SUMMARY OF UPSTREAM AND DOWNSTREAM FISH PASSAGE AT THE YORK HAVEN HYDROELECTRIC PROJECT IN 2013

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EXECUTIVE SUMMARY

The fish ladder was opened on 1 April allowing volitional (unmanned) passage for 43 days prior to initiating manned Fishway operation. In 2013, the Fishway was manned on a total of 28 days between 14 May and 10 June. On 11 June, the fish ladder and North fixed wheel gate were set to deliver a minimum flow of 400 cfs into the East Channel. The Fishway remained open until 11 December and was set to deliver a minimum stream flow of at least 400 cfs to the East Channel.

During manned operation some 110,051 fish of 16 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (104,951) was the dominant fish species passed and comprised almost 95.4% of the fish passed. Some 202 American shad were counted as they passed through the ladder. Other predominant fishes passed included channel catfish (1,892), quillback (1,080), carp (898), shorthead redhorse (450), and smallmouth bass (348). Passage varied daily and ranged from 1,473 fish on 7 June to 9,601 fish on 18 May when 8.7% of the season total was passed.

A total of 202 American shad passed upstream through the ladder in 2013. American shad passed upstream between 15 May and 30 May, no shad were observed passing the Fishway in June. Almost 70% (140 shad) of the shad passed during a three day period between 16 May and 18 May. Peak daily shad passage occurred on 17 May when some 52 shad (25.7% of season total) passed.

American shad were collected and passed at water temperatures of 58.4°F to 73.4°F, River flows of 17,800 cfs to 38,300 cfs and East Channel flows of 2,050 cfs to 4,700 cfs. Passage between 16 May and 18 May occurred during a period when flows were falling. River flows during this period decreased from 38,300 cfs to 27,600 cfs, average daily water temperature ranged from 63.5°F to 66.2°F and East Channel flows declined from 3, 800 cfs to 3,200 cfs.

Some 53.5% of the shad (108) passed between 0800 hrs and 1059 hrs; hourly passage varied from no shad to 9 shad. A total of 76 shad passed from 1100 hrs to 1359 hrs and some 53 shad passed between 1400 hrs and 1600 hrs. The peak hourly passage of shad (13) occurred on 17 May between 0900 hrs and 0959 hrs.

As in previous years YHPC agreed to make periodic observations for adult shad in the forebay and open the sluice gate if/when large numbers of adults were observed. No adult shad were observed by Station Personnel that made periodic observations of the forebay area from June through August. The station also planned to implement the juvenile Downstream Passage Protocol that was developed in concert with the FPTAC. Daily monitoring of the York Haven forebay for the presence of juvenile shad began on 15 September when water temperature was 70.0°F. Monitoring continued through 15 November. During this period River flows ranged from 5,650 cfs to 39,800 cfs. The detection of fish activity during this period was noted as being generally non-existent and/or extremely light by station personnel that monitored the forebay nightly for fish activity. Cast netting was conducted and observations in the forebay were made at dusk by a Kleinschmidt biologist on 10, 15 and 28 October that supported and verified observations made by station personnel. Given fish activity was non-existent there was no need to implement "Downstream Operation".

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.

Although the FPTAC did not schedule a specific meeting to discuss Fishway operation to discuss Fishway operation, committee members had the opportunity to discuss Fishway operation with Station personnel during project relicensing meetings. As in previous years, objectives of 2013 operation were to monitor passage of migratory and resident fishes through the Fishway and continue to assess operation.

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.

Fishway operation coincides with a springtime minimum flow release. As part of the 1997 agreement, 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 2,100 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 43 day unmanned period of Fishway operation between 1 April and 13 May.

Manned Fishway operation, commenced on Wednesday 14 May, 4 days after the Safe Harbor Fish Lift had passed 1,017 American shad. In 2013, the Fishway was manned on a total of 28 days between 14 May and 10 June. Normally, fish were counted and allowed to pass upstream between 0800 hrs and 1600 hrs. On 16 May counting was extended one hour to 1700 hrs. Since no shad were observed passing the ladder in June manned Fishway operation ended at 1600 hrs on 10 June, two days after the Safe Harbor fish lift was shut down for the 2013 season.

Between 14 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 0.5-ft to 1.2-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 8 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. On 11 June, the fish ladder and North fixed wheel gate were set to deliver a minimum flow of 400 cfs into the East Channel. The Fishway remained open until 11 December and was set to deliver a minimum stream flow of at least 400 cfs to the East Channel.

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 or 1700 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 12 in. to 24 in.

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 110,051 fish of 16 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (104,951) was the dominant fish species passed and comprised almost 95.4% of the fish passed. Some 202 American shad were counted as they passed through the ladder. Other predominant fishes passed included channel catfish (1,892), quillback (1,080), carp (898), shorthead redhorse (450), and smallmouth bass (348). Passage varied daily and ranged from 1,473 fish on 7 June to 9,601 fish on 18 May when 8.7% of the season total was passed.

2.4.1.2 American Shad Passage

A total of 202 American shad passed upstream through the ladder in 2013. American shad passed upstream between 15 May and 30 May; no shad were observed passing the Fishway in June. Almost 70% (140 shad) of the shad passed during a three day period between 16 May and 18 May. Peak daily shad passage occurred on 17 May when some 52 shad (25.7% of season total) passed.

American shad were collected and passed at water temperatures of 58.4°F to 73.4°F, River flows of 17,800 cfs to 38,300 cfs and East Channel flows of 2,050 cfs to 4,700 cfs (Tables 2 and 3, Figures 3 and 4). Passage between 16 May and 18 May occurred during a period when flows were falling. Rivers flows during this period decreased from 38,300 cfs to 27,600 cfs, average daily water temperature ranged from 63.5°F to 66.2°F and East Channel flows declined from 3, 800 cfs to 3,200 cfs.

The hourly passage of American shad through the fish ladder is given in Table 4. Some 53.5% of the shad (108) passed between 0800 hrs and 1059 hrs; hourly passage varied from no shad to 9 shad. A total of 76 shad passed from 1100 hrs to 1359 hrs and some 53 shad passed between 1400 hrs and 1600 hrs. The peak hourly passage of shad (13) occurred on 17 May between 0900 hrs and 0959 hrs.

Counting was extended for one hour on 16 May, no shad passed between 1600 hrs and 1700 hrs.

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

Once each day, visual observations of fish activity were made on a random basis below the Main Dam. On several occasions several gizzard shad were observed and a few were observed trying to swim over the Main Dam. No shad or other alosids were observed below the Main Dam.

Observations were made at the "weir cut" several times each day in an attempt to see if American shad or other fishes passed upstream through this section of the Fishway. On several occasions carp, quillback and gizzard 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

As in previous years, YHPC anticipated making periodic observations for adult shad in the forebay and opening the trash gate if/when large numbers of adults were observed. They also planned to implement the juvenile Downstream Passage Protocol that was developed in concert with the FPTAC.

3.1 Adult Passage

No physical observations of post-spawned adult American shad were noted by Station personnel that made periodic observations of the forebay area between 1 May and 31 August 2013. During the 4 month period between 01 May and 31 August, the sluice gate was opened on about 80 of those days.

3.2 Juvenile Passage

The Juvenile Downstream Passage Protocol provides for:

- Monitoring the forebay to determine when outmigrating juveniles arrive at the project
- Starting "Downstream Operation" when juveniles arrive at York Haven; Downstream Operation begins each evening at sunset and continue until about 11:30 p.m. Downstream Operation includes:
  - Turning on temporary lighting at the trash sluiceway and opening the sluiceway
  - Operating only Units 1-6 when river flow is insufficient for operation of any of the remaining units
  - Operating Units 7-20 only when river flow exceeds the hydraulic capacity of available Units 1-6; the operating priority for Units 7-20 is Unit 7, Unit 8, Unit 9 etc.
- Monitoring and sampling in the forebay as river water temperatures drop and/or River flows increase to determine when the juvenile shad emigration has ended for the season
- Ceasing "Downstream Operation" at the end of the run, in consultation with members of the FPTAC.

In accordance with the protocol, monitoring of the York Haven forebay for the presence of juvenile American shad began on 15 September when water temperature was 70.0°F and River flow at Harrisburg was 12, 900 cfs (Figure 5). Monitoring continued through 15

November. Excluding a three day period (11 to 13 October), River flows from 15 September to15 November was less than station capacity and ranged from 5,650 cfs to18, 200 cfs. Heavy rain in the lower portion of the River resulted in increased River flows between 11 and 13 October. During this three day period, River flows varied from a high of 39,800 cfs to 27,900 cfs on 12 and 13 October, respectively. Average daily water temperature during the observation period (15 September to 15 November) dropped a total of 35 degrees and ranged from a high of 76.0°F to a low of 41.0°F.

The detection of fish activity during this period was noted as being generally non-existent and/or extremely light by station personnel that typically monitored the forebay twice daily. Observations were typically made daily by station personnel between 0700 hrs and 0800 hrs and within one hour of dusk. In addition, cast netting was conducted and observations in the forebay were made at dusk by a Kleinschmidt biologist on 10, 15 and 28 October that supported and verified observations made by station personnel.

Given that fish activity was non-existent there was no need to implement "Downstream Operation". As a means of ensuring the downstream migration wasn't occurring without being noticed routine contact was maintained with others conducting juvenile shad sampling programs in the lower River. According to personnel conducting these sampling programs juvenile shad abundance was low in 2013. Only a few juveniles were collected in the River, one juvenile shad were collected at Columbia and no juveniles were collected at City Island while haul seining in 2013.

4.0 LITERATURE CITED

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 2013.

Date	14-May	15-May	16-May	17-May	18-May	19-May	20-May	21-May	22-May	23-May
Observation Time (hrs.)	**8.0**	**8.0**	**9.0**	**8.0**	**8.0**	**8.0**	**8.0**	**8.0**	**8.0**	**8.0**
Water Temperature (°F)	**61.7**	**58.4**	**63.5**	**66.2**	**66.2**	**64.3**	**65.3**	**70.0**	**72.2**	**73.4**
American shad		4	46	52	42	13	15	9	12	4
Alewife										
Blueback herring										
Gizzard shad	9,007	4,568	4,870	6,454	9,193	3,798	3,093	4,506	4,422	4,006
Hickory shad										
Striped bass			1			2	4			
White perch										
American eel										
Rainbow trout										
Brown trout						1				
Brook trout										
Muskellunge										
Carp	28	71	46	73	70	24	12	45	46	63
Quillback	45	39	130	64	72	50	11	45	49	79
White sucker	1		1		1					
Shorthead redhorse	10	35	115	27	42	14	15	43	25	17
White catfish										
Yellow bullhead										
Brown bullhead										
Channel catfish	258	118	85	191	147	63	42	76	57	95
Rock bass										
Redbreast sunfish									1	
Green sunfish										
Pumpkinseed										
Bluegill										
Smallmouth bass		3	39	43	19	18	10	51	31	9
Largemouth bass			4	8	2			1		
Yellow perch										
Walleye	2	6	21	6	10	12	10	39	7	11
River chub					1					
Northern hog sucker										
Fallfish										
Flathead catfish	8	1		1	2	1			4	2
Striped bass hybrid		2				4	1			
Tiger muskie										
TOTAL	**9,359**	**4,847**	**5,358**	**6,919**	**9,601**	**4,000**	**3,213**	**4,815**	**4,654**	**4,286**

Table 1. ***(continued)***

Date	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May	1-Jun	2-Jun
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 (^{o}F)	**71.6**	**71.4**	**64.9**	**62.9**	**64.4**	**65.3**	**70.7**	**71.8**	**75.8**	**75.6**
American shad	2			2			1			
Alewife										
Blueback herring										
Gizzard shad	3,395	3,446	2,936	2,211	3,124	4,997	4,308	3,225	3,466	3,765
Hickory shad										
Striped bass										
White perch										
American eel										
Rainbow trout										
Brown trout										
Brook trout										
Muskellunge										
Carp	24	12	14	11	10	3	49	22	26	34
Quillback	61	27	4	11	17	23	67	27	56	48
White sucker										
Shorthead redhorse	2	6	3	6	3	3	11		5	
White catfish										
Yellow bullhead										
Brown bullhead										
Channel catfish	82	35	11	11	13	35	50	100	62	39
Rock bass										
Redbreast sunfish										
Green sunfish										
Pumpkinseed										
Bluegill										
Smallmouth bass		1	1	6		2	17	15	6	10
Largemouth bass										
Yellow perch										
Walleye				1		4	2	2		
River chub										
Northern hog sucker										
Fallfish										
Flathead catfish	6	1							3	
Striped bass hybrid					1					
Tiger muskie										
TOTAL	**3,572**	**3,528**	**2,969**	**2,259**	**3,168**	**5,067**	**4,505**	**3,391**	**3,624**	**3,896**

Table 1. ***(continued)***

Date	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**	**177.0**
Water Temperature (^{o}F)	**76.1**	**73.0**	**73.0**	**71.7**	**68.3**	**69.5**	**69.7**	**73.2**	
American shad									**202**
Alewife									**0**
Blueback herring									**0**
Gizzard shad	3,511	2,615	1,669	1,734	1,383	1,880	1,925	1,444	**104,951**
Hickory shad									**0**
Striped bass									**7**
White perch									**0**
American eel									**0**
Rainbow trout									**0**
Brown trout									**1**
Brook trout									**0**
Muskellunge									**0**
Carp	29	32	25	20	23	32	35	19	**898**
Quillback	24	33	23	32	20			23	**1,080**
White sucker									**3**
Shorthead redhorse	3	7	2	7	4	13	20	12	**450**
White catfish									**0**
Yellow bullhead									**0**
Brown bullhead									**0**
Channel catfish	62	39	23	37	37	35	45	44	**1,892**
Rock bass									**0**
Redbreast sunfish									**1**
Green sunfish									**0**
Pumpkinseed									**0**
Bluegill									**0**
Smallmouth bass		23	12	3	5	6	9	9	**348**
Largemouth bass									**15**
Yellow perch									**0**
Walleye		7		3		1		7	**151**
River chub									**1**
Northern hog sucker									**0**
Fallfish									**0**
Flathead catfish	12				1		1		**43**
Striped bass hybrid									**8**
Tiger muskie									**0**
TOTAL	**3,641**	**2,756**	**1,754**	**1,836**	**1,473**	**1,967**	**2,035**	**1,558**	**110,051**

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 2013.

Date	River Flow (cfs)	East Channel Flow (cfs)	Main Channel Flow (cfs)	Water Temp. (°F)	Secchi (in)			Stop Log Gate	Elevation (ft)					
									Head Pond			Tailwater		
					Avg.	Min.	Max.		Avg.	Min.	Max.	Avg	Min.	Max.
14-May	43,800	13,000	30,800	61.7	14	14	14	Closed	281.2	281.1	281.2	275.2	275.1	275.3
15-May	38,300	4,700	33,600	58.4	14	14	14	Closed	279.9	279.8	280.0	274.6	274.5	275.0
16-May	34,400	3,800	30,600	63.5	16	16	16	Closed	279.6	279.5	279.6	274.3	274.2	274.4
17-May	30,900	3,500	27,400	66.2	16	16	16	Closed	279.5	279.4	279.5	274.1	274.1	274.1
18-May	27,600	3,200	24,400	66.2	12	12	12	Closed	279.4	279.4	279.4	273.9	273.9	273.9
19-May	24,700	3,000	21,700	64.3	13	13	13	Closed	279.3	279.2	279.3	273.7	273.6	273.7
20-May	22,100	2,200	19,900	65.3	24	24	24	Closed	279.0	279.0	279.0	273.6	273.6	273.6
21-May	20,200	2,100	18,100	70.0	24	24	24	Closed	278.9	278.8	278.9	273.5	273.5	273.5
22-May	18,700	2,050	16,650	72.2	24	24	24	Closed	278.8	278.8	278.8	273.5	273.5	273.5
23-May	17,800	2,050	15,750	73.4	24	24	24	Closed	278.8	278.8	278.8	273.5	273.5	273.5
24-May	18,600	2,100	16,500	71.6	14	14	14	Closed	278.9	278.9	278.9	273.5	273.5	273.5
25-May	18,300	2,050	16,250	71.4	15	15	15	Closed	278.8	278.7	278.8	273.5	273.5	273.5
26-May	18,500	2,050	16,450	64.9	24	24	24	Closed	278.8	278.8	278.8	273.6	273.6	273.6
27-May	21,300	2,100	19,200	62.9	24	24	24	Closed	278.9	278.9	278.9	273.7	273.7	273.7
28-May	21,700	2,200	19,500	64.4	20	20	20	Closed	279.0	279.0	279.0	273.8	273.8	273.8
29-May	20,200	2,100	18,100	65.3	18	18	18	Closed	278.9	278.9	278.9	274.6	274.6	274.6
30-May	23,500	2,200	21,300	70.7	20	20	20	Closed	279.0	279.0	279.0	273.7	273.7	273.7
31-May	27,100	2,200	24,900	71.8	15	15	15	Closed	279.0	279.0	279.2	273.8	273.8	273.8
1-Jun	28,200	3,000	25,200	75.8	15	15	15	Closed	279.3	279.3	279.3	273.8	273.8	273.8
2-Jun	30,700	3,200	27,500	75.6	15	15	15	Closed	279.4	279.4	279.4	273.8	273.8	273.8
3-Jun	32,600	3,800	28,800	76.1	20	20	20	Closed	279.6	279.6	279.6	274.2	274.2	274.2
4-Jun	26,500	3,400	23,100	73.0	24	24	24	Closed	279.3	279.3	279.3	273.8	273.8	273.9
5-Jun	21,600	2,100	19,500	73.0	24	24	24	Closed	279.0	279.0	279.0	273.6	273.6	273.6
6-Jun	18,600	2,000	16,600	71.7	24	24	24	Closed	278.6	278.6	278.6	273.5	273.5	273.5
7-Jun	17,800	2,050	15,750	68.3	24	24	24	Closed	278.8	278.8	278.8	273.4	273.4	273.4
8-Jun	17,100	2,050	15,050	69.5	24	24	24	Closed	278.8	278.8	278.8	273.5	273.5	273.5
9-Jun	16,300	2,025	14,275	69.7	24	24	24	Closed	278.7	278.7	278.7	273.5	273.5	273.5
10-Jun	17,000	2,025	14,975	73.2	24	24	24	Closed	278.7	278.7	278.7	273.5	273.5	273.5

Table 3. Summary of surface water elevations recorded during operation of the York Haven Fishway in 2013.

		Elevation (ft)																				
	River Flow	Head Pond			Tailwater			Inside Fishway			Inside Weir			Above Counting Room			Below Fixed Wheel Gate			Counting Room		
Date	(cfs)	Avg.	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.	Max.
14-May	43,800	281.2	281.1	281.2	275.2	275.1	275.3	275.7	275.6	275.8	279.2	279.1	279.3	280.0	280.0	280.0	278.0	278.0	278.0	279.8	279.7	279.8
15-May	38,300	279.9	279.8	280.0	274.6	274.5	275.0	275.6	275.6	275.7	278.0	278.0	278.8	279.7	279.6	279.8	277.8	277.7	277.9	279.5	279.4	279.7
16-May	34,400	279.6	279.5	279.6	274.3	274.2	274.4	275.3	275.3	275.4	277.8	277.7	277.9	279.4	279.4	279.5	277.7	277.6	277.7	279.3	279.3	279.5
17-May	30,900	279.5	279.4	279.5	274.1	274.1	274.1	275.1	275.1	275.1	277.7	277.7	277.7	279.3	279.3	279.3	277.5	277.5	277.5	279.2	279.2	279.3
18-May	27,600	279.4	279.4	279.4	273.9	273.9	273.9	274.9	274.9	274.9	277.7	277.6	277.7	279.2	279.1	279.2	277.6	277.5	277.6	279.1	279.0	279.1
19-May	24,700	279.3	279.2	279.3	273.7	273.6	273.7	274.9	274.8	274.9	277.6	277.5	277.6	279.1	279.0	279.1	277.4	277.3	277.5	278.7	278.6	279.1
20-May	22,100	279.0	279.0	279.0	273.6	273.6	273.6	274.7	274.7	274.7	277.5	277.5	277.5	278.9	278.8	278.9	277.3	277.3	277.3	278.4	278.4	278.8
21-May	20,200	278.9	278.8	278.9	273.5	273.5	273.5	274.6	274.6	274.6	277.4	277.3	277.4	277.6	277.5	277.7	277.1	277.1	277.1	278.5	278.5	278.6
22-May	18,700	278.8	278.8	278.8	273.5	273.5	273.5	274.6	274.6	274.6	277.3	277.3	277.3	278.5	278.5	278.5	277.2	277.2	277.2	278.5	278.5	278.6
23-May	17,800	278.8	278.8	278.8	273.5	273.5	273.5	274.6	274.6	274.6	277.4	277.4	277.4	278.6	278.6	278.6	277.1	277.1	277.1	278.4	278.4	278.4
24-May	18,600	278.9	278.9	278.9	273.5	273.5	273.5	274.6	274.6	274.6	277.3	277.3	277.3	278.7	278.6	278.7	277.2	277.2	277.2	278.5	278.5	278.6
25-May	18,300	278.8	278.7	278.8	273.5	273.5	273.5	274.7	274.7	274.7	277.4	277.3	277.4	278.7	278.6	278.7	277.3	277.2	277.3	278.4	278.3	278.4
26-May	18,500	278.8	278.8	278.8	273.6	273.6	273.6	274.6	274.6	274.6	277.5	277.3	277.5	278.6	278.6	278.6	277.3	277.3	277.3	278.3	278.3	278.3
27-May	21,300	278.9	278.9	278.9	273.7	273.7	273.7	274.7	274.6	274.7	277.4	277.4	277.4	278.8	278.8	278.8	277.4	277.3	277.4	278.5	278.5	278.5
28-May	21,700	279.0	279.0	279.0	273.8	273.8	273.8	274.9	274.9	274.9	277.5	277.5	277.5	278.9	278.9	278.9	277.6	277.5	277.6	278.7	278.7	278.7
29-May	20,200	278.9	278.9	278.9	274.6	274.6	274.6	273.6	273.6	273.6	277.3	277.3	277.3	278.7	278.6	278.7	277.3	277.2	277.3	278.5	278.5	278.5
30-May	23,500	279.0	279.0	279.0	273.7	273.7	273.7	274.7	274.7	274.7	277.5	277.5	277.5	278.8	278.8	278.8	277.3	277.3	277.3	278.7	278.7	278.7
31-May	27,100	279.0	279.0	279.2	273.8	273.8	273.8	274.7	274.7	274.7	277.7	277.7	277.7	279.1	279.1	279.1	277.5	277.4	277.5	278.8	278.8	278.9
1-Jun	28,200	279.3	279.3	279.3	273.8	273.8	273.8	274.8	274.8	274.8	277.7	277.7	277.7	279.1	279.1	279.1	277.5	277.5	277.5	278.9	278.9	278.9
2-Jun	30,700	279.4	279.4	279.4	273.8	273.8	273.8	274.8	274.8	274.8	277.6	277.6	277.6	279.1	279.1	279.1	277.5	277.5	277.5	278.9	278.9	278.9
3-Jun	32,600	279.6	279.6	279.6	274.2	274.2	274.2	275.0	275.0	275.0	277.8	277.8	277.8	279.4	279.3	279.4	277.6	277.6	277.6	279.1	279.1	279.2
4-Jun	26,500	279.3	279.3	279.3	273.8	273.8	273.9	274.8	274.8	274.8	277.6	277.6	277.6	279.1	279.1	279.1	277.4	277.4	277.5	278.9	278.9	278.9
5-Jun	21,600	279.0	279.0	279.0	273.6	273.6	273.6	274.6	274.6	274.6	277.4	277.4	277.4	278.8	278.8	278.8	277.3	277.3	277.3	278.6	278.6	278.7
6-Jun	18,600	278.6	278.6	278.6	273.5	273.5	273.5	274.5	274.5	274.5	277.3	277.3	277.3	278.0	278.0	278.0	277.2	277.2	277.2	278.3	278.3	278.5
7-Jun	17,800	278.8	278.8	278.8	273.4	273.4	273.4	274.5	274.5	274.5	277.3	277.3	277.3	278.6	278.6	278.6	277.1	277.1	277.1	278.4	278.4	278.4
8-Jun	17,100	278.8	278.8	278.8	273.5	273.5	273.5	274.5	274.5	274.5	277.3	277.3	277.3	278.6	278.6	278.6	277.2	277.2	277.2	278.4	278.4	278.5
9-Jun	16,300	278.7	278.7	278.7	273.5	273.5	273.5	274.5	274.5	274.5	277.3	277.3	277.3	278.5	278.5	278.5	277.2	277.2	277.2	278.3	278.3	278.3
10-Jun	17,000	278.7	278.7	278.7	273.5	273.5	273.5	274.5	274.5	274.5	277.3	277.3	277.3	278.5	278.5	278.5	277.3	277.3	277.3	278.3	278.3	278.3

Table 4. Hourly summary of American shad passage through the serpentine vertical notch fish ladder at the York Haven Hydroelectric Project in 2013.

Date	14-May	15-May	16-May	17-May	18-May	19-May	20-May	21-May	22-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**
Military Time (Hours)									
0800 - 0859	0	1	3	11	11	2	5	8	5
0900 - 0959	0	0	3	13	12	3	1	0	1
1000 - 1059	0	2	6	5	3	1	3	0	3
1100 - 1159	0	0	8	7	4	3	3	1	3
1200 - 1259	0	0	12	9	5	3	1	0	0
1300 - 1359	0	0	10	3	2	0	0	0	0
1400 - 1459	0	0	2	3	3	0	2	0	0
1500 - 1559	0	1	2	1	2	1	0	0	0
1600 - 1700	-	-	0	-	-	-	-	-	-
Total Catch	**0**	**4**	**46**	**52**	**42**	**13**	**15**	**9**	**12**

Date	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-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**
Military Time (Hours)									
0800 - 0859	2	0	0	0	0	0	0	0	0
0900 - 0959	1	0	0	0	0	0	0	0	0
1000 - 1059	1	0	0	0	1	0	0	1	0
1100 - 1159	0	1	0	0	1	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	1	0	0	0	0	0	0	0
1600 - 1700	-	-	-	-	-	-	-	-	-
Total Catch	**4**	**2**	**0**	**0**	**2**	**0**	**0**	**1**	**0**

Table 4.*(continued)*

Date	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-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**
Military Time (Hours)									
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
1600 - 1700	-	-	-	-	-	-	-	-	-
Total Catch	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Date	10-Jun		
Observation Time (Start)	**0800**		
Observation Time (End)	**1600**	**Total**	**%**
Military Time (Hours)			
0800 - 0859	0	**48**	**23.8**
0900 - 0959	0	**34**	**16.8**
1000 - 1059	0	**26**	**12.9**
1100 - 1159	0	**31**	**15.3**
1200 - 1259	0	**30**	**14.9**
1300 - 1359	0	**15**	**7.4**
1400 - 1459	0	**10**	**5.0**
1500 - 1559	0	**8**	**4.0**
1600 - 1700	-	**0**	**0.0**
Total Catch	**0**	**202**	**100.0**

FIGURES

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

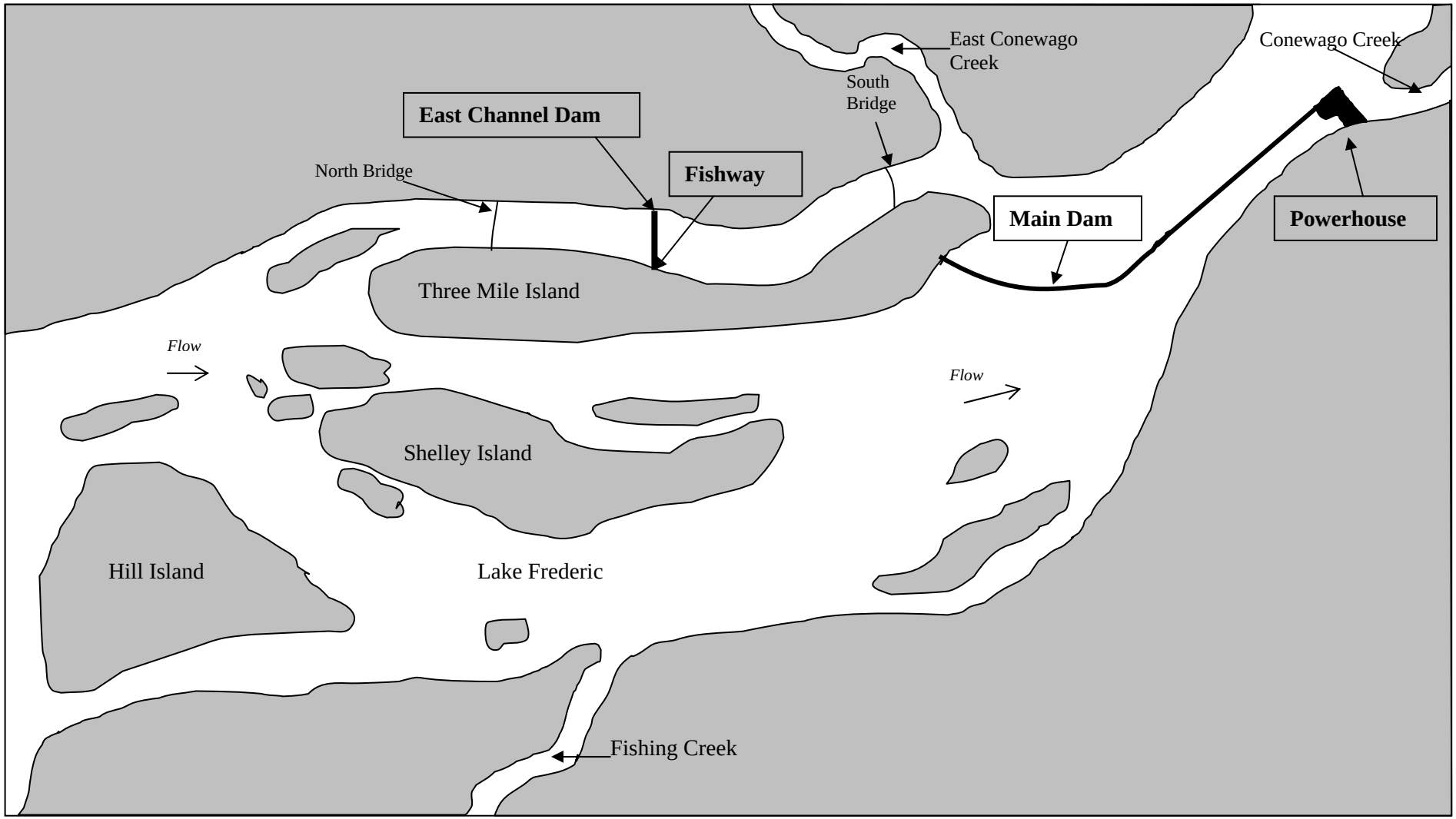

Figure 2. General Arrangement - York Haven Fishway.

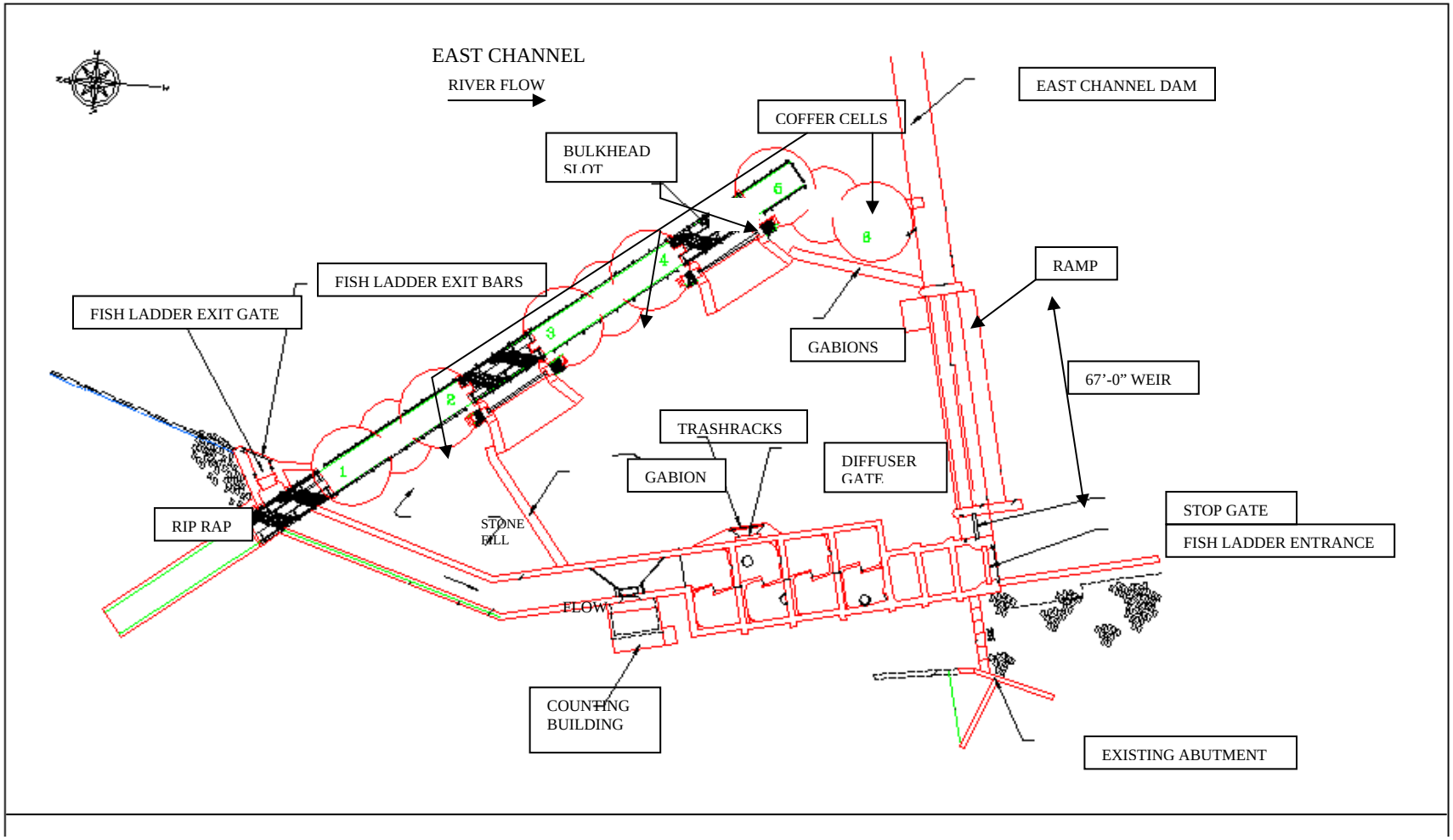

Figure 3. Plot of River Flow (x 1000 cfs) & Water Temperature (F) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2013

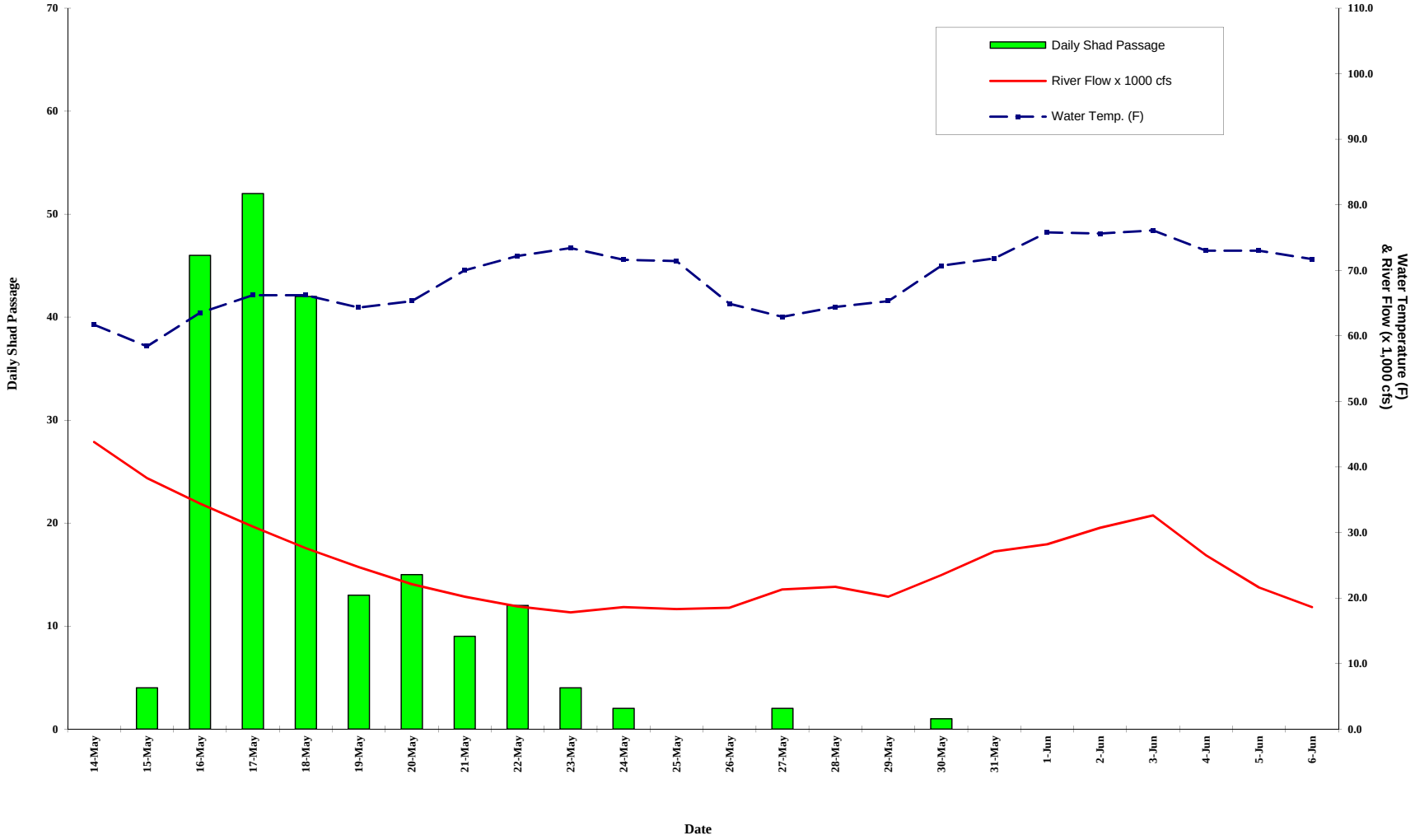

Figure 4. Plot of River Flow (x 1000 cfs) & East Channel Flow (x 1000 cfs) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2013

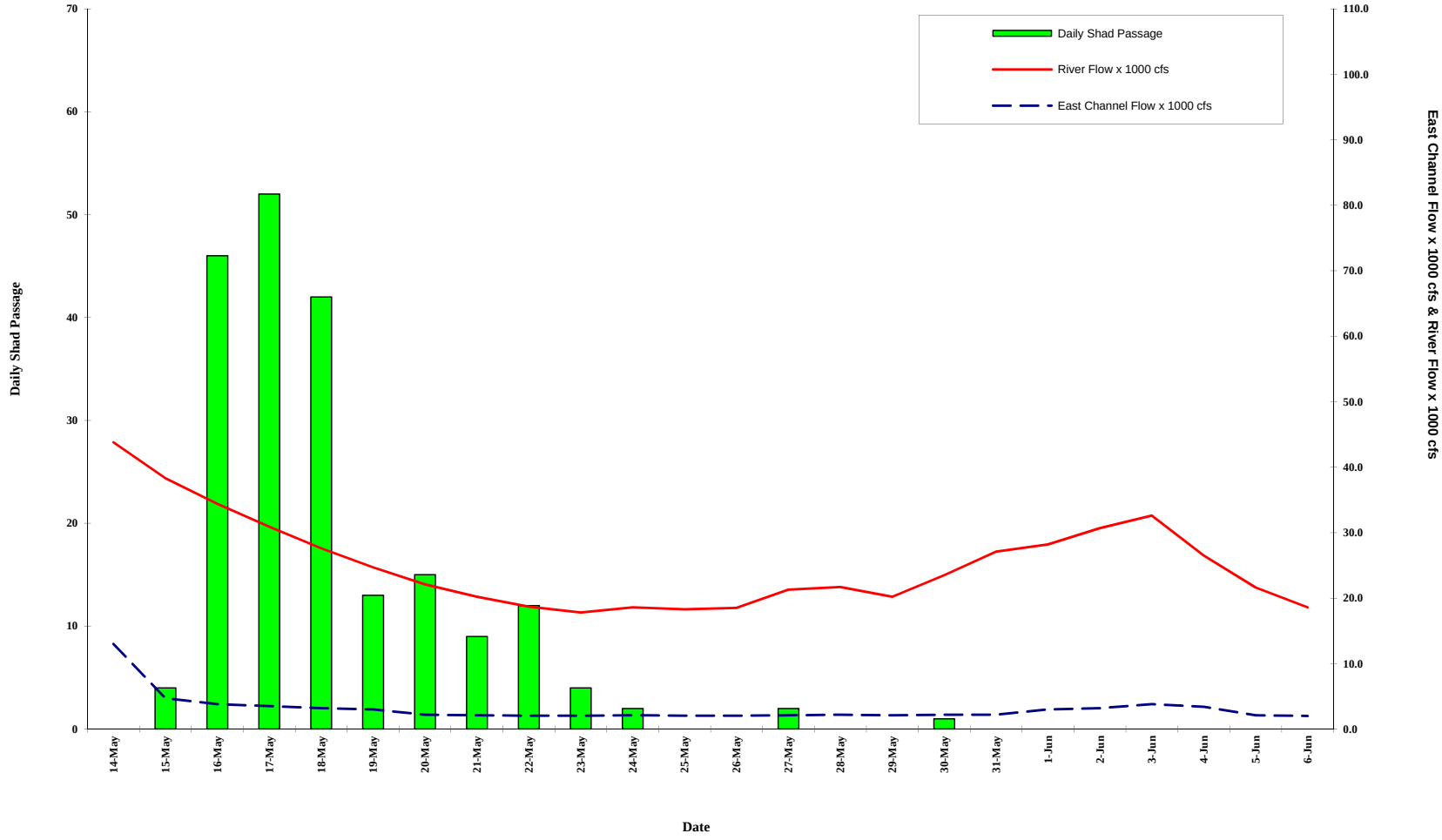

Figure 5. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River and Average Daily Water Temperature at the York Haven Power Station, 15 September to 15 November, 2013