NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

AGENCY: Federal Energy Regulatory Commission

ACTIVITY CONSIDERED: License Renewal for the Green Island Power Authority's Green Island Hydroelectric Project (FERC #13)
F/NER/2010/04745

CONDUCTED BY: National Marine Fisheries Service
Northeast Regional Office

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APPROVED BY: [signature]

This is NOAA's National Marine Fisheries Service's (NMFS) biological Opinion (Opinion) on the effects of the Federal Energy Regulatory Commission's (FERC) proposal to issue a new License for the Green Island Power Authority's Green Island Hydroelectric Project (Green Island Project) on the Hudson River in the Town and Village of Green Island, Albany County, New York on threatened and endangered species in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.).

This Opinion is based on information provided in the Biological Assessment dated September 2, 2010, the Environmental Assessment (EA) dated August 2010, the final license application dated March 2, 2009, a Settlement Agreement filed with FERC in January 2010, supplemental information provided by FERC in November 2010, the Final EA published by FERC in January 2011, the Shortnose Sturgeon Mitigation and Monitoring plan submitted to NMFS and FERC on February 2, 2011, information regarding the proposed construction submitted by the licensee to NMFS in May and June 2011, and other sources of information. A complete administrative record of this consultation will be kept at NMFS Northeast Regional Office.

CONSULTATION HISTORY

Extensive coordination has occurred between the licensee (GIPA), NMFS and the other resource agencies during the relicensing process, beginning in March 2006. GIPA was designated as FERC's non-federal representative for the purposes of informal ESA consultation in a notice issued April 28, 2006. On March 2, 2009, GIPA filed a license application with FERC. On January 15, 2010, pursuant to FERC's Rule 602(c)(i), GIPA, NMFS, the U.S. Fish and Wildlife Service and the New York State Department of Environmental Conservation filed a Settlement Agreement (Settlement) for Fish and Wildlife Issues and accompanying Appendices with FERC. In a letter dated September 2, 2010, FERC requested consultation with NMFS pursuant to section 7 of the ESA. In a letter dated October 6, 2010, NMFS stated that it had not received the draft shortnose sturgeon mitigation plan according to the terms of the Settlement, and requested additional information before initiating formal consultation. In a letter issued October 8, 2010, FERC requested that GIPA file a shortnose sturgeon mitigation plan or a schedule for submitting a draft plan to NMFS for review prior to filing a final plan with FERC for inclusion in any license that may be issued for the project. Additional information was received from FERC on November 2, 2010. In a letter filed November 8, 2010, GIPA stated that a draft shortnose sturgeon mitigation plan would be submitted to the NMFS by November 19, 2010, and a final plan filed with the Commission by January 31, 2011; this plan was received by NMFS on February 2, 2011. Additional information clarifying the scope and scale of in-water construction activities was received by NMFS from the licensee in May and June 2011. As outlined in the Settlement Agreement, FERC is to defer issuance of an order approving the Settlement until section 7 consultation is complete; additionally, FERC will not make a final licensing determination until the consultation is complete.

BACKGROUND ON THE ACTION

The Green Island Project is located at river mile 154 on the Hudson River (see Figure 1). As outlined fully in GIPA's 2009 License Application, the history of the Green Island Project dates back to December 1920, when Henry Ford & Son, Inc., filed an application with the Federal Power Commission (Commission) for a license to construct, operate and maintain a hydroelectric plant to divert and utilize water stored behind the Federal-government owned navigation dam on the Hudson River at Troy, New York. The dam had been constructed by the Federal government between 1913 and 1915. On March 3, 1921, the Commission issued a license for the Green Island Project (FERC No. 13), for a term of 50 years, expiring March 2, 1971. Construction commenced in April 1921, and the plant was placed into operation in February 1923, for the sole purpose of providing power to the adjacent Ford Motor Company manufacturing plant.

In February 1944, a substation was constructed at the plant as part of the "War Emergency" effort and provided an interconnection with the grid system operated by the predecessor of Niagara Mohawk Power Corporation. Due to changes in the manufacturing operations that eliminated the use of direct current, Ford ceased operation at the Project in November 1960. In August 1965, Henry Ford & Son, Inc., and Niagara Mohawk Power Corporation filed a joint application with the Commission to transfer the Project license from Ford to Niagara Mohawk. The transfer of the license was made effective as of September 15, 1967. In March 1968, Niagara Mohawk applied to the Commission to restore the plant to operation as part of its electric system. Rehabilitation of the plant began in 1969, and Niagara Mohawk applied for a new license for the Project in 1970.

The Commission issued Niagara Mohawk a new 40-year license on February 7, 1977, allowing for the continued operation of the four existing turbine/generator units with a combined installed capacity of 6.0 megawatts (MW). Consistent with the policy of the time, the license term was measured not from the effective date of the new license (*i.e.*, February 1977) but from the expiration date of the original license. Thus, the current license term expired on March 2, 2011 and has been administratively extended. In 1999, Niagara Mohawk sold the Green Island Project to Erie Boulevard Hydropower, L.P., and in July 2000, GIPA acquired the current license through an eminent domain proceeding. Currently, the Project operates to its licensed operating capacity of 6.0 MW.

Existing Project Operations

The Green Island-Troy lock and dam is the lowermost dam on the Hudson River. The dam was constructed from 1913-1915; the lock began operation in 1916 and continues to be operated by the US Army Corps of Engineers (Corps). During the typical navigation season (May 1 to November 15) the lock lifts and lowers vessels approximately 14 vertical feet. The Corps uses about 80 cubic feet per second (cfs) of water for lock operation.

Under the current license, GIPA operates the Green Island Project using only flows released by the Corps. Specifically, GIPA operates the project according to the following rules: (1) whenever the elevation of the pool created by the Troy Dam at Troy, N.Y., shall fall to a point level with the crest of the main spillway, the elevation of which is 14.33 feet mean sea level (msl), the operation of the power plant shall cease and further operation thereof shall be suspended until such time as the water level rises to or above 14.33 feet msl; and (2) flashboards may be maintained on the section of the spillway of the dam having an elevation of 14.33 feet msl to increase the elevation of this section to an elevation equal to that of the auxiliary spillway, or 16.33 feet msl, providing that the flashboards are so erected as to drop automatically when the pool level rises to an elevation of 18.5 feet msl.

Current project operation employs the use of pneumatically operated spillway gates that are installed on the crest of the main spillway dam. When the pneumatic spillway gates are fully inflated, the crest elevation is increased to 16.33 feet msl. During conditions when river flow is less than the minimum hydraulic capacity of the powerhouse (400 cfs), the impoundment level is maintained at 16.33 feet msl. During conditions when river flow exceeds the maximum hydraulic capacity of the powerhouse (6,000 cfs), the pneumatically operated spillway gates remain inflated until the impoundment level reaches 18.5 feet msl. At that point the pneumatic spillway gates automatically deflate to about 14.33 feet msl. GIPA states that under present operating conditions, it strives (in cooperation with the Corps) to maintain a normal pool elevation at 16.33 feet msl to the greatest extent possible by making adjustments to powerhouse turbine flow (i.e. as upstream inflow decreases, inflow to the powerhouse is reduced and vise-versa). GIPA estimates that the average annual generation at the project is approximately 47,800 megawatt hours (MWh).

DESCRIPTION OF THE PROPOSED ACTION

GIPA has applied to FERC for a new operating license which would authorize the continued operation of the facility for an additional 40 years; FERC is proposing to issue a renewed Operating License consistent with the terms of the 2010 Settlement. GIPA proposes to make modifications to the existing facility to increase generating capacity from 6.0 MW to 48.0 MW. These modifications would increase hydraulic capacity from 6,000 cfs to 31,500 cfs. As part of the modifications, changes to the physical structure of the facility will be needed.

GIPA proposes to remove the pneumatic flashboards and lower the existing main spillway to a crest elevation of 12.5 feet msl, and install new hydraulically operated crest gates with a maximum crest gate elevation of 18.5 feet msl; increase the auxiliary spillway elevation from 16.33 feet msl to 18.4 feet msl; raise the normal impoundment elevation to 18.4 feet msl and increase the surface area of the impoundment to 708 acres; install a new trash boom extending across and upstream of the forebay; expand the existing powerhouse to the east and west, install four new 6.0 megawatt (MW) generating units, and replace the four existing generating units with four new 6.0 MW generating units with draft tube aeration capability for a total installed capacity of 48 MW; and, install a new 13.8-kV, 70-foot-long transmission line (see Figures 2 and 3 for aerial photographs of the site pre and post modification).

Proposed Project Operation

The Licensee will operate the facilities at the Project in a run-of river (ROR) mode in which instantaneous outflow from the Project impoundment, including spillage, leakage, lockage, fish passage, etc. is equal to the instantaneous inflow to the impoundment. The new crest gates will be operated to maintain the impoundment level equal to the historic operating headwater curve (Stone & Webster, 1926) and as allowed under the War Department Order of 1924 (Weeks, 1924). The Project will employ synchronized operation of the turbines and crest gates in "dynamic head pond control" to achieve the following performance:

- Design flows through the downstream fishways from April 1 through November 30.
- Design flows for upstream fish passage from April 1 through November 30.
- Flows for navigation through the locks from May 1 through November 15 of any year, as required by the U.S. Army Corps of Engineers.
- For river flow exceeding the maximum hydraulic capacity of the fully developed facility (31,500 cfs) plus seasonal fishway flows, the excess flow will be passed over the dam and the Impoundment Elevation Control System will lower the crest gates to maintain an impoundment elevation at or below the historic headwater curve.
- For river flow less than the maximum hydraulic capacity of the facility (31,500 cfs) plus seasonal fishway flows, necessary flows for fishway operations will be maintained and the impoundment elevation must be maintained at or above the dam crest elevation of 14.33 feet with a maximum allowable deviation of 0.25 feet below crest.

GIPA proposes to fully automate project operation to meet the Corps' requirements for governing the pool level at the Green Island-Troy lock and dam. GIPA proposes to employ synchronized operation of the new turbines and crest gates to achieve the following operation: (a)When river flows are less than or equal to the maximum hydraulic capacity (31,500 cfs), the turbines would utilize all flow and the powerhouse elevation control system would maintain the impoundment elevation at 18.4 feet msl; and, (b) when river flow exceeds 31,500 cfs, the turbines would operate at their maximum hydraulic capacity, excess flow would spill over the dam, and the powerhouse elevation control system would lower the crest gates to maintain the impoundment elevation at 18.4 feet msl. During extremely high river flows, the crest gates would be lowered to the fixed crest elevation of 12.5 feet msl. GIPA estimates that the average annual generation of the proposed project would be about 142,290 MWh.

As explained above, on January 15, 2010, GIPA filed an explanatory statement and a signed resource-specific settlement agreement (Settlement). It is anticipated that FERC will issue a license consistent with the Settlement. In summary, consistent with the Settlement, GIPA proposes to:

- lower the existing fixed crest gate elevation to 12.5 feet msl, and replace the existing pneumatic flashboards with new crest gates with a maximum gate crest of 18.5 feet msl (Section 3.1 of the Settlement);

- operate the project in a run-of-river mode, maintain the impoundment level as allowed by the 1924 regulations, and employ synchronized operation of the turbines and crest gates to achieve: (a) design flows through the FISHIS (Fish Safe Hydro Intake System) downstream fish passage facility from April 1 through November 30; (b) design flows for the upstream Denil fishways and eel ladders from April 1 through November 30; (c) flows for navigation through the locks from May 1 through November 15; (d) spill flows over the dam when the maximum hydraulic capacity (31,500 cfs) is exceeded by lowering the crest gates to maintain an impoundment elevation at or below the historic headwater curve (16.33 feet msl); and (e) an impoundment elevation at or above the dam crest of 14.33 feet msl when river flow is less than the maximum hydraulic capacity plus seasonal fishway flows with a maximum allowable deviation of 0.25 feet below crest (Section 3.2 of the Settlement);
- provide 630 cfs conveyance flow for the downstream FISHIS fish passage facility, 473 cfs attraction flow and 40 cfs conveyance flow for each Denil upstream fish passage facility, and 200 gallons per minute (gpm) (about 0.445 cfs) attraction and conveyance flow for each upstream eel ladder (Section 3.3 of the Settlement);
- upon completion of construction activities, prepare a bathymetric map of the bypassed reach, initiate a joint field survey, prepare a report on the results of bypassed reach survey, and if in the judgment of the resource agencies there is potential for fish stranding, either provide additional minimum flow in the bypassed reach or present an alternative plan to reduce fish stranding
- construct, operate, and maintain upstream and downstream fish passage facilities that allow passage of all fish, except shortnose sturgeon, past Troy Dam from April 1 through November 30 annually (Section 3.4 of the Settlement);
- construct a fish exclusion screen at the project intake (the FISHIS facility) to prevent entrainment and impingement of fish moving downstream and to safely and effectively transport fish downstream from a collection trough to a plunge pool below the dam (Section 3.4.1 of the Settlement);
- construct two Denil fish ladders, one ladder located on the eastern-most side of the expanded powerhouse and one ladder located on the western-most side of the expanded powerhouse, to provide upstream fish passage for all fish except shortnose sturgeon (Section 3.4.2.1 of the Settlement);
- construct three ladders for the upstream passage of American eels: one to be located adjacent to the western-most Denil fish ladder noted above; one to be located at the apex of the auxiliary and main dam; and one to be located adjacent to the lock at the eastern end of the main dam; (Section 3.4.2.2 of the Settlement);
- prepare a fisheries facilities operation and maintenance plan that includes: monitoring and reporting on the operation of each fish passage facility; annual start-up and shut-down dates; procedures for responding to emergencies and project outages affecting fishway operation; shortnose sturgeon monitoring, reporting, and protocols; and a shortnose sturgeon handling plan (Section 3.4.4 of the Settlement);
- prepare a fishway effectiveness monitoring plan that includes: (1) conducting studies to assess the effectiveness of the FISHIS exclusion and downstream passage facilities and the upstream passage facilities including the Denil and eel ladders for five consecutive migratory seasons from April 1 through November 30 annually; (2) preparing annual reports of the monitoring; and (3) monitoring for the presence of shortnose sturgeon at

the Denil ladders for five consecutive years after license issuance (Sections 3.5.1, 3.5.3, and 3.5.5 of the Settlement);

- modify the FISHIS protection and downstream passage facilities to improve their effectiveness if necessary based on the effectiveness monitoring (Section 3.5.2 of the Settlement);
- modify the Denil ladders and eel ladders to improve their effectiveness if necessary based on the effectiveness monitoring (Section 3.5.4 of the Settlement);
- prepare a shortnose sturgeon mitigation plan to minimize the effects of project related construction and in-water work on the sturgeon population (Section 3.6 of the Settlement);
- prepare a water quality and stream flow monitoring plan that includes collecting temperature, dissolved oxygen (DO), pH, turbidity, total dissolved solids, river flow, river stage, and flows through the powerhouse, bypassed reach, lockage, and fish passage facilities (Section 3.7 of the Settlement); and,
- complete project construction and expansion activities in five established geographic zones according to a predetermined sequence, and implement specific environmental measures according to a predetermined schedule (Section 3.8 of the Settlement).

Construction

The proposed construction of the Green Island Project has been divided into five zones, as described below, and it is anticipated that construction activities will progress sequentially, by zone. There will be minimal, if any, overlap between zones. Work may occur concurrently within a zone. In total, construction is expected to be completed within 3 years.

Zone 1: West side construction activities including new powerhouse expansion and related headrace and tailrace excavations. Also includes construction of the west Denil fish ladder and west eel ladder. Construction of Zone 1 work is expected to take twelve (12) months. Denil and eel ladders will be operational at the conclusion of construction activities for Zone 1. Work in this zone is for expansion of the powerhouse westward; consequently, excavation work will predominantly be performed in the existing shoreline.

  - o The tailrace cofferdam for this phase will consist of steel pins and timbers installed in temporary, movable concrete blocks to a height of approximately six feet. The cofferdam will be designed to withstand floods of 100-year recurrence interval and will remain in place until all in-river work is completed. Construction of the west Denil fish ladder and west eel ladder will occur within this cofferdam.
  - o Excavation, via mechanical dredging and/or blasting, will occur within the headrace area (upstream of the powerhouse) and tailrace area (downstream of the powerhouse). A total of approximately 41,000 cubic yards of material will be removed from the tailrace area of Zone 1, which currently comprises approximately 1.0 acres of shoreline.

- Zone 2: Modification to main dam and installation of new trash boom. Construction of an eel ladder adjacent to the lock will also be included in work for this zone. Construction of Zone 2 work for modification of the dam is expected to take eight (8) months. The lock eel ladder will be operational at the conclusion of construction activities for Zone 2.
  - o Cofferdams for this work will consist of a steel pin and timber structure installed directly on the upstream and downstream faces of the dam, not on the riverbed.

This work will be sequenced so that only 300 feet of the dam will be out of service at any time. It is anticipated that work will progress in the direction from the lock and toward the powerhouse.
    - Work to install the new trash boom will be performed only in the impoundment area. There will be no excavation required for this work.
- Zone 3: East side construction activities including new powerhouse expansion and related headrace and tailrace excavations. Also includes construction of positive exclusion fish protection system and downstream passage facilities, east Denil fish ladder and east eel ladder, and modification of auxiliary spillway. Construction of Zone 3 work is expected to take fifteen (15) months for the powerhouse expansion, six (6) months for modification of the auxiliary spillway and seven (7) months for the construction of the positive exclusion system and downstream passage facilities. Zone 3 work will occur concurrently and there will be some overlap between construction activities. All Denil and eel ladders will be operational at the conclusion of construction activities for Zone 3.
    - All work in this zone is within the river channel.
    - Modification of the auxiliary spillway will include realignment to accommodate the construction of the east powerhouse and the conveyance channel and plunge pool for the downstream passage facilities.
    - The tailrace cofferdam for this phase will consist of steel pins and timber installed in temporary moveable concrete blocks to a height of approximately six feet. The cofferdam will be designed to withstand floods of 100-year recurrence interval and will remain in place until all in-river work is completed.
    - Excavation, via mechanical dredging and/or blasting, will occur within the headrace area (above the powerhouse) and tailrace area (below the powerhouse). A total of approximately 55,000 cubic yards of material will be removed from the tailrace area of Zone 3, which comprises approximately 1.7 acres. The excavation will extend from elevation -46.3 feet at the powerhouse draft tube to elevation -6.0 feet in the tailrace as described in the excavation description provided above..
- Zone 4: Refurbishment of the existing powerhouse including replacement of generating units and related headrace and tailrace excavations. Construction of Zone 4 work is expected to take nine (9) months.
    - The tailrace cofferdam for this phase will be cellular construction consisting of rock-filled steel sheet piling to approximately elevation 6.0 feet. The cofferdam will be designed to withstand floods of 100-year recurrence interval and will remain in place until all in-river work is completed.
    - Excavation, via mechanical dredging and/or blasting, will occur within the headrace area (above the powerhouse) and tailrace area (below the powerhouse). A total of approximately 37,000 cubic yards of material will be removed from the tailrace area of Zone 4, which comprises approximately 1.0 acres. The excavation will extend from -46.3 feet at the powerhouse draft tube to elevation -6.0 feet in the tailrace as described in the excavation description provided above. Disturbance of the streambed in this zone will be limited to the area directly beneath and adjacent to the existing powerhouse and will incorporate the existing tailrace at its current elevation of -6.0 feet.

- Zone 5: Construction of shoreline amenities related to park expansion. Work done in this zone will be confined within the shoreline and should not impose any turbidity concerns. There is no in-water work below the dam involved in the zone 5 work.

In general, the proposed excavation plan for the project will be conducted in three areas for the headrace, powerhouse and tailrace. A total of approximately 250,000 cubic yards of material will be removed from the construction site, 117,000 from the area upstream of the powerhouse and the remaining 133,000 cubic yards from the powerhouse and tailrace areas. Descriptions of the excavation areas are provided below with station references as depicted in the Project Design Drawings provided in Exhibit F of the license application (see Figure 4).

- The headrace excavation will extend approximately from Station 2+00 to the powerhouse intake at approximately Station 8+30 and will include the positive exclusion fish screen and new bulkhead structures. Excavation for these two structures will require removal of foundation material currently at elevation 0.0 feet to elevation -3.0 feet. Excavation for the powerhouse forebay will begin at Station 7+00 at elevation -3.0 feet and proceed downstream at a slope of 1 on 4 to elevation -30.0 feet at the powerhouse intake. The width of the headrace excavation will vary from approximately 330 feet to approximately 427 feet immediately upstream of the powerhouse intake.
- Powerhouse excavation will begin at elevation -33.0 feet at the intake. A concrete slab, three feet in thickness, will be constructed to achieve an intake invert elevation of -30.0 feet, which corresponds to the invert elevation at the downstream terminus of the headrace immediately upstream of the powerhouse. The powerhouse excavation will extend 39 feet downstream at elevation -30.0 feet to the point where the excavation for the draft tubes begins. At that point the powerhouse excavation will remove material a vertical depth of 17 feet to elevation -50.0 feet. The draft tube excavation will extend 41 feet downstream to the tailrace and across the entire width of the powerhouse, which is approximately 431 feet. A concrete slab, 41 feet by 431 feet and 3'-8" in thickness, will be constructed to achieve a draft tube invert elevation of -46.3 feet. The maximum depth of the powerhouse excavation, corresponding to the bottom of the concrete slab, will be at an elevation of -50.0 feet.
- Tailrace excavation begins at the downstream face of the powerhouse at elevation -48.3 feet. The excavation will extend downstream into the tailrace a distance of 35 feet and across the entire width of the draft tubes, which is approximately 416 feet at this location. A concrete draft tube slab, 35 feet by 416 feet and two feet in thickness, will be constructed to maintain the draft tube invert elevation of -46.3 feet. Beyond the concrete draft tube slab (at approximately Station 9+50) the tailrace excavation will continue downstream at a slope of 1 on 4 from elevation -46.3 feet to the existing river bottom at -6.0 feet. The tailrace excavation will extend a distance of approximately 160 feet downstream from the point where the draft tube slab terminates at a constant width of 416 feet. The tailrace will then angle towards the center of the river. The tailrace will reach its most narrow width of 393 feet at Station 14+00 and terminate at Station 18+00 where the excavation width will be approximately 473 feet. The total length of the tailrace excavation, from Station 9+50 to Station 18+00, is approximately 850 feet and the average width is approximately 420 feet. The proposed tailrace area will be 8.2 acres, compared to the existing tailrace area of 5.9 acres. The maximum depth of the proposed tailrace excavation is approximately 29 feet at the draft tube slab. The average depth of

the proposed tailrace will be approximately 26 feet, compared to the existing average tailrace depth of 12.5 feet, which is a difference of approximately 13.5 feet over the entire tailrace area.

Fish Protection and Passage
GIPA is proposing to construct and install several facilities designed to provide safe and effective upstream and downstream passage for fish. According to the terms of the Settlement, GIPA will: (1) construct, operate and maintain upstream and downstream fish passage facilities that pass diadromous and resident fish species (other than shortnose sturgeon) in a safe, timely and effective manner and (2) operate its facilities so that it neither passes shortnose sturgeon upstream nor causes sturgeon injury or significant impairment to essential behavioral patterns. The upstream and downstream passage facilities will be operational between April 1 and November 30 of each year and will operate whenever generation occurs during this migration period.

Downstream Fish Passage
For downstream passage, GIPA proposes to provide downstream passage through the construction of a fish exclusion screen, known as the FISHIS™ design. A bypass facility will be constructed adjacent to the proposed fish exclusion screen and will transport fish from the collection trough to a plunge pool below the Federal Dam.

Upstream Fish Passage
GIPA proposes to provide upstream fish passage for target species (other than American eel and shortnose sturgeon) through the construction of two Denil fish ladders. One ladder will be located on the eastern-most side of the expanded powerhouse and the other will be located at the western-most (shore) side of the expanded powerhouse. Each Denil will have a dedicated entrance that faces downstream.

GIPA also proposes to provide upstream eel passage through the construction of three eel ladders. One eel ladder will be located adjacent to the Denil fish ladder at the western-most side of the expanded powerhouse. The other two ladders will be located at the apex of the auxiliary and main dam and adjacent to the lock at the eastern end of the main dam.

Effectiveness Testing – Downstream Passage Facilities
Consistent with the Settlement, GIPA will conduct studies to assess the effectiveness of the fish exclusion and downstream passage facilities and confirm that hydraulic conditions are resulting in successful passage. These studies will involve blueback herring, American shad and American eels and will include velocity measurements in the vicinity of the screen and the use of radio tags (adults) and dye tests or other marking method (juveniles), supplemented by image capture technology to identify fish species movements and to assess conditions for both passage over the screen and through the bypass.

Additional effectiveness testing will be conducted utilizing video and visual monitoring of the downstream passage facilities. An imager will detect the size, shape, number, and direction of passing fish. Fish passing through the system will be identified to species either manually and/or through video imaging. The video imager will be positioned at several trial locations above the

FISHIS™ overflow weir and within the collection trough. Downstream passage monitoring will also include screen velocity measurements to ensure approach velocities and sweeping velocities are maintained according to the design criteria. GIPA will continue monitoring for at least five consecutive outmigration seasons, April 1 through November 30.

Effectiveness Testing – Upstream Passage Facilities

GIPA will also collect monitoring data to assess the effectiveness of all upstream passage facilities. Studies involving blueback herring, American eel and American shad will be conducted. Studies will use radio tags, passive integrated transponder (PIT) tags, video monitoring, and collection chambers.

Monitoring will also occur at the Denil ladders. Video image capture or other automated monitoring of upstream passage may be used to provide identification, enumeration and size of species; physical condition as determined by orientation; speed, and body image. Each Denil ladder will be equipped with either two image capture locations along the length of the ladder or three image capture locations at various heights at the ladder discharge, with at least one image capture location located near the entrance and one near the exit of each Denil ladder. Eel ladders will be equipped with two image capture locations, one near the entrance and one near the exit. Should the video image capture prove to be an ineffective means of counting fish, the Licensee will install automatic counters in the eel ladders and/or the Denil ladders. This monitoring will continue for at least five consecutive migration seasons, April 1 through November 30, after the upstream passage facilities are operational.

Shortnose Sturgeon Mitigation Plan

GIPA has prepared a Shortnose Sturgeon Mitigation Plan (SSMP), the terms of which are designed to minimize the effects of Project-related construction and in-water work on shortnose sturgeon. Compliance with the SSMP will be incorporated into the terms of the FERC license. Essential components of the SSMP are summarized below:

- No in-river work, excluding work within previously constructed cofferdams, will be performed during the spawning and rearing season for shortnose sturgeon, typically early April through late June when water temperatures downstream of the Federal Dam are approximately between 8ºC (46ºF) and 18ºC (64ºF).
- Cofferdams will be designed to withstand floods of 100-year recurrence interval. Cofferdams will remain in place until all in-river work is completed for each specific zone and will not be removed during the identified sturgeon spawning and rearing season.
- Silt booms and curtains will be installed at the downstream end of each construction zone prior to the installation of cofferdams and will remain in place until the cofferdams are removed. The silt curtains will be geotextile fabric screens, full-depth, with ballasted bottoms. They will be deployed approximately 5 to 10 feet downstream from the location of the cofferdams and will provide a controlled area of containment designed to mitigate the potential impact of suspended solids. The curtains will be installed in sections that are approximately 50 feet in length. It is not anticipated that adjacent sections will be lashed together, but rather will overlap by approximately 12 to 24 inches. This will ensure that any fish that manages to navigate through an overlap section will not likely become entrapped in the screen.

- Rock excavation will be performed by either mechanical equipment or by blasting in accordance with parameters identified in the SSMP. No in-river work will be performed during the spawning season for shortnose sturgeon.
- During construction activities, including dewatering of cofferdam areas, there will be continuous, real-time monitoring of turbidity at locations both upstream of the construction activity and immediately downstream of the construction zone. If at any time downstream turbidity readings exceed upstream turbidity readings, construction work will cease until downstream turbidity readings return to upstream levels. Turbidity monitoring will continue until after the cofferdams and silt curtains are removed from the river.

Monitoring for Shortnose sturgeon

It is intended that GIPA will design and operate its fish passage facilities so that they neither pass shortnose sturgeon upstream nor cause sturgeon injury or significant impairment to essential behavioral patterns. Manual and 24-hour continuous video monitoring will be required to monitor for the presence of shortnose sturgeon in the entrance of the Denils. If shortnose sturgeon are observed to be using the fish ladders, notification will be provided to NMFS and the appropriate provisions outlined in the approved Fishery Facilities Operation and Maintenance Plan (FFOMP) will be implemented immediately. According to the Settlement Agreement, the FFOMP will be designed to detect any shortnose sturgeon that enter the Denil ladder, remove the fish in a timely manner, and return them safely downstream without causing injury or delay to spawning or other essential behaviors. The FFOMP will be submitted for agency review and approval within twelve months of license issuance and prior to the commencement of construction activities for the fish passage and protection facilities.

Detection equipment appropriate for monitoring will be installed in coordination with NMFS and New York State Department of Environmental Conservation (NYSDEC) to detect tagged shortnose sturgeon present in the project area. If any tagged fish are detected, GIPA will immediately notify NMFS and NYSDEC.

It is not expected that shortnose sturgeon will enter the eel ladders. However, it is possible that they may enter the Denil ladders. Should any shortnose sturgeon be found in the Denil ladders, the following procedures and reporting requirements will be implemented:

1. For each shortnose sturgeon detected, the weight, length, and condition of the fish will be recorded. All fish will be checked for the presence of external identification tags. If a PIT tag reader is available onsite, all fish will also be checked for the presence of internal PIT tags. River flow and water temperature will be recorded. All relevant information will be recorded on the reporting sheet entitled Shortnose Sturgeon Reporting Form for the Green Island Hydroelectric Project.
2. The contact procedure provided by NMFS will be followed.
3. If alive and uninjured, the shortnose sturgeon will be immediately returned downstream. A long handled net will be used to place the shortnose sturgeon back into the river downstream of the dam.
4. If any injured shortnose sturgeon are found, the occurrence will immediately be reported to NMFS. Injured fish must be photographed and measured, if possible, and the reporting sheet must be submitted to NMFS within 24 hours. If the fish is badly injured,

the fish should be retained at the project site, if possible, until obtained by a facility recommended by NMFS for potential rehabilitation.

5. If any dead shortnose sturgeon are found, the occurrence will immediately be reported to NMFS. Any dead specimens or body parts will be photographed, measured and preserved at the project site until they can be obtained by NMFS for analysis.

Bypass Reach Monitoring

Upon completion of construction activities, GIPA will prepare a bathymetric map of the bypass reach and distribute it to the Resource Agencies for consultation. GIPA will initiate a joint field survey including representatives from all available Parties to be conducted at low tide during low water events immediately after construction is completed. A report on the bypass reach field survey results will be provided to the Resource Agencies. If results of the survey indicate, in the professional judgment of the Resource Agencies, potential for stranding of fish species, GIPA will either provide additional minimum flow over the bypass reach to ensure strandings do not occur or present to the Resource Agencies an alternative plan to remediate the problem within sixty days (60) of the field survey.

If any shortnose sturgeon are detected stranded in pools, the following protocol will be followed:

1. NMFS will be contacted immediately.
2. For each fish removed from the bypass reach, the weight, length, and condition will be recorded. All fish will be checked for the presence of external identification tags. If a PIT tag reader is available onsite, all fish will also be checked for the presence of internal PIT tags. River flow, bypass reach flow, and water temperature will also be recorded. All relevant information will be recorded on the reporting sheet entitled Shortnose Sturgeon Report Form for the Green Island Hydroelectric Project.
3. If stranded but alive and uninjured, the shortnose sturgeon will be moved to the river below the bypass reach.
4. If any injured shortnose sturgeon are found, the occurrence will immediately be reported to NMFS. Injured fish must be photographed and measured, if possible, and the reporting sheet must be submitted to NMFS within 24 hours. If the fish is badly injured, the fish should be retained at the project site, if possible, until obtained by a facility recommended by NMFS for potential rehabilitation.
5. If any dead shortnose sturgeon are found, the occurrence will immediately be reported to NMFS in accordance with the contact information provided below and as it may subsequently be updated. Any dead specimens or body parts should be photographed, measured and preserved at the project site until they can be obtained by NMFS for analysis.

ACTION AREA

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation encompasses the immediate area of the GIPA Project as well as the portion of the Hudson River that is impacted by project operations and will be impacted during project construction. While the action area includes upland areas and areas upstream of the Federal Dam, NMFS listed species do not occur in these areas. Thus, the consultation will focus on effects of the action in areas where NMFS listed species do occur, consisting of those areas within the mainstem Hudson River below the Federal Dam which are affected by project operations. This area is limited to the area extending downstream from the dam to the terminus of the to-be-expanded project tailrace.

STATUS OF SPECIES

The only endangered or threatened species under NMFS' jurisdiction in the Action Area is the endangered shortnose sturgeon (*Acipenser brevirostrum*). No critical habitat has been designated for shortnose sturgeon.

Shortnose sturgeon life history

Shortnose sturgeon are benthic fish that mainly occupy the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including mollusks, crustaceans (amphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979 *in* NMFS 1998). Shortnose sturgeon have similar lengths at maturity (45-55 cm fork length) throughout their range, but, because sturgeon in southern rivers grow faster than those in northern rivers, southern sturgeon mature at younger ages (Dadswell et al. 1984). Shortnose sturgeon are long-lived (30-40 years) and, particularly in the northern extent of their range, mature at late ages. In the north, males reach maturity at 5 to 10 years, while females mature between 7 and 13 years. Based on limited data, females spawn every three to five years while males spawn approximately every two years. The spawning period is estimated to last from a few days to several weeks. Spawning begins from late winter/early spring (southern rivers) to mid to late spring (northern rivers)[1] when the freshwater temperatures increase to 8-9ºC. Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse et al. 1987; Crowder et al. 1994; Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes.

Total instantaneous mortality rates (Z) are available for the Saint John River (0.12 - 0.15; ages 14-55; Dadswell 1979), Upper Connecticut River (0.12; Taubert 1980b), and Pee Dee-Winyah River (0.08-0.12; Dadswell et al. 1984). Total instantaneous natural mortality (M) for shortnose sturgeon in the lower Connecticut River was estimated to be 0.13 (T. Savoy, Connecticut Department of Environmental Protection, personal communication). There is no recruitment information available for shortnose sturgeon because there are no commercial fisheries for the species. Estimates of annual egg production for this species are difficult to calculate because females do not spawn every year (Dadswell et al. 1984). Further, females may abort spawning attempts, possibly due to interrupted migrations or unsuitable environmental conditions (NMFS 1998). Thus, annual egg production is likely to vary greatly in this species. Fecundity estimates have been made and range from 27,000 to 208,000 eggs/female and a mean of 11,568 eggs/kg body weight (Dadswell et al. 1984).

At hatching, shortnose sturgeon are blackish-colored, 7-11mm long and resemble tadpoles (Buckley and Kynard 1981). In 9-12 days, the yolk sac is absorbed and the sturgeon develops into larvae which are about 15mm total length (TL; Buckley and Kynard 1981). Sturgeon larvae

1 For purposes of this consultation, Northern rivers are considered to include tributaries of the Chesapeake Bay northward to the St. John River in Canada. Southern rivers are those south of the Chesapeake Bay.

are believed to begin downstream migrations at about 20mm TL. Dispersal rates differ at least regionally, laboratory studies on Connecticut River larvae indicated dispersal peaked 7-12 days after hatching in comparison to Savannah River larve that had longer dispersal rates with multiple, prolonged peaks, and a low level of downstream movement that continued throughout the entire larval and early juvenile period (Parker 2007). Synder (1988) and Parker (2007) considered individuals to be juvenile when they reached 57mm TL. Laboratory studies demonstrated that larvae from the Connecticut River made this transformation on day 40 while Savannah River fish made this transition on day 41 and 42 (Parker 2007).

The juvenile phase can be subdivided in to young of the year (YOY) and immature/sub-adults. YOY and sub-adult habitat use differs and is believed to be a function of differences in salinity tolerances. Little is known about YOY behavior and habitat use, though it is believed that they are typically found in channel areas within freshwater habitats upstream of the saltwedge for about one year (Dadswell et al. 1984, Kynard 1997). One study on the stomach contents of YOY revealed that the prey items found corresponded to organisms that would be found in the channel environment (amphipods) (Carlson and Simpson 1987). Sub-adults are typically described as age one or older and occupy similar spatio-temporal patterns and habitat-use as adults (Kynard 1997). Though there is evidence from the Delaware River that sub-adults may overwinter in different areas than adults and no not form dense aggregations like adults (ERC Inc. 2007). Sub-adults feed indiscriminately, typical prey items found in stomach contents include aquatic insects, isopods, and amphipods along with large amounts of mud, stones, and plant material (Dadswell 1979, Carlson and Simpson 1987, Bain 1997).

In populations that have free access to the total length of a river (e.g., no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware and Merrimack Rivers), spawning areas are located at the farthest upstream reach of the river (NMFS 1998). In the northern extent of their range, shortnose sturgeon exhibit three distinct movement patterns. These migratory movements are associated with spawning, feeding, and overwintering activities. In spring, as water temperatures reach between 7-9.7ºC, pre-spawning shortnose sturgeon move from overwintering grounds to spawning areas. Spawning occurs from mid/late March to mid/late May depending upon location and water temperature. Sturgeon spawn in upper, freshwater areas and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon spawning migrations are characterized by rapid, directed and often extensive upstream movement (NMFS 1998).

Shortnose sturgeon are believed to spawn at discrete sites within their natal river (Kieffer and Kynard 1996). In the Merrimack River, males returned to only one reach during a four year telemetry study (Kieffer and Kynard 1996). Squires (1982) found that during the three years of the study in the Androscoggin River, adults returned to a 1-km reach below the Brunswick Dam and Kieffer and Kynard (1996) found that adults spawned within a 2-km reach in the Connecticut River for three consecutive years. Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (Dadswell et al. 1984; NMFS 1998). Additional environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 8 - 15º, and bottom water velocities of 0.4 to 0.8 m/sec (Dadswell et al. 1984; Hall et al. 1991, Kieffer and Kynard 1996, NMFS 1998). For northern shortnose sturgeon, the temperature range for spawning is 6.5-

18.0ºC (Kieffer and Kynard in press). Eggs are separate when spawned but become adhesive within approximately 20 minutes of fertilization (Dadswell et al. 1984). Between 8° and 12°C, eggs generally hatch after approximately 13 days. The larvae are photonegative, remaining on the bottom for several days. Buckley and Kynard (1981) found week old larvae to be photonegative and form aggregations with other larvae in concealment.

Adult shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in spring and localized, wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (Dovel 1981) but remain within freshwater habitats. Older juveniles or sub-adults tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes and move upstream in spring and feed mostly in freshwater reaches during summer.

Juvenile shortnose sturgeon generally move upstream in spring and summer and move back downstream in fall and winter; however, these movements usually occur in the region above the saltwater/freshwater interface (Dadswell et al. 1984; Hall et al. 1991). Non-spawning movements include wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total length (Buckley and Kynard 1985). Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adult and juvenile shortnose sturgeon congregate (Flourney et al. 1992; Rogers et al. 1994; Rogers and Weber 1995; Weber 1996).

While shortnose sturgeon do not undertake the significant marine migrations seen in Atlantic sturgeon, telemetry data indicates that shortnose sturgeon do make localized coastal migrations. This is particularly true within certain areas such as the Gulf of Maine (GOM) and among rivers in the Southeast. Interbasin movements have been documented among rivers within the GOM and between the GOM and the Merrimack, between the Connecticut and Hudson rivers, the Delaware River and Chesapeake Bay, and among the rivers in the Southeast.

The temperature preference for shortnose sturgeon is not known (Dadswell et al. 1984) but shortnose sturgeon have been found in waters with temperatures as low as 2 to 3ºC (Dadswell et al. 1984) and as high as 34ºC (Heidt and Gilbert 1978). However, temperatures above 28ºC are thought to adversely affect shortnose sturgeon. In the Altamaha River, temperatures of 28-30ºC during summer months create unsuitable conditions and shortnose sturgeon are found in deep cool water refuges. Dissolved oxygen (DO) also seems to play a role in temperature tolerance, with increased stress levels at higher temperatures with low DO versus the ability to withstand higher temperatures with elevated DO (Niklitchek 2001).

Shortnose sturgeon are known to occur at a wide range of depths. A minimum depth of 0.6m is necessary for the unimpeded swimming by adults. Shortnose sturgeon are known to occur at depths of up to 30m but are generally found in waters less than 20m (Dadswell et al. 1984; Dadswell 1979). Shortnose sturgeon have also demonstrated tolerance to a wide range of salinities. Shortnose sturgeon have been documented in freshwater (Taubert 1980; Taubert and Dadswell 1980) and in waters with salinity of 30 parts-per-thousand (ppt) (Holland and Yeverton 1973; Saunders and Smith 1978). Mcleave et al. (1977) reported adults moving freely through a wide range of salinities, crossing waters with differences of up to 10ppt within a two hour period. The tolerance of shortnose sturgeon to increasing salinity is thought to increase with age (Kynard 1996). Shortnose sturgeon typically occur in the deepest parts of rivers or estuaries where suitable oxygen and salinity values are present (Gilbert 1989).

Status and Trends of Shortnose Sturgeon Rangewide
Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Although the original listing notice did not cite reasons for listing the species, a 1973 Resource Publication, issued by the US Department of the Interior, stated that shortnose sturgeon were "in peril…gone in most of the rivers of its former range [but] probably not as yet extinct" (USDOI 1973). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. In the late nineteenth and early twentieth centuries, shortnose sturgeon commonly were taken in a commercial fishery for the closely related and commercially valuable Atlantic sturgeon (*Acipenser oxyrinchus*). More than a century of extensive fishing for sturgeon contributed to the decline of shortnose sturgeon along the east coast. Heavy industrial development during the twentieth century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery; possibly resulting in substantially reduced abundance of shortnose sturgeon populations within portions of the species' ranges (e.g., southernmost rivers of the species range: Santilla, St. Marys and St. Johns Rivers). A shortnose sturgeon recovery plan was published in December 1998 to promote the conservation and recovery of the species (see NMFS 1998). Shortnose sturgeon are listed as "vulnerable" on the IUCN Red List.

Although shortnose sturgeon are listed as endangered range-wide, in the final recovery plan NMFS recognized 19 separate populations occurring throughout the range of the species. These populations are in New Brunswick Canada (1); Maine (2); Massachusetts (1); Connecticut (1); New York (1); New Jersey/Delaware (1); Maryland and Virginia (1); North Carolina (1); South Carolina (4); Georgia (4); and Florida (2). NMFS has not formally recognized distinct population segments (DPS)[2] of shortnose sturgeon under the ESA. Although genetic information within and among shortnose sturgeon occurring in different river systems is largely unknown, life history studies indicate that shortnose sturgeon populations from different river systems are substantially reproductively isolated (Kynard 1997) and, therefore, should be considered discrete. The 1998 Recovery Plan indicates that while genetic information may reveal that interbreeding does not occur between rivers that drain into a common estuary, at this time, such river systems are considered a single population compromised of breeding subpopulations (NMFS 1998).

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2 The definition of species under the ESA includes any subspecies of fish, wildlife, or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature. To be considered a DPS, a population segment must meet two criteria under NMFS policy. First, it must be discrete, or separated, from other populations of its species or subspecies. Second, it must be significant, or essential, to the long-term conservation status of its species or subspecies. This formal legal procedure to designate DPSs for shortnose sturgeon has not been undertaken.

Studies conducted since the issuance of the Recovery Plan have provided evidence that suggests that years of isolation between populations of shortnose sturgeon have led to morphological and genetic variation. Walsh et al. (2001) examined morphological and genetic variation of shortnose sturgeon in three rivers (Kennebec, Androscoggin, and Hudson). The study found that the Hudson River shortnose sturgeon population differed markedly from the other two rivers for most morphological features (total length, fork length, head and snout length, mouth width, interorbital width and dorsal scute count, left lateral scute count, right ventral scute count). Significant differences were found between fish from Androscoggin and Kennebec rivers for interorbital width and lateral scute counts which suggests that even though the Androscoggin and Kennebec rivers drain into a common estuary, these rivers support largely discrete populations of shortnose sturgeon. The study also found significant genetic differences among all three populations indicating substantial reproductive isolation among them and that the observed morphological differences may be partly or wholly genetic.

Grunwald et al. (2002) examined mitochondrial DNA (mtDNA) from shortnose sturgeon in eleven river populations. The analysis demonstrated that all shortnose sturgeon populations examined showed moderate to high levels of genetic diversity as measured by haplotypic diversity indices. The limited sharing of haplotypes and the high number of private haplotypes are indicative of high homing fidelity and low gene flow. The researchers determined that glaciation in the Pleistocene Era was likely the most significant factor in shaping the phylogeographic pattern of mtDNA diversity and population structure of shortnose sturgeon. The Northern glaciated region extended south to the Hudson River while the southern non-glaciated region begins with the Delaware River. There is a high prevalence of haplotypes restricted to either of these two regions and relatively few are shared; this represents a historical subdivision that is tied to an important geological phenomenon that reflects historical isolation. Analyses of haplotype frequencies at the level of individual rivers showed significant differences among all systems in which reproduction is known to occur. This implies that although higher level genetic stock relationships exist (i.e., southern vs. northern and other regional subdivisions), shortnose sturgeon appear to be discrete stocks, and low gene flow exists between the majority of populations.

Waldman et al. (2002) also conducted mtDNA analysis on shortnose sturgeon from 11 river systems and identified 29 haplotypes. Of these haplotypes, 11 were unique to northern, glaciated systems and 13 were unique to the southern non-glaciated systems. Only 5 were shared between them. This analysis suggests that shortnose sturgeon show high structuring and discreteness and that low gene flow rates indicated strong homing fidelity.

Wirgin et al. (2005), also conducted mtDNA analysis on shortnose sturgeon from 12 rivers (St. John, Kennebec, Androscoggin, Upper Connecticut, Lower Connecticut, Hudson, Delaware, Chesapeake Bay, Cooper, Peedee, Savannah, Ogeechee and Altamaha). This analysis suggested that most population segments are independent and that genetic variation among groups was high.

The best available information demonstrates differences in life history and habitat preferences between northern and southern river systems and given the species' anadromous breeding habits, the rare occurrence of migration between river systems, and the documented genetic differences between river populations, it is unlikely that populations in adjacent river systems interbreed with any regularity. This likely accounts for the failure of shortnose sturgeon to repopulate river systems from which they have been extirpated, despite the geographic closeness of persisting populations. This characteristic of shortnose sturgeon also complicates recovery and persistence of this species in the future because, if a river population is extirpated in the future, it is unlikely that this river will be recolonized. Consequently, this Opinion will treat the nineteen separate populations of shortnose sturgeon as subpopulations (one of which occurs in the action area) for the purposes of this analysis.

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. The range extended from the St John River in New Brunswick, Canada to the Indian River in Florida. Today, only 19 populations remain ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. Shortnose sturgeon are large, long lived fish species. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 km. Population sizes vary across the species' range. From available estimates, the smallest populations occur in the Cape Fear (~8 adults; Moser and Ross 1995) in the south and Merrimack and Penobscot rivers in the north (~ several hundred to several thousand adults depending on population estimates used; M. Kieffer, United States Geological Survey, personal communication; Dionne 2010), while the largest populations are found in the Saint John (~18, 000; Dadswell 1979) and Hudson Rivers (~61,000; Bain et al. 1998). As indicated in Kynard 1996, adult abundance is less than the minimum estimated viable population abundance of 1000 adults for 5 of 11 surveyed northern populations and all natural southern populations. Kynard 1996 indicates that all aspects of the species' life history indicate that shortnose sturgeon should be abundant in most rivers. As such, the expected abundance of adults in northern and north-central populations should be thousands to tens of thousands of adults. Expected abundance in southern rivers is uncertain, but large rivers should likely have thousands of adults. The only river systems likely supporting populations of these sizes are the St John, Hudson and possibly the Delaware and the Kennebec, making the continued success of shortnose sturgeon in these rivers critical to the species as a whole. While no reliable estimate of the size of either the total species or the shortnose sturgeon population in the Northeastern United States exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed.

Threats to shortnose sturgeon recovery

The Shortnose Sturgeon Recovery Plan (NMFS 1998) identifies habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges) and mortality (resulting, for example, from impingement on cooling water intake screens, dredging and incidental capture in other fisheries) as principal threats to the species' survival.

Several natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon. Shortnose sturgeon continue to be taken incidentally in fisheries along the east coast and are probably targeted by poachers throughout their range (Dadswell 1979; Dovel et al. 1992; Collins et al. 1996). Bridge construction and demolition projects may interfere with normal shortnose sturgeon migratory movements and disturb sturgeon concentration areas. Unless appropriate precautions are made, internal damage and/or death may result from blasting projects with powerful explosives. Hydroelectric dams may affect shortnose sturgeon by restricting habitat, altering river flows or temperatures necessary for successful spawning and/or migration and causing mortalities to fish that become entrained in turbines. Maintenance dredging of Federal navigation channels and other areas can adversely affect or jeopardize shortnose sturgeon populations. Hydraulic dredges can lethally take sturgeon by entraining sturgeon in dredge dragarms and impeller pumps. Mechanical dredges have also been documented to lethally take shortnose sturgeon. In addition to direct effects, dredging operations may also impact shortnose sturgeon by destroying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments. Shortnose sturgeon are susceptible to impingement on cooling water intake screens at power plants. Electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. The operation of power plants can have unforeseen and extremely detrimental impacts to water quality which can affect shortnose sturgeon. For example, the St. Stephen Power Plant near Lake Moultrie, South Carolina was shut down for several days in June 1991 when large mats of aquatic plants entered the plant's intake canal and clogged the cooling water intake gates. Decomposing plant material in the tailrace canal coupled with the turbine shut down (allowing no flow of water) triggered a low dissolved oxygen water condition downstream and a subsequent fish kill. The South Carolina Wildlife and Marine Resources Department reported that twenty shortnose sturgeon were killed during this low dissolved oxygen event.

Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) can have substantial deleterious effects on aquatic life including production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989; Sinderman 1994). Ultimately, toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms (Varanasi 1992) like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known (Ruelle and Henry 1992; Ruelle and Kennlyne 1993). Available data suggests that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976).

Although there is scant information available on the levels of contaminants in shortnose sturgeon tissues, some research on other related species indicates that concern about the effects of contaminants on the health of sturgeon populations is warranted. Detectible levels of chlordane, DDE (1,1-dichloro-2, 2-bis(p-chlorophenyl)ethylene), DDT (dichlorodiphenyl-trichloroethane), and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (Ruelle and Henry 1994). These compounds were found in high enough levels to suggest they may be causing reproductive failure and/or increased physiological stress (Ruelle and Henry 1994). In addition to compiling data on contaminant levels, Ruelle and Henry also determined that heavy metals and organochlorine compounds (i.e. PCBs) accumulate in fat tissues. Although the long term effects of the accumulation of contaminants in fat tissues is not yet known, some speculate that lipophilic toxins could be transferred to eggs and potentially inhibit egg viability. In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has been made between fish weight, fish fork length, and DDE concentration in pallid sturgeon livers indicates that DDE increases proportionally with fish size (NMFS 1998).

Contaminant analysis was conducted on two shortnose sturgeon from the Delaware River in the fall of 2002. Muscle, liver, and gonad tissue were analyzed for contaminants (ERC 2002). Sixteen metals, two semivolatile compounds, three organochlorine pesticides, one PCB Aroclor, as well as polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) were detected in one or more of the tissue samples. Levels of aluminum, cadmium, PCDDs, PCDFs, PCBs, DDE (an organochlorine pesticide) were detected in the "adverse affect" range. It is of particular concern that of the above chemicals, PCDDs, DDE, PCBs and cadmium, were detected as these have been identified as endocrine disrupting chemicals. Contaminant analysis conducted in 2003 on tissues from a shortnose sturgeon from the Kennebec River revealed the presence of fourteen metals, one semivolatile compound, one PCB Aroclor, Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in one or more of the tissue samples. Of these chemicals, cadmium and zinc were detected at concentrations above an adverse effect concentration reported for fish in the literature (ERC 2003). While no directed studies of chemical contamination in shortnose sturgeon have been undertaken, it is evident that the heavy industrialization of the rivers where shortnose sturgeon are found is likely adversely affecting this species.

During summer months, especially in southern areas, shortnose sturgeon must cope with the physiological stress of water temperatures that may exceed 28ºC. Flourney et al.(1992) suspected that, during these periods, shortnose sturgeon congregate in river regions which support conditions that relieve physiological stress (i.e., in cool deep thermal refuges). In southern rivers where sturgeon movements have been tracked, sturgeon refrain from moving during warm water conditions and are often captured at release locations during these periods (Flourney et al.1992; Rogers and Weber 1994; Weber 1996). The loss and/or manipulation of these discrete refuge habitats may limit or be limiting population survival, especially in southern river systems.

Pulp mill, silvicultural, agricultural, and sewer discharges, as well as a combination of non-point source discharges, which contain elevated temperatures or high biological demand, can reduce dissolved oxygen levels. Shortnose sturgeon are known to be adversely affected by dissolved oxygen levels below 5 mg/L. Shortnose sturgeon may be less tolerant of low dissolved oxygen levels in high ambient water temperatures and show signs of stress in water temperatures higher than 28ºC (Flourney et al. 1992). At these temperatures, concomitant low levels of dissolved oxygen may be lethal.

Global climate change may affect shortnose sturgeon in the future. Rising sea level may result in the salt wedge moving upstream in affected rivers, possibly affecting the survival of drifting larvae and YOY shortnose sturgeon that are sensitive to elevated salinity. Similarly, for river systems with dams, YOY may experience a habitat squeeze between a shifting (upriver) salt wedge and a dam causing loss of available habitat for this life stage.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with DO and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. One might expect range extensions to shift northward (i.e. into the St. Lawrence River, Canada) while truncating the southern distribution. Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too dry all shortnose sturgeon life stages, including adults, may become susceptible to strandings. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing shortnose sturgeon in rearing habitat.

Implications of climate change to shortnose sturgeon throughout their range have been speculated, yet no scientific data are available on past trends related to climate effects on this species and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species. While there is a reasonable degree of certainty that certain climate change related effects will be experienced globally (e.g., rising temperatures and changes in precipitation patterns), due to a lack of scientific data, the specific effects to shortnose sturgeon that may result from climate change are not predictable or quantifiable at this time. Information on current effects of global climate change on shortnose sturgeon is not available and while it is speculated that future climate change may affect this species, it is not possible to quantify the extent to which effects may occur. Further analysis on the likely effects of climate change on shortnose sturgeon in the action area is included in the Environmental Baseline and Cumulative Effects sections below.

Status of Shortnose Sturgeon in the Hudson River

The action area is limited to the reach of the Hudson River affected by project operations as described in the “Action Area” section above. As such, this section will discuss the available information related to the presence of shortnose sturgeon in the Hudson River.

Shortnose sturgeon were first observed in the Hudson River by early settlers who captured them as a source of food and documented their abundance (Bain et al. 1998). Shortnose sturgeon in the Hudson River were documented as abundant in the late 1880's (Ryder 1888 in Hoff 1988). Prior to 1937, a few fishermen were still commercially harvesting shortnose sturgeon in the Hudson River; however, fishing pressure declined as the population decreased. During the late 1800s and early 1900s, the Hudson River served as a dumping ground for pollutants that lead to major oxygen depletions and resulted in fish kills and population reductions. During this same time there was a high demand for shortnose sturgeon eggs (caviar), leading to overharvesting. Water pollution, overfishing, and the commercial Atlantic sturgeon fishery are all factors that may have contributed to the decline of shortnose sturgeon in the Hudson River (Hoff 1988).

In the 1930s, the New York State Biological Survey launched the first scientific analysis that documented the distribution, age, and size of mature shortnose sturgeon in the Hudson River (see Bain et al. 1998). In the 1970s, scientific sampling resumed precipitated by the lack of biological data and concerns about the impact of electric generation facilities on fishery resources (see Bain et al. 1998). The current population of shortnose sturgeon has been documented by studies conducted throughout the entire range of shortnose sturgeon in the Hudson River (see: Dovel 1979, Hoff et al. 1988, Geoghegan et al. 1992, Bain et al. 1998, Bain et al. 2000, Dovel et al. 1992).

Several population estimates were conducted throughout the 1970s and 1980s (Dovel 1979; Dovel 1981; Dovel et al. 1992). Moss recently, Bain et al. (1998) conducted a mark recapture study from 1994 through 1997 focusing on the shortnose sturgeon active spawning stock. Utilizing targeted and dispersed sampling methods, 6,430 adult shortnose sturgeon were captured and 5,959 were marked; several different abundance estimates were generated from this sampling data using different population models. Abundance estimates generated ranged from a low of 25, 255 to a high of 80,026; though 61,057 is the abundance estimate from this dataset and modeling exercise that is typically used. This estimate includes spawning adults estimated to comprise 93% of the entire population or 56,708, non-spawning adults accounting for 3% of the population and juveniles 4% (Bain et al. 2000). Bain et al. (2000) compared the spawning population estimate with estimates by Dovel et al. (1992) concluding an increase of approximately 400% between 1979 and 1997. Although fish populations dominated by adults are not common for most species, there is no evidence that this is atypical for shortnose sturgeon (Bain et al. 1998).

Woodland and Secor (2007) examined the Bain et al. (1998, 2000, 2007) estimates to try and identify the cause of the major change in abundance. Woodland and Secor (2007) concluded that the dramatic increase in abundance was likely due to improved water quality in the Hudson River, which allowed for high recruitment during years when environmental conditions were right, particularly between 1986-1991. These studies provide the best information available on the current status of the Hudson River population and suggests that the population is relatively healthy, large, and particular in habitat use and migratory behavior (Bain et al. 1998).

Shortnose sturgeon have been documented in the Hudson River from upper Staten Island (RM -3) to the Troy Dam (RM 155)[3] (Bain et al. 2000, ASA 1980-2002). Prior to the construction of the Troy Dam in 1825, shortnose sturgeon are thought to have used the entire freshwater portion of the Hudson River (NYHS 1809). Spawning fish congregated at the base of Cohoes Falls where the Mohawk River emptied into the Hudson. In recent years (since 1999), shortnose sturgeon have been documented below the Tappan Zee Bridge from June through December (ASA 1999-2002; Dynegy 2003). While shortnose sturgeon presence below the Tappan Zee Bridge had previously been thought to be rare (Bain et al. 2000), increasing numbers of shortnose sturgeon have been documented in this area over the last several years (ASA 1999-2002; Dynegy 2003) suggesting that the range of shortnose sturgeon is extending downstream. Shortnose sturgeon were documented as far south as the Manhattan/Staten Island area in June, November and December 2003 (Dynegy 2003).

3 See Figure 1 for a map of the Hudson River with these areas highlighted.

From late fall to early spring, adult shortnose sturgeon concentrate in a few overwintering areas. Reproductive activity the following spring determines overwintering behavior. The largest overwintering area is just south of Kingston, NY, near Esopus Meadows (rkm 139-152) (Dovel et al. 1992). The fish overwintering at Esopus Meadows are mainly spawning adults. Recent capture data suggests that these areas may be expanding (Hudson River 1999-2002, Dynegy 2003). Captures of shortnose sturgeon during the fall and winter from Saugerties to Hyde Park (greater Kingston reach), indicate that additional smaller overwintering areas may be present (Geoghegan et al. 1992). Both Geoghegan et al. (1992) and Dovel et al. (1992) also confirmed an overwintering site in the Croton-Haverstraw bay area (rkm 54-61). Fish overwintering in areas below Esopus Meadows are mainly thought to be pre-spawning adults. Typically, movements during overwintering periods are localized and fairly sedentary.

In the Hudson River, males usually spawn at approximately 3-5 years of age while females spawn at approximately 6-10 years of age (Dadswell et al. 1984; Bain et al. 1998). Males may spawn annually once mature and females typically spawn every 3 years (Dovel et al. 1992). Mature males feed only sporadically prior to the spawning migration, while females do not feed at all in the months prior to spawning.

In approximately late March through mid-April, when water temperatures are sustained at 8º-9° C for several days[4], reproductively active adults begin their migration upstream to the spawning grounds that extend from below the Federal Dam at Troy to about Coeymans, NY (rkm 245-212) (Dovel et al. 1992). Spawning typically occurs at water temperatures between 10-18°C (generally late April-May) after which adults disperse quickly down river into their summer range. Dovel et al. (1992) reported that spawning fish tagged at Troy were recaptured in Haverstraw Bay in early June. The broad summer range occupied by adult shortnose sturgeon extends from approximately rkm 38 to rkm 177.

There is scant data on actual collection of early life stages of shortnose sturgeon in the Hudson River. During a mark recapture study conducted from 1976-1978, Dovel et al. (1979) captured larvae near Hudson, NY (rkm 188) and young of the year were captured further south near Germantown. Between 1996 and 2004, approximately 10 small shortnose sturgeon were collected each year as part of the Falls Shoals Survey (FSS) (ASA 2007). Based upon basic life history information for shortnose sturgeon it is known that eggs adhere to solid objects on the river bottom (Buckley and Kynard 1981; Taubert 1980) and that eggs and larvae are expected to be present within the vicinity of the spawning grounds (rkm 245-212) for approximately four weeks post spawning (i.e., at latest through mid-June). Shortnose sturgeon larvae in the Hudson River generally range in size from 15 to 18 mm TL at hatching (Pekovitch 1979). Larvae gradually disperse downstream after hatching, entering the tidal river (Hoff et al. 1988). Larvae or fry are free swimming and typically concentrate in deep channel habitat (Taubert and Dadswell 1980; Bath et al. 1981; Kieffer ad Kynard 1993). Given that fry are free swimming and foraging, they typically disperse downstream of spawning/rearing areas. Larvae are found throughout the Hudson River estuary and are most commonly found in deep waters with strong currents, typically in the channel (Hoff et al. 1988; Dovel et al. 1992). The transition from the

4 Based on information from the USGS gage in Albany (gage no. 01359139), in 2002 water temperatures reached 8ºC on April 10 and 15ºC on April 20; 2003 - 8ºC on April 14 and 15ºC on May 19; 2004 - 8ºC on April 17 and 15ºC on May 11.

larval to juvenile stage generally occurs in the first summer of life when the fish grows to approximately 2 cm TL and is marked by fully developed external characteristics (Pekovitch 1979).

Similar to non-spawning adults, most juveniles occupy the broad region of Haverstraw Bay (RM 34-40) (Dovel et al. 1992; Geoghegan et al. 1992) by late fall and early winter. Migrations from the summer foraging areas to the overwintering grounds are triggered when water temperatures fall to 8°C (NMFS 1998), typically in late November[5]. Juveniles are distributed throughout the mid-river region during the summer and move back into the Haverstraw Bay region during the late fall (Bain et al. 1998; Geoghegan et al. 1992; Haley 1998).

Shortnose sturgeon are bottom feeders and juveniles may use the protuberant snout to "vacuum" the river bottom. Curran & Ries (1937) described juvenile shortnose sturgeon from the Hudson River as having stomach contents of 85-95% mud intermingled with plant and animal material. Other studies found stomach contents of adults were solely food items, implying that feeding is more precisely oriented. The ventral protrusable mouth and barbells are adaptations for a diet of small live benthic animals. Juveniles feed on smaller and somewhat different organisms than adults. Common prey items are aquatic insects (chironomids), isopods, and amphipods. Unlike adults, mollusks do not appear to be an important part of the diet of juveniles (Bain 1997). As adults, their diet shifts strongly to mollusks (Curran & Ries 1937).

Telemetry data has been instrumental in informing the extent of shortnose sturgeon coastal migrations. Recent telemetry data from the Gulf of Maine indicate shortnose sturgeon in this region undertake significant coastal migrations between larger river systems and utilize smaller coastal river systems during these interbasin movements (Fernandes 2008; UMaine unpublished data). Some outmigration has been documented in the Hudson River, albeit at low levels in comparison to coastal movement documented in the Gulf of Maine and Southeast rivers. Two individuals tagged in 1995 in the overwintering area near Kingston, NY were later recaptured in the Connecticut River. One of these fish was at large for over two years and the other 8 years prior to recapture. As such, it is reasonable to expect some level of movement out of the Hudson into adjacent river systems; however, based on available information it is not possible to predict what percentage of adult shortnose sturgeon originating from the Hudson River may participate in coastal migrations.

ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all State, Federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impacts of State or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this biological Opinion includes the effects of several activities that may have affected the survival and recovery of threatened and endangered species in the Action Area. The activities that shape the environmental baseline of this consultation include the effects of the past operation of the GIPA

5 In 2002, water temperatures at the USGS gage at Hastings-on-Hudson (No. 01376304; the farthest downstream gage on the river) fell to 8°C on November 23. In 2003, water temperatures at this gage fell to 8°C on November 29.

Project, additional dams and hydropower facilities located upstream of the project, in-water construction activities, fisheries, research projects, and water quality.

Impacts of Federal Actions that have Undergone Formal or Early Section 7 Consultation

To date, no formal or early consultations on the effects of actions occurring in the action area have occurred. To the extent that Federal actions occurring outside of the action area affect shortnose sturgeon in the action area, effects of these activities have been considered in the Status of the Species section above. Effects of the existence of the Troy Dam as built and maintained by the ACOE are discussed below; as the dam was constructed prior to the passage of the ESA, no consultation was conducted prior to its construction.

As explained above, the Federal Dam at Troy, where the Green Island project is located, represents the first barrier to upstream migration to shortnose sturgeon. The only available means of passing upstream of the dam is via the navigational locks, which are operated from May 1 – November 30 each year. The use of the locks by sturgeon has not been documented and it has been speculated that the tall sill (14 foot elevation) may prevent shortnose sturgeon from accessing the locks for passage. While research efforts targeted towards discovering shortnose sturgeon above the dam have not been undertaken, numerous studies have taken place above the dam that are likely to have resulted in the bycatch of this species if it was present. As described in Daniels et al. (2005), there is no evidence that shortnose sturgeon are present upstream of the Troy Dam in either the mainstem Hudson River or the Mohawk River.

The continued existence of the Troy Dam will continue to preclude shortnose sturgeon from accessing habitat upstream of the Dam. It is believed that prior to dam construction, shortnose sturgeon in the Hudson River ranged to at least Cohoes Falls at the confluence of the Mohawk River with the Hudson River (approximately 3 miles upstream of the dam). The dam then has restricted access to at least an additional 3 river miles of habitat, which may have been used for spawning. Given that suitable substrate is present in a large stretch of the Hudson River and that shortnose sturgeon are known to currently spawn over at least a 33 km length of river, it is reasonable to conclude that shortnose sturgeon likely lost a portion of their spawning range when the dam was built but that spawning likely occurred below the present location of the dam as well. At least 33 km of spawning habitat are currently available and the information available on recent recruitment of juvenile shortnose sturgeon to the population (Woodland and Secor 2007) indicates that significant recruitment occurs in the river. None of the research on shortnose sturgeon conducted in the Hudson River indicates that shortnose sturgeon are limited by available spawning habitat. The area upstream of the Dam was not likely to have been used for overwintering or foraging. The Troy Dam does not act to restrict the range of juvenile shortnose sturgeon nor does it prevent adult shortnose sturgeon from accessing overwintering or foraging grounds. Further, as the Hudson River population of shortnose sturgeon is successfully reproducing and has characteristics of a stable, long-lived population, it is unclear what effect to the population the restriction in spawning grounds resulting from the construction and continued existence of the Troy Dam has had. While the continued existence of the Troy Dam will continue to preclude access to these historic habitats and will restrict the range of shortnose sturgeon in the Hudson River the best available information indicates that spawning or recruitment of shortnose sturgeon has not been limited by the presence of the dam.

Impacts of Non-Federally Regulated Actions

Non-Federally Regulated Fishery Operations

Shortnose sturgeon are taken incidentally in anadromous fisheries along the East coast and may be targeted by poachers (NMFS 1998). It has been estimated that approximately 20 shortnose sturgeon are killed each year in the commercial shad fishery and an additional number are also likely taken in recreational fisheries (T. Savoy pers. comm. in NMFS 1998). The shad fishery was recently closed in New York. According to information provided to NMFS by New York State Department of Environmental Conservation (NYSDEC) shortnose sturgeon were routinely caught as bycatch in the recreational shad fishery that occurred during the spring in the action area. The effect of this capture is unknown; however, it likely resulted in some mortality and possibly some delay or disruption of spawning. Due to a lack of reporting, no information on the number of shortnose sturgeon caught and released or killed in commercial or recreational fisheries on the Hudson River is available. While the shad fishery is currently closed, should it be reopened during the license period shortnose sturgeon in the action area would be likely to be incidentally caught in the shad fishery.

Impacts of Other Potential Sources of Impacts in the Action Area

Scientific Studies

The Hudson River population of shortnose sturgeon have been the focus of a prolonged history of scientific research. In the 1930s, the New York State Biological Survey launched the first scientific sampling study and documented the distribution, age, and size of mature shortnose sturgeon (Bain et al. 1998). In the early 1970s, research resumed in response to a lack of biological data and concerns about the impact of electric generation facilities on fishery resources (Hoff 1988). In an effort to monitor relative abundance, population status, and distribution, intensive sampling of shortnose sturgeon in this region has continued throughout the past forty years. Sampling studies targeting other species also incidentally capture shortnose sturgeon. As a result of techniques associated with these sampling studies, shortnose sturgeon have been subjected to capturing, handling, and tagging. For example, 45 shortnose sturgeon were captured during one study in 2003. The same study captured 50 shortnose sturgeon in 2000. It is possible that research in the action area may have influenced and/or altered the migration patterns, reproductive success, foraging behavior, and survival of shortnose sturgeon.

There are currently three shortnose sturgeon scientific research permits issued pursuant to Section 10(a)1(A) of the ESA, in the Hudson River. NYSDECs' scientific research permit (#1547) authorizes NYSDEC to conduct river surveys in the Hudson River, specifically focusing on Haverstraw Bay and Newburgh areas to evaluate the seasonal movements of adults and juveniles. NYSDEC is authorized to capture up to 500 adults/juveniles annually in order to weigh, measure, tag, and collect tissue samples for genetic analyses. Permit # 1547 expires October 31, 2011.

Scientific research permit # 1575 authorizes Earth Tech, Inc. to conduct a study of fisheries resources in and around the Tappan Zee Bridge in support of the NY Department of Transportation, NY Thruway Authority, and the Metro-North Railroad efforts to improve the mobility in the I-287 corridor including the potential replacement of the Tappan Zee Bridge.

Data collection is focused on fish assemblages and relative species abundance in the vicinity of the bridge. Earth Tech, Inc. is authorized to capture, handle, and measure up to 250 adult/juvenile shortnose sturgeon annually. Permit # 1575 expires November 30, 2011.

The third scientific research permit (#1580, originally issued as #1254) is issued to Dynegy to evaluate the life history, population trends, and spacio-temporal and size distribution of shortnose sturgeon collected during the annual Hudson River Biological Monitoring Program. Dynegy is authorized to capture up to 82 adults/juveniles annually to measure, weigh, tag, photograph, and collect tissue samples for genetic analyses. Dynegy is also authorized to lethally take up to 40 larvae annually. Permit # 1580 will expire on March 31, 2012. These permits are issued for a period of five years and may be renewed pending a formal review by NMFS' Office of Protected Resources, Permits Division.

Impacts of Contaminants and Water Quality

Historically, shortnose sturgeon were rare in the lower Hudson River, likely as a result of poor water quality precluding migration further downstream. However, in the past several years, the water quality has improved and sturgeon have been found as far downstream as the Manhattan/Staten Island area. It is likely that contaminants remain in the water and in the action area, albeit to reduced levels. Sewage, industrial pollutants and waterfront development has likely decreased the water quality in the action area. Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable. Several characteristics of shortnose sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979).

Principal toxic chemicals in the Hudson River include pesticides and herbicides, heavy metals, and other organic contaminants such as PAHs and PCBs. Concentrations of many heavy metals also appear to be in decline and remaining areas of concern are largely limited to those near urban or industrialized areas. With the exception of areas near New York City, there currently does not appear to be a major concern with respect to heavy metals in the Hudson River, however metals could have previously affected shortnose sturgeon.

PAHs, which are products of incomplete combustion, most commonly enter the Hudson River as a result of urban runoff. As a result, areas of greatest concern are limited to urbanized areas, principally near New York City. The majority of individual PAHs of concern have declined during the past decade in the lower Hudson River and New York Harbor.

PCBs are the principal toxic chemicals of concern in the Hudson River. Primary inputs of PCBs in freshwater areas of the Hudson River are from the upper Hudson River near Fort Edward and Hudson Falls, New York. In the lower Hudson River, PCB concentrations observed are a result of both transport from upstream as well as direct inputs from adjacent urban areas. The action area has not been identified by United States Environmental Protection Agency (USEPA) as needing remediation for PCB contamination, however, this legacy pollutant may continue to affect shortnose sturgeon in the action area. PCBs tend to be bound to sediments and also bioaccumulate and biomagnify once they enter the food chain. This tendency to bioaccumulate and biomagnify results in the concentration of PCBs in the tissue concentrations in aquatic-dependent organisms. These tissue levels can be many orders of magnitude higher than those observed in sediments and can approach or even exceed levels that pose concern over risks to the environment and to humans who might consume these organisms. PCBs can have serious deleterious effects on aquatic life and are associated with the production of acute lesions, growth retardation, and reproductive impairment (Ruelle and Keenlyne 1993). PCB's may also contribute to a decreased immunity to fin rot (Dovel et al. 1992). Large areas of the upper Hudson River are known to be contaminated by PCBs and this is thought to account for the high percentage of shortnose sturgeon in the Hudson River exhibiting fin rot. Under a statewide toxics monitoring program, the NYSDEC analyzed tissues from four shortnose sturgeon to determine PCB concentrations. In gonadal tissues, where lipid percentages are highest, the average PCB concentration was 29.55 parts per million (ppm; Sloan 1981) and in all tissues ranged from 22.1 to 997.0 ppm. Dovel (1992) reported that more than 75% of the shortnose sturgeon captured in his study had severe incidence of fin rot.

In the Connecticut River, coal tar leachate was suspected of impairing sturgeon reproductive success. Kocan (1993) conducted a laboratory study to investigate the survival of sturgeon eggs and larvae exposed to PAHs, a by-product of coal distillation. Only approximately 5% of sturgeon embryos and larvae survived after 18 days of exposure to Connecticut River coal-tar (i.e., PAH) demonstrating that contaminated sediment is toxic to shortnose sturgeon embryos and larvae under laboratory exposure conditions (NMFS 1998). Manufacture Gas Product (MGP) waste is known to occur at several sites within the Hudson River and waste may have had similar effects on any shortnose sturgeon present in the action area over the years.

Point source discharge (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) and compounds associated with discharges (i.e., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon populations. The compounds associated with discharges can alter the pH of receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival.

Heavy usage of the Hudson River and development along the waterfront could have affected shortnose sturgeon throughout the action area. Coastal development and/or construction sites often result in excessive water turbidity, which could influence sturgeon spawning and/or foraging ability. Industries along the Hudson River have likely impacted the water quality, as service industries, such as transportation, communication, public utilities, wholesale and retail trades, finance, insurance and real estate, repair and others, have increased since 1985 in all nine counties in the lower Hudson River.

The Hudson River is used as a source of potable water, for waste disposal, transportation and cooling by industry and municipalities. Rohman et al. (1987) identified 183 separate industrial and municipal discharges to the Hudson and Mohawk Rivers. The greatest number of users were in the chemical industry, followed by the oil industry, paper and textile manufactures, sand, gravel, and rock processors, power plants, and cement companies. Approximately 20 publicly owned treatment works discharge sewage and wastewater into the Hudson River. Most of the municipal wastes receive primary and secondary treatment. A relatively small amount of sewage is attributed to discharges from recreational boats.

Global climate change
The global mean temperature has risen 0.76ºC over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (IPCC 2007a) and precipitation has increased nationally by 5%-10%, mostly due to an increase in heavy downpours (NAST 2000). There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007b).
These trends are most apparent over the past few decades.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next century. Both of the principal climate models used by the National Assessment Synthesis Team (NAST) project warming in the southeast by the 2090s, but at different rates (NAST 2000): the Canadian model scenario shows the southeast U.S. experiencing a high degree of warming, which translates into lower soil moisture as higher temperatures increase evaporation; the Hadley model scenario projects less warming and a significant increase in precipitation (about 20%). The scenarios examined, which assume no major interventions to reduce continued growth of world greenhouse gases (GHG), indicate that temperatures in the U.S. will rise by about 3^o-5^oC (5^o-9^oF) on average in the next 100 years which is more than the projected global increase (NAST 2000). A warming of about 0.2^oC per decade is projected for the next two decades over a range of emission scenarios (IPCC 2007). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has resulted in increased precipitation, river discharge, and glacial and sea-ice melting (Greene et al. 2008).

The past 3 decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene et al. 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (Greene et al. 2008, IPCC 2006). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the earth's atmosphere caused by anthropogenic forces (IPCC 2006). The NAO impacts climate variability throughout the northern hemisphere (IPCC 2006). Data from the 1960s through the present show that the NAO index has increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2006). This warming extends over 1000m deep and is deeper than anywhere in the world oceans and is particularly evident under the Gulf Stream/ North Atlantic Current system (IPCC 2006). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (Greene et al. 2008, IPCC 2006). There is evidence that the NADW has already freshened significantly (IPCC 2006). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the whole earth system (Greene et al. 2008).

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the Hudson River, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the United States. Additional information on potential effects of climate change specific to the action area is discussed below. Warming is very likely to continue in the U.S. during the next 25 to 50 years regardless of reduction in GHGs, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 25 to 50 years, and it is possible that they will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

A warmer and drier climate is expected to result in reductions in stream flows and increases in water temperatures. Expected consequences could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch et al. 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch et al. 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources in the southeast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer et al. 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development will experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer et al. 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2^{o}C per decade; and 3) a rise in sea level (NAST 2000). A warmer and drier climate will reduce stream flows and increase water temperature resulting in a decrease of DO and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing. Sea level is expected to continue rising: during the 20th century global sea level has increased 15 to 20 cm, and between 1985 and 1995 more than 32,000 acres of coastal salt marsh was lost in the southeastern U.S. due to a combination of human development activities, sea level rise, natural subsidence and erosion.

Effects on shortnose sturgeon throughout their range

Shortnose sturgeon have persisted for millions of years and throughout this time have experienced wide variations in global climate conditions and have successfully adapted to these changes. As such, climate change at normal rates (thousands of years) is not thought to have historically been a problem for shortnose sturgeon. Shortnose sturgeon could be affected by changes in river ecology resulting from increases in precipitation and changes in water temperature which may affect recruitment and distribution in these rivers. However, as noted in the "Status of the Species" section above, information on current effects of global climate change on shortnose sturgeon is not available and while it is speculated that future climate change may affect this species, it is not possible to quantify the extent to which effects may occur. However, effects of climate change in the action area during the temporal scope of this section 7 analysis on shortnose sturgeon in the action area are discussed below.

Information on how climate change will impact the action area is extremely limited. Available information on climate change related effects for the Hudson River largely focuses on effects that rising water levels may have on the human environment. The New York State Sea Level Rise Task Force (Spector in Bhutta 2010) predicts a state-wide sea level rise of 7-52 inches by the end of this century, with the conservative range being about 2 feet. This compares to an average sea level rise of about 1 foot in the Hudson Valley in the past 100 years. Sea level rise is expected to result in the northward movement of the salt wedge. The location of the salt wedge in the Hudson River is highly variable depending on season, river flow, and precipitation so it is unclear what effect this northward shift could have. Potential negative effects include restricting the habitat available for juvenile shortnose sturgeon which are intolerant to salinity and are present exclusively upstream of the salt wedge. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shift that may occur.

Air temperatures in the Hudson Valley have risen approximately 0.5°C since 1970. In the 2000s, the mean Hudson river water temperature, as measured at the Poughkeepsie Water Treatment Facility, was approximately 2°C higher than averages recorded in the 1960s (Pisces 2008). However, while it is possible to examine past water temperature data and observe a warming trend, there are not currently any predictions on potential future increases in water temperature in the action area specifically or the Hudson River generally. The Pisces report (2008) also states that temperatures within the Hudson River may be becoming more extreme. For example, in

2005, water temperature on certain dates was close to the maximum ever recorded and also on other dates reached the lowest temperatures recorded over a 53-year period. Other conditions that may be related to climate change that have been reported in the Hudson Valley are warmer winter temperatures, earlier melt-out and more severe flooding. An average increase in precipitation of about 5% is expected; however, information on the effects of an increase in precipitation on conditions in the action area is not available.

As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on shortnose sturgeon. The most likely effect to shortnose sturgeon would be if sea level rise was great enough to consistently shift the salt wedge far enough north which would restrict the range of juvenile shortnose sturgeon and may affect the development of these life stages. In the action area, it is possible that changing seasonal temperature regimes could result in changes in the timing of spawning, which would result in a change in the seasonal distribution of sturgeon in the action area. A northward shift in the salt wedge could also drive spawning shortnose sturgeon further upstream which may result in a restriction in the spawning range and an increase in the number of spawning shortnose sturgeon in the action area, as this area is the furthest accessible upstream spawning area.

As described above, over the long term, global climate change may affect shortnose sturgeon by affecting the distribution of prey, water temperature and water quality; however, there is significant uncertainty, due to a lack of scientific data, on the degree to which these effects may be experienced and the degree to which shortnose sturgeon will be able to successfully adapt to any such changes. Any activities occurring within and outside the action area that contribute to global climate change are also expected to affect shortnose sturgeon in the action area. Scientific data on changes in shortnose sturgeon distribution and behavior in the action area is not available. Therefore, it is not possible to say with any degree of certainty whether and how their distribution or behavior in the action area have been or are currently affected by climate change related impacts. Implications of potential changes in the action area related to climate change are not clear in terms of population level impacts, data specific to these species in the action area are lacking. Therefore, any recent impacts from climate change in the action area are not quantifiable or describable to a degree that could be meaningfully analyzed in this consultation. However, given the likely rate of climate change, it is unlikely that there will be significant effects to shortnose sturgeon in the action area, such as changes in distribution or abundance, over the time period considered in this consultation (i.e., through the 40 year license period) and it is unlikely that shortnose sturgeon in the action area will experience new climate change related effects not already captured in the "Status of the Species" section above concurrent with the proposed action.

EFFECTS OF THE PROPOSED ACTION

This section of a Biological Opinion assesses the direct and indirect effects of the proposed action on threatened or endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. This Biological Opinion examines the likely effects (direct and indirect) of the proposed action on shortnose sturgeon and their habitat within the context of the species' current status, the environmental baseline, and cumulative effects.

As noted above, the proposed action involves modifications to the existing electric generating facility as well as the continued operation of the facility under a new license. As explained above, the Green Island Dam was constructed by the US Army Corps of Engineers to aid navigation through the lock system. The dam continues to be owned and operated by the ACOE. Even if FERC did not issue an operating license to GIPA, the dam would continue to exist and be used for navigational purposes, although the power house would likely be decommissioned and the turbines removed. As the hydroelectric facility operates in run-of-river mode, there would be little change in flow or hydraulic conditions below the dam if the hydroelectric facility ceased operation.

Below, NMFS first considers the effects of the construction related to project modifications and then considers effects of continued operation of the modified facility.

As explained above, adult shortnose sturgeon are expected to be in the project area only during the spawning season, which typically lasts from mid-April to late May when river water temperature is in the range of 8-18°C. A review of water temperature data at the USGS gage at Albany (Gage 01359139, using data for the previous 9 years) indicates that water temperatures at Albany reach 8°C in mid-April, reach 15°C by mid-May and always reach 18°C by June 1. Depending on water conditions in a particular year, spawning can occur over a few days or over a three to four week period. Eggs hatch after approximately 9-12 days (Buckley and Kynard 1981); larvae are photonegative, remaining on the bottom for several days. Larvae are expected to begin swimming downstream at 9-14 days old (Richmond and Kynard 1995). Thus, even if spawning continues until June 1 (the latest date recorded for water temperatures to reach 18°C), all larvae will have moved downstream from the action area by June 26 at the latest, with early to mid-June being more typical. Between July and early April, no shortnose sturgeon of any life stage are likely to occur in the action area.

In-water construction includes installation of cofferdam, construction within the cofferdams, and excavation in the tailrace. Effects of the action include: noise and vibration associated with the installation and removal of cofferdams and piles, disturbance of and loss of access to benthic habitat, noise and disturbance within the cofferdams during construction and demolition, potential for overtopping of the cofferdams during high flow events, and impacts on water quality.

Installation of Cofferdams

Cofferdams will be installed at several locations in the action area, including areas below the powerhouse where shortnose sturgeon are likely to occur in the spring. A variety of types of cofferdams will be installed; however, all cofferdams will be designed to withstand a 100-year flood event so that no overtopping is anticipated. All cofferdams will be installed outside of the April 1 – June 30 time period. As explained in the "Description of the Action" section, cofferdams will be installed and removed in stages. Cofferdams will be of three types: timber pinned to moveable concrete blocks (zones 1 and 2), timber pinned directly to the dam face (zone 3), and driven steel sheet piles (zone 4).

The installation of piles via pile driving can produce underwater sound pressure waves that can affect aquatic species. A variety of pile types will be utilized for cofferdam construction, including steel sheet piles and possibly steel pipe piles. The available literature indicates that the single strike of a steel sheet pile results in a sound exposure level (SEL[6]) up to about 178 dB re 1 μPa^2-sec at a distance of 10 meters from the source. The available literature indicates that the single strike of a 24" diameter steel pile, the largest size that is likely to be used as a support pile, results in a sound exposure level (SEL) up to about 177 dB re 1 μPa^2-sec at a distance of 5 meters from the source. However, if a vibratory hammer is used to install the piles, sound exposure levels are 10-20 dB lower (Jones & Stokes 2007). These levels are dependent not only on the pile and hammer characteristics, but also on the geometry and boundaries of the surrounding underwater and benthic environment. Thus, depending on the type of hammer and the characteristics of the site, sound levels of 158 – 178 dB are expected at a distance of 5-10 meters of the site of pile driving. As the distance from the source increases, underwater sound levels produced by pile driving are known to dissipate rapidly. Using data from Illingworth and Rodkin, Inc. (2007), a conservative literature estimate of an attenuation rate of 5 to 20 dB per doubling of distance is expected when installing steel sheet piles. Therefore, sound levels are expected to be fully attenuated within 1000 meters of the pile being driven.

Pile driving affects fish through underwater noise and pressure, which can cause effects to hearing and air containing organs, such as the swim bladder. Effects to fish can range from temporary avoidance of an area to death due to injury of internal organs. The type and size of pile, type of installation method (i.e., vibratory vs. hammer), type and size of fish (smaller fish are more often impacted), and distance from the sound source (i.e., sound dissipates over distance so noise levels are greater closer to the source) all contribute to the likelihood of effects to an individual fish. The available literature on effects of pile driving on aquatic species is difficult to summarize due to inconsistent methods of measuring underwater sound, the diversity of pile driving methods and receiving substrates, and the differing tolerances of aquatic species to underwater noise. Generally, however, the larger the pile and the closer a fish is to the pile, the greater the likelihood of effects.

Popper et al. (2006) have proposed a set of criteria for injury to fish exposed to pile driving. They propose that pile strikes which result in an SEL of 187 dB re 1 µPa as measured 10 meters from the source are expected to produce injuries to fish. As different fish species demonstrate differing sensitivities to sound levels and there is little information on the effects of underwater noise on shortnose sturgeon, it is difficult to determine whether this criterion is appropriate for shortnose sturgeon. While no studies have been conducted on the effects of pile driving on shortnose sturgeon, two studies have been conducted on the effects of blasting on this species. Both activities produce sound waves that would act similarly in the water column, making effects comparable. Moser (1999) studied the effects of rock blasting in Wilmington Harbor on caged hatchery reared shortnose sturgeon. A study done in the Cooper River, South Carolina, by Collins and Post (2001) tested the use of blasting caps to possibly repel shortnose sturgeon from

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6 The SEL is defined as that level which, lasting for one second, has the same acoustic energy as the transient and is expressed as dB re: $1\mu Pa^2 \cdot sec$

a blasting site. These studies indicate that mortality of shortnose sturgeon only occurred when recorded sound levels were 234 dB. At sound levels between 196-229 dB, some shortnose sturgeon were temporarily stunned. These studies suggest that, consistent with the recommendations by Popper et al. 2006, exposure of shortnose sturgeon to sound levels below 187dB is unlikely to result in effects to this species. Sound levels associated with the driving of steel sheet piles (i.e., 178 dB at a distance of 10 meters of the piles being driven) and steel pipe piles (i.e., 177 dB at a distance of 5 meters of the piles being driven) are below the range that could negatively affect shortnose sturgeon.

As noted above, cofferdams will be constructed outside of the April 1 – June 30 time period. As explained in the "Status of the Species" section above (see p. 23-25), shortnose sturgeon are only likely to be present in the action area between late March and mid June. As no shortnose sturgeon are likely to occur in the action area when piles will be driven, no shortnose sturgeon are likely to be exposed to underwater noise associated with the driving of piles. Based on this information, it is extremely unlikely that any shortnose sturgeon will be affected by noise associated with the driving of piles.

The installation and removal of sheet piles for cofferdams and piles will disturb bottom sediments. However, given the rocky substrate and lack of fine sediments in the project area, little increase in sedimentation or turbidity is expected to result from these activities. Additionally, as piles will be installed outside of the time of year when shortnose sturgeon are likely to occur in the action area, no shortnose sturgeon will be exposed to any suspended sediment associated with the installation of piles. Similarly, as the piles will be removed outside of the time of year when shortnose sturgeon are likely to be present in the action area, no shortnose sturgeon will be exposed to any suspended sediment resulting from the removal of the piles. As effects to shortnose sturgeon from pile installation and removal are extremely unlikely to occur, any effects of pile driving and removal will be discountable.

Effects of Construction and Excavation within Cofferdams

While all cofferdams will be installed outside of the April 1 – June 30 time period, construction and/or excavation may be ongoing within the cofferdams during this time. While this work will result in noise, there is expected to be minimal transmission of this noise to the underwater area where shortnose sturgeon will be present due to the need for noise to transmit through the steel walls. The potential for elevated noise to be experienced within the underwater area is further reduced as sound from one environment (air or water) is not easily transmitted across the air-water interface (Akamatsu, et. al. 2002, as referenced in Popper 2003).

Construction ongoing within the cofferdams will include sediment disturbing activities. However, as the joints of the cofferdams are expected to be water tight, there is not expected to be any increase in suspended sediment outside of the cofferdams. GIPA will implement a water quality monitoring program that will monitor turbidity upstream and downstream of the work site and will require that work stop should there be any increase in turbidity recorded below the work site. As impacts of noise and suspended sediment are expected to be insignificant, it is unreasonable to expect that ongoing construction within the cofferdams or from the causeways will affect the ability of any individual shortnose sturgeon to spawn successfully or that it would affect the successful development of any eggs and larvae spawned in the action area.

Entrapment of Shortnose Sturgeon in the Cofferdams

As explained above, cofferdams will be constructed outside of the time of year when shortnose sturgeon are likely to be present in the action area. As such, there is no potential for shortnose sturgeon to become entrapped within the cofferdams during construction. Additionally, as the cofferdam steel sheeting will be driven to bedrock, all joints will be tightly sealed, and the top of the cofferdam will be above the water line, it is anticipated that spawning adults as well as shortnose sturgeon eggs and larvae will be precluded from entering the enclosed cofferdam areas.

The top of the cofferdam will be designed to be higher than the inundation anticipated with a 100-year flood. As such, it is not likely that the cofferdams would be overtopped during the time when they are in place. As such, it is not anticipated that any shortnose sturgeon would be swept into and stranded within any cofferdams.

Loss of Access to Benthic Habitat

The installation of cofferdams will result in the temporary loss of access to potential spawning habitat in the action area. It is anticipated that a three year construction period will be required and it is likely that one cofferdam will be in place throughout most of this period.

Based on preliminary engineering, GIPA has estimated the anticipated footprint of the cofferdams. The four areas below the powerhouse that will be isolated within cofferdams are as follows: 80' x 431' (34,480 square feet); 35' x 416' (14,560 sf); 160' x 416' (66,560 sf) and 690' x average 440' (303,600 sf). Construction will occur in phases, and it is anticipated that each cofferdam will be removed before the next is constructed.

To assess the effects of the loss of temporary access to benthic habitat within the cofferdams and the effects of the permanent loss of habitat where the concrete slabs will be installed, NMFS has considered the effects on spawning adults and early life stages of shortnose sturgeon.

Spawning in the Hudson River occurs over at least a 20 mile (33 km) stretch of river from Coeymans to the Troy Dam (Dovel et al. 1992; Bain 1997; Pekovitch 1979). The width of the river ranges from 2,500 feet to 900 feet along this stretch of river but is on average approximately 1,000 feet wide. Thus, spawning occurs over approximately 3.6 square miles (approximately 2,300 acres). As noted above, the proposed construction will result in a maximum temporary loss of access to 303,600 square feet (approximately 7 acres) of bottom habitat at any given time during the three year construction period.

As explained above, spawning adults are likely to occur in the action area for a two to three week period when water temperatures are between 8 and 18°C. Based on habitat characteristics in the action area (i.e., depth, water velocity, and substrate type), spawning may occur throughout the action area, of which access to no more than 7 acres will be precluded due to placement of the temporary cofferdams. The area that will be temporarily lost due to the presence of the cofferdams (approximately 7 acres) represents approximately 0.3% of the available spawning habitat in the Hudson River. The presence of the cofferdams will preclude adults from spawning in these areas; however, due to the relatively small amount of bottom habitat impacted by these structures and the fact that the cofferdams will not prevent access to other suitable spawning areas, unrestricted movement throughout the action area and the spawning range will not be precluded by the presence of these structures.

The loss of access to no more than 7 acres of river bottom during any one spawning season over the three year construction period could affect individual shortnose sturgeon by causing them to expend additional energy to seek out alternate spawning locations within the action area. It is important to note that the cofferdams will be placed adjacent to the existing dam which represents the upstream limit for shortnose sturgeon in the Hudson River; as the cofferdams themselves are to be placed at the upstream limit of shortnose sturgeon access in the river, the cofferdams will not preclude shortnose sturgeon from reaching areas further upstream or otherwise alter their distribution within the action area or the Hudson River. Additionally, due to the presence of existing bridge piers and islands within the entirety of the spawning grounds, as well as the lack of uniform substrate, some amount of searching behavior for suitable spawning sites is normal and shortnose sturgeon are expected to expend some amount of energy normally to seek out places to spawn that meet their criteria for water depth, velocity and substrate type. While the presence of the cofferdams will cause a small loss in the amount of available spawning habitat within the action area during the 3 year construction period and will temporarily decrease the available suitable habitat both in the action area and over the entirety of the spawning grounds, any modifications to movements of spawning adults will be limited to the very short time that it would take for an adult to swim around the edge of the cofferdam, which likely would not amount to more than a few minutes.

In summary, while the cofferdams are in place, spawning adults will need to make modifications to their normal movements to swim around the cofferdams; however, this increased amount of time or energy would be extremely small and not result in any delay in spawning or reduction in spawning success. As the area encompassed by any one cofferdam is small (i.e., maximum size of any one temporary structure is approximately 690 feet by 440 feet), any alterations to behavior are expected to be extremely limited in temporal and geographic scope. Any additional energy expenditure caused by a lack of access to benthic habitat associated with project activities is likely to be insignificant and is not likely to affect the ability of an individual adult to spawn. Therefore, these effects are not likely to affect the reproductive fitness of any spawning individual.

The loss of access to no more than 7 acres of river bottom during any one spawning season over the three year construction period is not expected to affect the ability of any individual shortnose sturgeon to spawn within the action area, nor is it expected to reduce the quantity or viability of any eggs or larvae produced. As such, while individual spawning adults may be affected by having to make additional movements within the action area to swim around the cofferdams, due to the small amount of area occupied by the cofferdams and the minor changes in behavior that their presence will cause, there is not expected to be any reduction in spawning adults, eggs or larvae within the action area resulting from the temporary loss of access to this habitat. This is due to the small percentage of lost habitat compared to the available spawning habitat (approximately 0.3%), the small duration of any extra movements required in both spatial and temporal extent (i.e., no more than a few minutes to swim several hundred feet), and the small amount of additional energy required to make the additional movements required to maneuver around the structures and seek out nearby suitable spawning habitat. As spawning adults do not forage on the spawning grounds, the loss of access to this habitat will not affect the ability of shortnose sturgeon to forage.

Following construction and excavation, the substrate type in the area is not expected to change. Based on velocity modeling conducted by GIPA, any changes in velocity in the action area will be minor and any area that is currently within the range of velocities used by spawning shortnose sturgeon will remain in that range. In the areas where excavation occurred, the area will be deeper following construction. Depths in the action area are variable and vary further with the tidal cycle; the tidal range in the action area is approximately 6 feet. The excavation of the tailrace will increase depths by a maximum of approximately 15 feet. Shortnose sturgeon are known to spawn over a wide variety of depths and it is not likely that this increase in depth would preclude shortnose sturgeon from spawning in these areas; particularly given that the deepening will not change the substrate type. While it is impossible to predict whether shortnose sturgeon will spawn in the areas once cofferdams are removed, there will be nothing precluding shortnose sturgeon from spawning at these sites and it is likely that if the substrate is of the appropriate size and if water depths and velocities are appropriate, these areas will be used for shortnose sturgeon spawning following cofferdam removal. Therefore, it is appropriate to consider these effects temporary. Further discussion on the effects of the operation of the modified project on spawning shortnose sturgeon is included below.

The installation of the concrete pad will result in permanent losses of the natural benthic habitat in this area as it will be converted from natural rock to concrete. Shortnose sturgeon are unlikely to spawn on top of the concrete pad as the concrete will be relatively smooth and will lack interstitial spaces for eggs to settle. Approximately 17,000 square feet (0.39 acres) of natural rocky substrate will be replaced with concrete. However, as the area encompassed by the concrete slab is small, any alterations to behavior of spawning adults are expected to be limited in temporal and geographic scope and within the range of normal behaviors of searching out suitable spawning habitat. As such, any additional energy expenditure of adult sturgeon resulting from the conversion of this small area of natural rocky substrate to concrete is likely to be insignificant and is not likely to affect the ability of an individual adult to spawn. Therefore, while these behavioral changes may affect the energy budget of an individual, these effects are likely to be small enough that they will not affect the reproductive fitness of any spawning individual.

The permanent conversion of approximately 0.39 acres of bottom habitat to concrete is not expected to affect the ability of any individual shortnose sturgeon to spawn within the action area, nor is it expected to reduce the quantity or viability of any eggs or larvae produced. This is due to the extremely small percentage of the available spawning habitat that this loss represents (0.017%) and the ability of sturgeon to navigate around the area and seek out suitable spawning habitat. There is not expected to be any reduction in spawning adults, eggs or larvae within the action area resulting from conversion of this habitat to concrete. This is due to the small percentage of converted habitat compared to the available spawning habitat, the small duration of any extra movements required in both spatial and temporal extent, and the small amount of additional energy required to make the additional movements required to maneuver around the structures and seek out nearby suitable spawning habitat. As spawning adults do not forage on the spawning grounds, the permanent conversion of 0.39 acres of bottom substrate to concrete will not affect the ability of shortnose sturgeon to forage.

Tailrace Excavation

Tailrace excavation will occur with a mechanical dredge and/or excavator and if necessary, with blasting to remove rock that can not be removed by mechanical means. All dredging and blasting will occur either within cofferdams or at a time of year when shortnose sturgeon are not present in the area. As such, no shortnose sturgeon will be exposed to noise, vibration or increases in suspended sediment that could result in injury, mortality or disturbance.

Geological survey results from studies completed in the tailrace indicate that substrate in the tailrace consists of bedrock, cobbles and large, coarse gravels. The removal of rock in the tailrace will not change the substrate type in the tailrace but will increase the depth. NMFS has considered whether this change in depth would result in changes in the use of the action area by shortnose sturgeon. Shortnose sturgeon adults occur at a wide range of depths and the excavation of the tailrace and deepening of the tailrace is not likely to preclude shortnose sturgeon from occurring within this area. Studies that have examined the location of shortnose sturgeon spawning indicate that spawning occurs over a wide range of depths. In the Connecticut River, shortnose sturgeon spawn over rock and cobble at depths of 3-16 feet, with the majority of spawning occurring at depths of 5-6 feet (Kieffer and Kynard, in press). Bottom water velocity at spawning site was a mean of 2.3 feet/second with the greatest usage of 2.5-4.1 feet/second. In the Androscoggin River (Maine), spawning has been documented at depths of approximately 8 to 12 feet on a substrate of ledge, boulder and cobble interspersed with sand and gravel at a water velocity of approximately 5 feet/second (FERC 1997). Given the wide variety in depths that spawning is known to occur, it is unlikely that the changes in depth caused by excavation in the tailrace will preclude shortnose sturgeon from spawning in the tailrace or alter the success of any spawning that does occur.

Water Quality

As part of the proposed action, the applicant will implement erosion control measures as well as a storm water pollution prevention plan and a spill reduction plan. As explained above, there is not likely to be any increase in suspended sediment outside of the cofferdams due to the water tight nature of the seals. Water discharges associated with the proposed action include the discharge of ground water pumped out of the cofferdam. Additionally, water quality could be affected by unforeseen circumstances such as oil or chemical spills.

In 1994 Niagara Mohawk Power Corporation, the previous owner of the Green Island Project, commissioned a boring program for the purpose of defining sediment characteristics and thickness as well as bedrock elevation and quality in an area proposed to be disturbed by construction activities associated with an experimental project within the existing headrace. Eight boring locations were selected and a total of 12 split spoon samples and standard penetration tests were taken at five of the boring location. All soils were classified in accordance with the Unified Soil Classification System. Five of the 12 samples were transferred to a laboratory for chemical analysis. The samples were tested for the eight RCRA (Resource Conservation and Recovery Act) metals of arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver as well as for PCBs, pesticides, herbicides and semi-volatile and volatile organic compounds. All results indicate that water quality is not likely to be impacted by excavation or other in-water construction activities.

Oil or chemical spills could occur either as a release from construction equipment or other accidental discharge. An oil or chemical spill would be an unintended, unpredictable event. Aquatic species, including shortnose sturgeon, are known to be negatively impacted by exposure to oil and other petroleum products. Depending on the chemical spilled, negative effects could also occur. Without an estimate of the amount of oil released it is difficult to predict the likely effects on listed species. Similarly, without an estimate of the amount of chemical released as well as information on the particular chemical, it is difficult to predict the likely effects on shortnose sturgeon. The applicant is required to develop an oil and chemical spill response plan which would ensure rapid response to any spill. As the effects of a spill are likely to be localized and temporary, any exposure of shortnose sturgeon is similarly expected to be localized and temporary. Additionally, should a response be required by the USEPA or the U.S. Coast Guard, there would be an opportunity for NMFS to conduct a consultation with the lead Federal agency on the spill response.

Operation of Project Post-Modification

Potential effects to shortnose sturgeon from the operation of the Green Island project include the effects of operations on flow and water quality downstream of the project. Below, NMFS considers the effects of the to-be-built fish passage facilities on shortnose sturgeon as well as effects of the operation of the hydroelectric facility.

Downstream Passage

As explained above, shortnose sturgeon are not known to occur upstream of the Troy Dam. As such, no shortnose sturgeon are expected to be attempting to pass downstream of the project. Currently, fish upstream of the project can pass downstream through the locks, over the dam in spill or through the turbines. GIPA will be installing a FISHIS system, designed to provide safe and effective passage for downstream migrating fish. However, as no shortnose sturgeon are anticipated to occur upstream of the dam, no shortnose sturgeon will be attempting to pass downstream of the project and no shortnose sturgeon will be exposed to effects of the FISHIS system. It is expected that monitoring of fish using the FISHIS system will confirm that no shortnose sturgeon are attempting to pass downstream of the project.

Upstream Passage

As noted above, several upstream passage facilities will be constructed, including two Denil ladders and three eel ladders. Eel ladders are designed for the exclusive use of eels, which are capable of navigating up steep areas with minimal water flow. Upstream passage on the eel ladders by shortnose sturgeon is not possible and no effects to shortnose sturgeon from the eel ladders are anticipated.

Fish ladders consist of a series of gradually inclining steps with resting pools located at regular intervals. These provide the fish with a means for active migration that simulates natural river conditions. A Denil fishway is a type of fish ladder designed with a series of sloped channels. The fishway can be constructed with an overall slope of 10 to 25 percent. Wooden baffles are placed at regular intervals, and are usually constructed with a 45 percent slope. A narrow entrance creates high water velocity to attract fish. Resting pools may be located between long segments of the fishway.

NMFS has considered the potential for shortnose sturgeon to use the Denil ladders that will be installed by GIPA. Limited information is available on the use of fish passage facilities by sturgeon generally. Ladders are installed at several hydroelectric facilities in the Northeast where shortnose sturgeon are known to occur, including the Brunswick Dam on the Androscoggin River, Maine, and Cabot Station on the Connecticut River, Massachusetts. Despite extensive monitoring programs at both facilities, no shortnose sturgeon have ever been documented using either ladder. The only documented occurrence of a shortnose sturgeon using a Denil ladder is at the Westfield River, a tributary to the Connecticut River, which hosts a substantially smaller population of shortnose sturgeon than the Hudson River. During the summer of 2007 a shortnose sturgeon was observed swimming near the base of the ladder. Approximately 48 hours later the fish was observed in the fish trap at the top of the ladder.

Limited information is available on the use of ladders by other species of sturgeon. White sturgeon occur in the western US and as adults are larger than shortnose sturgeon. Studies conducted by USGS at the Dalles Dam on the Columbia River indicate that white sturgeon, ranging in length from 37-105 inches, utilize two fish ladders present at this facility. For example, in 1995 fish counters at the dam noted 943 white sturgeon passing upstream in the east fish ladder and 104 in the north fish ladder. White sturgeon remained in the ladders for a time period ranging from 1 minute to 6 months. This study indicates that depending on the exact design and location of a fish ladder, use by sturgeon is possible. Sturgeon have also been documented to use the ladders at the Bonneville Dam on the Columbia River with some fish apparently overwintering within the ladders. In January 2011, 1700 sturgeon were removed from the ladders when they were dewatered for routine maintenance. United States Geological Survey (USGS) (Conte Lab) has also designed a spiral fish ladder that has been demonstrated to be able to be successfully navigated by shortnose sturgeon.

It is difficult to determine the likelihood that shortnose sturgeon would attempt to move upstream of the Troy Dam through the use of the new Denil ladders. Thousands of shortnose sturgeon are anticipated to spawn in the Hudson River each year, over a 33 kilometer-long area including the action area. Some of these sturgeon will be present near the dam, as evidenced by the incidental capture of shortnose sturgeon by recreational shad fishermen fishing near the dam. However, a similar situation is observed at the Brunswick Dam (Maine), where shortnose sturgeon are also known to spawn near the dam but have not been documented in the fish ladder. However, as evidenced by the instance at the Westfield River, which together with the Connecticut River host a substantially smaller shortnose sturgeon population than the Hudson, shortnose sturgeon are physically able to navigate Denil ladders. Evidence from USGS studies on the Columbia River and at the Conte Lab also indicate that sturgeon, including shortnose sturgeon, do navigate fish ladders. Based on this, over the 40 year license term, shortnose sturgeon may occasionally attempt to move upstream of the dam through the Denil ladder. As explained above, GIPA will implement a monitoring plan to monitor for shortnose sturgeon at the Denil ladders and will implement a handling plan to be approved by NMFS in the event that any shortnose sturgeon are observed within the ladder. Ultimately, these fish would be removed and placed back downstream of the ladder. While these fish may experience minor injuries such as abrasions due to contact with the concrete, no significant injuries or mortalities are anticipated. Given the occurrence of shortnose sturgeon entering and moving upstream in similar ladders in other rivers in the Northeast, albeit infrequently, it is likely that at least 1 shortnose sturgeon will occur in the Denil ladder over the 40 year license period. However, an upper limit on the number likely to enter the ladder can not be ascertained. Therefore, this Opinion anticipates 1 shortnose sturgeon is likely to enter the ladder over the license period. As explained above, GIPA will implement a monitoring program that will ensure that any shortnose sturgeon in the Denil ladders are identified and safely removed. As such, any shortnose sturgeon caught in the Denil will not be allowed to pass upstream of the project where they could be permanently trapped or subject to injury or mortality while attempting to pass downstream of the project. Further, as response and removal from the ladder is anticipated to occur within 24 hours, any delay in potential spawning will be temporary and not likely to result in the abandonment of spawning for that individual.

Other Effects of Project Operations

Effect on Suitable Spawning Habitat

Several studies of shortnose sturgeon spawning in the Hudson River have been made (see Pekovitch 1979, Dovel et al. 1992, Bain 1997 and 1998); however, none of these studies involved investigations in the tailrace. NMFS has used the best available information on known spawning conditions and the information provided by GIPA on conditions currently experienced in the tailrace and anticipated in the tailrace post construction to assess whether the proposed modifications to the facility and the operation of the facility will affect shortnose sturgeon in the action area.

A recent study in the Connecticut River (Kieffer and Kynard, in press) indicated that during spawning, the daily mean temperatures ranged from 6.5-14.7°C. This is similar to temperatures where spawning was recorded in the Hudson (10-17°C, Pekovitch 1979). As noted above, temperatures required for spawning are likely to be met in the Hudson River from mid-April through late May. The Kieffer and Kynard study also documented that females spawned in water depths of 3-16 feet with a peak at 5-6 feet. Bottom water velocity at the spawning site was a mean of 2.3 feet/second with the greatest usage of 2.5-4.1 feet/second. The only substrate type females used was cobble/rubble (4 – 12 inches diameter). However, in the Androscoggin River, shortnose sturgeon have been documented to spawn below the Brunswick Hydroelectric Project at depths of approximately 8 to 12 feet on a substrate of ledge, boulder and cobble interspersed with sand and gravel at a water velocity of approximately 5 feet/second (FERC 1997). In the Delaware River, shortnose sturgeon early life stages have been documented at water depths ranging from 1-7 feet and current velocities ranging from 2-5.6 feet/sec, over well flushed cobble substrates (ERC 2008).

Substrate in the tailrace area currently consists of bedrock, cobbles and coarse gravels. Water depth in the tailrace fluctuates with the tidal cycle but is within the range of depths where shortnose sturgeon spawning has been documented to occur. Spring flow is thought to be an important trigger for spawning. However, as the project will be operated in run of river mode, the facility will not alter the flow of water below the dam, and this potential trigger for spawning will not be affected by project operations. GIPA has examined the current velocities in the tailrace and compared these values to expected velocities post-construction as well as those values anticipated if there was no hydroelectric generation. As noted in this report, at the lower project boundary gross cross-sectional velocities are unchanged among existing with hydroelectric plant, existing without hydroelectric plant and proposed expanded plant operating conditions. These gross cross-sectional velocities range from 0.75 fps at mean August flows to over 3.5 fps during mean April flows. Both higher and lower gross cross-sectional velocities occur during flows above and below the mean monthly mean flows. When velocity conditions at specific distances below the dam are examined, minor differences are seen in comparing existing conditions to conditions anticipated following construction and operation of the modified facility; however, in all cases where velocities are currently within the range where spawning is known to take place, velocities remain in the suitable range.

Based on the analysis of conditions here, NMFS does not anticipate that the ability of shortnose sturgeon to spawn in the tailrace will be impacted by the operation of the modified facility, as suitable depths, velocities and temperatures will be maintained.

Other Effects of Hydroelectric Operations

Migratory patterns and strandings below the dam can be influenced by flow conditions. The License will require that the GIPA Project continue to be operated in a run-of-river mode where the project inflow will approximately equal the outflow into the tailrace. This should minimize the effect of hydroelectric generation on flow and water fluctuation patterns in the Hudson River. The hydropower projects located upstream of the Troy Dam on the Hudson River and its major tributaries effect the flows to the GIPA Project, so the flow conditions at the Project that could result in impeded migration will likely be influenced by conditions at the upstream hydropower facilities. Run-of-river operations at the proposed project will reduce, to the extent possible within this licensing action, flow fluctuations and elevated turbidity that could impact shortnose sturgeon downstream of the Project.

Stranding of Shortnose Sturgeon in Pools Below the Dam

In areas where water levels fluctuate rapidly there is the potential for fish to become stranded in pools. In these instances, when water levels are high fish have free access to areas that then become isolated as water levels fall. In addition to causing stress to fish that become stranded within these pools, this situation can also cause eggs or larvae to become exposed and dry out and die. Investigations have been made below the GIPA project and there is no evidence that this occurs below the dam. It is not anticipated that the potential for stranding will increase following project modifications, but GIPA has committed to conducting surveys once construction is complete to determine if conditions below the dam are changed in a way that increases the risk of isolated pools forming and therefore increases the risk of stranding of fish, including sturgeon. If it is determined that there is the potential for fish to become stranded in pools, GIPA will make operational changes to ensure that adequate flow is provided in these areas to continually allow a means of egress out of these pools, even in low flow conditions, and to ensure that no eggs or larvae potentially present in these pools potentially become exposed.

As there are not currently any pools or stranding that occurs and it is not anticipated that modifications to the facility will result in conditions that increase the risk of the presence of isolated pools or stranding, no shortnose sturgeon of any life stage are likely to become stranded as a result of project operations.

CUMULATIVE EFFECTS

Cumulative effects as defined in 50 CFR §402.02 includes the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they required separate consultation pursuant to section 7 of the ESA. Shortnose sturgeon in the action area are affected by factors occurring both within the action area (recreational fisheries, water quality) and outside of the action area in other regions of the Hudson River that have effects in the action area (water quality, in-water construction and associated impacts, dredging, fisheries, and interactions with power plant intakes).

Shortnose sturgeon are protected from directed fisheries, but in the action area they have been captured incidentally in recreational fisheries targeting American shad. While directed assessments of the amount of bycatch of shortnose sturgeon in fisheries in the Hudson River have not been undertaken, numerous anecdotal reports to the State of New York and on fishing forums indicate that snagging of shortnose sturgeon by anglers fishing for shad in the action area in the spring is common. While it is expected that most of these fish are released alive, it is unknown what impact this capture has on spawning success. In March 2010, the State of New York shut down the shad fishery on the Hudson River. It is unknown when the fishery will reopen, but it is expected that if it does shortnose sturgeon will continue to be exposed to fishing effort in the action area and incidental capture of shortnose sturgeon will occur.

Shortnose sturgeon continue to be negatively impacted by the presence of contaminants in the Hudson River. PCB contamination in the Hudson River has been linked to increased incidences of fin rot in shortnose sturgeon. The USEPA has designated the Hudson River as a Superfund Site from Hudson Falls to the Battery in New York City, which includes an approximately 200-mile stretch of the river, including the action area. While the substrate in the action area is not known to be contaminated with PCBs and the action area is not currently involved in Superfund remediation activities, shortnose sturgeon in the action area are likely impacted by exposure to PCBs and other contaminants in other regions of the river.

In the future, *global climate change* is expected to continue and may impact shortnose sturgeon and their habitat in the action area. However, as noted in the “Status of the Species” and “Environmental Baseline” sections above, given the likely rate of change associated with climate impacts (i.e., the century scale), it is unlikely that climate related impacts will have a significant effect on the status of shortnose sturgeon over the temporal scale of the proposed action (i.e., through the 40 year license period) or that in this time period, the abundance, distribution, or behavior of these species in the action area will change as a result of climate change related impacts.

Despite the threats faced by shortnose sturgeon in the Hudson River, including the continued presence of the Troy Dam (since 1913) and the operation of a hydroelectric facility at this location since the dam was built, shortnose sturgeon have experienced a dramatic increase in population size, possibly as large as 400%, between the 1970s and 1990s. The best available information indicates that the Hudson River population of shortnose sturgeon in the largest in the range of the species and that has stabilized at a high level, with sufficient numbers of adults and levels of recruitment to maintain the population despite losses resulting from anthropogenic impacts. The last comprehensive study of the status of shortnose sturgeon in this river (Bain 1997) indicates that the population is stable and has characteristics of a large, stable, long-lived population.

INTEGRATION AND SYNTHESIS OF EFFECTS

In the discussion below, NMFS considers whether the effects of the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery in the wild of any of the listed species considered in this Opinion by reducing the reproduction, numbers, or distribution of the species. The purpose of this analysis is to determine whether the proposed action would jeopardize the continued existence of the species. In the NMFS/USFWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as, "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter." Recovery is defined as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." Below, for each of the listed species that may be affected by the proposed action, NMFS summarizes the status of the species and considers whether the proposed action will result in reductions in reproduction, numbers or distribution of that species and then considers whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of that species.

The Hudson River population of shortnose sturgeon is the largest in the United States. Historical estimates of the size of the population are not available as historic records of sturgeon in the river did not discriminate between Atlantic and shortnose sturgeon. Population estimates made by Dovel et al. (1992) based on studies from 1975-1980 indicated a population of 13,844 adults. Bain et al. (1998) studied shortnose sturgeon in the river from 1993-1997 and calculated an adult population size of 56,708 with a 95% confidence interval ranging from 50,862 to 64,072 adults. Bain determined that based on sampling effort and methodology his estimate is directly comparable to the population estimate made by Dovel et al. Bain concludes that the population of shortnose sturgeon in the Hudson River in the 1990s was 4 times larger than in the late 1970s. Bain states that as his estimate is directly comparable to the estimate made by Dovel, this increase is a "confident measure of the change in population size." Bain concludes that the Hudson River population is large, healthy and particular in habitat use and migratory behavior. Woodland and Secor (2007) conducted studies to determine the cause of the increase in population size. Woodland and Secor captured 554 shortnose sturgeon in the Hudson River and made age estimates of these fish. They then hindcast year class strengths and corrected for gear selectivity and cumulative mortality. The results of this study indicated that there was a period of high recruitment (31,000 – 52,000 yearlings) in the period 1986-1992 which was preceded and succeded by 5 years of lower recruitment (6,000 – 17,500 yearlings/year). Woodland and Secor reports that there was a 10 fold recruitment variability over the 20 year period from the late

1970s to late 1990s and that this pattern is expected in a species such as shortnose sturgeon with periodic life history characterized by delayed maturation, high fecundity and iteroparous spawning, as well as variability in interannual hydrological conditions. Woodland and Secor examined environmental conditions throughout this 20 year period and determined that years where water temperatures drop quickly in the fall and flow increases rapidly in the fall (particularly October), are followed by high levels of recruitment in the spring. This suggests that these environmental factors may index a suite of environmental cues that initiate the final stages of gonadal development in spawning adults.

The Hudson River population of shortnose sturgeon has exhibited tremendous growth in the 20 year period between the late 1970s and late 1990s. Woodland and Secor conclude that this is a robust population with no gaps in age structure. Lower recruitment that followed the 1986-1992 period is coincident with record high abundance suggesting that the population may be reaching carrying capacity. The population in the Hudson River exhibits substantial recruitment and is considered to be stable at high levels.

While no reliable estimate of the size of either the shortnose sturgeon population in the Northeastern U.S. or of the species throughout its range exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed. Based on the number of adults in populations for which estimates are available, there are at least 104,662 adult shortnose sturgeon, including 18,000 in the Saint John River in Canada. Based on the best available information, NMFS believes that the status of shortnose sturgeon throughout their range is at best stable, with gains in populations such as the Hudson, Delaware and Kennebec offsetting the continued decline of southern river populations, and at worst declining. As described in the Status of the Species, Environmental Baseline, and Cumulative Effects sections above, shortnose sturgeon in the Hudson River are affected by habitat alteration, bycatch in commercial and recreational fisheries, water quality, power plant entrainment, and in-water construction activities. Despite these ongoing threats, numbers of shortnose sturgeon in the action area are considered stable at high levels and this trend is expected to continue over the duration of the proposed action (i.e., through the 40 year license period).

NMFS has determined that the proposed action will effect shortnose sturgeon by resulting in a temporary loss of spawning habitat where the cofferdams will be present; a permanent loss of spawning habitat in the area where the concrete slabs will be installed below the dam; and, by resulting in the capture of 1 shortnose sturgeon in the Denil ladders over the license period. As the only in-water work to occur at the time of year when shortnose sturgeon will be present in the action area will occur within water tight cofferdams, no shortnose sturgeon will be exposed to effects of construction. Adult shortnose sturgeon in the action area during the three springs when construction will take place will be precluded from the areas within the cofferdams. However, any effects will be limited to minor and temporary adjustments in movements. Due to the small footprint of the cofferdams and the small percentage of the available spawning habitat compared to the entirety of the spawning range (0.3%), any changes in normal behavior is not expected to result in a reduction in the fitness of any individual spawning adult, any reduction in the number of eggs spawned or in the successful development of those eggs and larvae.

Additionally, following the construction, the placement of the concrete pads will represent a conversion from the natural substrate (rocks, cobbles or bedrock) to smooth concrete where spawning is not likely to occur. However, given the extremely small area where the concrete pads will be placed, any additional expenditures in energy required to search out suitable substrate for spawning is expected to be negligible and is not expected to result in a reduction in the fitness of any individual spawning adult or any reduction in the number of eggs spawned or in the successful development of those eggs and larvae.

The action is also likely to result in the capture of 1 shortnose sturgeon in the Denil ladders over the license period. GIPA will adhere to a monitoring plan and handling plan to ensure that any shortnose sturgeon captured in the Denil ladders are removed within 24 hours and returned safely downstream. It is possible that some captured shortnose sturgeon could experience minor injuries, such as abrasions, due to contact with the concrete surface of the ladder. Shortnose sturgeon captured in the ladder will be temporarily delayed from carrying out spawning activities. However, given that monitoring will be continuous during the spawning season the amount of time that any shortnose sturgeon would spend in the ladders is short and certainly less than 24 hours. As such, it is extremely unlikely that the fish would miss a spawning opportunity. Similarly, it is unlikely that the temporary capture in the Denil ladder and subsequent removal and placement back downstream of the ladder would cause an individual shortnose sturgeon to abandon their spawning attempt. Considering this analysis, the capture of an individual shortnose sturgeon in the Denil ladder is not likely to result in any injury or mortality or affect the fitness of any individuals, or cause any reduction in the number of eggs spawned or in the successful development of those eggs and larvae.

The proposed action continued is not likely to reduce reproduction of shortnose sturgeon in the action area because: (1) there will be no reduction in the number of spawning adults; (2) there will be no reduction in fitness of spawning adults; (3) the temporary loss of spawning habitat during the construction period will be small and represents an extremely small percentage of available spawning habitat in the Hudson River; (4) the permanent conversion of 0.39 acres of natural substrate to concrete represents a loss of an extremely small percentage of spawning habitat in the Hudson River; (5) there is not anticipated to be any reduction in the number of eggs spawned or the fitness of any eggs or larvae; (6) the modifications in project operations will not change the velocities experienced in the action area; (7) the project will continue to operate in run of river mode thus there is no potential for pulsed flows which could disrupt spawning or rearing; and, (8) modifications in the tailrace will not change conditions in a way that will prevent shortnose sturgeon from spawning at this location or change the likelihood of successful spawning in this area.

The action is also not likely to reduce the numbers of shortnose sturgeon in the action area as there will be no mortality of any individuals and no reason shortnose sturgeon would abandon the action area during the spawning season. The distribution of shortnose sturgeon within the action area will be affected by the action; however, any changes in distribution are limited to being precluded from the small areas contained within the cofferdams. This change in distribution will be insignificant and will not affect the ability of individuals to successfully spawn of the ability of any eggs or larvae to develop and recruit to the population.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival for shortnose sturgeon in the wild (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect shortnose sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent shortnose sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the action will not result in the mortality of any shortnose sturgeon (2) as the action will not result in the mortality of any individuals, the action is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the temporary adverse effects to individuals captured in the Denil ladders will not affect the reproductive output of any individual or the species as a whole; (5) the action will have only minor effects on the distribution of shortnose sturgeon in the action area and no effects on the distribution of shortnose sturgeon beyond the action area (i.e., throughout its range); (6) the action will not affect the reproductive fitness of any individual spawning adult or result in any reductions in the number of eggs spawned or the successful development of any eggs or larvae; (7) the temporary and permanent losses of spawning habitat are extremely small and represent an extremely small percentage of the available spawning habitat; (8) the operations of the project will not affect the ability of shortnose sturgeon to successfully spawn or for eggs and larvae to successfully develop and, (9) the action will have no effect on the ability of shortnose sturgeon to shelter or forage.

In certain instances an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, NMFS has determined that the proposed action will not appreciably reduce the likelihood that shortnose sturgeon will survive in the wild. Here, NMFS considers the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate.

Section 4(a)(1) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (i.e., “endangered”), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (i.e., “threatened”) because of any of the following five listing factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, (5) other natural or manmade factors affecting its continued existence.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will not result in any reductions in the number of shortnose sturgeon in the action area and since it will not affect the overall distribution of shortnose sturgeon other than to cause temporary changes in movements throughout the action area. The proposed action will not utilize shortnose sturgeon for recreational, scientific or commercial purposes, affect the adequacy of existing regulatory mechanisms to protect this species, or affect their continued existence. The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the action will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. Therefore, the proposed action will not appreciably reduce the likelihood that shortnose sturgeon can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual shortnose sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual shortnose sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. While NMFS is not able to predict with precision how climate change will impact shortnose sturgeon in the action area or how the species will adapt to climate change-related environmental impacts, no additional effects related to climate change to shortnose sturgeon in the action area are anticipated over the life of the proposed action (i.e., through the 40 year license period). NMFS has considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and has concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change.

CONCLUSION

After reviewing the current status of the Hudson River population of shortnose sturgeon, the environmental baseline for the action area, the effects of the proposed action, including interdependent and interrelated actions and the cumulative effects, it is NMFS' biological opinion that as the action, is not likely to reduce the reproduction, numbers, and distribution of the Hudson River shortnose sturgeon population, it is not likely to jeopardize the continued existence of the Hudson River population of shortnose sturgeon or the species as a whole. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations prohibit the take of endangered and threatened species without special exemption. “Take” is defined in Section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is further defined by NMFS to include “any act, which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering” (50 CFR 222.102). The term “harass” has not been defined by NMFS; however, it is commonly understood to mean to annoy or bother. “Incidental take” is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 CFR 402.02). Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary, and must be undertaken by FERC so that they become binding conditions of the license issued to GIPA for the exemption in section 7(o)(2) to apply. If FERC (1) fails to assume and implement the terms and conditions or (2) fails to require GIPA to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the license, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of the incidental take, FERC must report the progress of the action and its impact on the species to NMFS as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)].

Amount or Extent of Incidental Take

The proposed action has the potential to directly affect shortnose sturgeon by resulting in the capture of 1 shortnose sturgeon at GIPA's upstream fish passage facility over the 40 year license period. This capture could occur in either of the two Denil ladders. This individual will be removed from the ladder and returned downstream. Any captured fish may suffer minor injuries due to abrasions on the ladder. This fish will also be temporarily delayed in carrying out spawning activities while in the Denil ladder. Over the 40 year term of the license, the capture of 1 shortnose sturgeon is likely. No mortality nor injuries other than minor injuries of any shortnose sturgeon is anticipated or exempted.

NMFS believes this level of incidental take is a reasonable estimate of incidental take that will occur given the seasonal distribution and abundance of shortnose sturgeon in the action area and the reports of shortnose sturgeon ascending Denil ladders in other rivers. In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species. NMFS considers this incidental take level to be exceeded if more than 1 shortnose sturgeon is captured at the Project (in either of the two Denil ladders) over the 40 year license period.

Reasonable and prudent measures

NMFS believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize and monitor incidental take of shortnose sturgeon:

1. The Denil ladders must be monitored for shortnose sturgeon for the full term of the license.
2. Shortnose sturgeon must be collected and handled appropriately if present in the Denil ladder.
3. Any interactions or observations of shortnose sturgeon must be promptly reported to NMFS.

Terms and conditions

In order to be exempt from prohibitions of section 9 of the ESA, FERC must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To implement RPM #1, FERC must require the licensee to comply with a shortnose sturgeon monitoring plan consistent with the requirements outlined in Appendix A and any amendments to it, for the duration of the license period.
2. To implement RPM #2, FERC must require the licensee to comply with the shortnose sturgeon handling plan (Appendix B), and any amendments to it.

3. To implement RPM #3, FERC must require the licensee and the licensee must report any interactions with shortnose sturgeon, including shortnose sturgeon observed in the Denil ladders within 24 hours. Until alerted otherwise, the NMFS contact is Julie Crocker: by email (julie.crocker@noaa.gov) or phone (978) 282-8480 or the Section 7 Coordinator by phone (978)281-9328 or fax (978-281-9394).

4. To implement RPM #3, FERC must require the licensee and the licensee must, by December 31 of each year, submit a report to NMFS on any interactions with or observations of shortnose sturgeon at the GIPA Project, including the numbers of identified sturgeon captured in the Denil ladder and information on other shortnose sturgeon observed at the Project.

5. To implement RPM #3, FERC must require the licensee to, and the licensee must document all observations of shortnose sturgeon on the form included as Appendix B. This form must be submitted to NMFS within 48 hours. This form will be submitted to NMFS via email (Julie.Crocker@noaa.gov) or fax (978-281-9394).

6. To implement RPM #3, should the level of incidental take be exceeded, FERC must immediately provide an explanation and evaluation of the possible causes of the taking and review with NMFS the need for possible modification of the reasonable and prudent measures.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, reinitiation of consultation and/or other action may be necessary.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will ensure that any shortnose sturgeon captured within the Denil ladders are promptly removed and will keep NMFS informed of when and where any interactions occur.

RPM#1 and 2 and Terms and Conditions #1 and 2 are necessary and appropriate to monitor the Denil ladders for the presence of shortnose sturgeon and to ensure the proper handling of any shortnose sturgeon removed from the ladders. This is essential for minimizing the potential for injury or delay in spawning and to monitor the level of incidental take associated with the proposed action. These RPMs and the Terms and Conditions represent only a minor change as compliance will not result in any delay of the project or decrease in the efficiency of the project. Any costs associated with these measures are anticipated to be small.

RPM #3 and Terms and Conditions #3-6 are necessary and appropriate to ensure the proper documentation of any interactions with listed species as well as requiring that these interactions are reported to NMFS in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. Term and Condition #6 is necessary and appropriate to ensure that any appropriate measures will be taken should the amount of exempted take be exceeded. This RPM and the Terms and Conditions represent only a minor change as compliance will not result in any delay of the project or decrease in the efficiency of the project. Any costs associated with these measures are anticipated to be small.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS recommends that FERC implement the following conservation measures.

1. FERC and/or the licensee should support future research to update abundance, age structure, sex ratio, and recruitment information for the Hudson River shortnose sturgeon population.
2. If any lethal take occurs, FERC and/or the licensee should arrange for contaminant analysis of the specimen. If this recommendation is to be implemented, the fish should be frozen and NMFS should be contacted immediately to provide instructions on shipping and preparation.
3. FERC should encourage GIPA to install telemetry receivers at the site to monitor for the presence of tagged shortnose sturgeon. This work should be coordinated with NY DEC.

REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed issuance of a new license to the GIPA by FERC for GIPA's Green Island Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the Incidental Take Statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this biological Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. If the amount or extent of incidental take is exceeded, FERC must reinitiate consultation immediately.

The conclusion of this Biological Opinion was based on the information available at the time of consultation. The conclusions of this consultation are based on the assumption that FERC will adopt the final Settlement Agreement as is and that the renewed License for the GIPA Project will include the license articles as proposed in the Settlement Agreement. Should the License that is ultimately issued by FERC differ from the intent of the Settlement Agreement, this would constitute a modification of the identified action and FERC would need to reinitiate consultation promptly.

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APPENDIX A

SHORTNOSE STURGEON MONITORING PLAN

Per the Settlement Agreement, GIPA will implement a Fishery Facilities Operation and Maintenance Plan (FFOMP). The FFOMP will be designed to detect any shortnose sturgeon that enter the Denil ladder, remove the fish in a timely manner, and return them safely downstream without causing injury or delay to spawning or other essential behaviors. In addition to the FFOMP, the following measures must be implemented by GIPA as the Shortnose Sturgeon Monitoring Plan:

1. For the first five years of operations of the Denil ladders, the Denil ladders must be monitored in person during the time of year when water temperatures downstream of the Dam are between 8°C and 18°C (typically early April – late June).
2. In-person monitoring must be sufficient to detect any shortnose sturgeon that enter the ladders before they have the opportunity to ascend to the top of the ladder and leave the ladder at the upstream end and sufficient to remove those fish within 24 hours. A monitoring schedule must be developed by GIPA and be reviewed and approved by NMFS prior to implementation.
3. Personnel monitoring the ladders must be trained in identification and handling of shortnose sturgeon as well as trained in the measures required by the Shortnose Sturgeon Handling Plan to ensure that any captured sturgeon are placed safely downstream of the project within 24 hours of entering the ladder.
4. The Denil ladders must be monitored by video. This video must be reviewed by personnel on a schedule agreed to by NMFS.
5. GIPA must conduct an assessment of the ability of the video monitoring to adequately monitor for the presence of shortnose sturgeon in the ladders. The results of this assessment must be shared with NMFS by December 31 of the fifth year of operation of the Denil ladders.
6. Prior to March 1 of the sixth year that the Denil ladders will be operational, GIPA and NMFS must meet to determine if in-person monitoring of the Denil ladders must continue during the spring shortnose sturgeon season (typically early April – late June), or whether video monitoring, with both review and response by personnel to shortnose sturgeon capture, may be substituted in future years. NMFS anticipates that this decision will be based on the following: (1) number of shortnose sturgeon detected at the Denil ladders in the first five years of operation; (2) condition of shortnose sturgeon captured in the Denil ladders; and (3) results of the assessment of the video monitoring system.
7. If it is determined that in-person monitoring must be continued, GIPA must continue to have personnel monitor the Denil ladders during the time of year when water temperatures downstream of the Dam are between 8°C and 18°C (typically early April – late June). This in-person monitoring must be sufficient to detect any shortnose sturgeon that enter the ladders before they have the opportunity to ascend to the top of the ladder and leave the ladder at the upstream end and sufficient to remove the fish from the ladder within 24 hours and return it safely downstream.

8. If it is determined that video monitoring, with both review and response by personnel is sufficient for the duration of the project license, GIPA must develop a procedure for NMFS review and approval that would allow for detection of any shortnose sturgeon ascending the ladder prior to the fish having the opportunity to leave the ladder at the upstream end and sufficient to remove those fish from the ladder within 24 hours and return it safely downstream.
9. Any shortnose sturgeon detected during monitoring must be responded to and handled consistent with the terms of the Shortnose Sturgeon Handling Plan.
10. A meeting or conference call must be held between GIPA and NMFS prior to March 1 of each year to discuss whether any updates to the shortnose sturgeon monitoring plan are necessary. If NMFS determines updates or modifications are necessary, GIPA must implement all changes by April 1 of that year. This meeting will also be used to discuss and evaluate monitoring results to determine if any procedural modifications or updates to contact information are needed.

APPENDIX B

Green Island Hydroelectric Project
Shortnose Sturgeon Handling Plan

PROCEDURES WHEN SHORTNOSE STURGEON ARE DETECTED IN THE DENIL LADDERS

1. For each shortnose sturgeon detected at the Denil ladder, the weight, length, and condition of the fish will be recorded. All fish will be checked for the presence of external identification tags. If a PIT tag reader is available onsite, all fish will also be checked for the presence of internal PIT tags. River flow and water temperature will be recorded. All relevant information will be recorded on the reporting sheet entitled Shortnose Sturgeon Report Form for the Green Island Hydroelectric Project, a copy of which is attached hereto.

2. The contact procedure outlined below will be followed.

3. If alive and uninjured, the shortnose sturgeon will be immediately returned downstream. A long handled net will be used to place the shortnose sturgeon back into the river downstream of the dam.

4. If any injured shortnose sturgeon are found, the occurrence will immediately be reported to NMFS in accordance with the contact information provided below and as it may subsequently be updated. Injured fish must be photographed and measured, if possible, and the reporting sheet must be submitted to NMFS within 24 hours. If the fish is badly injured, the fish should be retained at the project site, if possible, until obtained by a facility recommended by NMFS for potential rehabilitation.

5. If any dead shortnose sturgeon are found, the occurrence will immediately be reported to NMFS in accordance with the contact information provided below and as it may subsequently be updated. Any dead specimens or body parts should be photographed, measured and preserved at the project site until they can be obtained by NMFS for analysis.

CONTACT INFORMATION

- If any shortnose sturgeon are detected contact NMFS: Julie Crocker at NMFS Protected Resources Division (978-281-9328) and fax or email any reporting sheets to 978-281-9394 or julie.crocker@noaa.gov

- Within 24 hours of any stranding event or contact with an injured or dead shortnose sturgeon contact NMFS: Julie Crocker at NMFS Protected Resources Division (978-281-9328) and fax or email any reporting sheets to 978-281-9394 or julie.crocker@noaa.gov.

SUBMITTAL OF REPORT FORMS AND ANNUAL REVIEW

By December 31 of each year, and in conjunction with the reporting requirements stipulated in the Settlement Agreement, copies of all shortnose sturgeon report forms must be provided to NMFS. A meeting or conference call must be held between GIPA and NMFS prior to March 1 of the following year to discuss whether any updates to the shortnose sturgeon handling plan are necessary. If NMFS determines updates or modifications are necessary, GIPA must implement all changes by April 1 of that year. This meeting will also be used to discuss and evaluate monitoring results to determine if any procedural modifications or updates to contact information are needed.

Green Island Hydroelectric Project
Shortnose Sturgeon Report Form

Date: ______________________________ Time: ______________________________

Is flow being released over the dam? ____

What is the approximate river flow? ____

What is the approximate flow in the bypass reach? ________________________________

Water temperature: ____

Are the upstream fish passage facilities operating? ________________________________

Is the project generating? ____

If yes, which units are currently operating? ______________________________________

____

Where was the species recovered? (circle one)	West Denil	East Denil	Bypass Reach
If from the Denils, estimate condition. (circle one)	Empty	Partially Full	Very Full

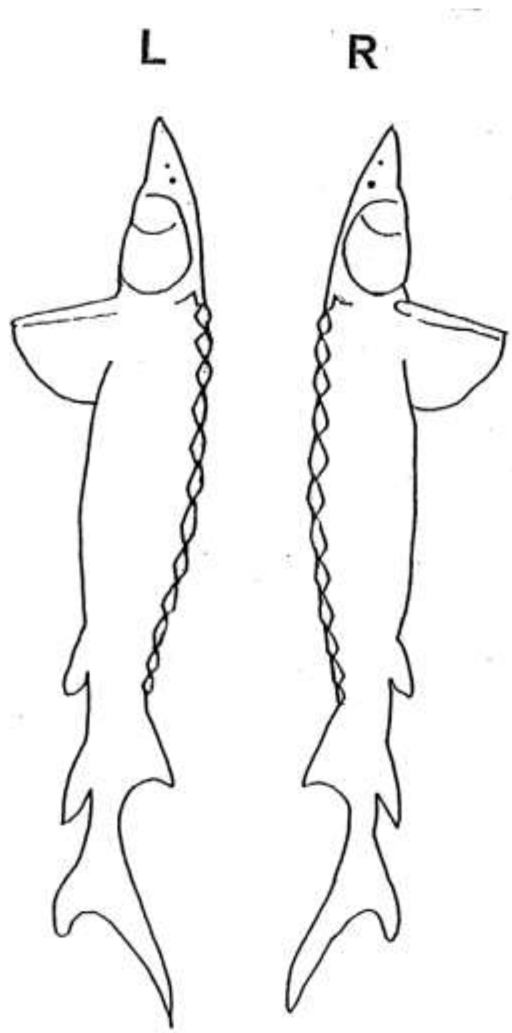
Photographs sent to NMFS? Mail _______ E-mail ______

FISH INFORMATION

Length (in): ________________________ Weight (lb, oz): ______________________

External tag: ________________________ PIT tag: ____________________________

Condition of fish? ____



Abrasions/Injuries: ____

Abrasion Codes:

Light:	Whitening or smoothed scutes. Early signs of skin abrasion.
Moderate:	Early signs of redness on skin, scutes, or fins. Erosion of skin over boney structures. Loss of skin pigment.
Heavy:	Large portion of skin red. Scutes excessively worn, damaged, or missing, Patches of skin missing. Boney structures exposed. Flaccid musculature.

Comments: ____

____

____

Name of Observer: ____

Signature of Observer: ____

Figure 1

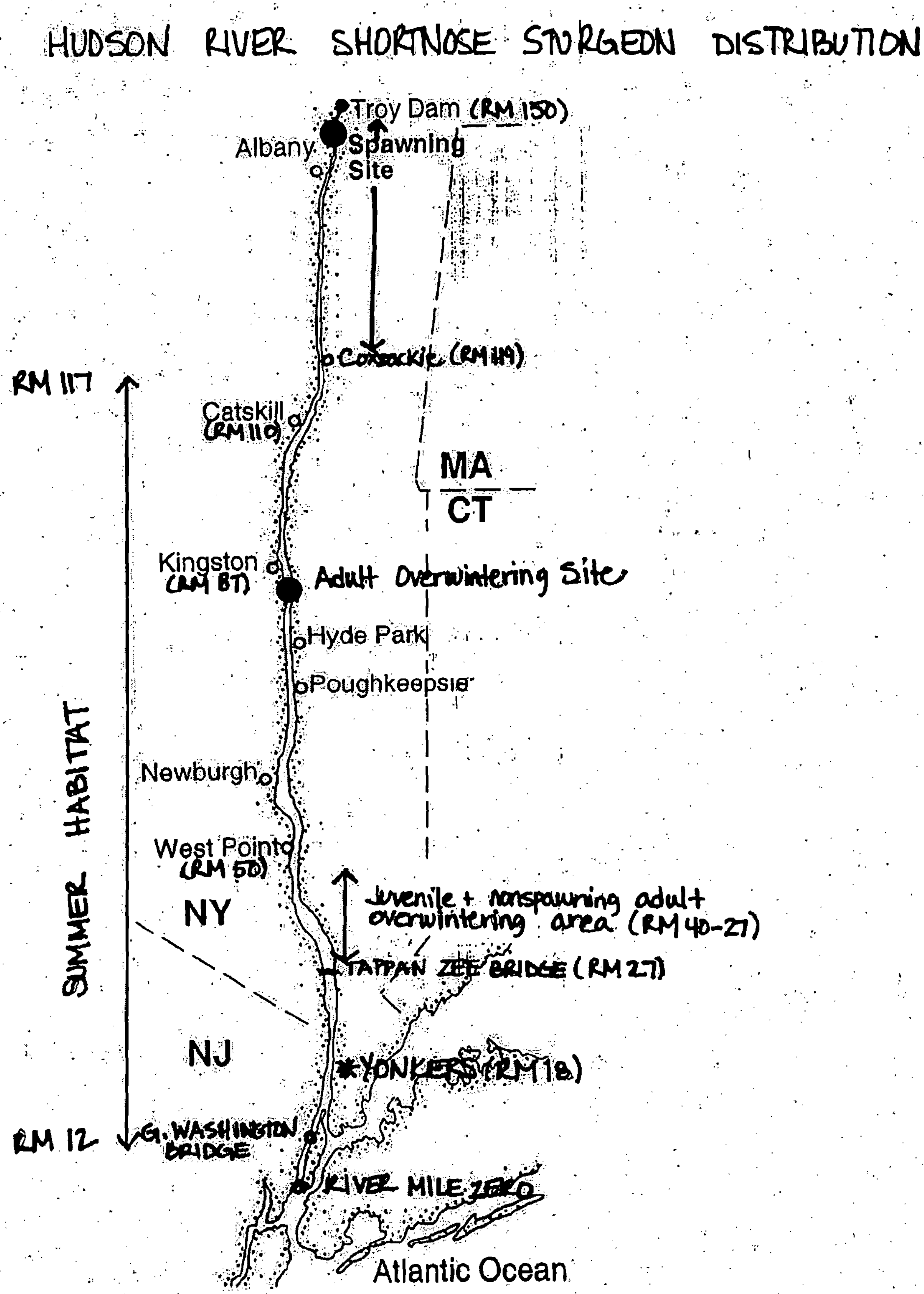

HUDSON RIVER SHORTNOSE STURGEON DISTRIBUTION
Troy Dam (RM 150)
Albany
Spawning Site
Coxsackie (RM 119)
RM 117
Catskill (RM 110)
MA
CT
Kingston (RM 87)
Adult Overwintering Site
Hyde Park
Poughkeepsie
Newburgh
West Point (RM 50)
SUMMER HABITAT
NY
Juvenile + nonspawning adult overwintering area (RM 40-27)
TAPPAN ZEE BRIDGE (RM 27)
NJ
YONKERS (RM 18)
RM 12
G. WASHINGTON BRIDGE
RIVER MILE ZERO
Atlantic Ocean

Figure 2

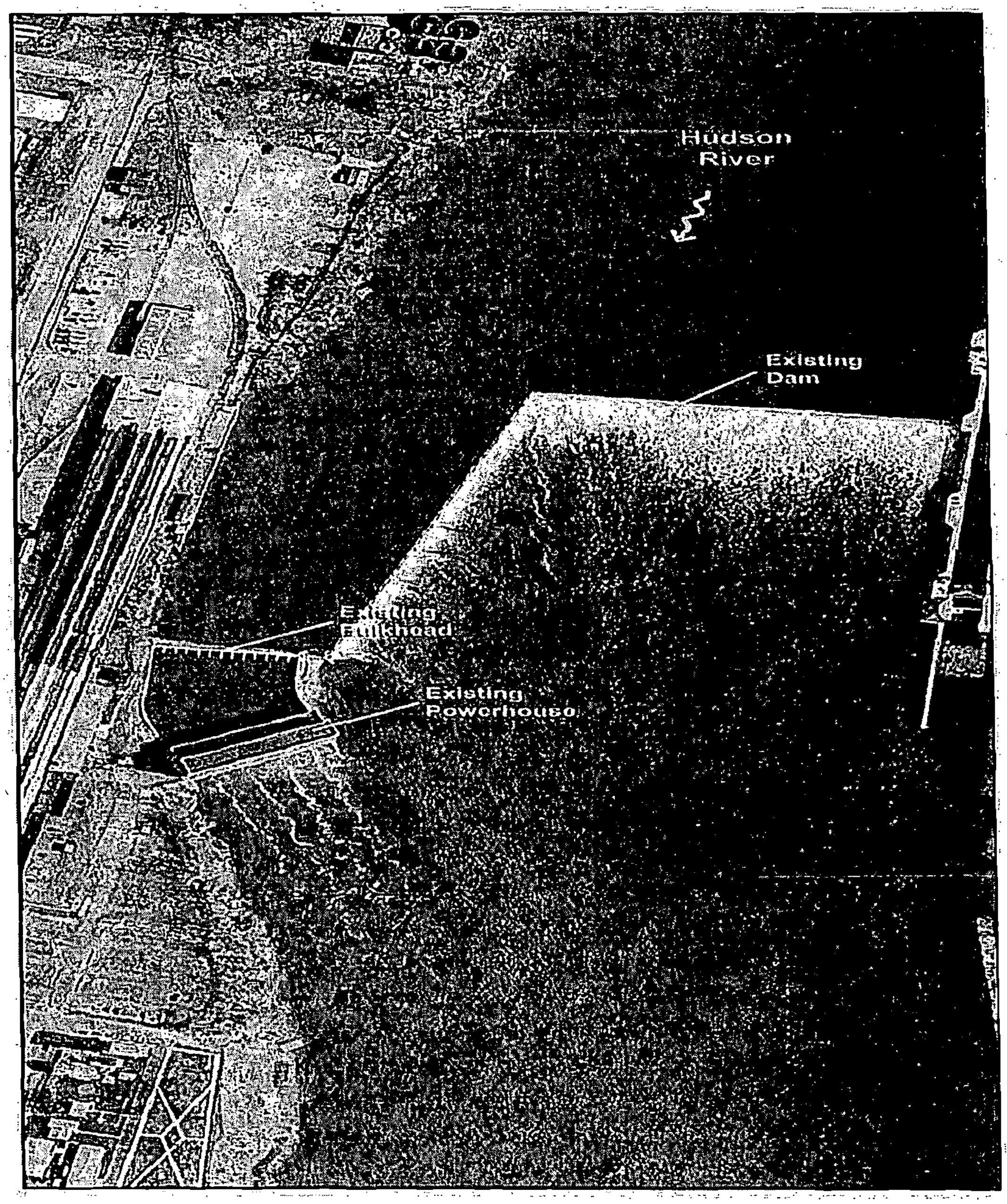


Figure 2. Existing Green Island Project. (Source: GIPA, as modified by Staff)

Figure 3

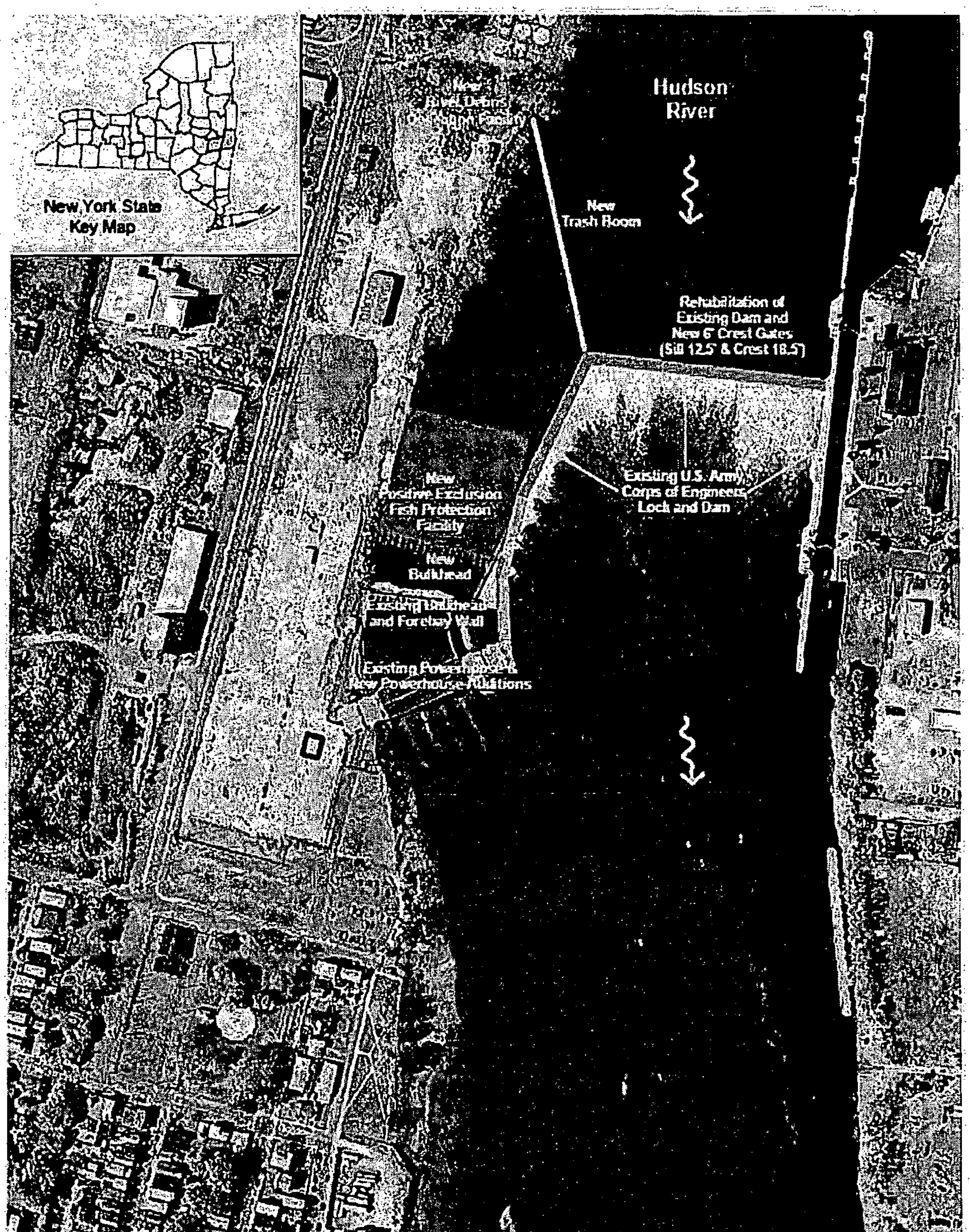


Figure 3. Proposed Green Island Project. (Source: GIPA, as modified by Staff)

Figure 4 – 2 pages of drawings

Sheet C-02 from Appendix F of License Application – Labeled as CEII

Figure 4 Continued

Sheet C-03 from Appendix F of License Application – Labeled as CEII