Appendix F: Ecology

F-5B Pile Installation Demonstration Project – Fish Monitoring Report

Pile Installation Demonstration Project

Fish Monitoring Report

AECOM

June 1, 2012

20 Exchange Place

New York, NY 10005

Table of Contents

List of Figures

List of Tables

1.0 Introduction

The driving of piles generates underwater sound energy that can cause physical and behavioral impacts to fish. In order to assess potential physical impacts to fish from the driving of piles during the Pile Installation Demonstration Project (PIDP), a fish monitoring program (MP) to assess the extent of such injuries was conducted. During the MP, collected dead and/or injured fish were analyzed (i.e. necropsied) to document whether there were any effects from pile driving.

2.0 Methods

2.1 Fish Monitoring Study Area

Fish monitoring was conducted in the fish monitoring survey areas (FMSA). The FMSAs were 110-acre (ac) hour glass-shaped polygons that encompassed an area north and south of each of the test pile driving locations (PLT 1-4) (Figure 1). The FMSA extended approximately 3,000 feet (ft) north and south of each test pile. Near the pile (Photo 1, Attachment A), the FMSA was approximately 600 ft in width adjacent to the test pile location and increased to 1,000 ft in width north and south of the pile. Within the FMSAs, survey transects were oriented east to west and spaced 300 ft apart. It should be noted that the FMSA identifies the location the survey boats traveled; however at the ends of the transects, scientists using binoculars, observed the adjacent waters outside the FMSAs. Any collected fish was necropsied to determine the cause of injury.

2.2 Monitoring Activities

The MP utilized three monitoring methods to search for and document fish prior to, during, and after pile driving. These methods included:

1) Surface Observations – a boat proceeded along transects within the FMSA noting the presence of fish on the water surface. See subchapter 2.2.1 for a description of the monitoring procedures.

2) Mid-water Observations – a net similar to a Tucker Trawl (Photo 2) was deployed at mid-water depths from a dedicated boat for this survey method throughout the FMSA. In addition, fish were observed within the water column prior to pile driving using an electronic fish finder. Note, a fish finder does not provide information on the number, species, or size of the fish displayed on the screen. See subchapter 2.2.2 for a description of the monitoring procedures.

3) Platform Stationed Scientist – A scientist located on a barge associated with the pile driving (Photo 1) searched for fish on the surface in the vicinity of the pile being driven. See subchapter 2.2.3 for a description of the monitoring procedures.

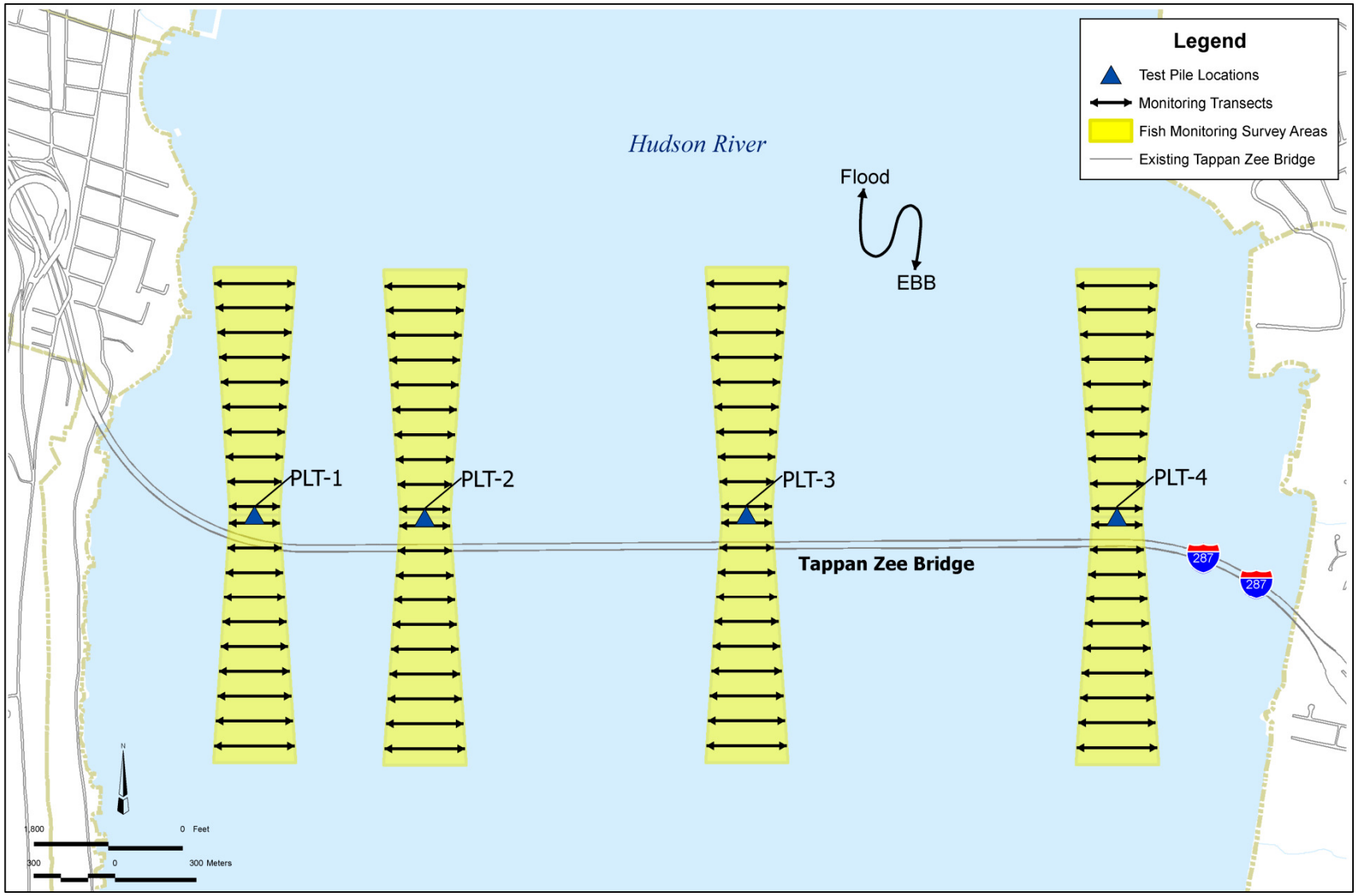

Figure 1 Fish Monitoring Survey Areas

2.2.1 Surface Observations

During a flood tide, the surface water flow of the river is south to north. During an ebb tide, the surface water flow is north to south. Approximately 1 hour prior to pile driving, a boat with AECOM scientists would transit upstream and downstream of the test pile (Photo 1) and search for fish. These observations were conducted by noting the presence of dead or injured fish on the surface and observation of schooling fish near the surface. Any dead fish or injured fish on the surface were collected for further examination.

In order to observe fish that may have been injured or killed during pile driving, the following methodology was used. For pile driving during flood tides, the boat was initially positioned south of the pile (Table 1). During slack and ebb tides, the boat was initially positioned north of the pile. Once pile driving commenced, the boat traversed a series of east/west transects within the FMSA upstream of the pile for a period of 10 minutes. After that period, the boat surveyed transects downstream of the pile for the duration of pile driving and about one hour after pile driving ceased.

Table 1
Fish Monitoring During Tide Stages

Tide Stage	Boat Monitoring Position	Monitor Duties
Flood	1) Boat initially located south of the pile. 2) Boat conducts monitoring transects for 10 minutes south of pile. 3) After 10 minutes, the boat transits north of the pile and conducts monitoring transects for the duration of pile driving and for one hour after pile driving. Transects furthest away from the pile would be surveyed first than each successive transect closer to the pile would be surveyed.	Scientists positioned on the boat so that one scientist is looking behind and north of the boat and the other scientist is looking in front of the boat and south.
Slack and Ebb	1) Boat initially located north of the pile. 2) Boat conducts monitoring transects for 10 minutes north of pile. 3) After 10 minutes, the boat transits south of pile and conducts monitoring transects for the duration of pile driving and for one hour after pile driving. Transects furthest away from the pile would be surveyed first than each successive transect closer to the pile would be surveyed.	

After transiting completely across the FMSA, the boat traveled to the next successive transect. If all transects were completed during the allotted time, the boat returned to the first transect accomplished (in the direction of the prevailing current) and repeated surveying the transects. Should the tide have changed during the monitoring, transects on the opposite side of the pile were surveyed.

The scientists used binoculars to view fish floating on the surface or, in the case of a sea bird capturing a fish, identify the fish to species or lowest possible taxa. When a fish was sighted on the surface, the boat would suspend monitoring along the transect to collect the fish. After a fish was collected, the boat returned to the transect and continued the survey. It should be noted that, AECOM scientists conducting the fish monitoring received prior training from the New York Department of Environmental Conservation (NYSDEC) on the proper handling of Atlantic and shortnose sturgeons.

2.2.2 Mid-water Observations

2.2.2.1 Mid-water Trawls

The NYSDEC requested that a Tucker trawl (photo 2) be employed to collect dead and injured fish in mid-water depths. Trawling using a second boat occurred for one hour prior to pile driving, during the pile driving, and about one hour after pile driving was completed. When conducting trawling operations, a deckhand operated the winch and davit and monitored the tow cable and net. AECOM scientists on the boat supervised the deployment and operation of the trawl as well as observed the water surface for the presence of dead and injured fish.

Trawls were conducted for five minutes each at a speed of approximately four knots (combined boat and current speed) and always into the prevailing current. Once in position, the trawl net was deployed from the boat and towed at mid-water depths. When the trawl was retrieved, the net was brought aboard the boat. The contents of the net were placed in a suitable container on board the boat and examined. Live fish that did not appear to be stunned were returned to the water as soon as possible. The net was then returned to the water to perform another trawl. Just prior to the start of test pile driving, the boat was positioned downstream (in relation to the prevailing current) of the pile at the end of the FMSA.

2.2.2.2 Fish Finder

For a one-hour period prior to pile driving, a boat traveling along the transects of the FMSAs noted fish presence through the use of a fish finder. The fish finder was used to determine the distribution of fish within the water column.

2.2.3 Stationed Observer

The scientist stationed on the barge noted any dead or injured fish on the water's surface prior to pile driving. During the pile driving operations, the scientist viewed the surface of the water in the vicinity of the pile being driven and around the barge. If a dead or injured fish was observed floating on the water's surface, the scientist contacted one of the fish survey boats to collect the fish.

2.2.4 Fish that Were Not Observed

It is possible that there were dead or injured fish that were not collected on the surface or in the mid-water trawl. Although, it should be noted that on days the largest piles were driven (May 14 and May

18) the water very calm (Photos 3 and 4), and it is unlikely and fish floating on the surface were not observed.

On May 24, a 6- to 8-ft long sturgeon was reported to be floating south of the Tappan Zee Bridge near Piermont. A search was conducted for the fish but it was not found. Due to the strong currents of the Hudson River and the fact that pile driving ceased six days prior, it is likely the presence of the reported dead sturgeon in the Hudson River is not related to the PIDP pile driving.

3.0 Observed and Collected Marine Fauna

3.1 Observed Marine Fauna

Prior to pile driving, scientists conducted numerous fish observation transects throughout the FMSA. Use of a fish finder indicated that targets (presumably fish) were distributed throughout the water column and throughout the FMSA. Observations of fish included; fish jumping out of the water, double crested cormorants returning to the surface with fish in their beaks, and gulls diving to feed on fish.

As part of the fish monitoring, two dead striped bass (*Morone saxatilis)* were observed floating on the water's surface, one on April 24 and the other on May 18. Both bass had been dead for several days and were in varying states of decomposition. The fish observed on April 24 was collected prior to the first day of pile driving.

3.2 Collected Marine Fauna

Table 2 identifies the times when trawls were conducted, the number of trawls, and the number of fish captured. Table 2 also identifies the times of pile driving activities.

Table 2

Trawl Sampling Fish Collection and Pile Driving Times

Date (2012)	Survey Periods	Number of Trawls	Number of Fish Collected	Time of Vibration and Impact Hammering*
Apr 28	10:27-11:55	9	13	13:31 - 14:25
	12:30-13:37	9	0	
	14:21-15:37	9	0	
May 2	6:07-6:12; 6:52-6:57; 7:09-8:13	8	0	10:34 - 11:02 Vibrating Pile 1B 11:06 - 12:11 Vibrating Pile 1A
	10:33—13:11	19	11	
May 5	11:02-11:05; 12:01-12:53;	10	6	13:50 - 13:52 Vibrating Pile 1B 13:56 - 13:58 Vibrating Pile 1B
	1:53-14:07; 15:32-20:00	30	90	15:21 - 17:06 Impact hammering Pile 1B 17:24 - 19:24 Impact hammering Pile 1A
May 7	10:30-11:36	8	77	Pile driving postponed

Date (2012)	Survey Periods	Number of Trawls	Number of Fish Collected	Time of Vibration and Impact Hammering*
	13:53-14:51	7	4	
May 8	6:31-7:35; 9:45-12:27	25	129	9:57 - 15:42 Impact hammering Pile 3A
	13:50-16:35	19	49	
May 9	9:14-10:26	9	25	19:33 19:43 Vibrating Pile 4A
	13:07-14:32	12	28	
	16:30-17:33	8	20	
	19:35-19:53	3	25	
May 12	12:58-13:03 13:52-15:00	11	70	Pile driving postponed.
	15:42-16:41	8	53	
May 14	6:59-11:27	33	55	8:03 - 10:23 Impact hammering Pile 4A
May 16	8:59-9:58	7	5	10:49 - 14:05 Vibrating Pile 2B
	11:02-14:39	22	59	11:40 - 11:59 Vibrating Pile 2A
	16:26-19:10	20	52	16:28 - 17:02 Impact hammering Pile 2A 17:20 - 18:13 Impact hammering Pile 2B
May 18	7:17-8:16; 9:08-10:06	17	12	9:02 - 9:22 Vibrating Pile 3B 13:37 - 15:35 Impact hammering Pile 3B
	12:12-16:36	29	44	
Notes: Pile driving times identified above indicate the start and stop of the driving for each pile. It should be noted that within the time periods, pile driving was not continuous.				

A total of eight species were collected during the trawls. Table 3 identifies the collected species.

Table 3

Collected Species

Taxa	Common Name	Scientific name
Crustaceans	blue crab	*Callinectes sapidus*
	shrimp	*Palaemonetes sp.*
	amphipod	Order Amphipoda
Fish	bay anchovy	*Anchoa mitchilli*
	tomcod	*Microgadus tomcod*
	white perch	*Morone americana*
	northern pufferfish	*Sphoeroides maculatus*
	hogchocker	*Trinectes maculatus*

A description of the collected marine fauna identified in Table 2 is provided below.

- Crustaceans – these organisms were rarely collected in the trawl net. Crustaceans were returned to the river and did not appear to exhibit any ill effects from pile driving.

- Bay anchovy – numerous adult and young-of-year bay anchovy (Photo 5) were captured during the trawls. No bay anchovy were observed to be injured or killed as a result of pile driving. On May 18, 2012, bay anchovy were collected approximately 300 ft from the 8-ft pile that was being driven. Those fish exhibited no signs of injury.

- Tomcod – two tomcod (photo 6) were collected. Both individuals were collected on the surface after the driving of the 8- and 10-ft piles. Both individuals exhibited injuries consistent with pile driving operations (See Analysis of Tissues of Fish Exposed to Pile Driving report for more information).

- White perch – two white perch (Photo 7) were observed during the survey. One perch was collected in a trawl on May 5. The fish was not injured and was returned to the river unharmed. The other perch was observed floating on the water surface after the 10-ft pile driving ceased. This fish had injuries consistent with pile driving operations (see Analysis of Tissues of Fish Exposed to Pile Driving report).

- Northern pufferfish - a northern pufferfish (Photo 8) was captured in the trawl on May 5, 2012. The fish was not injured and was returned to the river unharmed.

- Hogchocker – two hogchockers (Photo 9) were captured by trawls. Neither individual exhibited signs of injury from pile driving. These fish were captured in shallow water in the west side of the river. It is likely that the net scraped the bottom and collected these fish, as this species of fish is bottom dwelling. Also, during the monitoring, on several occasions, hogchockers were observed captured and then eaten by cormorants.

4.0 Identified Pile Driving Injuries

Three fish were collected during the fish surveys. The injuries observed in all three fishes were similar to those injuries found during extensive studies of the effects of pile driving on fish conducted over the past several years (see Halvorsen et al., 2011). Thus, it is reasonable to conclude that the injuries seen in the three fish collected during the PIDP were as a result of exposure to pile driving energy.

All three fishes were found downstream from the pile driving operation. While it is not possible to know where the fish was when it was injured, since there was a strong downstream current, it is possible that the fish was close to the pile driving operation, in a region that has the most intense sounds. The locations of where the dead fish were collected are indentified in Table 4.

Table 4

Location of Collection of Dead and Injured Fish

Date	Species	NAD 83 State Plane NY East		Driven Pile	Distance From Pile Fish Recovered
		X	Y		
May 14, 2012	white perch	664062.15	813017.94	10-ft	3,000 ft south
May 14, 2012	tomcod	664403.26	815530.24	10-ft	50 ft south
May 18, 2012	tomcod	660331.60	813283.25	8-Ft	2,700 ft south/southeast

5.0 Conclusions

During the PIDP, fish populations were distributed throughout the FMSAs. Three dead and/or injured fish were collected during or after the installation of the 8- and 10-ft piles; these fish exhibited injuries consistent with pile driving.

During active pile driving, small fish (adult and juvenile bay anchovy) were collected throughout the FMSA, and in some instances within close proximity (about 300 ft) of actively pile driving of an 8-foot pile. None of the anchovies collected in the trawl net showed any effects of pile driving.

6.0 References

Halvorsen, M.B., Casper, B.M., Woodley, C.M., Carlson, T.J., and Popper, A.N. (2011). Predicting and mitigating hydroacoustic impacts on fish from pile installations. NCHRP Research Results Digest 363, Project 25-28, National Cooperative Highway Research Program, Transportation Research Board, National Academy of Sciences, Washington, D.C

ATTACHMENT A

PHOTOGRAPHS

AECOM

PHOTOGRAPHIC LOG

Photo No.	Date:
1	5/14/2012

Direction Photo Taken:

West

Description:

View of the test pile and supporting barges and cranes.

Photo No.	Date:
2	4/24/2012

Direction Photo Taken:

North

Description:

View of Tucker Trawl net being retrieved. The net's mouth measured one meter by one meter. The net was approximately 2.5 meters in length.

Photo No.	Date:
3	5/18/2012

Direction Photo Taken:

West

Description:

View of water surface during the driving of the 8-ft pile. Note the very calm conditions.

AECOM

PHOTOGRAPHIC LOG

Photo No.	Date:
4	5/14/2012

Direction Photo Taken:

north

Description:

View of water surface during the driving of the 10-ft pile. Note the very calm conditions.

AECOM

PHOTOGRAPHIC LOG

Photo No.	Date:
5	5/5/12

Direction Photo Taken:

n/a

Description:

Bay anchovy

Photo No.	Date:
6	5/14/12

Direction Photo Taken:

n/a

Description:

Tomcod in photo was collected on water surface and subsequently necropsied

AECOM

PHOTOGRAPHIC LOG

Photo No.	Date:
7	5/9/12

Direction Photo Taken:

n/a

Description:

White perch

Photo No.	Date:
8	5/5/12

Direction Photo Taken:

n/a

Description:

Northern pufferfish

AECOM

PHOTOGRAPHIC LOG

Photo No.	Date:
9	5/8/2012

Direction Photo Taken:

n/a

Description:

Hogchocker