation and Natural Resources	Jim Gibson (HDR)	Response regarding Threatened and Endangered Species
12/6/11	Letter	PADEP	FERC	Confirmation that Project is located outside of State's coastal zone area.
3/22/12	Email	USACE	Jim Gibson (HDR)	Information regarding Environmental Gate
4/17/12	Email	PA Historical and Museum Commission	Jim Gibson (HDR)	Response regarding Historical and Cultural Information
4/20/12	Email	USACE	Jim Gibson (HDR)	Response to questions regarding operation of Environmental Gate
5/11/12	Letter	USACE	FERC	Comments on PAD
6/27/12	Letter	USACE	Jim Gibson (HDR)	Right-of-Entry Permit to perform water quality field work
8/6/12	Email	Jim Gibson (HDR)	Project Stakeholders	Coordination of a Stakeholder meeting in Pittsburgh or State College
8/9/12	Email	Jim Gibson (HDR)	Project Stakeholders	Distribution of Draft Fish Entrainment Study Report
8/30/12	Presentation	--	--	Agenda and meeting presentation
9/7-9/11	Emails	FWS, DEP, USACE	(Mark Stover (HGE)	Concurrence with filing a license application in lieu of a draft license application
9/11/12	Email	PADEP	Mark Stover (HGE)	Applicability of Water Obstruction and Encroachment Permit to project

October 11, 2011

TO: **Potentially Interested Parties**

SUBJECT: **Braddock Locks & Dam Hydroelectric Project (FERC No. 13739) Information Request in Support of Licensing**

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC (HGE), is beginning the Federal Energy Regulatory Commission ("FERC" or "Commission") licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect of the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania.

HGE focuses on developing new hydropower generation at existing, non-powered dams in an environmentally-responsible manner. For this Project, Hydro Friends Fund proposes to deploy a patented power-generating "Large Frame Module" just downstream of the existing dam to take advantage of the head (difference in elevation between the upper and lower pools of the river) found at the Braddock Locks & Dam. The Project will operate in run-of-river mode, meaning the Project will not impound water or control the flows of the river. Most importantly, the Project has been designed to be installed and operate without interfering with USACE's navigational mission.

HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project. The purpose of this letter is to:

1) Notify interested governmental agencies, local governments, tribal governments, non-governmental organizations, and individuals of the upcoming licensing proceedings; and

2) Request your assistance in identifying existing and reasonably available information relevant to the Project and its vicinity.

Although the Commission has issued a preliminary permit to Hydro Friends Fund to study the feasibility of developing the proposed Project, the formal FERC licensing process does not begin until Hydro Friends Fund files the required Pre-Application Document (PAD) and associated Notice of Intent. The PAD will provide FERC, resource agencies, and other stakeholders with existing and reasonably available information relevant to the proposed Project. The information presented in the PAD will assist FERC and other interested parties in identifying potential issues, determining information needs, developing study requests and plans, and preparing other documents required to analyze the license application. To prepare the PAD, Hydro Friends Fund will use information in its possession and information obtained from others.

Henningson, Durham & Richardson Architecture and Engineering, P.C.
in association with HDR Engineering, Inc.

1304 Buckley Road
Suite 202
Syracuse, NY 13212-4311

Phone: (315) 451-2325
Fax: (315) 451-2429
www.hdrinc.com

Hydro Friends Fund's goal is to file a complete and thorough PAD in a timely manner. We are asking for your assistance in identifying additional information of which you may be aware. To facilitate this information search, we have prepared an attached PAD Information Questionnaire.

Relevant information would include site or region-specific studies, data, reports, maps, or management plans related to any of the following resource areas:

- Geology and soils
- Water resources
- Fish and aquatic resources
- Wildlife and botanical resources
- Wetlands, riparian, and littoral habitat
- Rare, threatened, and endangered species
- Recreation and land use
- Aesthetic resources
- Historical and archaeological resources
- Socioeconomic resources
- Tribal resources

You have been identified as potentially interested in the proposed Project and a possible source of information for the PAD. To help ensure that information you may have is available for inclusion in the PAD, **please fill out the attached PAD Information Questionnaire and return it to HDR in the enclosed self-addressed, stamped envelope within 21 days of your receipt of this letter.** This will allow time for follow-up contacts that may be needed. Not responding within 21 days will indicate you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environments or known potential impacts of the Project.

We want to thank you in advance for helping identify information that meets the criteria for inclusion in the PAD. We appreciate your assistance and look forward to a positive licensing process for all participants. If you have any questions about the proposed Project, please contact Jim Gibson with HDR at (315) 414-2202 or via email at Jim.Gibson@hdrinc.com. You may also contact Mark R. Stover, vice president of corporate affairs for Hydro Green Energy, LLC, at (877) 556-6566 x-711 or via email at mark@hgenergy.com.

Thank you again for your help with this process.

Sincerely,

Jim Gibson
Vice President, Hydropower Service

Enclosures (4)

Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)

Licensing Pre-Application Document Information Questionnaire

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC, is beginning the Federal Energy Regulatory Commission ("FERC" or "Commission") licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect of the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania. HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project.

Hydro Friends Fund is preparing a Pre-Application Document (PAD) to provide FERC, resource agencies, and other stakeholders with existing and reasonably available information relevant to the proposed Project. The information presented in the PAD will assist FERC and interested parties in identifying potential issues, determining information needs, developing study requests and plans, and preparing other documents required to analyze the license application. To prepare the PAD, Hydro Friends Fund will use information in its possession and information obtained from others. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in Hydro Friends Fund's possession.

1. Information about person completing the questionnaire:

Name and Title	
Organization	
Address	
Phone	
E-mail Address	

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

___ Yes (*If yes, please complete 2a through 2e*) __ No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils	__ recreation and land use
__ water resources	__ aesthetic resources
__ fish & aquatic resources	__ historical resources
__ wildlife & botanical resources	__ socioeconomic resources
__ wetlands, riparian, & littoral habitat	__ tribal resources
__ rare, threatened & endangered species	__ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

c. Where can HDR obtain this information?

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* ___ No

Resource Area	Specific Issue

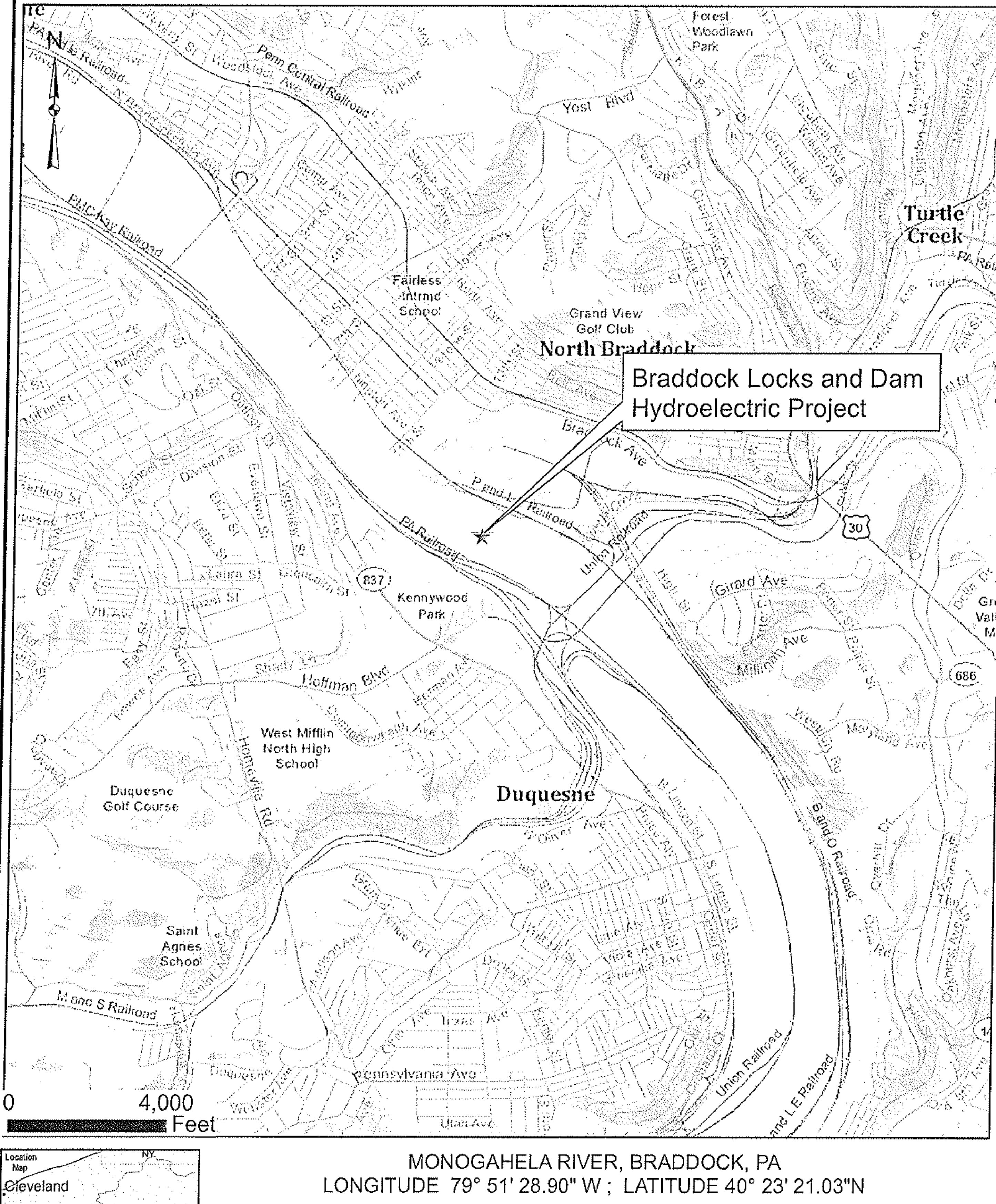
1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes ___ No

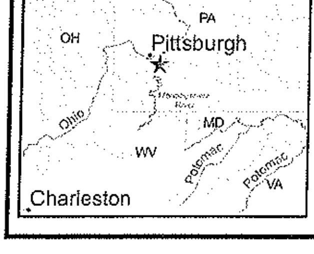
2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

Please return this Questionnaire to Jim Gibson with HDR in the enclosed, self-addressed, stamped envelope **within 21 days** of receipt to allow for any follow-up contact by Hydro Friends Fund's or HDR's representatives that may be needed. Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.





MONOGAHELA RIVER, BRADDOCK, PA

LONGITUDE 79° 51' 28.90" W ; LATITUDE 40° 23' 21.03"N

LOCK+ HYDRO FRIENDS FUND XLII

BRADDOCK LOCKS AND DAM HYDROELECTRIC PROJECT

Project Area Location Map

Monday, October 10, 2011 11:11:05 AMG:\Projects\HydroGreen\LocationMapNewCumberland101011kaa.mxd

Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)

Licensing Pre-Application Document Information Questionnaire

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1. Information about person completing the questionnaire:

Name and Title	DAVID GILLILAND BOROUGH ENGINEER
Organization	EAST PITTSBURGH BOROUGH
Address	813 LINDEN AVE E. PGH. PA 15112
Phone	412-824-5672 x 113
E-mail Address	daveg@glennengr.com

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

___ Yes (*If yes, please complete 2a through 2e*) X No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

- __ geology and soils
- __ water resources
- __ fish & aquatic resources
- __ wildlife & botanical resources
- __ wetlands, riparian, & littoral habitat
- __ rare, threatened & endangered species
- __ recreation and land use
- __ aesthetic resources
- __ historical resources
- __ socioeconomic resources
- __ tribal resources
- __ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

c. Where can HDR obtain this information?

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	Same as #1
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* X No

Resource Area	Specific Issue

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes X No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

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Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)
Licensing Pre-Application Document Information Questionnaire

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1. Information about person completing the questionnaire:

Name and Title	DEBRA FRAWLEY, GREENWAYS COORD.
Organization	for ALLEGHENY VALLEY TRAILS ASSOC.
Address	P.O. BOX 264 FRANKLIN, PA 16323
Phone	814-432-4476 EXT. 121
E-mail Address	greenways@ficda.org

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

___ Yes *(If yes, please complete 2a through 2e)* ✓ No *(If no, go to 3)*

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils	__ recreation and land use
__ water resources	__ aesthetic resources
__ fish & aquatic resources	__ historical resources
__ wildlife & botanical resources	__ socioeconomic resources
__ wetlands, riparian, & littoral habitat	__ tribal resources
__ rare, threatened & endangered species	__ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

c. Where can HDR obtain this information?

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

c. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* ___ No

Resource Area	Specific Issue

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes ✓ No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

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Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)
Licensing Pre-Application Document Information Questionnaire

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1. Information about person completing the questionnaire:

Name and Title	
Organization	Appalachian Watershed Corporation
Address	has Not Existed for more than 10 years 532 Penn Street, New Bethlehem PA 16242
Phone	
E-mail Address	

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

___ Yes (*If yes, please complete 2a through 2e*) ___ No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils	__ recreation and land use
__ water resources	__ aesthetic resources
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c. Where can HDR obtain this information?

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

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1. Information about person completing the questionnaire:

Name and Title	Paul Leger, Interim Manager
Organization	Braddock Borough
Address	415 Sixth Street Braddock, PA 15104
Phone	412-271-1018
E-mail Address	braddockmanager@comcast.net

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

___ Yes (*If yes, please complete 2a through 2e*)   X No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils	__ recreation and land use
__ water resources	__ aesthetic resources
__ fish & aquatic resources	__ historical resources
__ wildlife & botanical resources	__ socioeconomic resources
__ wetlands, riparian, & littoral habitat	__ tribal resources
__ rare, threatened & endangered species	__ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

c. Where can HDR obtain this information?

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* ✓ No

Resource Area	Specific Issue

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes ✓ No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com*)*

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Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)

Licensing Pre-Application Document Information Questionnaire

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1. Information about person completing the questionnaire:

Name and Title	Lawrence M. Miller - Project Leader
Organization	USFWS - Susquehanna River Coord.
Address	P.O. Box 67000 Harrisburg, PA 17106-7000
Phone	717-705-7838
E-mail Address	larry_m_miller@fws.gov

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

___ Yes (*If yes, please complete 2a through 2e*) [X] No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils
__ water resources
__ fish & aquatic resources
__ wildlife & botanical resources
__ wetlands, riparian, & littoral habitat
__ rare, threatened & endangered species
__ recreation and land use
__ aesthetic resources
__ historical resources
__ socioeconomic resources
__ tribal resources
__ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

c. Where can HDR obtain this information?

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* ___ No

Resource Area	Specific Issue

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes ___ No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

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1. Information about person completing the questionnaire:

Name and Title	Olivia Mowery, Environmental Planner
Organization	PA Game Commission
Address	2001 Elmerton Ave. Harrisburg, PA 17110
Phone	717-787-4250 ext. 3128
E-mail Address	OMOWERY@PA.GOV

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

X Yes *(If yes, please complete 2a through 2e)* __ No *(If no, go to 3)*

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils	X recreation and land use
__ water resources	__ aesthetic resources
__ fish & aquatic resources	__ historical resources
X wildlife & botanical resources	__ socioeconomic resources
__ wetlands, riparian, & littoral habitat	__ tribal resources
__ rare, threatened & endangered species	__ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

Pennsylvania Natural Diversity Inventory Database and PGC wildlife databases

c. Where can HDR obtain this information?

Submit a request to the PGC (attn: Olivia Mowery) or online @ www.naturalheritage.state.pa.us

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	PGC Division of Environmental Planning and Habitat Protection
Address	2001 Elmerton Ave Harrisburg PA 17110
Phone	717 783-5957
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* ___ No

Resource Area	Specific Issue
located within vicinity	peregrine falcon

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes ___ No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

Please return this Questionnaire to Jim Gibson with HDR in the enclosed, self-addressed, stamped envelope **within 21 days** of receipt to allow for any follow-up contact by Hydro Friends Fund's or HDR's representatives that may be needed. Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)
Licensing Pre-Application Document Information Questionnaire

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC, is beginning the Federal Energy Regulatory Commission ("FERC" or "Commission") licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect of the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania. HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project.

Hydro Friends Fund is preparing a Pre-Application Document (PAD) to provide FERC, resource agencies, and other stakeholders with existing and reasonably available information relevant to the proposed Project. The information presented in the PAD will assist FERC and interested parties in identifying potential issues, determining information needs, developing study requests and plans, and preparing other documents required to analyze the license application. To prepare the PAD, Hydro Friends Fund will use information in its possession and information obtained from others. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in Hydro Friends Fund's possession.

1. Information about person completing the questionnaire:

Name and Title	Derek Strohl, Natural Resources Specialist
Organization	Bureau of Land Management
Address	626 E. Wisconsin Ave., Ste 200 Milwaukee, WI 53202
Phone	414-297-4416
E-mail Address	DSTROHL@BLM.GOV

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

___ Yes (*If yes, please complete 2a through 2e*) ✓ No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils	__ recreation and land use
__ water resources	__ aesthetic resources
__ fish & aquatic resources	__ historical resources
__ wildlife & botanical resources	__ socioeconomic resources
__ wetlands, riparian, & littoral habitat	__ tribal resources
__ rare, threatened & endangered species	__ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

c. Where can HDR obtain this information?

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* ___ No

Resource Area	Specific Issue

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes ✓ No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

Please return this Questionnaire to Jim Gibson with HDR in the enclosed, self-addressed, stamped envelope **within 21 days** of receipt to allow for any follow-up contact by Hydro Friends Fund's or HDR's representatives that may be needed. Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)

Licensing Pre-Application Document Information Questionnaire

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC, is beginning the Federal Energy Regulatory Commission ("FERC" or "Commission") licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect of the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania. HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project.

Hydro Friends Fund is preparing a Pre-Application Document (PAD) to provide FERC, resource agencies, and other stakeholders with existing and reasonably available information relevant to the proposed Project. The information presented in the PAD will assist FERC and interested parties in identifying potential issues, determining information needs, developing study requests and plans, and preparing other documents required to analyze the license application. To prepare the PAD, Hydro Friends Fund will use information in its possession and information obtained from others. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in Hydro Friends Fund's possession.

1. Information about person completing the questionnaire:

Name and Title	Victoria Neboga, Senior Geologic Scientist
Organization	Bureau of Topographic and Geologic Survey
Address	3240 Schoolhouse road Middletown, Pa 17057
Phone	(717) 702-2026
E-mail Address	vneboga@pa.gov

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

✓ Yes (*If yes, please complete 2a through 2e*) __ No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

✓ geology and soils	✓ recreation and land use
✓ water resources	__ aesthetic resources
✓ fish & aquatic resources	__ historical resources
✓ wildlife & botanical resources	__ socioeconomic resources
__ wetlands, riparian, & littoral habitat	__ tribal resources
✓ rare, threatened & endangered species	✓ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

See attached document

c. Where can HDR obtain this information?

Most of the sources are available on-line (see attached document with the links)

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	Victoria Neboga
Address	3240 Schoolhouse Road Middletown, PA 17057
Phone	(717) 702-2026
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* ✓ No

Resource Area	Specific Issue

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes ✓ No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

Please return this Questionnaire to Jim Gibson with HDR in the enclosed, self-addressed, stamped envelope **within 21 days** of receipt to allow for any follow-up contact by Hydro Friends Fund's or HDR's representatives that may be needed. Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

DCNR – Bureau of Topographic and Geologic Survey

Information Request in Support of Licensing for
Braddock Locks and Dam Hydroelectric Project (FERC No. 13739)

Geology and Soils

1. M. E. Johnson, 1929, Geology and mineral resources of the Pittsburgh quadrangle, Pennsylvania (Pittsburgh East, Braddock, Glassport, and McKeesport 7.5-minute quadrangles, Allegheny and Westmoreland Counties), Pennsylvania Geological Survey, 4th ser., 236 p. (out of print).
2. Bedrock geologic units of Pennsylvania, scale 1:250,000, as digital data sets, prepared by Miles, C. E., and Whitfield, T. G. (compilers, 2001, Bedrock geology of Pennsylvania: Pennsylvania Geological Survey, 4th ser., dataset, scale 1:250,000): http://www.dcnr.state.pa.us/topogeo/map1/bedmap.aspx#quads
3. Three Rivers Conservation Plan, Chapter 2: Land Resources: Pennsylvania Environmental Council http://www.dcnr.state.pa.us/brc/rivers/riversconservation/registry/62chap2.pdf
4. Newbury, R. L., Belz, D. J., Grubb, R. G., Soil Survey of Allegheny County, Pennsylvania, 1981: U.S. Department of Agriculture, 103 p.
5. Wagner, W. R., Lytle, W. S., and Kelley, D. R., 1972, Stratigraphic framework of greater Pittsburgh area- Parts 1 and 2: Pennsylvania Geological Survey, 4th ser., 20 p., 9 sections in 13 sheets (maybe obtained from Subsurface Geology Section , 400 Waterfront Drive, Pittsburg, Pa 15222, tel. 412-442-4236.)
6. Subsurface Rock Correlation Chart: http://www.dcnr.state.pa.us/topogeo/drc/tablepm.aspx

Economic Resources

7. Plate 10. Coal crop lines and structure contours of the Braddock quadrangle, Allegheny County, PA, by Clifford Dodge: http://www.dcnr.state.pa.us/topogeo/coal/pdfs/alleg_pl10.pdf
8. Plate 9. Crop line and mined-out areas of the Redstone coal in the Braddock quadrangle, Allegheny County, PA, by Clifford Dodge: http://www.dcnr.state.pa.us/topogeo/coal/pdfs/alleg_pl09.pdf

Geologic Hazards

9. U.S. Geological Survey Open-File report 79-1314, Landslides and related features of the Braddock quadrangle, Pennsylvania [Pittsburgh 1-by 2-Degree sheet], by J.S. Pomeroy and W.E. Davies: http://ucmstg/ucmstg/groups/public/documents/document/dcnr_007286.pdf
10. Briggs, R. P., Pomeroy, J. S., and Davies, W. E., 1975, Landsliding in Allegheny County, Pennsylvania: U. S. Geological Survey Circular 728, 18 p.
11. Reese, S. O., 2010, Digital bedrock aquifer characteristics by physiographic section of Pennsylvanina, digital dataset, Pennsylvania Geological Survey, 4th ser.: http://www.dcnr.state.pa.us/topogeo/groundwater/gw_data/dac_data/index.htm
12. Landslides in Western PA. Pittsburgh Geological Society: www.pittsburghgeologicalsociety.org.

Groundwater

13. Arthur M. Piper, 1933, Ground Water in Southwestern Pennsylvania: Pennsylvania Geological Survey, 4th ser., Water Resource Report 1, 406 p.
14. Gallaher, J. T., 1973, Summary ground-water resources of Allegheny County, Pennsylvania: Pennsylvania Geological Survey, 4th ser., 71 p.(out of print)
15. J.H. Adamson, J. B. Graham, and N. H. Klein, 1949, Ground-Water Resources of the valley-fill deposits of Allegheny County, Pennsylvania, 181 p., (supplement to W1).
16. McCarren, E., F., 1967, Chemical Quality of Surface Water in the Allegheny River Basin, Pennsylvania and New York: U. S. Department of the Interior.
17. Pennsylvania StreamStats: http://water.usgs.gov/osw/streamstats/pennsylvania.html

Other resources

1. Statewide County Natural Heritage Inventory Map: http://www.naturalheritage.state.pa.us/cnhi/cnhi.htm
2. PA Aquatic Community Classification Map: http://www.naturalheritage.state.pa.us/acc/acc.htm
3. Recreation activities: http://www.dcnr.state.pa.us/forestry/recreation/index.htm
4. Pennsylvania Natural Heritage Program (PNHP): http://www.naturalheritage.state.pa.us/

Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)
Licensing Pre-Application Document Information Questionnaire

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC, is beginning the Federal Energy Regulatory Commission ("FERC" or "Commission") licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect of the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania. HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project.

Hydro Friends Fund is preparing a Pre-Application Document (PAD) to provide FERC, resource agencies, and other stakeholders with existing and reasonably available information relevant to the proposed Project. The information presented in the PAD will assist FERC and interested parties in identifying potential issues, determining information needs, developing study requests and plans, and preparing other documents required to analyze the license application. To prepare the PAD, Hydro Friends Fund will use information in its possession and information obtained from others. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in Hydro Friends Fund's possession.

1. Information about person completing the questionnaire:

Name and Title	DAVID GILLILAND, BORO ENGINEER
Organization	TURTLE CREEK BOROUGH
Address	125 MONROEVILLE AVE TURTLE CREEK, PA 15145
Phone	412-824-5672 x113
E-mail Address	daveg@glennengr.com

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

___ Yes (*If yes, please complete 2a through 2e*) X No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils __ recreation and land use
__ water resources __ aesthetic resources
__ fish & aquatic resources __ historical resources
__ wildlife & botanical resources __ socioeconomic resources
__ wetlands, riparian, & littoral habitat __ tribal resources
__ rare, threatened & endangered species __ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*

c. Where can HDR obtain this information?

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

___ Yes *(please list specific issues below)* ___ No

Resource Area	Specific Issue

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes _X_ No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments:

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

Please return this Questionnaire to Jim Gibson with HDR in the enclosed, self-addressed, stamped envelope **within 21 days** of receipt to allow for any follow-up contact by Hydro Friends Fund's or HDR's representatives that may be needed. Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)
Licensing Pre-Application Document Information Questionnaire

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC, is beginning the Federal Energy Regulatory Commission ("FERC" or "Commission") licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect of the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania. HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project.

Hydro Friends Fund is preparing a Pre-Application Document (PAD) to provide FERC, resource agencies, and other stakeholders with existing and reasonably available information relevant to the proposed Project. The information presented in the PAD will assist FERC and interested parties in identifying potential issues, determining information needs, developing study requests and plans, and preparing other documents required to analyze the license application. To prepare the PAD, Hydro Friends Fund will use information in its possession and information obtained from others. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in Hydro Friends Fund's possession.

1. Information about person completing the questionnaire:

Name and Title	Kierstin Carlson, Associate Information Manager
Organization	PA Natural Heritage Program/Western PA Conservancy
Address	800 Waterfront Drive Pittsburgh, PA 15222
Phone	412-586-2314
E-mail Address	kcarlson@paconserve.org

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project environment (i.e., information regarding the Monongahela River in the vicinity of the Project)?

X Yes (*If yes, please complete 2a through 2e*) __ No (*If no, go to 3*)

a. If yes, please indicate the specific resource area(s) that the information relates to:

__ geology and soils	__ recreation and land use
__ water resources	__ aesthetic resources
X fish & aquatic resources	__ historical resources
X wildlife & botanical resources	__ socioeconomic resources
__ wetlands, riparian, & littoral habitat	__ tribal resources
X rare, threatened & endangered species	__ other resource information

b. Please briefly describe the information or list available documents *(additional information may be provided on page 3 of this questionnaire).*
Allegheny County Natural Heritage Inventory and the PA Natural Heritage Program database

c. Where can HDR obtain this information?
Pennsylvania Natural Heritage Program – Western PA Conservancy
www.naturalheritage.state.pa.us

d. Please indicate whether there is a specific representative you wish to designate for a potential follow-up contact by Hydro Friends Fund's or HDR's representative for the resource area(s) checked above *(additional information may be provided on page 3 of this questionnaire).*

Representative Contact Information

Name	Same as person completing questionnaire
Address	
Phone	
Email Address	

Name	
Address	
Phone	
Email Address	

e. Based on the specific resources listed in 2a, are you aware of any specific issues pertaining to the identified resource area(s)? *(Additional information may be provided on page 4 of this questionnaire.)*

X Yes *(please list specific issues below)* ___ No

Resource Area	Specific Issue
rare, endangered and threatened species	They exist near the project area

1. Do you or your organization plan to participate in the Project licensing proceedings? ___ Yes X No

2. We are interested in your comments. If you have any questions or comments regarding the proposed Project, the PAD, or the licensing process, please add below:

Comments: You will probably need to do an environmental review (PNDI). You can get the County Natural Heritage Inventory report and polygons, and do the environmental review on our website - www.naturalheritage.state.pa.us

(Comments and/or questions may also be sent via email to: jim.gibson@hdrinc.com)

Please return this Questionnaire to Jim Gibson with HDR in the enclosed, self-addressed, stamped envelope **within 21 days** of receipt to allow for any follow-up contact by Hydro Friends Fund's or HDR's representatives that may be needed. Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

October 28, 2011

Pennsylvania Department of Environmental Protection
Coastal Zone Management Program
400 Market Street, 2nd Floor
Harrisburg, PA 17105

Subject: Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)
Coastal Zone Consistency Determination

Dear Sir or Ma'am:

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC (HGE), is beginning the Federal Energy Regulatory Commission (FERC) licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect of the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania.

HGE focuses on developing new hydropower generation at existing, non-powered dams in an environmentally responsible manner. For this Project, Hydro Friends Fund proposes to deploy a patented power-generating "Large Frame Module" just downstream of the existing dam to take advantage of the head (difference in elevation between the upper and lower pools of the river) found at the Braddock Locks & Dam. The Project will operate in run-of-river mode, meaning the Project will not impound water or control the flows of the river. In addition, the Project has been designed to be installed and operate without interfering with USACE's navigational mission.

HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project. HDR believes that the Braddock Locks & Dam Hydroelectric Project will be located outside of the State Coastal Zone; however, we respectfully request a determination from your office.

A general location map with the latitude and longitude indicating the location of the proposed Project along the Monongahela River has been enclosed with this letter, and the attached map shows the area for which the information is being requested.

It is our intent to include your decision in the Pre-Application Document, which we are currently finalizing. Therefore, we respectfully request a response to this determination at your earliest convenience. If you have any questions or need additional information regarding this Project or its location, please feel free to contact me at (315) 414-2202. Thank you for your assistance with this process.

Sincerely,
HDR Engineering, Inc.

Jim Gibson
Vice President

Enclosure

October 28, 2011

Pennsylvania Historical and Museum Commission
Bureau for Historic Preservation
Commonwealth Keystone Building, Second Floor
400 North Street
Harrisburg, PA 17120

Subject: Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)
Request for Historical and Cultural Information

Dear Sir or Ma'am:

HDR Engineering, Inc. (HDR), on behalf of our client Lock+™ Hydro Friends Fund XLII, is requesting any cultural or historical information your office may have regarding the upcoming licensing for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect of the existing U.S. Army Corps of Engineers' Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania.

As a requirement of the Pre-Application Document (PAD), HDR is responsible for including any information on historical and cultural resources that may have the potential to be affected by the Project.

A general location map with the latitude and longitude indicating the location of the proposed Project along the Monongahela River has been enclosed with this letter, and shows the area for which the information is being requested.

It is our intent to include the information that you may provide in the PAD, which we are currently finalizing. Please provide any information that you may have at your earliest convenience or within 30 days of receipt of this letter. If you have any questions or need additional information regarding this Project or its location, please feel free to contact me at (315) 414-2202. Thank you for your assistance with this process.

Sincerely,
HDR Engineering, Inc.

Jim Gibson
Vice President

Enclosure

HDR ONE COMPANY | *Many Solutions*

October 28, 2011

Pennsylvania Department of Conservation and Natural Resources
Rachel Carson State Office Building
P.O. Box 8767
400 Market St.
Harrisburg, PA 17105-8767

**Subject: Braddock Locks & Dam Hydroelectric Project (FERC No. 13739)
Pre-Application Document Request for Threatened and Endangered Species Information**

Dear Sir or Ma'am:

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC (HGE), is beginning the Federal Energy Regulatory Commission (FERC) licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect from the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania.

HGE focuses on developing new hydropower generation at existing, non-powered dams in an environmentally responsible manner. For this Project, Hydro Friends Fund proposes to deploy a patented power-generating "Large Frame Module" just downstream of the existing dam to take advantage of the head (difference in elevation between the upper and lower pools of the river) found at the Braddock Locks & Dam. The Project will operate in run-of-river mode, meaning the Project will not impound water or control the flows of the river. In addition, the Project has been designed to be installed and operate without interfering with USACE's navigational mission.

HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project. HDR is currently gathering information in support of the development of the Pre-Application Document (PAD). Under the FERC guidelines, the Project's developer is responsible for evaluating the potential impacts of the Project relicensing on threatened and endangered species.

In support of this process, HDR is requesting information regarding the following within the Project area:

- State and federally listed threatened or endangered species;
- Species proposed for listing as threatened or endangered, or species of concern;
- Designated critical habitat;
- Proposed critical habitat; and
- Candidate species.

Henningson, Durham & Richardson Architecture and Engineering, P.C
in association with HDR Engineering, Inc.

1304 Buckley Road
Suite 202
Syracuse, NY 13212-4311

Phone: (315) 451-2325
Fax: (315) 451-2429
www.hdrinc.com

A general location map with the latitude and longitude indicating the location of the proposed Project along the Monongahela River has been enclosed with this letter. The attached map shows the area for which the information is being requested.

It is our intent to include your input in the PAD, which we are currently finalizing. Therefore, we respectfully request a response to this determination at your earliest convenience or within 30 days of receipt of this letter. If you have any questions or need additional information regarding this Project or its location, please feel free to contact me at (315) 414-2202. Thank you for your assistance with this process.

Sincerely,

HDR Engineering, Inc.

Jim Gibson
Vice President

Enclosure

October 28, 2011

United States Fish and Wildlife Service
P.O. Box 67000
Harrisburg, PA 17106-7000

Subject: Braddock Locks & Dam Hydroelectric Project (FERC No. 13739) Pre-Application Document Request for Threatened and Endangered Species Information

Dear Sir or Ma'am:

Lock+™ Hydro Friends Fund XLII (Hydro Friends Fund), a wholly owned subsidiary of Hydro Green Energy, LLC (HGE), is beginning the Federal Energy Regulatory Commission (FERC) licensing process for the proposed Braddock Locks & Dam Hydroelectric Project (Project) (FERC No. 13739). The proposed Project would utilize the head effect from the existing U.S. Army Corps of Engineers' (USACE) Braddock Locks & Dam, located on the Monongahela River in Allegheny, Pennsylvania.

HGE focuses on developing new hydropower generation at existing, non-powered dams in an environmentally responsible manner. For this Project, Hydro Friends Fund proposes to deploy a patented power-generating "Large Frame Module" just downstream of the existing dam to take advantage of the head (difference in elevation between the upper and lower pools of the river) found at the Braddock Locks & Dam. The Project will operate in run-of-river mode, meaning the Project will not impound water or control the flows of the river. In addition, the Project has been designed to be installed and operate without interfering with USACE's navigational mission.

HDR Engineering, Inc. (HDR) is assisting Hydro Friends Fund in completing the requirements of the licensing process for the Project. HDR is currently gathering information in support of the development of the Pre-Application Document (PAD). Under the FERC guidelines, the Project's developer is responsible for evaluating the potential impacts of the Project relicensing on threatened and endangered species.

In support of this process, HDR is requesting information regarding the following within the Project area:

- State and federally listed threatened or endangered species;
- Species proposed for listing as threatened or endangered, or species of concern;
- Designated critical habitat;
- Proposed critical habitat; and
- Candidate species.

Henningson, Durham & Richardson Architecture and Engineering, P.C
in association with HDR Engineering, Inc.

1304 Buckley Road
Suite 202
Syracuse, NY 13212-4311

Phone: (315) 451-2325
Fax: (315) 451-2429
www.hdrinc.com

A general location map with the latitude and longitude indicating the location of the proposed Project along the Monongahela River has been enclosed with this letter. The attached map shows the area for which the information is being requested.

It is our intent to include your input in the PAD, which we are currently finalizing. Therefore, we respectfully request a response to this determination at your earliest convenience or within 30 days of receipt of this letter. If you have any questions or need additional information regarding this Project or its location, please feel free to contact me at (315) 414-2202. Thank you for your assistance with this process.

Sincerely,

HDR Engineering, Inc.

Jim Gibson
Vice President

Enclosure

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

BUREAU OF FORESTRY

November 23, 2011

PNDI Number: 21583

Jim Gibson
Henningson, Durham, and Richardson Architecture and Engineering
1304 Buckley Road, Suite 202
Syracuse, NY 13212
FAX: 315-451-2429 (Hard copy will not follow)

Re: Braddock Locks and Dam Hydroelectric Project (FERC no. 13739), Response to Pre-application notice West Mifflin and North Braddock Townships, Allegheny County

Dear Mr. Gibson

Thank you for the submission of the Pennsylvania Natural Diversity Inventory (PNDI) Environmental Review Receipt Number **21583** for review. PA Department of Conservation and Natural Resources screened this project for potential impacts to species and resources of concern under DCNR's responsibility, which include plants, terrestrial invertebrates, natural communities, and geologic features only. **NOTE:** please contact DCNR, Ecological Services, for subsequent reviews as additional project details become available.

No Impact Anticipated

PNDI records indicate species or resources of concern are located in the vicinity of the project. However, based on the information you submitted concerning the nature of the project, the immediate location, and our detailed resource information, DCNR has determined that no impact is likely. No further coordination with our agency is needed for this project.

This response represents the most up-to-date summary of the PNDI data files and is valid for one (1) year from the date of this letter. An absence of recorded information does not necessarily imply actual conditions on-site. Should project plans change or additional information on listed or proposed species become available, this determination may be reconsidered. Should the proposed work continue beyond the period covered by this letter, please resubmit the project to this agency as an "Update" (including an updated PNDI receipt, project narrative and accurate map).

This finding applies to impacts to DCNR only. To complete your review of state and federally-listed threatened and endangered species and species of special concern, please be sure the U.S. Fish and Wildlife Service, PA Game Commission, and the Pennsylvania Fish and Boat Commission have been contacted regarding this project as directed by the online PNDI ER Tool found at www.naturalheritage.state.pa.us.

Sincerely,

Adam M. Hnatkovich, Environmental Review Specialist FOR Chris Firestone, Wild Plant Program Mgr.
Ph: 717-705-2822 Fax: 717-772-0271 Email: c-ahnatkov@pa.gov

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
INTERSTATE WATERS OFFICE

December 6, 2011

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E. Room
Washington, DC 20426

Re: Project Nos. P-13739, P-13740

Dear Ms. Bose:

On November 1, 2011, the Pennsylvania Coastal Resources Management (CRM) Program received a request from HDR Engineering, Inc. for Coastal Zone Consistency Determinations for the following hydroelectric projects proposed on the Allegheny and Monongahela Rivers in Pennsylvania:

Docket #	Project Name
P-13739	Braddock Lock and Dam Hydroelectric Project (Monongahela River)*
P-13740	C.W. Bill Young Lock and Dam Hydroelectric Project (Allegheny River)

*CRM previously provided a consistency determination for this project on June 13, 2011.

These projects were sent for our federal consistency review as required under 15 CFR Part 930 Subpart D - Consistency for Federally Licensed and Permit Activities. We have determined that the above actions are located outside of Pennsylvania's Coastal Zones and will not impact upon them. Therefore, these actions are consistent with Pennsylvania's CRM Program.

Please note that this determination pertains only to the federal consistency review requirements under the Federal Coastal Zone Management Act of 1972, as amended, and does not constitute a waiver from further Department of Environmental Protection's review or other Departmental permits.

Sincerely,

Matthew D. Walderon
Federal Consistency Coordinator
Coastal Resources Management Program

cc: Jim Gibson, Vice President, HDR Engineering, Inc.

Rachel Carson State Office Building | P.O. Box 2063 | Harrisburg, PA 17105-2063
717.772.4785 www.depweb.state.pa.us

Gibson, James

From: Benedict, Jeffrey M LRP [Jeffrey.M.Benedict@usace.army.mil]
Sent: Thursday, March 22, 2012 8:31 AM
To: Gibson, James; rosemary.j.reily@usace.army.mil; Keppler, Mark E LRP
Cc: Mark R. Stover (HGE); Keppler, Dawn; Merry, Danielle; Eckerlin, Jessica
Subject: RE: Braddock Water Quality Data (UNCLASSIFIED)
Attachments: Braddock Dam hydropower development.pdf; Lower Mon Upper Ohio POR Dissolved Oxygen.pdf

Classification: UNCLASSIFIED
Caveats: NONE

Jim, I want to transmit the attached memo and water quality data summary just finalized concerning our operation of the water quality gate at Braddock Dam, authorized as fish and wildlife mitigation as part of the Lower Mon Project. Any questions or comments, let me know.

Thanks

-Jeff

-----Original Message-----
From: Gibson, James [mailto:Jim.Gibson@hdrinc.com]
Sent: Thursday, March 22, 2012 8:16 AM
To: Benedict, Jeffrey M LRP; rosemary.j.reily@usace.army.mil; Keppler, Mark E LRP
Cc: Mark R. Stover (HGE); Keppler, Dawn; Merry, Danielle; Eckerlin, Jessica
Subject: Braddock Water Quality Data

Good Morning,

As a follow up to the March 7th meeting and subsequent correspondence, wanted to check in regarding water quality data that the Corps may have associated with the Braddock Locks and Dam.

We are in the process of performing an analysis of the existing water quality data and based on conversations with the PADEP and the conversations during the March 7th meeting, it appears that the Corps may have water quality data directly associated with the Braddock facility.

We would be happy to schedule a call to discuss the data and the best way to obtain the information.

Thanks

JIm Gibson

HDR Engineering, Inc.
Vice President, Hydropower Services

1304 Buckley Road, Suite 202 | Syracuse, NY 13212

D: 315.414.2202 | C: 315.415.2729

O: 315.451.2325 | F: 315.451.2429

jim.gibson@hdrinc.com| hdrinc.com <http://www.hdrinc.com/>

Classification: UNCLASSIFIED
Caveats: NONE

Pittsburgh District, USACE
Planning and Environmental Branch
22 March 2012

Subject: Braddock Dam hydropower development, Water quality issues

The following information is critical to and must be addressed in any hydropower proposal at Braddock Dam.

1. Congressional authorization of Braddock Dam:

Braddock Dam was congressionally authorized in the 1992 Water Resources Development Act to include a water quality gate (Gate #1) for reaeration of flow as a fish and wildlife mitigation feature. This stated purpose of this authorized feature is to "maximize the dam's reaeration capability during low flow periods." The District will not allow the function of this authorized feature to be compromised.

2. Braddock Dam Water Quality Gate operating schedule:

Braddock Dam gate operation schedule has the Water Quality Gate (#1) fully open at 7360 CFS and the next gate does not open until flow reaches 9440 CFS. Diversion of flow to hydropower generation will be restricted to flows at or above 9440 CFS.

3. Pool elevations:

Former Dam 2 (1906-2004) maintained Pool 2 at elev. 718.7
Braddock Dam (2004 to present) maintains an interim pool at elev. 721.8
The authorized pool for Braddock Dam is elev. 723.7, to be established in the future as the Lower Mon Project nears completion.

4. Water Quality modeling:

Use of historic water quality data at Braddock Dam should not be used to represent anticipated future conditions. Upon completion of the District's Lower Mon Project, Locks and Dam 3 will be eliminated, creating a 30-mile Braddock Pool. Dissolved oxygen conditions in the elongated pool (no longer having reaeration provided at Dam 4 or Dam 3) will be different, and likely degraded, from present conditions. Therefore a reasonable evaluation of water quality impacts of hydropower generation will need to take into account future conditions with a higher and longer Braddock Pool and loss of reaeration at Dam 3 and the fixed weir at Dam 4. Graphs of summer sampling of dissolved oxygen on the Lower Mon River from 1974 – 2010, representing historic conditions, are enclosed.

Commonwealth of Pennsylvania
Pennsylvania Historical and Museum Commission
Bureau for Historic Preservation
Commonwealth Keystone Building, 2nd Floor
400 North Street
Harrisburg, PA 17120-0093
www.phmc.state.pa.us

17 April 2012

Jim Gibson
HDR Architecture and Engineering
1304 Buckley Road
Suite 202
Syracuse, NY 13212-4311

TO EXPEDITE REVIEW USE
BHP REFERENCE NUMBER

RE: ER# 12-0221-003-D
FERC: Braddock Locks and Dam Hydroelectric Project, Duquesne, North Braddock, West Mifflin, Allegheny Co.

Dear Mr. Gibson:

The Bureau for Historic Preservation (the State Historic Preservation Office) reviews projects in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended in 1980 and 1992, and the regulations (36 CFR Part 800) of the Advisory Council on Historic Preservation as revised in 1999 and 2004, and under the authority of the Environmental Rights amendment, Article 1, Section 27 of the Pennsylvania Constitution and the Pennsylvania History Code, 37 Pa. Cons. Stat. Section 500 et seq. (1988). These requirements include consideration of project potential effects upon both historic and archaeological resources.

ARCHAEOLOGY: There is a high probability that archaeological resources are located in this project area. In our opinion, the activity described in your proposal should have no effect on such resources. Should the scope of the project be amended to include additional ground disturbing activity this office should be contacted immediately and a Phase I Archaeological Survey may be necessary to locate all potentially significant archaeological resources.

STRUCTURES: The Bureau for Historic Preservation has reviewed the plans and specifications for the above referenced project. In our opinion these plans conform to the Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings. Therefore, this project will have no adverse effect upon the National Register listed **Monongahela River Navigation System**. Thank you for your cooperation.

If you need further assistance in this matter, contact Ann Safley at (717) 787-9121.

Sincerely

Ann Safley for

Douglas C. McLearen, Chief
Division of Archaeology & Protection

cc: Conrad Weiser, U.S. Army Corps of Engineers, Pittsburgh District
DCMcL/ras

Gibson, James

From: Benedict, Jeffrey M LRP [Jeffrey.M.Benedict@usace.army.mil]
Sent: Friday, April 20, 2012 11:00 AM
To: Gibson, James
Cc: Reilly, Rosemary J LRP; mark@hgenergy.com; Merry, Danielle; Keppler, Dawn
Subject: RE: Braddock DO Goals (UNCLASSIFIED)
Attachments: Braddock Response for Jim.pdf

Classification: UNCLASSIFIED
Caveats: NONE

Jim, please find attached responses to your questions below. I trust that these will be helpful. Any further questions let me know. Thanks. -Jeff

-----Original Message-----
From: Gibson, James [mailto:Jim.Gibson@hdrinc.com]
Sent: Monday, April 16, 2012 6:54 AM
To: Benedict, Jeffrey M LRP
Cc: Reilly, Rosemary J LRP; mark@hgenergy.com; Merry, Danielle; Keppler, Dawn
Subject: Braddock DO Goals

Jeff,

As we continue to evaluate the information provided since the March 7th meeting, wanted to check in regarding what level the district views the current DO baseline at Braddock.

Based on the provided data and our conversations, is this the minimum DO reading to date since operation of the water quality gate?

In addition, also wanted to confirm that the District views ER 1110-2-1462 dated February 20, 1991 and the applicable Engineer Regulation?

Thanks for you help with this question.

JIm Gibson

HDR Engineering, Inc.
Vice President, Hydropower Services

1304 Buckley Road, Suite 202 | Syracuse, NY 13212

D: 315.414.2202 | C: 315.415.2729

"As we continue to evaluate the information provided since the March 7th meeting, wanted to check in regarding what level the district views the current DO baseline at Braddock."

Definition of the current baseline is complicated by the transitional state of the Lower Monongahela River reflecting the on-going construction of the Lower Mon Project. Following completion of Braddock Dam in 2004, the pool maintained by the dam was raised about 3.1 feet of the authorized future 5.0-foot raise. This interim pool elevation will likely continue until Locks and Dam 3 can be removed, which will result in a longer Braddock Pool extending to Locks and Dam 4 at Charleroi. The five-foot pool increase downstream of Dam 3 will accompany a 3.2-foot pool decrease upstream of Dam 3 to equalize the 8.2-foot difference between the historic Pools 2 and 3. D.O. levels in this future elongated and deeper Braddock pool will probably be depressed over historic values for summer low-flow conditions.

Since the WQ gate became operational in 2004, we have seen about a 1-2 mg/l increase in dissolved oxygen downstream of Braddock Dam, ranging from 7.5 to 8.5 mg/l during the June – September summer season. This improvement can likely be attributed to operation of the WQ gate, whereas pre-1990 data showing increasing overall D.O. conditions were probably due to improvements in water quality due to Clean Water Act projects and regulation.

We cannot predict the future efficacy of the water quality (WQ) gate without additional monitoring data and modeling of the Elizabeth, Braddock, and Emsworth pools to allow a prediction of a future baseline condition. Both CE-QUAL-W2 and ResSim models or similarly capable models would be required. Without this monitoring and modeling, our best guess looking at the past data is that a range of D.O. of 7.2 to 8.5 would occur during the summer season downstream of Braddock without hydropower.

"Based on the provided data and our conversations, is this the minimum DO reading to date since operation of the water quality gate?"

As noted above the current minimum D.O. downstream of Braddock Dam under current pool conditions with the WQ gate is 7.5 mg/l.

"In addition, also wanted to confirm that the District views ER 1110-2-1462 dated February 20, 1991 and the applicable Engineer Regulation?"

The ER that you cite is an applicable water quality regulation. Note that this ER states that "The reaeration productivity of locks and dams through either weir or gate spillage must not be reduced by the addition of hydropower." This changes the focus of impact analysis to the function of the dam rather than maintaining ambient D.O. levels.

The Corps' water quality mission is supported by project-specific public laws that authorize operation of Corps facilities for water quality, water supply, low flow augmentation, pollution mitigation, recreation, and fish & wildlife protection, along with other Federal laws and regulations and Executive Orders that mandate sustainable management of Federal resources

(Clean Water Act; Fish & Wildlife Coordination Act; Endangered Species Act; Water Resources Development Act; Executive Order 12088, the Corps' Environmental Operating Principles; etc.). Nondegradation policy is defined in Corps' regulations, manuals, and pamphlets, including ER 1110-2-1462, Water Quality and Water Control Considerations for Non-Federal Hydropower Development at Corps of Engineers Projects; ER 1110-2-8154, Water Quality and Environmental Management for Corps Civil Works Projects; ER 1130-2-540 Project Operations - Environmental Stewardship Operations and Maintenance Policies; Engineering Pamphlet 1165-2-1, The Federal Responsibility in Water Resources; EM 1110-2-1420, Hydrologic Engineering Requirements for Reservoirs; ER 1130-2-344, Prevention, Control and Abatement of Environmental Pollution at Federal Facilities; and EM 1110-2-1201, Engineering and Design - Reservoir Water Quality Analysis Proponent. All of these regulations are under study for revision to enhance non-degradation requirements.

The Corps has responsibility for the quality of water discharged from its projects. The quality aspects relate to Corps' policy and objectives to meet state water quality standards, maintain present water quality where standards are exceeded, and maintain acceptable habitat for aquatic life.

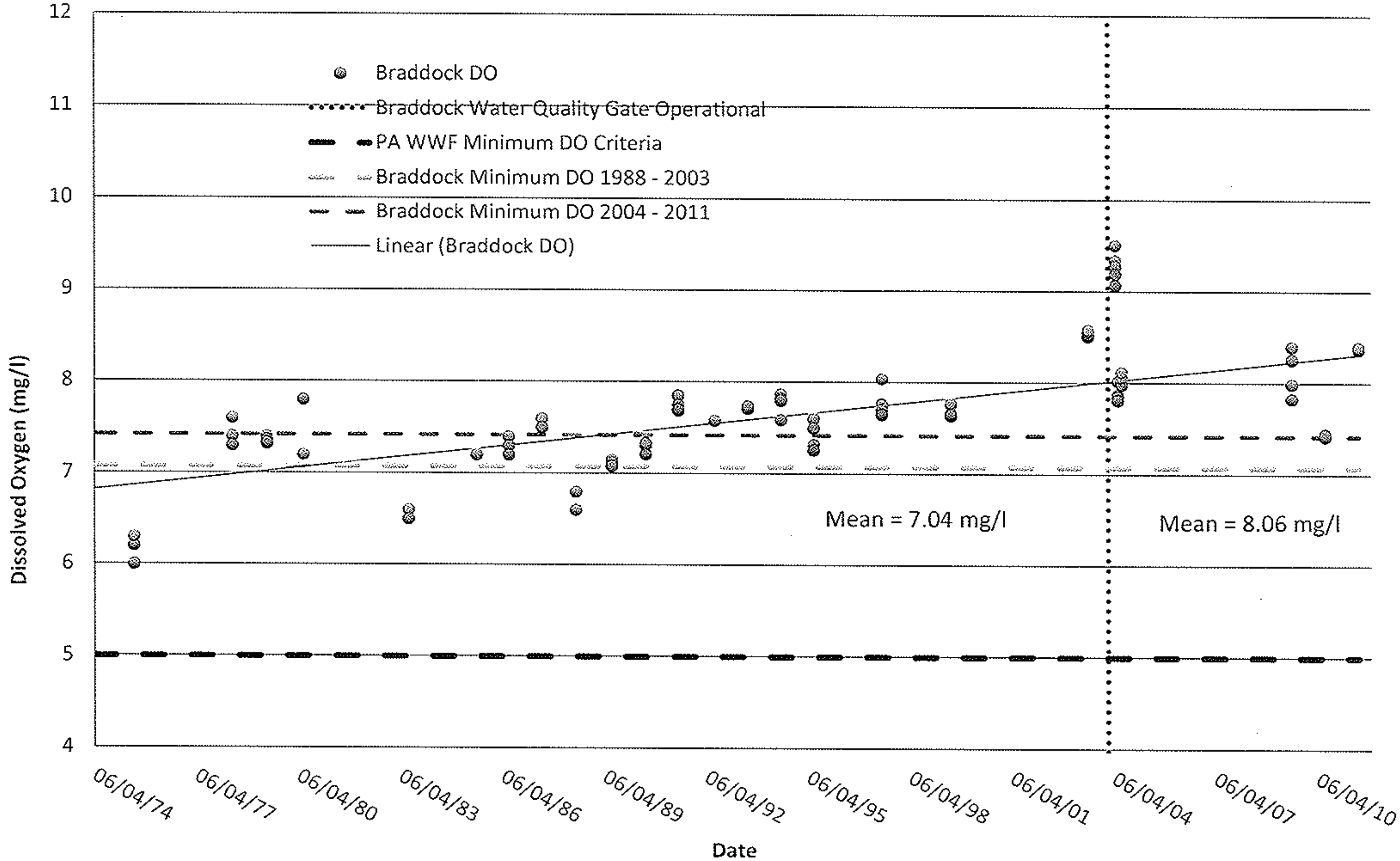
It is the Corps' policy is to sustainably manage aquatic resources by not allowing degradation worse than existing conditions and to strive towards the national goal of water quality improvement. This policy is applicable to all Corps facilities (reservoirs, navigation L/Ds, local flood protection projects, new construction, etc.) and river reaches managed, controlled, or regulated by the Corps.

The Corps has broad discretion to determine what constitutes "environmental protection" in the context of Section 306 of the Water Resources Development Act (WRDA) of 1990, which states that, "The Secretary shall include environmental protection as one of the primary missions of the Corps of Engineers in planning, designing, constructing, operating, and maintaining water resources projects." In addition, "Any physical or operational modification to a project ...shall not degrade water quality in the reservoir (pool) or project discharges". (EP 1165-2-1, EM 1110-2-1201, ER 1110-2-8154).

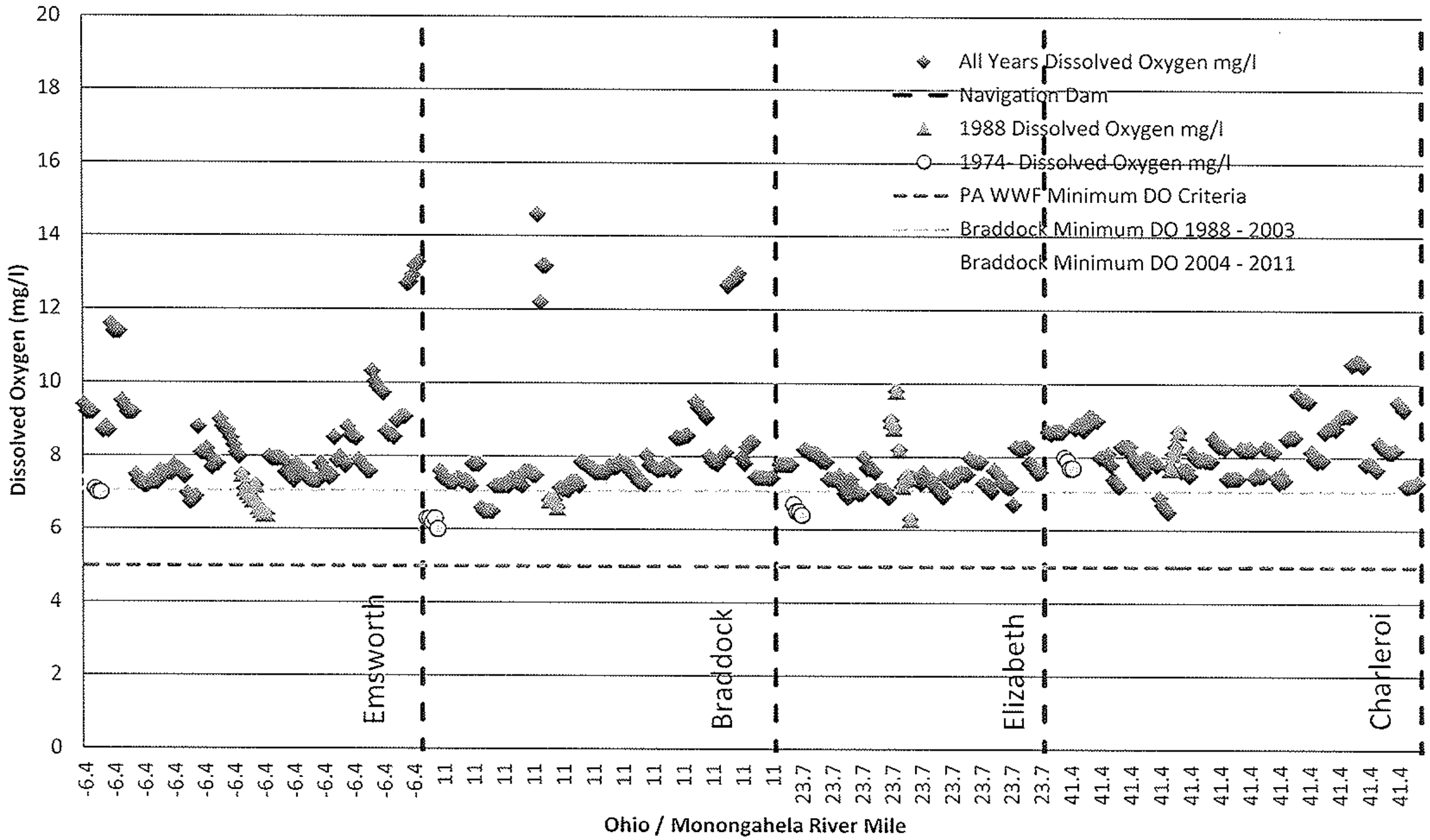
Water quality control is an authorized purpose at many Corps reservoirs (i.e. the Monongahela River is regulated by operation of Tygart, Stonewall Jackson, and Youghiogheny River Lakes). However, even if not an authorized project purpose, water quality is an integral consideration during all phases of a project's life, from planning through operation. The minimum goal is to meet State and Federal water quality standards in effect for the lakes, their tailwaters, and downstream regulated river reaches. The operating objective is to maximize beneficial uses of the resources through enhancement and nondegradation of water quality. (EM 1110-2-1420)

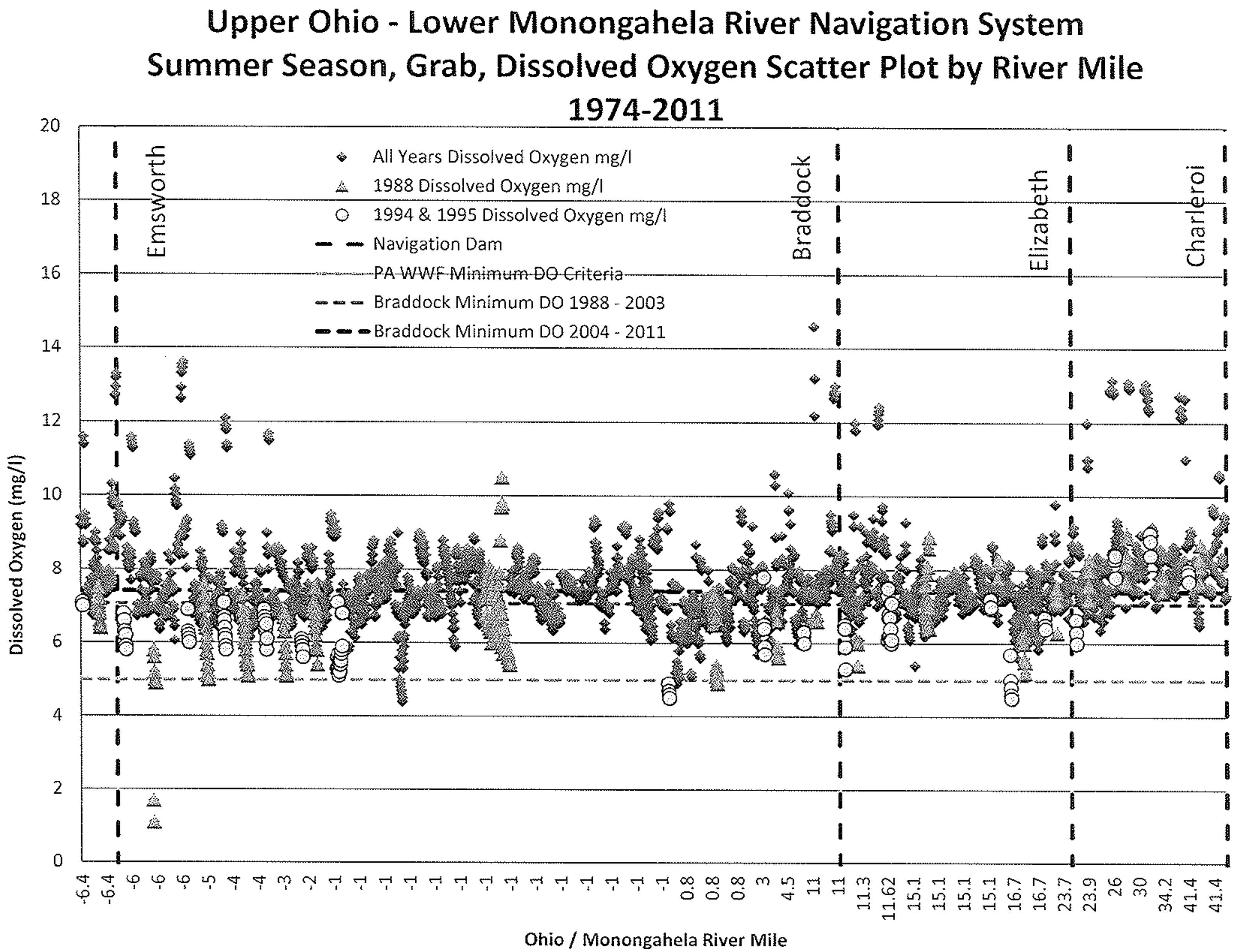
The Corps will make the final determination regarding existing use protection necessary for actions or activities that influence Corps managed surface waters and water quality control is critical for sustainable management of water resources. Activities that could have an adverse impact the Corps missions or operational benefits, where implementation of State and Federal water quality standards would result in adverse impact to aquatic resources, could potentially be subject to stricter regulation.

Upper Ohio - Lower Monongahela River Navigation System
Braddock Dam Tailwaters
Summer Season, Grab Dissolved Oxygen
for Period of Record 1974- 2010



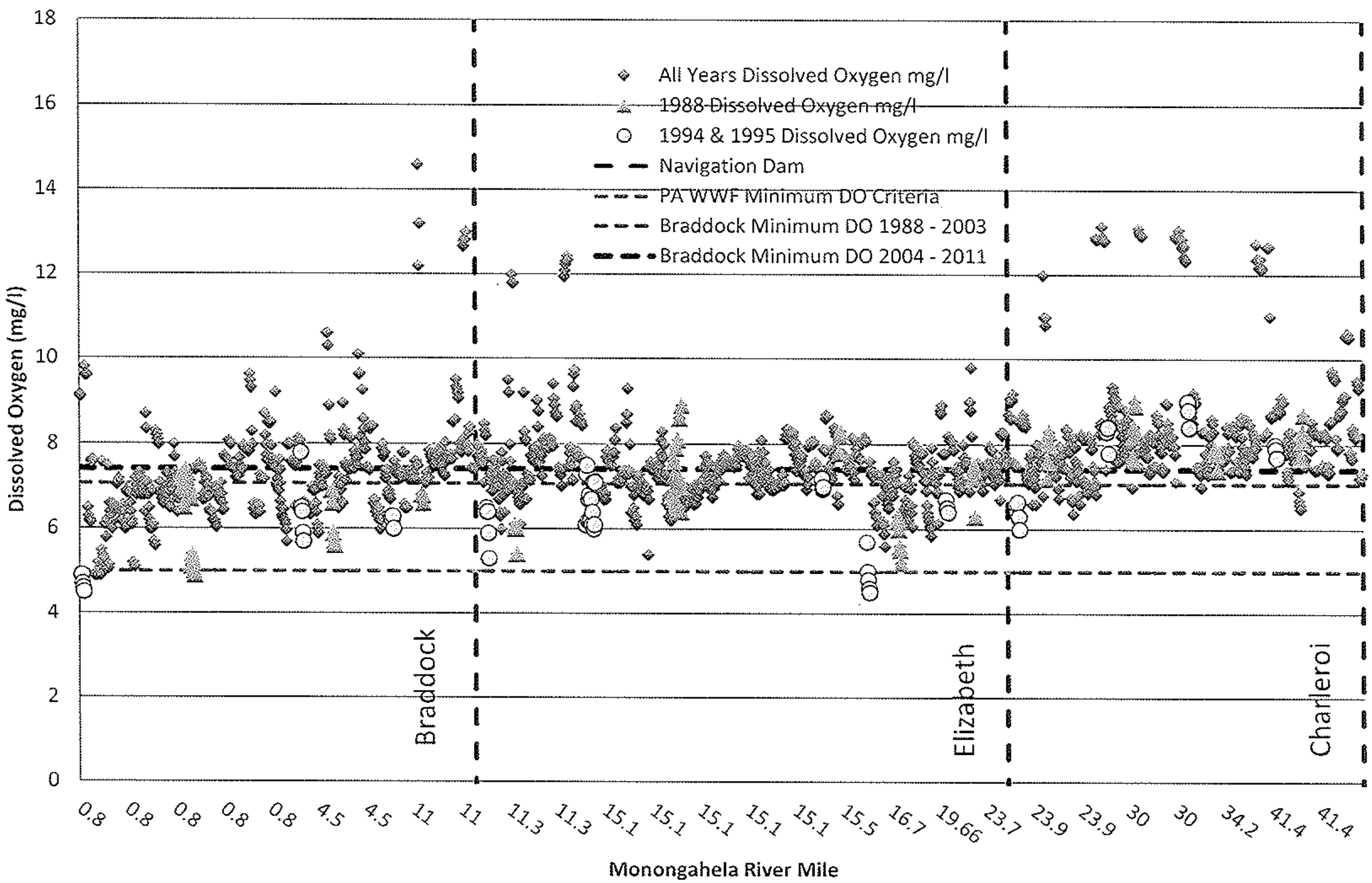
Upper Ohio - Lower Monongahela River Navigation System
Dam Tailwaters
Summer Season, Grab, Dissolved Oxygen Scatter Plot by River Mile
1974-2011





Upper Ohio - Lower Monongahela River Navigation System
Summer Season, Grab, Dissolved Oxygen Scatter Plot by River Mile
1974-2011
All Years Dissolved Oxygen mg/l
1988 Dissolved Oxygen mg/l
1994 & 1995 Dissolved Oxygen mg/l
Navigation Dam
PA WWF Minimum DO Criteria
Braddock Minimum DO 1988 - 2003
Braddock Minimum DO 2004 - 2011
Emsworth
Braddock
Elizabeth
Charleroi
Dissolved Oxygen (mg/l)
Ohio / Monongahela River Mile

Lower Monongahela River Navigation System
Summer Season, Grab, Dissolved Oxygen Scatter Plot by River Mile
1974-2011



DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222-4186

REPLY TO
ATTENTION OF

May 11, 2012

Planning and Environmental Branch

VIA EFILE

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Dear Secretary Bose:

The Pittsburgh District, Corps of Engineers is submitting the enclosed comments on the Pre-Application Document dated December 2011, prepared by Hydro Green Energy (HGE) for Project numbered P-13739 at Braddock Locks and Dam. The undersigned coordinated the timing of this submission with Mr. Mark Stover of HGE. If you have any questions on this matter, please have your staff contact me by either telephone, (412) 395-7202, or by e-mail at: jeffrey.m.benedict@usace.army.mil.

Enclosure

Sincerely

Jeffrey Benedict, P.E.

Jeffrey Benedict, P.E.
Hydropower Coordinator
Pittsburgh District Corps of Engineers

Corps of Engineers Pittsburgh District Comments on Project 13739 – Braddock Locks and Dam Pre-Application Document (PAD), December 2011, by Hydro Green Energy. 11 May 2012

1. **1.0 INTRODUCTION AND BACKGROUND.** "Additionally, the proposed Project footprint is small, and the proposed technology is designed to be installed and operated without interfering with USACE's navigational mission and with limited interaction with the USACE infrastructure." It is important at this point to note that there are laws that have authorized the Corps' Monongahela River basin headwater reservoirs (Youghiogheny, Tygart, and Stonewall Jackson Lakes), and their downstream regulated reaches (including the entire Monongahela River navigation system), for water quality control, low flow augmentation, fish & wildlife protection, and recreation. There are also Federal laws, Executive Orders, and Army regulations that require sustainable management of public resources (i.e. USACE Environmental Operating Principles, Executive Order 12088, "Prevention, Control and Abatement of Environmental Pollution at Federal Facilities", National Environmental Policy Act, the Army Strategy for the Environment with its emphasis on sustainability , the Water Resources Development Acts that govern Corps activities, etc.).

2. **4.0 PROJECT LOCATIONS, FACILITIES, AND OPERATIONS, 4.4 Existing Project Operations at the Braddock Locks and Dam.** "The Braddock Locks and Dam is operated by the USACE and is manned during routine business hours during a routine 5-day workweek and utilizes lockage schedules". Braddock L/D is actually manned and operated daily, 24-hours a day.

3. **4.5 Proposed New Project Facilities and Integrated Operations,** 4.5.1 Project Boundary.

    a. "The proposed Project Boundary will encompass the footprint of the LFM, which consists of an area immediately downstream and upstream from the dam, as well as the proposed new transmission line." Tailwaters provide the most valuable habitat in the navigation system. According to the USFWS, "....about two-thirds of the area's (Ohio River Islands) fishing takes place at dam tailwaters, although many islands and embayments offer productive fish habitats that also attract anglers." http://www.fws.gov/northeast/planning/Ohio%20River%20islands/chap3.html. Therefore, a thorough and adequate analysis of the impacts of the proposed project on this valuable resource would presumably require an instream flow study to assess impacts if the Lock Frame Module (LFM) is placed in tailwater habitat.

    b. "Hydro Friends Fund will lease lands from the USACE to obtain sufficient rights to construct the proposed Project and to maintain Project structures and facilities for Project operation." There is very limited real estate at Braddock dam. The Corps owns very little property at Braddock and nothing on the abutment side.

4. 4.5.2.1 *Reservoir Gross Storage Capacity and Normal Maximum Water Surface Area and Elevation* and throughout. Elevations should be noted as FT NGVD29, not msl. The Pittsburgh District (District) does not consider locks and dams as having any storage capacity.

5. 4.5.3 Energy Production. It is not stated what flows were assumed not available for power generation, including flows over and/or through the dams gates (spillage) necessary to maintain the navigation pools and environmental conditions, equivalent flows required to support lockages, and leakage through the dam and/or lock gates. Other than leakage, all of these bypass flows will be required. Lockage flows will depend primarily upon future traffic levels at the locks and leakage quantities will depend upon physical conditions and an accurate estimate of

energy generation potential must include realistic estimates of these values. At the Joint Agency Meeting, it was stated that energy estimates were made assuming these unavailable flows were equal to zero which is not realistic and therefore the energy potential overestimated. Spillage flows to ensure non-degradation must be determined through modeling. The 1988 Final Environmental Impact Statement for Hydroelectric Development in the Upper Ohio River Basin (1988 FEIS) prepared by the FERC noted a value of 250 cfs for lockage and leakage at Mon L/D 2 (now Braddock Locks and Dam). Future water requirements for lockages will depend on commercial and recreational traffic demands (which in turn impact the number of times the chambers must be filled and emptied).

6. 4.5.3. "The proposed Project will consist of five low-head bulb hydro turbines embedded into a patented and patented-pending LFM." The experimental nature of this patent pending application should be considered when developing study plans.

7. 4.5.4 Proposed Project Operations. "The proposed Project will operate in run-of-river mode, generating power using the head differential of the USACE's dam without affecting the USACE's operations." Hydropower generation could impact headwater reservoir project benefits including water quality, fish & wildlife protection, recreation, and low flow augmentation.

8. **5.0 DESCRIPTION OF EXISTING ENVIRONMENTAL RESOURCES AND POTENTIAL RESOURCE IMPACTS, 5.1 Description of Basin**, 5.1.2 Major Land and Water Uses.

    a. "The major consumptive water use for the Monongahela River is for industrial and commercial activities. Public water supply is a secondary consumptive source for the river, particularly in the Pittsburgh area. Non-consumptive uses of the Monongahela River include navigation, hydroelectric generation, and recreation." Water quality and protection of aquatic life are also non-consumptive uses.

    b. "Non-consumptive uses of the Monongahela River include navigation," There currently are no hydropower plants on the Monongahela River.

9. **5.1 Description of Basin**, 5.1.3 Dams and Diversions within the Basin. "In addition to the Braddock Locks and Dam, there are eight other locks and dams along the Monongahela River. Six locks and dams are located on the Monongahela River from Braddock, Pennsylvania, to 79 miles upstream at Point Marion, Pennsylvania". These two sentences are not consistent. It would be better to reference that there are eight additional locks and dams on the Monongahela River upstream of Braddock L/D, five in Pennsylvania and three in West Virginia. The most upstream lock is Opekiska L/D at River Mile 115.4.

10. **5.2 Topography, Geology and Soils**, 5.2.1 Existing Environment, 5.2.1.4 *Reservoir Shoreline and Streambanks*. "The proposed Project will not use or create a reservoir, and therefore, will have no effect on current shoreline uses or management. However, it is noteworthy to mention that based on the mapped soil types, soils in the vicinity of the proposed Project have been significantly modified with urban fill and the existing shoreline consists primarily of gravelly soils formed on outwash." While there may be no major impacts on shoreline habitat, there will be impacts to tailwater instream habitat since downstream flow patterns and velocities will

change. We therefore presume that an instream flow study will be required to adequately assess impacts on habitat & fishing success.

11. **Figure 5-2.** Monongahela River L/D 7 was decommissioned and replaced by Grays Landing L/D in the 1995.

12. **5.3 Water Resources** 5.3.1 Existing Environment, *5.3.1.6, Federally Approved Water Quality Standards.*

    a. The new Braddock Dam, constructed as part of the Congressionally authorized Locks and Dams 2, 3, and 4, Monongahela River, Pennsylvania, project and operated since 2004, includes a raised sill Water Quality (WQ) Gate. The purpose of the WQ gate is to maximize entrainment of air into the outflow as mitigation for the loss of reaeration from replacement of Dam 2 and future removal of fixed weir dams at Locks and Dam 3 (Elizabeth), and the weir section at Charleroi L/D (Dam #4). The reaeration function of this WQ gate cannot be diminished through diversion of flows from this gate to the hydro plant, particularly during low flow season without equal compensation.

    b. The District has been able to provide water quality conditions that exceed state standards at its locks and dams along the Monongahela River by operation of upstream reservoirs and the provision of spillage at the navigation dams. Non-degradation, defined as sustainable management of aquatic resources by not allowing degradation worse than existing conditions, while striving towards the national goal of water quality improvement, is an additional consideration. The protection of these existing resources in the Monongahela River is enabled by the laws that authorized the Corps' Monongahela River basin headwater reservoirs (Youghiogheny, Tygart, and Stonewall Jackson Lakes), and their downstream regulated reaches, including the entire Monongahela River navigation system, for water quality control, low flow augmentation, fish & wildlife protection, and recreation. Other Federal laws, Executive Orders, and Army regulations also require sustainable management of public resources (i.e. USACE Environmental Operating Principles; Executive Order 12088, "Prevention, Control and Abatement of Environmental Pollution at Federal Facilities"; National Environmental Policy Act; the Army Strategy for the Environment with its emphasis on sustainability; Water Resources Development Acts; etc.). We also note that the FERC recommended that dissolved oxygen levels above state standards be maintained at projects in the 1988 FEIS. In addition, the Corps is updating existing regulations to clarify the Corp's non-degradation policy. To assure sustainable development, continuous, real-time water quality monitoring downstream and possibly upstream of each project will be required prior to and during construction, and through the duration of the license. In addition, 2-dimensional water quality modeling may be necessary to predict project specific and cumulative impacts of stacked hydropower development on the navigation system.

13. *5.3.1.3 Monthly Flow Duration Curves.* How were the flow duration curves derived?

14. *5.3.1.5 Existing Instream Flow Uses.* "The Monongahela River is used for navigation and recreational activities. Other than the mainstem of the Monongahela River, there are no anticipated Project-affected streams associated with the proposed Project. The proposed Project has no potential to affect other existing water rights or uses." Again, generation could impact congressionally authorized reservoir project purposes, including water quality control, low flow

augmentation, recreation (fishing & fishing access) and fish and wildlife protection.

15. *5.3.1.7 Existing Water Quality Data.* "In 1988, the Commission prepared a Final Environmental Impact Statement (FEIS) to evaluate the impacts of proposed hydroelectric developments at up to 19 locations in the Upper Ohio River Basin, including the Braddock Locks and Dam. The FEIS included an assessment of historic water quality data collected by ORSANCO, the USGS, and the USACE. The Commission's 1988 assessment of conditions found a number of water quality parameters to be of concern in the basin. The FEIS indicated that water temperatures were elevated because many power plants and other industries discharged heated water into the Monongahela and other rivers within the basin. High water temperatures reduce dissolved oxygen (DO) concentrations and inhibit growth of some fish species." Dissolved oxygen (DO) is the water quality parameter of primary concern with hydropower generation at Braddock Dam. The 1988 FEIS recommended spill flows sufficient to prevent degradation of DO concentrations less than 6.5 mg/l. DO data presented for this review are either not current, not pertinent (tributary or sediment data), or are insufficient to characterize water quality conditions at Braddock Dam or to assess effects after the Elizabeth Dam is removed. USGS's NWQA study analyzed 1976 - 1994 dissolved oxygen data. No dissolved oxygen data were collected for USGS' Invertebrate study or for the PADEP's 2008 - 2011 Mon River water quality surveys. The Three Rivers (3R2N) study focused on tributaries to the Monongahela, Ohio, and Allegheny Rivers in Allegheny County. Monthly DO data were collected for the 3R2N 2000 - 2001 Monongahela River mainstem water quality surveys, which included a site at Braddock, PA, but only 10 dissolved samples were collected. Although not mentioned in the PAD, the District has been conducting annual, summer season water quality surveys along the entire navigation system since 1994 (excluding a few years). These survey included horizontal and vertical water quality sampling at many sites, including sites upstream and downstream of Braddock Dam, but we have only 120 dissolved oxygen readings collected over a 36 year period in the Braddock Dam tailwaters. We therefore recommend that, current, continuous WQ data, representative of hydrological and seasonal variation, be collected to define pre hydro conditions. We also recommend that the 1988 FEIS be updated to assess the cumulative impact of stacked hydropower development in the navigation system on water quality.

16. **5.4 Fish and Aquatic Resources**. "The locks at all projects on the Monongahela River allow both fish migrating upstream or downstream to pass around the dams to reach spawning or foraging grounds. This may be intermittent, though, as they are opened and closed for navigation. Because of this, similar species occur throughout the system but occupy different habitats based on life stage, flow conditions, water quality, and seasonal and diel behaviors (Stauffer et al. 1995, Jenkins and Burkhead 1993)." The District has conducted special lockages for fish passages during the spring spawn at Mon River L/Ds since 2009. In addition, both Monongahela River water quality and aquatic life resources have improved dramatically over the past 30 - 40 years.

17. 5.4.1. Existing Environment, *5.4.1.3 Temporal and Spatial Distribution of Fish and Aquatic Communities Fisheries*, Macroinvertebrate Resources. "As mentioned previously, there is limited to no information on temporal and spatial characteristics of Monongahela River mollusk, crayfish, and aquatic insect communities." Recommend including PADEP's 2010-2011 Monongahela River macroinvertebrate data.

18. *5.4.1.4 Life History.*

    a. No information or data specific to fish passage at Braddock were provided (i.e. fish passage; temporal, spatial, and seasonal distribution of fish in the pool upstream of the dam; upstream and downstream passage through the dam; current fish entrainment & mortality rates; expected change with passage through turbines; etc).

    b. No macroinvertebrate data or information were provided for Braddock L/D, the Mon River, or even big rivers in general. Unless the PADEP has project specific data, require that a macroinvertebrate survey be conducted to define pre-hydro project conditions.

19. **5.6 Floodplains, Wetlands, Riparian, and Littoral Habitats**, 5.6.1 Existing Environment, *5.6.1.4 Estimates of Wetland, Riparian and Littoral Habitat Acreage*, Wetland Acreage. "There are no wetlands located within the proposed Project Boundary. However, the total combined acreage of the two wetlands within the inset map on Figure 5-9 is 2.58 acres." The 3R2N group conducted a vegetation survey of the Mon River. A shoreline wetland/vegetation survey was also conducted for the USACE Lower Monongahela Project EIS around 1990.

20. **5.8 Recreation and Land Use**, 5.8.1 Existing Environment – Recreation, *5.8.1.1 Existing Recreation Facilities, Capacities, and Opportunities & 5.8.1.3 Recreation Needs Identified in Management Plans*. "There are no recreational facilities or opportunities associated with the proposed Project. The proposed Project will not affect or alter recreational uses of lands or nearby waters." "As discussed above, no recreation facilities are associated with the proposed Project." Hydropower generation could impact the tailwater fishery, modify fishing success, or affect fisherman access (bass tournaments, boating, shoreline and river fishing, etc.). Recommend that river recreation and angler access surveys be conducted.

21. **6.0 PRELIMINARY ISSUES AND STUDIES LIST**. To summarize, required studies/surveys to adequately document impacts include: continuous, real-time water quality monitoring prior to & during construction, and through the duration of the license; 2-dimensional water quality model for at least the Charleroi, Elizabeth, Braddock, and Emsworth Pools; angler access and recreation surveys; tailrace instream flow & habitat survey; Braddock Dam tailwaters macroinvertebrate & mussel surveys if there are no current data available for Braddock Dam; and field fish mortality and entrainment studies.

22. **6.2 Summary of Potential Issues and Study/Information Needs,** 6.2.1 Desktop Entrainment/Impingement Study. No information or data specific to fish passage at Braddock were provided. With the limited project specific data available, a desktop entrainment / impingement survey will be inadequate.

23. 6.2.2 Desktop Hydraulic Modeling Study.

    a. Details on the proposed study are not provided. The District should be provided with a detailed proposal and provided an opportunity to concur or non-concur.

    b. In addition to reviewing for potential navigation impacts, the Corps will be interested in reviewing the results of the hydraulic modeling study to determine in any revisions to the existing Restricted Area designation downstream of the dam will be required as a result of the effects of the hydropower facility.

24. 6.2.3 Desktop Water Quality Study. "....proposes to conduct a literature review and synthesis of existing data to describe the baseline water quality conditions in the vicinity of the proposed Project. The objective of this effort will be to characterize the trends in DO, water temperature, and turbidity occurring immediately upstream and downstream of the existing dam, as well as overall spatial and temporal trends in the Monongahela River. Particular focus will be placed on characterization of the late summer months when water quality conditions are typically at their most critical levels.... Pertinent data will be synthesized into a draft Desktop Water Quality Report, which will be distributed to resource agencies and other interested stakeholders for review. Following review by licensing stakeholders, a final report will be filed with the Commission." A desktop WQ study is unacceptable. Water quality conditions at Braddock have a significant effect on the water quality of downstream navigation pools, which could be complicated by possible hydro development at every L/D in the system. This, along with the fact that there are very few current, seasonal & hydrologic representative data available for Braddock Pool & tailwaters and that water quality has improved dramatically over the period of record, emphasizes the need for real-time water quality monitoring and modeling to 1) define pre-hydropower conditions, 2) predict the impacts of hydropower generation on water quality with and without the Elizabeth Dam (#3) scheduled for future removal; 3) to assess cumulative impacts of stacked hydropower on the entire navigation system, and 4) to assure nondegradation of current conditions.

25. **7.0 COMPREHENSIVE PLANS RELEVANT TO THE BRADDOCK PROJECT**. Water Quality was also described as a significant resource in the 1988 FEIS.

26. **7.1 Qualifying Comprehensive Plans Deemed Applicable.** Include Monongahela River Basin headwater reservoir Water Control Manuals.

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222-4186

27 June 2012

Real Estate Division
Management and Disposal Branch

SUBJECT: Braddock Lock and Dam, HDR Engineering, Inc., Right-of-Entry Permit for Access over Corps of Engineers' Property

Mr. Jim Gibson
Vice President, Hydropower Services
HDR Engineering, Inc
1304 Buckley Road, Suite 202
Syracuse, NY 13212

Dear Mr. Gibson:

This is in response to HDR Engineering's request for access to Government property at Braddock Lock and Dam, to perform field inspections and testing in conjunction with hydropower. This Right-of-Entry is approved subject to the following conditions:

1. Access is limited for the purpose of performing actions in conjunction with hydropower at Braddock Lock and Dam. The location and boundaries of the proposed inspection will be located just in front of the monolith. The term for this Right-of-Entry permit is beginning with the date of this letter. On or before the expiration of this permit, or if work is completed sooner, you must vacate the premises, remove your property, and restore the premises to a satisfactory condition.

2. The premises shall be kept in good order and in a clean, safe condition by and at your expense. You will be responsible for any damage that may be caused to the property. Any Government property damaged or destroyed shall be promptly repaired or replaced to a satisfactory condition as determined by the United States or at our discretion; you may be billed for any damage caused. The United States will not be responsible for damages to the property of HDR Engineering and/or its contractors, or injuries to its employees or contractors, except for those damages caused by the fault or negligence of the United States.

3. IAW the security requirements of the US Army Corps of Engineers, all members of the proposed team will be required to submit the following information prior to initiating inspection work in the vicinity of the Braddock Lock and Dame: full name, date of birth, place of birth, citizenship and current residence. USACE Pittsburgh District will grant access to the required areas upon approval entrance list. Requests can take up to 30 days to approve or longer for non-US citizens. Each member must possess valid government identification which includes a photograph, while on the facility.

4. You must notify Mr. James McKelvey, Braddock Lock and Dam, at 412-271-1272 at least two weeks prior to the start of any work. Access for the power conduit inspections must be further limited by daily coordination with and approval by the Park Ranger Supervisor. The inspections will take place just in front of the monolith. Access may be completely denied at any time if it is determined that a safety issues exist.

5. Issuance of this right of entry will not relieve you of the responsibility to obtain any other required state, local or Federal authorizations and/or permits. Violation of any of the above conditions may result in immediate termination of this permit.

If you have any questions, please contact Mr. Shekinah Bailey at 412-395-7185. Your cooperation is appreciated.

Sincerely,

Bert Edwardo

Bert Edwardo
Chief, Real Estate Division

Gibson, James

From: Gibson, James
Sent: Monday, August 06, 2012 1:26 PM
To: 'Lora_Zimmerman@fws.gov'; Spear, Richard; 'rventorini@pa.gov'; 'doufischer@pa.gov'; 'mhartle@pa.gov'; 'Lorson, Richard'; 'Snyder, Joseph (DEP)'
Cc: Mark R. Stover (HGE); Keppler, Dawn
Subject: Braddock Locks and Dam Hydroelectric Project

Good Afternoon,

As a follow up to the previous phone conversations and correspondence, Hydro Green Energy is looking to schedule a meeting/conference call to review the study activities and reports, as well as the application that has been prepared in support of issuance of a license from the Federal Energy Regulatory Commission.

We are currently in the process of updating this information (based on the most recent data and information obtained as a result of some of our recent discussions). As we wrap up these documents, we will be forwarding to this group in support of the meeting/call.

In order to start selecting a day and time for a meeting/call, we are proposing either August 29th or August 30th.

Please let me know if folks would be available for a meeting or call on either of these days. As of now we would propose a meeting that would start at approximately 8:30 either morning.

Thanks

JIM GIBSON | **HDR Engineering, Inc.**
Vice President, Hydropower Services

1304 Buckley Road, Suite 202 | Syracuse, NY 13212
D: 315.414.2202 | C: 315.415.2729
O: 315.451.2325 | F: 315.451.2429
jim.gibson@hdrinc.com | hdrinc.com

Gibson, James

From: Gibson, James
Sent: Thursday, August 09, 2012 10:32 AM
To: 'Lora_Zimmerman@fws.gov'; 'Spear, Richard'; 'rventorini@pa.gov'; 'doufischer@pa.gov'; 'mhartle@pa.gov'; 'Lorson, Richard'; 'Snyder, Joseph (DEP)'
Cc: 'Mark R. Stover (HGE)'; Keppler, Dawn
Subject: RE: Braddock Locks and Dam Hydroelectric Project
Attachments: 20120809 Braddock Project Entrainment Report.pdf

Good Morning,

As a follow up to the previous email, wanted to pass along that we will be forwarding an invite for a meeting/call for Thursday August 30th. Along with the invite, we will provide a proposed agenda for the meeting.

We are looking for any suggestions as to a location to hold the meeting. We are looking for a location that would be convenient for FWS, FBC, and DEP. It is our understanding that the best location may be near the FWS and FBC offices and that the DEP would then dial into the meeting.

In support of the meeting, we are passing along the draft version of the Fish Entrainment Report that has been prepared for the project. This is one of the studies and documents that we would like to review during the meeting. Over the next week, we will be forwarding the additional documents.

Thanks and please do not hesitate to contact me if there are any questions regarding the attachment or the meeting.

JIM GIBSON | **HDR Engineering, Inc.**
Vice President, Hydropower Services

1304 Buckley Road, Suite 202 | Syracuse, NY 13212
D: 315.414.2202 | C: 315.415.2729
O: 315.451.2325 | F: 315.451.2429
jim.gibson@hdrinc.com | hdrinc.com

Braddock Locks & Dam Hydroelectric Project
(FERC Project No. 13739)
Licensing Study and Application Review Meeting

August 30, 2012 - 9:00 AM

Dial in Option - 866-994-6437; 2938254026#

Purpose

Review the study activities and application in support of filing the license application with the Federal Energy Regulatory Commission

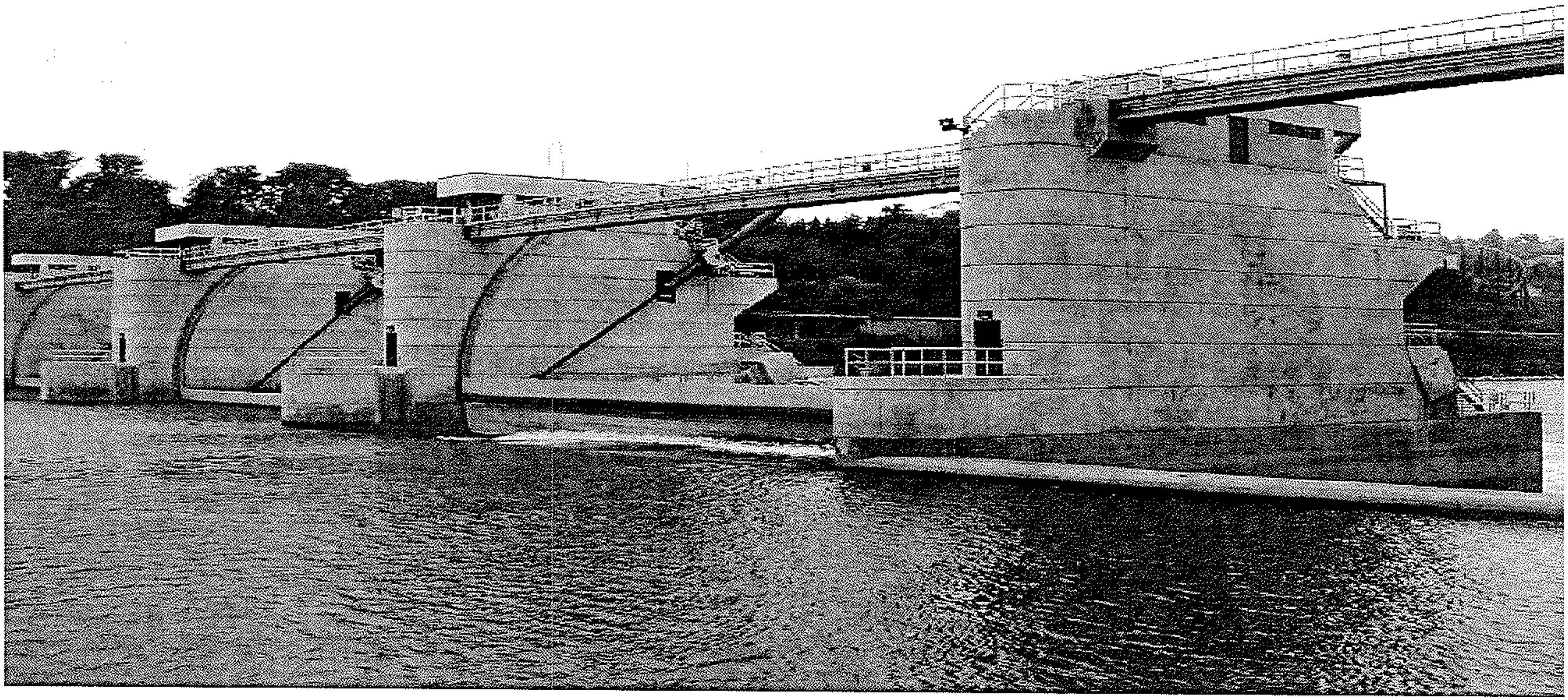
Introductions

Discussion Topics

1. Project Overview
2. License Application
3. Study Activities Performed Since March 7th Meeting
    a. Fish Entrainment Study
    b. Water Quality Desktop Study
    c. Water Quality Modeling
    d. Water Quality Field Study
4. Additional Topics
    a. Mussel Information
    b. Sediment Management
5. Proposed Recreational Enhancements
6. Filing of FERC License Application
7. Additional Permit Activities
    a. Section 401 and additional DEP approvals
    b. Section 404 and 408

Action Items

Hydro Green Energy®



Braddock Locks & Dam Hydropower Project

(FERC Project No. 13739)

Meeting Agenda

- Introductions
- HGE and Project Overview
- Overview of License Schedule, Status, and Application
- Study Activities Performed
  - Fish Entrainment Study
  - Water Quality Desktop Study
  - Water Quality Modeling
  - Water Quality Field Study
- Mussels
- Sediment Management
- Proposed Recreational Enhancements
- Filing of FERC License Application
- Additional Permit Activities

About HGE

- Privately-funded renewable energy development company with proprietary hydropower technology
- Based in Westmont, IL
- Focus on building new, low-impact hydropower capacity at non-powered dams
- Permits for ~400 MW of capacity in 15 states
- Nearly all sites are at USACE non-powered dams
- Braddock Project 1st in HGE development pipeline

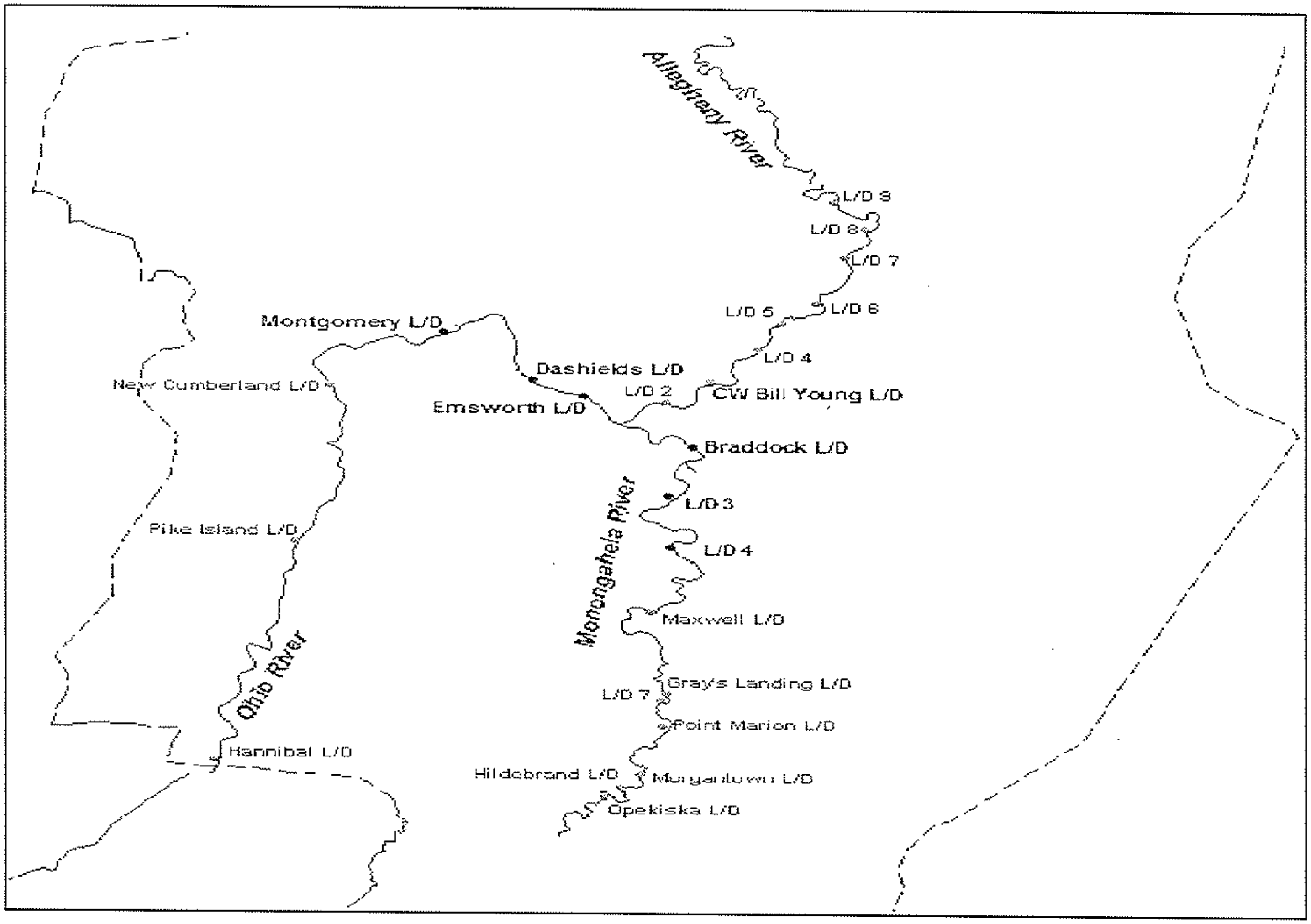
Braddock Locks & Dam Project

- Monongahela River in Pittsburgh area
- Nameplate capacity is 3.75 MW
- Maximum flow for full power is 6,250 cfs
- Expected capacity factor of ~72%
- Deploying low-impact HGE modular technology
- Extremely small footprint (less than 1,000 square feet) and integrated into existing weir
- "Run-of-release" mode

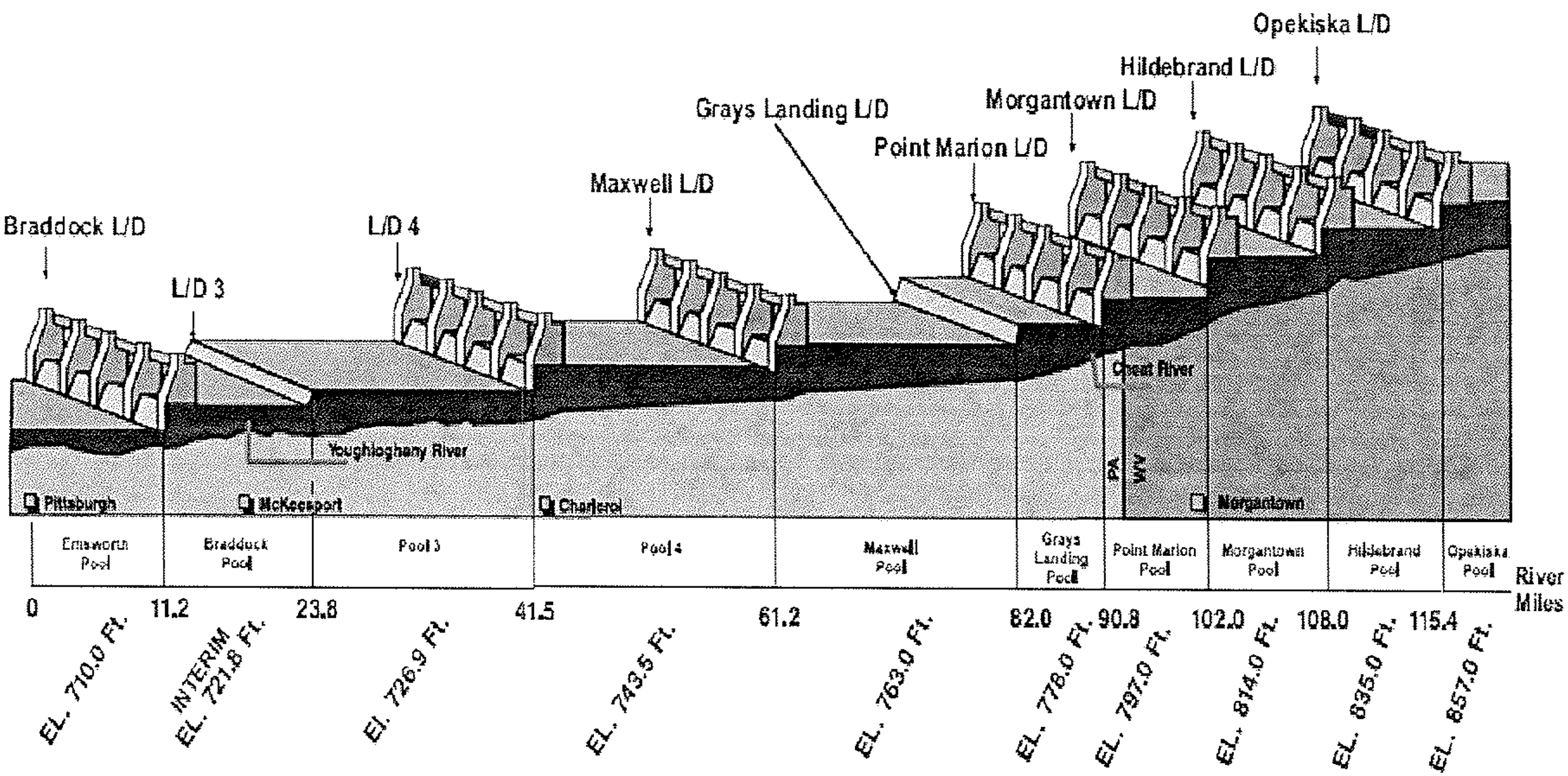
Braddock Locks & Dam Project

- Permit application filed 5/2010
- Permit awarded 4/2011
- NOI-PAD filed in 12/2011
- FERC acceptance of TLP request and NOI-PADs in 2/2012
- Public meetings/site visit held 3/2012
- Ongoing studies and consultation since 3/2012
- Comments to date include no impacts to historical resources, federal species limited to Indiana Bat, and no additional consultation required for state listed species
- $1.5 million DOE grant for demonstration of new American hydro technology

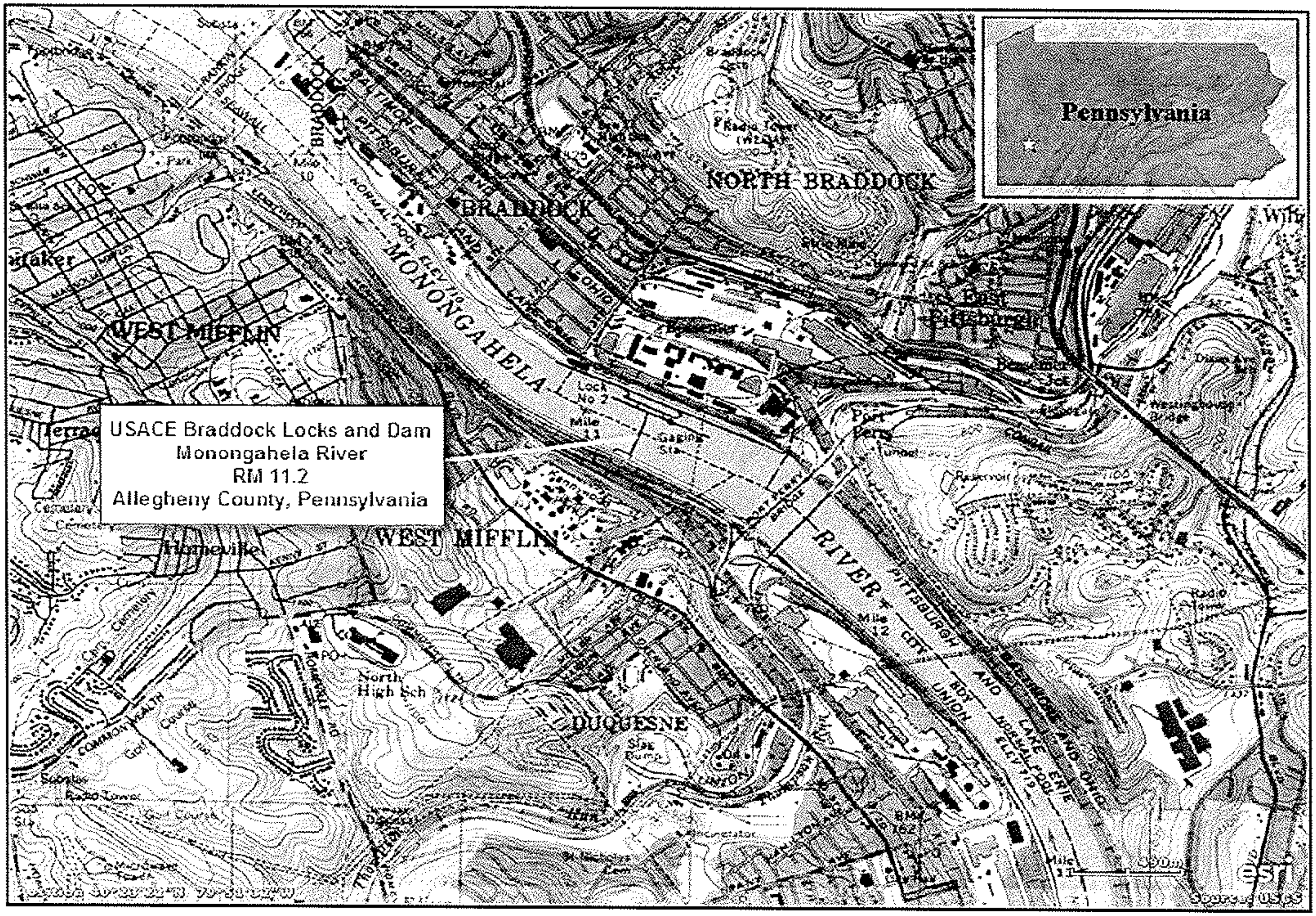
Project Location



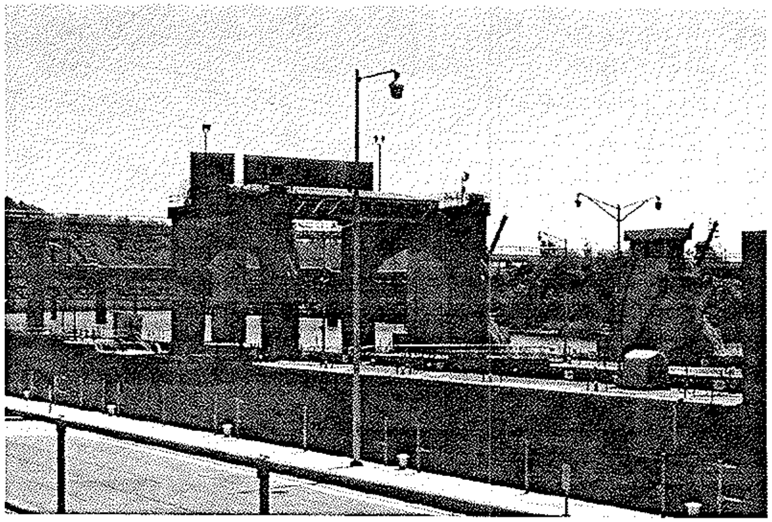
Project Location

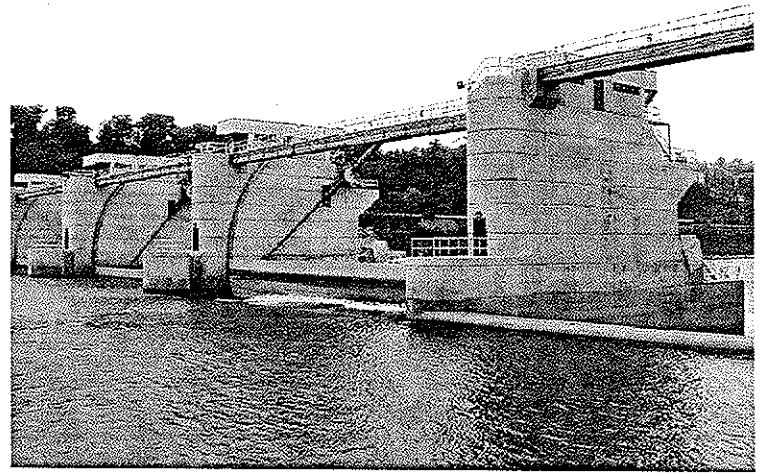


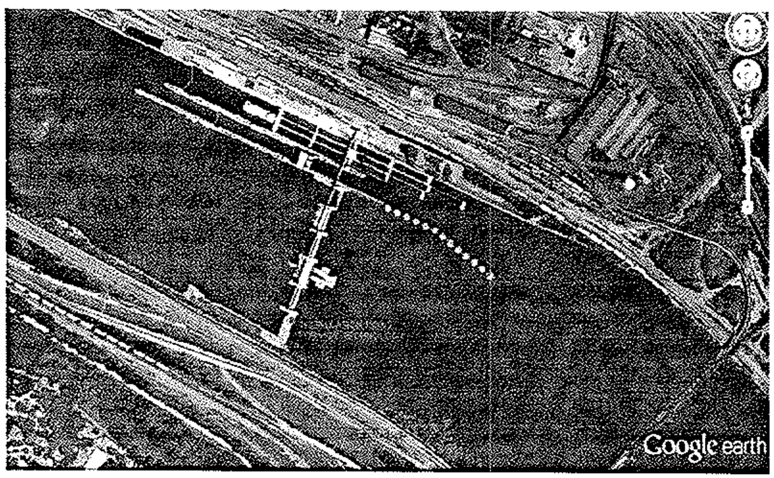
Project Location

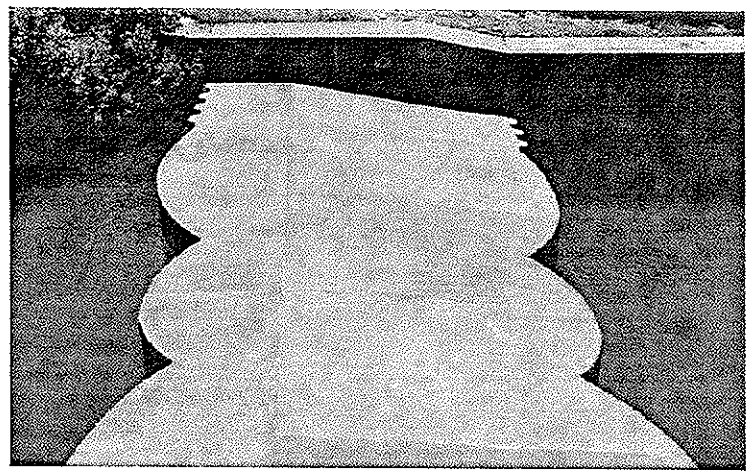


Braddock Project Site

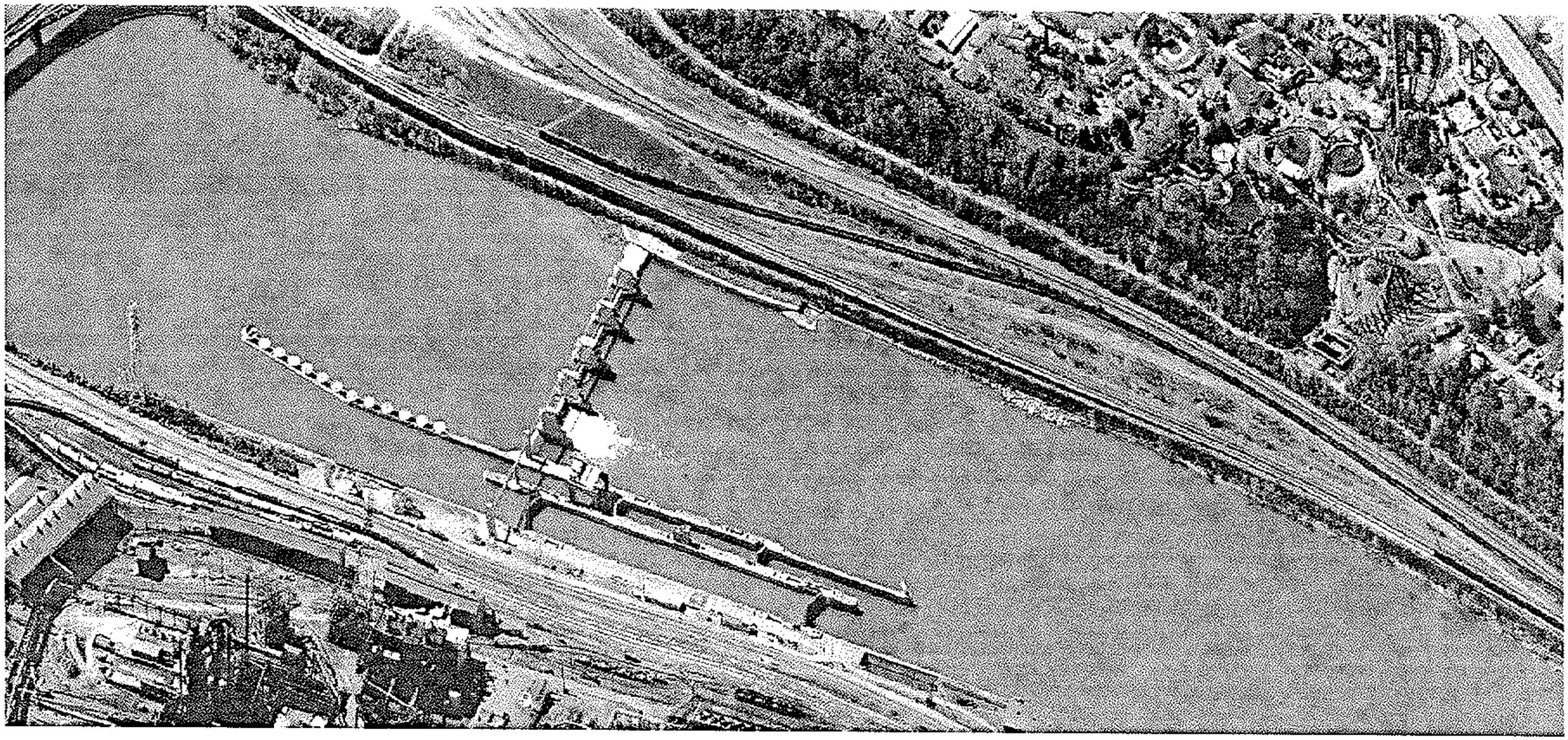




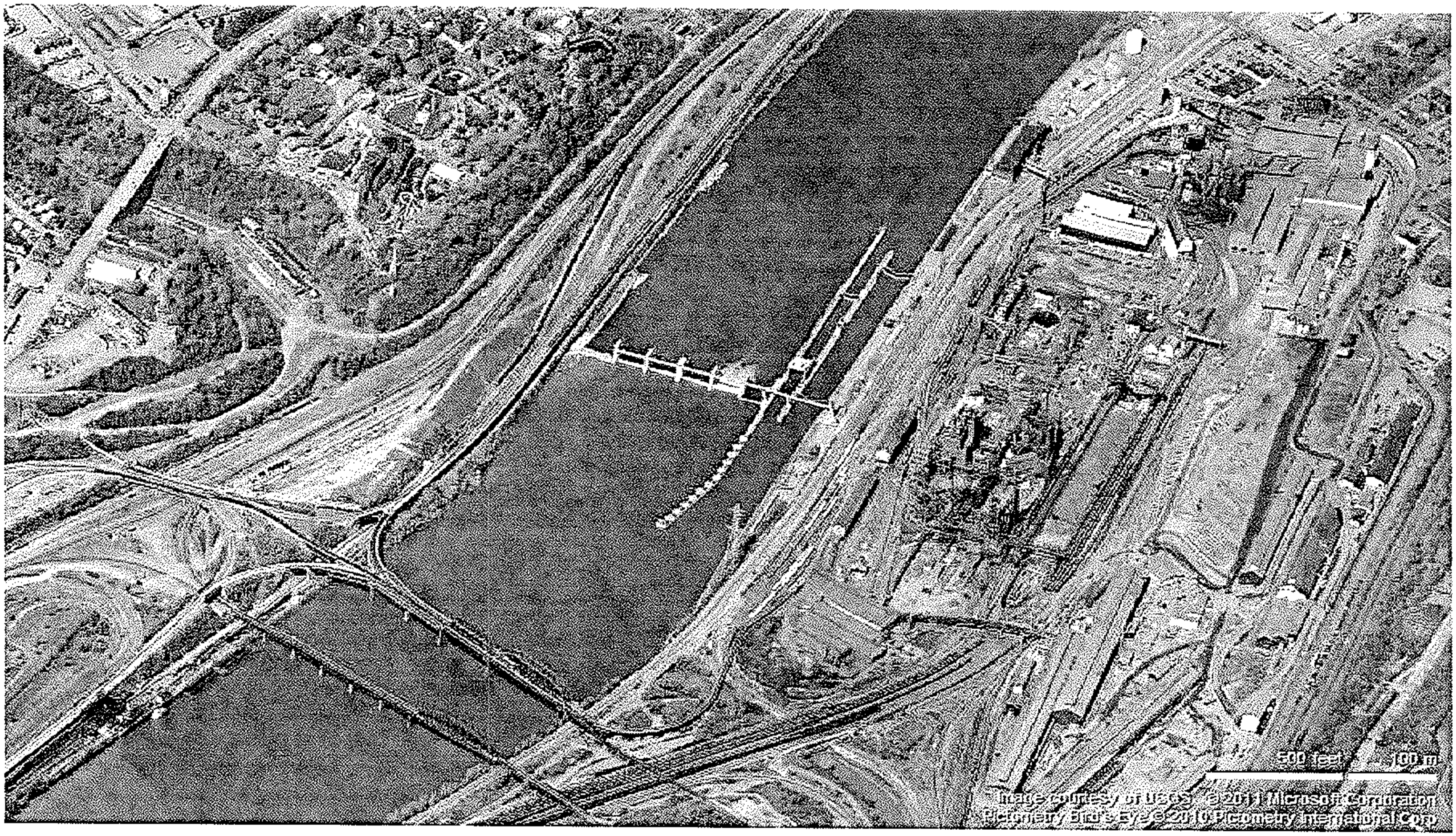




Braddock Project Site



Braddock Project Site



Major Licensing Milestones

Timeframe	Activity
October 11, 2011	Distribution of Pre-Application Document (PAD) Questionnaire
December 23, 2011	Filing and distribution of PAD, Notice of Intent, and Request to use Traditional Licensing Process (TLP)
January 30, 2012	FERC grants request to use TLP
February 10, 2012	FERC notices Notice of Intent and PAD
February 20, 2012	HGE notice of Joint Agency/Public Meeting
March 7, 2012	**Joint Agency/Public Meeting and Site Visit**
May 6, 2012	File comments on PAD and potential study requests

Major Licensing Milestones

Timeframe	Activity
February 2012 – August 2012	Conduct studies
August 2012	Issue study report(s) to Stakeholders
August 2012	**Review License Application with Stakeholders**
September 2012	**File License Application with FERC**
October 2012	Provide Stakeholders and FERC with results from water quality field study
Fall 2012	File applications for additional permits and approvals
Fall 2012/Winter 2013	Additional Stakeholder opportunities to comment on License Application

Braddock Locks & Dam Project

- Permit application filed 5/2010
- Permit awarded 4/2011
- NOI-PAD filed in 12/2011
- FERC acceptance of TLP request and NOI-PADs in 2/2012
- Public meetings/site visit held 3/2012
- Ongoing studies and consultation since 3/2012
- Comments to date include no impacts to historical resources, federal species limited to Indiana Bat, and no additional consultation required for state listed species
- $1.5 million DOE grant for demonstration of new American hydro technology

FERC License Application

Unconstructed Project, Less than 5 MW

- Initial Statement
- Exhibit A – Project Overview
- Exhibit E – Environmental Exhibit
- Exhibit F – Design Drawings and Preliminary Supporting Design Report (CEII Filing)
- Exhibit G – Project Map
- Appendices – Flow Duration Curves and Study Reports

FERC License Application

- E.1 – Introduction
- E.2 – General Setting
- E.3 – Water Quantity and Quality
- E.4 – Fish, Wildlife, and Botanical Resources
- E.5 – Cultural and Historical Resources
- E.6 – Socioeconomic Resources
- E.7 – Geological and Soil Resources
- E.8 – Recreational Resources
- E.9 – Aesthetic Resources
- E.10 – Land Use
- E.11 – Conformance with Comprehensive Plans
- E.12 – Alternative Locations, Designs, and Energy Sources
- E.13 – Proposed PM&E Measures

Resource Overview

- Study Activities Performed
  - **Fish Entrainment Study**
  - Water Quality Desktop Study
  - Water Quality Modeling
  - Water Quality Field Study
- Additional Topics
  - Mussels
  - Sediment Management

Resource Overview

- Study Activities Performed
  - Fish Entrainment Study
  - **Water Quality Desktop Study**
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Resource Overview

- Study Activities Performed
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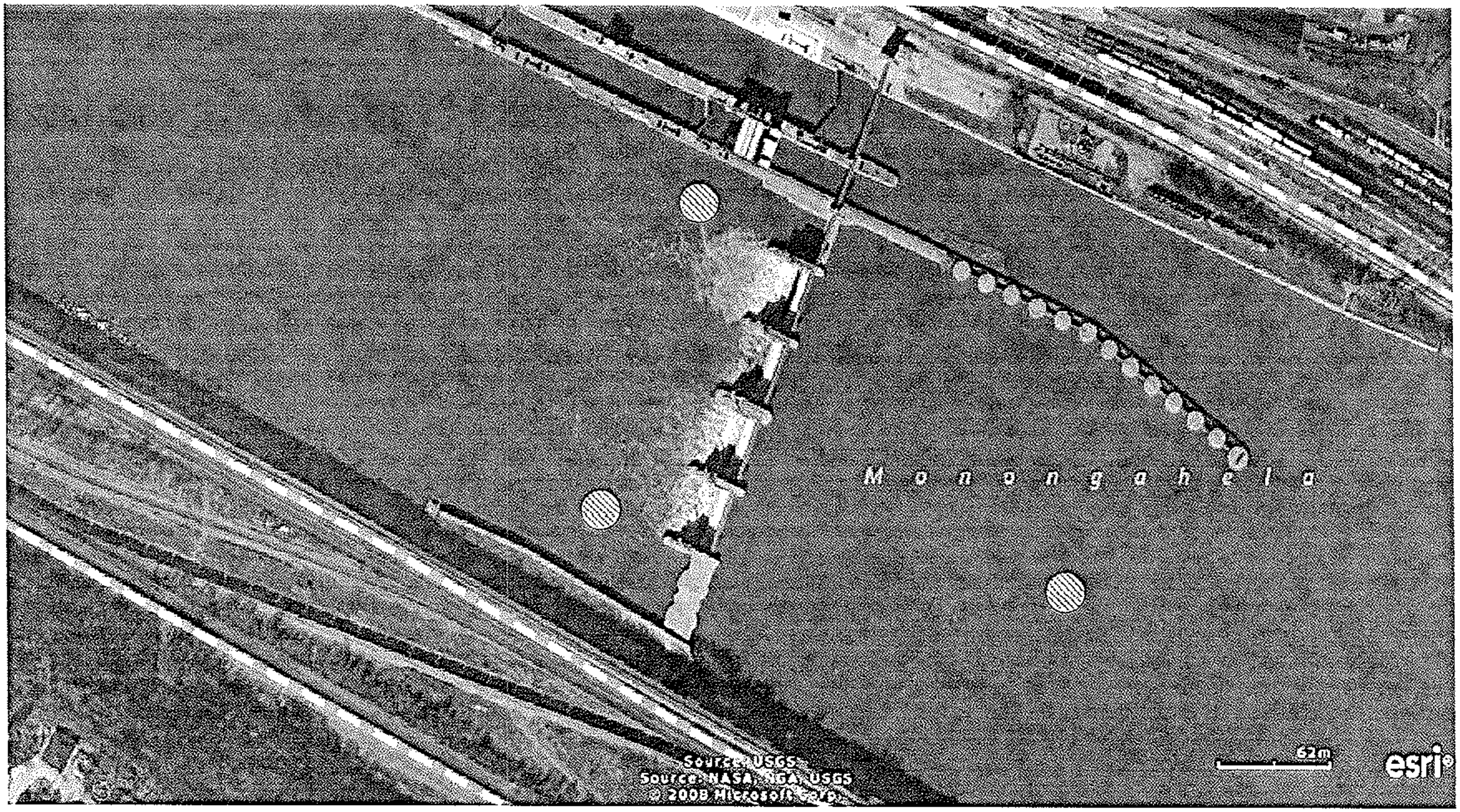
Resource Overview

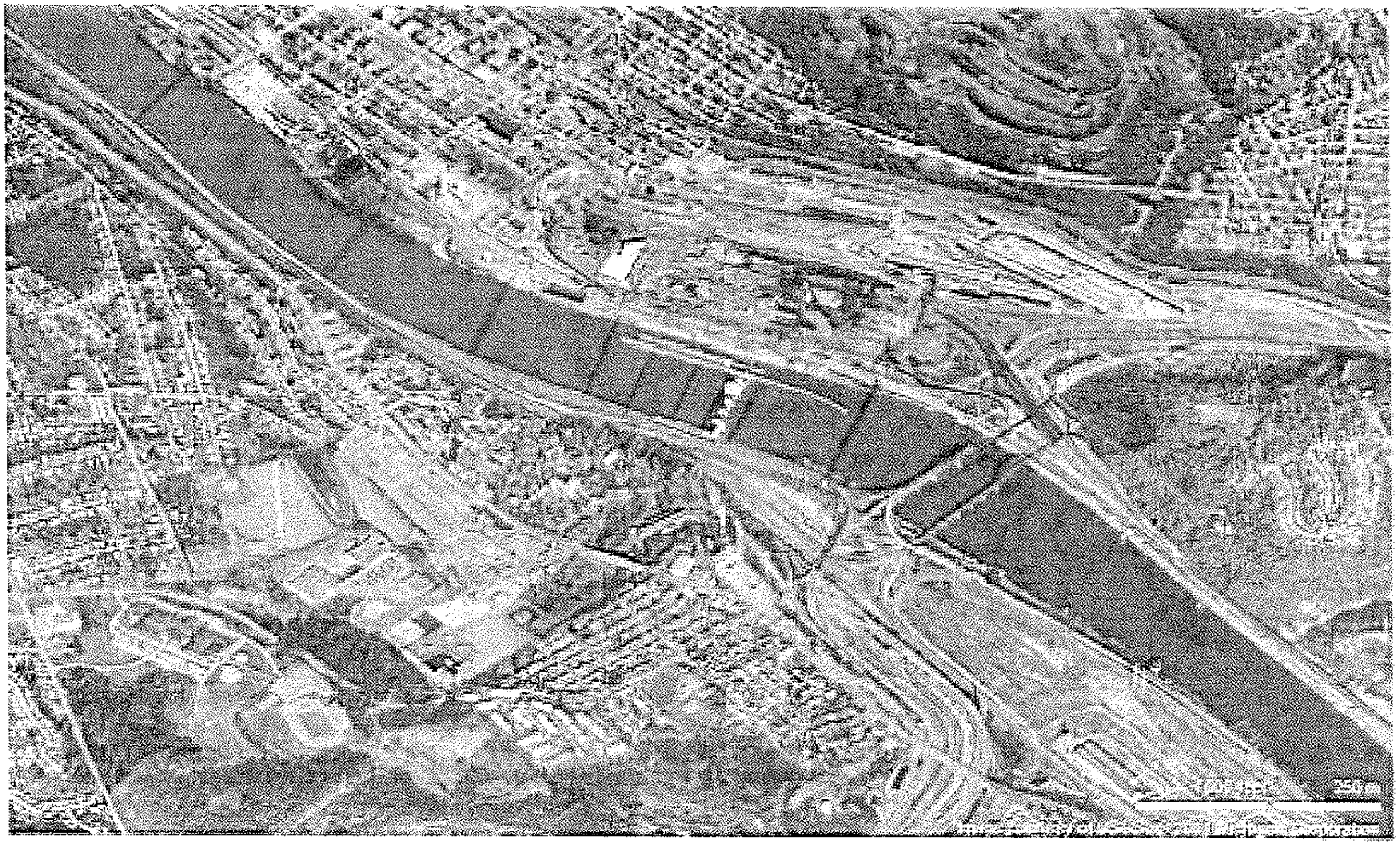
- Study Activities Performed
  - Fish Entrainment Study
  - Water Quality Desktop Study
  - Water Quality Modeling
  - **Water Quality Field Study**
- Additional Topics
  - Mussels
  - Sediment Management

Water Quality Field Study



Continuous Water Quality Monitoring Locations

Water Quality Field Study



Discrete (Intensified) Quality Monitoring Locations

Resource Overview

- Study Activities Performed
  - Fish Entrainment Study
  - Water Quality Desktop Study
  - Water Quality Modeling
  - Water Quality Field Study
- Additional Topics
  - **Mussels**
  - Sediment Management

Mussels Information

Pool Name	Number of Sample Sites	Total Numbers (live)	Species Diversity	Search Area (m^2)	Density (mussels/m^2)
Emsworth	5	19	6	1465	0.013
Braddock	6	72	2	2245	0.032
Pool 3	4	14	1	1763	0.008
Pool 4	7	22	3	3195	0.007
Maxwell	5	19	1	2442	0.008
Grays Landing	4	2	2	1867	0.001

Results of the 2008 Monongahela River mussel survey conducted by Hart (2012).

Mussels Information

Survey Site (RM)	Abundance (count)	Species Diversity	Search Area (m^2)	Density (mussels/m^2)
0.28	1	1	247	0.004
3.42	4	2	286	0.014
4.00	7	1	303	0.023
5.42	5	3	364	0.014
7.49	2	2	265	0.008
12.17	3	1	305	0.010
12.50	4	1	350	0.011
15.74	7	1	390	0.018
18.03	22	1	355	0.062
20.27	23	1	366	0.063
21.66	13	1	479	0.027

Table E.4.1.5-2 Results of the 2008 Monongahela River mussel survey for Emsworth and Braddock Pools; Braddock Dam at RM 11.2. Source: Hart 2012.

Mussels Information

Emsworth Pool Mussels

Pink heelsplitter (14)

Fluted shell (1)

Fragile papershell (1)

Giant floater (1)

Mapleleaf (1)

Fat mucket (1)

Braddock Pool Mussels

Pink heelsplitter (71)

Mapleleaf (1)

Resource Overview

- Study Activities Performed
  - Fish Entrainment Study
  - Water Quality Desktop Study
  - Water Quality Modeling
  - Water Quality Field Study
- Additional Topics
  - Mussels
  - **Sediment Management**

Project Website

Go to www.hgenergy.com

- Projects
- Licensing Activities
- Braddock Locks and Dam

Project Website

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Clean, Renewable Electricity from Water

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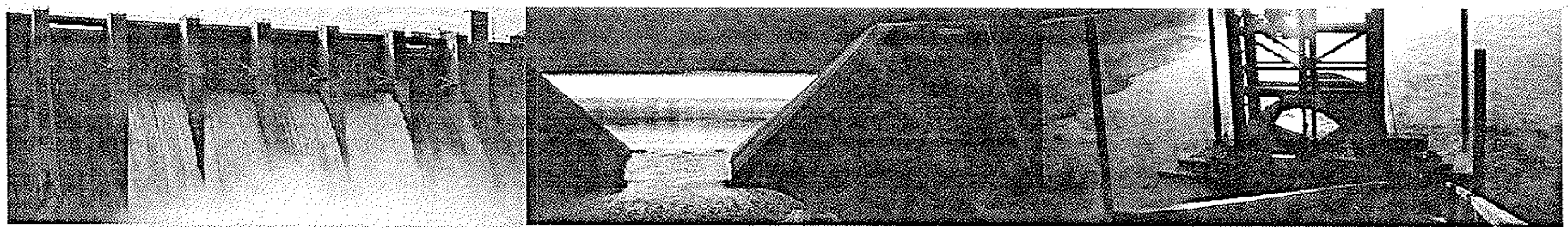

» Hydro Green Energy Projects

Braddock Locks & Dam Notice of Intent (NOI)

Braddock Locks & Dam Preliminary Application Document (PAD)

Hydro Green Energy, through its wholly owned project development subsidiaries, is developing a number of low-head hydropower projects around the country, including a project at USACE Braddock Locks & Dam in Pennsylvania.

Please see the links to the left for licensing documents filed at the Federal Energy Regulatory Commission (FERC) Questions can be directed to Mark Stover, HGE's Vice President of Corporate Affairs, at mark@hgenergy.com

Click here to access the Braddock PAD

Contact Information/Questions

Mark R. Stover
Vice President of Corporate Affairs
Hydro Green Energy
877-556-6566 x-711
mark@hgenergy.com

Jim Gibson
Vice President, Hydropower Services
HDR, Inc.
315-414-2202
jim.gibson@hdrinc.com

Written Correspondence from USACE, PA DEP and US F&WS to HGE Agreeing to Move to the filing of the Formal Application at FERC for Braddock Locks & Dam Project

RE: Braddock Locks and Dam FERC License Application - Message (HTML)

Message | ESET

Reply | Reply All | Forward | Meeting | More | Ignore | Junk | Delete | Translate | Find | Related | Select | Zoom

Respond | Delete | Editing | Zoom

You forwarded this message on 9/8/2012 8:56 AM.
If there are problems with how this message is displayed, click here to view it in a web browser.

From: Lora_Zimmerman@fws.gov
To: Mark R. Stover (HGE)
Cc:
Subject: RE: Braddock Locks and Dam FERC License Application
Sent: Fri 9/7/2012 3:35 PM

Yes, we are fine with you submitting a formal application. I don't think FWS will have significant comments on the project, given the location and the small footprint.

thanks,
Lora

Lora Zimmerman
Assistant Supervisor,
Contaminants and Conservation Planning Assistance

U.S. Fish & Wildlife Service
Pennsylvania Field Office
315 South Allen St., Suite 322
State College, PA 16801

RE: Braddock Locks and Dam FERC License Application - Message (HTML)

Message | ESET

Reply | Reply All | Forward | Meeting | More | Ignore | Junk | Delete | Translate | Find | Related | Select | Zoom

Respond | Delete | Editing | Zoom

You replied to this message on 9/11/2012 11:45 AM.

From: Schwartz, Ronald <roschwartz@pa.gov>
To: Mark R. Stover (HGE)
Cc: Snyder, Joseph; Kriley, Christopher; Graham, Rita
Subject: RE: Braddock Locks and Dam FERC License Application
Sent: Tue 9/11/2012 11:39 AM

Mr. Stover:

I have been working with Rita, Joe and Chris on several hydroelectric projects in the region and the response Joe provided has been used on other cases. For consistency, we decided to provide the same response on this project. While PADEP certainly has no objections to HGE filing a formal application with FERC, we simply did not want to leave you with the impression we will be reviewing those submittals or providing any comments on them. We will of course provide a prompt, thorough review of the state applications when they come in and we look forward to working on this project with you and our federal partners.

Ronald A. Schwartz, P.E., BCEE| Assistant Regional Director
Department of Environmental Protection| South-west Regional Office
400 Waterfront Drive| Pittsburgh, PA 15222-4745
Phone: 412.442.4181| Fax: 412.442.4194
www.dep.state.pa.us

RE: Braddock Locks and Dam FERC License Application (UNCLASSIFIED) - Message (Plain Text)

Message | ESET

Reply | Reply All | Forward | Meeting | More | Ignore | Junk | Delete | Translate | Find | Related | Select | Zoom

Respond | Delete | Editing | Zoom

You replied to this message on 9/11/2012 11:51 AM.
Extra line breaks in this message were removed.

From: Benedict, Jeffrey M LRP <Jeffrey.M.Benedict@usace.army.mil>
To: Mark R. Stover (HGE)
Cc: Gibson, James
Subject: RE: Braddock Locks and Dam FERC License Application (UNCLASSIFIED)
Sent: Tue 9/11/2012 11:50 AM

Classification: UNCLASSIFIED
Caveats: NONE

Mark, we do not have any objection to your filing of the formal application. I don't know what duration of the reviews will be, but if 30 days we may need to request additional time.

-Jeff
-----Original Message-----
From: Mark R. Stover (HGE) [mailto:mark@hgenergy.com]
Sent: Tuesday, September 11, 2012 12:42 PM
To: Benedict, Jeffrey M LRP
Cc: Gibson, James
Subject: FW: Braddock Locks and Dam FERC License Application

Gibson, James

From: Snyder, Joseph [jossnyder@pa.gov]
Sent: Tuesday, September 11, 2012 9:24 AM
To: Mark R. Stover (HGE)
Cc: Gibson, James
Subject: RE: HGE Braddock L&D Project Footprint

Importance: Low

Based on the information that you have provided, to date, an application for a dam permit and/or a Water Obstruction and Encroachment Permit will not be required for HGE's Braddock L&D hydroelectric project, since you will be applying for a license under the Federal Power Act. Please be aware, however, that you may need to request and obtain 401 Water Quality Certification (WQC), from PADEP, as part of the FERC licensing process. A request for 401 WQC must include a completed Environmental Assessment, on a form provided by PADEP, along with all required supporting documentation. Please note that the level of design detail and other information that is provided in your FERC license application may not be sufficient to address the informational requirements that are needed to obtain 401 WQC. Please also note that this determination regarding PADEP permit requirements may be null and void, if the scope, design and/or configuration of the project changes, and/or you do not obtain a FERC license for this project. If you have any questions concerning this message, feel free to contact me at 412-442-4308. JS

From: Mark R. Stover (HGE) [mailto:mark@hgenergy.com]
Sent: Friday, August 31, 2012 12:14 PM
To: Snyder, Joseph
Cc: Gibson, James
Subject: HGE Braddock L&D Project Footprint

Hi, Joe.

Thanks again very much for participating in yesterday's meeting to review the license application for our Braddock Locks & Dam Project. We appreciate your time and comments.

As promised, attached are some drawings that should help you and your colleagues determine if we need the Obstruction and Encroachment Permit.

Again, please keep these internal and safely pass around since these are CEII materials containing details on our patented technology.

I've also provided an updated overview of the project.

Please let me know if you need anything else and have a nice holiday weekend.

Mark

Mark R. Stover
Vice President of Corporate Affairs
Hydro Green Energy
877-556-6566 x-711 (office)
www.hgenergy.com
Skype: hgemark

APPENDIX F-1

DESIGN DRAWINGS

(Given CEII – filed under separate cover)

APPENDIX F-2

PRELIMINARY SUPPORTING DESIGN REPORT

(Given CEII – filed under separate cover)

APPENDIX G-1

PROJECT MAP

CAD FILENAME: P-13739, G-1, BRADDOCK PROJECT BOUNDARY MAP, XX-XX-XXXX.DWG

NOTE
THE APPLICANT PLANS TO ACQUIRE EASEMENTS FOR ALL THE LAND WITHIN THE BOUNDARY TO ALLOW OCCUPANCY AND USE FOR THE OPERATION OF THE PROPOSED PROJECT.

REFERENCE COORDINATE METADATA

PROJECTION	– PENNSYLVANIA STATE PLANE
DATUM	– NAD83
ZONE	– SOUTH
UNITS	– U.S. SURVEY FEET

GEOREFERENCE SOURCE DATA

- PASDA PENNSYLVANIA SPATIAL DATA ACCESS:
  AERIAL/VECTOR DATA: http://www.pasda.psu.edu/default.asp
  (ORIGINAL COORDINATE SYSTEM: PENNSYLVANIA STATE PLANE, NAD83, SOUTH ZONE, U.S. FEET)
- PICTOMETRY: GEOREFERENCED AERIAL IMAGERY
  (ORIGINAL COORDINATE SYSTEM: WGS84)

SURVEYORS STATEMENT

I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

RESERVED FOR SURVEYOR STAMP

SCALE: 1"=150'
150 75 0 150 FT

LEGEND:
- PROJECT BOUNDARY
- CITY/TOWN LINE
- SHORELINE/STREAM
- TRANSMISSION LINE
- FENCE
- PRIMARY ROADS
- SECONDARY ROADS
- RAILROAD TRACKS

EXHIBIT G-1		SHEET 1 OF 1
BRADDOCK PROJECT BOUNDARY MAP AND LOCATION MAP		
LOCK+ HYDRO FRIENDS FUND XLII, LLC FERC No. 13739 WESTMONT, IL		
DATE: JUNE 2012	SCALE: AS NOTED	APPROVED:

FERC NO. 13739-