Proposed Monitoring Plan for Indian Point Energy Center Take of Atlantic and Shortnose Sturgeon by Impingement at Cooling Water Intakes
Revision 3

Presented to:
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1.0 Introduction

1.1 Regulatory Context

On 30 January, 2013, the National Marine Fisheries Service (NMFS) issued a final Biological Opinion (Opinion) and Incidental Take Statement (ITS) authorizing takes of Atlantic and Shortnose Sturgeon during the continued operation of the Indian Point Energy Center (IPEC) pursuant to existing operating licenses and proposed renewed operating licenses to be issued by the U.S. Nuclear Regulatory Commission (NRC). In the Opinion, NMFS addressed Shortnose Sturgeon and the Gulf of Maine Distinct Population Segment (DPS), the New York Bight DPS, and the Chesapeake Bay DPS of Atlantic Sturgeon.

Among other things, the Opinion requires that "Entergy must develop a proposed, draft monitoring plan designed to document all Atlantic and Shortnose Sturgeon impinged at IP1, IP2 and IP3 (trash racks and intake screens) while these facilities are operating under their existing operating licenses and the proposed renewed operating licenses." The Opinion also contains Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T&C) that are to be "developed in coordination with the action agency and applicant, if any, to ensure that the measures are reasonable" (USFWS & NMFS, 1998). This monitoring plan constitutes Entergy's third draft monitoring plan (Revision 3 Monitoring Plan), revised to reflect ongoing consultation with NMFS, under the Opinion.

1.2 Description of IPEC and Operations Relevant to the Proposed Monitoring Plan

Entergy Nuclear Operations, Inc. (Entergy) currently operates two NRC-licensed pressurized water reactors and associated generating units at Unit 2 and Unit 3 (IP2 and IP3; collectively, IPEC). These units condense the steam exiting the turbines by transferring heat to water withdrawn from the Hudson River, which is then discharged back to the river. Maximum cooling water flow is 840,000 gallons per minute (gpm) at each unit (Enercon 2010).

Both IP2 and IP3 also use once-through systems to manage auxiliary heating loads, referred to as service water systems. These service water systems at IP2 and IP3 are significantly smaller than the cooling water systems, with maximum (design) service water flow of 30,000 gpm at IP2 and 36,000 gpm at IP3 (Enercon 2010), although service water flows are typically 15,000 gpm or less for each unit. The cooling water system for Unit 1 IP1 was originally designed to provide 280,000 gpm before the generating unit was retired in November 1974. The cooling water pumps at the IP1 intake were removed in the 1990s, but the IP1 service water system is still operational and provides up to 19,000 gpm of screen wash water and supplemental service water for IP2 when needed.

1.2.1 Cooling Water Intake Structures

Cooling water for IP2 and IP3 is obtained through their respective cooling water intake structures (CWISs), located approximately 700 feet apart along the eastern shoreline of the Hudson River at approximately Hudson River mile 41.8 (41.8 miles upstream from the southern end of Battery Park in lower Manhattan, New York City). The CWISs are located within IPEC's federally mandated Safety and Security Zone (S&SZ).

The IP2 intake structure is located north of the IP1 intake and contains seven bays or channels which are separated by 3-foot thick concrete walls (Figure 1-1). Each intake bay at IP2 is equipped with a debris wall at the outer (western) side that extends to a depth of -1 foot at mean sea level (MSL). A vertical bar rack, or trash rack, with 3-inch open spaces between bars, is also located at the outer (western or upstream) side of the IP2 intake bay to prevent large pieces of debris from entering the structure. The trash racks extend the full height of each IP2 intake bay opening (-27 feet to -1 foot MSL) (Figure 1-2). One optimized traveling screen is located at the inner (eastern or downstream) side of each IP2 intake bay. The chamber between the outer trash rack and the inner traveling screen is referred to as the forebay. Therefore, the submerged dimensions of each forebay at IP2 from the outer trash rack opening to the centerline of the traveling screen are 28 feet high by 13.3 feet wide by 11 feet long. Design velocities through the trash racks for the six cooling water intake bays range from 0.5 to 0.8 fps depending on pumping rate and tide height (Enercon 2010). Design velocity through the trash rack protecting the service water bay in the center of the intake structure at IP2 ranges from 0.06 fps to 0.17 fps (Enercon 2010).

The IP3 intake structure, located south of the IP1 intake, consists of a concrete structure with nine openings which provide flow into a common plenum (Figure 1-3). The seven openings along the outer (western) side of the IP3 intake structure are each equipped with a debris wall and vertical trash rack similar to those at IP2 (Figure 1-4). Partition walls begin to isolate each of the cooling water pumps near the traveling screens, which are 18 feet inward (east) of the vertical trash racks and common plenum at the IP3 CWIS (Figure 1-4). Therefore, the submerged (at plant MSL) dimensions of each forebay at IP3 from the outer trash rack opening to the centerline of the traveling screen are 28 feet high by 13.3 feet wide by 18 feet long. Design velocity through the trash racks is 0.5 fps to 0.9 fps depending on cooling water flow rate and water level (Enercon 2010). Actual velocities through the seven trash racks is less than the design value because there are two additional openings, one at the north end and one at the south end of the structure (Figure 1-3). These openings contain additional trash racks. The design of the IP3 intake structure makes it possible for fish that pass through the trash racks associated with any of the seven openings on the western side of the structure to swim within the structure parallel to the traveling screens and exit the structure through the openings at the north and south ends.

The IP1 intake structure is located between the IP2 and IP3 intakes (south of IP2 and north of IP3) behind a pile-supported dock (Enercon 2010). The IP1 CWIS originally had six conventional traveling screens: four screens servicing the cooling water system that were removed after power generation ceased and two auxiliary screens for the service water system that were replaced with 0.06-inch square mesh dual- flow screens located within the service water portion of each of the two intake bays at IP1. Since IP1 ceased power generation in 1974, the cooling water pumps have been removed, and the intake is now used to supply ancillary service water to IP2, when needed, as well as IP2 screen wash water. The IP1 CWIS was originally outfitted with four trash racks, one at each of four intake bays that were arranged in two sets of two bays each (Attachment 1). The trash racks at the IP1 CWIS were not removed but have deteriorated since power generation ceased. A diver's inspection report from 27 March 2014 verified the absence of trash racks at IP1, and sonar images provided to NMFS on 30 October 2014 confirmed this diver's inspection report. Because the IP1 trash racks have deteriorated, they will not be monitored unless IPEC repairs or reinstalls them or another structure with similar purpose.

1.2.2 Cooling Water Flow Management

The dual speed cooling water pumps at IP2 and variable speed cooling water pumps at IP3 were installed in the mid-1980s to minimize impingement and entrainment of fish by reducing the amount of water used for cooling (Enercon 2010). Since the amount of water needed for efficient operation varies seasonally with the river temperature, cooling water flow is reduced as much as 45% during winter months when river temperature is at its annual low. Lower flow rates not only reduce the amount of water withdrawn, but also reduce the intake velocity, facilitating escapement of fish that otherwise might be susceptible to impingement.

At IP2, each of the six cooling water bays provides water to an individual cooling water pump, which is located 35 feet behind the traveling screens. At the maximum pumping rate (140,000 gpm per pump), the maximum (calculated at mean low water) average through-screen velocity for the IP2 traveling screens is calculated as 1.6 fps (Enercon 2010). The IP2 cooling water pumps can also be operated at 84,000 gpm, which proportionally reduces the calculated maximum average through-screen velocity to 1 fps. For the service water intake bay at IP2, the calculated maximum through-screen velocity is 0.35 fps when all six service water pumps are operated at a maximum (design) capacity of 30,000 gpm.

The six IP3 cooling water pumps, each enclosed in an intake bay and located 28 feet behind the traveling screens, have a continuously variable capacity between 70,000 gpm and 140,000 gpm. Three of the bays are also equipped with 3,200 gpm screen wash pumps that wash seven traveling screens. The seventh bay, located in the center of the structure, provides water to the six service water pumps, which have a maximum combined capacity of 36,000 gpm. As at IP2, the maximum average through-screen velocity for the cooling water bays at IP3 is calculated as 1.6 fps (Enercon 2010), and is 0.4 fps for the service water bay at full flow.

The dual-flow screens in the IP1 intake filter the water drawn by the single 16,000-gpm service water pump and the two 1500-gpm spray wash pumps in each of the two intake bay sets. The screens are washed automatically when water level differences between the front and back of the screens exceed predetermined settings. Materials removed from the traveling screen mesh are sluiced to the Hudson River in the wash water flow. During normal operation only one of the two service water pumps and two of the spray wash pumps is in operation at any given time at IP1(Enercon 2010).

1.2.3 Optimized Ristroph-Type Traveling Water Screens

The IP2 and IP3 intakes are outfitted with optimized Ristroph-type traveling screens and fish handling and return systems. The Ristroph-type screens and fish return systems were operational at IP3 in 1990, and at IP2 in 1991, following a collaborative research, design, and validation effort among the former owners of IP2 and IP3, the New York State Department of Environmental Conservation (NYSDEC), and the then scientific advisor to the Hudson River Fisherman's Association (HRFA, now Riverkeeper).

The Ristroph-type screens are located between the trash racks and the cooling water pumps at the CWIS and have the following features to protect the aquatic organisms impinged:

- **Dual-speed continuous rotation -** The screens are rotated continuously. Under low debris loading conditions, the screens are rotated at 2.5 fpm and under high debris loading at 10 fpm. Impingement on the screens and mortality of those organisms that are impinged is less likely to occur when low through-screen velocities are maintained by the continuous removal of debris. Continuous rotation also minimizes the time that impinged organisms are retained on the screen panels or in the fish buckets. These features significantly reduce the potential stress on impinged organisms.
- **Smooth screen mesh -** The 0.5 inch × 0.25 inch clear opening slot mesh on the screen panels is smooth, to minimize abrasion to fish transferred into the fish return systems.
- **Flow deflector lip on fish buckets -** The curved lip at the leading edge of the fish buckets is designed to minimize vortex stress on fish inside the buckets. The lip eliminates turbulent flow in the interior of the buckets and provides sufficient water depth to allow fish to maintain a stable, upright position (Fletcher 1985).
- **Dual-pressure spray wash systems -** The screens encounter a series of spray washes in the operating rotation. First, high-pressure sprays are used to remove debris from the screen mesh surface. During this process, deflector plates are used to protect aquatic organisms in the fish buckets. Low-pressure sprays are then used to gently remove aquatic organisms from the fish buckets for release through the fish return system. Finally, another series of high-pressure sprays is used to wash off any remaining debris to prevent “carryover” into the intake bays and assist in maintaining the available open area of each screen panel to reduce the potential for impingement.

The current fish handling and return systems at IPEC also incorporate several design features specifically selected to enhance the survival of impinged fish that are returned to the river:

- Separate fish return and debris return systems are provided.
- Fish return systems have smooth surfaces and gentle transition sections to minimize the potential for fish abrasion during transport.
- Design water depths are maintained to allow the fish to remain in a stable, upright position during transport.
- Design trough and sluice water velocities are maintained between 2 fps and 5 fps, which are sufficient to transport the organisms back to the river while minimizing stress during transport.
- Return pipe discharge locations were selected following dye and fish release studies to minimize the potential for re-impingement.

Collectively, the optimized Ristroph-type screens and the fish return systems reflected a first-in-kind design when installed, and continue to reflect state-of-the-art design today. The effectiveness of the modified Ristroph-type screens in reducing impingement losses was demonstrated in studies showing the technology to be fully optimized as BTA for impingement (Fletcher 1990), a conclusion supported by the inclusion of the IPEC configuration as BTA for impingement on a nationwide basis (USEPA 2011).

Entergy proposes to continue operating IPEC using this system for the duration of its operating licenses, or until a different system is determined to be BTA for the IPEC facility as a result of a final NYSDEC determination and the alternative system can be permitted, constructed, and installed.

2.0 Program Components

Consistent with prior consultation with NMFS under the Opinion, we have defined the following terms to differentiate three types of studies requested and proposed in this Revision 3 Monitoring Plan, as follows:

- Feasibility Study –Reasonable effectiveness testing of a technology (like sonar) for a duration of up to one year. Being relatively temporary in nature, it is expected that there will be relatively few plant modifications needed to implement most expected types of feasibility studies at IPEC relating to the Opinion. The feasibility study will include a phase of preliminary equipment trials.
- Pilot Program – A subsequent evaluation of a technology determined to be feasible at IPEC to provide the desired information under seasonally varying conditions, among other factors. The pilot study is expected to extend beyond one year, as necessary to inform the statistical method for long-term monitoring.
- Approved Monitoring Program – Subsequent monitoring of sturgeon at IPEC that has been approved and will continue annually to the extent required by NMFS.

Descriptions of the materials, methods and implementation schedules for feasibility or pilot studies at the IPEC trash racks and intake forebays, for monitoring the traveling screens, as well as collecting ancillary data associated with sturgeon occurrences, are set forth in the program components below (with references to the specific section of the Opinion in which the program element is specified).

The primary objective of the Feasibility Studies is to develop methods using sonar technologies to monitor the presence of Shortnose and Atlantic Sturgeon at the trash racks and forebays of IP2 and IP3. As with all feasibility-level studies, equipment selection and deployment, data collection and analysis, and overall performance will be evaluated, reviewed and refined throughout the course of the study as feasible adaptations or improvements are identified. In addition, because this is the first monitoring effort to utilize advanced acoustic technologies at the Indian Point Energy Center to examine potential incidental takes of sturgeon, site-specific constraints to certain monitoring approaches may be identified and require further evaluation. However, after careful consideration by the Entergy team, the use of sonar technologies to collect these data, in a tiered and layered approach (i.e., overlapping various sonars with different resolutions and ranges) as further discussed below, will support the goals of the NMFS's Biological Opinion.

Entergy has designated a crew of sonar and biological specialists for a minimum of 2 days per week on the following monitoring items, in addition to other areas for the duration of this Feasibility Study.

The one-year Feasibility Study is divided into quarters, with goals to be obtained/identified for each quarter. Separate considerations will be specific to areas of the intakes, such as the forebays and trash racks, and these will be addressed separately in the following sections.

The quarterly goals are as follows:

1. Quarter 1: Focus on means and methods to monitor the trash racks with one or more of the proposed sonar systems to establish which system can collect the best information. Develop reliable methods of data collection, management and refinement. Commence preliminary inspection studies of a single trash rack per unit to start working through/gain greater understanding of the logistics involved with future trash rack monitoring, in anticipation of scaling up efforts over the course of the Feasibility Study. Initiate plant and engineering review of logistics involved with studies of the forebay areas. Installation of trial sonar in Unit 3 forebay.
2. Quarter 2: Continue efforts that require additional preparation time, such as studies within the forebays due to plant safety and engineering review initiated in the first Quarter. Further refine and develop the study plan, which will include real-time data on plant operations and weather-related factors. Compare findings with available research to further refine the process. Determine the logistics of expanding the number of trash racks studied. By the end of the second quarter, select the optimal sonar system(s) evaluated with the goal of keeping that system in place for further studies and refinement for the remaining portion of the Feasibility Study.
3. Quarter 3: Evaluate how sonar systems and methods need to be adjusted/refined at the trash racks and within the forebays to address winter weather conditions (e.g. freezing temperatures, ice formation, extended periods of foul weather). Initiate development of data collection and monitoring methods in anticipation of Pilot Study commencement.
4. Quarter 4: Incorporate impingement experiments into the study which will entail securing fish to the trash racks to test capabilities of different sonars to recognize an impinged fish - assuming that a naturally occurring impinged fish event(s) has not already occurred in an earlier quarter(s). It should be noted that Entergy is awaiting guidance from NMFS on the most appropriate species and size of fish to use for these experiments. This will support the transition into the Pilot Study phase of the monitoring plan at the site. This quarter will additionally provide contingency time for any additional testing and refining that Entergy may deem necessary.

During each quarter, strategies may be revised as needed in response to findings or observations of that quarter. Results will be shared with NMFS in one Feasibility Study Report at the end of the study period.

2.1 Trash Rack Feasibility Studies

Monitoring sturgeon at the trash racks is specified by RPM#1, and T&C#s 1.a, 1.b, and 1.c of the Opinion and will be performed by S. T. Hudson Engineers Inc.

In preparation of the trash rack studies, we are adapting sonar imaging technologies with methods previously used successfully at this site and other sites for monitoring divers and related siltation issues. These technologies and methods will be used to verify the real time conditions including the potential impingement of sturgeon at the Indian Point plant site. Different sonar technologies have associated strengths and weaknesses (e.g. the ARIS Explorer provides a high resolution, almost video-quality image, but has a limited range, in that it can only view an object less than 15-30 feet away with observable clarity). Most of the limitations of sonar are based on the physical limits of using sound in water and subsequent limits/trade-offs of resolution and range. That said, we intend to continuously review, revise, and improve our efforts, where possible, and address any significant limitations that are identified, by optimizing the most appropriate technology and methods at our disposal. To accomplish this, we intend to initiate studies and testing at the intakes with a minimum of 2 days per week of effort at one trash rack for IP2 and one trash rack at IP3. This effort will commence during the first quarter.

The studies will entail the inspection of the selected trash racks, to look for/verify any impinged sturgeon on the racks using a combination of imaging sonar technologies, the most appropriate of which will be determined over the course of the Feasibility Study. The trash rack studies will be accomplished by comparing successive images collected and recorded by using a sonar technology, at an interval that will be determined and optimized during the Feasibility Study. The studies will be conducted by field personnel trained in underwater inspections and sonar technologies, specifically in industrial and environmentally sensitive applications. The survey team will include supervision by a certified Hydrographer and a fisheries biologist familiar with the technology.

If changes are observed at the trash racks (i.e. the presence of an object such as an impinged fish, new detrital material or unusual debris coverage over a portion of the structure) between successive imaging intervals, further verification of the changes will be conducted using a Remotely Operated Vehicle ("ROV"). The ROV will be outfitted with sonar positioning, a retrieval/ sampling arm, and video capabilities to document the observed object. These findings will be logged and documented through a standard procedure that will be developed during the Feasibility Study. Daily logs and data collection will include related information such as weather, tidal data, temperatures, etc. and plant related information in addition to specific location of observations, pump operational information and water velocities at the trash rack.

Should retrieval of sturgeon be required during the course of the Feasibility Study, these activities will follow the RPMs (2-5) that have been outlined in the Biological Opinion and addressed in detail in Section 2.4.

It is anticipated that over the course of the Feasibility Study, we will be able to further address the following essential components previously identified by NMFS:

- Demonstrate the feasibility of the proposed technology to provide a view of the trash racks clear enough to document impinged fish.
- Demonstrate the efficiency of the detection system (which will likely be a combined configuration of acoustic technologies) and provide detailed plans of verification for the Pilot Study as determined necessary. This will likely be accomplished by first showing the detection of fish at the trash racks, and then developing a plan to define the ability to detect species as previously discussed, with the goal of determining absence or presence of sturgeon impinged on the racks remotely (i.e. sonar(s) only) if possible and with the ROV as necessary, where validation of a fish identification cannot be done remotely and must be physically collected. As previously noted, we will also use the ROV to verify any new anomalies detected on the racks.
- Demonstrate the range of conditions (weather, tides, lightning, turbidity) in which the system is reliable.
- Measure the retention time of sturgeon;
- Evaluate the influence of seasonal, weather, tidal or operational conditions on retention time and/or detection ability; and
- Evaluate the ability to uniquely identify sturgeon impinged on the trash racks.

The number and condition of sturgeon to be collected from the trash racks, if any, will be reported to NMFS (RPM#5). All sturgeon collected from the trash racks will be processed by Normandeau as described in Section 2.4 below.

The previous section addressing goals for Quarter 4 notes the use of introduced fish for impingement detection experiments. It is anticipated that these studies (or impingement events should they occur earlier) will be key to addressing components 1 and 2 as identified by NMFS. It is further noted that NMFS will provide guidance on the appropriate species and sizes of fish to be used for these impingement experiments. Component 3 will be addressed based on the cumulative results collected over the course of the Feasibility Study.

2.1.1 Access to IP2 and IP3 Trash Racks

The following information is provided to further describe relevant details about how the specific structures (IP2 and IP3) will be inspected as currently planned in the Feasibility Study. Additional specifics will be developed as the Feasibility Study continues. Information provided below has been reviewed and developed during the preliminary equipment testing effort at the Indian Point site during the month of June 2014.

As previously stated, inspections of the IP2 and IP3 CWIS have been conducted by IPEC's engineering staff to determine if there are feasible access points to perform acoustic data collection at the trash racks at IP2 or IP3. These inspections focused on access from the bulkheads and decks of the CWISs without significant civil or structural modifications, or the need to significantly modify the security system in these areas. The recent inspections revealed potential deck-level access through narrow slots providing clearance to the water immediately upstream and downstream of the trash racks at IP2 and IP3.

However, due to security issues and added challenges from working at the deck elevations, it has been determined that the majority of trash rack field work during the Feasibility Study will be conducted from boats moored at the face of the intakes. This on-water approach will offer several benefits in verification of the data collected, and in the case that retrieval or verification of observed impinged objects is required, access is significantly enhanced by working at the water level. However, should significant weather-related issues (wind generated waves, floods, or ice) become a challenge, the evaluation and implementation of appropriate inspection sonar will be considered from the walkways adjacent to or above the trash racks during the Feasibility Study, for incorporation into the Pilot Study if necessary.

2.1.2 Trash Rack Studies at IP2 and IP3 (Feasibility Study)

The proposed trash rack studies are designed to observe and quantify the presence of sturgeon, likely moribund or dead sturgeon, which could be impinged on the trash racks as they are carried by the river flow past the plant. Preliminary equipment trials performed in June 2014 successfully showed that sonar imaging technologies are likely the most appropriate methods to observe sturgeon impinged on the trash racks at IP2 and IP3. Access to the fixed trash racks at IP2 and IP3 was available from outside the Protected Area via boat. Mounted sonar technologies from the deck level walkways will also be evaluated as part of the Study.

Sonar technologies evaluated in the preliminary equipment trials included multiple system types that included side scan, scanning, and forward looking sonar systems. At this time, a combination of scanning sonar units, with forward looking sonar (multi-beam) systems, appears to hold the most promise. In addition, pan and tilt units will be included so that the field of view for a system will be enhanced for fixed location applications allowing the observer to "look around" when necessary. All data will be collected in a digital format. As the Feasibility Study continues, acoustic processing software packages will be evaluated to manage and post-process the data.

At this time, we have not selected a specific frequency or beam width of the anticipated sonars to be used. Since some of the different systems have multiple frequency and beam width options, and the benefits of utilizing multiple settings will allow greater reliability of inspection of the intake structures, the optimal settings will be determined over the course of the Feasibility Study.

As noted previously, during the first quarter of the Feasibility Study, we intend to select one trash rack at each unit, and completely image the rack several days each week. A minimum of 2 field days are planned each week, with time shared between each of the study stations both inside and outside the Protected Area (PA), and reviewing data. This will allow the field crew to flexibly manage their time between each of the study stations, and review data, in the most effective manner during this one year period adjusting as needed for weather, equipment, or changes in field conditions that warrant revisions in effort.

2.1.3 Trash Rack Studies at IP1

There are no trash racks at IP1 to monitor, as discussed in Section 1.2.1 above. The relevance of the missing trash racks to NMFS's conclusion in the Opinion is discussed in Attachment 1.

2.1.4 Trash Rack Studies Implementation Schedule, Modifications, and Permits

A proposed schedule is presented in Attachment 2.

2.2 Forebay Feasibility Studies

Monitoring for and removal of sturgeons from the intake forebays (i.e., the spaces between the trash racks and the traveling screens) is specified in RPM#1 and T&C#s 1.d, 1.e, and 1.f. The goal of forebay monitoring is to determine the presence or absence of living, moribund and dead sturgeon in the forebays of IP2 and IP3 and to observe any accumulations of sturgeon there. S.T. Hudson Engineers Inc. will place sonar devices in the forebays and perform Feasibility Studies. Forebay monitoring will not be performed at IP1, because the IP1 CWIS no longer has trash racks that could trap fish within the forebay area, as discussed in Section 1.2.1 above.

The goal of forebay monitoring is to determine the presence or absence of fish, specifically sturgeon, and if sturgeon are present further determine if the fish are living, moribund or dead, and their residence time within the forebays. During the Feasibility Study, sonar devices will be placed in the forebays of IP2 and IP3 and studies will be conducted to evaluate the applicability and efficiency of various sonar technologies and methods in determining the presence/absence of sturgeon, their status (living, moribund, or dead), and the residence time of sturgeon within those areas. Forebay monitoring will not be performed at IP1, because the IP1 CWIS no longer has trash racks that might affect egress behavior of fish in the forebay area.

2.2.1 Access to the Forebays at IP2 and IP3

The forebays of IP2 and IP3 have additional challenges compared to the trash rack structures that will be addressed during the Feasibility Study. The forebays at IP2 and IP3 are located inside the Protected Area of each plant. Access adjacent to the waterline of each forebay is limited without major modifications of the intake structures. The ability to safely install sonar devices has been identified as a challenge, and significant consideration and planning must be given to ensuring the safety of personnel, plant equipment, and any sonar systems that are installed.

Special issues/considerations to be further addressed and reviewed during the Feasibility Study for forebay studies include:

- limited access through structural components of the plant,
- types, size and maintenance of sonar equipment to be placed through access point into the forebays,
- location and geometry (field of view) for various sonar systems and methods,
- bio-fouling of sonar equipment, and
- avoiding potential impacts to plant equipment.

These issues, and others, influence the technology and methods for the Feasibility Study recommended for forebay studies as described in Section 2.2.2 below.

2.2.2 Forebay Studies at IP2 and IP3

During the Feasibility Study, bracket mounting of sonar devices will be tested and further developed as necessary. Due to limited access, no ROV use is currently anticipated for the forebays. We anticipate deploying and testing a potential combination of sonar technologies and alignment geometries with the goal of insonifying the entire forebay area when possible, so that any fish (specifically sturgeon species) entering or departing the area can be observed and those residing within the area of interest will be continuously observed. Once the appropriate configuration is determined, additional levels of imaging will be implemented and evaluated to attempt to verify species.

The Feasibility Study will continue using the selected technology, believed to be at this time a combination of forward looking sonar and scanning sonar systems with pan and tilt units to observe the presence or absence of sturgeon entering, exiting, and present within the forebays of IP2 and IP3. The Feasibility Study will be performed for up to one year to evaluate system performance over the range of conditions (weather, tides, ice flows, debris loading) experienced at IPEC to determine the conditions in which the system is reliable. Special attention will be given to documenting swimming patterns (e.g., general orientation, tail beats, water column location, and swimming direction) and size of the two sturgeon species using the best available acoustic technologies and software to collect and process such data

In addition to quantifying the presence or absence of fish, determining the ability to distinguish sturgeon from other fish then identify sturgeon to species, and determining sturgeon resident times will be evaluated based on comparing results of different sonar technologies. Site-specific conditions and their relationship to any observed sturgeon in the forebays of IP2 and IP3, including plant operations, structural issues, and the effects of weather and tides will also be observed and documented.

It should be noted that our preliminary work to date has determined that access to the single forebay at Unit 3 will require additional logistical efforts currently being evaluated and scheduled to begin by August using access from the deck area inside the PA, at the Unit 3 building. By using a combination of sonar technologies, we believe we will be able to monitor the entire bay from one or two access points. We currently intend to install a sonar system for evaluation on a temporary trial basis for the first quarter of the Feasibility Study, and depending upon those results, the system(s) may remain in place or be modified accordingly for daily/continuous monitoring. Further evaluation and optimization of the study configuration will take place over the course of the Feasibility Study.

For the forebay at Unit 2, monitoring options are limited. Access through the concrete deck is currently not possible and any changes would require significant planning and modification in order to avoid structural issues, potential structural failures, and mitigate safety concerns. Additionally, we have determined that the 3-5 inch gap between the trash bars and the concrete deck is not a viable point of entering sonar equipment into the Unit 2 forebay since the pole lengths, and geometry of the structures make this a difficult, and a low quality access point at best, based on this point in our early evaluation.

We are concurrently evaluating several other access options as the Feasibility Study continues. Since the distance from the face of the trash racks to the face of the Ristroph screen is approximately 7 ft, we are evaluating the possibility of sonar technologies having access through the trash racks from below the concrete wall at elevation -1.0 plant datum. We are also evaluating passing a smaller transducer through the space between the trash rack bars. Further evaluation and results will be summarized in the monthly letter reports.

2.2.3 Forebay Monitoring Implementation Schedule, Modifications, and Permits

As discussed above, additional access logistics planning and engineering evaluations are scheduled to evaluate potential points of access to the forebays. The Feasibility Study for forebay monitoring at IP2 and IP3 is expected to follow different schedules at the respective units due to the anticipated need for unit-specific plant modifications. During the ongoing Feasibility Study, the selected sonar technologies and methods will be deployed, and be continually evaluated and optimized for longer term monitoring for the anticipated duration of one year. A proposed schedule is presented in Attachment 2.

2.3 Approved Monitoring Program at the Ristroph Traveling Screens

Monitoring, detection, and handling of sturgeons that encounter the optimized traveling screen and fish return system is specified in RPM#1 and T&C#1.e of the Opinion. We propose the following sampling approach that will permit accurate estimation of the levels of sturgeon encounters (Cochran 1977), while allowing other fish to be returned rapidly to the river, thus minimizing mortality attributable to the sturgeon monitoring program.

2.3.1 Traveling Screen Sluice Sampling

Stress will be minimized on all fish (including sturgeon) by sampling sturgeon that are collected by the continuously rotated traveling screens during three 24-hour sampling days per week at each operating unit. Traveling screen sluice sampling will occur on each scheduled sampling date if at least one circulating water pump and one traveling screen are operating at each intake. If operational or maintenance issues (e.g., mechanical failure, preventative maintenance, or outages) interfere with the continuous operation of one or more traveling screens at either unit on the scheduled sampling days, sampling will occur from the remaining operating screens on the sampling date or will be rescheduled to another date, and these deviations from the planned schedule will be noted. The statistical theory and equations supporting this sampling design are described in detail in Attachment 3.

To enable IPEC's fish handling and return system to convey live fish promptly back into the Hudson River with minimal stress, sampling will be scheduled for 24 consecutive hours (one sampling day) on three sampling days per week (typically Monday, Wednesday, and Friday). Operation of IP2 and IP3 is very consistent from day to day, including both weekdays and weekends, so sampling on Mondays, Wednesdays, and Fridays are representative of the operational conditions and volume of water withdrawal throughout the year. Daily circulating water flow data will be obtained from IPEC for all non-sampling dates as well as for the sampling dates throughout the monitoring period to document any unexpected short-term deviations from typical withdrawal rates.

Sampling will be accomplished by filtering the screen wash contents from all operating traveling screens at IP1, IP2, and IP3 through sampling nets inserted in the combined return sluices at each unit. At each unit, both the fish sluice and the debris sluice will be sampled. Two blocking nets made of 3/8 inch delta mesh liner and an outer 1-inch knotted-twine chafing net will be inserted into each sluice and held in place by U-channel guides (Figure 2-2), one immediately downstream of the other. The use of two blocking nets in the same sluice will insure that no sturgeon are missed during the time that one of the nets is briefly removed for processing the sample. A minimum water depth of 6 inches in the sluice sections with the nets will be maintained by damming the water with a low (≤ 6-inch) partition in each sluice just downstream of the two nets if necessary, to insure adequate water depth for fish accumulating in the nets.

The pairs of sluice sampling nets for IP2 will be installed and operated in the combined fish sluice and in the combined debris sluice at the north end of IP2 (Figure 2-3). The sluice sampling nets for IP3 will be installed in the fish sluice and the debris sluice outside the southwest end of the IP3 screen house (Figure 2-4). The sluice sampling nets for IP1 will be installed and operated where the combined fish sluice and combined debris sluice exit at the southwest end of the IP1 screen house (Figure 2-5).

Field crews of three will be present continuously to monitor the collection nets during 24-hours of each sampling day to detect and remove each sturgeon shortly after it is collected (usually within a few minutes, but always in less than one hour). One person will be stationed to observe the IP2 sampling nets and adjacent sluices, a second will observe the IP3 sampling nets and adjacent sluices, and the third crew member will move around to check the IP1 nets and the sluices upstream of the sampling nets at all three units. The two technicians monitoring the sluice nets will remove the nets least once per hour or more frequently if needed to avoid excessive accumulation of debris and fish and to be able to remove any sturgeon quickly. The roving third person will systematically inspect the entire sluice system and water boxes at each intake structure for the potential presence of sturgeon, and assist in the processing of any sturgeon collected. The recovery location (sluice, water box, net) and time of each sturgeon will be recorded.

The sampling nets will be cleared frequently so that fish are not overcrowded and not exposed to sampling stress for an extended period of time, by removing one net while the second net continues to sample 100% of the flow through the sluice. The contents of the raised net will be examined, any previously undetected sturgeon will be gently removed to the holding tank, and the remaining fish, invertebrates, and debris will be washed into the sluice flow downstream of the sampling location before replacing the cleared net back in its sampling position. The time of detection and removal to a holding tank will be recorded for any sturgeon found. The two nets will be cleared alternately so that at least one net will be in position at all times, with both in sampling position for most of the time throughout each 24-hour sampling day.

As soon as a sturgeon is observed, it will be removed from the sluice sampling net and placed in a 150-gallon oval holding tank (Figure 2-6) located on the deck level adjacent to the sampler for subsequent processing (described in Section 2.4). The holding tank at each unit will be covered with a mesh panel to prevent fish escapement and the tank will be supplied with a continuous flow of ambient river water from a raw water tap or submersible pump at a flow rate where the volume is replaced every 15 minutes. Water temperature (to the nearest 0.1°C), dissolved oxygen concentration (to the nearest mg/l), and salinity (to the nearest 0.1 PSU) will be monitored and recorded in the water of the holding tank(s) during each interval when one or more sturgeon are being held for processing.

To verify that the combination of the paired sluice sampling nets with frequent examination of the sluice systems upstream of the collection locations effectively prevents non-detection of fish, collection efficiency testing will be conducted on the first sampling date of each month. Fish between 100 mm TL and 600 mm TL will be obtained from prior impingement collections (e.g., white perch, striped bass, or white catfish), NY-certified commercial hatchery operations, or certified local bait dealers as needed and used to determine the collection efficiency of the sluice samplers. Twenty-five dead fish will be marked and introduced into each sampled sluice upstream of the sampling nets. On those dates, all fish species collected in the sluice sampling nets will be examined for marks and collection efficiency fish will be removed before releasing the rest of the fish. The number of collection efficiency fish recovered in the deployed sluice samplers compared to the number released will determine the collection efficiency of the sluice net samplers in each sampled sluice.

2.3.2 Traveling Screen Monitoring Implementation Schedule, Modifications, and Permitting

Once NMFS has approved the final monitoring plan and NYSDEC has approved any modifications to the CWIS within its jurisdiction, reviews required by IPEC and mandated by NRC will be conducted to ensure that continued safe operation of IPEC is not jeopardized by the proposed CWIS sampling activities. Installation of sluice sampling systems at IP1, IP2, or IP3 is not expected to require any major plant modifications. Our proposed traveling screen monitoring in the fish and debris sluices of IP1, IP2 and IP3 were selected to avoid major CWIS modifications at IPEC, and therefore will not require the full process of engineering evaluation, reviews, approvals, design, construction, and testing that could take up to 270 days to complete. This approval process has begun, with the goal of being prepared to initiate traveling screen monitoring five months after NMFS and NYSDEC approve this Revision 3 Monitoring Plan. A proposed schedule is presented in Attachment 2.

The proposed traveling screen monitoring samplers will be inserted into the existing NYSDEC-approved fish return systems without requiring any significant modifications to those systems. The operation of the fish return systems, however, will need to be slightly altered by temporarily interrupting the transit of fish through the sluices with the sampling nets, so that any sturgeon can be collected. Thus, NYSDEC Staff's prior approval may be required before making these procedural changes to the operation of IPEC's fish return system. Consultations will be held with NYSDEC Staff to obtain the necessary approval in advance of sampling.

In the second year of traveling screen monitoring, Entergy will examine the results from the first year to consider and discuss with NMFS whether a variable frequency sampling plan can be implemented in which that sampling effort is redistributed among seasonal sampling strata (Mattson *et al*. 1988) to better reflect the observed seasonality of sturgeon encounters with the optimized travelling screen and fish return system. If a variable frequency sampling plan is not approved by NMFS, monitoring will continue at the frequency of three days per week.

2.4 Fish Handling Procedures

Any Atlantic or Shortnose Sturgeon collected will be processed by Normandeau as required under the federal Endangered Species Act following the stated RPMs and T&Cs of the Opinion. Sturgeon handling procedures are summarized for live fish in Section 2.4.1 and for dead fish in Section 2.4.2. Genetic sample collection is summarized in Section 2.4.3. A full Quality Assurance Plan and Standard Operating Procedures (QA Plan and SOP) will be developed for IPEC sturgeon monitoring once the final Monitoring Plan is approved. Attachment 4 provides our preliminary sampling procedures and a detailed description of sturgeon handling procedures that will be provided in a complete QA Plan and SOP and submitted for NMFS review prior to the start of sampling.

2.4.1 Live Sturgeon

All live sturgeon will be processed as specified in RPM#2 and T&C#3 of the Opinion by the procedures described in this section to check for previously applied tags, measure the length and weight, record any physical abnormalities, photograph, apply a passive-integrated transponder (PIT) tag in each untagged live sturgeon larger than 250 mm TL that was not previously tagged, collect a genetic sample, and release the specimen away from the intake via the existing fish return system.

Previously applied tags could include yellow USFWS Floy tags, Carlin-Ritchie disc tags, or PIT tags. A hand-held PIT tag reader will be used to examine for the presence of internal PIT tags. The tag type and number of any tags found will be recorded and the condition of the tag insertion site will be noted (whether healed or infected).

The total length (TL) will be measured to the nearest mm and the fish will be weighed to the nearest gram.

Any obvious external physical abnormalities, such as fin rot or injury will be recorded on an "Incidental Report Sturgeon Take – Indian Point" form (Section 2.6.1) and photographed.

Photographs will also be taken of all sturgeon to provide verification of the species identification and condition. Digital photographs of each specimen will include a close-up of the eyes with a mm ruler for scale, a close-up of the mouth with a mm rule for scale, a close-up side view of the base of the anal fin to reveal the presence or absence of anal scutes, and lateral views of the left and right side of the fish.

Before a live sturgeon >250 mm TL is released, it will be tagged with a PIT tag (if one is not already present and, if in the judgment of the field crew, doing so would not disable or kill the fish). The tag will be inserted with a large hypodermic needle into the dorsal musculature just anterior and left of the dorsal fin. The copper antenna will be inserted first into the needle so that it is oriented upward near the dorsal surface when inserted into the fish. If necessary, and to ensure tag retention and prevent mortality to small juvenile sturgeon of both species (e.g., 250 mm TL to 350 mm TL), the PIT tag may be inserted at the widest dorsal position just to the left of the 4th dorsal scute. PIT Tags larger than the standard 11.9 mm by 2.1 mm will not be used to tag sturgeon less than 330 mmTL.

The fish will be scanned with the PIT tag reader and the tag number will be recorded. Tagging effects on sturgeon may confound results, and must be accounted for in subsequent assessment.

A genetic sample will be collected by the procedures in Section 2.4.3 from all sturgeon collected and sent every six months to the NOAA archives in Charleston, SC.

Live sturgeon will be released in the screen wash flow through existing return sluices, which were designed to transport fish to properly identified, designated release locations.

2.4.2 Dead Sturgeon

All dead sturgeon will be processed as specified in RPM#3 and T&C#4 of the Opinion. Dead sturgeon will be checked for previously applied tags. External criteria will be used to determine, where practicable, if a dead sturgeon was previously dead in the field at the time of collection, based on signs of life (e.g., body movement or opercular movement) or other indications of death (e.g., red or only slightly faded gill filaments, bodily decay, bleached gill filaments, or other signs of morbidity or death prior to sample collection (King *et al*. 2010). The nature of observed external injuries will be described. Genetic samples will be collected by the procedures in Section 2.4.3 from all dead sturgeons that were not previously tagged. An "Incidental Report Sturgeon Take – Indian Point" form (Section 2.6.1) and a Sturgeon Salvage Form (Section 2.6.4) will be completed for each dead sturgeon. Dead specimens or body parts of Atlantic or Shortnose Sturgeon retrieved from the IPEC intakes will be photographed, measured, labeled with a unique sample number, and retained by freezing until delivered on a NMFS-approved schedule to a qualified individual (recommended by NMFS), to perform necropsies.

2.4.3 Genetic Samples

RPM#4 and T&C#5 of the Opinion requires that a genetic sample will be taken from any live or dead Atlantic or Shortnose Sturgeon collected that was not previously tagged. Genetic sampling procedures will follow the description in the Appendix provided with the Opinion. A new pair of surgical gloves and a new scalpel blade will be used for each individual fish to avoid cross-contamination of genetic material. If obvious contamination is observed, that genetic sample will be discarded. A 1 cm^2 section will be cut from a pelvic fin and placed in a vial of 95% to 100% ethanol that has not been denatured with methanol or other chemical additives. The vial will be taped to prevent leakage, labeled with the sample number and fish identification number using a permanent marker, and sealed in a small Ziploc bag labeled internally and externally with the sample number. All genetic samples collected from alive or dead Atlantic and Shortnose Sturgeon observed while monitoring at IPEC will be accumulated in the field laboratory and shipped once every six months to the NOAA-NOS genetic tissue sample archive in Charleston, SC following the procedures specified in Section 2.6.3 below. Genetic sampling, in connection with tagging, effects on sturgeon may confound subsequent movement and survival, and must be accounted for in subsequent assessment.

2.5 Ancillary Data

2.5.1 Temperature

RPM#1 and T&C#1.l of the Opinion specifies temperature measurements at the trash racks and at the traveling screens, at surface, mid-depth, and bottom for each unit when a take of either species of sturgeon is observed.

RPM#1 and T&C#1.l of the Opinion will be addressed by reporting the measured water temperature for each sampling event when a sturgeon of either species is observed on the trash racks or traveling screens at IP1, IP2, or IP3. A sampling event is defined as the time interval during which the sturgeon was collected. Measured water temperatures will be obtained from loggers (e.g., Onset TidbiT v2 Water Temperature Data Logger) installed in the fish and debris sluices of IP1, IP2, and IP3 at the locations of the sluice samplers that will continuously measure water temperature and log the values at 15-minute intervals. The number of valid temperature observations and the mean, standard deviation, maximum and minimum values will be reported for each sturgeon sampling event.

2.5.2 Water Velocity

RPM#1 and T&C 1.k of the Opinion request velocity information at the trash racks (approach velocity and through the rack), in the intake forebays, and at the traveling screens (both approach velocity and through-screen velocity) at the relevant IPEC units. We interpret the request for velocity data by NMFS as seeking representative conditions, specifically the high and low approach and through-screen velocities on a per-screen representative basis, consistent with a 2-foot square grid across the face of each trash rack and traveling screen under a range of tidal, weather and pump conditions.

The proposed approach to provide the requested velocity data is expected to involve the following, detailed below for the trash rack, forebay and travelling screen locations:

1. Representative water current and/or velocity measurements at the trash racks, consistent with the Opinion.
2. Employing the representative measurements, development of a state-of-the-art computational fluid dynamics (CFD) model of the IP2 and IP3 CWISs parameterized by river flow boundary conditions of ambient river current velocity, flow direction, and tide height measured by acoustic Doppler current profilers (ADCP) in the river near the intakes. The CFD model will establish velocities at the trash racks, within the forebays and upstream surface of the traveling water screens, as described in Attachment 5.

Due to the difficulties of access at the forebays in front of the traveling screens at IP2 and IP3 during station operation (as a function of the confined space and flows), in conjunction with the risk to Station equipment of losses of monitoring systems, direct velocity measurements within the forebays and at the traveling screens of IP2 and IP3 may not be feasible.

2.5.2.1 Measurements at the Trash Racks, Forebays, and Traveling Screens

Water current magnitude measurements will be obtained by S. T. Hudson Engineers Inc. using a Hach® model electromagnetic probe, such as the OTT MF Pro, as recommended by

NMFS (March 2, 2014 correspondence, p. 7). Depending on specific conditions, the probe will be deployed in one of several ways: mounted on a scaled pole or on an appropriately weighted down line, on a ROV platform with a custom built bracket, or by divers if the effort is conducted during the routine screen cleaning. In the case of diver deployment, divers would hold the probe in front and pass it through the fixed bars at IP2 and IP3. For non-diver fixed deployments, water current magnitude measurements will be collected throughout a given tidal cycle at incremental water column depths recorded hourly at each monitoring station for a 12-hour period to establish base line conditions.

The proposed water current measurements will be taken over the course of several complete tidal cycles, or in conjunction with scheduled screen cleaning by divers, in addition to spot checks during various weather conditions and pump operations so it can be considered to represent many expected scenarios. The baseline measurements will also be carried out in conjunction with the proposed sonar imaging to verify any critical areas of blockage or potential hot spots of high water velocity. Special attention will be made to verify and account for conditions due to partially clogged screens or siltation above the floor of the intakes.

Initial measurements will be conducted during the trash rack feasibility study at IP2 and IP3 (Section 2.1.2 above) at representative trash racks on grid locations determined by the range of readings observed during the infield monitoring. Should readings at any trash rack survey grid either exceed the average observed field conditions for that rack (accounting for tide, weather, and pump operations) by more than 0.5 ft/sec or 30%, or exceed 1.47 ft/sec in a specific area, additional readings will be collected at the relevant survey grids. Note that the use of 1.47 ft/sec was specified as a critical threshold velocity below which the probability of entrainment of juvenile sturgeon could be minimized by maintaining dredge head flow fields at less than 1.47 ft/sec (Boysen and Hoover 2009, cited on page 62 of the Opinion).

Once the initial grid readings have been verified as accurate baseline conditions, a single additional survey will be conducted to verify that there are no significant variations relative to the baseline data.

In the forebays and at the traveling water screens of IP2 and IP3, personnel access is limited, making use of divers infeasible. The ability to safely install velocity probes is likewise highly limited, and the risk of loss of mounted equipment to Station structures, operations, and equipment is a serious concern. While the risks to Station structures, operations, and equipment of introducing monitoring devices is also significantly higher and more difficult to protect against, Entergy is willing to explore this option. To do so, and in the interest of safety and operational reliability, we propose collecting water velocity readings accessible by the same velocity probe either mounted on a calibrated pole or on a weighted downline as proposed for use in the trash rack feasibility study (Section 2.1.2 above). Evaluation of these measurements will determine the quality of the data and/or if further evaluation using CFD modeling would address the concerns of NMFS.

In addition to using the referenced water velocity probe deployment, imaging sonar may be used in the accessible areas to verify general conditions and water flow characteristics through a visual method.

Due to the absence of trash racks at IP1, no measurements will be taken at Unit 1. However, should IPEC decide to re-install trash racks at IP1, NMFS will be notified and consulted regarding monitoring of those racks.

2.5.2.2 CFD at the Trash Racks, Forebays, and Traveling Screens

In the absence of, or in addition to, appropriate velocity data at the forebays and at the traveling screens, we propose to use two existing nearfield Hudson River water current data sets to parameterize a computational fluid dynamics (CFD) model of the IP2 and IP3 CWISs. The CFD model will then be used to describe the mean, standard deviation and range of approach and through-screen velocities at a resolution no greater than 1 square foot across the face of each trash rack and each traveling screen operated at IP2 and IP3 under a bounding range of tidal, river flow, weather and intake pump scenarios. The measurements taken as described in the previous section will also be used to calibrate CFD model predictions (Attachment 5).

2.5.3 Plant Operating Data

RPM#1 and T&C 1.m of the Opinion requires that the plant operating conditions at each unit are documented for the previous 48 hours associated with each take, the field staff will contact the control room and obtain and record data provided by the plant operators regarding the number of circulating pumps operating.

2.5.4 Ancillary Data Collection Implementation Schedule, Monitoring, and Permits

Ancillary data collection will be implemented when sturgeon impingement monitoring is initiated. No NRC or State of New York approvals are required before implementation of ancillary data collection. No physical plant alterations are necessary to allow ancillary data collection to be implemented other than affixing temperature loggers in the return sluices near the collection nets.

2.6 Reporting

This section describes procedures for reporting to NMFS all incidental takes of sturgeon and all sample transfers as required by RPM#5 and T&C#s 6, 7 and 8 of the Opinion.

2.6.1 Take Notification

NMFS will be notified within 24 hours of finding any live or dead Atlantic or Shortnose Sturgeon in association with the IPEC intakes as required by RPM#5 T&C#6 of the Opinion. The form for reporting each incidental take of any sturgeon (alive or dead) is shown in Figure 2-7.

2.6.2 Annual Report

An annual report of all incidental takes of Atlantic and Shortnose Sturgeon occurring at the IPEC intakes during each calendar year will be submitted to NMFS and NRC by 15 February of the following year as required by RPM#5 T&C#7 of the Opinion. The annual report will include any necropsy reports of specimens, all incidental take reports, photographs, a record of all sightings of Atlantic or Shortnose Sturgeon in the vicinity of Indian Point, conditions at the time of the take (IPEC operations as well as environmental conditions including water temperature and water flow), and a record of when inspections of the intake trash racks and Ristroph screens were conducted. The report will include a summary table of environmental sampling data in the format specified by NMFS (Figure 2-8). The annual report will also identify any potential measures to reduce Atlantic or Shortnose Sturgeon impingement, injury, and mortality at the intake structures along with any plans to implement those measures.

Following the submittal of each annual report and prior to 15 April of each year, Entergy will participate in a meeting or conference call with NMFS and NRC to discuss the take information of the prior year and any changes to the monitoring program that NMFS, NRC, or Entergy believes are necessary as required by RPM#5 T&C#8 of the Opinion.

2.6.3 Genetic Samples

As specified in the NMFS instructions for collecting, certifying, identifying, and shipping sturgeon tissue samples (Figure 2-9), each shipment of sturgeon genetic tissue samples will be accompanied by (1) a completed Certification of Species, Sample Identification, and Chain of Custody form for each fish (Figure 2-10); (2) a completed Summary Sheet for Genetic Tissue Samples form if the shipment contains multiple samples (Figure 2-11); (3) a completed NMFS Guidelines for Air-Shipment of “Excepted Quantities” of Ethanol Solutions form (Figure 2-12); and (4) a copy of the ESA permit authorizing the collection of the sample(s). Because the origin of impinged fish factors into the take limits specified in the ITS, Entergy requests to receive the results of the genetic analysis as testing is completed on each fish.

2.6.4 Dead Sturgeon or Sturgeon Parts

If any dead specimens of Atlantic or Shortnose Sturgeon are found in association with the IPEC intake sampling procedures specified in this monitoring plan, after they are processed as described in Section 2.4.2, NMFS may request transfer of the specimens to NMFS or to a NMFS-approved laboratory or researcher for necropsy. In addition to the Take Notification form (Section 2.6.1), a Sturgeon Salvage form (Figure 2-13) will also be submitted to an individual or laboratory qualified to perform necropsies and recommended by NMFS, to document the disposition of each dead specimen.

2.7 Training of Field Biologists

Qualifications of all personnel who will be handling sturgeon will include previous training and experience in the implementation of NMFS Permit to Take Protected Species for Scientific Purposes Permit No. 17095 (and its predecessor, Permit No. 1580) for the Hudson River Biological Monitoring Program (HRBMP). All field personnel participating in the IPEC sturgeon monitoring will be required to read the SOP and will be provided with the appropriate training by previously qualified individuals. Monitoring personnel unfamiliar with a task will be directly supervised by an experienced technician for at least the first two attempts and be subjected to 100% inspection of at least the first five samples analyzed by a second, qualified individual with previous experience identifying sturgeon.

2.8 Normandeau QA/QC Procedures

The basis for all of Normandeau's quality control (QC) and quality assurance (QA) monitoring of traveling screen sluice sampling activities will be the SOP, consisting of written documentation of sampling and data collection protocols. The SOP will be developed from the objectives and methods in the final monitoring plan approved by NMFS, and will be prepared before monitoring begins. The SOP will function to (1) insure that consistent and appropriate procedures are followed, (2) provide Entergy with documentation of the procedures used, and (3) enable a QA auditor observing program activities to determine whether the required procedures are being followed.

QC will be conducted continually by qualified project staff. All field observations and measurements of sturgeon (identification, length, weight, injury, condition, tag numbers, etc.) will be subject to a standard and appropriate QC and QA review based on a Military Inspection Standard (MIL-STD) inspection plan derived from MIL-STD 1235 Single and Multiple Level Continuous Sampling Procedures and Tables for Inspection by Attributes to achieve a 10% AOQL (Figure 2-14). QC re-inspections for these sample processing tasks will be performed according to the continuous sampling plan CSP-1 at the 10% AOQL level, to insure that at least 90% of samples satisfy the project's acceptance criteria. This level of quality meets or exceeds New York, industry-wide, and HRBMP standards for fisheries measurement data.

All final data files and reports will be subject to a standard and appropriate QC inspection to achieve a 1% AOQL so that the final data files will be certified through statistical inspection to document that less than one record (line of data) out of every 100 records will be in error. A QC inspection plan (CSP-1) will be used at the 1% AOQL level to insure that values of all variables in at least 99% of the data records provided in each data file correctly correspond to values coded on the original data sheets. This level of quality meets or exceeds New York, industry-wide, and HRBMP standards for fisheries data files.

At least one QA Audit of the field activities described in Sections 2.3 and 2.4 above will be performed per year to verify adherence to the technical protocols specified in the SOP and verify the effectiveness of the QC system. QA auditors will be technically qualified to evaluate the activities being observed but independent from the project team. The audits will cover all activities described in the SOP, including transfer of data from field to completed data deliverables. The audit results will be documented in a written report for review by project management and Entergy.

3.0 Literature Cited

ASA (Applied Science Associates, Inc.). 2011. 2010 field program and modeling analysis of the cooling water discharge from the Indian Point Energy Center. Final report. ASA Project 2009-167. Prepared for: Indian Point Energy Center, Buchanan, New York. 31 January 2011.

Bergman, P. 2011. Videography Monitoring of Adult Sturgeon in the Feather River Basin, CA. Report prepared by Cramer Fish Sciences for Anadromous Fish Restoration Program. http://www.fws.gov/stockton/afrp/documents/Feather_Sturgeon_Report_022811.pdf

Bergman, P., J. Merz, and B. Rook. 2011. Memo: Green Sturgeon observations at Daguerre Point Dam, Yuba River, CA. FWS Grant Number: 813329G011. http://www.fws.gov/stockton/afrp/documents/Yuba_River_Sturgeon_Memo.pdf

Cochran, W.G. 1977. Sampling techniques. Third Edition. John Wiley and Sons, New York. 428pp.

Enercon (Enercon Services, Inc.). 2010. Evaluation of alternative intake technologies at Indian Point Units 2 & 3. Prepared for Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC, February 2010.

EPRI (Electric Power Research Institute). 2004. Impingement abundance monitoring technical support document. EPRI Report 1008470. Palo Alto, CA.

Fletcher, R.I. 1985. Risk analysis for fish diversion experiments: pumped intake systems. Trans. Amer. Fish. Soc. 114:652-694.

Fletcher, R.I. 1990. Flow dynamics and fish recovery experiments: water intake systems. Trans. Amer. Fish. Soc. 119:393-415.

Garman, G.C. 1992. Fate and potential significance of postspawning anadromous fish carcasses in an Atlantic coastal river. Trans. Amer. Fish. Soc. 121: 390-394.

King, R.G., G. Seegert, J. Vondruska, E.S. Perry, and D. A. Dixon. 2010. Factors Influencing Impingement at 15 Ohio River Power Plants. North American Journal of Fisheries Management 30: 1149-1175.

Mattson, M.T., J.B. Waxman, and D.A. Watson. 1988. Reliability of impingement sampling designs: an example from Indian Point Station. Amer. Fish. Soc. Monogr. 4:161-169.

Normandeau (Normandeau Associates, Inc.). 2011. Analysis of Near-Bottom Flow in the Hudson River at Indian Point Energy Center from Data Collected by Acoustic Doppler Current Profilers 4 March through 2 November 2010. Prepared for Indian Point Energy Center; Buchanan, NY.

Normandeau. 2012. Current velocity and turbulence monitoring for the cylindrical wedgewire screen efficacy study at Indian Point Energy Center. Prepared for Indian Point Energy Center; Buchanan, NY.

Normandeau. 2013a. 2013 Hudson River ichthyoplankton survey standard operating procedures. Revision 1. Prepared for Indian Point Energy Center. May 2013.

Normandeau. 2013b. 2013 Hudson River fall juvenile and beach seine surveys standard operating procedures. Prepared for Indian Point Energy Center. June 2013.

Normandeau. 2013a. 2013-2014 Hudson River Striped Bass and Atlantic Tomcod surveys standard operating procedures. Prepared for Indian Point Energy Center. October 2013.

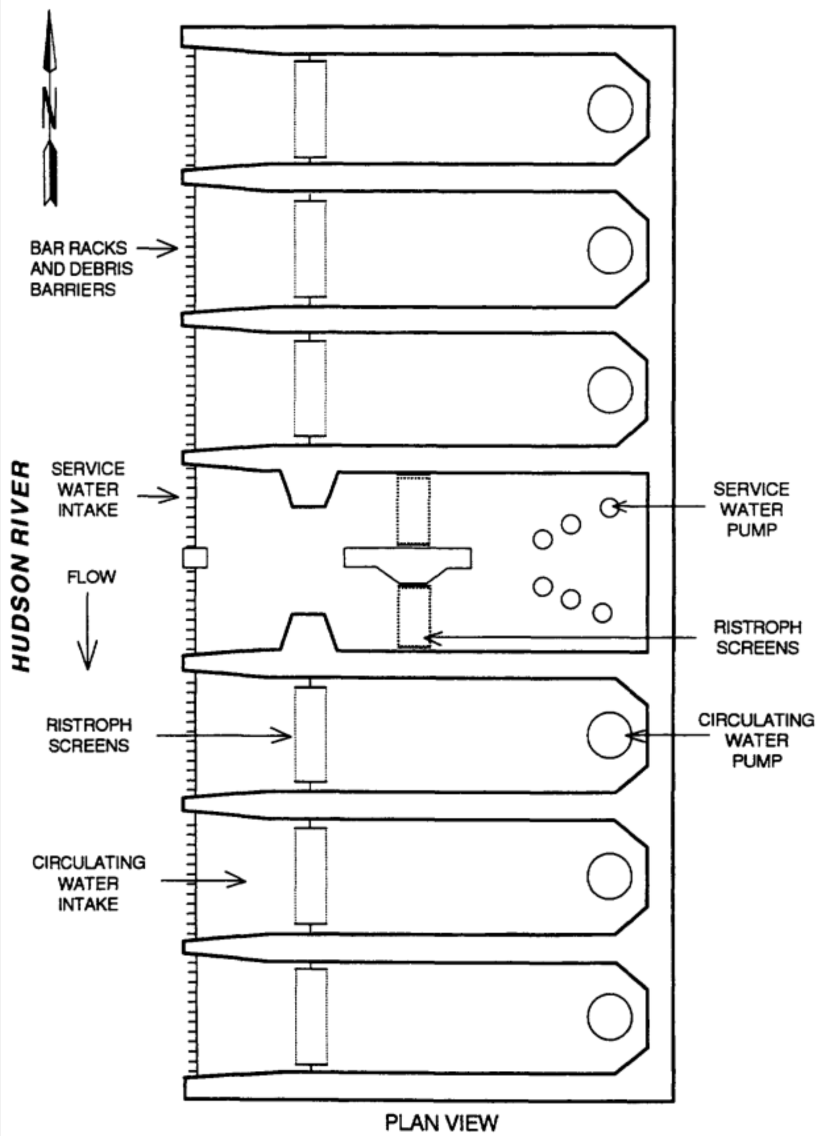
Schneider, J.C. 1998. Fate of dead fish in a small lake. Am. Midland Naturalist 140 (1): 192-196.

Substructure, Inc. 2010. Data report for the April 2010 multibeam and sub-bottom profile survey in the Hudson River near Peekskill, New York. Prepared for Normandeau Associates, Inc. Bedford, NH.

USEPA (U.S. Environmental Protection Agency). 2011. Technical development document for the proposed Section 316(b) Phase II existing facilities rule, March 28, 2011, p. 7-2.

USFWS (U.S. Fish and Wildlife Service) and NMFS (National Marine Fisheries Service). 1998. Endangered Species Act consultation handbook procedures for conducting Section 7 consultations and conferences. March 1998 Final.

Figures



Source: Con Ed and NYPA 1990, Indian Point Units 2 and 3 Ristroph Screen Fish Return System Prototype Evaluation and Siting Study.

Figure 1-1. Indian Point Unit 2 (IP2) cooling water intake structure – plan view.

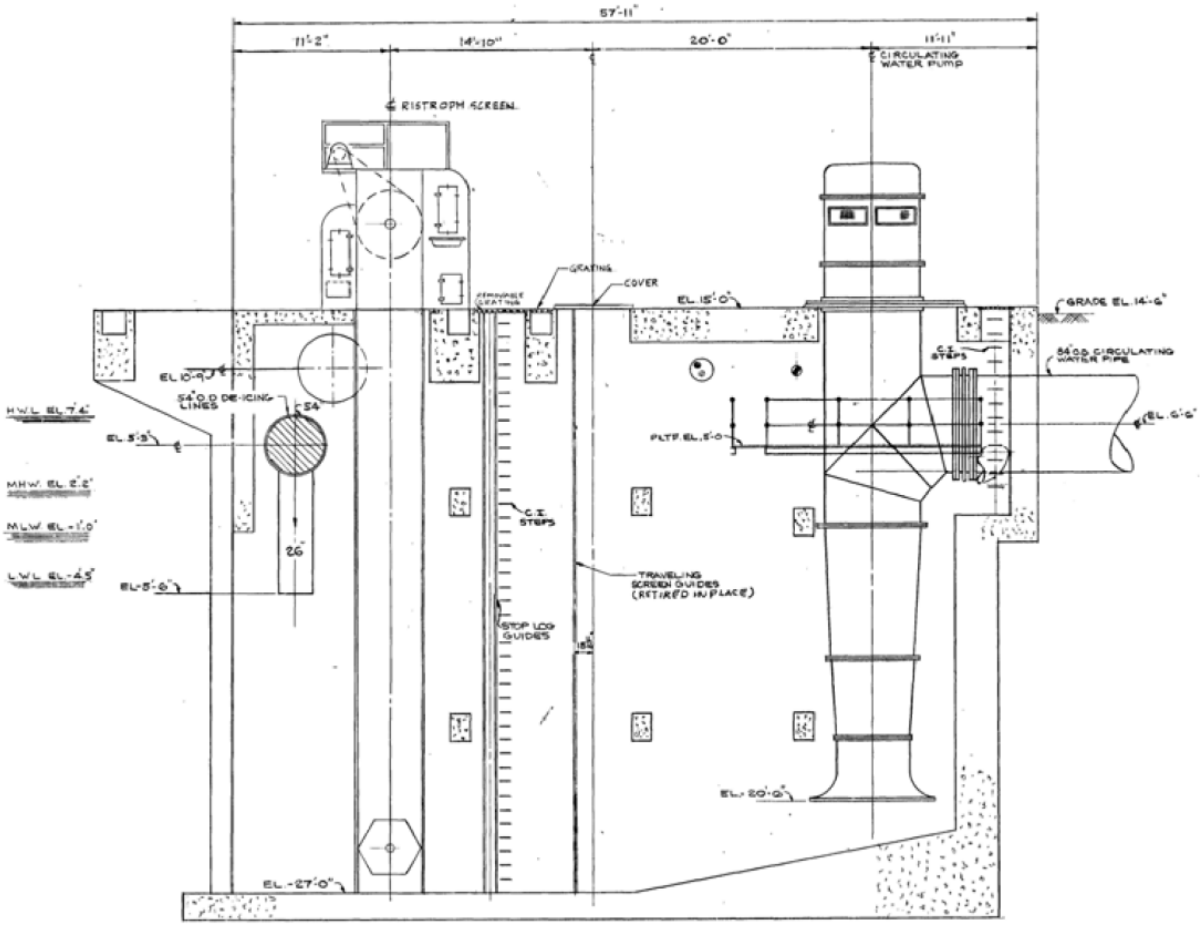
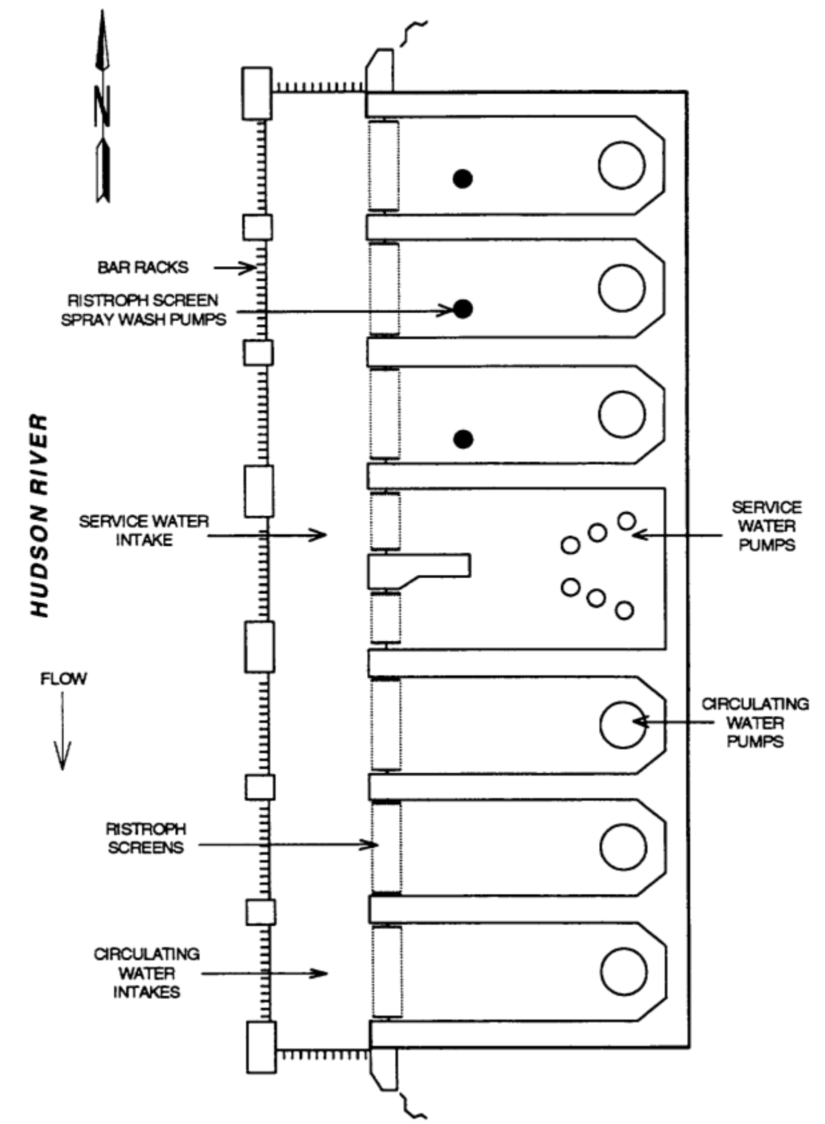


Figure 1-2. Indian Point Unit 2 (IP2) cooling water intake structure – sectional view.



Source: Con Ed and NYPA 1990, Indian Point Units 2 and 3 Ristroph Screen Fish Return System Prototype Evaluation and Siting Study.

Figure 1-3. Indian Point Unit 3 (IP3) cooling water intake structure – plan view.

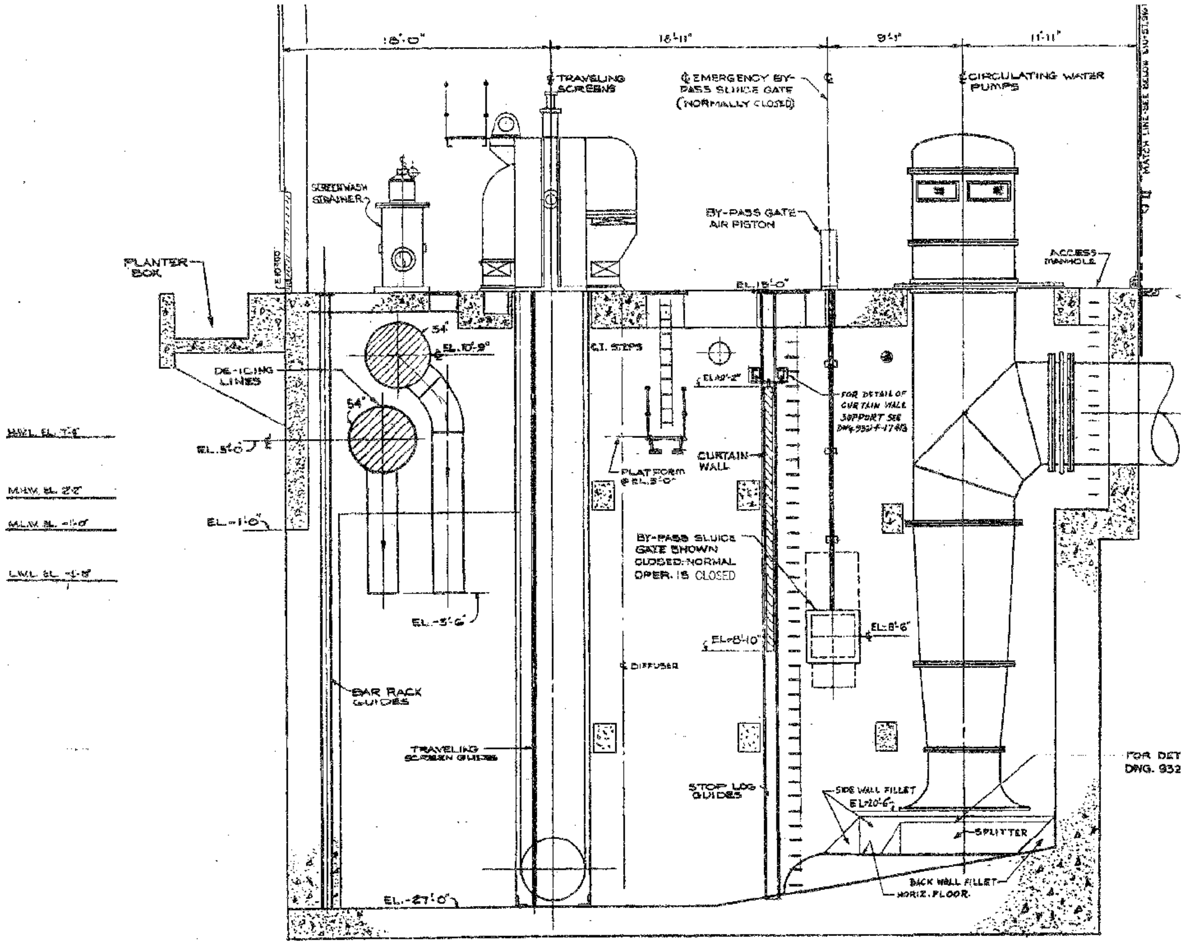


Figure 1-4. Indian Point Unit 3 (IP3) cooling water intake structure — sectional view.

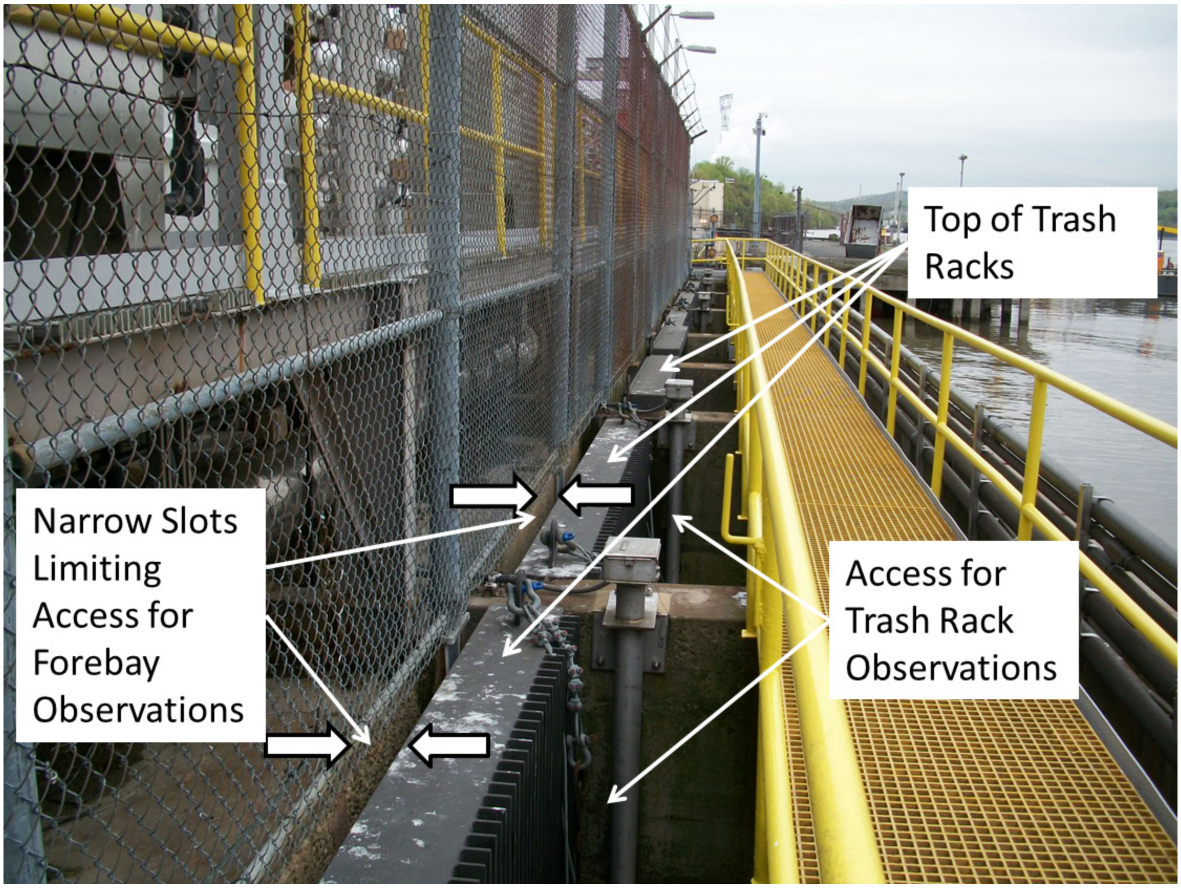


Figure 2-1. Deck-level access to trash racks at the outer (western) side of the IP2 cooling water intake structure.

Figure 2-2. Example of a pair of sluice sampling nets inserted in the IP1 sluice sampler.

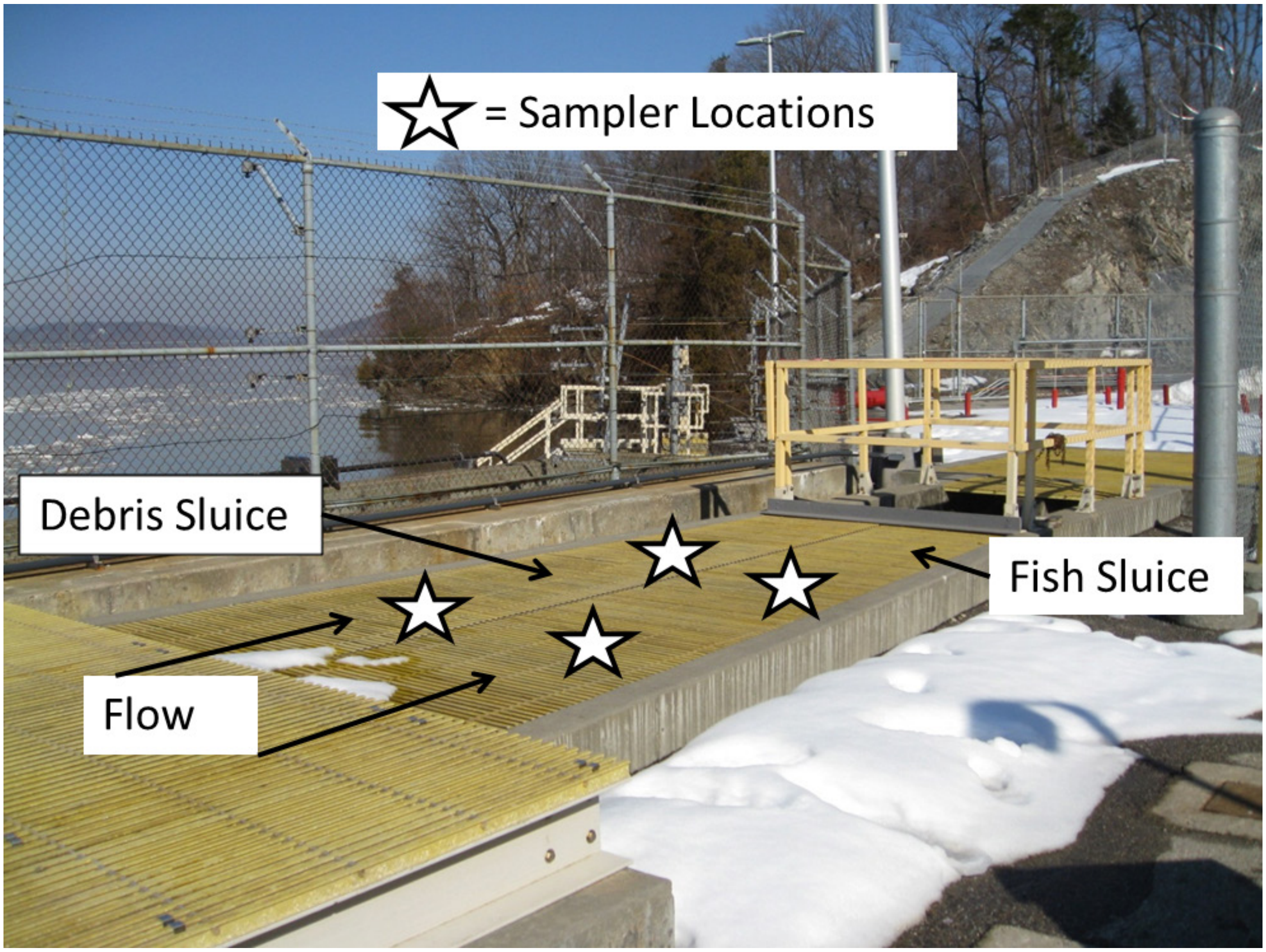


Figure 2-3. IP2 Ristroph screen fish sluice (right) and debris sluice (left) return system shown under yellow deck grating looking north from the north end of the IP2 intake bulkhead.

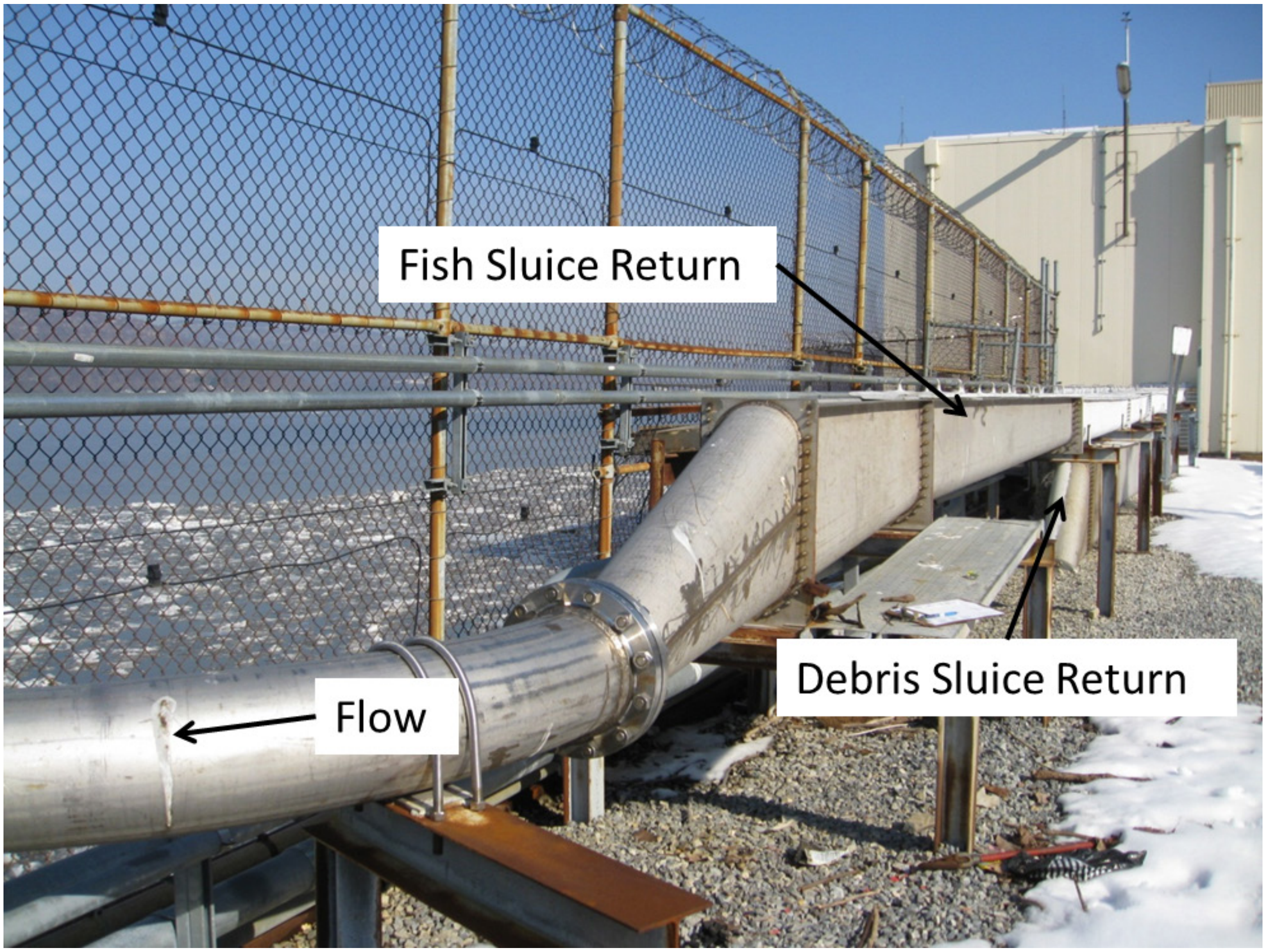


Figure 2-4. IP3 Ristroph screen fish sluice (top) and debris sluice (bottom) return system shown looking north from the south end of the IP3 intake bulkhead.

Figure 2-5. IP1 sluice system located under deck plates outside the screen house where sluice sampling would occur when the plates are removed.

Figure 2-6. Example of two 150-gallon sturgeon holding tanks.

Incident Report Sturgeon Take – Indian Point

Photographs should be taken and the following information should be collected from all sturgeon (alive and dead) found in association with the Indian Point intakes. Please submit all necropsy results (including sex and stomach contents) to NMFS upon receipt.

Observer's full name:____
Reporter's full name:____

Species Identification :____

Site of Impingement (Unit 2 or 3, CWS or DWS, Bay #, etc.):_________________________________

Date animal observed:________________ Time animal observed: ________________________
Date animal collected:________________ Time animal collected:_________________________

Environmental conditions at time of observation (i.e., tidal stage, weather):
____
____

Date and time of last inspection of intakes:_____________________________________
Water temperature (°C) at site and time of observation:_________________________
Number of pumps operating at time of observation:____________________________________
Average percent of power generating capacity achieved per unit at time of observation:________
Average percent of power generating capacity achieved per unit over the 48 hours previous to observation:____

Sturgeon Information:
Species ____________________________________

Fork length (or total length) ______________________ Weight _______________________

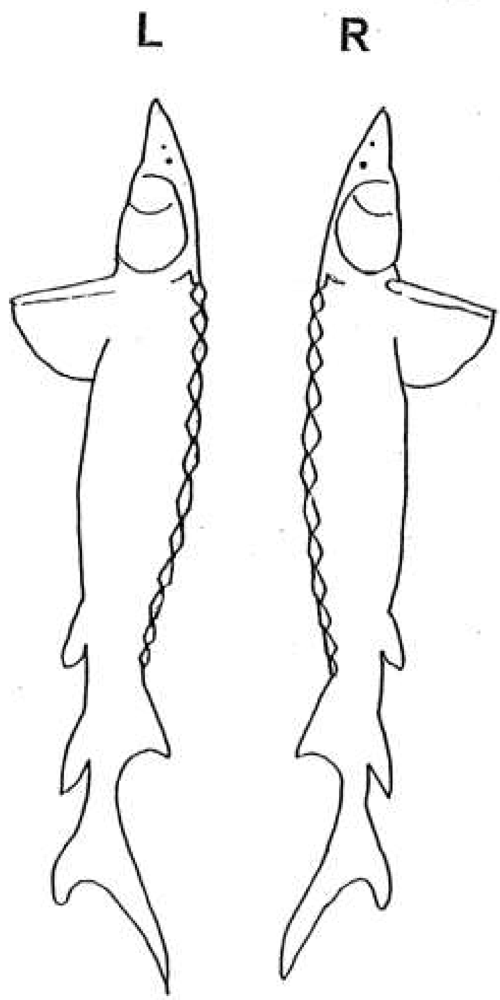
Condition of specimen/description of animal
____
____
____
____

Fish Decomposed: NO SLIGHTLY MODERATELY SEVERELY
Fish tagged: YES / NO *Please record all tag numbers.* Tag # _________________

Photograph attached: YES / NO
(please label *species, date, geographic site* and *vessel name* on back of photograph)

Figure 2-7. Incident report form for incidental take of Atlantic Sturgeon or Shortnose sturgeon by impingement at the IPEC cooling water intakes.

Draw wounds, abnormalities, tag locations on diagram and briefly describe below



Description of fish condition:

Figure 2-7 (continued).

Appendix 4: Summary of Environmental Sampling Data for Research Activity [1,2]

Date	Species (ASN or SSN)	Unique ID	Location River	Location (Lat/Long or rkm)	Gear & Mesh	Net Set (min/hr)	Bottom Depth (m)	Bottom Temp (°C)	Salinity (ppt)	DO (mg/l)	Total Length (mm)	Total Weight (kg)	Mortality	Comments

1. Please coordinate with NMFS to receive a file copy of this appendix in spreadsheet format.
2. List individual fish (ASN or SNS) concurrently when recording data for multiple sturgeons in a catch

Figure 2-8. Summary form for environmental data associated with incidental take of Atlantic Sturgeon or Shortnose sturgeon.

Instructions: Collecting, Certifying, Identifying &Shipping Tissue Samples Collected from Sturgeon.

1. **Species Certification**:
For each shipment a "*Certification of Species Identification*" (Section A) must be provided. This form documents the collector has identified the fish or fishes sampled in the shipment as either a shortnose or Atlantic sturgeon. If there is any doubt about the identity of a sample, then mark unknown and include comments on the take.

2. **Sample Identification**:
Assign a unique number identifying each individual fish captured and subsequently sampled. This number must be recorded in Section B and on the collection vial for each sample taken. Record tissue type; preservative used; date of capture; location of capture (river & description, lat/long, river km, and nearest city); length of specimen; weight; and sex, if known. Check the box provided if you are submitting multiple samples, and provide a hard-copy and/or email a copy of the sample spreadsheet with information for each of the data fields listed above.

3. **Tissue Sampling Instructions:**
a. Cleanliness of Samples: Cross contamination should be avoided. For each fish, use a clean cutting tool, syringe, etc. for collecting and handling samples.

b. Preserving & Packaging Samples:
i. Label vial with fish's unique ID number.
ii. Place a 1-2 cm^2 section of pelvic fin clip in vial with preservative (95% absolute ETOH (un-denatured), recommended).
iii. Seal individual vials or containers with leak proof positive measure (e.g., tape).
iv. Package vials and absorbent within a double sealed container (e.g., zip lock baggie).
v. Label air package properly identifying ETOH warning label (**See Appendix 3c**).

c. Shipping Instructions:
When shipping samples, place separately Appendix 3a, 3b and 3c (Sample ID and Chain of Custody Forms and Shipping Training Form) in container and seal the shipping box to maintain the chain of custody. (Note: A copy of the ESA permit authorizing the collection of the sample(s) must also accompany the sample(s)).

Important Notice: You must be certified before shipping tissue samples preserved with 95% ETOH in "excepted quantities" (A Class 3 Hazardous Material Due to Flammable Nature). See Appendix 3c: "NMFS Guidelines for Air-Shipment of Excepted Quantities of Ethanol Solutions" to comply with the DOT/IATA federal regulations.

4. **Chain of Custody Instructions:**
The "*Chain of Custody*" (Section C) should be maintained for each shipment of tissue samples and must accompany the sample(s) at all times. To maintain the chain of custody, when sample(s) are transferred, the sample(s) and the documentation should be packaged and sealed together to ensure that no tampering has occurred. All subsequent handlers breaking the seal must also sign and document the chain of custody section.

5. **Contact Information**:
A. **NMFS, Office of Protected Resources**:
 i. **Primary Contact**: Malcolm Mohead (malcolm.mohead@noaa.gov) Phone: 301/713-2289
 ii. **Primary Contact:** Colette Cairns (colette.cairns@noaa.gov) Phone: 301/713-2289
 i. **Secondary Contact: (Northeast)** Jessica Pruden (jessica.pruden@noaa.gov) Phone: 978/281-9300
 ii. **Secondary Contact: (Southeast)** Stephania Bolden (stephania.bolden@noaa.gov) Phone: 727/824-5312

B. **NOS Archive:**
 i. **Primary Contact**: Julie Carter (julie.carter@noaa.gov) Phone: 843/762-8547

Figure 2-9. Instructions for collecting, certifying, identifying, and shipping sturgeon tissue samples.

Certification, Identification and Chain of Custody Form for Submitting Sturgeon Genetic Tissue Samples.[1],[2]

(A) CERTIFICATION OF SPECIES (Collector)

I, ______________________, hereby certify that I have positively identified the
Full Name

fish or fishes sampled in this shipment as: ☐ shortnose sturgeon; ☐ Atlantic sturgeon; ☐ other ☐ unknown
based on my knowledge and experience as a ______________________.
Position Job Title

Signature: ______________________ Date Identified: ______________________
Address: ______________________
____

Phone Number: ______________________

(B) SAMPLE IDENTIFICATION

Species Identification: ☐ shortnose sturgeon; ☐ Atlantic sturgeon; ☐ unknown
Unique ID No: __________; Tissue Type: __________; Preservative: __________;
Location: (River: __________; River-km: ______; Lat/Long: __________;
River Location Description: ______________________);
Total Length (TL) of Specimen (mm): ______ Weight of Specimen (g): ______; Sex (if known) ____

Specific comments on take: ______________________
____

☐ Check here if multiple samples are submitted and use *Field Collection Report* (Appendix 3b) with the data fields listed in this section.

(C) EVIDENCE OF CHAIN OF CUSTODY

1.	Release Signature	NMFS Permit No.	Method of Transfer	Date
	Receipt Signature	NMFS Permit No.		Date
2.	Release Signature	NMFS Permit No.	Method of Transfer	Date
	Receipt Signature	NMFS Permit No.		Date
3.	Release Signature	NMFS Permit No.	Method of Transfer	Date
	Receipt Signature	NMFS Permit No.		Date

[1] Instructions on next page.
[2] If multiple samples are shipped, attach summary sheet in Appendix 3b.

Figure 2-10. Certification of species, sample identification, and chain of custody form.

Appendix 3b

Summary Sheet for Genetic Tissue Samples [1,2]

Date	Species	Unique ID.	Genetic Tissue Type	Preservative	Location: (River)	Location (River km)	Location (Lat/Long)	Total Length (mm)	Weight (g)	Sex	Comments

1. Please coordinate with NMFS to receive a file copy of this appendix in spreadsheet format.
2. If multiple samples are shipped, attach this form (and disk copy) to supplement Appendix 3a.

Figure 2-11. Summary form for sturgeon genetic tissue samples.

Appendix 3c

NMFS Guidelines for Air-Shipment of "Excepted Quantities" of Ethanol Solutions

These guidelines have been adapted with permission from the University of New Hampshire-Office of Environmental Health & Safety; our appreciation is to Andy Glode for providing reference materials upon which this guide was created.

The U.S. Department of Transportation (DOT: 49 CFR 173.4) and the International Air Transport Association (IATA: 2007 Dangerous Goods Regulations, Sec. 2.7) regulate shipments of ethanol (ETOH) in *excepted quantities*. As a result, specific procedures must be followed as well as certifying proper training of individuals prior to packaging and shipping specimens preserved in ETOH. These guidelines will inform proper shipping and also satisfy certifying requirements. Failure to meet such requirements could result in regulatory fines and/or imprisonment.

Therefore, prior to submitting ETOH preserved samples and appropriate documentation (*e.g.*, a FedEx Airbill) to a carrier, please read, initial and sign this document, affirming you have understood the requirements as outlined. Please include this document in the shipping package and retain a copy for your records.

1) Packages and documents submitted to a carrier must not contain any materials other than those described in this document (*i.e.* containers holding ethanol-preserved specimens and related absorbent and packaging materials). Also, laboratory or sampling equipment, *unrelated documents*, or other goods must be packaged and shipped in separate boxes. (Note: ETOH solutions are not permitted to be transported in checked baggage, carry-on baggage, or airmail.) **I understand (______)**

2) Please read the manufacturer's Material Safety Data Sheet (MSDS) for ETOH recognizing ETOH (55 - 100%) is classed as hazardous flammable material (NFPA Rating = 3). Note also, its vapor is capable of traveling a considerable distance to an ignition source causing "flashback." Properly packaging and labeling shipments of ethanol solutions will minimize the chance of leakage, and would also communicate the potential hazard to transport workers in the event of a leak. **I understand (______)**

a) **Quantity Limits**: Small quantities (inner container less than 30 ml, with a maximum net quantity of 500 ml for the entire package) of ETOH can be shipped with "Excepted Quantities" labels without completion of a Dangerous Goods Declaration. (e.g., If shipping vials having a maximum volume of 10 ml each, you may put up to 50 vials in one box.) **I understand (______)**

b) **Package Components**:

i. ***Inner (primary) packaging (e.g., vial, tube, jar, etc.)***: Do not completely fill inner packaging; allow 10% head-space for liquid expansion. Liquids must not completely fill inner packaging at a temperature of 55°C (130°F). Closures of inner packaging (e.g., vials with tops) must be held securely in place with tape or other positive means. **I understand (______)**

ii. ***Intermediate (secondary) packaging (e.g. Ziplock or other plastic bag)***: Place inner container(s) (*e.g.*, vials with ETOH) into a high-quality plastic bag. Then add an absorbent material capable of absorbing any spillage without reacting with the ethanol. Seal the first bag tightly and then tape the locking seals. Next, seal the inner bag within a second bag for added safety. **I understand (______)**

iii. ***Outer packaging (e.g., cardboard box)***: Ethanol solutions may not be shipped in envelopes, Tyvek® sleaves, or other non-rigid mailers. The dimensions of the outer box must be at least 100 mm (~4 inches) on two sides. Any space between the inner packing containers placed in the outer packaging should be eliminated with additional filler. **I understand (______)**

c) **Package Labels**:

i. ***Dangerous Goods in Excepted Quantities Label* (Figure 1.)**: The label must display a "3" as the ethanol hazard class number using a black marker. You may obtain self-adhesive labels from NMFS, or else, order online. **I understand (_____)**

ii. ***Name and Address:*** The outer container must display the name and address of the shipper and consignee. When re-using shipping boxes, completely remove or black out all unnecessary labels or marks. **I understand (______)**

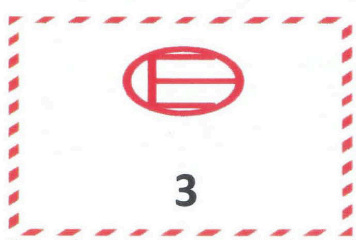


Figure 1. Dangerous Goods in Excepted Quantities label

Figure 2-12. Guidelines and form for air shipment of "excepted quantities" of ethanol solutions.

Appendix 3c (continued)

d) **Package Tests:**
A representative example of packaging used for excepted quantities of ethanol solutions must pass a drop test and compressive load test without any breakage or leakage of any inner packaging and without any significant reduction in package effectiveness. Perform the following tests on a representative example of your packaging and keep a record of the results.

i. ***Drop Test*:** Drop a representative package from a height of 1.8 m (5.9 feet) directly onto a solid unyielding surface:

		Test Results
a.	One drop flat on the base;	(____________________)
b.	One drop flat on top;	(____________________)
c.	One drop flat on the longest side;	(____________________)
d.	One drop flat on the shortest side; and	(____________________)
e.	One drop on a corner.	(____________________)

ii. ***Compressive Load Test*:** Apply a force to the top surface of a representative package for a duration of 24 hours, equivalent to the total weight of identical packages if stacked to a height of 3 meters. (____________________)

e) **Package Documentation:**
Proper documentation is required for all shipments of hazardous materials. Incorrect documentation is the most common cause for package refusal. If using documentation for couriers other than FedEx, UPS and DHL, please contact NMFS for assistance.

i. ***FedEx*:** For domestic shipments with FedEx Express, fill out the standard US Airbill. Fill out the form completely including the following information:

a. In Section 6, Special Handling, check the box "Yes, Shipper's Declaration not required."
b. On the top of the form above the FedEx tracking number, include the statement, "***Dangerous Goods in Excepted Quantities***" See example in **Figure 2.** **I understand (______)**

ii. ***DHL*:** The "*Nature and Quantity of Goods*" box of the air waybill must include "**Dangerous Goods in Excepted Quantities.**" **I understand (______)**

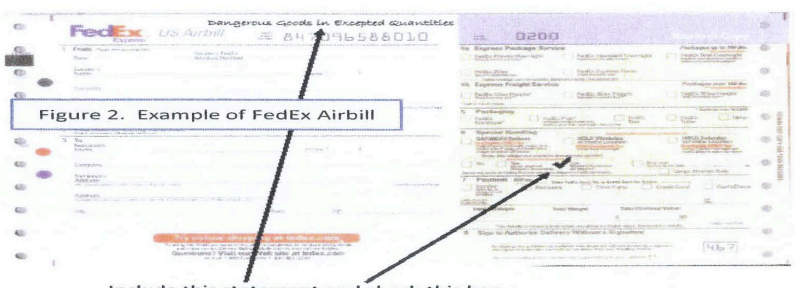


Figure 2. Example of FedEx Airbill

Include this statement and check this box.

By signing this document, I affirm I understand the hazards associated with ethanol and the shipping requirements for ethanol solutions, as outlined in this guide. I also understand I am required to include a copy of this document in the package and that it should be appended to an ESA permit (if listed samples are shipped).

Print Name:		**Signature:**	
Employer:		**Employer Address:**	
Date:			**Phone:**

Figure 2-12 (continued).

Appendix 5: **Sturgeon Salvage Form**

For use in documenting dead sturgeon in the wild under ESA Permit No. 1614 (version 07-20-2009)

INVESTIGATORS'S CONTACT INFORMATION
Name: First ________________ Last ________________________
Agency Affiliation ________________ Email_______________________
Address ____
____
Area code/Phone number ____

UNIQUE IDENTIFIER (Assigned by NMFS)

DATE REPORTED:
Month ☐☐ Day☐☐ Year 20☐☐
DATE EXAMINED:
Month ☐☐ Day☐☐ Year 20☐☐

SPECIES: (check one)
☐ shortnose sturgeon
☐ Atlantic sturgeon
☐ Unidentified *Acipenser* species
Check "Unidentified" if uncertain.
See reverse side of this form.

LOCATION FOUND: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)
River/Body of Water______________ City______________________ State ____
Descriptive location (be specific)____
____
____
Latitude _____________N (Dec. Degrees) Longitude _____________ W (Dec. Degrees)

CARCASS CONDITION at time examined: (check one)
☐ 1 = Fresh dead
☐ 2 = Moderately decomposed
☐ 3 = Severely decomposed
☐ 4 = Dried carcass
☐ 5 = Skeletal, scutes/ cartilage

SEX:
☐ Undetermined
☐ Female ☐ Male
How was sex determined?
☐ Necropsy
☐ Eggs/milt present when pressed
☐ Borescope

MEASUREMENTS: Circle unit
Fork length _________ cm / in
Total length _________ cm / in
Length ☐ actual ☐ estimate
Mouth width (inside lips, see reverse side) _________ cm / in
Interorbital width (see reverse side) _________ cm / in
Weight ☐ actual ☐ estimate _________ kg / lb

TAGS PRESENT? Examined for external tags including fin clips? ☐ Yes ☐ No Scanned for PIT tags? ☐ Yes ☐ No

Tag #	Tag Type	Location of tag on carcass
____________________	________________________	____________________________
____________________	________________________	____________________________

CARCASS DISPOSITION: (check one or more)
☐1 = Left where found
☐2 = Buried
☐3 = Collected for necropsy/salvage
☐4 = Frozen for later examination
☐5 = Other (describe)
____

Carcass Necropsied?
☐Yes ☐No
Date Necropsied:___________
Necropsy Lead:
____

PHOTODOCUMENTATION:
Photos/vide taken? ☐ Yes ☐ No
Disposition of Photos/Video:__________
____
____

SAMPLES COLLECTED? ☐ Yes ☐ No

Sample	How preserved	Disposition (person, affiliation, use)
__________________	____________________	______________________________
__________________	____________________	______________________________
__________________	____________________	______________________________
__________________	____________________	______________________________
__________________	____________________	______________________________
__________________	____________________	______________________________
__________________	____________________	______________________________
__________________	____________________	______________________________

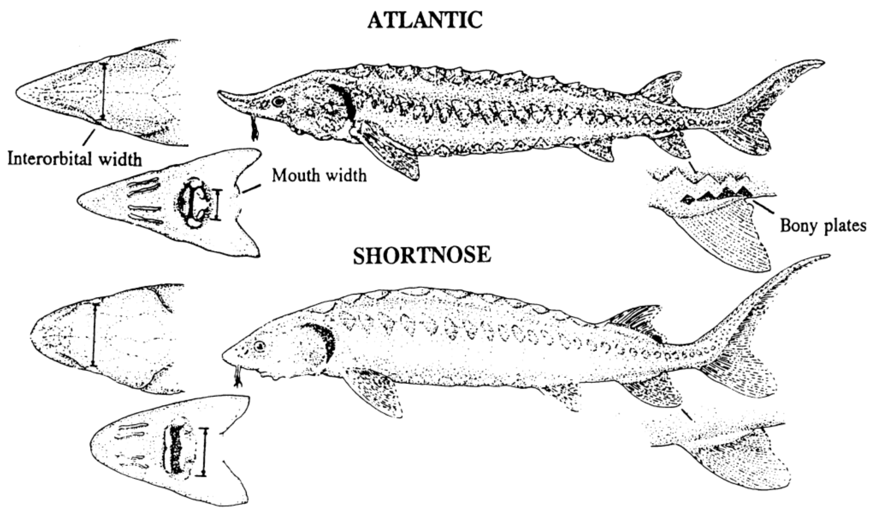
Comments:
____
____
____
____

Figure 2-13. Sturgeon salvage form.

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 07-20-2009)

Characteristic	Atlantic Sturgeon, *Acipenser oxyrinchus*	Shortnose Sturgeon, *Acipenser brevirostrum*
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004



Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). **Please note if no wounds / abnormalities are found.**

____
____
____
____
____

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Submit completed forms (within 30 days of date of investigation) to: Jessica Pruden, Shortnose Sturgeon Recovery Coordinator, NOAA Fisheries Northeast Region, 55 Great Republic Drive, Gloucester, MA 01930. Phone: 978-282-8482; Fax: 978-281-9394; E-Mail Jessica.Pruden@noaa.gov

Figure 2-13 (continued)

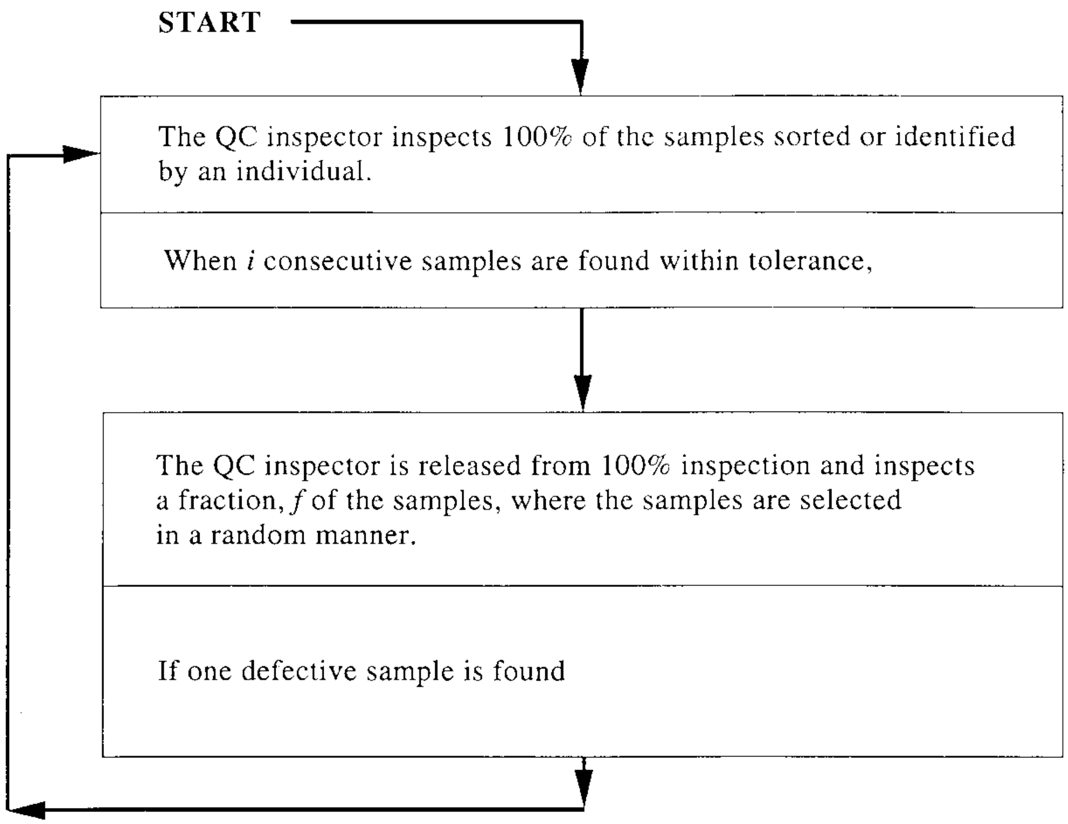


Figure 2-14. 10% AOQL continuous sampling plan CSP-1 for quality control inspections.

Attachment 1

Unit 1 Trash Racks

Attachment 1: Indian Point Unit 1 Intake Structure

The cooling water intake structure for Indian Point Unit 1 (Figure 1, Figure 2), which began operations in 1962, has four intake bays situated behind the Unit 1 wharf. Cooling water was supplied by two 140,000 gpm circulating pumps, each withdrawing through two of the bays. There were two sets of the screen wash and river water pumps, with each set capable of up to 19,000 gpm of service water. There was a fixed fine screen (3/8" mesh) at the river side of each intake bay, with a trash rack (3" spacing) situated between the fixed screen and the traveling screen. The side bays containing the river water and screen wash pumps had small auxiliary traveling screens. The intake bays were approximately 11 ft in width, with a bottom elevation of -26 ft (below MSL). Since the curtain wall for Unit 1 extended 5 ft below MSL, then each bay would have an opening of approximately 235 ft^2 and average velocity through the bay opening (not accounting for the screens) of 0.75 fps. At the trash racks the withdrawal area was 291 ft^2 for each bay (not accounting for the area of the rack), with an average velocity of 0.61 fps.

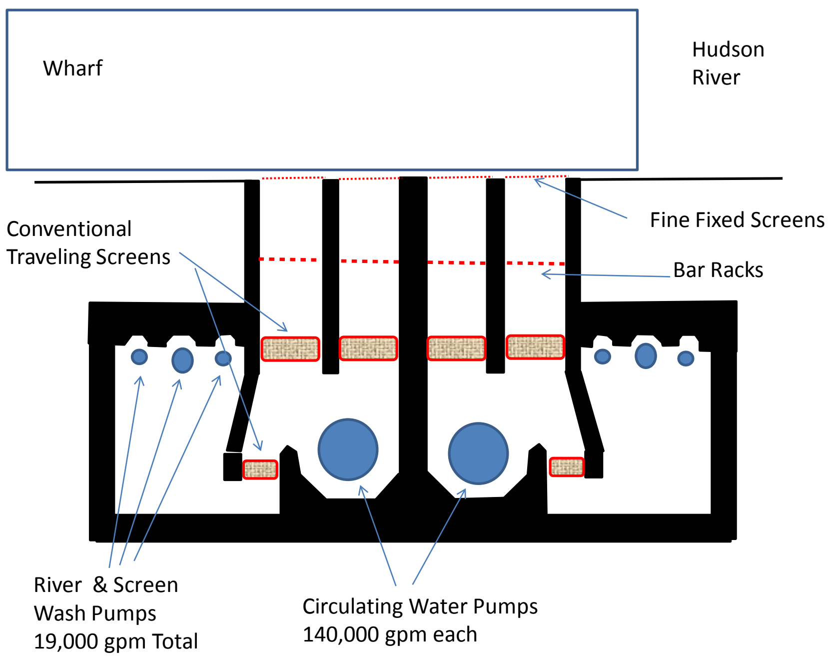


Figure 2 Schematic plan view diagram of Unit 1 cooling water intake as originally built.

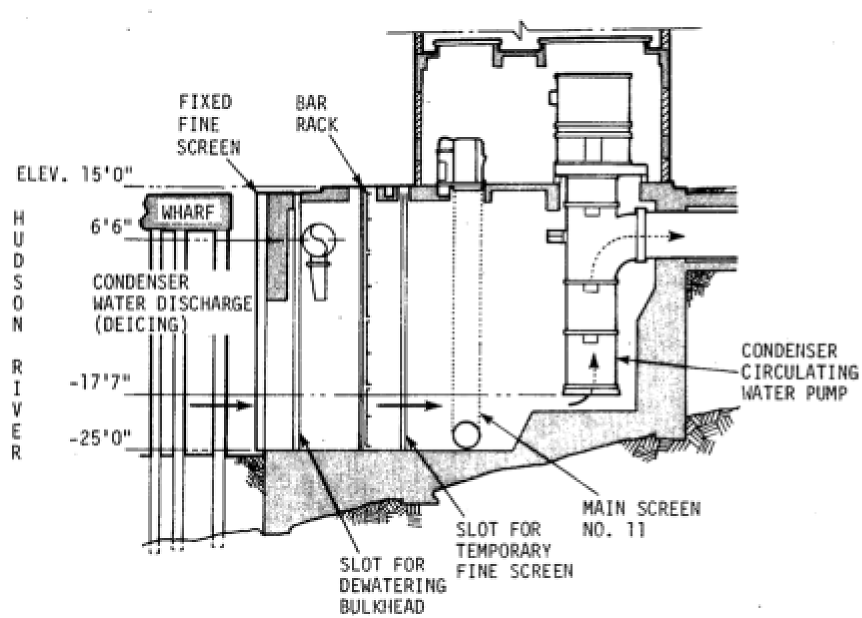


Figure 3 Cross section of Unit 1 cooling water intake as originally built.

Subsequent to the retirement of Unit 1, the fixed fine screens, conventional traveling screens, and cooling water pumps were removed (Figure 3). The auxiliary traveling screens have been replaced by two dual flow traveling screens with 0.06-inch mesh, each one serving 19,000 gpm flow capability from the river water and screen wash pumps. Typically only one set of pumps and screen is operated at a time. At 19,000 gpm, the average velocity through the bay openings would be 0.09 fps, and at the former location of the bar racks 0.07 fps.

Diver inspection of the intakes has confirmed that there are no longer any trash racks. Because the velocities into the Unit 1 intake bays are so low (<0.1 fps on the operating side, 0 on the non-operating side) and during most of the time less than the tidal currents at the face of the intake, dead or moribund fish are unlikely to be drawn into the intake structure. Live fish would have free access to enter or leave the intake bays at will in these low intake velocities.

Given the changes to the Unit 1 intake structure that were previously documented, and as updated here, entry of dead sturgeon into the Unit 1 intake is likely to be a very rare event. There is no reason to believe that involvement of either sturgeon species with the Unit 1 intake structure would be higher than was anticipated in the Biological Opinion.

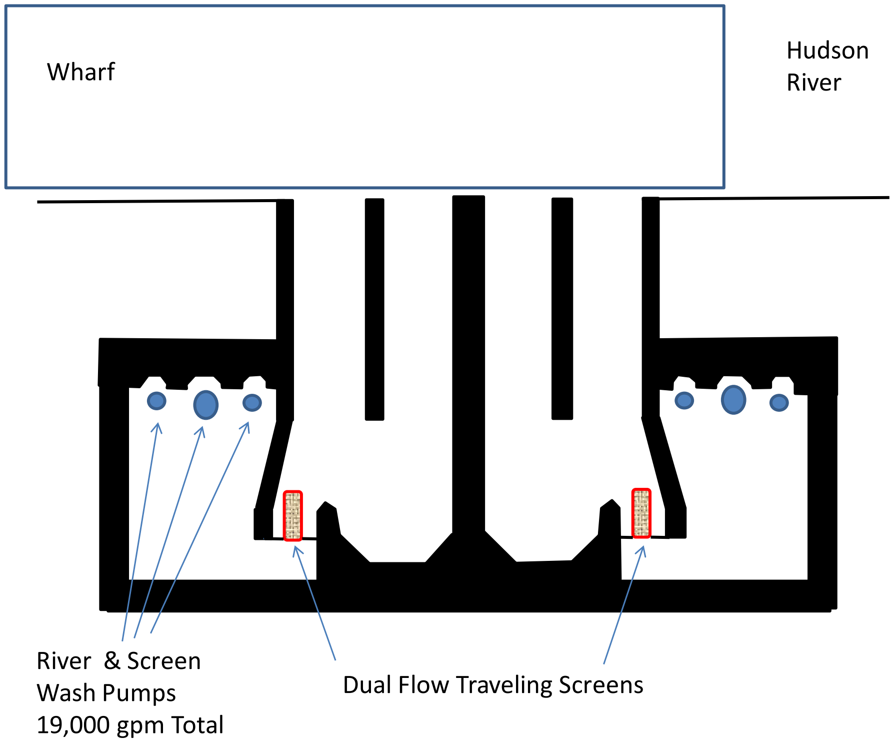


Figure 4 Schematic plan view diagram of Unit 1 cooling water intake as currently configured.

Attachment 2

Schedule for Monitoring Plan Implementation

Attachment 2: Implementation Schedule* for Revision 3 Sturgeon Monitoring Plan at IPEC

1) Preliminary Equipment Trials for Trash Bars, Forebay and Velocity Studies
   a) Start – 2 June 2014

2) NMFS/Entergy meeting in Gloucester, MA
   a) Occurred 1 July 2014

3) Addendum to Revision 2 Monitoring Plan to NMFS
   a) Submitted – 4 August 2014
   b) Additional comments supplied by NMFS - 22 April 2015

4) Revision 3 Monitoring Plan to NMFS
   a) Submit – 10 July 2015
   b) NMFS Approval - one month after submitted (estimate)

5) Revision 3 Monitoring Plan to NYSDEC
   a) Submit – two weeks after NMFS approval of Monitoring Plan Revision 3
   b) NYSDEC Approval – one month after submitted (estimate)

6) Trash Rack Feasibility Study
   a) Start Study – In progress
   b) Finish Study – determined after consultation with NMFS
   c) Report to NMFS – two months after feasibility study is completed

7) Trash Rack Pilot Study
   a) Submit Trash Rack Pilot Study SOP to NMFS - one month after Trash Rack Feasibility Study Report is reviewed and discussed with NMFS.
   b) Start Study – two months after Trash Rack Pilot Study SOP is approved by NMFS
   c) Finish Study – 12 months after start
   d) Report to NMFS – two months after study is completed

8) IP3 Forebay Feasibility Study
   a) Design and install plant modifications at IP3 – in progress
   b) Start Study – in progress
   c) Finish Study – determined after consultation with NMFS
   d) Report to NMFS – two months after study is completed

9) IP3 Forebay Pilot Study
   a) Submit Forebay Pilot Study SOP to NMFS - one month after Forebay Feasibility Study Report is reviewed and discussed with NMFS

b) Start Study – two months after Forebay Pilot Study SOP is approved by NMFS
c) Finish Study – 12 months after start
d) Report to NMFS – two months after study is completed

10) Ristroph Traveling Screen Approved Monitoring Program
   a) Design and Install plant modifications
      i) Completion of modifications – four months after NMFS and NYSDEC approval of Monitoring Plan Revision 3
   b) Submit full Impingement Sampling SOP – two months after NMFS approval of Monitoring Plan Revision 3
   c) Start monitoring – four months after plant modifications are completed and the full Impingement Sampling SOP is approved by NMFS
   d) Review results with NMFS and adjust as necessary

11) Velocity measurements/CFD Report
   a) Submit to NMFS – six months after NMFS approval of monitoring Plan Revision 3

---

*Schedule provided is a best effort estimate relative to NMFS approval of Revision 3 of the Monitoring Plan. The scheduled items subject to prior regulatory approval or relying on third-party equipment providers may themselves be delayed or cause follow-on tasks to be delayed. Where delays are expected or materialize, some of which may be weather or seasonally dependent, Entergy will promptly provide NMFS with a revised schedule.

Attachment 3

Traveling Screen Sluice Sampling and Data Analysis Plan

Attachment 3:
Data Analysis Plan for
Traveling Screen Sluice Sampling

3/18/14

Prepared for:

INDIAN POINT ENERGY CENTER
450 Broadway, Suite 1
Buchanan, NY 10511

Prepared by

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A. Introduction

1. Background

The proposed plan for sampling sturgeon impinged on the travel screens is to record all sturgeon that are impinged during 3, 24-hour periods of each week (Monitoring Plan for IPEC Sturgeon Impingement – Revision 1, page 11):

> "… impingement sampling will be scheduled for 24 consecutive hours (one sampling day) on the three selected sampling days per week."
>
> "… impingement sampling will be accomplished by filtering the screen wash contents from all operating traveling screens at IP1, IP2, and IP3 through sampling nets inserted in the combined return sluices at each unit. At each unit, both the fish sluice and debris sluice will be sampled. The file crew will continuously staff and monitor each collection net during all 24-hours of each sampling day to detect and remove each sturgeon shortly after it is collected (i.e., within one hour) … A second blocking net, located in the same sluice but just downstream from the firs, will insure that one net is always collecting the sluice flow contents while the other net is being cleaned of debris and checked for sturgeon."
>
> "During each scheduled sampling day the field crew will also systematically inspect the entire sluice system and water boxes at each intake structure for the presence of "resident" sturgeon and remove any sturgeon that were not washed through the system into the collection nets."

Accordingly, the traveling screen sluice sampling will provide a census of all sturgeon impinged on the traveling screens during each day of sampling. Separate records will be kept for IP1, IP2 and IP3, and the condition of each sturgeon observed will be recorded.

2. Sampling Design

The proposed plan for traveling screen sluice sampling has the key elements of a stratified random sampling design (Cochran, 1977) in which each week of the year is a statistical stratum, and each day of the week is a sampling unit. In stratified random sampling, units within each stratum typically are selected at random for sampling. Due to logistical consideration, sampling in this case is planned to be conducted every Monday, Wednesday and Friday. The statistical methods developed for stratified random sampling are still valid in this case if impingement of sturgeon is random in time with respect to day of the week. That assumption is made for this data analysis plan.

A separate analysis will be conducted for each unit (i.e., IP1, IP2 and IP3). In addition, separate analyses will be conducted for each condition category of sturgeon (e.g., live, injured, dead) as well as for all condition categories combined.

B. Notation

The subscript h denotes stratum (i.e., week) and the subscript i denotes sampling unit (i.e., day) with in the stratum (Cochran, 1977):

$N_h = 7$, is the total number of units (days) per stratum (week)

$n_h = 3$, is the number of units (days) sampled per stratum (week)

y_{hi} = the number of sturgeon impinged on day i in week h

$W_h = \frac{N_h}{N}$, is the stratum weight for stratum h

$f_h = \frac{n_h}{N_h}$, is the sampling fraction within stratum h

$\overline{Y}_h = \frac{\sum_{i=1}^{N_h} y_{hi}}{N_h}$, is the true mean number impinged per day within stratum (week) h

$\overline{y}_h = \frac{\sum_{i=1}^{n_h} y_{hi}}{n_h}$, is the sample mean number impinged per day within stratum (week) h

$S_h^2 = \frac{\sum_{i=1}^{N_h} \left(y_{hi} - \overline{Y}_h\right)^2}{N_h - 1}$, is the true variance in the number impinged among days within stratum (week) h

$\overline{Y} = \sum_{h=1}^{L} W_h \overline{Y}_h$, is the true mean number impinged per day averaged over the year, where L is the number of strata (weeks) per year

$N = \sum_{h=1}^{L} N_h$, is the number of days per year.

C. Unbiased Estimates

The annual total number impinged, Y, can be expressed as the number of days per year times the average number impinged per day:

$$Y = N\overline{Y} = N\sum_{h=1}^{L} W_h \overline{Y}_h$$

An unbiased estimate of the total, based on stratified random sampling is:

$$\hat{Y}_{st} = N\sum_{h=1}^{L} W_h \bar{y}_h$$

The variance of this unbiased estimate (Cochran, 1977) of the total number impinged is:

$$Var\left(\hat{Y}_{st}\right) = \sum_{h=1}^{L} N_h \left(N_h - n_h\right)\frac{S_h^2}{n_h}$$

An unbiased estimate of the variance of the estimated total number (Cochran, 1977) impinged is:

$$v\left(\hat{Y}_{st}\right) = \sum_{h=1}^{L} N_h \left(N_h - n_h\right)\frac{s_h^2}{n_h}$$

where

$$s_h^2 = \frac{1}{n_h - 1}\sum_{i=1}^{n_h}\left(y_{hi} - \bar{y}_h\right)^2$$

D. Discussion

The data analysis plan for analyzing data from the traveling screen sluice sampling is to use the system of equations documented in the foregoing sections to compute unbiased estimates of the annual total numbers of sturgeon impinged. In addition, for each estimate of the annual total number impinged, an unbiased estimate of the variance will be computed.

As part of this analysis, estimates of variance components for each weekly stratum will be computed. These estimates of variance components can be used to guide the optimization of the sampling design for use in future years. In stratified random sampling with a fixed overall sample size, n, the variance of the estimated total is minimized when the samples are allocated to the strata as follows (Cochran, 1977):

$$n_h = n \frac{N_h S_h}{\sum_{h=1}^{L} N_h S_h}$$

This is referred to as the Neyman allocation (Neyman, 1934).

If impingement of sturgeon exhibits a seasonal pattern, then re-allocation of sampling effort can lead to improved precision of estimates and/or reduced sampling effort with no reduction in precision of estimates.

E. Literature Cited

Cochran, W.G. 1977. Sampling techniques. Third edition. John Wiley and Sons. New York. 428 pages.

Neyman, J. 1934. On the two different aspects of the representative method: The method of stratififed sampling and the method of purposive selection. Jour. Roy. Stat. Soc., 97, 558-606.

Attachment 4

Indian Point Sturgeon Impingement Quality Assurance Plan and Standard Operating Procedures

Indian Point Sturgeon Impingement Quality Assurance Plan and Standard Operating Procedures

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1.0 Introduction

On 30 January, 2013, the National Marine Fisheries Service (NMFS) issued a final Biological Opinion (Opinion) and Incidental Take Statement (ITS) authorizing takes of Atlantic and Shortnose sturgeon during the continued operation of the Indian Point Energy Center (IPEC) pursuant to existing operating licenses and proposed renewed operating licenses to be issued by the U.S. Nuclear Regulatory Commission (NRC). In the Opinion, NMFS addressed Shortnose Sturgeon and the Gulf of Maine Distinct Population Segment (DPS), the New York Bight DPS, and the Chesapeake Bay DPS of Atlantic Sturgeon.

Among other things, the Opinion requires that Entergy must develop a proposed, draft monitoring plan designed to document all Atlantic and Shortnose sturgeon impinged at Indian Point Unit 1 (IP1), Indian Point Unit 2 (IP2) and Indian Point Unit 3 (IP3) while these facilities are operating under their existing operating licenses and the proposed renewed operating licenses. The Opinion also contains Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T&C) that are to be "developed in coordination with the action agency and applicant, if any, to ensure that the measures are reasonable" (USFWS & NMFS, 1998).

This Quality Assurance Plan and Standard Operating Procedures (i.e., "the QA Plan and SOP") was prepared to implement the approved impingement monitoring plan for sturgeon at the IPEC Ristroph traveling screens. This QA Plan and SOP provides detailed field, laboratory, quality assurance (QA), and quality control (QC) procedures consistent with NMFS protocols and requirements specified in the Opinion and approved in the Monitoring Plan.

1.1 Objective

The objective of performing sturgeon impingement sampling at the intakes of IP1, IP2 or IP3 is to implement monitoring, detection, and handling of sturgeons that encounter the optimized traveling screen and fish return system as specified in RPM#1 and T&C#1.e of the Opinion. Any sturgeon collected in the impingement samples will be processed as specified in RPM#2, RPM#3, and T&C#3, T&C#4, T&C#5, and T&C#6 of the Opinion. We expect sturgeon collected from the Ristroph traveling screens may be alive or dead. Any live sturgeon collected will be released back into the Hudson River at a location away from the intakes and thermal plume as specified by RPM#2 of the Opinion.

1.2 Organization of this Document

This QA Plan and SOP is a companion document to the approved Monitoring Plan. The Monitoring Plan describes the basis for implementing the requirements of the Opinion and the applicable RPMs and T&Cs. The QA Plan and SOP describe the equipment, methods and procedures to be followed specifically for sturgeon impingement sampling (Section 2.0), the processing of any sturgeon collected in the impingement samples (Section 3.0), and the QA and QC of these procedures (Section 4.0). It should be noted that, until the IPEC impingement sluices are modified and the sampling devices are installed, Section 2.0 and Section 4.0 of this QA Plan and SOP cannot be completed because these protocols must be coordinated with IPEC operations.

2.0 Impingement Sampling

2.1 Traveling Screen Sluice Sampling

Traveling screen sluice sampling will be conducted in a reasonable and prudent manner to minimize the stress on all fish (including sturgeon) by sampling sturgeon that are collected by the continuously rotated traveling screens. The screen wash contents from all operating traveling screens at IP1, IP2, and IP3 will be filtered the through sampling nets inserted in the combined return sluices at each unit. At each unit, both the fish sluice and the debris sluice will be sampled. Two blocking nets made of 3/8 inch delta mesh liner will be inserted into each sluice and held in place by U-channel guides (Figure 2-1 of the Monitoring Plan), one immediately downstream of the other. The use of two blocking nets in the same sluice will insure that no sturgeon are missed during the time that one of the nets is briefly removed for processing the sample. A minimum water depth of 6 inches in the sluice sections with the nets will be maintained by damming the water with a low (≤ 6-inch) partition in each sluice just downstream of the two nets if necessary, to insure adequate water depth for fish accumulating in the nets.

The pairs of sluice sampling nets for IP2 will be installed and operated in the combined fish sluice and in the combined debris sluice at the north end of IP2 (Figure 2-2 of the Monitoring Plan). The sluice sampling nets for IP3 will be installed in the fish sluice and the debris sluice outside the southwest end of the IP3 screen house (Figure 2-3 of the Monitoring Plan). The sluice sampling nets for IP1 will be installed and operated where the combined fish sluice and combined debris sluice exit at the southwest end of the IP1 screen house (Figure 2-4 of the Monitoring Plan). (Note: once installed, Figures 2-1 through 2-4 will be incorporated into this QA Plan and SOP to depicting the as-built and installed samplers for IP1, IP2, and IP3).

Field crews of three will be present continuously to monitor the collection nets during 24-hours of each sampling day to detect and remove each sturgeon shortly after it is collected (usually within a few minutes, but always in less than one hour). One person will be stationed to observe the IP2 sampling nets and adjacent sluices, a second will observe the IP3 sampling nets and adjacent sluices, and the third crew member will move around to check the IP1 nets and the sluices upstream of the sampling nets at all three units. The two technicians monitoring the sluice nets will remove the nets least once per hour or more frequently if needed to avoid excessive accumulation of debris and fish and to be able to remove any sturgeon quickly. The roving third person will systematically inspect the entire sluice system and water boxes at each intake structure for the potential presence of sturgeon, and assist in the processing of any sturgeon collected. The recovery location (sluice, water box, net) and time of each sturgeon will be recorded.

The sampling nets will be cleared frequently so that fish are not overcrowded and not exposed to sampling stress for an extended period of time, by removing one net while the second net continues to sample 100% of the flow through the sluice. The contents of the raised net will be examined, any previously undetected sturgeon will be gently removed to the holding tank, and the remaining fish, invertebrates, and debris will be washed into the sluice flow downstream of the sampling location before replacing the cleared net back in its sampling position. The time of detection and removal to a holding tank will be recorded for any sturgeon found. The two nets will be cleared alternately so that at least one net will be in position at all times, with both in sampling position for most of the time throughout each 24-hour sampling day.

2.1.1 Pre-Wash Inspection

Prior to the collection of the first one-hour impingement sample on the scheduled sampling date, the traveling screens, debris deflector shields, fish and debris sluices will be thoroughly cleaned and washed to remove all debris and organisms. This process is referred to as "pre-wash". Pre-washing means that each traveling screen is rotated for at least one complete revolution to clean the accumulated debris and organisms from the screen, deflector, and return sluices. There is no need to pre-wash before each subsequent one-hour sample. The purpose of the pre-wash is to clean the sluices and traveling screen housings and debris deflectors of all previously retained debris and fish and identify any sturgeon retained in this material.

2.1.2 Collecting each One-Hour Impingement Sample

Following pre-wash cleaning of the fish and debris sluices, the holding tanks will be filled with ambient, un-chlorinated water, and the sluice nets will be inserted to start the first one-hour sample. The exact time that the upstream sluice net was installed in each sluice will be recorded to the nearest minute to start the first one-hour collection of the 24-hour collection period. The exact time that sluice net was removed from the sluice flow will be recorded to the nearest minute to end the first one-hour collection. If a sturgeon is observed at any time during the hour-long collection interval, the collection net containing that sturgeon is removed and the exact time recorded to the nearest minute for that collection.

2.1.3 Sample Collection Information

Ristroph screen operating conditions, water quality conditions, and observations describing the amount and type of debris will be recorded for each one-hour impingement sample on the Impingement Field Data Sheet. A separate data sheet will be used for each one-hour impingement sample from the fish sluice and from the debris sluice collection tanks. Water temperature (to the nearest 0.1°C), dissolved oxygen concentration (to the nearest mg/l), and salinity (to the nearest 0.1 PSU) will be monitored and recorded in the sluice flow supplying each sampler at IP1, IP2 and IP3.

2.2 Traveling Screen Sluice Sampling

As soon as a sturgeon is observed, it will be removed from the sluice sampling net and placed in a 150-gallon oval holding tank (Figure 2-5 of the Monitoring Plan) located on the deck level adjacent to the sampler for subsequent processing (described in Section 3.0). The holding tank at each unit will be covered with a mesh panel to prevent fish escapement and the tank will be supplied with a continuous flow of ambient river water from a raw water tap or submersible pump at a flow rate where the volume is replaced every 15 minutes. Water temperature (to the nearest 0.1°C), dissolved oxygen concentration (to the nearest mg/l), and salinity (to the nearest 0.1 PSU) will be monitored and recorded in the water of the holding tank(s) during each interval when one or more sturgeon are being held for processing.

2.3 Collection Efficiency

To verify that the combination of the paired sluice sampling nets with frequent examination of the sluice systems upstream of the collection locations effectively prevents non-detection of fish, collection efficiency testing will be conducted on the first sampling date of each month. Fish between 100 mm TL and 600 mm TL will be obtained from prior impingement collections (e.g., white perch, striped bass, or white catfish), NY-certified commercial hatchery operations, or certified local bait dealers as needed and used to determine the collection efficiency of the sluice samplers. Twenty-five dead fish will be marked and introduced into each sampled sluice upstream of the sampling nets. On those dates, all fish collected in the sluice sampling nets will be examined for marks and collection efficiency fish will be removed before releasing the rest of the fish. The number of collection efficiency fish recovered in the deployed sluice samplers compared to the number released will determine the collection efficiency of the sluice net samplers in each sampled sluice.

2.4 Monitoring Schedule

Traveling screen sluice sampling will be conducted by sampling sturgeon that are collected by the continuously rotated traveling screens during three 24-hour sampling days per week at each operating unit. To enable IPEC's fish handling and return system to convey live fish promptly back into the Hudson River with minimal stress, sampling will be scheduled for 24 consecutive hours (one sampling day) on three sampling days per week (Monday, Wednesday, and Friday). Each scheduled sampling day is expected to begin between 0700 and 0900, and will be coordinated with IPEC operators schedule and shift changes. Daily circulating water flow data will be obtained from IPEC for all non-sampling dates as well as for the sampling dates throughout the monitoring period to document any unexpected short-term deviations from typical withdrawal rates.

Impingement samples will be collected on scheduled dates when at least one circulating water pump and the associated traveling screen in each of the IP1, IP2 or IP3 intake structures are operating. On each of the selected impingement sampling dates, 24 consecutive one-hour impingement samples will be collected to represent one 24-hour period, beginning, for example, at 0900 on day 1 and ending at 0859 on the next day (day 2). The beginning and ending time of each scheduled sampling date may be adjusted by the field crew depending on plant maintenance, operating, or scheduling constraints.

3.0 Impingement Sample Processing and Handling Procedures

All sturgeon collected at the intakes of IP1, IP2 or IP3 will be processed as specified in RPM#2, RPM#3, and T&C#3, T&C#4, T&C#5, and T&C#6 of the Opinion. We expect sturgeon collected from the trash racks will be moribund or dead, while sturgeon collected from the Ristroph traveling screens may be alive or dead. Any live sturgeon collected will be released back into the Hudson River at a location away from the intakes and thermal plume as specified by RPM#2 of the Opinion. Each sturgeon collected will be subjected to the following processing:

- Sturgeon will be identified to species with length (total length in millimeters), weight (wet weight in grams) recorded.
- Sturgeon will be checked for previously applied tags, including PIT tags, external streamer tags, acoustic tags, and coded wire tags. If a tag is found, the tag type and identification number will be recorded.
- Genetic samples will be obtained from all sturgeon or sturgeon parts collected from the intakes as specified in Appendix IV of the Opinion.
- All dead sturgeon and sturgeon parts collected will be processed as described below. External criteria will be used to determine, where practicable, if a dead sturgeon was

previously dead in the field at the time of collection, based on signs of life (e.g., body movement or opercular movement) or other indications of death (e.g., red or only slightly faded gill filaments, bodily decay, bleached gill filaments, or other signs of morbidity or death prior sample collection (King *et al*. 2010).

- The nature of observed external injuries for all dead sturgeon will be recorded as part of the initial field necropsy performed at the time of collection.
- An "Incidental Report Sturgeon Take – Indian Point" form and a Sturgeon Salvage Form will be completed for each dead sturgeon as specified Appendix II and Appendix III of the Opinion.
- Dead sturgeon or body parts retrieved from the IPEC intakes will be photographed, measured, labeled with a unique sample number, and retained by freezing until delivered on a NMFS-approved schedule to a qualified individual (recommended by NMFS), to perform necropsies.

3.1 Atlantic and Shortnose Sturgeon Processing Procedures

External criteria will be used to determine, where practicable, if a dead sturgeon collected at the IP1, IP2 or IP3 intakes was previously dead prior to the time of collection, based on signs of life (King et al. 2010). Alive vs. dead (i.e., A_D) and A_D_STATUS (i.e., new, fresh within 24 hours; or old, dead for more than 24 hours) status is determined for each sturgeon in the field at the time of collection. There are two classes of sturgeon collected with regard to alive vs. dead, two classes of dead sturgeon (old or new), and four classes of injury status, providing the following unique alive vs. dead categories of sturgeon coded as follows:

An alive sturgeon (A_D = 1, A_D Status = blank) is visibly in excellent condition, swimming upright when placed in a holding tank in well oxygenated water or in a net pen, with good coordination and speed. An alive fish attempts to avoid capture when handled.

A newly dead sturgeon (A_D = 2, A_D Status = 1; considered to have died within the previous 24 hours) will exhibit one or more of the following features when held in ambient, well oxygenated water in the holding tank or net pen:

- slight or infrequent body movement or reflexive twitching,
- slight or occasional opercular movement,
- eyes are clear,
- red or only slightly faded gill filaments,
- body mucus layer fresh and intact,
- bleeding, or
- no bodily decay.

A previously dead sturgeon (A_D = 2, A_D Status = 2; considered to have died 24 hours or more before collection) will exhibit one or more of the following features when held in ambient, well oxygenated water in the holding tank or pen:

- no opercular or body movement,
- eyes are cloudy or opaque,

- bleached gill filaments,
- body mucus slight or none,
- no bleeding,
- bodily decay, or
- other signs of morbidity or death prior sample collection.

Newly dead sturgeon will be processed at the time of collection and either delivered in fresh condition (within 24 hours of collection) to an individual or facility qualified to carry out necropsy procedures, including pathogenic analysis, as identified by NMFS, or frozen for subsequent delivery and necropsy analysis. Old dead sturgeon will be processed at the time of collection and then frozen until transferred to NMFS or an appropriately permitted researcher to perform necropsy as specified in RPM #3 and T&C #4 of the Opinion.

3.1.1 Species Identification

Three different external features will be used to distinguish juvenile and older Shortnose and Atlantic Sturgeon in the field:

1. the mouth width to eye distance ratio,
2. the presence or absence of bony plates (scutes) found between the base of the anal fin and the midlateral line, and
3. the presence of one or two rows of scutes found along the dorsal midline posterior to the dorsal fin, and along the ventral midline anterior to the anal fin.

To identify the correct sturgeon species, first the ratio of the mouth width to the distance between the eyes is calculated. A Shortnose Sturgeon has a relatively large mouth compared to an Atlantic Sturgeon (see Figure 3-1 and Figure 3-2). Shortnose Sturgeon are reported to exhibit a mouth width to eye distance ratio of greater than 62% (typically 63% to 81%, Musick in Collette and Klein-MacPhee, 2002). An Atlantic Sturgeon has a smaller mouth and exhibits a mouth width to eye distance ratio typically less than 62% (range 43% to 66%, Musick in Collette and Klein-MacPhee, 2002, Table 3-1). The mouth width in mm is measured with calipers inside of the lips, and the distance between the eyes in mm is also measured with calipers (see Figure 3-1). The ratio of the mouth width to the distance between the eyes is calculated by taking the measured mouth width and dividing it by the eye width and multiplying by 100 to express the number as a percentage. For example, if the measured mouth width is 47 mm and the measured eye width is 64 mm, then ratio is 47/64 = 0.734 * 100 = 73.4%, and this fish is likely to be a shortnose sturgeon.

Because there is some overlap between the range of mouth widths to eye width ratios reported for some Atlantic Sturgeon distinct population segments (63% to 66% for both species, Musick in Collette and Klein-MacPhee, 2002), a second characteristic must also be used to distinguish the two sturgeon species. The presence or absence of bony plates (scutes) above the anal fin will also be used to distinguish Shortnose and Atlantic Sturgeon. If two to six scutes at least as large as the pupil of the eye are found above the anal fin in the space between the base of the anal fin and the midlateral row of scutes (see Figure 3-2), then the sturgeon is an Atlantic Sturgeon. If no scutes are found between the base of the anal fin and the midlateral row of scutes, the sturgeon is a Shortnose Sturgeon.

A third characteristic can also be used to verify the sturgeon species identification based on the mouth to eye ratio and the presence or absence of anal fin scutes. This is the presence of a single or double row of scutes in the post-dorsal or pre-anal portions of the body (Smith 1985). Looking at the dorsal (top) surface of the fish, an Atlantic Sturgeon will have two rows of scutes between the posterior edge of the dorsal fin and the anterior edge of the caudal fin, one row on either side of the mid-dorsal line. Turning the fish over and looking at the ventral (belly) area between the anterior edge of the anal fin and the pelvic fins, an Atlantic Sturgeon will also have two rows of scutes, one row on either side of the mid-ventral line. If the fish is a Shortnose Sturgeon, it will have a single row of scutes in both the post-dorsal and pre-anal areas, with this row aligned directly down the mid-line. In some Shortnose Sturgeon, particularly on smaller specimens, the post-dorsal row of scutes may be almost completely absent. A comparison of these distinguishing features is shown in Table 3-1.

Table 3-1. Identification characteristics for Atlantic and Shortnose Sturgeon.

Species	Mouth/ Eye Ratio	Anal Fin Lateral Scutes	Post-Dorsal Scutes	Pre-Anal Scutes
Atlantic Sturgeon TAXON = 29	<62%	2 to 6 bony plates present	Double row	Double row
Shortnose Sturgeon TAXON = 27	>62%	Absent	Single row or absent	Single row

If a live, young-of-the year sturgeon (<70 mm total length) is collected in an impingement sample, it may be classified as TAXON = 70 (unidentified sturgeon) and a tissue sample taken for positive identification, if determined by the field crew leader at the time of collection that examining the fish for taxonomic characteristics could harm the fish or reduce its survival upon release.

3.1.2 Field Processing Procedures

Processing of sturgeon at the time of collection at the IP1, IP2 or IP3 intakes will include the following:

1. Identify each Atlantic and Shortnose Sturgeon caught in each sample using the external features listed above in Section 3.1.1.
2. All alive Atlantic and Shortnose Sturgeon are handled with care and returned to the Hudson River away from the intakes and thermal plume after being identified, closely examined for injuries and other factors affecting their condition, examined for external and internal tags, measured to the nearest millimeter total length (TL) and to the nearest millimeter fork length (FL) and weighed to the nearest gram (wet weight).
3. Alive Atlantic Sturgeon greater than 250 mm TL and alive Shortnose Sturgeon greater than 300 mm TL that have not been tagged may be PIT tagged if in good condition and released following the procedures listed below.

4. Record all pertinent sturgeon data on the Sturgeon M2 data sheet (see Section 3.1.3 below).
5. Any Atlantic or Shortnose Sturgeon that is dead at capture is processed in the field and then placed on ice and transported to the laboratory, where it will be frozen and saved for the NMFS.
6. Notify the IPEC 3 Control Room (914.254.8277) and NMFS within 24 hours as required by RPM #5 and T&C #6. Complete an "Incidental Report – Sturgeon Take – Indian Point" form as specified in Appendix II of the Opinion and shown in Figure 3-3.
7. Photographs will be taken and a Sturgeon Salvage Form (Appendix III of the Opinion and shown as Figure 3-4) is completed.
8. Every reasonable effort should be taken to release any live Atlantic and Shortnose Sturgeon in the same condition as at the time of collection. If, in the judgment of the principal investigator or co-investigators, complete processing of Atlantic or Shortnose Sturgeon at the time of capture is likely to endanger the survival of the fish, the minimum processing of identification to species will be performed and the fish will be released with a comment made on the data sheet describing the reasons why full processing was not completed.
9. Taxonomic features used to distinguish juvenile, immature, and adult Shortnose and Atlantic Sturgeon (Section 3.1.1 above) will be documented on the M2 Data Sheet (Section 3.1.3 below) under the variables EYE WIDTH, MOUTH WIDTH, MOUTH/EYE RATIO, LATERAL ANAL SCUTES, POST-DORSAL SCUTES, and PRE-ANAL SCUTES. Check the data recorded for these variables recorded against Table 3-1 in Section 3.1.1 above to be sure that all values agree with the assigned taxon code.
10. Take at least five photographs of each sturgeon collected. Additional photographs should be taken if one or more injuries are observed. One purpose of taking photographs is to verify taxonomy based on external traits and to document the condition of each fish. Taxonomy of the smaller (juvenile) sturgeon may be more variable compared to larger fish, and the photographs will be used to document this variability. Recaptured fish will be also be photographed because of their importance to the management program. Photographs of injuries will document where on the fish they are located and the nature and severity of the injury. In the field of view of each photograph, include a paper label with TASK_CD, SAMPLE, FISH_ID, TAXON, DATE, TIME, LENGTH, and INJURY written on it. The five photographs (digital images) taken for each sturgeon will include:
    a) a close up of the eyes with a millimeter ruler for scale,
    b) a close up of the mouth with a millimeter ruler for scale,
    c) a close up side view of the base of the anal fin to reveal the presence or absence of anal scutes,
    d) a view of the entire left side of the sturgeon, and
    e) a view of the entire right side of the sturgeon.
    f) If the sturgeon has one or more external injuries or suspected tag wounds, one or more additional photographs will be taken to illustrate the wound(s) from a lateral, ventral or dorsal view with a pointer or a millimeter ruler used to identify each injury or abnormality observed.

11. Check all Atlantic Sturgeon and Shortnose Sturgeon for external tags and internal (PIT) tags, indicate the fish was checked for tags (TAGS = 1), and record all pertinent tag data on the Sturgeon M2 data sheet (Section 3.1.3 below).
12. Cornell University tagged Hudson River sturgeon (Atlantic and Shortnose Sturgeon) greater than 200 mm TL in 1993 and 1994 with two yellow USFWS Floy tags, one at the base of the left pectoral fin and the other at the anterior base of the dorsal fin. Atlantic Sturgeon between 60 mm TL and 140 mm TL were also tagged with magnetic tags and released in Newburgh Bay in October of 1994. These magnetic tags were inserted in either the head region or under the 4th dorsal scute. However, Normandeau will not scan live sturgeon for magnetic tags because recovery and reading of the tag if detected would require killing the fish.
13. Examine each sturgeon for an external Carlin-Ritchie disc dangler tag inserted through the dorsal fin.
14. Scan each sturgeon caught with a hand-held PIT tag reader (BioMark Pocket Reader/EX with Memory) along its entire dorsal length of the body to search for a previously applied PIT tag.
15. Scan each sturgeon caught with a Lotek receiver to search for an active previously applied acoustic tag.
16. Each sturgeon caught with a tag present will be assigned a REL_REC = 2 and have the tag number or description of the mark recorded on the Sturgeon M2 data sheet (Section 3.1.3 below).
17. A comment will also be written to describe the condition of the tag insertion site for each recaptured sturgeon.
18. Length (mm TL and mm FL), wet weight (grams), condition at time of capture, and sex if readily apparent, are determined and recorded on the Sturgeon M2 data sheet (Section 3.1.3 below) for each sturgeon caught.
19. A genetic tissue sample must be taken from <u>all</u> sturgeon collected as specified in Appendix IV of the Opinion (Figure 3-5) by removing a 1.0 cm^2 finclip from the tip of the soft fin area of the pelvic fin using a clean pair of sharp scissors. Previously tagged Atlantic or Shortnose Sturgeon will not have a genetic sample taken unless the fish is dead.
    a) Cross contamination of genetic samples must be avoided. For each fish sampled use a new pair of surgical gloves and new scalpel blade or clean scissors for cutting and handling the sample. If contamination occurs discard the sample.
    b) The scissors will be washed clean in an antiseptic bath (70% isopropyl alcohol or 90% ethanol) before and after being used to obtain each tissue sample to prevent cross contamination of the genetic material in each tissue sample.
    c) Place a 1 cm^2 clip of pelvic fin section in a vial with the preservative (95-100% ethanol). Be sure to use ethanol that has not been denatured with methanol or other chemical additions. Use the vials and paperwork provided by NOAA-NOS within Ziploc bags.
    d) Label the genetic sample vial using a waterproof pen (Sharpie) with the sample number and fish ID number. Then place this properly closed vial in a small

Ziploc bag labeled with an Internal and External label as specified by Appendix IV (Figure 3-5).

e) Place the Ziploc bag containing the genetic tissue sample vial in a cooler on ice. Upon returning to the laboratory the tissue samples are to be kept refrigerated until shipped to NOAA-NOS as specified in Appendix IV of the Opinion (Figure 3-5).

f) Record on the Sturgeon M2 data sheet (Section 3.1.3 below) that a tissue sample was taken.

20. Obvious abnormalities or injuries are entered on the Sturgeon M2 data sheet (Section 3.1.3 below) as specified in the data coding instructions for each sturgeon caught. Each injury is described separately, as Injury #1, Injury #2, Injury #3, or Injury #4. The status, type and location of each injury observed on each sturgeon caught are described by entering the codes for the variables INJURY_STATUS, INJURY_TYPE, and INJURY_LOC on the Sturgeon M2 data sheet (Section 3.1.3 below). It is important to distinguish between injuries that are recent and likely caused by our sampling activities and those injuries that occurred to the sturgeon before it was captured in the sample. An alive or dead sturgeon with no observed injuries will have an INJURY_STATUS left blank.
21. An alive sturgeon is one that exhibits body movement and opercular movement, and other signs of life when held in well oxygenated, ambient water. An alive sturgeon that is bleeding from the mouth, body, fins or gills at the time of capture, or has an open wound with little evidence of infection or healing, is considered to be a recent or “new” injury and assigned an INJURY_STATUS = 1.
22. If the sturgeon is alive or dead and has one or more injuries, and the injury is internal but visible (e.g., scoliosis, lordosis), or is an external injury that shows signs of healing, it is considered to be an “old” injury that occurred prior to collecting the fish and assigned an INJURY_STATUS = 2.
23. A dead sturgeon that was recently killed (newly dead, within 24 hours) will exhibit red or slightly faded gill filaments, determined by lifting the operculum and examining the gills, is assigned an INJURY_STATUS = 1.
24. A dead sturgeon that was previously killed (old dead) will exhibit bodily decay, bleached or black gill filaments, or other signs of morbidity, is assigned an INJURY_STATUS of either = 2.
25. If it is not possible to classify an alive or dead sturgeon according to injury status, INJURY_STATUS = 3 is entered on the Sturgeon M2 data sheet (Section 3.1.3 below) and a comment is added to explain the observations leading to this status assignment.
26. TASK CD, SAMPLE, UNIT, LOCATION, FISH_ID, TAXON, DATE, TIME, LENGTH, and INJURY and will be written on a paper label and included within the field of view of each photograph taken.

3.1.3 Sturgeon M2 Data Sheet

The Sturgeon M2 data sheet (Figure 3-6) is used to record all pertinent information associated with the collection and field processing of each Atlantic Sturgeon or Shortnose Sturgeon from IPEC. There is one record for each fish caught. The term "enter" appears in the data sheet coding instructions below for all variables assigned a numeric classification or code as specified in this SOP. The term "record" indicates the data is a measurement variable that should be written to the precision and format specified in this SOP. The term "N/A" indicates this variable is not applicable to the present task.

VARIABLE NAME	CODING INSTRUCTIONS
TASK CODE:	Enter 90 = Indian Point Surgeon Impingement
SAMPLE:	Enter a unique, four digit, sample tracking number
UNIT:	Enter Indian Point Unit Number: 1 = Unit 1 2 = Unit 2 3 = Unit 3
INTAKE BAY:	Enter the intake bay where the sturgeon was collected from either LOCATION = 2 or 3; See Figure 3-7 for IP2 and Figure 3-8 for IP3 intake bay locations: 1 = bay 1 2 = bay 2 3 = bay 3 4 = bay 4 5 = bay 5 6 = bay 6 7 = service water bay 8 = Unit 3 south end trash rack #8 9 = Unit 3 north end trash rack #9
DATE:	Record date (Month/Day/Year) of sample collection
TIME:	Record time of sample collection (military time; 24 hour clock)
TAXON:	Enter: 27 = Shortnose Sturgeon 29 = Atlantic Sturgeon 70 = unidentified sturgeon
REL_REC:	Enter: 1 = Not previously tagged or marked 2 = Recapture
FISH_ID:	Enter the fish identification number (1-999) assigned sequentially within each sample to each Atlantic or Shortnose Sturgeon processed
LENGTH_TOTAL:	Measure and record total length of each Atlantic or Shortnose Sturgeon to the nearest mm (refer to Figure 3-1)
LENGTH_FORK:	Measure and record fork length of each Atlantic or Shortnose Sturgeon to the nearest mm (refer to Figure 3-1)
WEIGHT:	Measure and record wet weight of each Atlantic or Shortnose Sturgeon to the nearest gram

VARIABLE NAME	CODING INSTRUCTIONS
EYE WIDTH:	Measure and record interorbital width of Atlantic or Shortnose Sturgeon to the nearest mm (refer to Figure 3-1)
MOUTH WIDTH:	Measure and record mouth width of Atlantic or Shortnose Sturgeon to the nearest mm (refer to Figure 3-1)
MOUTH/EYE RATIO:	Record the mouth width dividing by the eye width to the nearest whole percentage (e.g. 45% or 73%)
LATERAL ANAL SCUTES:	Enter a code for the presence or absence of scutes (bony plates at least as large as the pupil of the eye) found between the base of the anal fin and the mid-lateral row of scutes (refer to Figure 3-2): 1 = no scutes found just above base of the anal fin 2 = two to six scutes found just above the base of the anal fin
POST-DORSAL SCUTES:	Enter a code for the presence or absence of scutes (bony plates at least as large as the pupil of the eye) found along the dorsal surface between the base of the dorsal fin and the caudal (tail) fin (refer to Figure 3-2): 1 = one row of scutes found along the dorsal mid-line, or absent 2 = two rows of scutes, one on either side of the dorsal mid-line
PRE-ANAL SCUTES:	Enter a code for the presence or absence of scutes (bony plates at least as large as the pupil of the eye) found along the ventral surface between the base of the anal fin and the pectoral fins (refer to Figure 3-2): 1 = one row of scutes found along the ventral mid-line 2 = two rows of scutes, one on either side of the ventral mid-line
A_D:	Enter the code for alive or dead status of the observed fish at the time of collection: 1 = alive 2 = dead
A_D Status:	Enter the code for alive or dead status of the observed fish at the time of collection: 1 = new dead (fresh; 24 hours or less) 2 = old dead (more than 24 hours)
INJURY_LOC:	Enter a code for location of injury observed: Blank = none (used for A_D=1 fish only) 1 = head 2 = opercle(s) 3 = eyes 4 = body

VARIABLE NAME	CODING INSTRUCTIONS
	5 = caudal peduncle
	6 = tail fin
	7 = dorsal fin
	8 = anal fin
	9 = pectoral fin(s)
	10 = pelvic fin(s)
	11 = not used
	12 = not used
	13 = other (describe in comments)
INJURY_TYPE:	Enter a code for type of injury observed:
	Blank = none (Use for A_D = 1 fish only)
	1 = tag wound
	2 = gash or cut
	3 = crushed
	4 = scute loss
	5 = hemorrhage
	6 = fin rot
	7 = body fungus
	8 = skeletal deformities (lordosis or scoliosis)
	9 = lesions or ulcers
	10 = lamprey wound
	11 = tumor(s)
	12 = blindness
	13 = emaciated
	14 = parasites
	15 = gas bubble disease
	16 = other anomaly (describe in comments)
	17 = not used
	18 = missing multiple fins
	19 = external abraision (e.g., net rash)
TISSUE:	Blank = no sample taken
	1 = tissue sample taken.
PHOTO:	Record the number of digital photographs taken
	Blank = no photos taken
PIT TAG NUMBER:	Record 15 digit PIT tag number if present
CARLIN-RITCHIE:	Record 5 digit Carlin Ritchie tag number if present
FLOY DART TAG:	Record the Floy dart tag number if present

VARIABLE NAME	**CODING INSTRUCTIONS**
ACOUSTIC TAG:	Record the VEMCO or Lotek tag number if present in comments
COMMENTS:	Blank = no comments 1 = Describe any pertinent information entered or recorded in the Sturgeon M2 card type that may affect data interpretation in the lines at the bottom of the data sheet

Figures

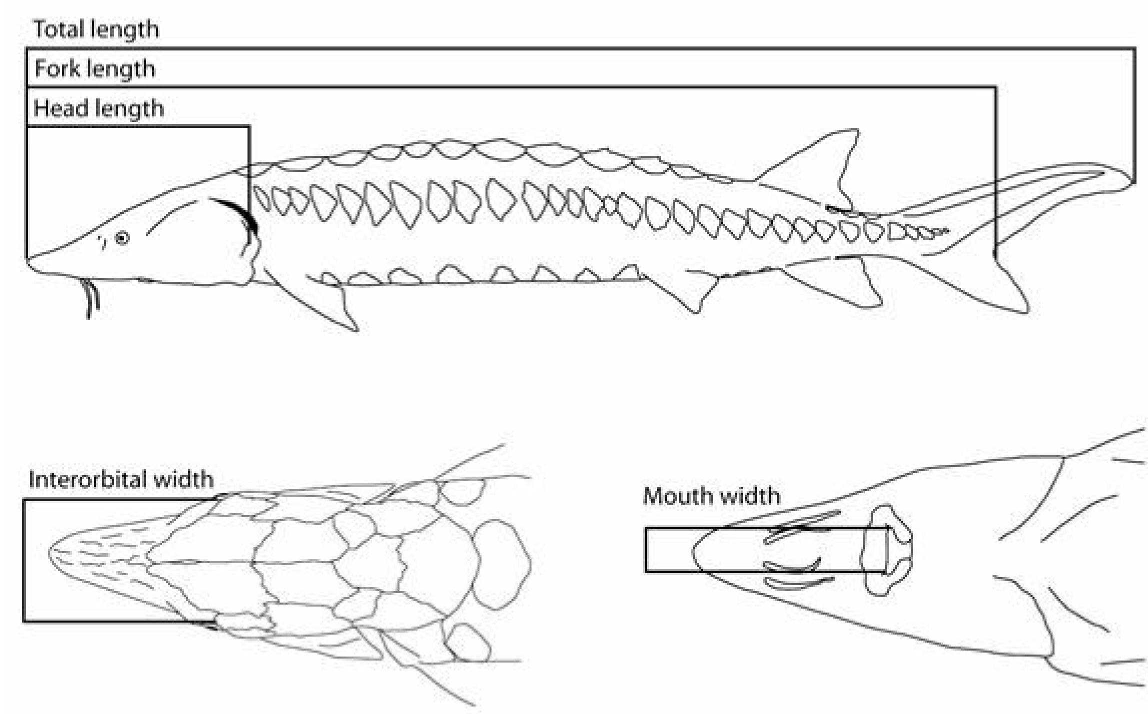
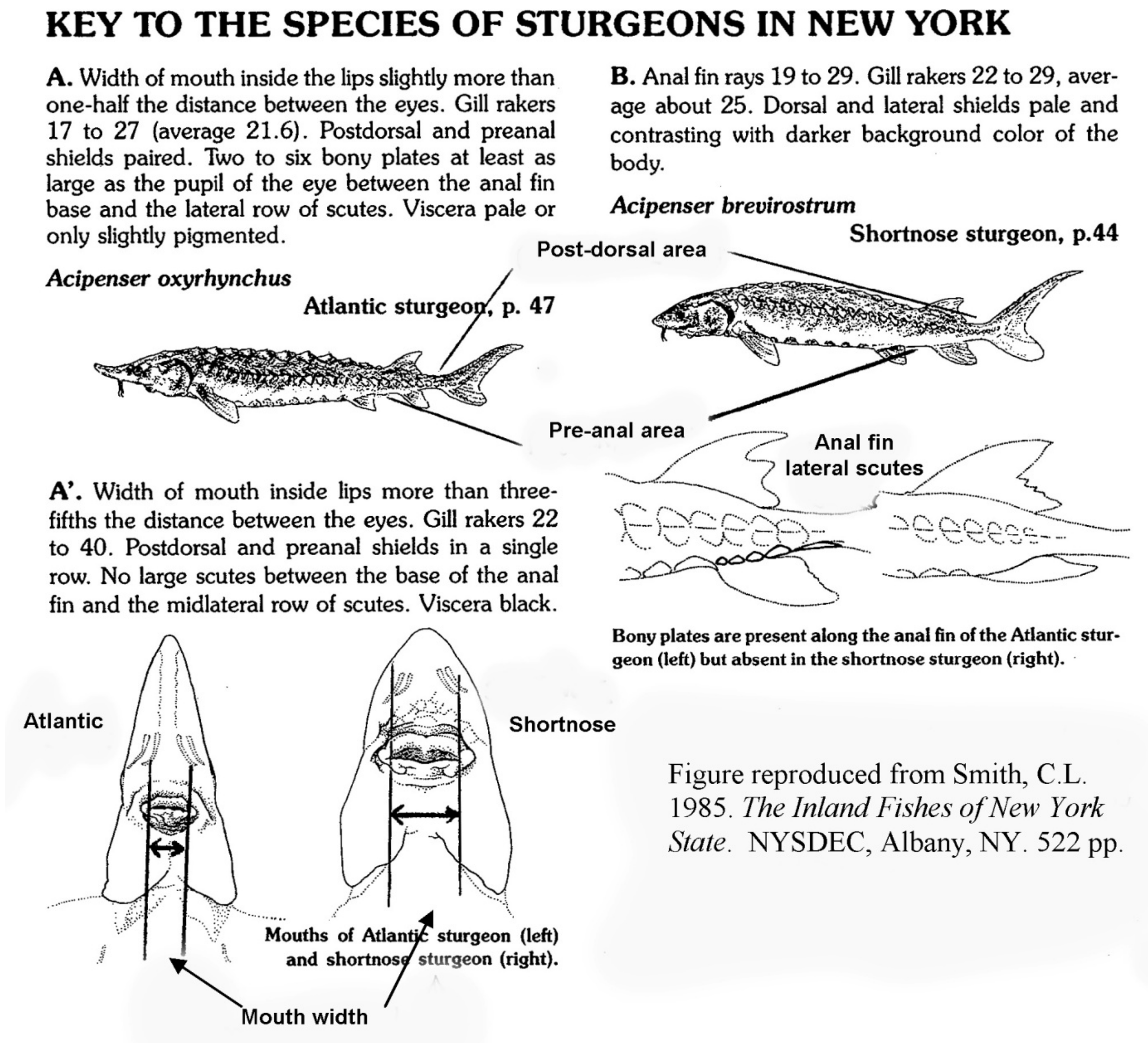


Figure 3-1. Five measurements relevant to field processing of sturgeon (reproduced from Figure 3-1 of NOAA Technical Memorandum NMFS-NE-215; May 2010).



KEY TO THE SPECIES OF STURGEONS IN NEW YORK

A. Width of mouth inside the lips slightly more than one-half the distance between the eyes. Gill rakers 17 to 27 (average 21.6). Postdorsal and preanal shields paired. Two to six bony plates at least as large as the pupil of the eye between the anal fin base and the lateral row of scutes. Viscera pale or only slightly pigmented.

Acipenser oxyrhynchus

Atlantic sturgeon, p. 47

A'. Width of mouth inside lips more than three-fifths the distance between the eyes. Gill rakers 22 to 40. Postdorsal and preanal shields in a single row. No large scutes between the base of the anal fin and the midlateral row of scutes. Viscera black.

B. Anal fin rays 19 to 29. Gill rakers 22 to 29, average about 25. Dorsal and lateral shields pale and contrasting with darker background color of the body.

Acipenser brevirostrum

Shortnose sturgeon, p.44

Bony plates are present along the anal fin of the Atlantic sturgeon (left) but absent in the shortnose sturgeon (right).

Mouths of Atlantic sturgeon (left) and shortnose sturgeon (right).

Figure reproduced from Smith, C.L. 1985. *The Inland Fishes of New York State*. NYSDEC, Albany, NY. 522 pp.

Figure 3-2. Distinguishing taxonomic features of Hudson River Atlantic Sturgeon and Shortnose Sturgeon (from Smith, C.L. 1985. The Inland Fishes of New York State. NYSDEC, Albany, NY).

APPENDIX II Incident Report Sturgeon Take – Indian Point

Photographs should be taken and the following information should be collected from all sturgeon (alive and dead) found in association with the Indian Point intakes. Please submit all necropsy results (including sex and stomach contents) to NMFS upon receipt.

Observer's full name: ____

Reporter's full name: ____

Species Identification: ____

Site of Impingement (Unit 2 or 3, CWS or DWS, Bay #, etc.): ______________________________

Date animal observed: _______________ Time animal observed: ______________________

Date animal collected: _______________ Time animal collected:________________________

Environmental conditions at time of observation (i.e., tidal stage, weather):

____

____

Date and time of last inspection of intakes: ___________________________________

Water temperature (°C) at site and time of observation: ________________________

Number of pumps operating at time of observation: ___________________________________

Average percent of power generating capacity achieved per unit at time of observation: ________

Average percent of power generating capacity achieved per unit over the 48 hours previous to

observation: ____

Figure 3-3. Incident report form for incidental take of Atlantic Sturgeon or Shortnose sturgeon by impingement at the IPEC cooling water intakes (Appendix II of the Opinion).

Sturgeon Information:

Species ___________________________________

Fork length (or total length) ______________________ Weight _______________________

Condition of specimen/description of animal

____

____

____

____

Fish Decomposed: NO SLIGHTLY MODERATELY SEVERELY

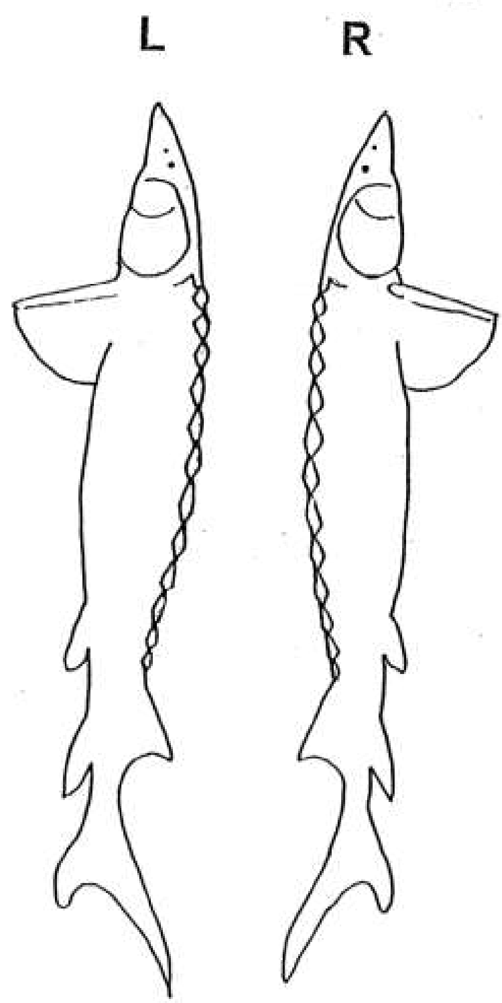
Fish tagged: YES / NO *Please record all tag numbers.* Tag # _________________

Photograph attached: YES / NO

(please label *species*, *date*, *geographic site* and *vessel name* on back of photograph)

(Figure 3-3 continued, page 2 of 3).

Draw wounds, abnormalities, tag locations on diagram and briefly describe below



Description of fish condition:

Figure 3-3 (continued, page 3 of 3).

APPENDIX III

STURGEON SALVAGE FORM

For use in documenting dead sturgeon in the wild under ESA permit no. 1614 (version 05-16-2012)

INVESTIGATORS'S CONTACT INFORMATION
Name: First _______________ Last ______________________
Agency Affiliation _______________ Email_____________________
Address ____
____
Area code/Phone number _____________________________________

UNIQUE IDENTIFIER (Assigned by NMFS)

DATE REPORTED:
Month ☐☐ Day☐☐ Year 20☐☐
DATE EXAMINED:
Month ☐☐ Day☐☐ Year 20☐☐

SPECIES: (check one)
☐ shortnose sturgeon
☐ Atlantic sturgeon
☐ Unidentified *Acipenser* species
Check "Unidentified" if uncertain .
See reverse side of this form for aid in identification.

LOCATION FOUND: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)
River/Body of Water_______________ City______________________ State ____
Descriptive location (be specific)____
____
____
Latitude _____________N (Dec. Degrees) Longitude _____________ W (Dec. Degrees)

CARCASS CONDITION at time examined: (check one)
☐ 1 = Fresh dead
☐ 2 = Moderately decomposed
☐ 3 = Severely decomposed
☐ 4 = Dried carcass
☐ 5 = Skeletal, scutes & cartilage

SEX:
☐ Undetermined
☐ Female ☐ Male
How was sex determined?
☐ Necropsy
☐ Eggs/milt present when pressed
☐ Borescope

MEASUREMENTS: **Circle unit**
Fork length ________ cm / in
Total length ________ cm / in
Length ☐ actual ☐ estimate
Mouth width (inside lips, see reverse side) ________ cm / in
Interorbital width (see reverse side) ________ cm / in
Weight ☐ actual ☐ estimate ________ kg / lb

TAGS PRESENT? **Examined for external tags including fin clips? ☐ Yes ☐ No** **Scanned for PIT tags? ☐ Yes ☐ No**

Tag #	**Tag Type**	**Location of tag on carcass**
____________________	_______________________	___________________________
____________________	_______________________	___________________________

CARCASS DISPOSITION: (check one or more)
☐1 = Left where found
☐2 = Buried
☐3 = Collected for necropsy/salvage
☐4 = Frozen for later examination
☐5 = Other (describe) ____________________

Carcass Necropsied?
☐Yes ☐No
Date Necropsied:___________
Necropsy Lead:
____

PHOTODOCUMENTATION:
Photos/vide taken? ☐ Yes ☐ No
Disposition of Photos/Video:__________
____
____

SAMPLES COLLECTED? ☐ **Yes** ☐ **No**

Sample	**How preserved**	**Disposition (person, affiliation, use)**
____________________	_______________________	___________________________
____________________	_______________________	___________________________
____________________	_______________________	___________________________
____________________	_______________________	___________________________
____________________	_______________________	___________________________
____________________	_______________________	___________________________
____________________	_______________________	___________________________
____________________	_______________________	___________________________

Comments:
____
____
____

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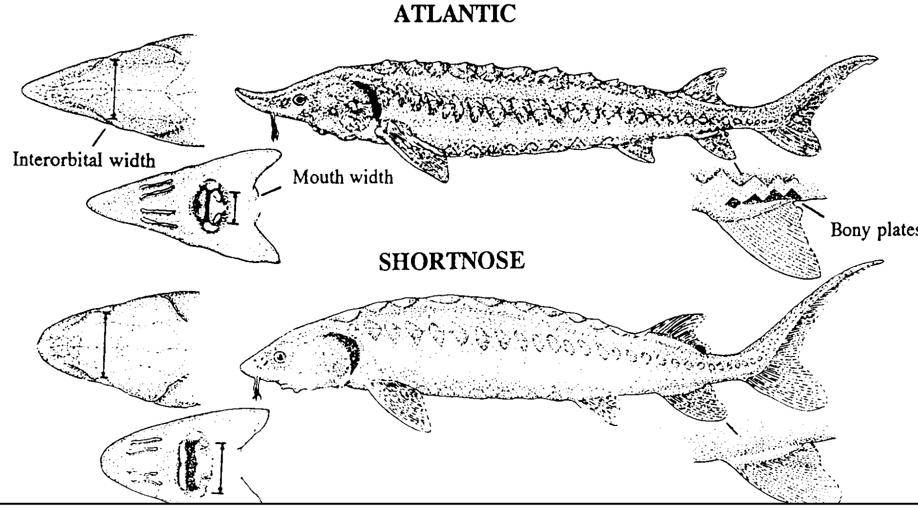
Figure 3-4. Sturgeon salvage form (Appendix III of the Opinion).

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 07-20-2009)

Characteristic	Atlantic Sturgeon, *Acipenser oxyrinchus*	Shortnose Sturgeon, *Acipenser brevirostrum*
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004



Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). **Please note if no wounds / abnormalities are found.**

____

____

____

____

____

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Submit completed forms (within 30 days of date of investigation) to: **Northeast Region Contacts** – Shortnose Sturgeon Recovery Coordinator (Jessica Pruden, Jessica.Pruden@noaa.gov, 978-282-8482) or Atlantic Sturgeon Recovery Coordinator (Lynn Lankshear, Lynn.Lankshear@noaa.gov, 978-282-8473); **Southeast Region Contacts-** Shortnose Sturgeon Recovery Coordinator (Stephania Bolden, Stephania.Bolden@noaa.gov, 727-824-5312) or Atlantic Sturgeon Recovery Coordinator (Kelly Shotts, Kelly.Shotts@noaa.gov, 727-551-5603).

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(Figure 3-4 continued, page 2 of 2).

APPENDIX IV of the Indian Point Biological Opinion

Procedure for obtaining fin clips from sturgeon for genetic analysis

Obtaining Sample

1. Wash hands and use disposable gloves. Ensure that any knife, scalpel or scissors used for sampling has been thoroughly cleaned and wiped with alcohol to minimize the risk of contamination.
2. For any sturgeon, after the specimen has been measured and photographed, take a one-cm square clip from the pelvic fin.
3. Each fin clip should be placed into a vial of 95% non-denatured ethanol and the vial should be labeled with the species name, date, name of project and the fork length and total length of the fish along with a note identifying the fish to the appropriate observer report. All vials should be sealed with a lid and further secured with tape.

Please use permanent marker and cover any markings with tape to minimize the chance of smearing or erasure.

Storage of Sample

1. If possible, place the vial on ice for the first 24 hours. If ice is not available, please refrigerate the vial. Send as soon as possible as instructed below.

Sending of Sample

1. Vials should be placed into Ziploc or similar re-sealable plastic bags. Vials should be then wrapped in bubble wrap or newspaper (to prevent breakage) and sent to:

    Julie Carter
NOAA/NOS – Marine Forensics
219 Fort Johnson Road
Charleston, SC 29412-9110
Phone: 843-762-8547

    a. Prior to sending the sample, contact Russ Bohl at NMFS Northeast Regional Office (978-282-8493) to report that a sample is being sent and to discuss proper shipping procedures

Figure 3-5. Appendix IV of the Indian Point Biological Opinion specifying procedures for obtaining fin clips from sturgeon for genetic analysis.

Indian Point Sturgeon Impingement

Sturgeon Data Sheet

Page ___ of ___

CARD TYPE M2 | TASK CODE 90 | SAMPLE | UNIT | LOCATION | BAY | DATE m m d d y y | TIME h h m m

Taxon | Rel_Rec | Rel_time | Fish_ID | Length | Weight | Eye Width | Mouth Width | Mouth/Eye Ratio | Scutes: Lat. Anal, Post-Dorsal, Pre-Anal | Sex

A-D | A_D status | Injury #1: Injury status, Injury type, Injury_loc | Injury #2: Injury status, Injury type, Injury_loc | Injury #3: Injury status, Injury type, Injury_loc | Injury #4: Injury status, Injury type, Injury_loc

Tissue | Photo | PIT Tag Number | Carlin-Ritchie Tag Number | Floy Dart Tag Number | Comment

Species	Mouth/ Eye ratio	Lateral anal scutes	Post-dorsal scutes	Pre-anal scutes
Shortnose Sturgeon Taxon = 27	>62%	Absent = 1	Single row or Absent = 1	Single row or Absent = 1
Atlantic Sturgeon Taxon = 29	<62%	2 - 6 bony plates present = 2	Double row = 2	Double row = 2

A_D
1=alive
2=dead

A_D Status
1=new dead
2=old dead

Injury status
blank = no injury
1 = new injury
2 = old injury
3 = unable to determine

Injury type
blank = none (used for A_D 1 fish only)
1 = tag wound
2 = gash or cut
3 = crushed
4 = scale loss
5 = hemmorrhage
6 = fin rot
7 = body fungus
8 = sketetal deformities (lordosis or scoliosis)
9 = lesions or ulcers
10 = lamprey wound
11 = tumor(s)
12 = blindness
13= emaciated
14 = parasites
15 = gas bubble disease
16 = other anomoly (describe in comments)
17 = not used
18 = missing multiple fins
19 = net rash

Injury_loc
blank = none (used for A_D 1 fish only)
1= head
2 = opercle(s)
3 = eyes
4 = body
5 = caudal peduncle
6 = tail fin
7 = dorsal fin
8 = anal fin
9 = pectoral fin(s)
10 = pelvic fin(s)
11 = not used
12 = not used
13 = other (describe in comments)

Comments: ______________________________

Indian_Point_Sturgeon_Inj4.ai Rev 6/2015

Figure 3-6. Indian Point Project Sturgeon M2 Data Sheet.

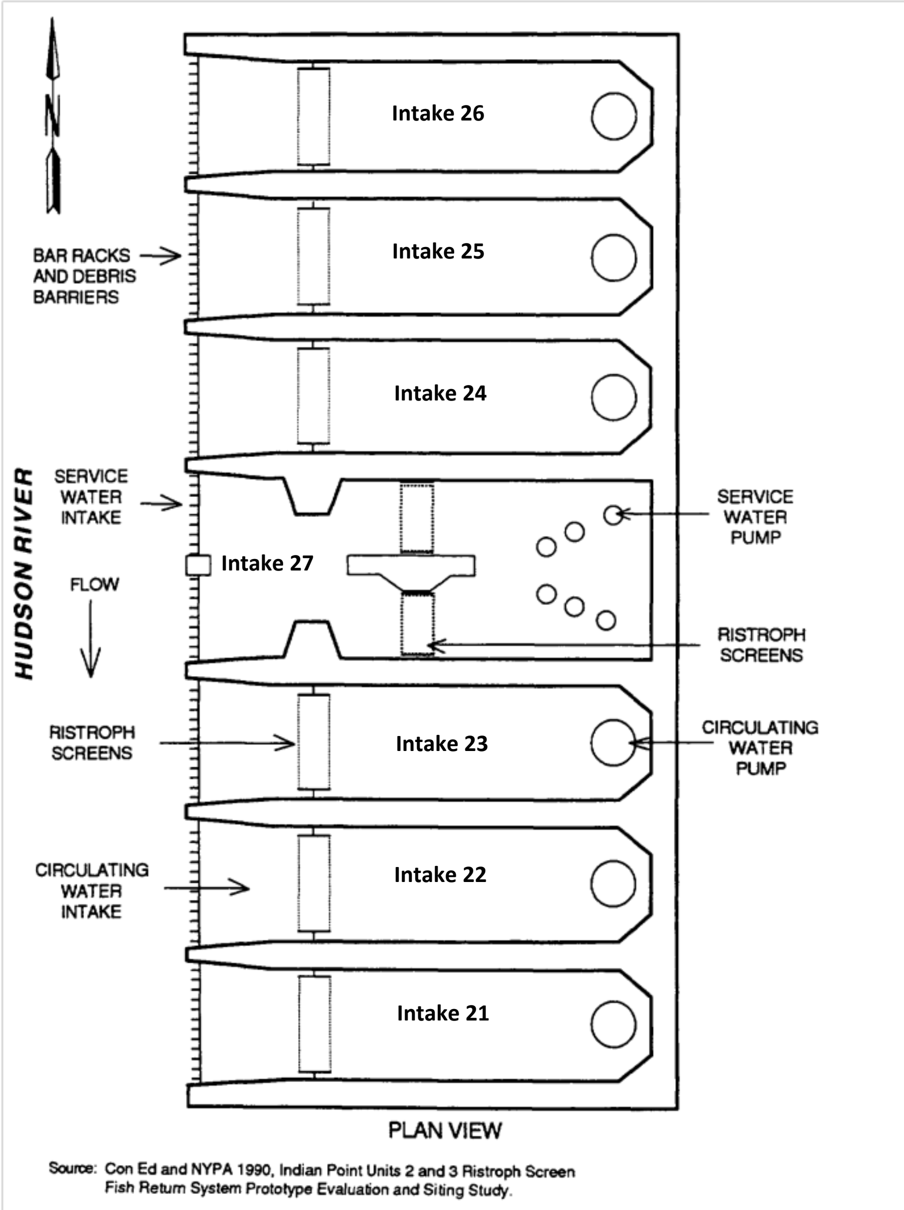


Figure 3-7. Indian Point Unit 2 (IP2) cooling water intake structure in plan view showing the location and numbering of each intake bay.

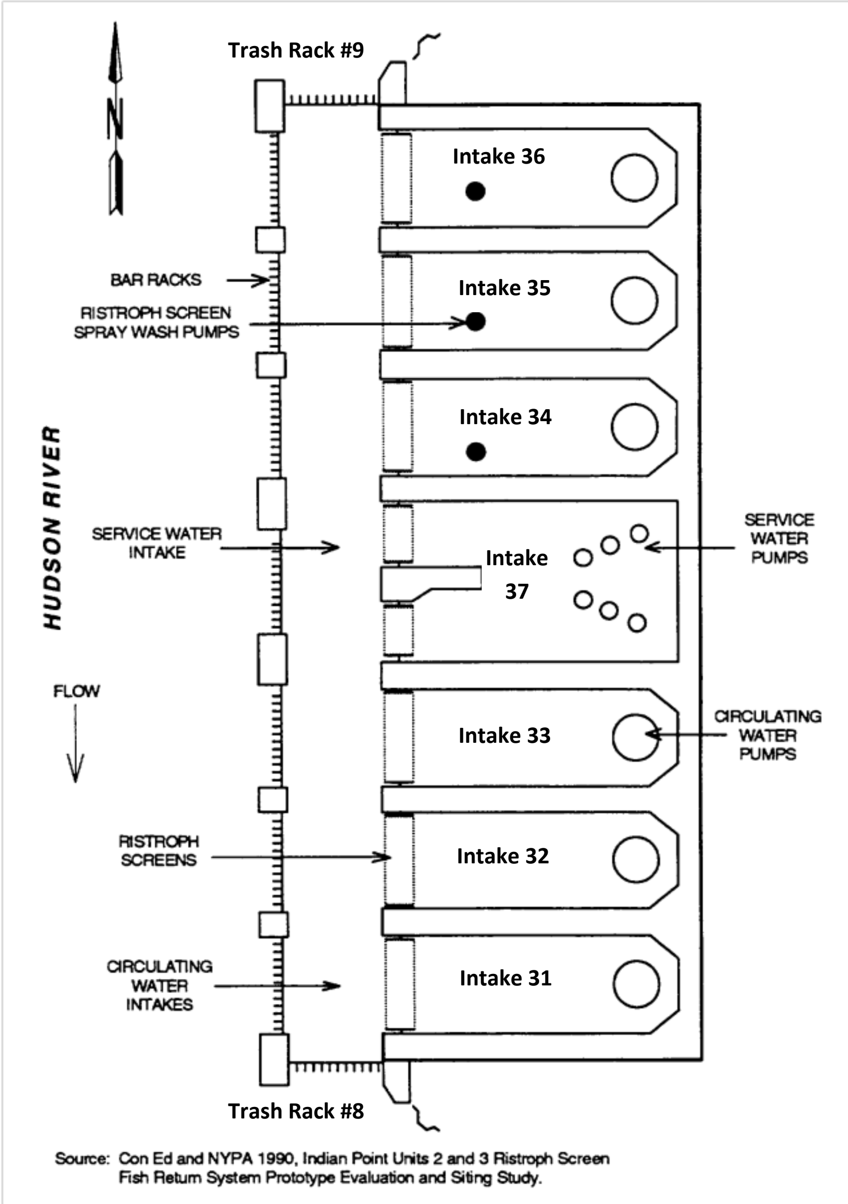


Figure 3-8. Indian Point Unit 3 (IP3) cooling water intake structure in plan view showing the location and numbering of each intake bay.

Attachment 5

CFD Analysis of Forebay and Approach Velocities

Attachment 5
Computational Fluid Dynamics Analysis of Forebay and Approach Velocities

Prepared by
ALDEN RESEARCH LABORATORY, INC.
30 Shrewsbury Street
Holden, MA 01520

The through slot velocity distribution at the face of the trash rack and the traveling water screens can vary when the approach flow is not normal to the screen surface. At IPEC this occurs because of the river currents. The river currents will cause a higher through screen velocity towards the downstream end of the trash rack. The skewed velocity profile can propagate through the forebay resulting in a skewed velocity distribution at the traveling screens. The skew in the velocity distribution is caused by and proportional to the free stream (river current) velocity component parallel to the screen surface.

One of several commercially available computational fluid dynamics models that exist will be applied to the proposed modeling effort (e.g., Fluent, by ANSYS; or FLOW-3D, by Flow Science). The two models are similar in that both solve the Reynolds Averaged Navier-Stokes (RANS) equations with options for various turbulence models to simulate the creation, transport and dissipation of turbulent kinetic energy. However, implementation of the governing equations differs; Fluent uses a boundary fitted grid and FLOW-3D uses a structured grid. The solver in Fluent is better suited to steady state simulations while the FLOW-3D solver is very efficient for unsteady (time-dependent) simulations. Both models have the ability to simulate the trash rack and the traveling water screens with a porous media approximation. We propose to use Fluent with a steady state approximation for an efficient modeling effort rather than FLOW-3D and an unsteady simulation.

The proposed CFD model will extend from downstream of the traveling water screens to a distance of two to four intake widths into the Hudson River. Because the skew in the velocity profile is expected to increase with increasing river currents (shear flow), the skew can be bounded without knowing exact river current magnitudes or direction. Shear flow will be applied in the model without a need to model the cause of the shear flow. High resolution river bathymetry in front of the intake (Substructure 2010) will be used to describe the Hudson River bottom contours and substrate near the IP2 and IP3 CWISs.

The magnitude of the shear flow will be bounded using the existing ADCP data sets from two studies performed in the nearfield area of the Hudson River adjacent to IP2 and IP3 during 2010 (Normandeau 2011) and 2011 (Normandeau 2012). Typically river currents are slower near the shore than in the center of the river. A conservative estimate of the shear flow is to use the maximum observed velocities from the 2010 ADCP Stations 2A and 2B offshore near the IP2 CWIS and Stations 3A and 3B offshore near the IP3 CWIS (Figure 1). A less conservative estimate would use the measured ADCP velocities from in between the IP2 and IP3 CWIS's at the IP1 barge site from the 2011 study (Figure 1). To cover the range of possible maximum velocities, this model will use the maximum from all locations for the initial simulations. Skew in the velocity should also be more pronounced at lower intake pump flows that typically occur during the winter. Therefore, a bounding simulation for each model will be run with the minimum pumping flow.

Two models will be created, one for each of the IP2 and IP3 CWIS. Each model will include the actual trash racks and traveling screens and the relevant intake geometry. Each trash rack or screen surface will be modeled as a porous medium with either the observed or designed headloss characteristics of that trash rack or screen. The headloss characteristics will be obtained either from measurements recorded by IPEC, or directly from the screen manufacturer. If sufficient headloss information is not available from either of these two sources, headloss will be estimated from the screen open area and screen design. Manufacturer's data is considered more reliable than the estimates. Each model will be run for the maximum upriver and downriver velocity resulting in four simulations to define the extreme case condition. Depending on model results, additional simulations may be used to simulate average river conditions or river conditions with a specific exceedence probability.

The velocity distribution three inches upstream of each trash rack and traveling screen will be post-processed to create plots that show the percentage of screen area on the horizontal axis and the velocity percentile above or below the nominal through screen velocity on the vertical axis. The plots will quantitatively show the skew in the approach velocity for a bounding flow condition.

The trash racks and the traveling screens cause headloss which serves to create a more uniform velocity distribution through the screens. The velocity distribution on the surface of the screen can be used to estimate the variability in the through screen velocity. The distribution is considered an estimate because the model will not include every bar and every gap in the trash rack or the traveling water screens. Resolving each screen member is beyond the limitations of existing computational resources. However, the estimated through slot velocity is expected to be very reliable. Plots quantifying the variability in velocity distribution across each trash rack or traveling screen will be made. In addition to the quantitative plots described above, color contour plots will be created for each trash rack and screen colored by absolute velocity or by or a dimensionless velocity showing the velocity distribution.

IPEC has two data sets of continuously recorded nearfield Hudson River water currents available to be used to develop the CFD model of the IP2 and IP3 intakes described above. These two data sets encompass the range of tidal and weather conditions, river flows, and pump operations that are representative of the Hudson River near IPEC. The first data set consists of more than 4.5 million data points of current velocity and direction obtained during five-minute periods from 0.5 m or 1.0 m vertical depth layers overlying four acoustic Doppler current profilers (ADCPs) deployed in the Hudson River near the IP2 and IP3 CWIS's during 4 March through 2 November 2010 (Figure 1). Water current velocity and direction were continuously monitored in each depth layer at four locations (Stations 2A and 2B offshore from IP2; Stations 3A and 3B offshore from IP3) throughout the overlying water column water to (1) evaluate the percentage of time that river currents of a particular velocity range equaled or exceeded designated current velocity increments, (2) determine the primary axes of current flow direction at each of the four Stations, and (3) determine frequency distributions of peak tidal current velocity data throughout the entire nine month monitoring period at each of the four Stations.

Two *in situ* upward-looking ADCPs were also installed on the Hudson River bottom at Stations 1S and 2N in close proximity to the IP1 pier (Figure 1) to continuously record river current velocity and direction throughout the overlying water column from 25 May through 26 September 2011. Water column turbulence data was also collected to provide actual field values of turbulence intensity for CFD modeling of the intake structures. The fixed position ADCPs measured and recorded the physical dynamics of the Hudson River currents in a data set consisting of more than 729,000 data points of current direction and velocity during five-minute intervals from 0.5 m and 1.0 m depth intervals throughout a 50 foot deep water column at the IP1 location, which is in between the IP2 and IP3 CWISs. This 2011 ADCP data set also includes approximately 58 million data points represented by bursts of water direction and velocity data obtained to measure turbulence at one-second intervals. Data recorded from this IP1 site are available for analysis from daily and tidal timescales down to one-second turbulence timescales, including velocity, direction, temperature, depth, and water surface elevation.

The proposed use for the model is to determine the bounding skew in the through slot velocity distribution based on maximum velocities in the river and minimum pump flow conditions. The model can be validated and used to predict the variation in through slot velocity for specific conditions. For this purpose, new velocity measurements will be made near the IP2 and IP3 CWIS's. The measurements will include the river current velocity in front of the CWIS's about 2 to 4 intake widths out from the intake face. Velocity measurements will also be made as close to the trash rack as possible at four locations for IP2 and IP3 CWISs. The predicted velocity distribution at the trash rack will be compared to the measured velocity. Differences in the measured and predicted velocity distribution are typically the result of an incorrect headloss through the trash racks and traveling screens. The headloss coefficient can be adjusted to calibrate the model. The calibrated model can be used to predict the velocity distribution on the trash racks and traveling screens for any river flow condition.

Examples illustrating output graphic capabilities of the proposed CFD models are shown in Figure 2 and Figure 3.

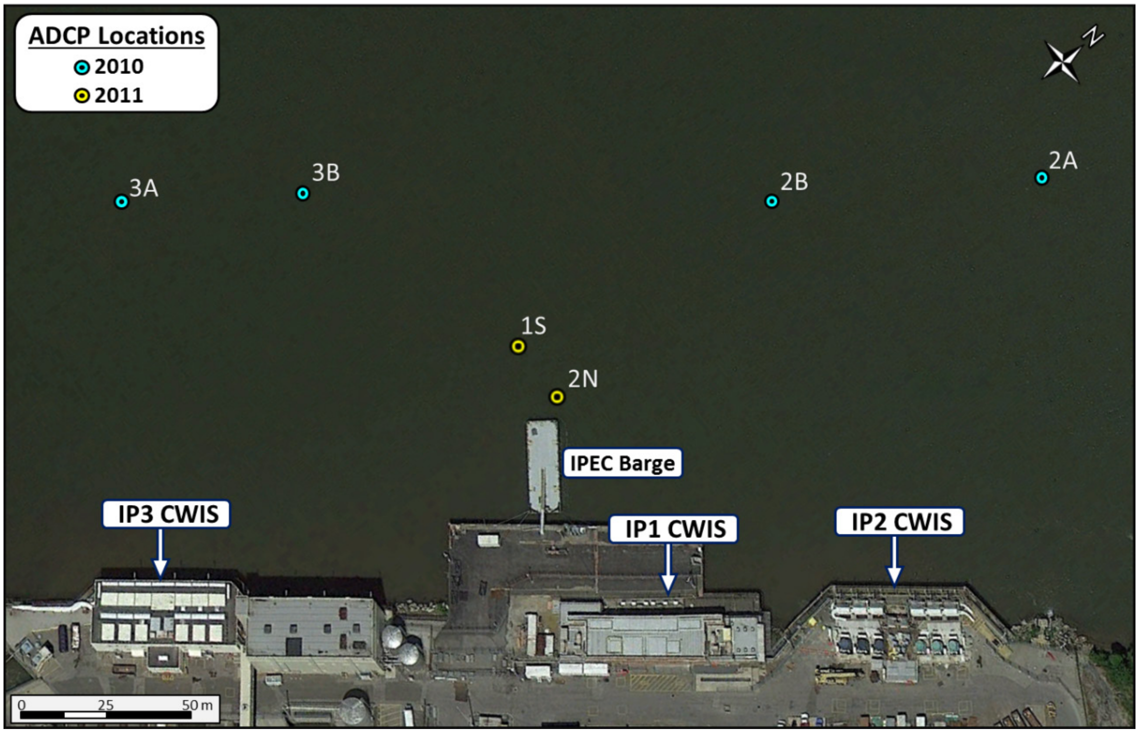


Figure 1. Acoustic Doppler current profiler (ADCP) monitoring station locations near IP2 and IP3 from continuous monitoring studies performed during 2010 (Stations 2A, 2B, 3A, 3B) and 2011 (Stations 1S and 2N). The base image is from Google Earth.

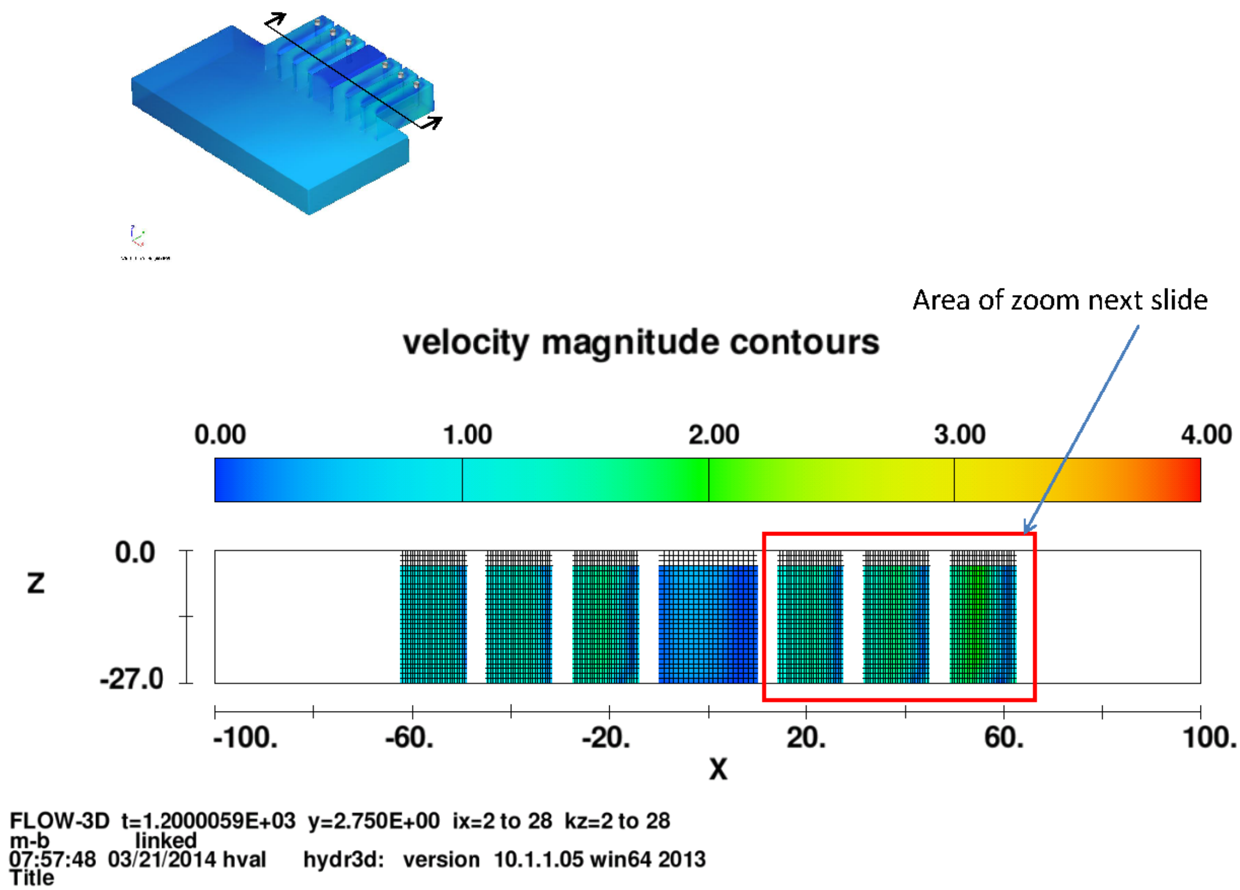
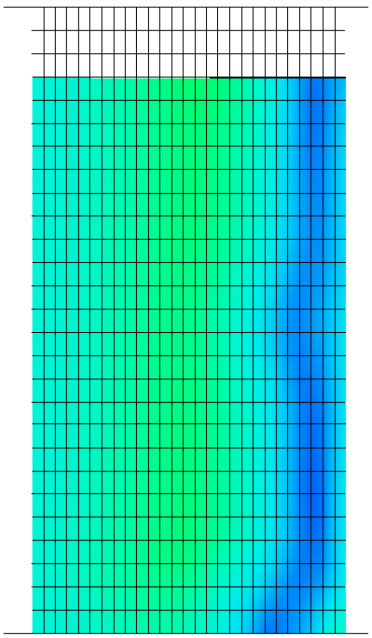


Figure 2. Example of CFD model output showing variation in intake velocity across the face of the traveling screens at the IP2 or IP3 intake at IPEC.

0.5 ft horizontal by 1 ft vertical computational grid shown.
The velocity in each cell is computed, velocity between cells can be interpolated



- Average velocity perpendicular to face = 0.89 ft/s
- 30 percent of area has velocity less than average
- 70 percent of area is above average velocity
- Can do statistics on velocity distribution

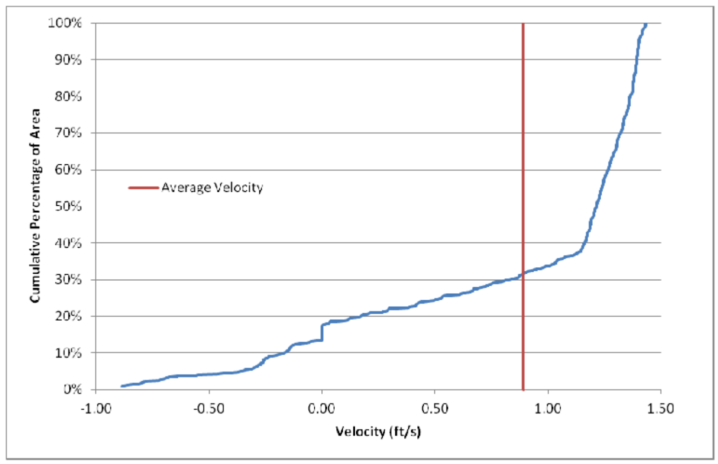


Figure 3. Example of CFD model output showing variation in intake velocity across the face of a single traveling screen in a CWIS at IPEC.