SUMMARY OF UPSTREAM AND DOWNSTREAM FISH PASSAGE AT THE YORK HAVEN HYDROELECTRIC PROJECT IN 2008

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NOVEMBER 2008

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EXECUTIVE SUMMARY

The fish ladder was opened on 9 April allowing volitional (unmanned) passage for 43 days prior to initiating manned Fishway operation. Due to limited shad passage at Safe Harbor in 2008, the Fishway was manned for 12 days between 21 May and 12 June. During this same period fish were allowed to pass on a volitional basis during 11 days. During manned operation a total of 23,028 fish of 16 taxa were enumerated as they passed upstream though the ladder into Lake Frederic. Gizzard shad (15,930) was the dominant fish species passed and comprised over 69% of the fish passed. Passage varied daily and ranged from 303 fish on 21 May to 5,851 fish on 4 June.

A total of 21 American shad passed upstream through the ladder in 2008. Six shad passed in May while 15 passed in June. Most shad (eight) passed on 4 June. American shad were passed at water temperatures of 69.4° F to 74.3° F, and River flows that ranged from 16,200 cfs to 28,100 cfs and East Channel flows of 2,100 cfs to 3,400 cfs (Tables 2 and 3, Figures 3 and 4).

Over 71% of the shad (15) passed between 0800 hrs and 1200 hrs; hourly passage varied from no shad to 5 shad. Six shad passed between 1201 and 1700 hrs. The peak hourly passage of shad (5) occurred on 4 June between 1101 hrs and 1200 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 nine 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 fish began on 29 September when water temperature was 69.0° F. Monitoring continued through 16 November. River flow during this period ranged varied daily and ranged from 3,630 cfs to 19,000 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 that 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 2, 2008. 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 2008, the ninth year of Fishway operation incorporated experience gained during the first eight seasons, along with FPTAC recommendations. Objectives of 2008 operation were to monitor passage of migratory and resident fishes through the Fishway and continue to assess operation and the springtime minimum flow release.

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 2008 season began in late March enabling volitional fish passage (unmanned) through the ladder to commence on 9 April. Only the entrance and exit gate(s) were open during the 43 day unmanned period of Fishway operation between 9 April and 20 May.

Although 1,000 shad had not passed through the Safe Harbor fishway (the agreed upon criteria to initiate manned Fishway operation) manned Fishway operation commenced on 21 May. Due to limited shad passage at Safe Harbor in 2008, the Fishway was manned for 12 days between 21 May and 12 June (21 to 23 May, 27 to 29 May, 3 to 5 June and 10 to 12 June). Fish were also allowed to pass on a volitional basis during this same period on 11 days; volitional passage was provided on 24 to 26 May, 30 May to 2 June and 6 to 9 June. Generally, during manned operation fish were counted and allowed to pass upstream daily between 0800 hrs and 1600 hrs based on shad passage. The decision to stop manned Fishway operation on 12 June was mutually agreed to by members of the FPTAC.

Between 21 May and 12 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 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 12 June, the South fixed wheel gate was closed. On 13 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 20 November

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 1500 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 4 in to 20 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 23,028 fish of 16 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (15,930) was the dominant fish species passed and comprised over 69% of the fish passed. Some 21 American shad were counted as they passed through the ladder. Other predominant fishes passed included channel catfish (3,286), quillback (2,045), walleye (905), and carp (332). Passage varied daily and ranged from 303 fish on 21 May to 5,851 fish on 4 June.

2.4.2 American Shad Passage

A total of 21 American shad passed upstream through the ladder in 2008 (Table 1). Six shad passed in May while 15 passed in June. Most shad (eight) passed on 4 June.

American shad were passed at water temperatures of 69.4° F to 74.3° F, and River flows that ranged from 16,200 cfs to 28,100 cfs and East Channel flows of 2,100 cfs to 3,400 cfs (Tables 2 and 3, Figures 3 and 4).

The hourly passage of American shad through the fish ladder is given in Table 4. Over 71% of the shad (15) passed between 0800 hrs and 1200 hrs; hourly passage varied from no shad to 5 shad. Six shad passed between 1201 hrs and 1700 hrs. The peak hourly passage of shad (5) occurred on 4 June between 1101 hrs and 1200 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 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 9 April allowing unmanned passage for 43 days prior to initiating manned Fishway operation. Due to limited shad passage at Safe Harbor in 2008 the fishway was manned for 12 days between 21 May and 12 June. During this same period fish were allowed to pass on a volitional basis on 11 days. During manned operation a total of 23,028 fish of 16 taxa were enumerated as they passed upstream though the ladder into Lake Frederic.

A total of 21 shad were observed as they passed upstream through the ladder. American shad were passed at water temperatures of 69.4° F to 74.3° F, and River flows that ranged from 16,200 cfs to 28,100 cfs and East Channel flows of 2,100 cfs to 3,400 cfs. Six shad passed in May while 15 passed in June. Peak shad passage occurred on 4 June when 8 shad passed. Most shad (15) passed through the ladder between 0800 hrs and 1200 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 continue to build on the previous nine 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 August, 2008. During this period (6 June to 27 August) station personnel opened the trash sluice opened on 17 days. This observation process will continue in 2009.

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 29 September when water temperature was 69.0° F and River flow at Harrisburg had increased to 19,000 cfs. Monitoring continued through 16 November. River flow during this period varied daily and ranged from 3,630 cfs to 19,000 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 monitored the forebay nightly for fish activity.

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 2008. No juvenile shad were collected at Columbia while haul seining and only one juvenile shad had been collected in the lift net at the Holtwood station through mid-November.

4.0 LITERATURE CITED

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White. D.K., and J. Larson. 1998. Model study of the fish passage facility at the East Channel Dam York Haven Project. Alden Research Laboratory, Inc. August, 39 pp.

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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 2008.

Date	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May
Observation Time (hrs.)	9.0	8.0	7.0	-	-	-	8.9	8.0	9.0	-
Water Temperature (^{o}F)	58.1	60.9	58.3	-	-	-	71.6	69.8	69.4	-
AMERICAN SHAD	0	0	0	-	-	-	2	2	2	-
ALEWIFE	0	0	0	-	-	-	0	0	0	-
BLUEBACK HERRING	0	0	0	-	-	-	0	0	0	-
GIZZARD SHAD	273	350	369	-	-	-	750	468	770	-
HICKORY SHAD	0	0	0	-	-	-	0	0	0	-
STRIPED BASS	0	0	0	-	-	-	2	0	0	-
WHITE PERCH	0	0	0	-	-	-	0	0	0	-
AMERICAN EEL	0	0	0	-	-	-	0	0	0	-
RAINBOW TROUT	1	0	0	-	-	-	0	0	0	-
BROWN TROUT	0	1	0	-	-	-	0	0	0	-
MUSKELLUNGE	0	0	0	-	-	-	0	0	0	-
CARP	0	1	12	-	-	-	31	59	43	-
QUILLBACK	4	11	163	-	-	-	328	158	54	-
NORTHERN HOGSUCHER	0	0	0	-	-	-	0	0	0	
WHITE SUCKER	0	4	3	-	-	-	1	2	2	-
SHORTHEAD REDHORSE	4	50	131	-	-	-	45	24	27	-
CHANNEL CATFISH	6	16	26	-	-	-	130	346	86	-
PUMPKINSEED	0	0	0	-	-	-	1	0	0	-
BLUEGILL	0	0	0	-	-	-	0	0	0	-
SMALLMOUTH BASS	0	3	29	-	-	-	39	23	16	-
WALLEYE	15	105	121	-	-	-	68	71	44	-
FALLFISH				-	-	-				-
Total	**303**	**541**	**854**	-	-	-	**1,397**	**1,153**	**1,044**	-

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.)	-	-	-	8.8	9.0	7.8	-	-	-	-
Water Temperature (^{o}F)	-	-	-	74.3	74.0	72.5	-	-	-	-
AMERICAN SHAD	-	-	-	3	8	4	-	-	-	-
ALEWIFE	-	-	-	0	0	0	-	-	-	-
BLUEBACK HERRING	-	-	-	0	0	0	-	-	-	-
GIZZARD SHAD	-	-	-	4428	4376	1698	-	-	-	-
HICKORY SHAD	-	-	-	0	0	0	-	-	-	-
STRIPED BASS	-	-	-	0	0	1	-	-	-	-
WHITE PERCH	-	-	-	0	0	0	-	-	-	-
AMERICAN EEL	-	-	-	0	0	0	-	-	-	-
RAINBOW TROUT	-	-	-	0	0	0	-	-	-	-
BROWN TROUT	-	-	-	0	0	0	-	-	-	-
MUSKELLUNGE	-	-	-	0	0	0	-	-	-	-
CARP	-	-	-	21	53	28	-	-	-	-
QUILLBACK	-	-	-	172	361	46	-	-	-	-
NORTHERN HOGSUCHER	-	-	-	1	0	0	-	-	-	-
WHITE SUCKER	-	-	-	2	0	0	-	-	-	-
SHORTHEAD REDHORSE	-	-	-	5	3	1	-	-	-	-
CHANNEL CATFISH	-	-	-	428	968	235	-	-	-	-
PUMPKINSEED	-	-	-	0	0	0	-	-	-	-
BLUEGILL	-	-	-	0	0	0	-	-	-	-
SMALLMOUTH BASS	-	-	-	18	3	1	-	-	-	-
WALLEYE	-	-	-	158	79	7	-	-	-	-
FALLFISH	-	-	-	0	0	0	-	-	-	-
Total	-	-	-	**5,236**	**5,851**	**2,021**	-	-	-	-

Table 1. Continued

Date	10-Jun	11-Jun	12-Jun	Total
Observation Time (hrs.)	7.7	9.0	8.0	**100.2**
Water Temperature (^{o}F)	84.2	82.4	82.4	
AMERICAN SHAD	0	0	0	**21**
ALEWIFE	0	0	0	**0**
BLUEBACK HERRING	0	0	0	**0**
GIZZARD SHAD	869	862	717	**15,930**
HICKORY SHAD	0	0	0	**0**
STRIPED BASS	0	2	0	**5**
WHITE PERCH	0	0	0	**0**
AMERICAN EEL	0	0	0	**0**
RAINBOW TROUT	0	0	0	**1**
BROWN TROUT	0	0	0	**1**
MUSKELLUNGE	0	0	0	**0**
CARP	35	31	18	**332**
QUILLBACK	457	216	75	**2,045**
NORTHERN HOGSUCHER	0	0	0	**1**
WHITE SUCKER	0	3	0	**17**
SHORTHEAD REDHORSE	1	2	0	**293**
CHANNEL CATFISH	491	392	162	**3,286**
PUMPKINSEED	0	0	0	**1**
BLUEGILL	1	0	0	**1**
SMALLMOUTH BASS	10	5	3	**150**
WALLEYE	154	57	26	**905**
FALLFISH	19	17	3	**39**
Total	**2037**	**1587**	**1004**	**23,028**

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 2008.

	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.
21-May	58,900	8,500	50,400	58.1	12	12	12	CLOSED	280.6	280.4	280.8	276.0	276.0	276.0
22-May	56,400	8,300	48,100	60.9	18	18	18	CLOSED	280.4	280.4	280.4	275.9	275.8	276.0
23-May	51,200	6,400	44,800	58.3	20	20	20	CLOSED	280.2	280.2	280.2	275.5	275.4	275.6
24-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-May	28,100	3,400	24,700	71.6	15	15	15	CLOSED	279.6	279.6	279.6	274.1	274.1	274.1
29-May	25,900	2,150	23,750	69.8	20	20	20	CLOSED	279.4	279.3	279.4	273.8	273.7	273.9
30-May	23,600	2,100	21,500	69.4	15	15	15	CLOSED	279.2	279.2	279.2	273.8	273.7	273.9
31-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun	16,800	2,100	14,700	74.3	17	12	18	CLOSED	278.5	278.5	278.6	273.3	273.3	273.4
4-Jun	16,200	2,100	14,100	74.3	16	12	18	CLOSED	278.4	278.4	278.5	273.5	273.5	273.5
5-Jun	18,300	2,100	16,200	72.5	7	4	12	CLOSED	278.8	278.8	278.8	273.5	273.4	273.5
6-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jun	12,900	2,100	10,800	84.2	12	12	12	CLOSED	278.4	278.3	278.4	273.4	273.4	273.4
11-Jun	11,900	2,100	9,800	82.4	10	10	10	CLOSED	278.0	277.8	278.1	273.4	273.0	273.6
12-Jun	11,500	2,100	9,400	82.4	18	18	18	CLOSED	278.3	278.3	278.4	273.3	273.3	273.3

Table 3. Summary of surface water elevations recorded during operation of the York Haven Fishway in 2008.

		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.
21-May	58,900	280.6	280.4	280.8	276.0	276.0	276.0	276.4	276.4	276.4	278.4	278.4	278.5	280.1	280.1	280.2	277.6	276.6	278.1	279.8	279.8	279.8
22-May	56,400	280.4	280.4	280.4	275.9	275.8	276.0	276.4	276.4	276.4	278.3	278.3	278.4	280.0	280	280.1	278.0	278.0	278.1	279.8	279.8	279.9
23-May	51,200	280.2	280.2	280.2	275.5	275.4	275.6	276.0	276.0	276.1	278.2	278.1	278.2	279.8	279.8	279.8	277.8	277.8	277.9	279.6	279.6	279.7
24-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-May	28,100	279.6	279.6	279.6	274.1	274.1	274.1	274.8	274.7	274.8	277.7	277.7	277.8	279.0	279.0	279.0	277.4	277.4	277.5	279.8	279.8	279.8
29-May	25,900	279.4	279.3	279.4	273.8	273.7	273.9	274.6	274.6	274.6	277.6	277.5	277.6	279.0	279.0	279.0	277.4	277.4	277.4	278.7	278.7	278.7
30-May	23,600	279.2	279.2	279.2	273.8	273.7	273.9	274.5	274.5	274.5	277.6	277.5	277.6	278.9	278.8	278.9	277.3	277.3	277.3	278.5	278.5	278.5
31-May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun	16,800	278.5	278.5	278.6	273.3	273.3	273.4	274.1	274.1	274.2	277.0	277.0	277.1	278.1	278.1	278.2	276.9	276.8	277.0	278.0	277.9	278.0
4-Jun	16,200	278.4	278.4	278.5	273.5	273.5	273.5	274.2	274.2	274.2	277.0	277.0	277.0	278.1	278.1	278.2	277.0	277.0	277.0	278.0	277.9	278.1
5-Jun	18,300	278.8	278.8	278.8	273.5	273.4	273.5	274.2	274.2	274.3	277.2	277.2	277.3	278.3	278.2	278.4	277.1	277.0	277.1	278.2	278.1	278.2
6-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jun	12,900	278.4	278.3	278.4	273.4	273.4	273.4	274.1	274.1	274.2	276.9	276.9	277.0	277.8	277.8	277.9	276.8	276.8	276.9	277.5	277.5	277.5
11-Jun	11,900	278.0	277.8	278.1	273.4	273.0	273.6	274.1	274.1	274.1	277.6	277.6	277.6	277.6	277.6	277.6	276.8	276.8	276.8	277.4	277.4	277.4
12-Jun	11,500	278.3	278.3	278.4	273.3	273.3	273.3	274.1	274.0	274.1	276.9	276.9	276.9	277.6	277.6	277.7	276.8	276.8	276.8	277.5	277.4	277.5

Table 4. Hourly summary of American shad passage through the sepentine vertical notch fish ladder at the York Haven Hydroelectric Project in 2008.

Date	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May
Observation Time (Start)	0800	0800	0800	-	-	-	0806	0800	0800
Observation Time (End)	1700	1600	1500	-	-	-	1700	1700	1700
Military Time (Hours)									
0801 - 0900	0	0	0	-	-	-	0	1	0
0901 - 1000	0	0	0	-	-	-	0	0	1
1001 - 1100	0	0	0	-	-	-	0	0	1
1101 - 1200	0	0	0	-	-	-	0	0	0
1201 - 1300	0	0	0	-	-	-	0	1	0
1301 - 1400	0	0	0	-	-	-	0	0	0
1401 - 1500	0	0	0	-	-	-	1	0	0
1501 - 1600	0	0	-	-	-	-	1	0	0
1601 - 1700	0	-	-	-	-	-	0	0	0
Total Catch	**0**	**0**	**0**	**-**	**-**	**-**	**2**	**2**	**2**

Table 4. ***(continued)***

Date	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun
Observation Time (Start)	-	-	-	-	0810	0800	0810	-	-
Observation Time (End)	-	-	-	-	1700	1700	1600	-	-
Military Time (Hours)									
0801 - 0900	-	-	-	-	0	0	3	-	-
0901 - 1000	-	-	-	-	0	0	1	-	-
1001 - 1100	-	-	-	-	1	1	0	-	-
1101 - 1200	-	-	-	-	1	5	0	-	-
1201 - 1300	-	-	-	-	0	0	0	-	-
1301 - 1400	-	-	-	-	0	0	0	-	-
1401 - 1500	-	-	-	-	1	1	0	-	-
1501 - 1600	-	-	-	-	0	1	0	-	-
1601 - 1700	-	-	-	-	0	0	0	-	-
Total Catch	**-**	**-**	**-**	**-**	**3**	**8**	**4**	**-**	**-**

Table 4. ***(continued)***

Date	8-Jun	9-Jun	10-Jun	11-Jun	12-Jun		
Observation Time (Start)	-	-	0820	0800	0800		
Observation Time (End)	-	-	1600	1700	1600	**Total**	%
Military Time (Hours)							
0801 - 0900	-	-	0	0	0	**4**	**19.0**
0901 - 1000	-	-	0	0	0	**2**	**9.5**
1001 - 1100	-	-	0	0	0	**3**	**14.3**
1101 - 1200	-	-	0	0	0	**6**	**28.6**
1201 - 1300	-	-	0	0	0	**1**	**4.8**
1301 - 1400	-	-	0	0	0	**0**	**0.0**
1401 - 1500	-	-	0	0	0	**3**	**14.3**
1501 - 1600	-	-	0	0	0	**2**	**9.5**
1601 - 1700	-	-	-	0	-	**0**	**0.0**
Total Catch	**-**	**-**	**0**	**0**	**0**	**21**	**100.0**

FIGURES

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

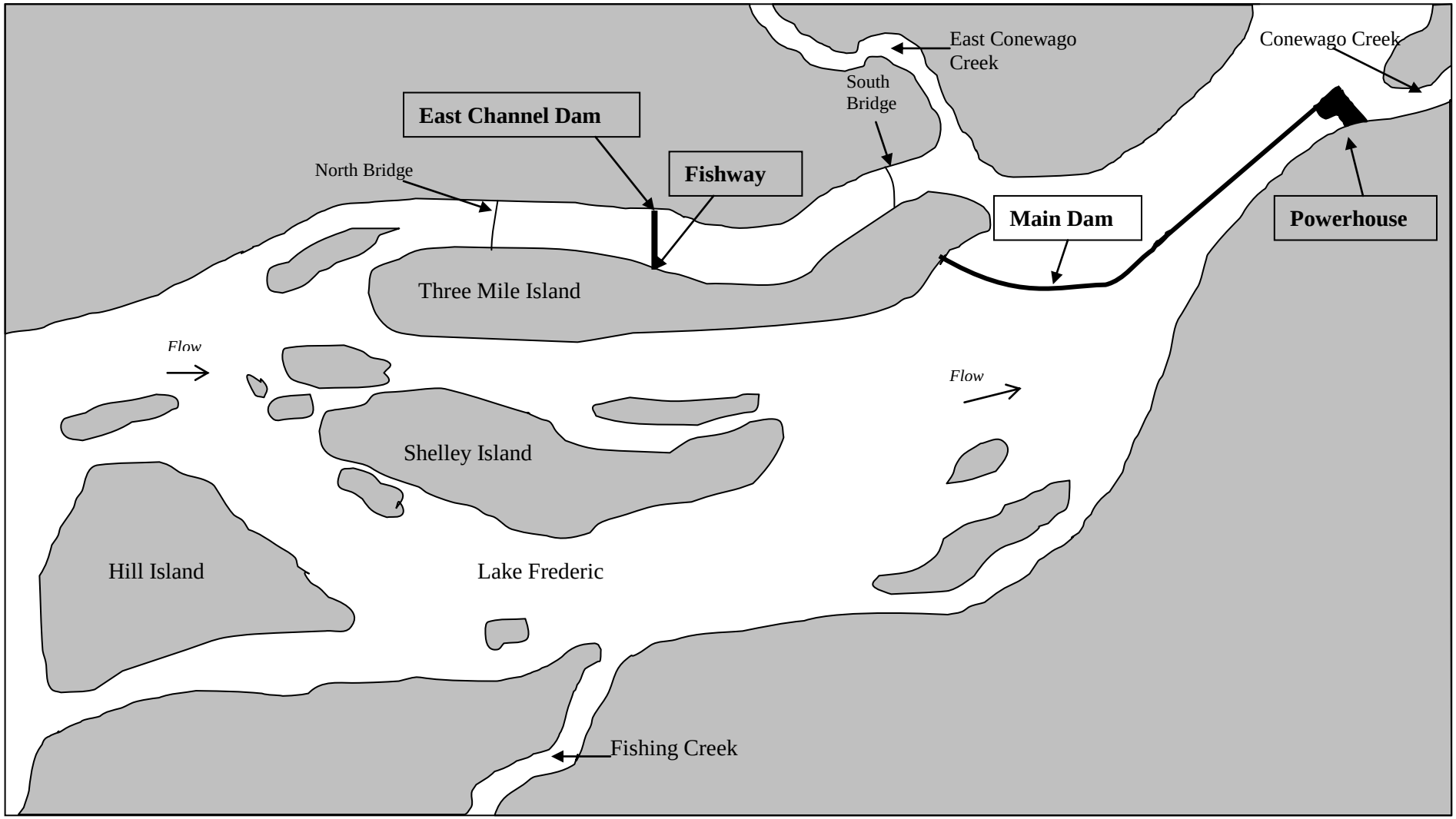

Figure 2. General Arrangement - York Haven Fishway.

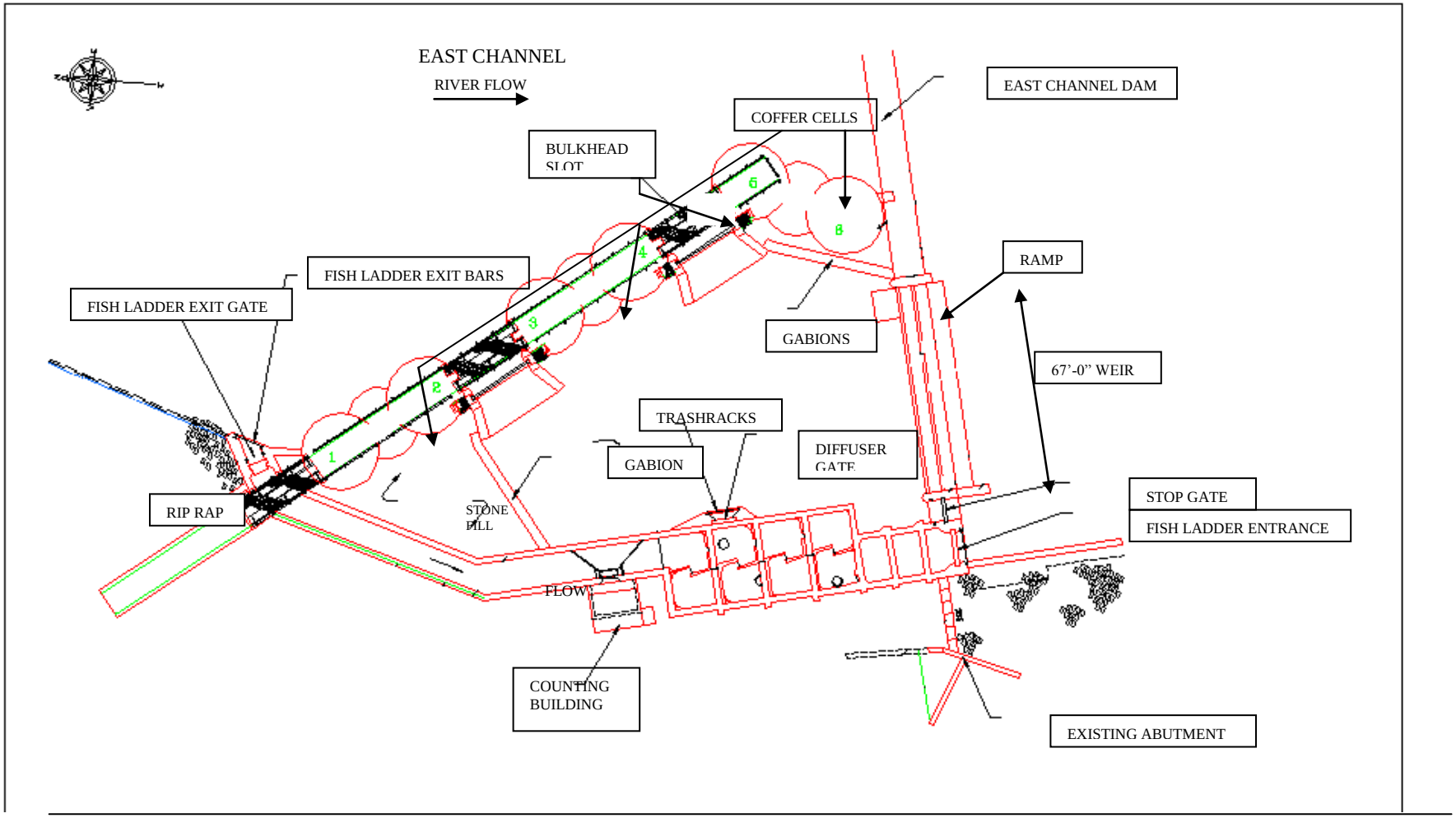

Figure 3. Plot of River Flow (x 1000 cfs) & Water Temperature (F) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2008

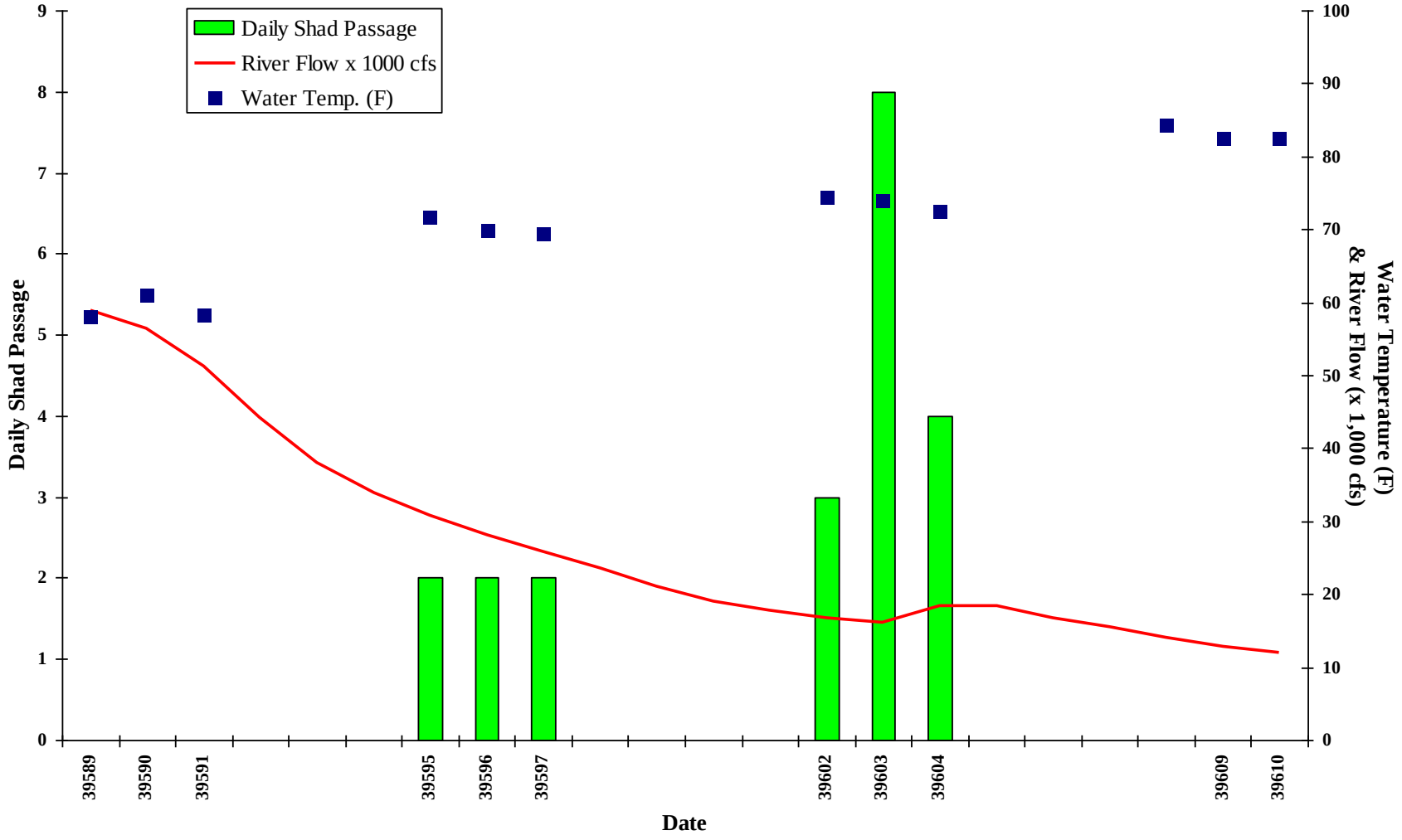

Figure 4. Plot of River Flow (x 1000 cfs) & East Channel Flow (x 1000 cfs) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2008

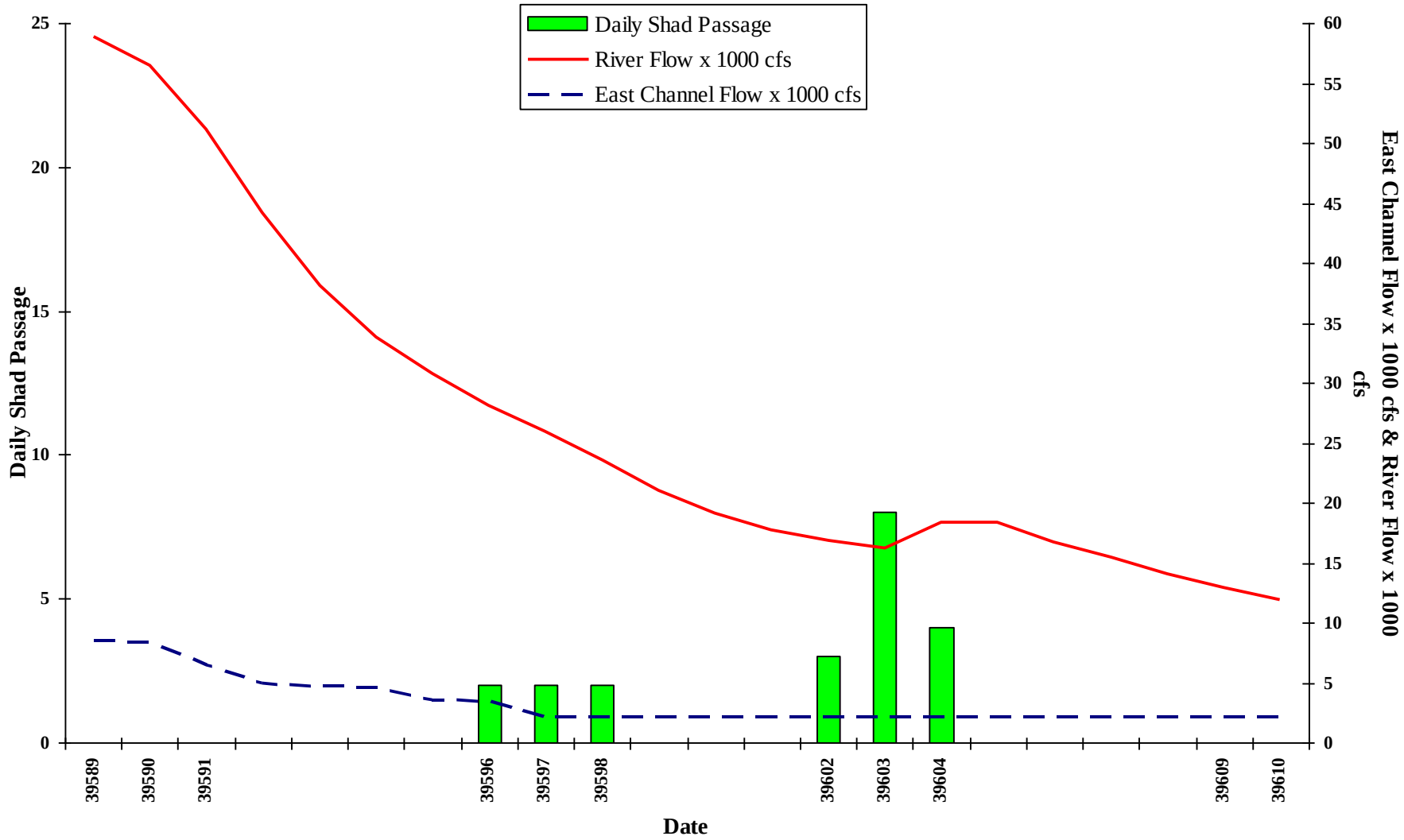

Figure 5. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River, 22 September to 16 November, 2008