SUMMARY OF UPSTREAM AND DOWNSTREAM FISH PASSAGE AT THE YORK HAVEN HYDROELECTRIC PROJECT IN 2009

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EXECUTIVE SUMMARY

The fish ladder was opened on 1 April allowing volitional (unmanned) passage for 40 days prior to initiating manned Fishway operation. Manned Fishway operation started on 11 May and ended on 15 June. A total of 88,329 fish of 26 taxa were enumerated as they passed upstream though the ladder into Lake Frederic during manned operation. Gizzard shad (76,995) was the dominant fish species passed and comprised 87% of the fish passed. Passage varied daily and ranged from 9,000 fish on 21 May to 158 fish on 15 June.

A total of 402 American shad passed upstream through the ladder in 2009. Some 346 shad passed in May while 56 passed in June. Most shad (31) passed on 14 May. American shad were passed at water temperatures of 60.3° F to 70.5° F, and River flows that varied from 22,067 cfs to 56,617 cfs and East Channel flows of 2,100 cfs to 7,400 cfs (Tables 2 and 3, Figures 3 and 4).

Over 41.2 % of the shad (166) passed between 1101 hrs and 1400 hrs; hourly passage varied from no shad to 10 shad. Some 155 shad passed from 0801 hrs to 1100 hrs. A total of 81 shad passed between 1401 hrs and the end of manned operation each day (1600 and/or 1700 hrs). The peak hourly passage of shad (10) occurred on 31 May between 1401 hrs and 1500 hrs.

YHPC will continue working with members of the FPTAC to develop and implement practical changes to Fishway operation that are geared toward improving passage through the Fishway. Future operations of the Fishway will build on the past ten years of experience.

As in previous years YHPC agreed to make periodic observations for adult shad in the forebay and open the trash 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 September

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 18 September when water temperature was 70.0° F. Monitoring continued through 2 November. During this period River flows ranged from 6,530 cfs to 85,200 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. 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.

A draft of the York Haven Fishway Operation Plan was reviewed with the members of the FPTAC and subsequently finalized following discussion at the FPTAC meeting held on May 6, 2009. During the meeting, YHPC agreed to make periodic observations for adults in the forebay and open the trash gate if/when large numbers of adults were observed. They also planned to the implement the juvenile Downstream Passage Protocol that was developed in concert with the FPTAC.

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.

Operation in 2009, the tenth year of Fishway operation incorporated experience gained during the first eight seasons, along with FPTAC recommendations. Objectives of 2009 operation were to monitor passage of migratory and resident fishes through the Fishway and continue to assess operation.

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 flow was less than 23,000 cfs, a nominal minimum spill of 4,000 cfs was maintained over the Main Dam during daily Fishway 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 five 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 for the 2009 season began in mid-March enabling volitional fish passage (unmanned) through the ladder to commence on 1 April. Only the entrance and exit gate(s) were open during a 40 day unmanned period of Fishway operation between 1 April and 10 May.

Manned Fishway operation, commenced on Monday 11 May, 6 days after the Safe Harbor Fish Lift was placed in service and had passed 2,537 American shad. In 2009, the Fishway was manned on a total of 34 days between 11 May and 15 June. Normally, fish were counted and allowed to pass upstream between 0800 hrs and 1600 hrs. However, per the Fishway Operation Plan, counting was extended to 1700 hrs on 11, 14 and 29 May as five shad had passed between 1600 hrs and 1700 hrs. As only 11 shad were observed passing upstream through the Fishway between 4 June and 12 June a plan to stop manned operation for the 2009 season was developed. The plan, mutually agreed to by members of the FPTAC, called for unmanned operation (volitional passage) of the Fishway on 13 June and 14 June with a final day of manned operation on 15 June to confirm that upstream passage of pre-spawned shad had in fact ended. Since no shad were observed passing the ladder on 15 June, manned Fishway operation ended that afternoon at 1600 hrs.

Between 11 May and 15 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 throughout the season maintaining a 0.5-ft to 0.8-ft differential between the surface water elevation downstream of the entrance and the water elevation in the diffuser area of the fish ladder. This setting resulted in an average velocity of 4 ft/sec to 6 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. This individual also recorded water elevations several times each day on staff gauges located throughout the Fishway.

After manned Fishway operation ended on 15 June, the South fixed wheel gate was closed. On 16 June, the fish ladder and North fixed wheel gate were set to deliver a minimum flow of 400 cfs into the East Channel. As agreed to, the fish ladder and the North wheel gate remained open through 24 October.

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 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. This gate was closed nightly during periods of manned Fishway operation at 1600 to 1700 hrs based on shad passage. The stop gate was usually opened each morning the Fishway was manned at 0800 hrs. Occasionally, it was closed for brief periods of time as needed each day to enable the person manning the Fishway to 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 varied from 8 in. to 24 in. depending on river conditions.

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 Relative Abundance

The number of fish that passed through the York Haven fish ladder is presented in Table 1. Some 88,329 fish of 26 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (76,995) was the dominant fish species passed and comprised over 87% of the fish passed. Some 402 American shad were counted as they passed through the ladder. Other predominant fishes passed included walleye (3,752), quillback (3,429), channel catfish (1,632), and shorthead redhorse (1,130). Passage varied daily and ranged from 158 fish on 15 June to 9,000 fish on 21 May.

2.4.2 American Shad Passage

A total of 402 American shad passed upstream through the ladder in 2009 (Table 1). Some 346 shad passed in May while 56 passed in June. Peak shad passage occurred on 14 May when 31 shad passed.

American shad were passed at water temperatures of 69.4° F to 74.3° F, and River flows that ranged from 22,067 cfs to 56,617 cfs and East Channel flows of 2,100 cfs to 7,400 cfs (Tables 2 and 3, Figures 3 and 4). Shad passage varied daily with over 86% of total shad passed (346) in May. Passage during May occurred at Rivers flows that averaged 36,026 cfs and varied from 22,067 cfs to 56,617 cfs. Water temperature during this period averaged 65.4° F and ranged from 60.3° F to 72.5° F. East Channel flows averaged 4,238 cfs (2,100 cfs to 7,400 cfs). Over 80% (45 of 56 shad) of the shad observed in June passed between 1 and 3 June as flows declined from 45,933 cfs to 35,200 cfs. During this three day period East Channel flows declined from 5,400 cfs to 3,800 cfs and the average daily water temperature varied from 66.3° F to 68.5° F.

The hourly passage of American shad through the fish ladder is given in Table 4. Over 41.2 % of the shad (166) passed between 1101 hrs and 1400 hrs; hourly passage varied from no shad to 10 shad. Some 155 shad passed from 0801 hrs to 1100 hrs. A total of 81 shad passed between 1401 hrs and the end of manned operation each day (1600 and/or 1700 hrs). The peak hourly passage of shad (10) occurred on 31 May between 1401 hrs and 1500 hrs.

2.4.3 Other Alosids

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

2.4.4 Observations

Once each day, visual observations of fish activity were made on a random basis below the Main Dam. On several occasions a few carp and gizzard shad 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.

2.5 Summary

The ladder was opened on 1 April allowing unmanned passage for 40 days prior to initiating manned Fishway operation. During 34 days of manned operation between 11 May and 15 June a total of 88,329 fish of 26 taxa were enumerated as they passed upstream though the ladder into Lake Frederic.

A total of 402 shad were observed as they passed upstream through the ladder. Some 346 shad passed in May while 56 passed in June. Some 41.2%, 38.6 % and 20.2% of the shad passed between 1101 hrs and 1400 hrs, 0801 hrs and 1100 hrs and 1401 hrs and the end of manned operation each day (1600 hrs or 1700 hrs), respectively. Most shad (31) passed on 14 May. American shad were passed at water temperatures of 60.3° F to 70.5° F, and River flows that ranged from 22,067 cfs to 56,617 cfs and East Channel flows of 2,100 cfs to 7,400 cfs.

YHPC will continue working with members of the FPTAC to develop and implement practical changes to Fishway operation that are geared toward improving passage through the Fishway. Future operations of the Fishway will continue to build on the previous ten years of experience

3.0 DOWNSTREAM FISH PASSAGE

As in previous years, YHPC agreed to make periodic observations for adult shad in the forebay and open 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 observations of post-spawned adult shad were noted by Station personnel that made periodic observations of the forebay area from June through September, 2009. During this period (1 June to 30 September station personnel opened the trash sluice opened on 56 days.

3.2 Juvenile Passage

The Juvenile Downstream Passage Protocol provides for:

- Monitoring the forebay to determine when out migrating 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 18 September when water temperature was 70.0° F and River flow at Harrisburg had increased to 8,420 cfs. Monitoring continued through 2 November. River flow during this period varied daily and ranged from 6,530 cfs to 85,200 cfs (Figure 5). 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, observations of the forebay were made at dusk by a Kleinschmidt biologist on 29 September, 8 October, and 13 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 extremely low again in 2009. No juvenile shad were collected at Columbia while haul seining and as of 31 October no shad were collected in the lift net at the Holtwood station.

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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 2009.

Date	11-May	12-May	13-May	14-May	15-May	16-May	17-May	18-May	19-May	20-May
Observation Time (hrs.)	9.0	8.0	8.0	9.0	8.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (^{o}F)	62.6	60.3	61.8	63	62.8	65.5	65.8	65.0	63.3	64.2
AMERICAN SHAD	25	25	18	31	17	26	1	11	10	27
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	3,117	3,405	2,455	2,169	2,173	2,934	1,151	1,439	3,607	5,823
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	0	0	0	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
RAINBOW TROUT	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	1	0	0	1	0	0	0	0
BROOK TROUT	0	0	0	0	0	0	0	0	0	0
MUSKELLUNGE	0	0	1	0	1	1	0	0	0	0
TIGER MUSKIE	0	0	0	0	0	0	0	0	0	0
CARP	32	25	15	14	20	45	14	19	0	12
QUILLBACK	145	108	136	182	367	340	82	58	33	82
WHITE SUCKER	7	1	3	1	0	4	0	0	0	3
S. REDHORSE	90	159	145	151	165	105	31	15	32	68
WHITE CATFISH	0	0	0	0	0	0	0	0	0	0
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	0	0
BROWN BULLHEAD	0	0	0	0	0	0	0	0	0	0
CHANNEL CATFISH	112	53	20	22	40	58	57	78	65	65
FLATHEAD CATFISH	0	0	0	0	0	0	0	4	1	5
ROCK BASS	0	0	0	0	0	0	0	0	0	0
REDBREAST SUNFISH	0	0	0	0	0	2	0	0	0	0
GREEN SUNFISH	0	0	0	0	0	0	0	0	0	0
PUMKINSEED	0	0	0	0	0	0	0	0	0	0
BLUEGILL	0	0	0	0	0	0	0	0	0	0
SMALLMOUTH BASS	3	25	29	17	13	14	0	0	0	0
LARGEMOUTH BASS	0	0	0	0	0	8	0	0	0	0
WALLEYE	226	199	214	180	180	135	37	37	8	22
FALLFISH	1	0	0	1	0.0	0.0	0.0	1	0	1
Total	**3,758**	**4,000**	**3,037**	**2,768**	**2,977**	**3,673**	**1,374**	**1,662**	**3,756**	**6,108**

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

Date	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	9.0	8.0
Water Temperature (^{o}F)	64.4	66.7	68.3	70.5	72.5	68.4	65.3	68.5	65.4	65.5
AMERICAN SHAD	18	17	19	18	16	12	2	4	24	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	8550	5004	2957	1988	1539	2148	1601	912	902	180
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	1	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
RAINBOW TROUT	0	1	0	0	1	0	0	0	0	0
BROWN TROUT	0	0	0	0	3	1	0	0	0	5
BROOK TROUT	0	0	0	0	0	2	0	0	0	0
MUSKELLUNGE	0	1	0	0	0	0	0	0	0	0
TIGER MUSKIE	1	1	0	0	0	0	0	0	0	0
CARP	18	22	38	35	39	31	22	6	12	5
QUILLBACK	126	434	362	222	216	87	21	3	15	4
WHITE SUCKER	2	3	3	0	1	1	0	0	0	0
S. REDHORSE	69	47	20	8	4	2	0	2	1	2
WHITE CATFISH	0	0	0	0	0	0	0	0	0	0
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	1	0
BROWN BULLHEAD	0	0	0	0	0	0	0	0	3	3
CHANNEL CATFISH	96	45	19	22	20	22	4	3	41	83
FLATHEAD CATFISH	9	10	11	4	4	2	1	0	2	3
ROCK BASS	0	0	0	4	0	0	0	0	0	0
REDBREAST SUNFISH	0	0	0	7	1	0	0	0	1	0
GREEN SUNFISH	0	0	0	0	0	1	0	0	0	0
PUMKINSEED	0	1	0	0	0	0	0	0	0	0
BLUEGILL	0	0	0	1	0	0	0	0	0	0
SMALLMOUTH BASS	6	9	14	6	4	5	0	0	0	0
LARGEMOUTH BASS	4	10	5	2	0	4	0	0	0	0
WALLEYE	101	230	443	460	296	355	96	61	24	3
FALLFISH	0	1	0	0	0	0	0	0	0	0
Total	**9,000**	**5,837**	**3,891**	**2,777**	**2,144**	**2,673**	**1,747**	**991**	**1,026**	**288**

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

Date	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-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)	66.6	66.3	67.1	68.0	67.5	66.0	67.5	67.8	69.4	70.5
AMERICAN SHAD	25	21	11	13	0	0	0	2	6	1
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	6,791	8,304	2,679	1,928	886	364	158	455	327	370
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	0	0	0	0	1	0	1	2	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
RAINBOW TROUT	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	0	0	0	0	0	0	0	0
BROOK TROUT	0	0	0	0	0	0	0	0	0	0
MUSKELLUNGE	0	0	0	0	1	0	0	0	0	0
TIGER MUSKIE	0	0	0	0	0	0	0	0	0	0
CARP	17	20	23	20	3	6	6	16	25	4
QUILLBACK	15	45	58	39	8	0	1	46	82	62
WHITE SUCKER	1	0	0	0	0	0	0	1	1	0
S. REDHORSE	2	3	4	1	0	1	0	1	2	0
WHITE CATFISH	0	0	1	1	0	0	0	0	0	0
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	0	0
BROWN BULLHEAD	3	3	1	1	0	1	0	0	2	0
CHANNEL CATFISH	99	104	59	66	21	8	6	36	129	77
FLATHEAD CATFISH	0	4	6	0	0	0	0	0	0	0
ROCK BASS	0	0	0	0	0	0	0	0	0	0
REDBREAST SUNFISH	0	1	1	0	0	1	0	0	0	0
GREEN SUNFISH	0	1	0	0	0	0	0	0	0	0
PUMKINSEED	0	1	0	0	0	0	0	0	1	0
BLUEGILL	0	0	0	0	0	0	0	0	0	0
SMALLMOUTH BASS	0	3	12	8	1	0	0	4	3	0
LARGEMOUTH BASS	0	0	4	2	0	0	0	3	2	0
WALLEYE	8	23	58	126	32	15	12	35	68	62
FALLFISH	1	0	0	0	0	0	0	0	0	0
Total	**6,962**	**8,533**	**2,917**	**2,205**	**952**	**397**	**183**	**600**	**650**	**576**

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

Date	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun	15-Jun	Total
Observation Time (hrs.)	8.0	8.0	8.0	-	-	8.0	**0.0**
Water Temperature (^{o}F)	69.8	69.0	69.8	-	-	68.8	
AMERICAN SHAD	1	0	1	-	-	0	**402**
ALEWIFE	0	0	0	-	-	0	**0**
BLUEBACK HERRING	0	0	0	-	-	0	**0**
GIZZARD SHAD	247	147	181	-	-	104	**76,995**
HICKORY SHAD	0	0	0	-	-	0	**0**
STRIPED BASS	0	0	0	-	-	0	**7**
WHITE PERCH	0	0	0	-	-	0	**0**
AMERICAN EEL	0	0	0	-	-	0	**0**
RAINBOW TROUT	0	0	0	-	-	1	**3**
BROWN TROUT	0	2	0	-	-	0	**13**
BROOK TROUT	0	0	0	-	-	0	**2**
MUSKELLUNGE	0	0	0	-	-	0	**5**
TIGER MUSKIE	0	0	0	-	-	0	**2**
CARP	11	3	3	-	-	3	**584**
QUILLBACK	18	4	3	-	-	25	**3,429**
WHITE SUCKER	0	0	0	-	-	0	**32**
S. REDHORSE	0	0	0	-	-	0	**1,130**
WHITE CATFISH	0	0	0	-	-	0	**2**
YELLOW BULLHEAD	0	0	0	-	-	0	**1**
BROWN BULLHEAD	0	3	0	-	-	0	**20**
CHANNEL CATFISH	39	29	14	-	-	20	**1,632**
FLATHEAD CATFISH	0	0	0	-	-	0	**66**
ROCK BASS	0	0	0	-	-	0	**4**
REDBREAST SUNFISH	0	0	0	-	-	0	**14**
GREEN SUNFISH	0	0	0	-	-	0	**2**
PUMKINSEED	0	1	0	-	-	0	**4**
BLUEGILL	0	0	0	-	-	0	**1**
SMALLMOUTH BASS	0	0	0	-	-	0	**176**
LARGEMOUTH BASS	1	0	0	-	-	0	**45**
WALLEYE	0	0	1	-	-	5	**3,752**
FALLFISH	0	0	0	-	-	0	**6**
Total	**317**	**189**	**203**	-	-	**158**	**88,329**

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 2009.

	River	East	Main Dam	Water				Stop	Elevation (ft)					
	Flow	Channel	Flow	Temp.	Secchi (in)			log	Head Pond			Tailwater		
Date	(cfs)	Flow (cfs)	(cfs)	(^{o}F)	Avg.	Min.	Max.	Gate	Avg.	Min.	Max.	Avg	Min.	Max.
11-May	38,000	4,700	33,300	62.6	24	24	24	closed	279.8	279.8	279.8	274.5	274.5	274.5
12-May	35,120	4,700	30,420	60.3	24	24	24	closed	279.8	279.8	279.9	274.3	274.3	274.3
13-May	31,800	3,800	28,000	61.8	24	24	24	closed	279.6	279.6	279.6	274.1	274.1	274.1
14-May	29,720	3,200	26,520	63.0	24	24	24	closed	279.4	279.4	279.4	274.0	274.0	274.0
15-May	29,580	3,200	26,380	62.8	24	24	24	closed	279.4	279.4	279.4	274.1	274.1	274.1
16-May	31,200	3,500	27,700	65.5	24	24	24	closed	279.5	279.5	279.5	274.1	274.1	274.1
17-May	32,967	4,000	28,967	65.8	8	8	10	closed	279.7	279.7	279.8	274.4	274.4	274.5
18-May	42,517	4,700	37,817	65.0	13	10	15	closed	279.8	279.7	279.8	274.5	274.5	274.5
19-May	53,800	7,400	46,400	63.3	15	15	15	closed	280.4	280.4	280.4	275.6	275.6	275.6
20-May	50,967	6,200	44,767	64.2	12	10	15	closed	280.2	280.2	280.3	275.5	275.4	275.5
21-May	43,683	5,400	38,283	64.4	10	10	10	closed	280.0	280.0	280.1	274.9	274.9	274.9
22-May	36,367	4,000	32,367	66.7	10	10	10	closed	279.7	279.6	279.7	274.5	274.4	274.5
23-May	30,667	3,500	27,167	68.3	10	10	10	closed	279.5	279.4	279.5	274.0	274.0	274.1
24-May	27,067	3,000	24,067	70.5	16	16	16	closed	279.3	279.3	279.3	273.8	273.8	273.9
25-May	24,733	2,800	21,933	72.5	10	10	10	closed	279.2	279.2	279.2	273.7	273.7	273.7
26-May	22,900	2,200	20,700	68.4	10	10	10	closed	279.0	279.0	279.0	273.7	273.7	273.7
27-May	22,067	2,100	19,967	65.3	18	16	20	closed	278.9	278.9	278.9	273.6	273.5	273.6
28-May	22,067	2,200	19,867	68.5	20	20	20	closed	279.0	279.0	279.0	273.6	273.6	273.7
29-May	42,567	4,000	38,567	65.4	10	8	15	closed	279.7	279.3	280.1	274.4	273.9	275.0
30-May	56,617	7,400	49,217	65.5	8	8	8	closed	280.4	280.4	280.4	275.8	275.8	275.8
31-May	52,150	7,000	45,150	66.6	8	8	8	closed	280.3	280.2	280.3	275.5	275.4	275.5
1-Jun	45,933	5,400	40,533	66.3	8	8	8	closed	280.0	280.0	280.0	274.9	274.9	274.9
2-Jun	39,367	4,000	35,367	67.1	17	8	18	closed	279.7	279.7	279.7	274.6	274.6	274.6
3-Jun	35,200	3,800	31,400	68.0	18	18	18	closed	279.6	279.6	279.6	274.3	274.3	274.3
4-Jun	32,633	3,200	29,433	67.5	18	18	18	closed	279.4	279.4	279.4	274.1	274.1	274.1
5-Jun	30,767	3,200	27,567	66.0	18	18	18	closed	279.4	279.4	279.4	274.0	273.9	274.0
6-Jun	28,833	3,400	25,433	67.5	18	18	18	closed	279.3	279.2	279.3	273.9	273.8	273.9
7-Jun	26,500	2,200	24,300	67.8	20	18	20	closed	279.1	279.1	279.1	273.7	273.7	273.7
8-Jun	24,467	2,100	22,367	69.4	20	20	20	closed	279.0	279.0	279.0	273.6	273.6	273.6
9-Jun	23,867	2,100	21,767	70.5	18	12	20	closed	278.9	278.9	278.9	273.6	273.6	273.6
10-Jun	22,167	2,100	20,067	69.8	8	8	8	closed	278.9	278.9	278.9	273.6	273.6	273.6
11-Jun	21,800	2,100	19,700	69.0	8	8	8	closed	278.9	278.9	278.9	273.6	273.6	273.6
12-Jun	22,467	2,100	20,367	69.8	8	8	8	closed	278.9	278.9	278.9	273.6	273.6	273.6
13-Jun	24,600	2,100	22,500											
14-Jun	23,500	2,100	21,400											
15-Jun	25,067	2,200	22,867	68.8	8	8	8	closed	279.0	279.0	279.9	273.6	273.6	273.6

Table 3. Summary of surface water elevations recorded during operation of the York Haven Fishway in 2009.

		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
11-May	38,000	279.8	279.8	279.8	274.5	274.5	274.5	275.4	275.4	275.4	277.9	277.9	277.9	279.7	279.7	279.7	277.6	277.6	277.6	279.5	279.5	279.5
12-May	35,120	279.8	279.8	279.9	274.3	274.3	274.3	275.4	275.3	275.4	277.8	277.8	277.8	279.5	279.4	279.5	277.6	277.6	277.6	279.4	279.4	279.4
13-May	31,800	279.6	279.6	279.6	274.1	274.1	274.1	275.1	275.1	275.1	277.7	277.7	277.7	279.4	279.4	279.4	277.5	277.5	277.5	279.3	279.3	279.3
14-May	29,720	279.4	279.4	279.4	274.0	274.0	274.0	275.0	275.0	275.0	277.6	277.6	277.6	279.3	279.3	279.3	277.4	277.4	277.4	279.2	279.2	279.2
15-May	29,580	279.4	279.4	279.4	274.1	274.1	274.1	275.0	275.0	275.0	277.7	277.7	277.7	279.3	279.3	279.3	277.6	277.6	277.6	279.2	279.2	279.2
16-May	31,200	279.5	279.5	279.5	274.1	274.1	274.1	275.0	275.0	275.0	277.7	277.7	277.7	279.3	279.3	279.3	278.6	278.6	278.6	279.2	279.2	279.2
17-May	32,967	279.7	279.7	279.8	274.4	274.4	274.5	275.2	275.2	275.3	277.9	277.8	277.9	279.6	279.5	279.6	277.6	277.6	277.7	279.4	279.3	279.4
18-May	42,517	279.8	279.7	279.8	274.5	274.5	274.5	275.5	275.3	275.5	277.9	277.9	277.9	279.7	279.6	279.7	277.7	277.7	277.7	279.5	279.4	279.5
19-May	53,800	280.4	280.4	280.4	275.6	275.6	275.6	276.1	276.0	276.1	278.3	278.3	278.3	280.2	280.1	280.2	278.0	278.0	278.1	280.0	279.9	280.1
20-May	50,967	280.2	280.2	280.3	275.5	275.4	275.5	276.1	275.9	276.2	278.3	278.2	278.2	280.0	280.0	280.1	278.0	277.9	278.0	279.9	279.8	279.9
21-May	43,683	280.0	280.0	280.1	274.9	274.9	274.9	275.9	275.9	275.9	278.0	278.0	278.0	278.0	278.0	278.0	279.8	279.8	279.8	279.7	279.6	279.6
22-May	36,367	279.7	279.6	279.7	274.5	274.4	274.5	275.5	275.5	275.7	277.8	277.9	277.9	279.6	279.5	279.5	277.7	277.6	277.7	279.4	279.3	279.3
23-May	30,667	279.5	279.4	279.5	274.0	274.0	274.1	275.3	275.3	275.3	277.8	277.7	277.8	279.4	279.3	279.4	277.5	277.5	277.5	279.1	279.1	279.2
24-May	27,067	279.3	279.3	279.3	273.8	273.8	273.9	275.2	275.2	275.2	277.6	277.6	277.6	279.2	279.2	279.2	277.5	277.4	277.5	278.9	278.9	279.1
25-May	24,733	279.2	279.2	279.2	273.7	273.7	273.7	275.1	275.1	275.1	277.5	277.5	277.5	279.0	279.0	279.0	277.3	277.3	277.3	278.8	278.8	278.8
26-May	22,900	279.0	279.0	279.0	273.7	273.7	273.7	275.0	275.0	275.0	277.4	277.4	277.4	278.9	278.9	278.9	277.3	277.3	277.3	278.7	278.6	278.7
27-May	22,067	278.9	278.9	278.9	273.6	273.5	273.6	275.0	275.0	275.0	277.4	277.4	277.4	278.8	278.8	278.8	277.3	277.2	277.3	278.5	278.5	278.6
28-May	22,067	279.0	279.0	279.0	273.6	273.6	273.7	275.1	275.1	275.1	277.4	277.4	277.5	278.9	278.9	278.9	277.3	277.3	277.3	278.6	278.6	278.6
29-May	42,567	279.7	279.3	280.1	274.4	273.9	275.0	275.7	275.2	275.9	278.0	277.6	278.1	279.7	279.2	280.0	277.7	277.4	277.7	279.5	279.1	280.0
30-May	56,617	280.4	280.4	280.4	275.8	275.8	275.8	276.4	276.4	276.4	278.3	278.3	278.3	280.2	280.2	280.2	278.1	278.0	278.1	280.0	280.0	280.0
31-May	52,150	280.3	280.2	280.3	275.5	275.4	275.5	276.2	276.1	276.1	278.3	278.2	278.2	280.0	280.0	280.0	277.9	277.9	277.9	279.8	279.8	279.8
1-Jun	45,933	280.0	280.0	280.0	274.9	274.9	274.9	275.8	275.8	275.8	278.1	278.0	278.1	279.9	279.8	279.9	277.8	277.7	277.8	279.7	279.7	279.7
2-Jun	39,367	279.7	279.7	279.7	274.6	274.6	274.6	275.5	275.5	275.5	277.9	277.9	277.9	279.6	279.6	279.6	277.7	277.7	277.7	279.5	279.5	279.5
3-Jun	35,200	279.6	279.6	279.6	274.3	274.3	274.3	275.3	275.3	275.3	277.8	277.8	277.8	279.5	279.5	279.5	277.6	277.6	277.6	279.3	279.3	279.3
4-Jun	32,633	279.4	279.4	279.4	274.1	274.1	274.1	275.2	275.2	275.2	277.7	277.7	277.7	279.3	279.3	279.3	277.5	277.5	277.5	279.2	279.2	279.2
5-Jun	30,767	279.4	279.4	279.4	274.0	273.9	274.0	275.1	275.1	275.1	277.7	277.6	277.7	279.2	279.2	279.2	277.6	277.5	277.5	279.1	279.1	279.1
6-Jun	28,833	279.3	279.2	279.3	273.9	273.8	273.9	275.1	275.0	275.1	277.6	277.5	277.6	279.2	279.1	279.2	277.5	277.4	277.5	279.0	278.9	279.0
7-Jun	26,500	279.1	279.1	279.1	273.7	273.7	273.7	274.9	274.9	274.9	277.5	277.5	277.5	279.0	279.0	279.0	277.3	277.3	277.4	278.8	278.8	278.9
8-Jun	24,467	279.0	279.0	279.0	273.6	273.6	273.6	274.9	274.9	274.9	277.4	277.4	277.4	278.9	278.9	278.9	277.2	277.2	277.2	278.8	278.8	278.8
9-Jun	23,867	278.9	278.9	278.9	273.6	273.6	273.6	274.9	274.9	274.9	277.4	277.4	277.4	278.8	278.8	278.8	277.2	277.2	277.2	278.7	278.7	278.8
10-Jun	22,167	278.9	278.9	278.9	273.6	273.6	273.6	274.9	274.9	274.9	277.4	277.4	277.4	278.8	278.8	278.8	277.2	277.1	277.2	278.7	278.7	278.7
11-Jun	21,800	278.9	278.9	278.9	273.6	273.6	273.6	274.9	274.9	274.9	277.4	277.4	277.4	278.8	278.8	278.8	277.2	277.2	277.2	278.7	278.7	278.8
12-Jun	22,467	278.9	278.9	278.9	273.6	273.6	273.6	274.9	274.9	274.9	277.3	277.3	277.3	278.8	278.8	278.8	277.2	277.2	277.2	278.7	278.7	278.7
13-Jun	24,600																					
14-Jun	23,500																					
15-Jun	25,067	279.0	279.0	279.9	273.6	273.6	273.6	274.9	274.9	274.9	277.3	277.3	277.3	278.8	278.8	278.8	277.2	277.2	277.2	278.7	278.7	278.7

Table 4. Hourly summary of American shad passage through the sepentine vertical notch fish ladder at the York Haven Hydroelectric Project in 2009.

Date	11-May	12-May	13-May	14-May	15-May	16-May	17-May	18-May	19-May
Observation Time (Start)	0801	0801	0801	0801	0801	0801	0801	0801	0801
Observation Time (End)	1700	1600	1600	1700	1600	1600	1600	1600	1600
Military Time (Hours)									
0801 - 0900	0	0	7	4	3	5	0	2	1
0901 - 1000	0	6	1	5	4	5	1	2	0
1001 - 1100	2	4	4	5	3	4	0	1	0
1101 - 1200	5	4	2	2	-	5	0	2	3
1201 - 1300	6	3	2	2	3	2	0	3	3
1301 - 1400	6	3	0	5	4	1	0	0	2
1401 - 1500	1	3	2	1	0	3	0	0	0
1501 - 1600	5	2	0	5	0	1	0	1	1
1601 - 1700	0			2					
Total Catch	**25**	**25**	**18**	**31**	**17**	**26**	**1**	**11**	**10**

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)	**0801**	**0801**	**0801**	**0801**	**0801**	**0801**	**0801**	**0801**	**0801**
Observation Time (End)	**1600**	**1600**	**1600**	**1600**	**1600**	**1600**	**1600**	**1600**	**1600**
Military Time (Hours)									
0801 - 0900	4	3	3	8	6	2	2	0	0
0901 - 1000	2	4	0	3	1	1	0	1	1
1001 - 1100	0	6	1	2	1	0	5	0	0
1101 - 1200	5	1	3	1	6	2	1	0	2
1201 - 1300	6	3	5	2	3	8	2	0	1
1301 - 1400	2	1	1	2	0	0	1	1	0
1401 - 1500	7	0	2	1	0	1	1	0	0
1501 - 1600	1	0	2	0	1	2	0	0	0
1601 - 1700									
Total Catch	**27**	**18**	**17**	**19**	**18**	**16**	**12**	**2**	**4**

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)	0801	0801	0801	0801	0801	0801	0801	0801	0801
Observation Time (End)	1700	1600	1600	1600	1600	1600	1600	1600	1600
Military Time (Hours)									
0801 - 0900	2	0	0	3	0	7	0	0	0
0901 - 1000	3	0	0	0	1	1	0	0	0
1001 - 1100	1	0	1	6	2	0	0	0	0
1101 - 1200	2	0	0	4	5	1	0	0	0
1201 - 1300	1	0	4	3	2	3	0	0	0
1301 - 1400	0	0	6	2	0	0	0	0	0
1401 - 1500	7	0	10	1	0	1	0	0	0
1501 - 1600	7	0	4	2	1	0	0	0	0
1601 - 1700	1								
Total Catch	**24**	**0**	**25**	**21**	**11**	**13**	**0**	**0**	**0**

Date	7-Jun	8-Jun	9-Jun	10-Jun	11-Jun	12-Jun	15-Jun		
Observation Time (Start)	0801	0801	0801	0801	0801	0801	0801		
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	**Total**	%
Military Time (Hours)									
0801 - 0900	0	0	1	0	0	0	0	**63**	**15.7**
0901 - 1000	0	0	0	0	0	0	0	**42**	**10.4**
1001 - 1100	0	2	0	0	0	0	0	**50**	**12.4**
1101 - 1200	0	1	0	0	0	0	0	**57**	**14.2**
1201 - 1300	1	3	0	0	0	1	0	**72**	**17.9**
1301 - 1400	0	0	0	0	0	0	0	**37**	**9.2**
1401 - 1500	0	0	0	0	0	0	0	**41**	**10.2**
1501 - 1600	1	0	0	1	0	0	0	**37**	**9.2**
1601 - 1700								**3**	**0.7**
Total Catch	**2**	**6**	**1**	**1**	**0**	**1**	**0**	**402**	**100.0**

FIGURES

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

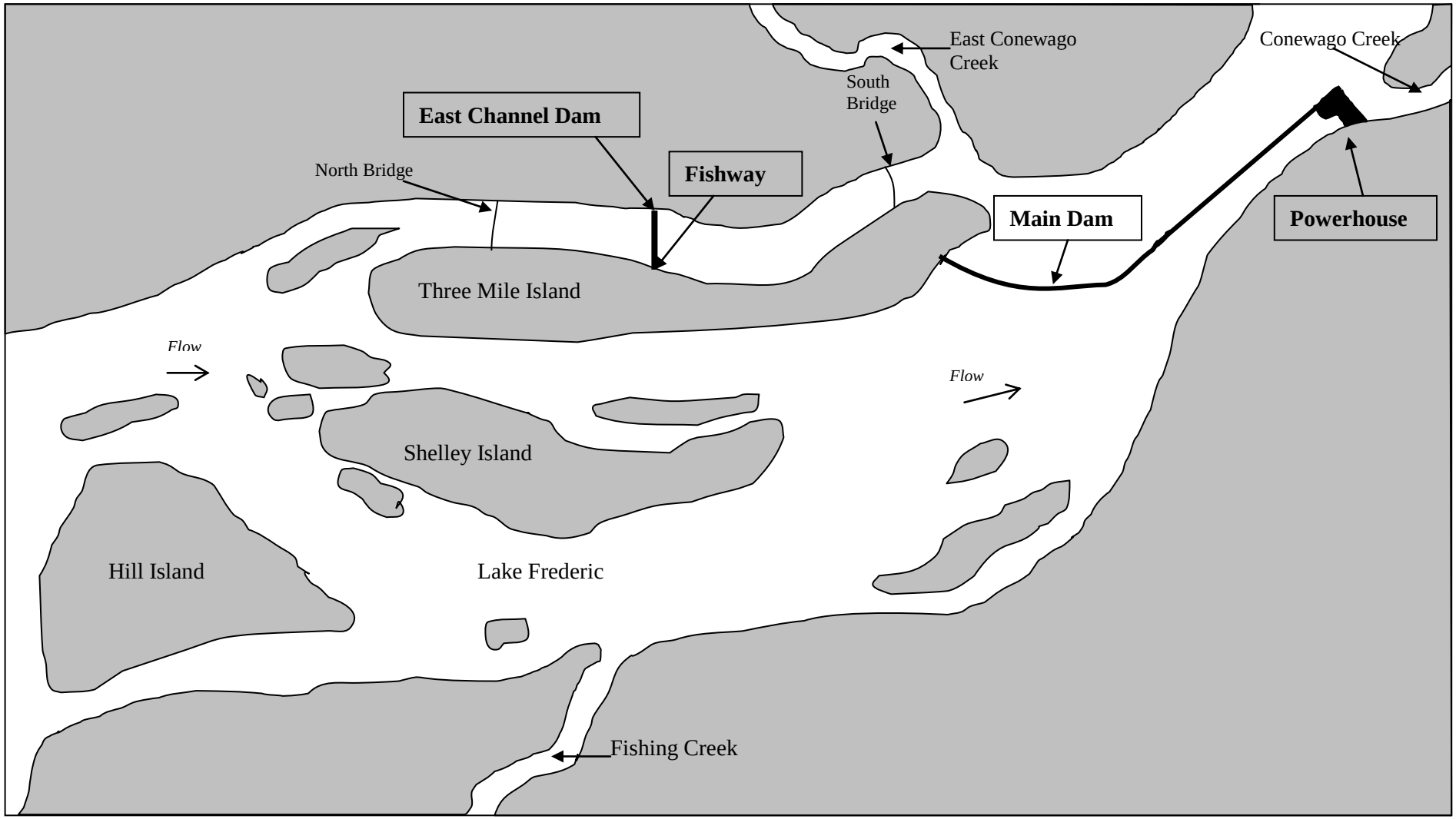

Figure 2. General Arrangement - York Haven Fishway.

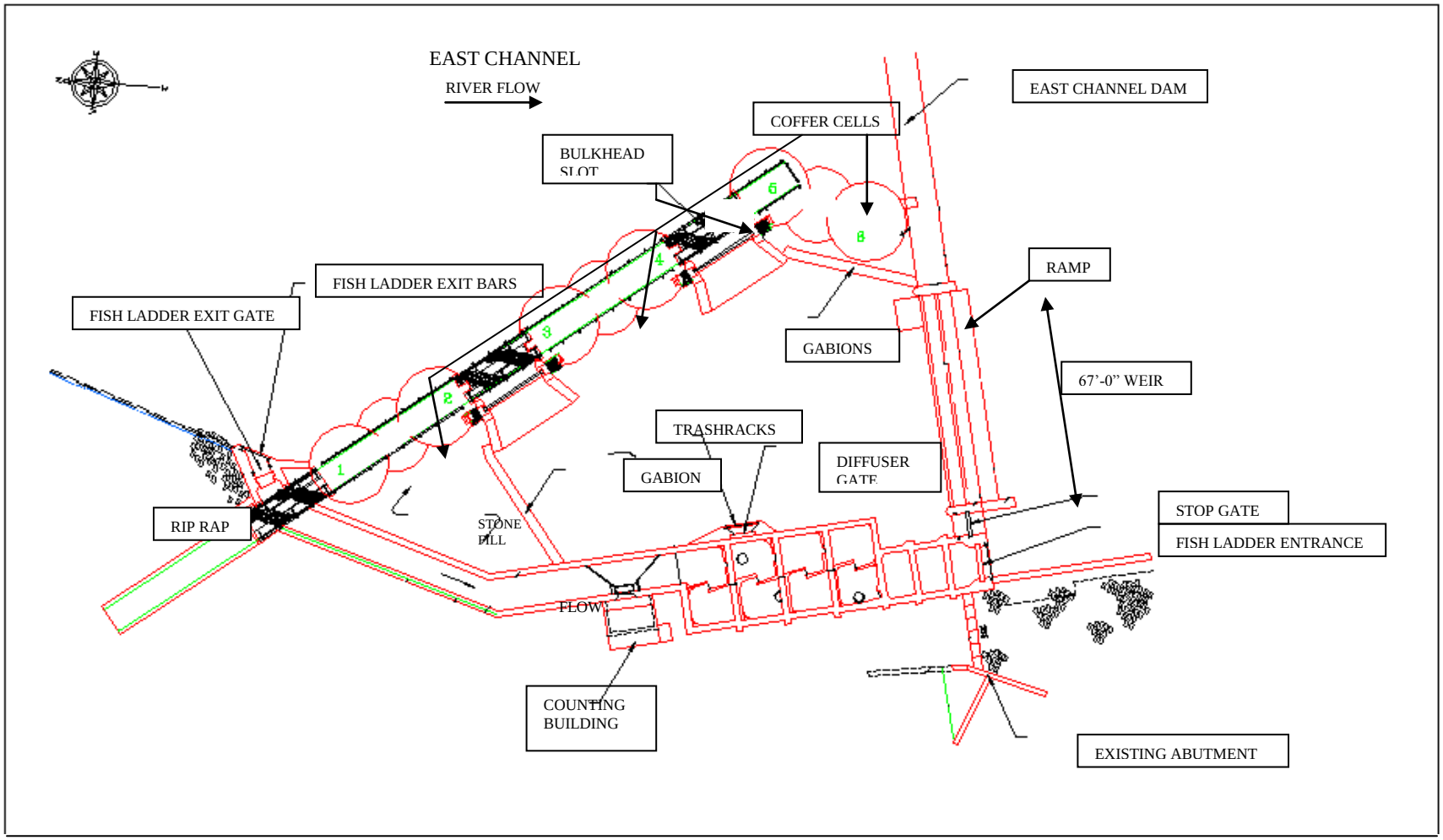

Figure 3. Plot of River Flow (x 1000 cfs) & Water Temperature (F) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2009

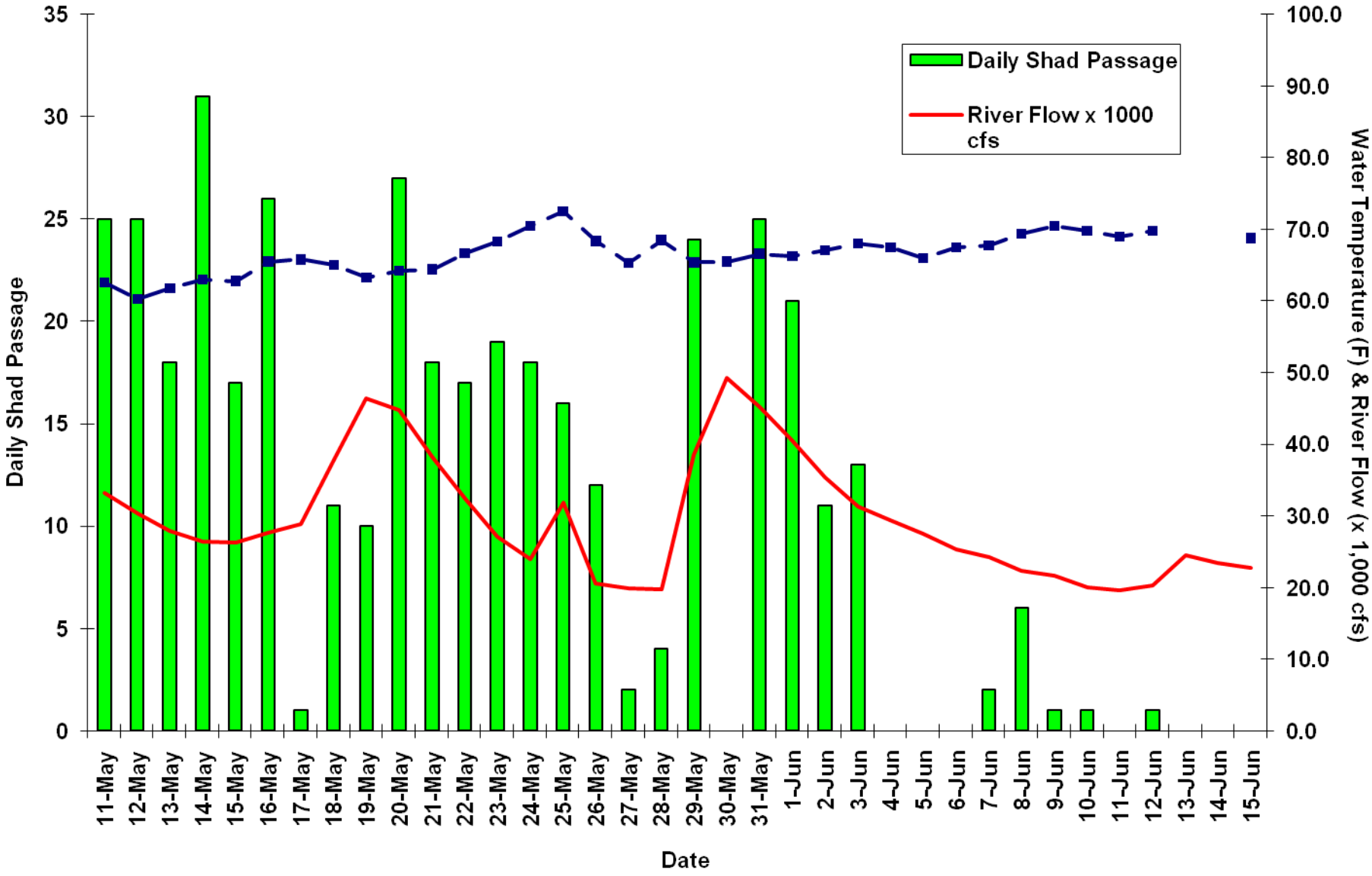

Figure 4. Plot of River Flow (x 1000 cfs) & East Channel Flow (x 1000 cfs) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2009

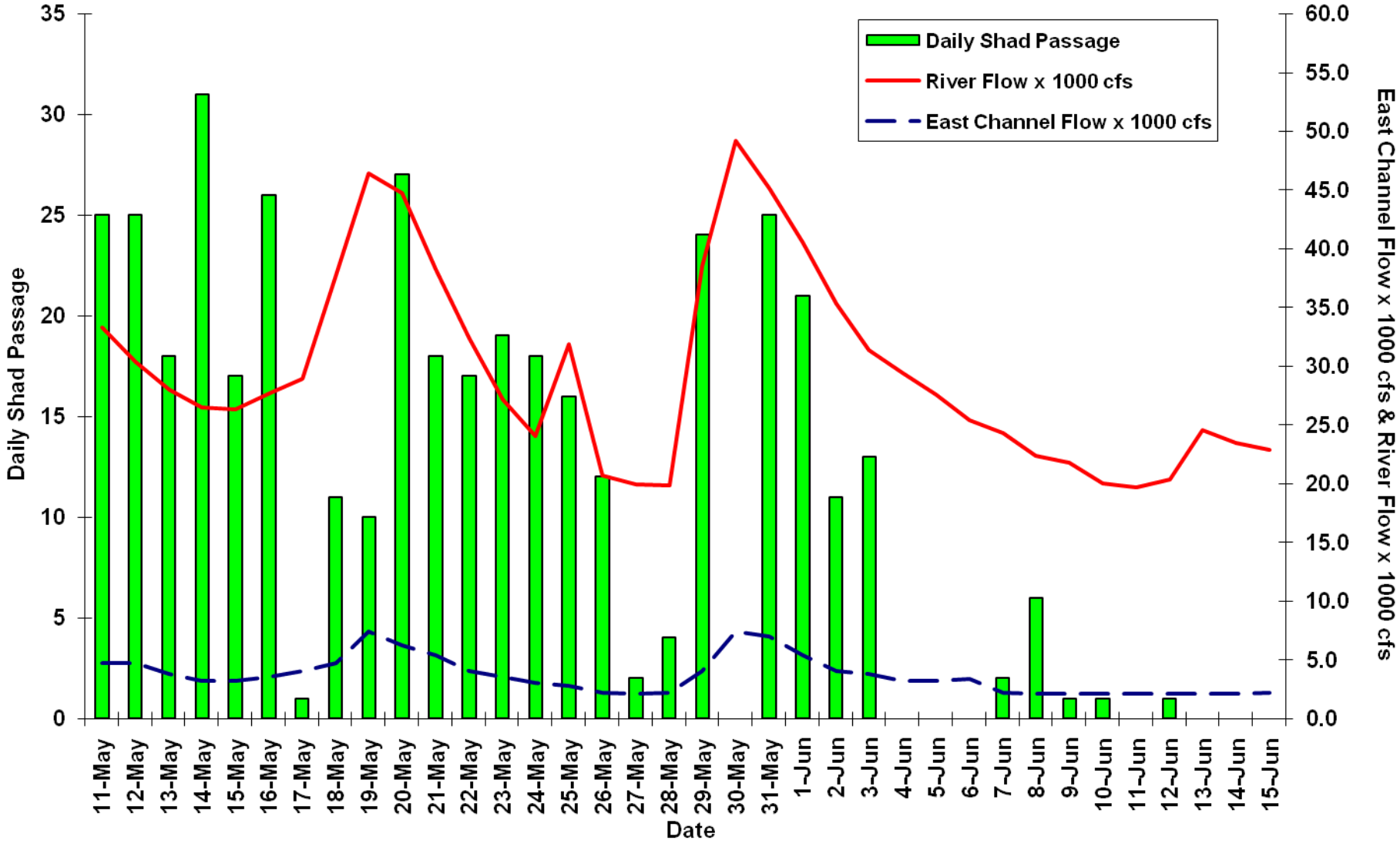

Figure 5. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River and Average Daily Water Temperature at the York Haven Power Station, 18 September to 2 November, 2009