

**SUMMARY OF UPSTREAM AND DOWNSTREAM  
FISH PASSAGE AT THE  
YORK HAVEN HYDROELECTRIC PROJECT  
IN 2016**

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## EXECUTIVE SUMMARY

The fish ladder was opened on 1 April allowing volitional (unmanned) passage for 31 days prior to initiating manned Fishway operation. In 2016, the Fishway was manned on a total of 40 days between 2 May and 10 June. After manned operation ended on 10 June, the fish ladder and North fixed wheel gate were set to deliver a minimum flow of 400 cfs into the East Channel. Permission was granted to close the facility on 14 December. Fishway closure was scheduled for later in the month.

During manned Fishway operation some 61,223 fish of 16 taxa and one hybrid were enumerated as they passed upstream into Lake Frederic. Gizzard shad (52,646) was the dominant fish species passed and comprised over 85.9% of the fish passed. Some 178 American shad were counted as they passed through the ladder. Other predominant fishes passed included shorthead redhorse (3,211), channel catfish (1,564), quillback (1,141), carp (1,010), smallmouth bass (778) and walleye (611). Passage varied daily and ranged from 3,882 fish on 4 May when 6.3% of the season total was passed to 499 fish on 24 May.

A total of 178 American shad passed upstream through the ladder in 2016. American shad passed upstream between 3 and 18 May. American shad were collected and passed at water temperatures of 54.5°F to 61.0°F, River flows of 26,300 cfs to 51,000 cfs and East Channel flows of 2,000 cfs to 4,600 cfs. Some 116 shad (65%) passed before 1200 hrs. A total of 47 shad (26.4%) passed between 0800 hrs and 0859 hrs. Hourly passage varied from one to 11 shad.

Downstream passage of adult American shad was expected to occur from 1 May to 30 June. The forebay Sluice Gate was generally opened as required in May. However, by June, River flows had fallen off and there was insufficient water available to open the Sluice Gate. Although River flow was limited in June, the Sluice Gate was routinely opened for several hours on Monday and Friday mornings to sluice debris. No physical observations of post-spawned adult American shad were noted by Station personnel.

The forebay Sluice Gate was opened daily from 1 October to 30 November to provide downstream passage of juvenile shad. Sunday through Thursday the Sluice Gate was generally opened between 2:30 PM and 3:30 PM and closed the following morning, after debris had been sluiced. On Friday and Saturday, the Sluice Gate was opened in the afternoon and closed each night allowing angler access.

During the fall juvenile shad outmigration period, River flow remained relatively stable between 1 and 22 October before increasing to 47,300 cfs on 24 October. River flows dropped off to 20,300 cfs by 29 October. This decline was followed by a slight increase in flow on 31 October to 26,400 cfs on 31 October when flows declined steadily to 8,410 cfs on 26 November. Flows increased slightly to 10,800 cfs before the downstream passage season ended on 31 November. Average daily water temperature during the fall downstream migration period (1 October to 31 November) dropped over 18 degrees and ranged from a high of 62.5°F to a low of 43.9°F.

## 1.0 INTRODUCTION

In 1993, York Haven Power Company (YHPC), the licensees of the Safe Harbor and Holtwood Projects, the U.S. Department of the Interior represented by the Fish and Wildlife Service (“USFWS”), the Susquehanna River Basin Commission (“SRBC”), the states of Maryland and Pennsylvania and their involved agencies – Maryland Department of Natural Resources (“MDNR”), Pennsylvania Fish and Boat Commission (“PFBC”) and Pennsylvania Department of Environmental Resources (“PADEP”), and two other parties signed the Susquehanna River Fish Passage Settlement Agreement.

This agreement established for each project a Fish Passage Technical Advisory Committee (“FPTAC”) comprised of representatives of the affected licensee, USFWS, PFBC and MDNR. Each FPTAC is responsible for reviewing and monitoring the design, construction, maintenance and operation of the fish passage facilities at the respective project, preparing an annual report, and recommending studies and/or modifications to improve upstream and downstream passage. As in previous years, objectives of 2016 operation were to monitor passage of migratory and resident fishes through the Fishway during the spring migration and continue to assess operation. The FPTAC meet on March 22, 2016 to discuss Fishway operation. In addition, The USFWS met with Station personnel and the Fishway operator on 4 May to conduct an inspection of the Fishway.

## 2.0 YORK HAVEN FISHWAY OPERATIONS

The installation and operation of the Fishway are part of a cooperative private, state and federal effort to restore American shad (*Alosa sapidissima*) and other migratory fish to the Susquehanna River. In 1997, YHPC and the resource agencies reached a new settlement agreement to revise the type and location of the York Haven fish passage facility. The Fishway is located in Dauphin County, PA at the Three Mile Island end of the East Channel Dam at the York Haven Hydroelectric Project (FERC No. 1888). The Fishway was placed in service by YHPC in April 2000. Upstream and downstream Fishway operation is provided for in the Projects new FERC License (FERC, 2015) and the Pennsylvania Department of Environmental Protection Water Quality Certification (PA DEP, 2014) issued on December 15, 2015 and 19 August 2014, respectively.

Fishway operation coincides with a springtime minimum flow release. As part of the 1997 agreement and in accordance with its new License and Water Quality Certification, YHP agreed to maintain a spill of up to 4,000 cfs over the Main Dam and a minimum release of approximately 2,000 cfs in the East Channel through the Fishway during spring operation. River flow in excess of spring minimum flow requirements and station capacity is spilled over the Main and East Channel Dams and through the Fishway. A nominal 2,000 cfs East Channel minimum flow is released through the fishway 24 hrs a day during the entire Fishway operating season. When River flows are less than 23,000 cfs, a nominal minimum spill of 4,000 cfs is maintained over the Main Dam during daily Fishway operation by reducing the number of Units in operation.

### 2.1 Project Operation

The hydroelectric station located in York Haven, PA built in 1904, is situated on the River (river mile 55) in Dauphin and York counties, Pennsylvania (Figure 1). It is the fourth upstream hydroelectric facility on the River. The Project is a 20 unit run-of-river facility capable of producing approximately 19 MW and has an estimated hydraulic capacity of 17,000 cfs. It includes two dams that impound approximately 5 miles of the River forming Lake Frederic. The Main Dam is approximately 5,000-ft long, with a maximum height of 17-ft. The East Channel Dam is approximately 925-ft long with a maximum height of 9-ft. When River flow exceeds station hydraulic capacity (55% of the year), water is spilled over the two dams.

## **2.2 Fishway Design and Operation**

### **2.2.1 Fishway Design**

Fishway design incorporated numerous criteria established by the USFWS and the other resource agencies. The Fishway has an operating limit of 150,000 cfs River flow (East Channel flow limit of approximately 22,000 cfs). The Fishway includes two sections; a “weir cut” and a vertical notch fish ladder. Figure 2 provides the general arrangement of the Fishway. A detailed description of the Fishway and its major components is located in 2000 and 2001 summary reports (Kleinschmidt 2000 & 2002).

### **2.2.2 Fishway Operation**

Fishway preparations began in early March and volitional passage (unmanned) began on 1 April. Only the entrance and exit gate were open during a 31-day unmanned period of Fishway operation between 1 April and 1 May.

Manned Fishway operation, commenced on Monday 2 May, 4 days after the Safe Harbor Fish Lift had passed 1,225 American shad. In 2016, the Fishway was manned on a total of 40 days between 2 May and 10 June. Fish were counted and allowed to pass upstream between 0800 hrs and 1600 hrs. Given that no shad were observed passing the ladder since 19 May a 23 day period, manned Fishway operation ended at 1600 hrs on 10 June, the same day that the Safe Harbor fish lift was shut down for the 2016 season.

Between 2 May and 10 June both fixed wheel gates and the diffuser gate were opened. These gates remained opened throughout the spawning migration. The entrance gate was the only gate that was adjusted throughout the season. This gate was adjusted manually maintaining a 0.4-ft to 1.0-ft differential between the surface water elevation downstream of the entrance and the water elevation in the diffuser area of the fish ladder. This range of settings resulted in an average velocity of 4 ft/sec to 9.0 ft/sec at the entrance to the ladder. The 7-ft wide stop gate, located between the weir and the fish ladder entrance, remained closed during the entire period of operation.

Excluding the first and last day of manned operation, the Fishway was typically staffed by one person. This person, a biologist or technician, adjusted the position of the entrance gate, counted and recorded the number of fish that passed through the ladder hourly, removed debris from the exit of the ladder, made visual observations of fish activity and movement in and through the ladder, and made observations once each day below the Main Dam. These individuals also recorded water elevations several times each day on staff gauges located throughout the Fishway.

After manned Fishway operation ended on 10 June, the South fixed wheel gate was closed and the North fixed wheel gate and ladder were set to deliver a minimum flow of 400 cfs into the East Channel. The Fishway was set to deliver a minimum stream flow of at least 400 cfs to the East Channel. Permission was granted to close the facility on 14 December. The closure was scheduled for later in the month, but the final closure date was unknown by the due date of the annual report.

## **2.3 Fish Counts**

Fish that passed through the ladder were identified to species and enumerated as they passed the counting window by a biologist and/or technician. A description of the procedures used to count fish is described in prior annual operating reports (Kleinschmidt 2000 and 2002). Fish passage by the viewing window was controlled by opening or closing an aluminum grating gate with an electric hoist that was controlled from inside the viewing room. The stop gate was opened each morning at 0800 hrs and closed nightly at 1600 hrs when the Fishway was manned. Occasionally, it was closed for brief periods of time as needed each day to enable personnel manning the Fishway to remove debris from screens and the fishway exit other conduct other activities. In addition, in an effort to improve viewing, the adjustable crowder screen was adjusted

as needed to allow all fish that passed to be observed. Gate settings on the days the Fishway was manned varied from 20 to 24 inches.

As in previous seasons, fish passage data was entered on a field data sheet and uploaded into a computer. Files were uploaded each evening, checked and corrected as necessary. Data reporting was PC-based and accomplished by program scripts, or macros, created within Microsoft Excel spreadsheets. Passage data and operational conditions were supplied electronically to YHPC's on-site coordinator/manager and other appropriate YHPC personnel on a daily basis. Passage information was subsequently provided electronically by YHPC personnel to members of the FPTAC.

## **2.4 Results**

### **2.4.1 Spring Fishway Operation**

#### **2.4.1.1 Relative Abundance**

The number of fish that passed through the York Haven fish ladder is presented in Table 1. Some 61,223 fish of 16 taxa and one hybrid (Striped bass hybrid) were enumerated as they passed upstream into Lake Frederic. Gizzard shad (52,646) was the dominant fish species passed and comprised over 85.9% of the fish passed. Some 178 American shad were counted as they passed through the ladder. Other predominant fishes passed included shorthead redhorse (3,211), channel catfish (1,564), quillback (1,141), carp (1,010), smallmouth bass (778) and walleye (611). Passage varied daily and ranged from 3,882 fish on 4 May when 6.3% of the season total was passed to 499 fish on 24 May.

The USF&WS scheduled a site visit on 4 May and the fishway engineer determined that the Fishway was being operated as designed and no operational issues were noted.

#### **2.4.1.2 American Shad Passage**

A total of 178 American shad passed upstream through the ladder in 2016. American shad passed upstream between 3 and 18 May. American shad were collected and passed at water temperatures of 54.5°F to 61.0°F, River flows of 26,300 cfs to 51,000 cfs and East Channel flows of 2,000 cfs to 4,600 cfs (Tables 2 and 3, Figures 3 and 4).

The hourly passage of American shad through the fish ladder is given in Table 4. A total of 116 shad (65%) passed before 1200 hrs. Some 47 shad (26.4%) passed between 0800 hrs and 0859 hrs. The hourly passage varied from one to eleven shad.

#### **2.4.1.3 Other Alosids**

No other alosids (alewife, blueback herring and hickory shad) were observed passing through the ladder (Table 1).

#### **2.4.1.4 Observations**

Observations were made at the "weir cut" occasionally each day in an attempt to see if American shad or other fishes passed upstream through this section of the Fishway. On several occasions gizzard shad, carp, and quillback shad were observed trying to swim over the 67 ft. weir. However, no fish were observed trying to swim through the fixed wheel gates.

## **3.0 DOWNSTREAM FISH PASSAGE**

The Projects recently issued FERC license and new Water Quality Certification provide for downstream passage of adult and juvenile shad. Downstream passage of adult shad is expected to occur from 1 May to 30 June while downstream passage of juvenile shad is anticipated to occur from 1 October through 30 November.

### **3.1 Adult Passage**

Downstream passage of adult shad was expected to occur from 1 May to 30 June. When River flows exceed the sum of Project Hydraulic Capacity, and required flows through the East Channel and required flows (if any) over the Main Dam, the Project, according to its FERC License and 401 Water Quality Certification, the Station is to open and spill water via the forebay Sluice Gate (~370 cfs) to the extent practicable for a period of one to two hours during the morning on weekdays, subject to Project personnel availability and access requirements for operations and maintenance purposes. Spilling may be provided in connection with opening of Forebay Sluice Gate for purposes of passing debris.

The Sluice Gate was generally opened as required in May. However, by June, River flows had fallen off and there was insufficient water available to open the Sluice Gate. Although River flow was limited in June, the Sluice Gate was routinely opened for several hours on Monday and Friday mornings to sluice debris. No physical observations of post-spawned adult American shad were noted by Station personnel.

### **3.2 Juvenile Passage**

During the juvenile American shad Passage Period (JASPP), 1 October to 30 November, the Project is to operate its turbines in the following order. Depending on available River flow, Unit 1-6 (Propeller Units) may be operated without restriction up to available River flow, Unit 14 (larger single Francis Unit) may be operated if River flows exceeds capacity of Units 1-6 Units and Units 7-13 and 15-20 (double Francis Units may be operated in ascending order if river flows exceeds capacity of Units 1-6 and Unit 14 during the JASPP, During the downstream juvenile passage period, the Station is to open and spill water via the Forebay Sluice Gate (~370 cfs) between the hours of 5 PM to 11 PM EST. If during the downstream passage period, River flow exceeds the sum of Project hydraulic capacity, required flows through the East Channel and required flows (if any), the Project is also to open and spill water via the Forebay Sluice Gate to the extent practicable for one to two hours during the morning, subject to Project access requirements for operations and maintenance purposes.

In accordance with the Projects new FERC License and 401 Water Quality Certification, the Sluice Gate was opened daily from 1 October to 30 November. Sunday through Thursday the sluice gate was generally opened between 2:30 PM and 3:30 PM and closed the following morning, following sluicing of debris. On Friday and Saturday, the forebay Sluice Gate was opened in the afternoon and closed each night allowing angler access as inquiries were made by PFBC personnel regarding angler complaints associated with the loss of access to fish in the tailrace that resulted from spills from the Sluice Gate to pass juvenile shad outmigrants.

During the fall juvenile shad outmigration period, River flow remained relatively stable between 1 and 22 October before to increasing to 47,300 cfs on 24 October. River flows dropped off to 20,300 cfs by 29 October. This decline was followed by a slight increase in flow on 31 October to 26,400 cfs on 31 October when flows declined steadily to 8,410 cfs on 26 November. Flows increased slightly to 10,800 cfs before the downstream passage season ended on 31 November. Average daily water temperature during the fall downstream migration period (1 October to 31 November) dropped over 18 degrees and ranged from a high of 62.5°F to a low of 43.9°F.

#### **4.0 LITERATURE CITED**

Commonwealth of Pennsylvania Department of Environmental Protection. August 19, 2014, Water Quality Certification for the York Haven Hydroelectric Project and Related Mitigation, DEP File N0. –EA67-023: York Haven Power Company, LLC, 65 pp.

Federal Energy Regulatory Commission, December 15, 2015. Order Issuing New License for York Haven Power Company, LLC. 135 pp.

Kleinschmidt. 2000. Summary of operation at the York Haven Fishway in 2000. Prepared for York Haven Power Company, GPU Energy by Kleinschmidt, Strasburg, Pennsylvania. 21 pp.

Kleinschmidt. 2002. Summary of operation at the York Haven Fishway in 2001. Prepared for York Haven Power Company, GPU Energy/FirstEnergy by Kleinschmidt, Strasburg, Pennsylvania. 21 pp.



## **TABLES**

**Table 1. Summary of the daily number of fish that passed by the York Haven Hydroelectric Project through the serpentine vertical notch ladder at the East Channel Dam in 2016.**

Date	2-May	3-May	4-May	5-May	6-May	7-May	8-May	9-May	10-May	11-May
Observation Time (hrs.)	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (°F)	55.0	57.0	56.5	57.0	55.5	55.0	56.5	58.5	56.0	54.5
AMERICAN SHAD	0	18	25	19	4	5	28	30	11	12
ALEWIFE	0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	721	725	3,253	1,777	2,181	2,684	2,238	2,541	2,340	2,242
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	0	0	2	1	0	1	0	0	0
WHITE PERCH	0	0	0	0	0	0	0	0	0	0
AMERICAN EEL	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	0	0	0	0	1	0	0	0
MUSKELLUNGE	0	0	0	0	0	0	1	0	0	0
CARP	13	153	50	49	11	6	24	39	15	23
QUILLBACK	8	132	77	63	54	22	59	88	34	46
WHITE SUCKER	1	0	1	0	0	0	0	0	1	0
SHORTHEAD. REDHORSE	14	193	310	84	162	212	346	215	111	371
CHANNEL CATFISH	0	29	91	73	33	48	92	40	27	38
REDBREAST SUNFISH	0	0	0	0	0	0	0	0	0	0
SMALLMOUTH BASS	8	45	40	37	16	0	16	27	17	32
WALLEYE	3	60	35	29	26	6	24	13	19	37
RIVER CHUB	0	0	0	0	0	0	0	0	0	0
NORTHERN HOG SUCKER	2	0	0	0	0	0	0	0	0	0
FLATHEAD CATFISH	0	0	0	0	0	0	0	0	0	0
STRIPED BASS HYBRID	3	0	0	1	3	1	0	0	0	0
<b>Total</b>	<b>773</b>	<b>1,355</b>	<b>3,882</b>	<b>2,134</b>	<b>2,491</b>	<b>2,984</b>	<b>2,830</b>	<b>2,993</b>	<b>2,575</b>	<b>2,801</b>

Table 1. (continued)

Date	12-May	13-May	14-May	15-May	16-May	17-May	18-May	19-May	20-May	21-May
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (°F)	58.0	60.0	61.0	58.0	58.0	59.0	58.5	61.0	64.0	62.0
<b>AMERICAN SHAD</b>	4	8	2	8	2	0	2	0	0	0
<b>ALEWIFE</b>	0	0	0	0	0	0	0	0	0	0
<b>BLUEBACK HERRING</b>	0	0	0	0	0	0	0	0	0	0
<b>GIZZARD SHAD</b>	1,772	784	1,241	846	900	590	1,663	2,296	1,461	773
<b>HICKORY SHAD</b>	0	0	0	0	0	0	0	0	0	0
<b>STRIPED BASS</b>	0	0	0	0	0	0	0	0	0	0
<b>WHITE PERCH</b>	0	0	0	0	0	0	0	0	0	0
<b>AMERICAN EEL</b>	0	0	0	0	0	0	0	0	0	0
<b>BROWN TROUT</b>	0	0	0	1	0	0	0	0	0	0
<b>MUSKELLUNGE</b>	0	1	0	0	0	0	0	0	0	0
<b>CARP</b>	14	18	30	7	8	11	0	22	28	48
<b>QUILLBACK</b>	20	68	54	52	21	17	11	43	18	17
<b>WHITE SUCKER</b>	1	0	1	0	0	0	0	0	1	0
<b>SHORthead. REDHORSE</b>	219	346	187	120	23	32	68	69	62	12
<b>CHANNEL CATFISH</b>	24	76	76	34	8	11	10	106	104	31
<b>REDBREAST SUNFISH</b>	0	0	0	0	0	0	0	0	0	0
<b>SMALLMOUTH BASS</b>	56	87	44	25	6	11	6	30	44	26
<b>WALLEYE</b>	22	94	64	25	7	18	17	25	18	20
<b>RIVER CHUB</b>	0	0	0	0	0	0	0	0	0	0
<b>NORTHERN HOG SUCKER</b>	0	0	0	0	0	0	0	0	0	0
<b>FLATHEAD CATFISH</b>	0	0	0	0	0	0	0	0	0	0
<b>STRIPED BASS HYBRID</b>	1	1	1	0	0	0	0	0	0	0
<b>Total</b>	<b>2,133</b>	<b>1,483</b>	<b>1,700</b>	<b>1,118</b>	<b>975</b>	<b>690</b>	<b>1,777</b>	<b>2,591</b>	<b>1,736</b>	<b>927</b>

Table 1. (continued)

Date	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (°F)	63.0	63.5	65.0	68.0	71.0	74.0	75.5	77.0	79.5	79.5
AMERICAN SHAD	0	0	0	0	0	0	0	0	0	0
ALEWIFE	0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	703	496	418	901	1,282	1,207	1,284	1,374	1,572	811
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	0	0	0	0	0	0	0	0	0
WHITE PERCH	0	0	0	0	0	0	0	0	0	0
AMERICAN EEL	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	0	0	0	0	0	0	0	0
MUSKELLUNGE	0	0	0	0	0	0	0	0	0	0
CARP	18	3	15	11	19	39	20	57	23	29
QUILLBACK	13	10	13	8	11	40	33	30	25	19
WHITE SUCKER	2	0	0	0	2	0	3	0	11	3
SHORTHEAD. REDHORSE	30	15	4	1	2	1	2	0	0	0
CHANNEL CATFISH	23	9	28	24	33	36	30	22	26	44
REDBREAST SUNFISH	0	0	0	1	0	0	0	0	0	0
SMALLMOUTH BASS	5	8	8	16	13	12	19	16	14	17
WALLEYE	11	10	13	7	1	0	6	0	0	1
RIVER CHUB	0	0	0	0	0	0	0	0	0	5
NORTHERN HOG SUCKER	0	0	0	0	0	0	0	0	0	0
FLATHEAD CATFISH	0	0	0	0	1	0	0	0	0	0
STRIPED BASS HYBRID	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>805</b>	<b>551</b>	<b>499</b>	<b>969</b>	<b>1,364</b>	<b>1,335</b>	<b>1,397</b>	<b>1,499</b>	<b>1,671</b>	<b>929</b>

Table 1. (continued)

Date	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun	10-Jun	Total
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	312
Water Temperature (°F)	79.5	78.5	77.0	76.5	77.5	78.0	77.5	74.0	70.0	68.5	
AMERICAN SHAD	0	0	0	0	0	0	0	0	0	0	178
ALEWIFE	0	0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING	0	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	1,101	736	820	972	1,008	762	805	1,037	1,168	1,161	52,646
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	0	0	0	0	0	0	0	0	0	4
WHITE PERCH	0	0	0	0	0	0	0	0	0	0	0
AMERICAN EEL	0	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	0	0	0	0	0	0	0	0	2
MUSKELLUNGE	0	0	0	0	0	0	0	0	0	0	2
CARP	60	24	14	10	6	18	32	17	11	15	1,010
QUILLBACK	7	5	8	0	5	2	3	5	0	0	1,141
WHITE SUCKER	0	0	0	0	0	0	0	0	0	0	27
SHORthead. REDHORSE	0	0	0	0	0	0	0	0	0	0	3,211
CHANNEL CATFISH	21	34	31	39	40	50	56	26	20	21	1,564
REDBREAST SUNFISH	0	0	0	0	0	0	0	0	0	0	1
SMALLMOUTH BASS	15	8	4	10	8	5	8	5	5	9	778
WALLEYE	0	0	0	0	0	0	0	0	0	0	611
RIVER CHUB	0	0	0	0	0	0	0	0	0	0	5
NORTHERN HOG SUCKER	0	0	0	0	0	0	0	0	0	0	2
FLATHEAD CATFISH	0	2	2	3	0	4	4	3	4	7	30
STRIPED BASS HYBRID	0	0	0	0	0	0	0	0	0	0	11
<b>Total</b>	<b>1,204</b>	<b>809</b>	<b>879</b>	<b>1,034</b>	<b>1,067</b>	<b>841</b>	<b>908</b>	<b>1,093</b>	<b>1,208</b>	<b>1,213</b>	<b>61,223</b>

**Table 2. Summary of daily average river flow (USGS, Harrisburg Gage), average flow in the East channel, sum of average flow from power station and main dam, water temperature, secchi, stop log gate position, and East channel and fishway water elevations during operation of the York Haven fishway complex in 2016.**

Date	River Flow (cfs)	East Channel Flow (cfs)	Main Channel Flow (cfs)	Water Temp. (°F)	Secchi (in)			Stop log Gate	Elevation (ft)					
					Avg.	Min.	Max.		Head Pond			Tailwater		
								Avg.	Min.	Max.	Avg	Min.	Max.	
2-May	22,100	2,025	20,075	55.0	24	24	24	Closed	278.5	278.4	278.5	273.4	273.4	273.4
3-May	26,300	2,150	24,150	57.0	24	24	24	Closed	278.9	278.9	278.9	273.5	273.5	273.5
4-May	39,500	2,250	37,250	56.5	24	24	24	Closed	279.2	279.1	279.4	274.0	273.8	274.2
5-May	50,200	4,600	45,600	57.0	20	20	20	Closed	280.0	280.0	280.1	274.9	274.8	274.9
6-May	51,000	4,600	46,400	55.5	20	20	20	Closed	280.0	280.0	280.0	275.0	274.9	275.0
7-May	49,900	4,600	45,300	55.0	24	24	24	Closed	280.0	280.0	280.0	275.0	275.0	275.0
8-May	49,600	4,600	45,000	56.5	21	21	21	Closed	280.0	280.0	280.0	275.0	275.0	275.0
9-May	47,700	4,500	43,200	58.5	24	24	24	Closed	279.9	279.9	279.9	274.9	274.8	274.9
10-May	44,300	4,200	40,100	56.0	24	24	24	Closed	279.9	279.8	279.9	274.8	274.7	274.8
11-May	39,400	4,000	35,400	54.5	24	24	24	Closed	279.7	279.7	279.7	274.4	274.4	274.4
12-May	35,200	3,200	32,000	58.0	24	24	24	Closed	279.4	279.4	279.4	274.1	274.1	274.2
13-May	32,500	3,000	29,500	60.0	24	24	24	Closed	279.3	279.3	279.3	274.0	273.9	274.0
14-May	30,900	2,750	28,150	61.0	24	24	24	Closed	279.2	279.2	279.2	273.8	273.8	273.8
15-May	30,400	2,750	27,650	58.0	24	24	24	Closed	279.2	279.2	279.2	273.8	273.8	273.8
16-May	30,700	2,750	27,950	58.0	24	24	24	Closed	279.2	279.2	279.2	273.8	273.8	274.6
17-May	30,800	2,750	28,050	59.0	24	24	24	Closed	279.2	279.1	279.2	273.8	273.8	273.8
18-May	29,400	2,500	26,900	58.5	24	24	24	Closed	279.1	279.1	279.1	273.7	273.7	273.7
19-May	27,500	2,500	25,000	61.0	24	24	24	Closed	279.0	279.0	279.0	273.7	273.7	273.7
20-May	25,100	2,150	22,950	64.0	24	24	24	Closed	278.9	278.9	278.9	273.5	273.5	273.6
21-May	23,400	2,150	21,250	62.0	24	24	24	Closed	278.9	278.9	278.9	273.3	273.3	273.3
22-May	22,400	2,050	20,350	63.0	24	24	24	Closed	278.6	278.6	278.6	273.4	273.4	273.4
23-May	24,900	2,075	22,825	63.5	24	24	24	Closed	278.7	278.7	278.7	273.4	273.4	273.4
24-May	30,400	2,750	27,650	65.0	24	24	24	Closed	279.1	279.1	279.1	273.8	273.8	273.8
25-May	32,900	3,000	29,900	68.0	24	24	24	Closed	279.3	279.3	279.3	273.9	273.8	273.9
26-May	30,200	3,000	27,200	71.0	24	24	24	Closed	279.3	279.3	279.3	273.9	273.9	273.9

Date	River Flow (cfs)	East Channel Flow (cfs)	Main Channel Flow (cfs)	Water Temp. (°F)	Secchi (in)			Stop log Gate	Elevation (ft)			Tailwater		
					Avg.	Min.	Max.		Avg.	Min.	Max.	Avg.	Min.	Max.
27-May	27,200	2,200	25,000	74.0	24	24	24	Closed	279.0	279.0	279.0	273.8	273.8	273.8
28-May	24,400	2,200	22,200	75.5	24	24	24	Closed	279.0	279.0	279.0	273.6	273.6	273.6
29-May	22,200	2,200	20,000	77.0	24	24	24	Closed	279.0	279.0	279.0	273.4	273.4	273.4
30-May	20,700	2,025	18,675	79.5	24	24	24	Closed	278.5	278.5	278.6	273.6	273.6	273.6
31-May	19,200	2,010	17,190	79.5	24	24	24	Closed	278.4	278.3	278.4	273.4	273.4	273.4
1-Jun	17,300	2,010	15,290	79.5	24	24	24	Closed	278.3	278.3	278.3	273.4	273.4	273.4
2-Jun	16,000	2,010	13,990	78.5	24	24	24	Closed	278.3	278.3	278.3	273.4	273.4	273.4
3-Jun	15,300	2,010	13,290	77.0	24	24	24	Closed	278.3	278.3	278.3	273.4	273.4	273.4
4-Jun	15,000	2,000	13,000	76.5	24	24	24	Closed	278.2	278.2	278.2	273.4	273.4	273.4
5-Jun	15,700	2,000	13,700	77.5	24	24	24	Closed	278.2	278.2	278.2	273.3	273.3	273.3
6-Jun	18,400	2,000	16,400	78.0	24	24	24	Closed	278.5	278.5	278.5	273.4	273.4	273.4
7-Jun	20,700	2,010	18,690	77.5	24	24	24	Closed	278.4	278.4	278.4	273.4	273.4	273.4
8-Jun	22,200	2,025	20,175	74.0	24	24	24	Closed	278.5	278.5	278.5	273.4	273.4	273.4
9-Jun	21,500	2,050	19,450	70.0	24	24	24	Closed	278.4	278.4	278.4	273.4	273.4	273.4
10-Jun	21,800	2,050	19,750	68.5	24	24	24	Closed	278.4	278.4	278.4	273.4	273.4	273.4

**Table 3. Summary of surface water elevations recorded during operation of the York Haven Fishway in 2016.**

Date	River Flow (cfs)	Elevation (ft)																				
		Head Pond			Tailwater			Inside Fishway			Inside Weir			Above Counting Room			Below Fixed Wheel Gate			Counting Room		
		Avg.	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.
2-May	22,100	278.5	278.4	278.5	273.4	273.4	273.4	274.4	274.4	274.4	277.2	277.2	277.2	278.2	278.1	278.2	277.1	277.0	277.2	278.1	278.0	278.1
3-May	26,300	278.9	278.9	278.9	273.5	273.5	273.5	274.4	274.4	274.4	277.4	277.4	277.4	278.4	278.4	278.4	277.2	277.2	277.2	278.3	278.3	278.3
4-May	39,500	279.2	279.1	279.4	274.0	273.8	274.2	274.8	274.7	274.8	277.8	277.7	277.8	279.0	278.9	279.2	277.6	277.5	277.7	278.9	278.7	279.1
5-May	50,200	280.0	280.0	280.1	274.9	274.8	274.9	275.5	275.3	275.6	278.1	278.1	278.2	279.7	279.6	279.8	277.8	277.8	277.9	279.6	279.5	279.7
6-May	51,000	280.0	280.0	280.0	275.0	274.9	275.0	275.7	275.7	275.7	278.2	278.2	278.2	279.8	279.8	279.8	277.8	277.8	277.8	279.6	279.6	279.6
7-May	49,900	280.0	280.0	280.0	275.0	275.0	275.0	275.7	275.6	275.7	278.1	278.0	278.2	279.7	279.7	279.8	277.8	277.7	277.9	279.6	279.6	279.7
8-May	49,600	280.0	280.0	280.0	275.0	275.0	275.0	275.6	275.6	275.7	278.1	278.1	278.2	279.7	279.7	279.7	277.8	277.7	277.8	279.6	279.6	279.7
9-May	47,700	279.9	279.9	279.9	274.9	274.8	274.9	275.6	275.5	275.6	278.1	278.1	278.1	279.7	279.7	279.7	277.8	277.8	277.9	279.6	279.6	279.6
10-May	44,300	279.9	279.8	279.9	274.8	274.7	274.8	275.4	275.3	275.4	278.0	277.9	278.0	279.6	279.6	279.6	277.7	277.7	277.7	279.5	279.5	279.5
11-May	39,400	279.7	279.7	279.7	274.4	274.4	274.4	275.2	275.2	275.2	277.9	277.9	277.9	279.4	279.4	279.4	277.6	277.6	277.6	279.3	279.3	279.3
12-May	35,200	279.4	279.4	279.4	274.1	274.1	274.2	275.0	274.9	275.1	277.8	277.8	277.9	279.2	279.2	279.2	279.4	279.4	279.4	279.1	279.1	279.1
13-May	32,500	279.3	279.3	279.3	274.0	273.9	274.0	274.7	274.7	274.8	277.8	277.7	277.8	279.1	279.1	279.1	277.4	277.4	277.4	278.9	278.9	279.1
14-May	30,900	279.2	279.2	279.2	273.8	273.8	273.8	274.6	274.6	274.6	277.8	277.7	277.8	279.0	279.0	279.0	277.4	277.4	277.4	278.8	278.8	278.8
15-May	30,400	279.2	279.2	279.2	273.8	273.8	273.8	274.6	274.6	274.6	277.6	277.6	277.6	279.0	279.0	279.0	277.5	277.5	277.5	278.9	278.9	278.9
16-May	30,700	279.2	279.2	279.2	273.8	273.8	274.6	274.6	274.6	274.6	277.6	277.6	277.6	279.0	279.0	279.0	277.4	277.4	277.4	278.9	278.9	278.9
17-May	30,800	279.2	279.1	279.2	273.8	273.8	273.8	274.6	274.6	274.6	277.7	277.7	277.7	279.0	278.9	279.0	277.5	277.5	277.5	278.8	278.8	278.8
18-May	29,400	279.1	279.1	279.1	273.7	273.7	273.7	274.5	274.5	274.6	277.6	277.5	277.6	278.9	278.9	278.9	277.4	277.4	277.4	278.8	278.8	278.8
19-May	27,500	279.0	279.0	279.0	273.7	273.7	273.7	274.5	274.6	274.6	277.6	277.6	277.6	278.8	278.8	278.9	277.4	277.4	277.4	278.7	278.7	278.8
20-May	25,100	278.9	278.9	278.9	273.5	273.5	273.6	274.2	274.2	274.3	277.4	277.4	277.4	278.7	278.7	278.7	277.4	277.4	277.4	278.6	278.6	278.6
21-May	23,400	278.9	278.9	278.9	273.3	273.3	273.3	274.2	274.2	274.2	277.3	277.3	277.3	278.6	278.6	278.6	277.1	277.1	277.1	278.4	278.4	278.4
22-May	22,400	278.6	278.6	278.6	273.4	273.4	273.4	274.1	274.1	274.1	277.3	277.3	277.3	278.4	278.4	278.4	277.3	277.3	277.3	278.3	278.3	278.3
23-May	24,900	278.7	278.7	278.7	273.4	273.4	273.4	274.1	274.1	274.1	277.4	277.4	277.4	278.5	278.5	278.5	277.2	277.2	277.2	278.4	278.4	278.4
24-May	30,400	279.1	279.1	279.1	273.8	273.8	273.8	274.5	274.5	274.5	277.6	277.6	277.6	278.9	278.9	278.9	277.4	277.4	277.4	278.8	278.7	278.8
25-May	32,900	279.3	279.3	279.3	273.9	273.8	273.9	274.6	274.6	274.6	277.7	277.7	277.7	279.0	279.0	279.1	277.5	277.5	277.5	278.9	278.9	278.9
26-May	30,200	279.3	279.3	279.3	273.9	273.9	273.9	274.5	274.5	274.5	277.6	277.6	277.6	279.0	279.0	279.0	277.4	277.4	277.4	278.9	278.9	278.9
27-May	27,200	279.0	279.0	279.0	273.8	273.8	273.8	274.4	274.4	274.4	277.6	277.6	277.6	278.8	278.8	278.8	277.4	277.4	277.4	278.7	278.7	278.7
28-May	24,400	279.0	279.0	279.0	273.6	273.6	273.6	274.2	274.2	274.2	277.4	277.4	277.4	278.8	278.8	278.8	277.4	277.4	277.4	278.5	278.5	278.8
29-May	22,200	279.0	279.0	279.0	273.4	273.4	273.4	274.2	274.2	274.2	277.3	277.3	277.3	278.6	278.4	278.9	277.6	277.6	277.6	278.4	278.2	278.6
30-May	20,700	278.5	278.5	278.6	273.6	273.6	273.6	274.0	274.0	274.0	277.4	277.4	277.4	278.3	278.3	278.4	277.3	277.3	277.3	278.2	278.2	278.4
31-May	19,200	278.4	278.3	278.4	273.4	273.4	273.4	274.1	274.1	274.1	277.4	277.3	277.4	278.2	278.1	278.2	277.3	277.3	277.3	278.1	278.0	278.1
1-Jun	17,300	278.3	278.3	278.3	273.4	273.4	273.4	274.1	274.1	274.1	277.2	277.2	277.2	278.0	278.0	278.0	277.0	277.0	277.0	277.9	277.9	277.9
2-Jun	16,000	278.3	278.3	278.3	273.4	273.4	273.4	274.1	274.1	274.1	277.2	277.2	277.2	278.0	278.0	278.0	277.0	277.0	277.0	277.8	277.8	277.8
3-Jun	15,300	278.3	278.3	278.3	273.4	273.4	273.4	274.0	274.0	274.0	277.1	277.1	277.1	278.0	278.0	278.0	277.1	277.1	277.1	277.9	277.9	277.9
4-Jun	15,000	278.2	278.2	278.2	273.4	273.4	273.4	274.2	274.2	274.2	277.1	277.1	277.1	278.0	278.0	278.0	277.2	277.2	277.2	277.7	277.7	278.0
5-Jun	15,700	278.2	278.2	278.2	273.3	273.3	273.3	273.9	273.9	273.9	277.1	277.1	277.1	277.8	277.8	277.8	277.0	277.0	277.0	277.7	277.7	277.7
6-Jun	18,400	278.5	278.5	278.5	273.4	273.4	273.4	274.1	274.1	274.1	277.3	277.3	277.3	278.3	278.3	278.3	277.2	277.2	277.2	278.2	278.2	278.2
7-Jun	20,700	278.4	278.4	278.4	273.4	273.4	273.4	274.0	274.0	274.0	277.3	277.3	277.3	278.1	278.1	278.1	277.2	277.2	277.2	278.0	278.0	278.0
8-Jun	22,200	278.5	278.5	278.5	273.4	273.4	273.4	274.0	274.0	274.0	277.3	277.3	277.3	278.3	278.3	278.3	277.3	277.3	277.3	278.2	278.2	278.2
9-Jun	21,500	278.4	278.4	278.4	273.4	273.4	273.4	274.0	274.0	274.0	277.3	277.3	277.3	278.2	278.2	278.2	277.2	277.2	277.2	278.1	278.1	278.1
10-Jun	21,800	278.4	278.4	278.4	273.4	273.4	273.4	274.0	274.0	274.0	277.3	277.3	277.3	278.2	278.2	278.2	277.2	277.2	277.2	278.1	278.1	278.1



**Table 4. Hourly summary of American shad passage through the serpentine vertical notch fish ladder at the York Haven Hydroelectric Project in 2016.**

Date	2-May	3-May	4-May	5-May	6-May	7-May	8-May	9-May	10-May
Observation Time (Start)	0800	0800	0800	0800	0800	0800	0800	0800	0800
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	1600	1600
<b>Military Time (Hours)</b>									
0800 - 0859	0	1	4	3	2	1	4	11	6
0900 - 0959	0	1	6	0	1	0	6	4	1
1000 - 1059	0	2	3	3	0	0	5	6	0
1100 - 1159	0	3	3	4	0	0	5	4	2
1200 - 1259	0	3	4	4	0	0	1	2	2
1300 - 1359	0	3	2	0	0	2	3	1	0
1400 - 1459	0	2	1	3	1	2	1	1	0
1500 - 1559	0	3	2	2	0	0	3	1	0
<b>Total Catch</b>	<b>0</b>	<b>18</b>	<b>25</b>	<b>19</b>	<b>4</b>	<b>5</b>	<b>28</b>	<b>30</b>	<b>11</b>

**Table 4. (continued)**

Date	11-May	12-May	13-May	14-May	15-May	16-May	17-May	18-May	19-May
Observation Time (Start)	0800	0800	0800	0800	0800	0800	0800	0800	0800
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	1600	1600
<b>Military Time (Hours)</b>									
0800 - 0859	6	0	2	1	6	0	0	0	0
0900 - 0959	1	0	3	1	1	0	0	0	0
1000 - 1059	0	1	1	0	0	0	0	0	0
1100 - 1159	1	1	0	0	0	0	0	0	0
1200 - 1259	0	0	0	0	1	0	0	1	0
1300 - 1359	1	1	0	0	0	2	0	1	0
1400 - 1459	2	0	2	0	0	0	0	0	0
1500 - 1559	1	1	0	0	0	0	0	0	0
<b>Total Catch</b>	<b>12</b>	<b>4</b>	<b>8</b>	<b>2</b>	<b>8</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>

Table 4. (continued)

Date	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May
Observation Time (Start)	0800	0800	0800	0800	0800	0800	0800	0800	0800
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	1600	1600
<b>Military Time (Hours)</b>									
0800 - 0859	0	0	0	0	0	0	0	0	0
0900 - 0959	0	0	0	0	0	0	0	0	0
1000 - 1059	0	0	0	0	0	0	0	0	0
1100 - 1159	0	0	0	0	0	0	0	0	0
1200 - 1259	0	0	0	0	0	0	0	0	0
1300 - 1359	0	0	0	0	0	0	0	0	0
1400 - 1459	0	0	0	0	0	0	0	0	0
1500 - 1559	0	0	0	0	0	0	0	0	0
<b>Total Catch</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

Table 4. (continued)

Date	29-May	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun
Observation Time (Start)	0800	0800	0800	0800	0800	0800	0800	0800	0800
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	1600	1600
<b>Military Time (Hours)</b>									
0800 - 0859	0	0	0	0	0	0	0	0	0
0900 - 0959	0	0	0	0	0	0	0	0	0
1000 - 1059	0	0	0	0	0	0	0	0	0
1100 - 1159	0	0	0	0	0	0	0	0	0
1200 - 1259	0	0	0	0	0	0	0	0	0
1300 - 1359	0	0	0	0	0	0	0	0	0
1400 - 1459	0	0	0	0	0	0	0	0	0
1500 - 1559	0	0	0	0	0	0	0	0	0
<b>Total Catch</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Table 4. (continued)**

Date	7-Jun	8-Jun	9-Jun	10-Jun		
Observation Time (Start)	0800	0800	0800	0800		
Observation Time (End)	1600	1600	1600	1600	Total	%
<b>Military Time (Hours)</b>						
0800 - 0859	0	0	0	0	47	26.4
0900 - 0959	0	0	0	0	25	14.0
1000 - 1059	0	0	0	0	21	11.8
1100 - 1159	0	0	0	0	23	12.9
1200 - 1259	0	0	0	0	18	10.1
1300 - 1359	0	0	0	0	16	9.0
1400 - 1459	0	0	0	0	15	8.4
1500 - 1559	0	0	0	0	13	7.3
<b>Total Catch</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>178</b>	<b>100.0</b>

## FIGURES

Figure 1. General Layout of the York Haven Hydroelectric Project Showing the Location of the Fishway.

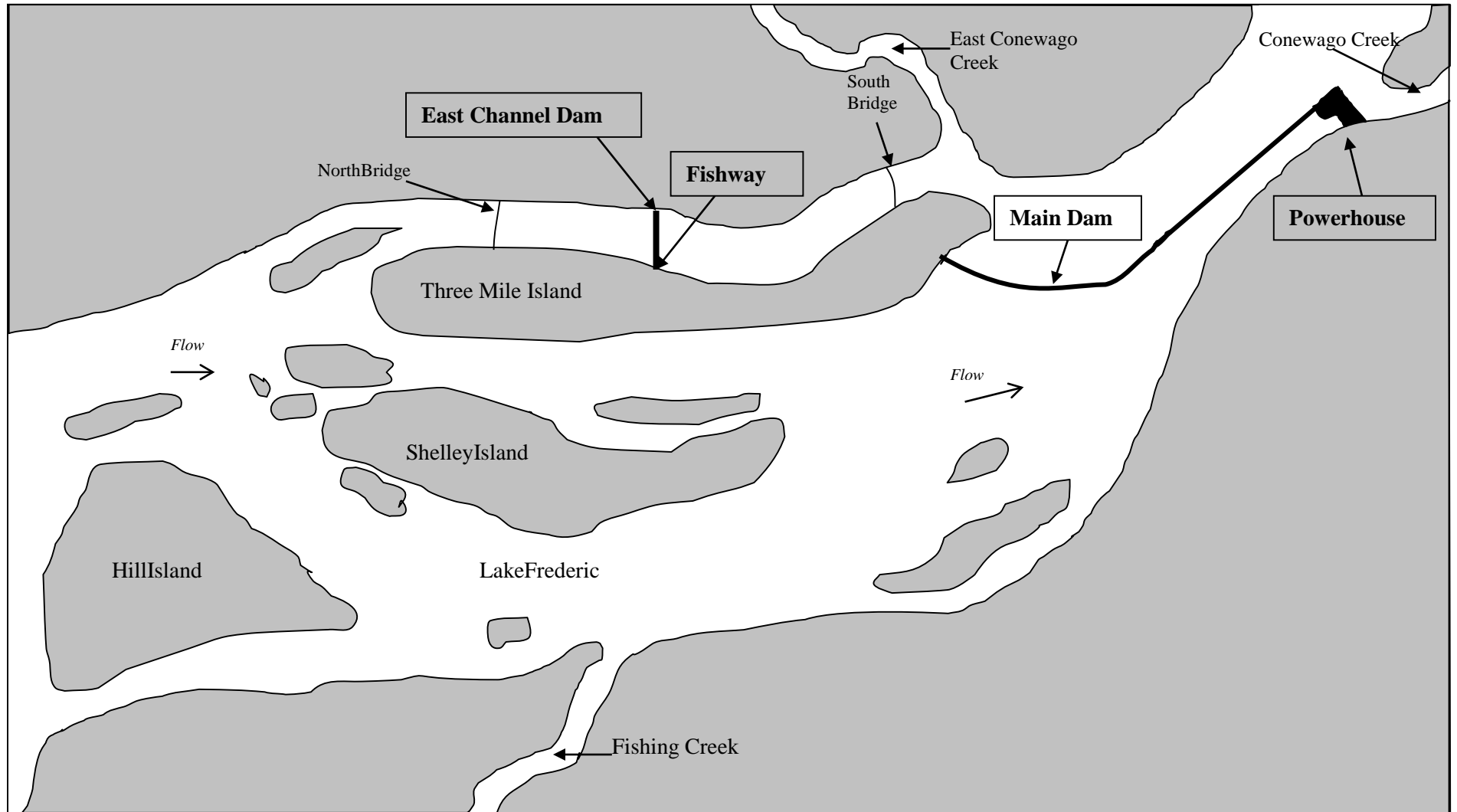
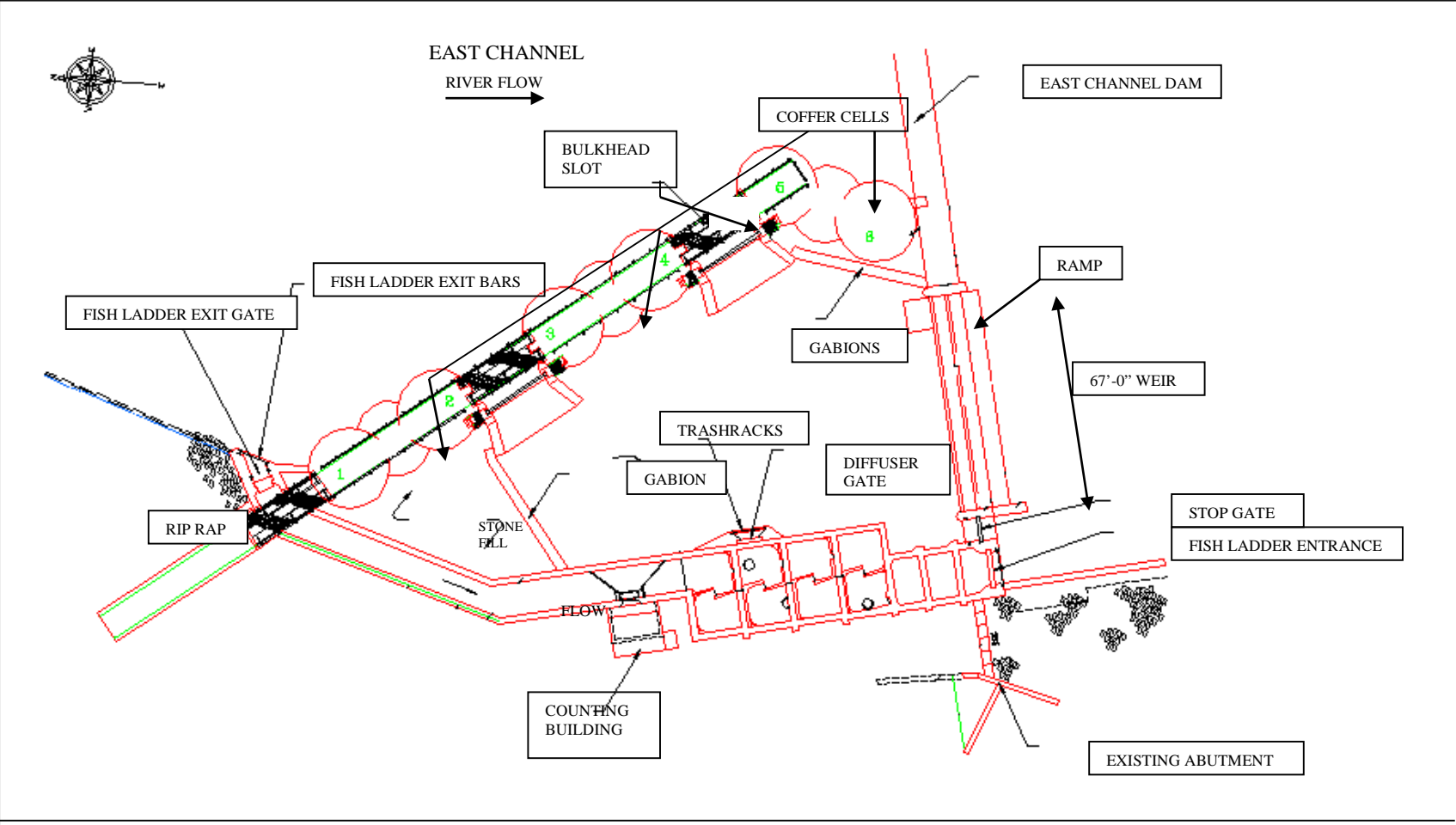


Figure 2. General Arrangement - York Haven Fishway.



**Figure 3. Plot of River Flow (x 1000 cfs) & Water Temperature (F) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2016**

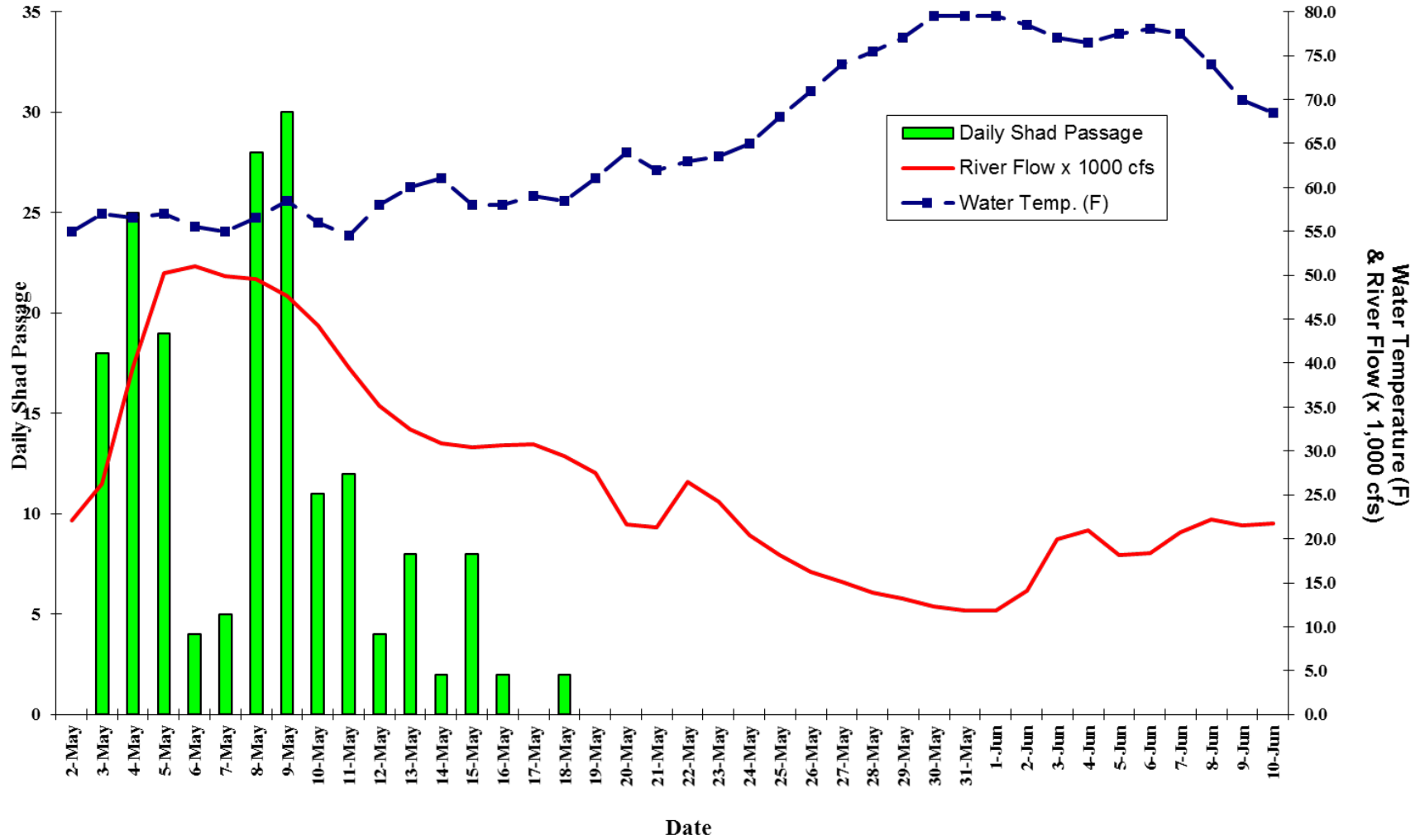


Figure 4. Plot of River Flow (x 1000 cfs) & East Channel Flow (x 1000 cfs) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2016

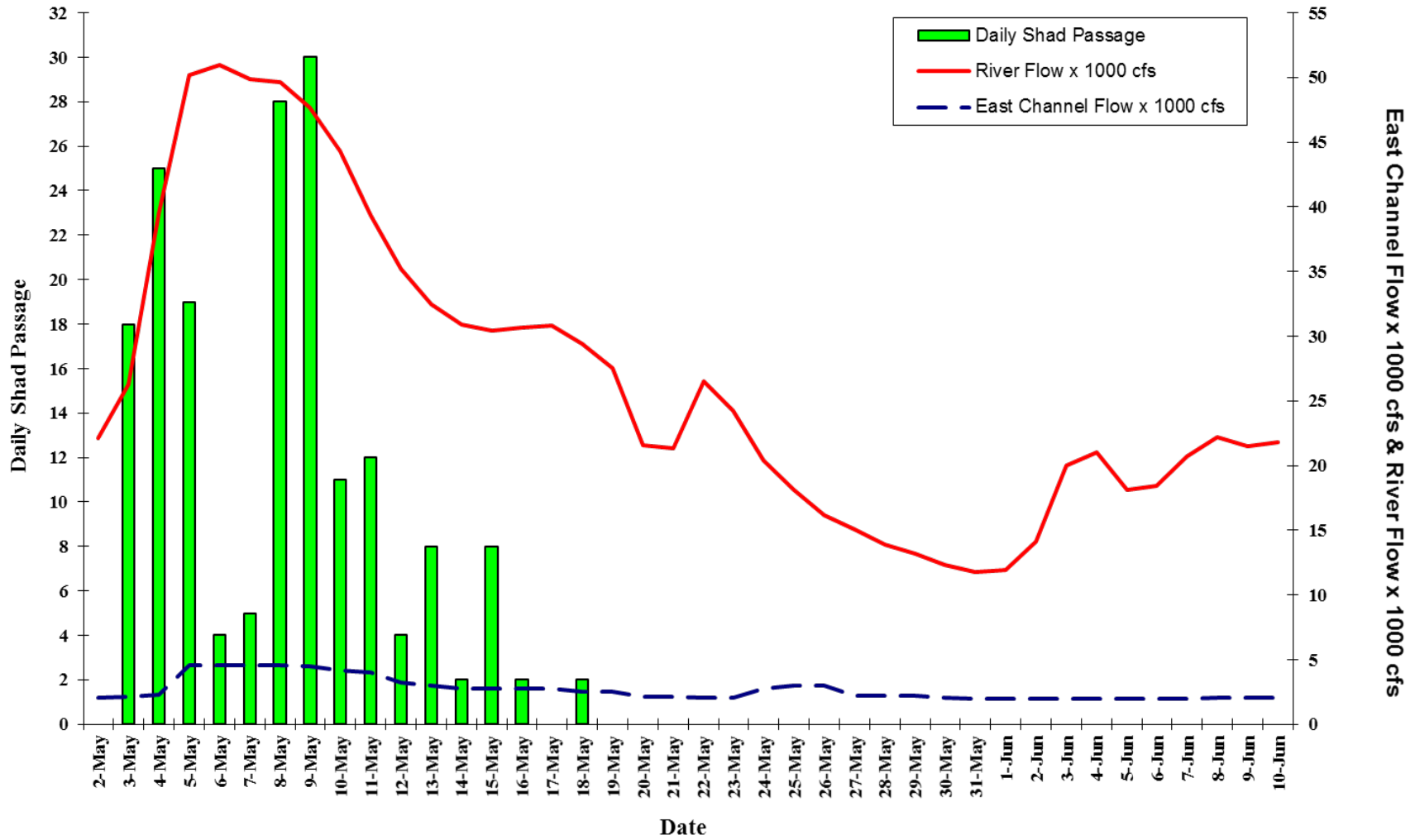




Figure 5. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River and Average Daily Water Temperature at the York Haven Power Station, 1 October to 30 November, 2016

