ATTACHMENT 6
ATLANTIC SALMON DRAFT
BIOLOGICAL ASSESSMENT &
SPECIES PROTECTION PLAN
SEPTEMBER 28, 2018

Brookfield

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September 28, 2018

VIA E-FILING

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N. E.
Washington, DC 20426

Ellsworth Hydroelectric Project FERC No. 2727-086
Atlantic Salmon Draft Biological Assessment and Species Protection Plan

Dear Secretary Bose:

Black Bear Hydro Partners, LLC (Black Bear), licensee for the Ellsworth Hydroelectric Project (Project), filed an Application for New License (Application) for the Project on December 30, 2015. The Application detailed the plan and timeline for conducting several continuing studies necessary to inform the Commission's license decision. Licensee had also planned to file a revised Draft Biological Assessment (BA) and proposed Species Protection Plan (SPP) for Atlantic salmon following review of the study results and further consultation with the agencies. Enclosed is the Licensee's Draft BA and proposed SPP for the Ellsworth Project.

The Draft BA considers the various studies and fish passage measures that have been undertaken by the Licensee since the Application was filed with FERC in 2015 (BA Section 5), and assesses the effects of those measures and the measures proposed in the SPP (BA Section 6). The proposed SPP is primarily focused on Atlantic salmon, but also considers the needs of other anadromous fish species in the Union River.

Development of the proposed SPP, and the measures included therein, was done in close consultation with the fisheries resource agencies, including both the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) through a series of meetings that were held between June 2017 and July 2018. The July 27, 2018 Draft BA and proposed SPP have been reviewed by the agencies; NMFS provided comments on the Draft BA and those comments have been addressed as appropriate in the attached.

The Licensee proposes to implement the SPP and the fish passage measures contained therein at the Ellsworth Project, and requests that the Commission consider the SPP and the SPP measures as a relicensing proposal for evaluation in the Environmental Assessment currently being prepared by Commission staff.

If you have any questions regarding this filing, please contact me by phone at (207) 755-5603 or by email at Frank.Dunlap@BrookfieldRenewable.com.

Sincerely,

Frank H. Dunlap
Licensing Specialist
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Encl.: Ellsworth Project Draft Biological Assessment and Proposed Species Protection Plan

cc: Distribution List
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CERTIFICATE OF SERVICE
Ellsworth Hydroelectric Project (FERC No. 2727)
Atlantic Salmon Draft Biological Assessment and Species Protection Plan

I, Frank H. Dunlap, Licensing Specialist, Brookfield Renewable, hereby certify that a link to the foregoing document on the Commission website has been transmitted to the following parties on September 28, 2018.

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ELLSWORTH PROJECT
FERC NO. 2727

DRAFT BIOLOGICAL ASSESSMENT
FOR
ATLANTIC SALMON, ATLANTIC STURGEON, AND SHORTNOSE STURGEON

Black Bear Hydro Partners, LLC
Milford, Maine

HDR

September 2018

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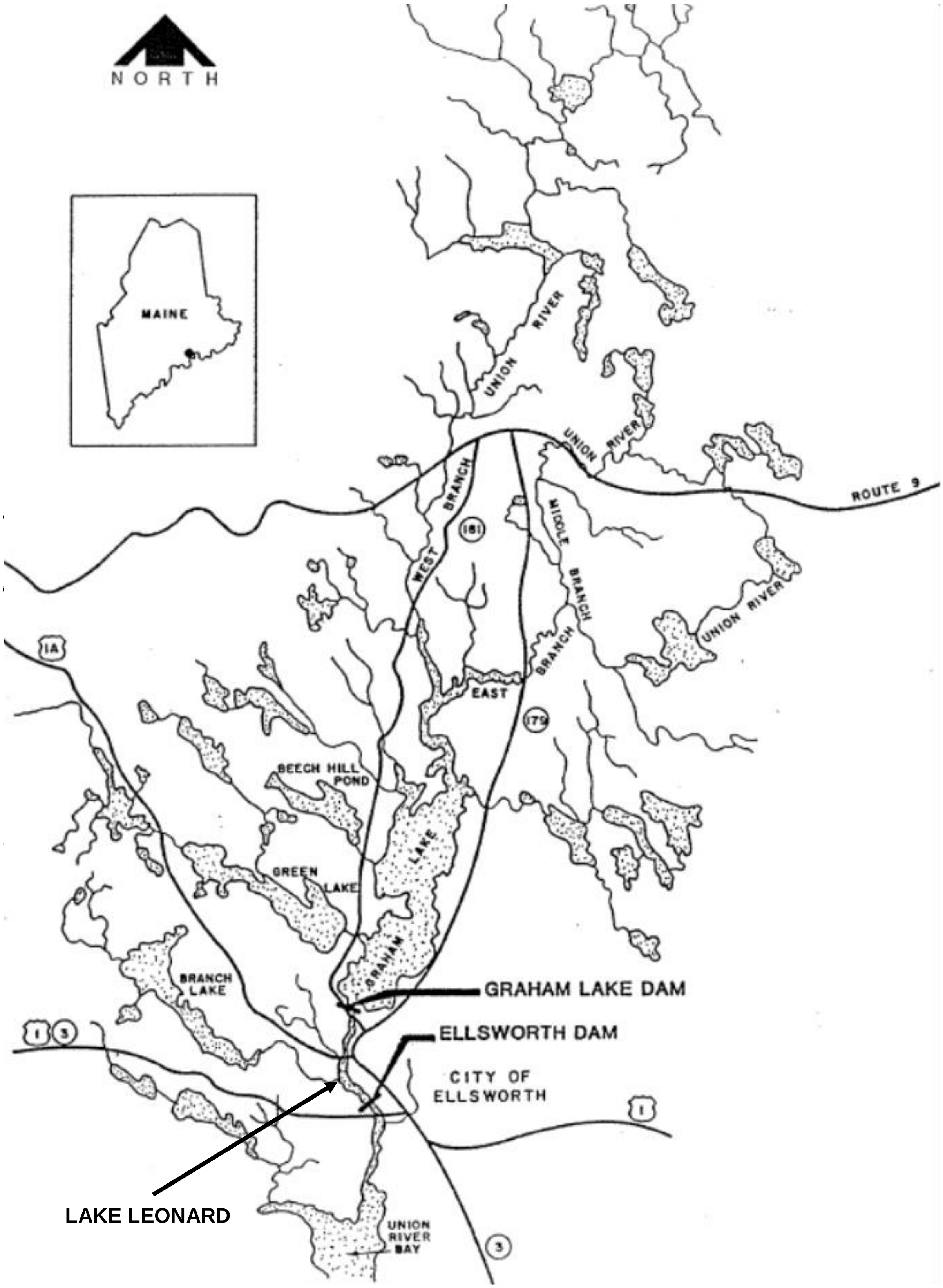
1.0 Background

Black Bear Hydro Partners, LLC (Black Bear) is in the process of relicensing the Ellsworth Project (FERC No. 2727), an 8.9 megawatt (MW) hydroelectric facility located on the Union River in the City of Ellsworth, Hancock County, Maine. Black Bear submitted an application for a new license to the Federal Energy Regulatory Commission (FERC) on December 30, 2015, and FERC is currently reviewing the application and developing an Environmental Assessment (EA). FERC's issuance of a new license for the Ellsworth Project is a federal action and, therefore, requires consultation under Section 7 of the Endangered Species Act (ESA) to assess the potential effects of the action on federally protected species and determine whether incidental take is expected to occur. A federal agency may designate a non-federal representative to conduct informal consultation or prepare a biological assessment to assess the effects of a proposed federal action on listed species. On September 14, 2011, FERC designated Black Bear as its non-federal representative for ESA consultation for the relicensing of the Ellsworth Project.

Consistent with its designation as FERC's non-federal representative for ESA consultation for the relicensing of the Ellsworth Project, Black Bear developed a draft Biological Assessment (BA) for the federally endangered Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic salmon, along with shortnose sturgeon and the federally threatened GOM DPS of Atlantic sturgeon, at the Ellsworth Project, and submitted it as Appendix E-12 in the license application filed on December 30, 2015. The Ellsworth Project consists of the Ellsworth Development, the Graham Lake Development, and appurtenant facilities. The Ellsworth Dam has an integral intake structure and powerhouse. Graham Lake Dam is located on the Union River upstream of Ellsworth Dam, creating the water storage reservoir known as Graham Lake (Figure 1).

In 2017 and 2018, Black Bear held six meetings with the agencies to identify measures to avoid and minimize potential adverse effects of Project operation on listed Atlantic salmon and designated critical habitat at the Ellsworth Project. Black Bear has developed a Species Protection Plan (SPP; Attachment A) to present the measures that were agreed to during these meetings. Black Bear is herein updating the 2015 Draft BA to analyze the effects of the proposed SPP measures, and to incorporate recently collected Project-specific information related to Atlantic salmon.

FIGURE 1
PROJECT LOCATION MAP



1.1 Overview of the Draft Biological Assessment, Species Protection Plan, and Agency Consultation

1.1.1 Purpose and Description of Draft Biological Assessment

Black Bear is updating the Draft BA, which was submitted with the December 30, 2015 license application, to analyze the effects of the proposed SPP measures and to incorporate recently collected Project-specific information related to Atlantic salmon (Attachment A).

The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) (the Services) stated that activities related to the listing of the GOM DPS of Atlantic salmon in Maine will be jointly managed and administered; however, NMFS will have the lead on issues pertaining to hydroelectric operations and their effects on Atlantic salmon and their critical habitat (USFWS and NMFS 2016). Section 9 of the ESA prohibits the take of endangered species, including the GOM DPS of Atlantic salmon, unless the take is authorized under specific provisions of the ESA. "Take" is defined by the ESA as "to harass, harm, pursue, ban, shoot, wound, kill, trap, capture, or collect," or to attempt to engage in any such conduct.

Exemptions to the prohibitions of take under Section 9 of the ESA can be provided by the Services through Section 10 or Section 7 of the ESA. Under ESA Section 10(a)(1)(B), permits may be issued for taking that is incidental to the purposes of an otherwise lawful activity (incidental take permits). Under ESA Section 7(a)(2), incidental take statements may be issued to exempt from the prohibitions any take anticipated as an incidental result of an activity conducted, permitted, or funded by a federal agency, provided this take would not be likely to result in jeopardy to the species or destruction of its critical habitat. Section 7 of the ESA mandates that all federal agencies consult with the Secretaries of Commerce (through NMFS) and Interior (through the USFWS) to determine whether a proposed action is likely to be categorized, with respect to listed species and designated critical habitat, as follows:

1. ***No Effect:*** No effects to the species and its critical habitat from the proposed action, either positive or negative, are expected.
2. ***May Affect, Not Likely to Adversely Affect:*** All effects of the proposed action to the species and its critical habitat are beneficial, insignificant, or discountable. Beneficial effects have positive effects to the species or its critical habitat. Insignificant effects relate

to the size of the impact and should not reach the scale where incidental or unintentional take (harming or killing) occurs. Discountable effects are those that are extremely unlikely to occur. Determinations of "not likely to adversely affect" due to beneficial, insignificant, or discountable effects require written concurrence from the USFWS or NMFS.

3. ***May Affect, Likely to Adversely Affect:*** The action would have an adverse effect on the species or its critical habitat. Any action that would result in take of an endangered species is considered an adverse effect. A combination of beneficial and adverse effects is still considered "likely to adversely affect" even if the net effect is neutral or positive. Adverse effects are not considered discountable because they are expected to occur. This determination requires formal consultation with the USFWS or NMFS.

This Draft BA is organized as follows:

- Section 1 provides the background and need for the Draft BA for the GOM DPS of Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon.
- Section 2 provides the Project description of the existing facilities and existing operations.
- Section 3 describes the life histories for the GOM DPS of Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon.
- Section 4 describes the presence of listed species in the Project Area.
- Section 5 evaluates the effects of the Project's existing conditions on listed species.
- Section 6 describes the Project's proposed SPP measures and actions to further protect listed species and evaluates the effects of these proposed measures and actions on listed species.
- Section 7 identifies the determination of the effects on listed species considering the proposed SPP measures and actions.
- The proposed SPP is attached to this Draft BA in Attachment A.

1.1.2 Purpose and Description of Proposed Species Protection Plan

In consultation with the agencies, Black Bear has developed a proposed SPP that identifies measures and actions to avoid and minimize potential adverse effects of Project operation on listed Atlantic salmon and designated critical habitat at the Ellsworth Project (Attachment A).

Provisions of the previous Draft BA submitted in 2015 required Black Bear to evaluate the effectiveness of the existing downstream fish passage facilities for passing Atlantic salmon for up to three years, as well as other protection measures and monitoring efforts, in order to inform the development of an appropriate SPP. Results of these efforts are summarized herein, and have been utilized by Black Bear in consultation with NMFS and other resource agencies to inform development of the SPP with agreed upon protection measures.

Assuming the protection measures are adequate to avoid jeopardizing the continued existence of the listed GOM DPS of Atlantic salmon and avoid destroying or adversely modifying designated critical habitat, NMFS will issue a Biological Opinion (BO) based on the BA and SPP with protective measures, which will include an Incidental Take Statement.

1.1.3 Consultation

Both prior to and after the June 19, 2009 ESA listing of the GOM DPS of Atlantic salmon, Black Bear held discussions with the Services to develop measures to protect the GOM DPS of Atlantic salmon. Between 2009 and 2011, Black Bear had numerous discussions with the Services to develop a Draft BA and SPP for the Ellsworth Project as part of the prospective documents also covering Black Bear's Penobscot River hydroelectric projects (Orono, Stillwater, Milford, West Enfield, and Medway projects). In September 2011, NMFS requested that Black Bear remove the Ellsworth Project from the Penobscot draft BA and, instead, develop a separate draft BA for the Ellsworth Project. This was done, and a draft BA for the Ellsworth Project was sent to the Services for their review on August 16, 2012. Black Bear held a meeting with NMFS to discuss development of the Draft BA and Draft SPP on November 13, 2012. NMFS provided comments on that Draft BA on December 7, 2012. With the initiation of relicensing activities in late 2012, development of the Draft BA had been coordinated with the schedule for developing the FERC license application in 2015. Based on further consultation with NMFS regarding potential protection measures and the lack of adequate information for determining suitable measures, a Draft SPP was not developed at that time for the Ellsworth Project.

As described above, Black Bear continued consultation with NMFS and resource agencies and decided to conduct an Atlantic salmon smolt downstream passage study at the Project. Based on the results of the study, additional enhancements were made to enhance downstream passage. A second year of study was conducted to evaluate the effectiveness of the enhancements. Following the completion of two years of these studies (2016 and 2017), Black Bear and the resource agencies agreed a third year was not necessary to further inform protection measures. Several consultation meetings occurred in 2017 and 2018 between Black Bear, NMFS, and the other interested resources agencies to discuss updated Draft SPP measures, contained and evaluated herein. Black Bear provided an updated Draft BA and SPP to the agencies for their review and comment in August 2018. The NMFS provided comments on the draft documents, those comments have been addressed to a large degree in this revised Draft BA.

1.2 ESA Listing of Atlantic Salmon

The GOM DPS of Atlantic salmon was first listed as endangered by the Services on November 17, 2000 (USFWS and NMFS 2000). The GOM DPS designation in 2000 included all naturally reproducing Atlantic salmon populations occurring in an area from the Kennebec River downstream of the former Edwards Dam site extending north to the international border between Canada and the United States at the mouth of the St. Croix River. This range includes the Union River. The listing in 2000 identified nine watersheds likely to contain naturally reproducing Atlantic salmon populations, including the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers, Cove Brook and Kenduskeag Stream. The GOM DPS also included river-specific hatchery fish that were being propagated at the Craig Brook Hatchery for release into the wild. The November 2000 final rule listing the GOM DPS did not include fish that inhabit the mainstem and tributaries of the Penobscot River above the site of the former Bangor Dam, the Kennebec River above the site of the former Edwards Dam, or the Androscoggin River (USFWS and NMFS 2000).

The 2006 Status Review for anadromous Atlantic salmon in the U.S. (Fay et al. 2006) assessed genetic and life history information and concluded that the GOM DPS, as defined in 2000, should be redefined to encompass the Penobscot, Kennebec, and Androscoggin Rivers. On June 19, 2009, the Services published a final rule determining that naturally spawned and conservation hatchery populations of anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, including those that were already listed in November 2000, constitute a DPS and hence a “species” for listing as endangered under the ESA (USFWS and NMFS 2009). This range includes the Union River.

1.2.1 Downeast Coastal Salmon Habitat Recovery Unit

The GOM DPS of Atlantic salmon is divided into three salmon habitat recovery units (SHRUs) within the range of the GOM DPS and includes the following: the Downeast Coastal SHRU, the Penobscot Bay SHRU, and the Merrymeeting Bay SHRU. The three SHRUs were created to ensure that Atlantic salmon were widely distributed across the DPS such that recovery of the GOM DPS is not limited to one river or one geographic location, because widely distributed species are less likely to become threatened or endangered by limited genetic variability and tend to be more stable over space and time (NOAA 2009).

The Downeast Coastal SHRU contains 61,395 units[1] of historically accessible spawning and rearing habitat for Atlantic salmon, of which 53,390 units are considered to be currently occupied, and 29,111 of these units are estimated to be functional units of spawning and rearing habitat (NMFS 2009a, NMFS 2009b). Within the Downeast Coastal SHRU, the Union River has about 12,000 units of historic spawning and rearing habitat, although NMFS concludes that dams reduce its equivalent functional habitat value to 4,062 units of habitat (NMFS 2009a). In addition to dams, a variety of issues and conditions affect Atlantic salmon recovery in the Union River, including agriculture, forestry, changing land use, hatcheries and stocking, roads and road crossings, mining, dredging, aquaculture, and introductions of non-native species such as smallmouth bass (NMFS 2009a).

1.2.2 Critical Habitat Designation

As a result of the June 19, 2009, endangered species listing, NMFS was required to evaluate historical occupancy of the watershed for the process of designating critical habitat for the GOM DPS. Section 3 of the ESA defines critical habitat as the following:

1. Specific areas within the geographical area occupied by the species at the time of listing, in which are found those physical or biological features that are essential to the conservation of the listed species and that may require special management considerations or protection; and
2. Specific areas outside the geographical area occupied by the species at the time of listing that are essential for the conservation of a listed species.

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[1] One unit of habitat is $100m^2$ (NMFS 2009a).

As part of the critical habitat designation, NMFS described the known primary constituent elements (PCEs) that are deemed essential to the conservation of the GOM DPS, including (1) sites for spawning and rearing and (2) sites for migration (excluding marine migration). The physical and biological features of the two PCEs for Atlantic salmon critical habitat are as follows:

Physical and Biological Features of the Spawning and Rearing PCE

A1. Deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.

A2. Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.

A3. Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development and feeding activities of Atlantic salmon fry.

A4. Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.

A5. Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr’s ability to occupy many niches and maximize parr production.

A6. Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.

A7. Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

Physical and Biological Features of the Migration PCE

B1. Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.

B2. Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.

B3. Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.

B4. Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

B5. Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.

B6. Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

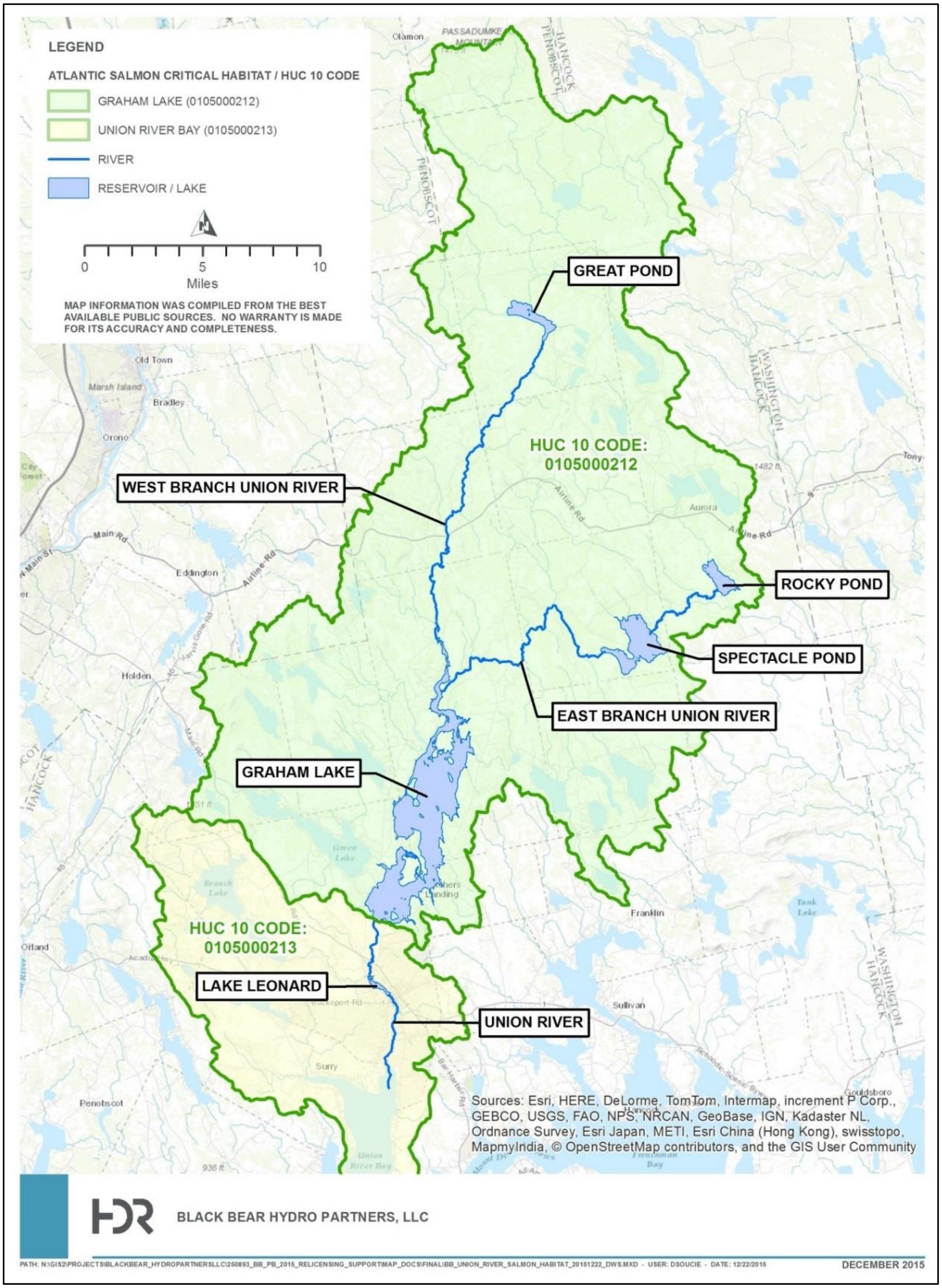
On June 19, 2009, NMFS designated as critical habitat 45 specific areas occupied by GOM DPS Atlantic salmon at the time of listing. Critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line (33 C.F.R. 329.11). Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater. Critical habitat is designated to include all perennial rivers, streams, and estuaries and lakes connected to the marine environment within the range of the GOM DPS of Atlantic salmon, except for those particular areas within the range which are specifically excluded (NMFS 2009a).

The Ellsworth Project falls within the designated critical habitat of the Downeast Coastal SHRU for Atlantic salmon. Critical habitat is further delineated into HUC 10 watersheds. The Union River includes two HUC 10 watersheds listed as critical habitat, including the Graham Lake HUC 10 (code 0105000212) and the Union River Bay HUC 10 (code 0105000213). The entire Project area is within GOM DPS Atlantic salmon critical habitat as shown in Figure 2.

1.2.3 Atlantic Salmon Recovery Plan Overview

Efforts aimed at protecting Atlantic salmon and their habitats in Maine have been underway for well over one hundred years. These efforts are supported by a number of federal, state, and local government agencies, as well as many private conservation organizations. The 2005 *Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon* for the originally-listed GOM DPS (NMFS and USFWS 2005) presented a strategy for recovering

FIGURE 2
ATLANTIC SALMON CRITICAL HABITAT, UNION RIVER WATERSHED



Atlantic salmon in the rivers listed as endangered under the ESA in 2000. An updated draft recovery plan was recently published for public comment, which addresses recovery within the expanded range of the GOM DPS of Atlantic salmon described in the 2009 listing rule (USFWS and NMFS 2016).

The 2016 *Draft Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon* (USFWS and NMFS 2016) reflects a new recovery planning approach (termed the Recovery Enhancement Vision, or REV) that focuses on the three statutory requirements in the ESA including: site-specific recovery actions; objective, measurable criteria for delisting; and time and cost estimates to achieve recovery and intermediate steps. The draft recovery plan is based on two premises: first, that recovery must focus on rivers and estuaries located in the GOM DPS until threats in the marine environment are better understood; and second, that survival of Atlantic salmon in the GOM DPS depends on conservation hatcheries through much of the recovery process (USFWS and NMFS 2016). The main objectives of the draft 2016 recovery plan is to maintain self-sustaining, wild populations with access to sufficient suitable habitat in each SHRU, and ensure that necessary management options for marine survival are in place. In addition, the plan seeks to reduce or eliminate all threats that either individually or in combination might endanger the DPS (USFWS and NMFS 2016).

The current recovery criteria for downgrading classification from endangered to threatened consist of:

1. The entire DPS has a total annual escapement of at least 1,500 naturally reared adults spawning in the wild, with at least two of the three SHRUs having at least 500 naturally reared adult returns;
2. The population in each of at least two of the three SHRUs must also have a population growth rate greater than 1.0 in the 10-year period preceding reclassification;
3. Adults originating from stocked eggs, fry, and parr are included when estimating population growth rates; and
4. Sufficient suitable spawning and rearing habitat for the offspring of the 1,500 naturally reared adults is accessible and distributed throughout designated Atlantic salmon critical habitat, with at least 7,500 accessible and suitable habitat units in each of at least two of the three SHRUs (USFWS and NMFS 2016).

The longer-term recovery target for the delisting of Atlantic salmon consists of:

1. The DPS has a self-sustaining annual escapement of at least 2,000 wild adult salmon returns in each of the three SHRUs for a DPS-wide total of at least 6,000 wild adults;
2. Each SHRU has a population growth rate of greater than 1.0 in the 10-year period preceding delisting, and at the time of delisting, the DPS demonstrates self-sustaining persistence; and
3. Sufficient suitable spawning and rearing habitat for the offspring of 6,000 wild adults is accessible and distributed throughout designated Atlantic salmon critical habitat, and with at least 30,000 accessible and suitable habitat units in each SHRU, located according to the known migratory patterns of returning wild adult salmon.

This recovery plan includes a table that generally identifies the priority, timing, and involved parties for the various actions, but it is important to recognize that annual decisions made about recovery priorities will be formulated in SHRU-level work plans (USFWS and NMFS 2015). SHRU-level work plans provide the basis for determining activities that should be implemented in the short term for each of the plan's recovery actions. The seven categories of recovery actions include:

- Habitat Connectivity, intended to enhance connectivity between the ocean and freshwater habitats important for salmon recovery;
- Genetic Diversity, intended to maintain the genetic diversity of Atlantic salmon populations over time;
- Conservation Hatchery, intended to increase adult spawners through the conservation hatchery program;
- Freshwater Conservation, intended to increase adult spawners through the freshwater production of smolts;
- Marine and Estuary, intended to increase survival in these habitats by increasing understanding of these salmon ecosystems and identifying the location and timing of constraints to the marine productivity of salmon in support of management actions to improve survival;
- Federal/Tribal Coordination, intended to facilitate consultation with all involved Tribes on a government-to-government basis; and

- Outreach, Education, and Engagement, intended to collaborate with partners and engage interested parties in recovery efforts for the GOM DPS (USFWS and NMFS 2016).

For geographically based recovery actions, the SHRU-level work plans (USFWS and NMFS 2015) describe threats and recovery activities with a high priority within a 5-year period. Threats listed for the overall Downeast Coastal SHRU consist of:

- Climate change and the adverse effect it may have on habitats most suitable for Atlantic salmon.
- Dams and culverts that block or impeded access to Atlantic salmon spawning and rearing habitat degrade habitat features for native riverine species.
- The stocking and introduction of non-native species, particularly smallmouth bass, compete with and prey on Atlantic salmon.
- Pollution attributed to land use and development practices in the Downeast Coastal SHRU can harm Atlantic salmon and degrade the productive capacity of freshwater and estuary habitats.
- Historic and current land uses have degraded the complexity and productivity of freshwater habitats that support Atlantic salmon (e.g., historic log drives, past and current agriculture and forestry practices, and residential development practices).
- The small population size and small number of remaining family groups within the Downeast Coastal SHRU compromises the overall fitness of the GOM DPS.
- Limited resources to assess all areas that could be occupied by Atlantic salmon.

Specific to the Ellsworth Project, the work plan described these threats to the Union River (USFWS and NMFS 2016):

- The Ellsworth Dam impairs upstream and downstream passage efficiency of adult salmon, smolts, and other diadromous fish, and decreases water quality above the dam. Graham Station does not have an upstream fishway, blocking all upstream migratory fish. Current operations block upstream migration of diadromous fish and may delay or block downstream migration of emigrating smolts and other diadromous fish.

Recovery actions are also outlined in the work plan (USFWS and NMFS 2015) to address these threats. Those actions potentially relevant to the Ellsworth Project include:

- Continue to provide fry to the Union River Salmon Association to support stock rebuilding efforts in the Union River.
- Ensure hydro operations at the Ellsworth Dam will minimize harm to Atlantic salmon and adverse effects to their critical habitat.
- Ensure operations at the Graham Lake Dam will minimize harm to Atlantic salmon and adverse effects to their critical habitat.
- Develop a stock rebuilding and management plan for the Union River.

1.3 Other ESA Listed Species - Atlantic and Shortnose Sturgeon

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*) have the potential to occur in the Union River downstream of the Ellsworth Project. On February 6, 2012, NOAA published notice in the Federal Register listing the Atlantic sturgeon as "endangered" in the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs, and as "threatened" in the GOM DPS (77 FR 5880 and 77 FR 5914). The Ellsworth Project falls within the Atlantic sturgeon GOM DPS. On August 17, 2017, NOAA designated critical habitat for Atlantic sturgeon in the threatened GOM DPS (82 FR 39160). Critical habitat for Atlantic sturgeon was not designated within the Union River and is, therefore, not present within the Project area.

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 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; Maine; Massachusetts; Connecticut; New York; New Jersey/Delaware; Maryland and Virginia; North Carolina; South Carolina; Georgia; and Florida. Critical habitat has not been designated for shortnose sturgeon.

2.0 Project Description

2.1 Project Facilities

The Ellsworth Project consists of the Ellsworth Development, the Graham Lake Development, and appurtenant facilities. The Ellsworth Dam has an integral intake structure and powerhouse, and creates the impoundment, Leonard Lake. Graham Lake Dam is located on the Union River about 4 miles upstream of Ellsworth Dam, creating the water storage reservoir known as Graham Lake (Figure 1).

Construction of the Ellsworth Dam was completed in 1907. Ellsworth Dam is approximately 377 feet long and 65 feet high with 1.7-foot-high flashboards on the spillway. Lake Leonard extends approximately 1 mile above Ellsworth Dam and has a surface area of 90 acres at a normal full pond water surface elevation of 66.7 feet U.S. Geological Survey (USGS) datum. The powerhouse is a reinforced-concrete and concrete block masonry powerhouse containing four turbine-generator units, which have a total FERC authorized capacity of 8,900 kilowatts (kW) (Table 1) and a total combined maximum flow capacity of approximately 2,460 cubic feet per second (cfs).

The Graham Lake Dam is an earthen dam with concrete core walls about 750 feet long and 30 feet high, and it includes a gated concrete spillway. The Graham Lake reservoir is approximately 10 miles long with a surface area of approximately 10,000 acres at normal full pond water surface elevation of 104.2 feet (Table 1). There are no generating facilities at the Graham Lake Development.

The Ellsworth Dam fish trap and transport facility is equipped with a four-baffle vertical slot upstream fishway leading to a trap fitted with a hopper and hoisting structure to facilitate fish transport in circular transport tanks (Figure 3). The fishway entrance is immediately adjacent to the powerhouse tailrace with a pumped attraction flow of up to 50 cfs. The upstream fishway and fish trapping facility were constructed at the Ellsworth Dam in 1974, originally to provide a supplemental source of Atlantic salmon broodstock for use in the restoration of populations to the Penobscot and other rivers (Baum 1982).

TABLE 1
CHARACTERISTICS OF THE ELLSWORTH PROJECT

Facility Characteristics	Ellsworth Dam	Graham Lake Dam
Reservoir Length	1 mile	10 miles
Reservoir Surface Area	90 acres	10,000 acres
Reservoir Normal Full Pond Elevation	66.7 feet mean sea level (msl) (includes 1.7-foot-high flashboards)	104.2 feet msl
Length of Dam	377 feet	750 feet
Height of Dam	65 feet	30 feet
Turbines Rated Capacity*	• Unit 1 – 3,800 horsepower (hp) (2,850 kW) (vertical shaft propeller) • Unit 2 – 2,900 hp (2,175 kW) (Kaplan) • Unit 3 – 2,900 hp (2,175 kW) (Kaplan) • Unit 4 – 3,800 hp unit (2,850 kW) (vertical shaft propeller)	NA
Turbine Rotational Speeds (RPM)	• Unit 1 – 200 RPM • Unit 2 – 360 RPM • Unit 3 – 360 RPM • Unit 4 – 200 RPM	NA
Generator Rated Capacity**	• Unit 1 – 3,125 kVA @ power factor 0.8; 2,500 kW • Unit 2 – 2,500 kVA @ power factor 0.8; 2,000 kW • Unit 3 – 2,500 kVA @ power factor 0.8; 2,000 kW • Unit 4 – 3,000 kVA @ power factor 0.8; 2,400 kW	NA
Trashrack Spacing	Variable – Typical configuration based on normal pond elevation: Top 6-8 feet is concrete Unit 1 – 2.44 in. Units 2-4 – 1.00 in.(top)/2.37 in. (bottom)	NA

*The total combined maximum hydraulic capacity of the turbines is estimated to be 2,460 cfs.
**The total FERC-authorized capacity of the facility, based on the limiting unit components, is 8.9 MW.

The upstream passage facility was described as an interim measure until additional information became available from assessments incorporated in the Union River Fisheries Management Plan that would provide information needed to make decisions regarding permanent fish passage measures (URFCC 2000). Since Atlantic salmon broodstock collection has been discontinued, the upstream fishway is now used primarily during the river herring migration, but also to collect any salmon that might use the facility for potential upriver transport (depending on origin of fish) in the Union River. Adult Atlantic salmon that are captured in the fishway are examined to determine origin, and the Maine Department of Marine Resources (MDMR) determines whether Atlantic salmon caught in the fishway are released downstream of the Ellsworth Dam, upstream of the Graham Lake Dam, or removed by MDMR. Graham Lake Dam does not have an upstream fishway, because fish are transported from the Ellsworth trap and transport facility to locations above Graham Lake Dam.

Black Bear operates downstream passage facilities at both Ellsworth Dam (Figures 4 and 5) and Graham Lake Dam (Figure 6). Downstream measures at the Ellsworth Dam consist of two stoplog-controlled surface weirs above Units 2 through 4 and a transport pipe that discharges to a downstream sluiceway located on the overflow section of the dam. A third surface weir is located adjacent to the Unit 1 intake that discharges directly to the same sluiceway leading to a plunge pool immediately downstream of the dam. The downstream face of the spillway was resurfaced in 2017 to limit fish injuries when passed over the dam section adjacent to the third surface weir. In addition, a permanent stainless steel inlet screen was installed over the intake of the cooling water system at the Ellsworth Dam on May 26, 2015 as a downstream passage protection measure, following review and consultation with the resources agencies, including guidance to prevent fish impingement provided by the USFWS and NMFS.

In addition to the activities associated with operation and maintenance of the fish passage facilities at the Ellsworth Dam, Black Bear operates a surface weir to provide downstream passage of out-migrating Atlantic salmon and river herring on the west end of the Graham Lake Dam gate structure. The development of this passage route was completed in 2003, coinciding with increased upstream stocking of alewives. The weir is very similar to the downstream passage system at the Ellsworth Dam in that it is a surface weir that contains stoplogs, which enable Black Bear to adjust the opening as necessary. However, these stoplogs have been removed from the surface weir year round. The opening empties into a downstream plunge pool and provides downstream migrants with another route of passage in addition to the existing Tainter gates, which are operated to pass minimum flows and flows used for generation purposes at the Ellsworth Dam. This weir at Graham Lake Dam was modified in 2017 by adding a sloped floor, two side panels, and a bell shaped entrance to create an Alden weir to improve approach velocities and fish attraction to the weir (Figure 6). The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow.

FIGURE 3
VIEW OF FISHWAY LIFT IN OPERATION USED FOR TRANSFERRING FISH TO THE HOLDING TANK AT THE ELLSWORTH DAM

FIGURE 4
VIEW OF COLLECTION CHAMBER AND ENTRANCE TO DOWNSTREAM FISH PASSAGE PIPE AT THE ELLSWORTH DAM

FIGURE 5
VIEW OF DISCHARGE FROM DOWNSTREAM FISH PASSAGE PIPE AND SURFACE WEIR AT THE ELLSWORTH DAM

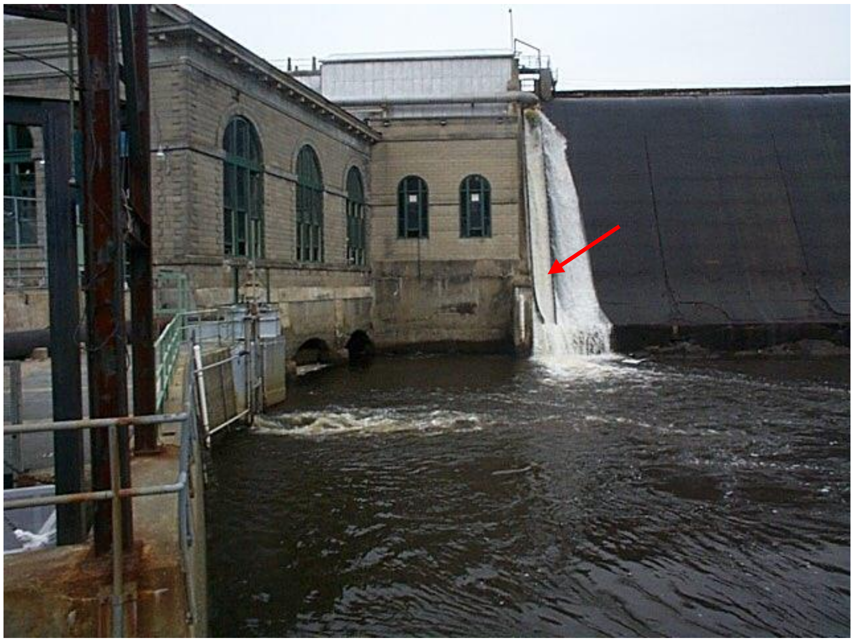


FIGURE 6
GRAHAM LAKE DAM FISH PASSAGE WEIR

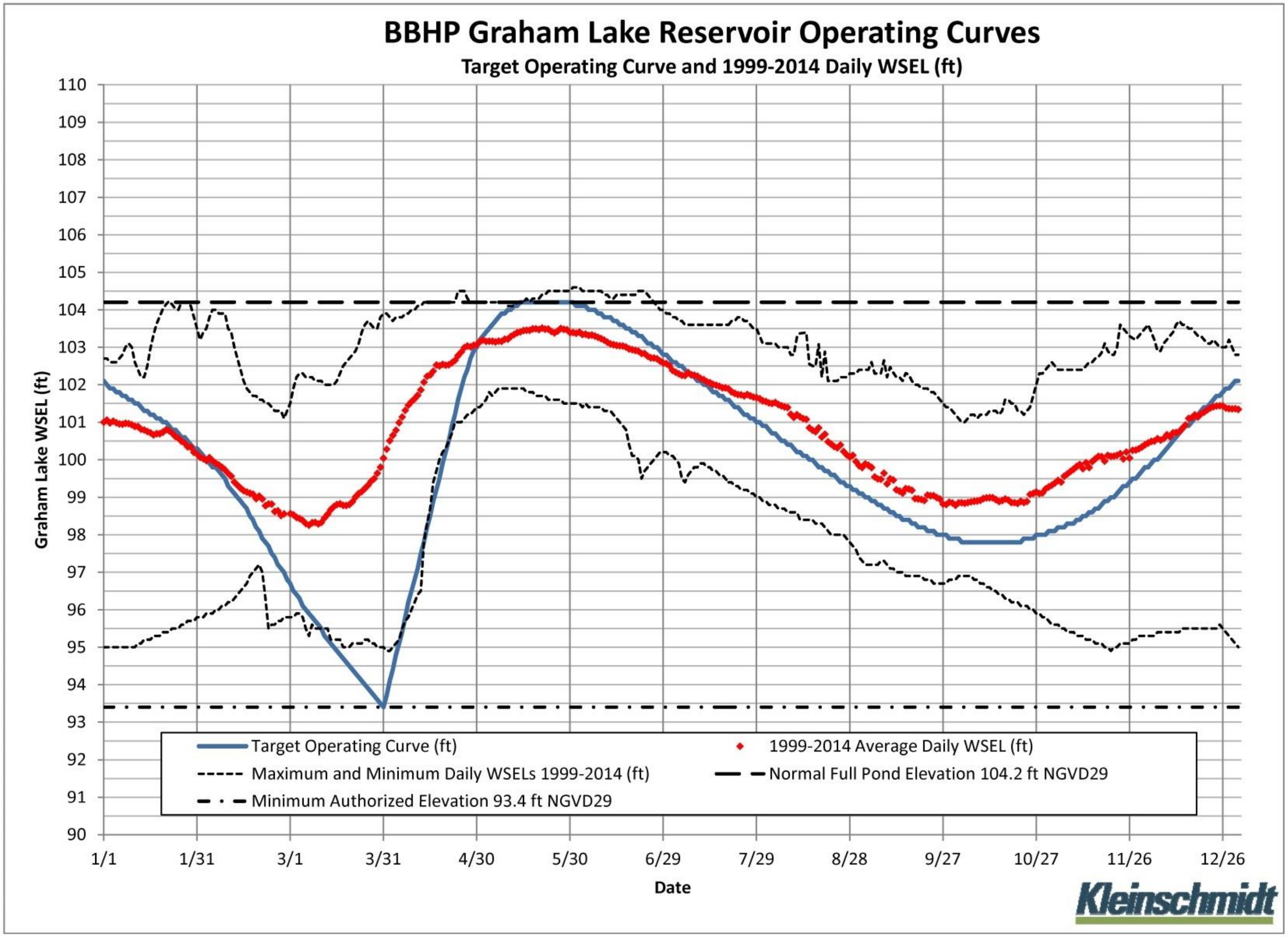
2.2 Project Operations

The Ellsworth Project operates as both a water storage facility and as a peaking generation facility, depending on available inflows, while maintaining minimum flows. Timed releases at Graham Lake are used at Ellsworth Dam for power production. The releases may result in minor (approximately 1 foot) surface elevation variations in Lake Leonard. During high flow conditions, primarily in the spring and fall, the Project may operate at full load up to 24 hours a day. Graham Lake generally follows an operating curve that can result in fluctuations approaching 11 feet over the course of a year (Figure 7). As per Articles 401 and 402 of the 1987 Order Issuing New License, minimum flows and water levels are required and maintained by Black Bear. Article 401 specifies a continuous minimum flow release of 105 cfs from the Graham Lake Dam and Ellsworth Dam from July 1 through April 30, and a continuous minimum flow release of 250 cfs from May 1 through June 30 for the protection of fishery resources. Article 402 of the FERC license specifies that the licensee operate the Ellsworth Project so that the following water levels are maintained: Lake Leonard 1-foot fluctuation (65.7 feet to 66.7 feet mean sea level [msl]) and Graham Lake 10.8-foot fluctuation (93.4 feet to 104.2 feet msl). Black Bear has proposed to continue these fundamental operating parameters for the Ellsworth Project in the December 2015 application for a new license.

The upstream fishway is typically operated for river herring (alewife; blueback herring) stocking and harvesting from early May through mid-June, and continuing through October 31 for Atlantic salmon (URFCC 2015). The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow.

In 2014 and 2015, Black Bear implemented physical and operational measures to enhance fish passage at the Project, including development of a site-specific Fish Passage Operation and Maintenance (O&M) Plan for the fishways. The Fish Passage O&M Plan, which is consistent with the original design criteria for the fishways, includes a daily checklist that is used to ensure that the upstream and downstream fishways are operating properly. The plan also includes both a list of spare parts critical to fishway operation and a checklist of proper fishway operating characteristics. Since 2015, Black Bear has also hired staff dedicated to operate the Project fish passage facilities annually; these staff are dedicated to fishway operations, oversight, fish trap tending, and transporting the fish upriver. These dedicated fishway staff complete the daily checklists and prepared weekly reports on fishway operations, which have been provided to the fisheries management agencies throughout the fishway operational seasons since 2015. Black Bear also repaired the Ellsworth downstream fishway recovery pump, installed a pump failure monitor, and purchased a spare pump as a backup in 2015. In addition, Black Bear installed a cover screen at the primary intake of the cooling water system to prevent fish entrainment into this system, and then modified the cooling water operations and re-plumbed this system to allow for auxiliary and secondary intakes to be used only as an emergency backup water source. This intake cover screen is inspected weekly via underwater video camera during the fish passage season. A 2017 change to improve downstream Atlantic salmon smolt passage included the installation of an Alden-type weir at the entrance to the downstream passage facility at Graham Lake Dam to improve flow characteristics and attraction to the weir.

FIGURE 7
OPERATING CURVES, GRAHAM LAKE



2.2.1 Union River Comprehensive Fisheries Management Plan

Through 2017, the Project's fish passage facilities were managed and operated in consultation with the relevant fisheries agencies through the *Comprehensive Fishery Management Plan (CFMP) for the Union River Drainage*, which was updated every five years. In 1997, a group of agencies and interested parties (including the USFWS and MDMR) signed an agreement for the purposes of addressing interim and long-term fisheries management in the Union River drainage, including the provision of fish passage at the Ellsworth Hydroelectric Project. The stakeholders agreed that they would develop a comprehensive, biologically-based plan in order to support decisions on fishery management in the Union River. The Union River Fisheries Coordinating Committee (URFCC), consisting of state and federal natural resource agencies and non-governmental conservation organizations[2]; as well as the City of Ellsworth; Black Bear; and interested members of the public, developed the CFMP (URFCC 2000, 2015). The URFCC adopted the following Mission Statement:

> It is the goal of the Union River Stakeholders Group to achieve timely and effective restoration and/or management of populations of resident and self-sustaining diadromous fish in the Union River watershed, consistent with a comprehensive fishery management plan, and in a manner that balances the interests of the public, regulatory agencies, and the licensee of the Ellsworth Hydroelectric Project.

The CFMP (URFCC 2000, 2015) identified agency goals and objectives for diadromous and resident fish populations in the Union River drainage, and described the various tasks and responsibilities related to the restoration and management of those resources, including stocking, habitat assessment, population monitoring, and fish passage.

The most recent plan covered the three-year period of 2015-2017 due to the scheduled expiration of the Project license in December 2017 (URFCC 2015). Although the plan has expired, Black Bear has and will continue the operations of the upstream fish trap at the Ellsworth Project as described in the plan in order to continue annual transport of at least 315,000 river herring (if

[2] The URFCC included the USFWS, MDMR (formerly including the Maine Atlantic Salmon Commission), Maine Department of Inland Fisheries and Wildlife (MDIFW), City of Ellsworth, Union River Watershed Coalition, Union Salmon Association, the Maine Council of the Atlantic Salmon Federation, Black Bear, and interested members of the public.

available) upstream during the interim period before a new license is issued. Black Bear will also continue to operate the downstream fishway per the operational and physical modifications identified in 2014 and 2015, described above, while continuing to prioritize unit operations to favor Units 1 and 4 during downstream fish migration periods.

2.3 Water Quality in the Project Area

The Ellsworth Project area is located within the Union River watershed and encompasses portions of the Union River, Lake Leonard, and Graham Lake. The Union River watershed encompasses approximately 547 square miles in Hancock and Penobscot Counties in Maine (Maine DEP, MDIF&W, and MEGIS 2010) and includes 484 miles of streams and 81 miles of lakes and ponds) (College of the Atlantic 2004). The Union River watershed is bordered by coastal rivers and by the Gulf of Maine to the south, the Penobscot River basin to the west and north, and the Narraguagus River basin to the east (FERC 1987).

The Project creates two impoundments on the Union River, Lake Leonard, which is a small impoundment upstream of the Ellsworth Dam, and Graham Lake, which is a larger storage reservoir upstream of Graham Lake Dam. Lake Leonard has a surface area of approximately 90 acres at its normal maximum elevation of 66.7 feet msl, a width of up to 0.3 miles, and a maximum length of approximately 1.0 mile. Lake Leonard has a volume of 751 acre-feet. Graham Lake has a surface area of approximately 10,000 acres at a normal full pond surface elevation of 104.2 feet msl; a maximum width of 2.75 miles; and a maximum length of approximately 10 miles. Graham Lake has a volume of approximately 124,000 acre-feet.

Maine statute 38 MRSA (§464-470) establishes the basis for the State's classification system of surface waters. The State has one water quality standard for lakes and great ponds (GPA) which includes inland bodies of water artificially formed or increased that have a surface area greater than 30 acres. Graham Lake is included in this classification. The Maine Department of Environmental Protection (MDEP) currently interprets the water quality statutes to classify Lake Leonard as a GPA water (K. Howatt, MDEP personal communication, June 16, 2015). There are four standards for the classification of fresh surface waters which are not classified as great ponds: Class AA, A, B, and C waters. The Union River from the outlet of Graham Lake to tidewater, excluding the impounded portion, Lake Leonard, is classified as Class B (38 M.R.S.A. §467.18.A (1)).

Impoundment water quality sampling was conducted in accordance with MDEP's Lake Trophic State Sampling Protocol for Hydropower Studies on a bi-weekly basis in Graham Lake from April 23 through October 24, 2013, and in Lake Leonard from June 13 through October 24, 2013, as part of the relicensing studies for the Project. Graham Lake weakly stratifies during the summer months, but due to the shallowness of the lake and long fetch from multiple directions, the stratification often breaks down during windy periods that prevail on the lake. Water quality in Lake Leonard is similar to Graham Lake, though slightly less turbid.

Riverine water quality sampling was also conducted as part of the relicensing of this Project in the Union River in the tailwater area of Graham Lake Dam in accordance with MDEP's River Sampling Protocol on a weekly basis from July 2 through September 12, 2013, in both the early morning (before 7:00 AM) and afternoon (after 1:00 PM) on each sampling day. Sampling was not conducted in the Ellsworth Dam tailwater, as the Union River is subject to tidal fluctuations at that point. Over the course of the 11-week sampling period, temperatures ranged from 19.1 – 26.6 degrees Celsius ($^{\circ}$C) and dissolved oxygen (DO) levels ranged from 8.3 and 10.4 milligrams per liter (mg/l) (96 – 114% saturation). The impoundments and riverine reaches sampled during the 2013 relicensing studies met applicable water quality Class GPA (impoundments) and Class B (riverine) state standards.

3.0 Listed Species Life History

3.1 Atlantic Salmon

Anadromous Atlantic salmon have a complex life history that includes spawning and rearing in freshwater rivers and streams, as well as extensive feeding migrations and sexual maturation in the marine environment (Fay et al. 2006). The freshwater juvenile stage of the life cycle can last from one to three years, after which juveniles undergo a physiological transformation (called smoltification) and migrate downstream to spend one to three years at sea before returning to freshwater to spawn in their natal rivers. Unlike Pacific salmon, Atlantic salmon do not die after spawning, and can return to sea to repeat the migratory cycle.

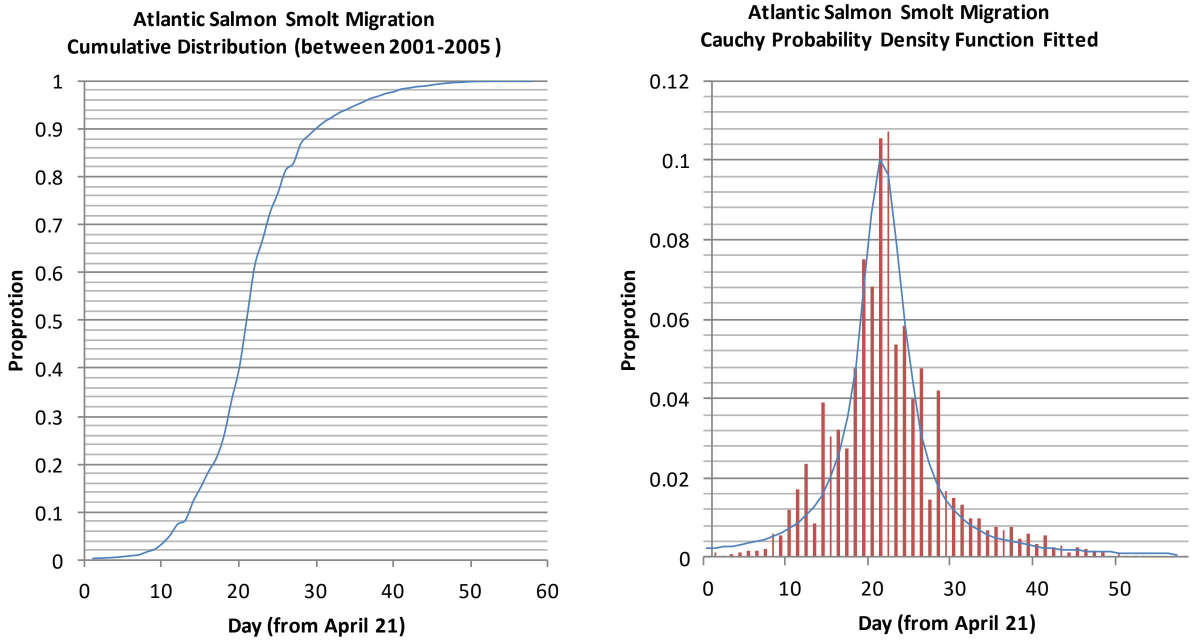
Although spawning by Atlantic salmon does not occur until late October or November, most adult Atlantic salmon ascend rivers beginning in the spring. In the GOM rivers, the peak upstream migration occurs in June, but may persist until the fall (Fay et al. 2006). After fish enter the freshwater environment, they cease feeding and darken in coloration. Salmon that return early in the spring spend nearly five months in the river before spawning, seeking cool water refuges (e.g., deep pools, springs, and mouths of small cold-water tributaries) during the summer months (Fay et al. 2006). Following spawning, adults (referred to as "kelts") may move downstream in either the fall or the following spring, eventually reaching the estuary and ocean. Once in the marine environment, these salmon resume feeding and a very small percentage may return as repeat spawners one to two years later.

Preferred spawning habitat consists of gravel substrate with adequate water circulation to keep buried eggs well oxygenated. Water depth at spawning sites is typically 30 centimeters (cm) to 61 cm, and water velocity averages 60 cm per second (Fay et al. 2006). Spawning occurs from late October through November when water temperatures are roughly between 7.2 degrees Celsius (°C) to 10.0°C. The female uses its tail to scour or dig a series of nests in the gravel where the eggs are deposited; this series of nests is called a redd. One or more males fertilize the eggs as they are deposited in the redd. The female then continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel. A female salmon returning to spawn after spending two years at sea will produce approximately 7,500 eggs (Fay et al. 2006).

The eggs hatch in late March or April. At this stage, the young salmon are referred to as alevin or sac fry. Alevins remain in the redd for about six more weeks and are nourished by their yolk sac. Alevins emerge from the gravel in mid-May, and begin active feeding, at which time they are called fry (Fay et al. 2006). Within days, the salmon fry enter the parr stage, indicated by vertical bars (parr marks) visible on their sides. Parr prefer areas with adequate cover, water depths ranging from approximately 10 cm to 60 cm, water velocities between 30 cm and 92 cm per second, and water temperature near 16°C (Fay et al. 2006). Juvenile salmon are territorial and feed on a variety of aquatic invertebrates, including larvae of mayflies, stoneflies, chironomids, and caddis flies; aquatic annelids; mollusks; and numerous terrestrial invertebrate species that fall into the river (Fay et al. 2006). In fall as flows increase, and as temperature and day length decrease, parr often shelter in the substrate. Movement may be quite limited in the winter, but can occur, particularly if the formation of ice reduces available habitat (Fay et al. 2006).

After remaining in freshwater habitat for one to three years (typically two years in Maine), parr undergo a series of physiological, morphological, and behavioral changes in a process called "smoltification." This transformation occurs in the spring and prepares the salmon "smolt" for its dramatic change in osmoregulatory needs that come with movement from a freshwater to marine environment (Fay et al. 2006). The smolt emigration period is rather short and lasts only two to three weeks for each individual (NMFS 2008). While not specifically assessed in the Union River, naturally reared and wild smolts in Maine typically enter the sea during May to begin their ocean migration (Fay et al. 2006). In the Penobscot River, smolts migrate between late April and early June with a peak migration in early May (Fay et al. 2006). The majority of smolts migrate in a short period of time, as demonstrated by NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005. These data show that 74 percent of the downstream run occurs in 15 days in mid-May (Figure 8) and that the majority of the smolt migration appears to take place after water temperatures rise to 10°C (USFWS unpublished *cited in* Black Bear 2012). The USFWS conducted a review of literature regarding diurnal migration timing and found that a median of 80.7 percent of smolts migrated at night (USFWS unpublished *cited in* Black Bear 2012).

FIGURE 8
SMOLT MIGRATION TIMING IN THE PENOBSCOT RIVER BASED ON NMFS SMOLT TRAPPING STUDIES BETWEEN 2001 AND 2005



Source: Review of NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005 - USFWS unpublished *cited in* Black Bear 2012.

Smolts have been documented to move through the Narraguagus River estuary (located in Downeast Maine) to the middle portion of the bay at 0.7 kilometers per hour (km/h) and 1.0 km/h in the outer Narraguagus Bay (Kocik et al. 2009). Higher survival rates were observed for smolts that exhibited a reversal migratory pattern through the bay, suggesting that smolts moving out to sea with the flooding and ebbing tides are more likely to survive than those that do not, likely falling prey to various predators. Overall, this study documented low survival between the estuary and open marine environment from 36 percent to 47 percent (Kocik et al. 2009).

Once in the ocean, Atlantic salmon become highly migratory and undertake long migrations from their natal rivers (Fay et al. 2006). Major feeding areas in the ocean include the Davis Strait between Labrador and Greenland (USFWS and NMFS 2009). During their time at sea, Atlantic salmon undergo a period of rapid growth until they reach maturity and return to their natal river to complete the life cycle. Although the GOM DPS yields the highest adult returns, millions of salmon are stocked annually, and these data indicate that freshwater and marine survival rates are extremely low (USFWS and NMFS 2009).

3.2 Atlantic Sturgeon

The Atlantic sturgeon is a long-lived, late maturing, estuarine dependent, anadromous species. Information in the following subsections is taken from the 2007 Atlantic sturgeon status review (Atlantic Sturgeon Status Review Team 2007), unless otherwise noted. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida. Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems. In some southern rivers, a fall spawning migration may also occur. A fall migration of ripening adults upriver in the Saint John River, New Brunswick is also observed; however, this fall migration is not considered a spawning run as adults do not spawn until the spring. Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers, where optimal flows are 46-76 cm/s and depths of 11-27 meters. Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble). Hatching occurs approximately 94-140 hours after egg deposition at temperatures of 20° and 18°C, respectively, and larvae assume a demersal existence. The yolk-sac larval stage is completed in about 8-12 days, during which time the larvae move downstream to rearing grounds over a 6-12 day period. During the first half of their migration downstream, movement is limited to night. During the day, larvae use benthic structure (e.g., gravel matrix) as refugia. During the latter half of migration when larvae are more fully developed, movement to rearing grounds occurs both day and night. Juvenile sturgeon continue to move further downstream into brackish waters and eventually become residents in estuarine waters for months or years.

Upon reaching a size of approximately 76-92 cm, the subadults may move to coastal waters where populations may undertake long-range migrations. Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Subadult Atlantic sturgeon transit between coastal and estuarine habitats, undergoing rapid growth. These migratory subadults, as well as adult sturgeon, are normally found in shallow (10-50 meters) near-shore areas dominated by gravel and sand substrate. Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina, which presumably provide better foraging opportunities. Despite extensive mixing in coastal waters, Atlantic sturgeon return to their natal river to spawn as indicated from tagging records and the relatively low rates of gene flow reported in population genetic studies. Males usually begin their spawning migration early and leave after the spawning season, while females make rapid spawning migrations upstream and quickly depart following spawning.

Atlantic sturgeon have been aged to 60 years; however, this should be taken as an approximation, as the only age validation study conducted to date shows variations of ±5 years. Vital parameters of sturgeon populations show clinal variation with faster growth and earlier age at maturation in more southern systems, though not all data sets conform to this trend. For example, Atlantic sturgeon mature in South Carolina at 5-19 years, in the Hudson River at 11-21 years, and in the Saint Lawrence River at 22-34 years. Atlantic sturgeon likely do not spawn every year. Multiple studies have shown that spawning intervals range from 1-5 years for males and 2-5 for females. Fecundity of Atlantic sturgeon has been correlated with age and body size (ranging from 400,000 - 8 million eggs). The average age at which 50 percent of maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3-10 times longer than for other bony fish species examined (NOAA 2012a).

The GOM DPS includes all Atlantic sturgeon that are spawned in the watersheds from the Maine/Canadian border and extending southward to include all associated watersheds draining into the Gulf of Maine as far south as Chatham, Massachusetts (NOAA 2012a). Tagging and tracking data indicate that there is mixing of sturgeon from different DPSs throughout their marine range, and, consequently, NMFS determined that the marine ranges for the five DPSs are the same: all marine waters, including coastal bays and estuaries, from Labrador Inlet, Labrador, Canada to Cape Canaveral, Florida (NOAA 2012a, 2012b).

3.3 Shortnose Sturgeon

The shortnose sturgeon is an endangered fish species that occurs in large coastal rivers of eastern North America. In the northern part of its range, the species is considered to be “freshwater amphidromous,” meaning it spawns in freshwater, but regularly enters seawater during various stages of its life (NMFS 1998). Shortnose sturgeon are occasionally found near the mouths of rivers, and coastal migrations between the lower Penobscot River and the Androscoggin/Kennebec estuary (i.e., Merrymeeting Bay) have been documented (Zydlewski 2009, Fernandes et al. 2010). Juveniles typically move upstream in rivers in spring and summer and downstream in fall and winter, but inhabit reaches above the freshwater - saltwater interface. Adults may move into higher salinity areas on a more regular basis (NMFS 1998).

Shortnose sturgeon are a long-lived species. The maximum documented age is 67 years for females, while males seldom exceed 30 years of age (NMFS 1987). In the northern part of their range, females do not spawn until about 18 years of age, while males spawn at about 12 years of age (NMFS 1987). Shortnose sturgeon females typically spawn every three to five years, while males may spawn as often as every one to three years (NMFS 1998). Spawning typically takes place in mid- to late spring when water temperatures reach 8-9°C; spawning ends when the water temperature reaches 12-15°C. Spawning may occur over a period of days to a few weeks. Overall spawning success can be negatively impacted if flows are unusually high during the spawning period (NMFS 1998).

Shortnose sturgeon typically seek the most accessible upstream areas for spawning, and may use a variety of micro-habitats. Channels appear to be important for spawning, which takes place over a variety of substrates (often gravel, rubble, or boulders), in shallow to relatively deep water and in moderate velocities (NMFS 1998).

Eggs are demersal and adhesive and remain near the spawning site. After eggs hatch, larval shortnose sturgeon are poor swimmers, and react negatively to light, instead seeking refuge among crevices and other cover on the bottom near the spawning site (NMFS 1998). After 9-12 days, the yolk sac is absorbed and the young sturgeon actively migrate downstream to locate suitable habitat. Young of year sturgeon typically inhabit deeper freshwater areas, and assume a more migratory behavior in the second summer of life (NMFS 1998).

Juvenile shortnose sturgeon (3 to 10 years old) typically inhabit the saltwater/freshwater interface in the lower reaches of rivers, foraging over fine-grained sand/silt/mud substrates. Juvenile and adult sturgeon can often use the same micro-habitats (NMFS 1998).

Adult shortnose sturgeon often inhabit short reaches of rivers, or concentration areas in summer and winter, where depth, velocity and substrate conditions combine to create favorable habitat for freshwater mussels, a preferred food item. Shortnose sturgeon will also forage in backwaters and in tidal channels under various levels of salinity (NMFS 1998).

Shortnose sturgeon are considered to be omnivorous. Juvenile sturgeon feed on a variety of benthic aquatic invertebrates (crustaceans, insects, worms, mollusks); adults show a preference for mollusks (NMFS 1998).

4.0 Presence of Listed Species in the Project Area

4.1 Atlantic Salmon

Runs of Atlantic salmon and other anadromous fish were once common in the Union River (Havey 1961), but disappeared in the late 1700s and early 1800s with the construction of dams in the lower portion of the river. Dams at outlets of many of the lakes and ponds in the drainage prevent full access of migratory fish to historical habitat (URFCC 2010).

Annual releases of hatchery-reared Atlantic salmon smolts (one- and two-year-old fish) began in the Union River in 1971, and were continued until 1991, when stocking was suspended due to funding reductions and a redirected focus on wild salmon rivers and the Penobscot River (USASAC 1992). In the last 10 years of the broodstock program of that period, an average of approximately 36,000 smolts were stocked annually. Since 1992, there has been sporadic stocking of salmon fry and parr by the USFWS in the Union River in an effort to continue the restoration effort (Table 2).

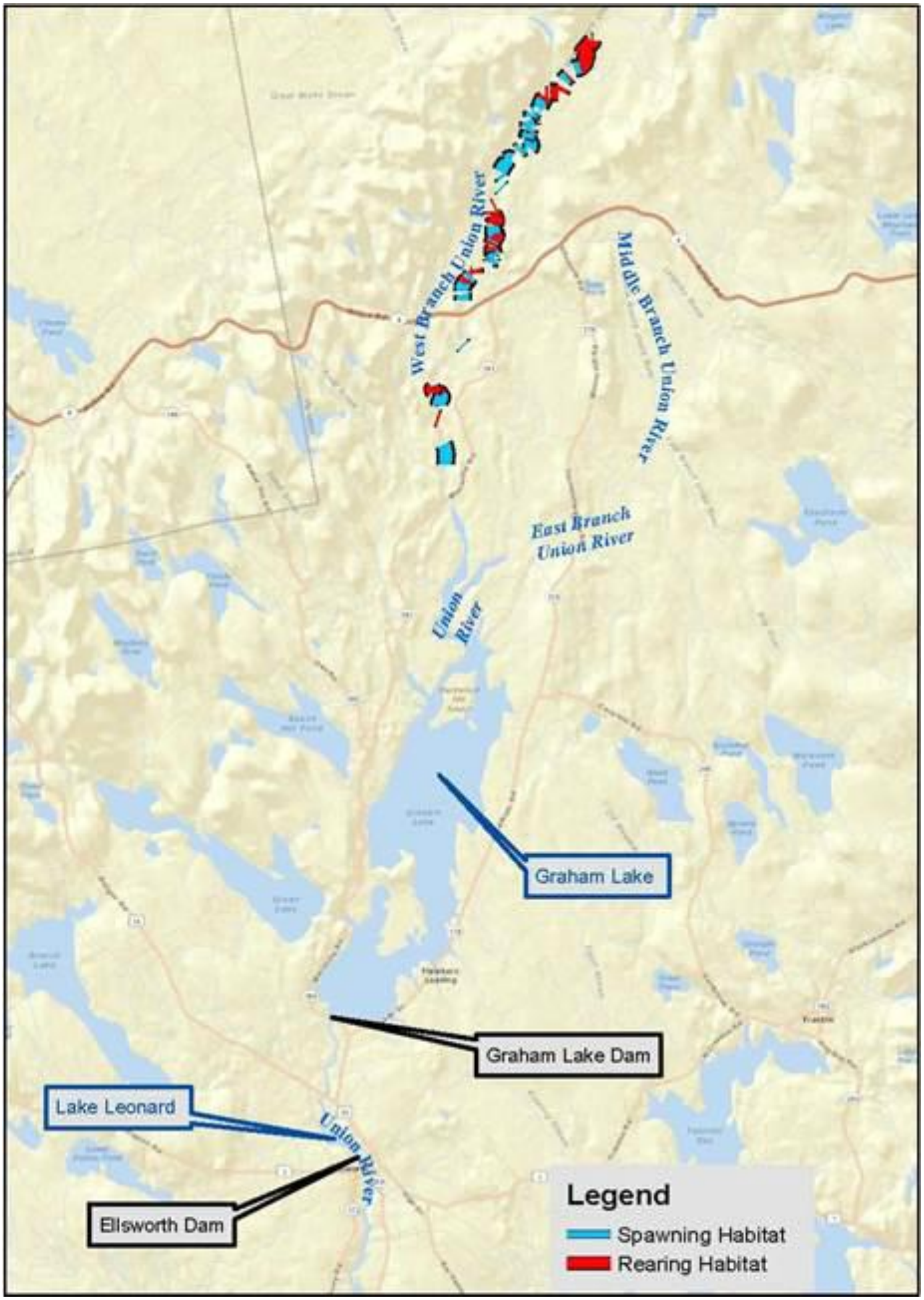
In 2011, 19,000 fry and 282 excess brood stock (pre-spawn) were stocked in the West Branch Union River in Amherst (URFCC 2015). Spawning activity was assessed through redd counts near the release location, and over 200 redds were well distributed through the area (Figure 9). Fry stocking did not occur the next two years because of this natural reproduction. The Union River Salmon Association resumed fry stocking in 2014, which has continued each year since. Smolts from radio telemetry studies associated with this Project have also been reported as stocked in the Union River in 2017 (USASAC 2018).

TABLE 2
NUMBER OF ATLANTIC SALMON STOCKED
BY LIFE STAGE IN THE UNION RIVER

Year	Fry	0 Parr	1 Parr	2 Parr	1 Smolt	2 Smolt	Adult
1971-2006	440,000	371,400	0	0	379,700	251,000	0
2007	22,000	0	0	0	0	0	0
2008	23,000	0	0	0	0	0	0
2009	28,000	0	0	0	0	0	0
2010	19,000	0	0	0	0	0	0
2011	19,000	0	0	0	0	0	282
2012	Natural recruitment from 282 adult spawners stocked in September, 2011 – no fry stocking						
2013	Natural recruitment from 282 adult spawners stocked in September, 2011 – no fry stocking						
2014	24,000	0	0	0	0	0	0
2015	25,000	0	0	0	0	0	0
2016*	26,000	0	0	0	294	0	0
2017*	25,000	0	0	0	383	0	0

Source: USASAC 2018, Normandeau 2016, 2017.
* Note: The smolts stocked in 2016 and 2017 were the smolts used for the studies conducted by the Licensee in 2016 and 2017.

FIGURE 9
MAP SHOWING LOCATION OF SALMON SPAWNING AND REARING HABITAT UTILIZED BY ADULT HATCHERY BROODSTOCK RELEASED IN THE UNION RIVER IN 2011



Source: URFCC 2012.

Completion of the fish trap at the Ellsworth Dam in 1974 has aided in the collection of returning adult salmon. According to Baum (1982), initially, the effectiveness of the facility was hampered by inadequate attraction flow and other operational problems. To improve attraction, water flow at the entrance of the fishway was manipulated by stoplogs, depending upon whether or not the powerhouse turbines were operating. The fishway was determined to be more effective in attracting salmon when turbines were not operating, resulting in reduced river flow. Further, salmon tended to hold in the pool below the trap where they were captured by hand or dip net when the fishway pump was turned off and water drained out of the fishway (Baum 1982). From 1975 to 1981, the fish trap was operated between two and six hours per day depending upon river flow, and one to two days per week generally from June to October. The infrequent schedule for fishway operation was due to the lack of personnel to operate it (the trap was operated by Atlantic Salmon Commission; Baum 1982). Since 2015, the upstream fishway operation has been expanded to seven days a week from May 1 through October 31 (subject to water temperature protocols), with the trap checked for Atlantic salmon multiple times a day from approximately 7 am to 6 pm. Brookfield maintains staff dedicated to monitoring and maintaining the fishway operation.

Adult Atlantic salmon returns to the Union River are shown in Table 3. Prior to aquaculture development in nearby marine areas, salmon origin was determined by fin condition and general appearance; however, this does not conclusively discriminate between aquaculture escapees and hatchery origin salmon. Large numbers of apparent aquaculture escapees were caught in 1996, but not verified with scale analyses.

Since 1999, the resource agencies have examined scale samples from each adult salmon returning to the Union River to determine origin. The assessments of salmon origin show that returns to the Union River since 1993 (i.e., following cessation of the broodstock program) consist of a few hatchery origin strays and a few wild or fry stocked salmon. The former are most likely strays from the Penobscot River. The latter include salmon that originated from fry stocking, natural reproduction, or wild/fry stocked strays from other rivers. A few strays into the Union River that originated from the Penobscot River, or from the other eastern Maine rivers, is consistent with the homing and straying behavior of Atlantic salmon and the typical rate of straying described in the Status Review (i.e., 2% [Fay et al. 2006]). Between 2006 and 2011, no salmon returned to the Union River. Since then, three aquaculture escapees (non-GOM DPS salmon) were captured in

2012, one salmon (wild) returned in 2013, and two (one wild and one hatchery[3]) in 2014. No adult salmon have been documented returning to the Union River since 2014 (Table 3) (URFCC 2018).

The Union River has about 12,000 units of historic spawning and rearing habitat, of which 4,062 units are considered occupied and functional spawning and rearing habitat (NMFS 2009a). Most (67%) of the potential Atlantic salmon habitat is located in the West Branch of the Union River based on surveys that were conducted in the late 1950s (Havey 1961; Baum 1982)[4]. The main stem of the river and tributaries (above Ellsworth Dam) account for 16 percent of the salmon habitat, with the balance occurring in the East Branch (13%) and Middle Branch (3%) of the system. Using an assumed production of 3.0 smolts/100 square yards of stream bottom, and a marine survival of 1-3 percent, the habitat in the Union River above Ellsworth could generate a self-sustaining run of about 250-750 salmon (Baum 1997). Additional production of adult salmon could result from fish spawning in three minor tributaries below the Ellsworth Dam (Meadow Stream, Patten Stream, and Card Brook).

TABLE 3
UNION RIVER SALMON RETURNS BY ORIGIN

Year	Aquaculture*	Hatchery	Wild	Total
1973 - 1986	0	1892	4	1896
1984	undetermined	40	0	40
1985	undetermined	82	0	82
1986	undetermined	67	0	67
1987	undetermined	63	0	63
1988	undetermined	45	2	47
1989	undetermined	30	0	30
1990	undetermined	21	0	21
1991	undetermined	2	6	8
1992	undetermined	4	0	4
1993	undetermined	0	0	0
1994	undetermined	0	0	0
1995	undetermined	0	0	0
1996	undetermined	68	1	69
1997	undetermined	8	0	8
1998	undetermined	13	0	13

[3] Wild and hatchery Atlantic salmon returning to the Union River are considered part of the GOM DPS.
[4] As noted, in 2011, 19,000 fry and 282 excess brood stock (pre-spawn) were stocked in the West Branch Union River in Amherst (URFCC 2015). Spawning activity was assessed through redd counts near the release location, and over 200 redds were well distributed through the area (Figure 9).

Year	Aquaculture*	Hatchery	Wild	Total
1999	63	6	3	72
2000	3	2	0	5
2001	2	0	0	2
2002	6	5	0	11
2003	0	1	0	1
2004	0	1	1	2
2005	4	0	0	4
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	3	0	0	3
2013	0	0	1	1
2014	0	1	1	2
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	0	0

Source: URFCC 2018.
* Aquaculture fish are not considered GOM DPS Atlantic salmon.
Note: Salmon returns before 2000 included rod and trap captures.

4.2 Atlantic Sturgeon and Shortnose Sturgeon

Atlantic sturgeon have been observed in the Union River below Ellsworth Dam, according to state fishery personnel. The status of the populations of Atlantic sturgeon and shortnose sturgeon, which may also occur in the river, is unknown at this time (URFCC 2010). In the Status Review of Atlantic sturgeon, it was noted that, "The geomorphology of most small coastal rivers in Maine is not sufficient to support Atlantic sturgeon spawning populations, except for the Penobscot and the estuarial complex of the Kennebec, Androscoggin, and Sheepscot Rivers," though subadults may use the estuaries of smaller coastal drainages during the summer months (Atlantic Sturgeon Status Review Team 2007). Zydlewski et al. (2011) found that shortnose sturgeon use small coastal rivers as they migrate between the Kennebec and Penobscot Rivers.

Historically, Atlantic and shortnose sturgeon had very limited access to the Union River. From review of the limited bathymetry data of the original river channel that has been inundated by

Leonard Lake, there may be steep gradient reaches that would have historically kept Atlantic and shortnose sturgeon from accessing the Union River above the site of the Ellsworth Dam. Specific to the Union River, NOAA-Fisheries deployed acoustic monitoring receivers in the Union River approximately 1.5 km downstream of the Ellsworth Dam between 2008 and 2016. During this time, two acoustic-tagged Atlantic sturgeon were detected in the vicinity, the first on June 20, 2011, and the second on June 23 and June 24, 2014 (Pers. Comm., G. Goulette, NOAA-Fisheries, March 30, 2018).

5.0 Potential Effects from Existing Conditions on Listed Species

5.1 Atlantic Salmon

The following section examines the effects of existing Project conditions and operations on various life stages of Atlantic salmon. Section 6 describes the additional measures and actions included in the proposed SPP and evaluates the effects of those measures and actions to improve Atlantic salmon protection at the Project.

5.1.1 Life Stage Assessments of Project Interactions

The Union River in the Project area serves as a migration corridor to suitable spawning habitat upstream of the Project. There is no documented salmon spawning and rearing habitat downstream of the Project. Thus, the life stages of Atlantic salmon affected by the Project include adults migrating upstream to spawn and downstream migrating smolts and kelts (Fay et al. 2006). Some of the effects of the existing Project on Atlantic salmon adults and smolts have been reduced through provision of upstream fish passage (vertical slot upstream fish passage and trapping facility) and downstream fish passage (downstream fish bypass facility integral at each dam). The additional measures included in the proposed SPP and described in Section 6 will provide further protection for these life stages of Atlantic salmon.

5.1.2 Upstream Passage

This section evaluates the effects of the existing Ellsworth Project and its operation on upstream passage of adult Atlantic salmon.

The upstream fish passage facility at the Ellsworth Project is designed to trap Atlantic salmon and other anadromous fish and to transport fish to suitable upstream habitat located above the Project dams. Trap and transport systems have been used successfully to pass other species, such as for shad restoration on the Susquehanna River and river herring restoration in the Sebasticook River. Sigourney et al. (2015) evaluated trap and transport of Atlantic salmon on the Penobscot River over four mainstem dams and found it increased arrival success, decreased transit time, and that fish transport did not strongly influence passage.

The existing Ellsworth Dam fishway trap and transport facility is managed in consultation with the agencies, and historically, MDMR has annually directed Black Bear whether to transport any returning adult Atlantic salmon upstream of the Project. The vertical slot upstream fish passage and trap and transport facility enhances habitat connectivity by providing migrating adults entering the Union River with access to suitable spawning habitats upstream. However, trapping, trucking, and transporting of adult Atlantic salmon can potentially have adverse effects from migration delay/interruption, and handling and holding stress or injury.

Empirical studies to evaluate the upstream passage effectiveness for adult Atlantic salmon at Ellsworth Dam have not been conducted to date, primarily due to a lack of available study fish. However, in 2015, Black Bear conducted an Upstream Atlantic Salmon Passage Study to evaluate whether increased operations at the trapping facility resulted in an increase in the capture, or rate of capture, of adult Atlantic salmon. The Ellsworth Dam fishway trap was operated from sunrise to sunset from May 1 to October 31 and checked at least four times a day. No Atlantic salmon were collected or observed in 2015, nor in any following years (through 2018) at the Ellsworth Project.

Hydroelectric facilities may also result in delays of upstream migration of Atlantic salmon. Several studies on the Penobscot River have evaluated upstream passage behavior, including the time needed for individual adult salmon to pass upstream (via fishway) of various dams once detected in the vicinity of a spillway or tailrace. These studies have documented certain migratory behaviors that may contribute to migration delays, including frequent upstream and downstream movement, periods of holding in fast water, seeking thermal refuge in tributaries, attraction to spillage at dams, reduced migratory behavior in late summer, and inhibited movement at temperature above 23°C (Power and McCleave 1980, Shepard 1995).

On the Union River, as part of the ongoing relicensing of the Project, Black Bear reviewed historic information relating to Ellsworth Project operations and environmental conditions during historic captures of Atlantic salmon to assist in evaluating the efficacy of the trap and truck facility and operations (Black Bear 2014). Recorded data on fishway operations when salmon were captured were available for years 2002 to 2005. There were no apparent trends in salmon captures and flow conditions, as salmon were collected over a wide range of river flows from summer flows as low as 48 cfs to the higher June flow of 937 cfs. Salmon were also captured over a range in temperatures up to 74 degrees Fahrenheit (°F). The fish trap was not operated when water temperatures were at or exceeded 77°F, as per direction from Atlantic Sea-Run Salmon Commission and MDMR protocol. Temperatures in the upper seventies are more typical of late summer when salmon are not expected to be entering the river, or would be expected to be holding in thermal refugia. It was assumed that the fish trap at the Ellsworth Dam would be closed for up to a week or two each year when temperatures exceed 77°F. (Water quality studies in 2013 confirmed water temperatures in excess of 77°F in the river reach below Graham Lake.)

The MDMR protocol was revised in 2015 (MDMR 2015 draft), and the current MDMR protocol for the Union River is to minimize handling of Atlantic salmon when the river temperature exceeds 73.4°F; therefore, any Atlantic salmon collected in the trap are to be adipose punched and returned immediately to the river adjacent to the trap (MDMR 2018). Black Bear follows the current MDMR protocol.

Run size relative to fishway design and operation can also be a contributing factor to migration delay. Baum (1997 *cited in* URFCC 2010) used an assumed production of 3.0 smolts/100 square yards of stream bottom, and a marine survival of 1 - 3 percent, and estimated the habitat in the Union River upstream of the Ellsworth Project could generate a self-sustaining run of about 250 - 750 Atlantic salmon. More recently, marine survival has been estimated to be 0.09 to 1.02 percent, from 1995 to 2004 (ICES 2008 *cited in* USFWS and NMFS 2009); which would result in a run of approximately 250 or less fish based on the Baum assumptions.

Fisheries management agencies have expressed a concern for the safe, timely, and effective passage of Atlantic salmon adults at the Ellsworth Dam fishway, especially during river herring harvest operations, and the potential for migration delay due to fishway crowding or infrequent trap and transport operation. Under current operations, the trap and hopper are visually inspected for Atlantic salmon. If one is spotted, the hopper is left in the water and the salmon is dip-netted out and placed in a holding tank. The salmon is then measured, examined for fin clips, fin wear, or other markings; a scale sample is taken; and the magnified scale image and fish photo is digitally captured. This information is transmitted to the MDMR, which then determines whether the Atlantic salmon caught in the fishway are to be released downstream of the Ellsworth Dam (unknown origin, or lack of direction from MDMR); moved via transport tank truck upstream (GOM hatchery origin or wild fish) and released in the West Branch of the Union River, approximately 17 miles upstream; or removed (aquaculture escapees). Generally, this process takes one to two hours.

The Ellsworth Dam fishway trap and transport facility was originally designed and operated to pass Atlantic salmon. Historically, the facility handled up to 263 adult Atlantic salmon broodstock in a year, including times concurrent with alewife harvesting. Between 2000 and 2015, trap and transport facilities and operating protocols at Ellsworth provided for the handling of 190,000 to 1,200,000 river herring and 0 to 8 Atlantic salmon, annually.

In 2014, Black Bear examined the Ellsworth fishway hopper capacity for salmon with regard to the estimated maximum self-sustained run size of 750 Atlantic salmon (Baum 1997 *cited in* URFCC 2010), and found that the Ellsworth lift hopper has more than four times the required capacity to pass a run of 750 Atlantic salmon (Black Bear 2014). Many river herring also use the trap, and there is concern that this could limit Atlantic salmon use during peak periods of the river herring run. Black Bear conducted an Upstream Fish Passage Alternatives Analysis as part of the Ellsworth Project relicensing process that evaluated the adequacy of the existing fishway facility to handle design populations of multiple species and potential fishway modifications and alternative designs (e.g., excluding river herring from the hopper; the Upstream Fish Passage Alternatives Analysis was included as an appendix to the December 2015 License Application).

The upstream fishway and trap and truck facility has not been tested for efficiency and safe handling of Atlantic salmon due in part to the lack of adequate numbers of returning adults. Based on the literature review of effects of other similar fishways, operation of the Ellsworth fishway may affect adult Atlantic salmon through migration delay. Some adult Atlantic salmon that successfully used upstream fishways or had been transported and released upstream have been known to drop back downstream. In studies of upstream migrating adult Atlantic salmon in the Penobscot River, Sigourney et al. (2015) observed a 2.4-2.6% fallback rate for trucked salmon. Spencer et al. (2010, 2011) observed variable fallback rates. Study fish were collected at the Veazie Dam fishway in late spring/summer and then transported and held at the Craig Brook National Fish Hatchery until the fall spawning season. The selected study fish were tagged and released in early October in the upper Piscataquis River, approximately 150 km upstream from the original Veazie capture site in the lower Penobscot River. Nearly half of the study fish moved downstream immediately after release, with the distance traveled varying from a few kilometers to 152 km.

Many of the study fish then resumed upstream movement, while some were suspected to have spawned at other locations. The authors theorized that some of the tagged Atlantic salmon were homing to their original smolt release site near Bradley (Spencer et al. 2010).

Migratory delays for upstream migrating salmon may also be affected by river flow. During the Ellsworth Project relicensing, agencies expressed concern that Project peaking flows may be affecting aquatic habitat and upstream passage effectiveness downstream of the Ellsworth Dam. During the Upstream Fish Passage Study conducted by Black Bear in 2014 and 2015, it was consistently observed that anadromous fish (river herring) occurrence and densities in the river downstream of Ellsworth Dam were higher in the afternoon and evening (prior to sunset) hours, regardless of river flow or other conditions. A review of Project operations/river flow data did not indicate that fish migration or fishway numbers responded to changes in flow. Because river herring are a weaker swimming fish species compared to other diadromous species (Bell 1991) and can access the river below Ellsworth Dam, it is expected that turbine discharge would not affect other diadromous fish species from accessing Ellsworth Dam.

5.1.3 Downstream Passage - Smolts

This section evaluates the effects of the existing Ellsworth Project and its operation on downstream passage of Atlantic salmon smolts. During relicensing, Black Bear conducted downstream Atlantic salmon smolt studies. Black Bear has also undertaken significant additional measures to enhance downstream smolt passage at the Ellsworth Project dams, including structural and operational modifications to the downstream passage facilities. The effects of the existing Project conditions, including recent modifications to downstream passage facilities and operations undertaken by Black Bear are discussed herein. Section 6 describes and evaluates the effects of additional measures for downstream passage of Atlantic salmon smolts to be undertaken in the proposed SPP, which includes the installation of trashracks with reduced clear-spacing (i.e., 1-inch, clear-spaced, full-depth trashracks), modification to the downstream fishways, and improved guidance to these fishways.

Downstream passage facilities are provided at both of the Project dams. The downstream fish passage facility at each of the dams consists of a stoplog-controlled surface weir leading to a plunge pool immediately downstream of each dam. Historically, the downstream fish passage weirs have been operated from April 1 to December 31 each year, as river conditions allow.

The presence of dams can potentially affect downstream migrating Atlantic salmon smolts in several ways. Dams can cause downstream migration delays for salmon smolts. Also, if salmon pass through the turbines, there is a risk of injury or mortality from blade strike or other factors. To further understand the effects of the Ellsworth Project dams on Atlantic salmon smolts, Black Bear conducted a desktop fish entrainment and downstream passage assessment, as well as undertook 2 years (2016-2017) of downstream smolt passage studies at the Project, which are described below.

5.1.3.1 Downstream Fish Passage Studies

In a 2014 relicensing study, Black Bear conducted a desktop fish entrainment and downstream passage assessment (referred to as the Downstream Fish Passage Study [Black Bear 2014]) to evaluate downstream passage at the Project for Atlantic salmon smolts and kelts (along with other species), including the potential for entrainment, turbine-induced mortality, migratory route selection, and whole station survival. The results of this study are reported in the Initial Study Report (Black Bear 2014). Following the 2014 desktop Downstream Fish Passage Study (Black Bear 2014), Black Bear conducted two field seasons of empirical downstream salmon smolt passage studies in 2016 and 2017. These studies were designed to examine the effectiveness of the downstream passage facilities at Ellsworth. The study plan for the 2016 effort was prepared in consultation with the agencies and in accordance with FERC's December 30, 2014 Determination on Requests for Study Modifications and New Studies for the Ellsworth Hydroelectric Project. The study plan was filed with FERC on March 31, 2015, and approved by Order from the FERC dated April 21, 2015. The study was conducted in spring 2016, and based on those results, a second year of study was proposed and conducted in 2017 to evaluate temporary downstream passage modifications made at both dams. In addition, Black Bear voluntarily conducted an independent study of direct injury and relative survival of fish (juvenile brown trout used as surrogate for Atlantic salmon smolts) that were passed through each turbine type, as well as through the downstream fishway at the Ellsworth Dam (Normandeau 2016, 2017).

Graham Lake Dam

At the Graham Lake Dam in 2016, only 23 percent (23 of 100 smolts) of the smolts released upstream approached the dam and were passed downstream. The median residence time for these smolts was 79.8 hours (range = 2.1-287.4 hours; average = 106.5 hours) (Table 4). Based on the 2016 study results, Black Bear, in consultation with the agencies, undertook some modifications to the downstream passage weir at Graham Lake Dam to try to improve the approach, reduce delay, and increase downstream smolt passage rates and survival. The approach to the downstream passage weir at Graham Lake Dam was modified by adding a sloped floor, two side panels, and a bell-shaped entrance to create an Alden weir to improve approach velocities and fish attraction to the weir. The smolt study was repeated in 2017 following these modifications. In addition, test smolts were released in a different location in 2017 and additional telemetry monitoring locations were added. The 2017 smolt study found improved passage results when 83 percent (86 of 104) of the smolts released upstream approached and passed downstream of Graham Lake Dam. Most of these smolts (73%) utilized the modified downstream bypass route (Table 4), and 67 percent of the smolts that passed downstream of Graham Lake Dam in 2017 did so in less than 24 hours (Normandeau 2016, 2017).

In summary, in 2016 survival of smolts that passed through Graham Lake Dam was 14 percent (95% CI = 8.0 – 21.0%), and included mortality from background effects (e.g., predation), along with direct Project-related effects. In 2017, following modifications to the downstream passage weir, smolt survival at Graham Lake Dam increased to 74.4 percent (95% CI = 65.5 – 82.5%) in 2017, and 82.2 percent (95% CI = 68.4 – 98.2%) when corrected for background mortality (Normandeau 2016, 2017) (Table 4). Comparison of these results suggest that the weir modifications to create an Alden weir improved passage conditions at Graham Lake Dam. Other factors that may have contributed to the improved downstream passage and movement rates were higher spring flows in 2017 compared to 2016, and changes in smolt release location (Normandeau 2017).

TABLE 4
GRAHAM DAM 2016 AND 2017 DOWNSTREAM SMOLT PASSAGE STUDY RESULTS

	2016	2017
Residence Time	median = 79.8 hours range = 2.1-287.4 hours mean = 106.5 hours	median = 5.6 hours range = 0.1 – 118.1 hours mean = 20.7 hours
Passage Route Utilization	NA	73% bypass 27% undetected during passage or through bottom opening gates
Survival	14% (95% CI = 8.0 – 21.0%) – not corrected for background mortality	74.4 percent (95% CI = 65.5 – 82.5%) – not corrected for background mortality 82.2% (95% CI = 68.4 – 98.2%) – corrected for background mortality

Ellsworth Dam

Acoustic-tagged smolts were utilized in the 2016 and 2017 Ellsworth Dam survival studies to track smolts downstream of the Project and into brackish water. Radio tags were also detected in the 2016 study, and survival was calculated for radio-tagged and acoustic-tagged smolts in 2016 (but not in 2017). In the 2016 study, survival for radio and acoustic-tagged smolts were comparable at the Ellsworth Dam (73.7% [95% CI = 61.4 – 84.2%] for acoustic-tagged smolts; 74.6% [95% CI = 64.8 – 84.5%] for radio-tagged smolts). Background mortality was not accounted for in the 2016 study. In 2016, 59.1 percent of radio-tagged smolts passed downstream through Units 2 and 3[5], and 37.9 percent via the downstream fish bypass system at the Ellsworth Dam[6] (Table 5) (Normandeau 2016).

Since the 2016 study showed a high level of smolt passage through the Ellsworth powerhouse and high residence times in the forebay, three approximately 7-foot-wide sections of flashboards adjacent to the existing downstream passage weir were removed to provide an additional bypass passage route through the flashboard section and over the spillway for the 2017 study. In addition, Black Bear resurfaced the section of spillway below the area of removed flashboards to limit injury of smolts utilizing this passage route.

[5] Unit 1 was not operated during the 2016 smolt study due to low river flows that study year.
[6] Passage Route percentages do not total 100% because passage routes could not be identified for several radio-tagged smolts each study year.

These modifications resulted in mean and median residence time improvements in 2017 (median = 1.5 hours; range = 0.2 - 39.5 hours; mean = 5.6 hours), compared to 2016 (median = 17.9 hours; range = 0.6 - 213 hours; mean = 29.9 hours) for radio-tagged smolts. Similarly, the 2017 acoustic-tagged smolts had a median residence time of 5.7 hours (range = 0.1 – 104.2 hours; mean = 16.6 hours), compared to 21.9 hours (range = 0.1 – 355.7 hours; mean = 55.1 hours) for acoustic-tagged smolts in 2016 (Table 5). It is also possible that higher mean river flow in 2017 contributed to reduced residence time.

In addition, the flashboard removal combined with operation of Unit 1 created more downstream passage route options for smolts at the Ellsworth Dam in 2017 compared to 2016. In 2017, 30.6 percent of radio-tagged smolts passed through the open flashboards, with 59.4 percent through Units 1-3, and 6.6 percent via the downstream fish bypass system. The percentage of smolts passing through the turbines was similar for both years of study. In 2017, the Ellsworth Dam smolt survival (including background mortality) was estimated at 62.3 percent (95% CI = 48.6 – 74.2%), and at 80.8 percent (95% CI = 64.4 – 93.6%) when corrected for background mortality (Normandeau 2016, 2017) (Table 5).

TABLE 5
ELLSWORTH DAM 2016 AND 2017 DOWNSTREAM SMOLT PASSAGE STUDY RESULTS

	2016	2017
Residence Time (radio-tagged smolts)	median = 17.9 hour range = 0.6 - 213 hour mean = 29.9 hour	median = 1.5 hour range = 0.2 - 39.5 hour mean = 5.6 hour
Residence Time (acoustic-tagged smolts)	median = 21.9 hour range = 0.1 – 355.7 hour mean = 55.1 hour	median = 5.7 hour range = 0.1 – 104.2 hour mean = 16.6 hour
Passage Route Utilization	59.1% through turbines 37.9% bypass	59.4% through turbines 6.6% bypass 30.6% through open flash boards
Survival (radio-tagged smolts)	74.6% (95% CI = 64.8 – 84.5%)– not corrected for background mortality	NA
Survival (acoustic-tagged smolts)	73.7% (95% CI = 61.4 – 84.2%) – not corrected for background mortality	62.3% (95% CI = 48.6 – 74.2%) - not corrected for background mortality 80.8% (95% CI = 64.4 – 93.6%) - corrected for background mortality

5.1.3.2 Delayed Mortality

Delayed mortality is a potential effect from smolt passage at hydropower projects. There is considerable uncertainty regarding how to assess indirect survival (delayed mortality), given the difficulty in measuring it (NMFS and USFWS 2005). Indirect survival, or delayed mortality, has been evaluated at some west coast projects. Alden (2012) used results from these studies that averaged 93 percent for indirect survival, and based on professional judgment, suggested that indirect survival would be 95 percent for Atlantic salmon passing the Penobscot River hydroelectric projects in Maine, due to the low head relative to the west coast projects where the studies were performed. The results of some more recent studies conducted on the Penobscot River system have attempted to quantify differences in survival for smolts migrating through free-flowing river reaches and impounded river reaches and decreased estuarine survival for smolts migrating past multiple dams (Stich et al. 2015). However, challenges remain in regards to quantifying delayed or indirect mortality and, therefore, neither was included as part of this analysis. Rather, only direct survival was evaluated for smolt passage at Ellsworth and Graham Lake dams (Black Bear 2014).

An Injury and Survival Study was performed at the Ellsworth Project as part of the 2017 Downstream Smolt Passage Effectiveness and Survival Study, which address delayed mortality. Results of this study found that juvenile salmonids survived one hour after passage at estimated rates of 84.4 percent, 65.9 percent, and 98.1 percent for Unit 1 (vertical shaft propeller turbine), Unit 2 (Kaplan turbine), and the downstream fish bypass system, respectively. The 48-hour, after-passage survival rate estimates were 81.0 percent, 62.4 percent, and 96.2 percent, respectively. The dominant injuries observed for fish through Unit 1 were bruising (5.6%), severance/decapitation (3.7%), and broken bones (3.7%). Unit 2 injuries included 8.1 percent severance/decapitation, and 8.1 percent gill/operculum damage. Only two fish were injured passing through the downstream bypass system. Compared to other similar studies, the survival estimates are lower and injury rates are higher for the Kaplan turbines (Units 2 and 3) at the Ellsworth Dam than at other hydropower facilities. This may be attributed to the small runner diameter and high runner speed of the Ellsworth turbines compared to other Kaplan units studied; these are known parameters that affect survival (Normandeau 2017). Unit 2 is composed of the smallest runner diameter and highest runner speed compared to all other Kaplan/propeller type turbines evaluated using the HI-Z tag methodology. Two general trends observed from previous studies suggest that survival decreases with an increase in runner speed and survival increases as runner diameter increases. The relatively small diameters (4.65 and 5.0 feet) and rotational speeds of the runners (200 and 360 rpm) of Units 1 and 2, respectively, increase the probability of injury and mortality during passage through these units (Normandeau 2017).

5.1.4 Downstream Passage - Kelts

As kelt abundance at the Ellsworth Project is currently low, there is no information on Atlantic salmon kelt passage for the Ellsworth Project. However, based on evaluations done for salmon kelts on the Penobscot River, summarized below, it is assumed that kelts at Ellsworth would pass over the spillways, through the downstream bypasses, or, depending on trashrack spacing, through turbines during out-migrations.

Downstream passage success of kelts was assessed on the Penobscot River at Weldon Dam and several other sites in the lower Penobscot River (GNP 1989, Shepard 1989, Hall and Shepard 1990). The study fish were hatchery kelts that were tagged and released in the spring, and the kelts tended to move downstream with high flows in early spring (mostly April through early May). Some of the adult salmon tagged at Weldon Dam during the fall upstream spawning migration returned downstream after spawning, and several of these pre-spawn tagged salmon returned downstream prior to spawning, indicating they may have been imprinted on other areas in the watershed and were trying to locate these areas (GNP 1989).

Kelt studies in the lower Penobscot River documented that most kelts passed the dams during high flow periods, typically over the spillways, but also through gates and sluices (Hall and Shepard 1990). The initial approach of kelts at the Veazie and Milford Dams reflected the distribution of flow, which means the proportion of kelts that approached spillways was highly correlated with spillway flow. Similarly, at the confluence of the Stillwater Branch and the main stem, kelts followed the routes in approximate proportion to flow in the two channels (Shepard 1989). Kelts that approached powerhouse intakes were deterred by trashracks and sought alternative routes of passage, typically passing via spillage after hours to days at the site (GNP 1989, Hall and Shepard 1990) and there were no mortalities in the two years of study (Hall and Shepard 1990).

In 2010, eight fish that migrated downstream of Veazie Dam were recaptured 17 days after being released in the Piscataquis River, and “appeared in excellent condition and showed no adverse effects from passing downstream over multiple (seven) dams" (Spencer et al. 2011). Spencer et al. (2010) reported a number of tagged Atlantic salmon passing downstream over multiple dams, including a gravid female that was resuming upstream migration and appeared in excellent health despite passing seven dams. It should be noted that in normal flow years, the Ellsworth Dam spills about 11 percent of the time in May, while it spills about 21 percent of the time in April. In addition, the Ellsworth Dam spills approximately 16 percent of the time during the downstream kelt passage season (November 1 – June 1).

From the 2014 desktop Downstream Fish Passage Study (Black Bear 2014) briefly summarized above, Atlantic salmon kelts are expected to be fully excluded by trashrack spacing at the Project (2.44-inch clear space at Unit 1, and 1.0-inch on the top half, and 2.37 inches on the bottom half on Units 2, 3, and 4). This finding is supported by a downstream passage assessment conducted by Alden (2012), which suggests 100 percent kelt exclusion at Maine hydroelectric projects with trashrack clear-spacing less than 2.4 inches. Kelts could experience impingement on trashracks if hydraulic conditions exceed the kelt's swimming capabilities; however, according to observed burst swim speeds of adult salmon ranging from 16.5 to 19.7 feet per second (Wolter and Arlinghaus 2003), salmon kelts can easily avoid involuntary entrainment or impingement, and have no risk of entrainment due to their inability to pass through trashracks less than 2.4 inches (Alden 2012), and would likely have a 100 percent bypass effectiveness rate at the Project (via downstream bypass, or over the spillway if spill is occurring).

The Ellsworth Project's effects on downstream passage of Atlantic salmon kelts are expected to be improved through the implementation of the proposed SPP actions described in Section 6, which includes the installation of trashracks with reduced clear-spacing (i.e., 1-inch, clear-spaced, full-depth trashracks), modification to the downstream fishways, and improved guidance to these fishways.

5.1.5 Migration Delay

Smolt migration from freshwater to estuarine environments must be completed during a brief period of suitable environmental conditions—what researchers have termed a "smolt window"—or they may suffer irreversible effects that reduce their survival upon entering seawater (McCormick et al. 1999). Studies of Atlantic salmon smolt migration at other locations have documented certain migratory patterns, diel behaviors, responses to hydroelectric project structures, and effects of water temperature and river flow.

Smolt migration is primarily nocturnal in the early phases of the run (Ruggles 1980, Mudre and Saunders 1987, Shepard 1991). During the later phases of the smolt run, smolts exhibit movements throughout the day. During daylight, smolts generally cease migrating and hold station to avoid predators, most of which use vision to locate their prey. Daytime holding habitats tend to have characteristics similar to large parr habitats (i.e., moderate velocity, shallow depth, and large substrates), when these habitats are available (BPHA 1994).

Barriers may affect the timing of the smolt migration. Migrating fish that do not reach the sea within the physiological smolt window may start reverting to the parr condition (Hoar 1988, Nielsen et al. 2001, Shrimpton et al. 2000). Thus, any significant delay of smolts may result in fish either becoming residents or reaching the estuary in sub-optimal physiological condition (McCormick et al. 1998; Shrimpton et al. 2000). Late migrants lose physiological smolt characteristics due to high water temperatures during spring migration (McCormick et al. 1999).

The onset of the smolt migration has often been linked to a thermal threshold of 10°C, although the rate of increase may be a more important environmental stimulus than the absolute temperature (Jonsson and Ruud-Hansen 1985). While not specifically assessed in the Union River, naturally-reared and wild smolts in Maine typically enter the sea during May to begin their ocean migration (Fay et al. 2006). In the Penobscot River, smolts migrate between late April and early June with a peak migration in early May (Fay et al. 2006). The peak of movement shifted from year to year in response to environmental conditions (Bakshtansky et al. 1976, Jonsson and Ruud-Hansen 1985). Smolt migratory movement is a combination of passive entrainment with flow, particularly in areas of high water velocity, and active swimming (Ruggles 1980). Active swimming speeds may exceed 1 meter per second for prolonged periods (Vanderpool 1992, Shepard 1993) and can include directed movement through very large lakes and reservoirs in the absence of rheotactic cues (Bourgeois and O'Connell 1986).

At the Ellsworth Project, smolts may pass the Project facilities through a combination of routes. At the Graham Lake Dam, smolts may pass either via the dedicated passage weir, or via the Tainter gates when they are open. At the Ellsworth Dam, smolts may pass via the three dedicated passage weirs that constitute the downstream fish bypass system, via spill depending on operations/river flow, or via the turbines. Results of passage route utilization and residency time within the Graham Lake Dam and Ellsworth Dam headponds during the 2016 and 2017 studies were presented above.

No information on Atlantic salmon kelt migration is available for the Ellsworth Project, but evaluations were conducted on the Penobscot River. MDMR research tracking tagged adult salmon (transported from Veazie Dam to spawning habitat in the Piscataquis River) has shown that adults can drop downstream quickly past many dams (Spencer et al. 2010, 2011). Researchers noted that "the presence of dams did not appear to impede downstream movement of motivated salmon and some fish passed seven dams in as many days." In two years of kelt telemetry studies at Veazie and Milford Dams, 35 of 49 kelts were delayed less than 2.0 hours (minimum – 0.1 hour, maximum – 155 hours) before finding a safe route of passage in spilled water.

The Ellsworth Project's effects on migration delay for Atlantic salmon are expected to be improved through the implementation of the proposed SPP actions described in Section 6, which includes improvements to upstream and downstream fish passage facilities. Also as discussed in Section 6, Black Bear is committed to achieving upstream and downstream performance standards under the new license.

5.1.6 Habitat in Project Area

The Union River watershed is listed as critical habitat for Atlantic salmon (See Section 1.2.2). The Union River contains two main stem dams (the Ellsworth and Graham Lake Dams) and numerous tributary dams, primarily at the outlets of lakes and ponds. The Project's upstream passage (trap and truck from the Ellsworth Dam) and downstream passage facilities (at both dams) allow access to spawning and rearing habitat but the efficacy of this passage method has not been tested, primarily due to low numbers of returning salmon. Further, low-level stocking has occurred; consequently, very few salmon parr would be expected to utilize the habitat for growth and development to the smolt stage prior to out-migration through the Project area. The proposed SPP actions described in Section 6 are expected to provide increased access to and utilization of habitat in the Project Area.

5.1.6.1 Project Impoundments

Graham Lake is about 10 miles long with a surface area of approximately 10,000 acres; Graham Lake is relatively shallow, with an average depth of approximately 17 feet, and it showed only weak short-term stratification during water quality studies conducted in 2013. The temperature in Graham Lake was fairly uniform through the water column on each of the summer sampling dates. Lake Leonard is about one mile long with a surface area of 90 acres; it averages 25 feet deep and is approximately 55 feet deep at its deepest point. Lake Leonard showed some thermal stratification during the 2013 studies. Article 402 of the 1987 FERC license specifies that the licensee operate the Ellsworth Project so that the following normal water levels are maintained: Lake Leonard 1-foot fluctuation (65.7 feet to 66.7 feet) and Graham Lake 10.8-foot fluctuation (93.4 feet to 104.2 feet). As stated in Section 2.2, Black Bear has proposed in the December 2015 application for a new license to continue these fundamental operating parameters for the Ellsworth Project.

In general, dam impoundments increase water depth, increase the water retention time (decreased flushing rate) within a given river reach, and dampen daily fluctuations in water temperatures (FERC 1997). Large and deep reservoirs that thermally stratify in summer may release water that is warmer or colder than ambient inflows, depending on the depth of withdrawal in relation to the depth of the thermocline, whereas run-of-the-river impoundments are typically shallow and have little effect on water temperatures (EPA modeling conducted on the Columbia River; Public Utility District No. 1 of Chelan County 2005). Water quality studies conducted at Graham Lake during relicensing did not show significant stratification, and therefore the depth of discharge would not affect outflow temperatures. Impoundment conditions that result in reduced flow cues can result in migratory delay and result in habitat changes that are preferred by warmwater species that prey on juvenile Atlantic salmon, such as largemouth and smallmouth bass (NMFS and USFWS 2015). Impounded waters can also result in slower water velocities which may result in longer migration times and increased risk of predation. The 2016 downstream smolt passage study estimated an impoundment mortality rate for the 15.5 km study reach in Graham Lake, which equates to 0.97%/km. This mortality rate is in line with mortality rates observed for Atlantic salmon smolts in riverine reaches (free flowing and impounded) of the Penobscot, Kennebec, and Androscoggin rivers (Normandeau draft 2018).

Additional study is needed to better understand the impoundment mortality rate and predation risk of salmon smolts moving through Graham Lake from the West Branch Union River where the spawning and rearing habitat is located.

Graham Lake provides a majority of the spawning and rearing habitat for river herring in the Union River watershed, and Black Bear's trap and transport efforts have allowed for development of one of the largest alewife runs in the country. NMFS has suggested that increased river herring populations may provide some predation buffer to Atlantic salmon (NOAA 2009). Atlantic salmon adults (depending on their origin) collected in the upstream fish trap are transported upstream of Graham Lake where they have access to suitable spawning habitat in the West Branch of the Union River and other tributaries.

5.1.6.2 Riverine Sections

The Ellsworth Project operates in a store and release mode while maintaining minimum flows and modest generation at all times. The current Project license requires that Black Bear release a continuous minimum flow of 105 cfs from the Graham Lake Dam and the Ellsworth Dam from July 1 through April 30, and a continuous minimum flow of 250 cfs from May 1 through June 30 to protect fishery resources. Black Bear proposes to continue these minimum flows under the terms of a new license. Because the Ellsworth Project starts at the head of tide, there are no Project flow effects on juvenile salmon habitat below the dam. Observations below the Ellsworth dam indicate the river bed remains watered under minimum flow conditions with no evidence of areas of potential stranding.

Minimum flow releases from the Project dams have protected and maintained the area fisheries. This was demonstrated in the relicensing study (Instream Flow and Union River Tributary Access Study [Black Bear 2015]) conducted in 2014. Flows analyzed included two low flows (150 and 300 cfs), a mid-range flow (1,230 cfs), and a high level (2,460 cfs) generating capacity flow. The study found that aquatic habitat criteria for Atlantic salmon are sufficient at all flows analyzed. In addition, a zone of passage is provided throughout the Union River during the observed low flows. Projecting the hydraulic parameter curves from 150 cfs to the target 105 cfs, the depths and velocities throughout the study reaches continued to meet the aquatic habitat criteria, and the wetted widths of the channel provided habitat connectivity and an adequate zone of passage for Atlantic salmon (Black Bear 2015).

Pursuant to Article 404 of the current FERC license, the Bangor Hydro-Electric Company (licensee prior to Black Bear) developed a minimum flow study plan in consultation with the USFWS, NMFS, MDMR, and MDEP to study the effectiveness of the seasonal 250 cfs minimum flow downstream of the project to determine if it was adequate to provide sufficient dissolved oxygen (DO) during the river herring migration. Study results, filed with FERC on September 4, 1990, indicated that DO concentrations were not significantly reduced under the operational conditions of the study. The agencies asserted that the study was not conducted during the worst-case scenario and recommended that the licensee repeat the study when annual alewife runs were high to determine potential effects. The licensee repeated the study and found in a 2006 report that the required minimum flow provides sufficient DO and is protective of water quality for upstream migrant alewife, as well as other aquatic life, under all (including worst-case) scenarios. Resource agencies concurred with the conclusion and agreed that the current minimum flow should be maintained and that no additional DO sampling was needed (FERC Order dated October 13, 2006 Modifying Minimum Flow Study Plan Under Article 404). Black Bear proposes to continue these minimum flow releases under a new license.

5.1.6.3 Tributaries

Atlantic salmon spawning and rearing areas have been identified in the West Branch of the Union River upstream of Graham Lake (USFWS 2011) (Figure 9). Juvenile Atlantic salmon, specifically parr, seek riffle habitat associated with diverse rough gravel substrate, as typically found in tributaries (Kircheis and Liebich 2007). Parr can also move great distances into or out of tributaries and main stems to seek out habitat that is more conducive to growth and survival, such as areas of thermal refuge, resistance to dewatering, or increased prey abundance (McCormick et al. 1998). Access to tributaries for all life stages of Atlantic salmon is important.

As demonstrated in the 2014 Union River Tributary Access Study (Black Bear 2014), tributaries to the Union River between Graham Lake and Lake Leonard (Greys, Shackford, Moore, and Gilpatrick brooks) maintained adequate connectivity for Atlantic salmon and other diadromous fish and aquatic species during the flows observed. The study was also conducted in 2015 and 2016 during managed low flow conditions to include observations of additional tributaries of Graham Lake and Lake Leonard. All tributary confluences had adequate depths (> 6 inches) during the observed low flows that would allow Atlantic salmon access. In addition, the tributary confluences had low velocities that would not preclude access by Atlantic salmon. Therefore, the confluence at each of the tributaries provide a zone of passage into the tributaries for Atlantic salmon to access any suitable spawning habitat that may be present upstream in these tributaries. Natural low flows within the tributaries themselves were observed during the study, suggesting that low flows within the tributaries could potentially be a limiting factor for migratory fish accessibility further up in the tributaries.

It should be noted that Atlantic salmon typically migrate upstream following freshets (Bigelow and Schroeder 2002), rather than during the low flow period observed in this study when Atlantic salmon tend to not migrate upstream in rivers (Bigelow and Schroeder 2002). This further suggests that accessibility to these tributaries is available during the Atlantic salmon migratory season, and access to these tributaries will be improved with the implementation of the proposed SPP actions described in Section 6.

Gilpatrick Brook likely has the most preferable salmon habitat at the confluence to the Union River than the other tributaries observed, as the lower portion of this stream contained adequate depth (>1.25 ft), flow (approximately 2 ft/s), substrate (cobble and gravel), and cover (large woody debris, shoreline vegetation, boulders) suitable for various life stages of Atlantic salmon (Fay et al. 2006) (Black Bear 2014). Other tributaries evaluated and considered to provide access for diadromous fish during low flow conditions include all main Graham Lake tributaries (Hapworth Brook, Webb Brook, East and West Branches on the Union River, Garland Brook, Tannery Brook, Beech Hill Pond Stream, and Reed Brook [outlet of Green Lake]), the primary Lake Leonard tributary (Branch Lake Stream), and all main stem Union River (between lakes) tributaries (Grey Brook, Shackford Brook, and Moore Brook).

5.1.7 Maintenance Activities

Project maintenance activities affecting Atlantic salmon primarily pertain to periodic maintenance to the fishways. Black Bear has developed a site-specific Fish Passage Operations and Maintenance Plan (O&M Plan) for the fishways at this Project to ensure that the upstream and downstream fishways are operating properly, and the O&M Plan will be updated as needed and reviewed with NMFS as it pertains to the approval of the proposed SPP actions described and evaluated in Section 6. The plan, provided in Attachment B, also includes both a list of spare parts critical to fishway operation and a checklist of proper fishway operating characteristics. Since 2015, Black Bear has hired staff dedicated to operating the Project fish passage facilities; the staff are dedicated to fishway operations, oversight, fish trap tending, and transporting fish upriver. These dedicated fishway staff have completed the daily checklists and prepared weekly reports on fishway operations each year since 2015, which are provided to the fisheries management agencies throughout the fishway operational seasons. The activities performed for upstream and downstream fishway maintenance have a positive effect on Atlantic salmon, as these activities ensure the fishways remain effective.

5.1.8 Predation

Atlantic salmon smolts face predation risk during their migration from freshwater to estuarine and marine environments. Anthropogenic factors may contribute to conditions that support known predators of Atlantic salmon, such as chain pickerel, smallmouth bass, and double crested cormorants (Fay et al., 2006). Dams may increase predation risk due to smolt disorientation, injuries, congregating behavior, and decreased abundance of other diadromous fishes that act as a prey buffer by providing a robust alternative food source for predators (Northeast Salmon Team 2011). Dam passage may also affect predator detection and avoidance by salmonids (Raymond 1979, Mesa 1994).

The Union River drainage supports a variety of resident and migratory fish species. Principal resident sportfish include landlocked Atlantic salmon, brook trout, lake trout, brown trout, splake, landlocked arctic char, smallmouth bass, largemouth bass, chain pickerel, and white perch. Populations of resident fish are maintained through natural reproduction and stocking. The Union River also contains migratory fish such as striped bass and American eel (URFCC 2010) in addition to the robust river herring population.

Fish species such as brook trout and American eel are native to all major drainages in Maine and likely feed on salmon eggs and small salmon. Introductions of top predator fish (e.g., smallmouth bass, chain pickerel, and brown trout are non-native fish species that occur in the Union River watershed) negatively affect resident fish communities by disrupting normal feeding behavior (Bystrom et al. 2007), decreasing prey abundance (He and Kitchell 1990, Findlay et al. 2005), and through extirpation of native species (Findlay et al. 2005, Bystrom et al. 2007). Striped bass are also known predators of Atlantic salmon smolts (Blackwell and Juanes 1998); however, their abundance in Maine is variable each year, indicating that predation by striped bass doesn't have an appreciable effect on Atlantic salmon populations (Beland et al. 2001).

Smallmouth bass are a warm-water species whose range now extends through north-central Maine and well into New Brunswick (Jackson 2002). Smallmouth bass are numerous in Graham Lake and occur in the riverine reaches of the Union River. Smallmouth bass likely feed on salmon fry and parr, though little quantitative information exists regarding the extent of bass predation. Smallmouth bass are predators of smolts in main stem habitats, and bioenergetics modeling indicates that bass predation is insignificant at 5°C, but increases with increasing water temperature during the smolt migration (Van den Ende 1993). Largemouth bass, another top predator species, were introduced illegally into Graham Lake in 2009 or 2010 and are expanding rapidly (pers. comm. Greg Burr, Maine Department of Inland Fisheries and Wildlife [MDIFW] July 3, 2014).

Chain pickerel, which are also common in Graham Lake, are known to feed upon salmon smolts within the range of the GOM DPS and certainly feed upon fry and parr, as well as smolts, given their piscivorous feeding habits (Van den Ende 1993). Chain pickerel feed actively in temperatures below 10°C (Van den Ende 1993, MDIFW 2002). Smolts were, by far, the most common item in the diet of chain pickerel observed by Barr (1962) and Van den Ende (1993). However, Van den Ende (1993) concluded that, "daily consumption was consistently lower for chain pickerel than that of smallmouth bass," apparently due to the much lower abundance of chain pickerel.

It is important to note that the 2016 and (to a lesser extent) 2017 Downstream Smolt Passage Efficiency and Survival Studies observed high smolt losses in Graham Lake, which is likely due to piscivorous and possibly avian predation on salmon smolts, particularly directly upstream from Graham Lake Dam (Normandeau Associates 2016, 2017). The majority of the smolt losses occurred just upstream of the dam in 2016. As noted previously, the observed smolt mortality rate during the 2016 study was in line with smolt losses observed at other river reaches in Maine when put on a per-kilometer basis. The proposed SPP actions in Section 6 includes further study on the predation of smolts in Graham Lake.

Birds known to prey upon Atlantic salmon throughout their life cycle include species such as mergansers, belted kingfisher, bald eagles, ospreys, double-crested cormorants, gulls, and gannets (Fay et al. 2006). The USFWS has concluded that avian predation poses a high-level threat to the survival and recovery of the GOM DPS of Atlantic salmon (NMFS and USFWS 2005). Blackwell et al. (1997) reported that salmon smolts were the most frequently occurring food items in cormorants sampled at main stem dam foraging sites. In a study in the Penobscot River, cormorants were present during the spring smolt migration as migrants, stopping to feed before resuming northward migrations, and as resident nesting birds using Penobscot Bay nesting islands (Blackwell 1996, Blackwell and Krohn 1997). Another study found Atlantic salmon comprised 26 percent of cormorant's diet during the smolt run (Hatch and Weseloh 1999). Meister and Gramlich (1967) studied salmon predation by cormorants in the Machias River estuary. The results of this study documented that cormorants consumed an estimated 8,000 tagged hatchery smolts during the period 1966-1967 in the Machias River. Predation rates on migrating hatchery-reared salmon smolts were found to be as high as 13.4 percent in the Machias River (Meister and Gramlich 1967).

Breeding pairs of double-crested cormorants in Maine have increased significantly since the late 1970s, and smolts are a frequent prey item (Northeast Salmon Team 2011). The abundance of alternative prey resources, such as upstream migrating alewife, helps reduce the impacts of cormorant predation on the GOM DPS of Atlantic salmon (Northeast Salmon Team 2011). Common mergansers and belted kingfishers are likely the most important predators of Atlantic salmon fry and parr in freshwater environments, as well as seals that also predate upon adult salmon (Fay et al. 2006). Studies conducted in Canada found mergansers consumed more juvenile Atlantic salmon than cormorants (NMFS and USFWS 2005). These birds are common in Maine, including the Union River watershed (Cornell Lab of Ornithology 2012).

Observations of predatory avian species were conducted as part of the 2017 downstream smolt passage study conducted at the Ellsworth Project (Normandeau 2017). Avian observations immediately upstream and downstream of Graham Lake Dam as noted by both Brookfield and Normandeau personnel, ranged from 0 to 2 birds per day of observation. The species observed included common loon, bald eagle, cormorant, osprey, and unknown gull and heron species. The number of cormorants and gulls observed just upstream of the Ellsworth Dam ranged from 20 to 115 cormorants and 3 to 16 gulls, with some fewer numbers observed downstream of Ellsworth Dam (cormorants ranged from 4 to 40, gulls ranged from 2 to 10).

A restored run of river herring in the Union River drainage is expected to be beneficial to Atlantic salmon restoration efforts, because river herring provide a predation buffer by providing predators with alternative and potentially more abundant prey.

5.2 Atlantic Sturgeon and Shortnose Sturgeon

Because sturgeon only rarely occur in the Project tailwaters, normal Project operations should have minimal effect on shortnose and Atlantic sturgeon, or their habitat. There is a potential that sturgeon could be encountered during maintenance activities, for example, during planned dewatering of the draft tubes for turbine inspection or maintenance activities; however, the likelihood of this occurring is very low due to their rare occurrence in the area. There is also a possibility that sturgeon could be captured in the fish trap and handled during the sorting process. Black Bear has developed and will implement if needed a sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations, and in the event of stranding during periodic dewatering of the draft tubes (Appendix A of the proposed SPP).

5.3 Potential for Cumulative Effects

Cumulative effects are those effects of future state and private activities, not involving federal activities, that are reasonably certain to occur within the action area (50 C.F.R. § 402.02). Cumulative effects do not include future federal or federally authorized action, which would be subject to future ESA section 7(a)(2) consultations. Activities that occur now and are expected to continue in the future include recreational fishing and boating, which are regulated by the state of Maine.

Impacts to the GOM DPS of Atlantic salmon from non-federal activities are largely unknown in the Union River. It is possible that occasional recreational fishing could result in incidental takes of GOM DPS Atlantic salmon. There is no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past. The cumulative effects from forestry and agricultural practices will continue to occur in the watershed area, potentially affecting water quality and spawning and rearing habitat.

While not directly linked to Atlantic salmon, the Ellsworth Project will continue to have positive cumulative environmental effects by providing renewable energy, thus decreasing the nation's dependence on fossil fuels and minimizing the substantial adverse cumulative effects that fossil fuels have on the environment. Cumulative effects in the Union River watershed may occur from the need to pass numerous non-licensed small dams, if located within critical habitat.

6.0 Proposed SPP Actions and Effects Analysis

This section describes the measures and actions that Black Bear proposes to undertake during the term of its new Project license as part of the attached proposed SPP (Attachment A), and evaluates the effects of these SPP measures and actions on Atlantic salmon in the Project area, Downeast Coastal SHRU, and overall GOM DPS.

6.1 Upstream Passage

6.1.1 Ellsworth Dam

The following outlines the measures and actions proposed for upstream fish passage at the Ellsworth Dam:

1) Maintain and operate the existing upstream fish passage facility at the Ellsworth Project (fishway and trap) for alosines and salmon unless new or modified fish passage measures are provided.
    a) Conduct effectiveness testing of upstream adult Atlantic salmon attraction into and passage at the existing fish trap facility subsequent to (i) below:
        i) Coordinate with resource agencies to stock uniquely marked Atlantic salmon smolts upstream of Ellsworth Dam to serve as a source of imprinted adult fish (target of 40 marked returning adults annually) for studying upstream passage once downstream passage improvements have been implemented and downstream passage testing is completed;
    b) In annual consultation with the agencies, modify the existing fishway entrance or location, and/or attraction water system or other changes, if necessary, to meet the required performance standard (see Section 3 below). Effectiveness testing is anticipated to occur for 1 to 3 years, beginning in the fish passage season following each modification.
2) Design and install new upstream Atlantic salmon passage measures 15 years following FERC license issuance. The Licensee may consult with the resource agencies prior to the specified dates/time frames to determine whether changes in management and/or restoration priorities would warrant a delay in construction of new fish passage measures.

a) Conduct effectiveness testing of new upstream Atlantic salmon passage measures (also requires stocking of smolts with a target of 40 returning adults annually, as detailed above). Effectiveness testing is anticipated to occur for 1 to 3 years, beginning in the second fish passage season after each fish passage measure is operational to allow for one season of commissioning.

3) Performance Standard – design modifications to the existing fish passage measures, and any new fish passage measures, to meet a performance standard of 90% passage effectiveness for upstream passage.[7] Performance standards shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

6.1.2 Graham Lake Dam

The following outlines the measures and actions proposed for upstream passage at the Graham Lake Dam:

1) Design and install upstream passage measures for Atlantic salmon concurrent with, but not later than, any new upstream Atlantic salmon passage measure at the Ellsworth Dam. The Licensee may consult with the resource agencies prior to the specified dates/time frames to determine whether changes in management and/or restoration priorities would warrant a delay in construction of new fish passage measures.
   a) Conduct effectiveness testing of upstream Atlantic salmon passage concurrent with the Ellsworth Dam upstream passage effectiveness testing (also requires stocking of smolts with a target of 40 returning adults annually, as described above). Effectiveness testing is anticipated to occur for 1 and 3 years, beginning in the second fish passage season after each fish passage measure is operational to allow for one season of commissioning.
2) Performance standard – any new fish passage measures to meet a performance standard of 90% effectiveness for upstream passage[8]. Performance standard shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

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[7] The 90% upstream fish passage performance standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive); measured as fish passing when the river temperature is at or below 23°C.

[8] The 90% upstream fish passage performance standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive); measured as fish passing when the river temperature is at or below 23°C.

6.1.3 Effects Analysis of Upstream Passage Measures and Actions

The proposed actions for upstream Atlantic salmon passage described above and in the attached SPP aim to continue existing practices that protect upstream migrating salmon, as well as provide additional actions and measures proposed by Black Bear in the event adult salmon are available to study and/or adult Atlantic salmon returns increase in the Union River during the term of the new license. The implementation of these actions and measures will promote enhanced upstream Atlantic salmon passage in the Union River at the Project by supporting continued existing operations and monitoring in the short-term, with the long-term goal of modifying or installing new fish passage measures for Atlantic salmon at both Project dams. Black Bear will continue to operate the upstream fish passage facility at the Ellsworth Project (fishway and trap) for alosids[9] and salmon until new or modified fishways or measures are required in the future.

Specific effects resulting from the actions and measures listed above to enhance upstream Atlantic salmon passage at the Ellsworth and Graham Lake Dams are discussed in the following paragraphs.

Limited information suggests the existing fishway is not effective at attracting and capturing upstream migrating Atlantic salmon. Fishway effectiveness has been difficult to evaluate due to the lack of study fish returning to the river. The proposed stocking of Atlantic salmon smolts upstream of Ellsworth Dam in sufficient numbers to provide a minimum target sample size of 40 returning Atlantic salmon should provide necessary numbers of study fish for evaluating the effectiveness of the fishway in coming years. Fish imprinted to waters upstream of the Ellsworth Dam will provide the most realistic evaluation of the upstream fishway effectiveness. The results of this study will provide the information needed to evaluate whether any fishway entrance/attraction water modifications are needed to meet the required performance standard, which would include increasing upstream passage efficiency of the existing or modified fishway, and decreasing migratory delay if the study determines delay occurs. Timing the study to occur after the proposed downstream passage modifications and effectiveness testing will provide the

[9] Black Bear will continue to coordinate with the MDMR on river herring stocking and escapement targets, as well as continue to coordinate and support river herring harvesting efforts. Black Bear will also consider conducting future effectiveness testing of the existing upstream fish passage facility in consultation with the agencies for American shad if management goals for this species in the Union River changes or alewife passage targets increase.

highest downstream passage survival of the stocked and marked smolts to be used for the upstream passage study when they return as adults.

The installation of new upstream Atlantic salmon passage measures at both the Ellsworth Dam and Graham Lake Dam will improve access to spawning and rearing habitats available in the Union River to support future recovery of Atlantic salmon in the Downeast Coastal SHRU and overall GOM DPS. Currently, upstream migrating Atlantic salmon collected in the Ellsworth Dam upstream fishway are trucked upstream of the Graham Lake Dam. By providing upstream passage at Graham Lake Dam, Atlantic salmon using the upstream passage at Ellsworth Dam will have access to suitable spawning and rearing habitat in tributaries located between the Project dams that are not currently accessible. Termination of the trapping and trucking of Atlantic salmon from Ellsworth Dam to Graham Lake would eliminate the potential injury and stress resulting from the handling and transport process, as well as reduce the potential fallback that has been observed for some Atlantic salmon transported upstream.

The existing trap and truck fishway is currently not operated when temperatures exceed 71.7°F due to expected injury and stress resulting from handling and transport activities. While the frequency varies each year based on environmental conditions, the fishway has been closed several weeks each migration season due to excessive temperatures. Construction of a new upstream fishway that can be operated when summer temperatures exceed 71.7°F will maximize the operational period for the fishway and reduce potential fishway closure.

Follow-up monitoring studies of the new upstream fish passage measures will determine if performance standards are met or whether any additional modifications are needed to meet the standards. Effectiveness testing will be conducted following each modification until the performance standard is met and will ensure the desired passage improvements are realized.

6.2 Downstream Passage

6.2.1 Ellsworth Dam

The following outlines the measures and actions proposed for downstream passage at the Ellsworth Dam:

1) Install a fish guidance system (Worthington boom or similar technology) with rigid panel depths between 10 to 15-feet, where water depths are adequate, by May 1 of the third year following license issuance.
2) Install 1-inch, clear-space, full-depth trashracks or overlays at the existing trashracks for Units 2, 3, and 4[10] by May 1 of the third year following license issuance, as well as implement unit prioritization during critical downstream passage seasons, determined in consultation with the agencies.
3) Improve the existing downstream fish passage system by May 1 of the third year following license issuance, as follows:
   a) Modify the existing spillway downstream fish passage weir entrance to increase the depth to a minimum of 3 feet, install tapered walls similar to an Alden weir, and increase the spillway downstream fish passage weir capacity to pass up to 5 percent of station hydraulic capacity.
   b) Increase the height of the flume sides to improve containment of fish passing through the flume. Flume height increase to be determined in consultation with the resource agencies.
   c) Modify the existing fish transport pipe to improve its discharge angle into the flume to limit potential injury to fish at this transition point.
   d) Prioritize Units 1 and 4 over Units 2 and 3 for operations during critical downstream passage seasons, determined in consultation with the agencies.
4) Starting one year after the new downstream passage measures (fish guidance boom, 1-inch trashracks, and improvements to the existing spillway downstream fish passage weir) are operational, conduct downstream Atlantic salmon smolt passage effectiveness testing (anticipated to occur for 1 to 3 years).

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[10] Trashracks at Unit 1 cannot be 1-inch due to trashrack raking restrictions.

5) If necessary to further improve fish passage effectiveness to meet the performance standard, implement, in consultation with the agencies, the following additional downstream passage Adaptive Management Measures. Such measures may include, in no particular order:
   a) Additional panels/curtains to deepen the fish guidance boom,
   b) Increased flows over the spillway through reduced generation or turbine shut-downs at night for two weeks[11] during May for Atlantic salmon smolts,
   c) Modify the ledge/plunge pool and spillway surface, if necessary, to reduce injury to fish passing over the spillway.
6) Conduct downstream Atlantic salmon smolt passage effectiveness testing. Effectiveness testing is anticipated to occur for 1 to 3 years following implementation of the additional downstream passage Adaptive Management Measure(s).
7) Performance Standard - any design modifications to the existing measures, and any new measures, to meet a performance standard of 90% effectiveness for downstream passage[12]. Performance standard shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

6.2.2 Graham Lake Dam

The following outlines the measures and actions proposed for downstream passage at the Graham Lake Dam.

1) By May 1 of the third year following issuance of a new license, modify the invert elevation of the existing downstream passage weir to accommodate a 3-foot depth of flow over the full range of lake elevations allowed in the new license, and implement structural modifications of the Alden weir, if necessary, to accommodate changes in headpond elevation.
2) Starting one year after modified measures are operational, conduct downstream Atlantic salmon smolt passage effectiveness testing (anticipated to occur for 1 to 3 years).

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[11] As noted in Section 3.1, the majority of smolts migrate in a short period of time, as demonstrated by NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005. These data show that 74 percent of the downstream run occurs in 15 days in mid-May, and that the majority of the smolt migration appears to take place after water temperatures rise to 10°C (USFWS unpublished cited in Black Bear 2012).

[12] The 90% downstream passage standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive).

3) Within three years of issuance of a new license, conduct 1-year study to investigate the potential cause(s) of smolt losses in the downstream most reaches of the impoundment to continue the research of existing downstream passage conditions at Graham Lake Dam.
4) Implement additional downstream passage Adaptive Management Measures, if necessary, through agency consultation following effectiveness testing of any modified downstream passage conditions to further improve fish passage to meet the performance standard.
5) Conduct downstream Atlantic salmon smolt passage effectiveness testing. Effectiveness testing is anticipated to occur for 1 to 3 years following implementation of any additional downstream passage Adaptive Management Measure(s).
6) Performance Standard - any design modifications to the existing measures, and any new measures, to meet a performance standard of 90% effectiveness for downstream passage[13]. Performance standard shall be demonstrated for two of the test years following implementation of a given measure.

6.2.3 Effects Analysis of Downstream Passage Measures and Actions

Safe and effective downstream passage at the Project is critical for the protection of downstream migrating Atlantic salmon smolts and kelts. Black Bear is proposing to undertake measures and actions in the SPP to enhance downstream passage effectiveness and survival at the Project.

The proposed actions listed above include modifications and upgrades of existing downstream fishways at both Project dams. Specific effects resulting from the actions and measures listed above to enhance downstream Atlantic salmon passage at the Ellsworth and Graham Lake Dams are discussed in the following paragraphs.

Downstream smolt passage studies conducted at the Ellsworth Dam demonstrated that overall dam survival was approximate 74 percent in 2016 and 62 percent in 2017 (without correcting for background mortality). The majority of smolts used the turbine passage route during both years of study, despite modifications made to the spillway and fishway flows in 2017. The installation of a fish guidance system and full-depth, 1-inch, clear-spaced trashracks for three of the units at the Ellsworth Dam should ultimately improve downstream passage efficiency and survival rates. A

[13] The 90% downstream fish passage standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive).

study of delayed passage mortality using surrogate fish (brown trout smolts) demonstrated that fish using the turbine route, most notably through Unit 2 (Kaplan turbine), had a higher delayed mortality rate compared to fish using the downstream fish bypass system or Unit 1 (vertical shaft propeller turbine). It is reasonable to expect Atlantic salmon smolts would exhibit a similar trend of delayed mortality. Therefore, the added prioritization of Units 1 and 4 (both vertical shaft turbines) over Units 2 and 3 (both Kaplan turbines), as proposed, will provide further protection and benefit to Atlantic salmon by reducing injury and increasing survival for smolts that use the turbine passage route.

Atlantic salmon smolt studies conducted in 2016 demonstrated substantial residence time for smolts that approached Ellsworth Dam and Graham Lake Dam, resulting in migratory delay. Increased residence time likely also resulted in increased predation based on the difference in numbers of smolts approaching the dams and the number that eventually passed. Modifications made to the downstream fishway at Ellsworth Dam and flashboard removals in 2017 reduced the mean residence time at Ellsworth Dam from 17.9 hours in 2016 to 1.5 hours in 2017. Modifications to the downstream weir at Graham Lake Dam in 2017 resulted in reducing the residence time from a mean of 79.8 hours to 5.6 hours, a substantial reduction in delay at both dams. A complicating factor in 2017 is the higher mean river flow that may have contributed to reduced residence time. More study is needed to evaluate the effect of river flow. Improvements to the existing downstream fish passage system provided in the SPP are designed to increase attraction to the downstream fishways and to decrease migratory delay, and for Ellsworth Dam, directing smolts away from the turbine route. These fish passage improvements will ultimately improve fish passage efficiency and survival for Atlantic salmon smolts, but also for Atlantic salmon kelts and river herring.[14] Increased river herring survival will benefit downstream salmon passage, as river herring populations are included in the GOM DPS Atlantic salmon critical habitat component, because of the predation buffer effect that can benefit salmon smolts during downstream migration.

Follow-up monitoring studies of the downstream fish passage measures and improvements, as proposed, will determine if performance standards are met or whether any additional modifications

14 Observations of river herring mortalities have occurred below the Ellsworth Dam in recent years. Improvements to downstream passage would benefit both river herring and salmon downstream passage. River herring may provide a predation buffer effect that can benefit salmon smolts during downstream migration.

are needed to meet the standards. The SPP contains an Adaptive Management Strategy such that additional downstream passage measures will be implemented, if necessary, through agency consultation to further improve fish passage to meet the performance standard.

As noted previously, additional study is needed to better understand the impoundment mortality rate and predation risk of salmon smolts moving through Graham Lake. The proposed study may reveal options for further increasing smolt survival in the impoundment, allowing more smolts to complete their migration to the ocean to mature and potentially return to the Union River to spawn.

Proposed improvements to downstream fishways will result in increased riverine survival of smolts migrating successfully downstream to the ocean will provide a larger population of salmon able to mature and potentially return to the Union River to spawn. This will provide a benefit to the Downeast Coastal SHRU and the entire GOM DPS of Atlantic salmon. The monitoring studies and adaptive management measures following the upgrades to downstream fishways will ensure these improvements are realized when the performance standards above are achieved.

6.3 Fish Passage Facility Management

Black Bear has developed and implemented a site-specific Fish Passage O&M Plan for the fishways for the Ellsworth Project. The plan includes a daily checklist that has been employed throughout each fish passage season since 2015; the O&M Plan will continue to be utilized in future seasons to ensure that the upstream and downstream fishways are operating properly. The site-specific Fish Passage O&M Plan for the fishways includes both a list of spare parts critical to fishway operations and a checklist of proper fishway operating characteristics. Black Bear will continue providing dedicated staff to implement the site-specific Fish Passage O&M Plan for the fishways each year. The staff are dedicated to fishway operations, oversight, fish trap tending, and trucking of fish upriver at the Project. Black Bear maintains a spare recovery pump, which provides 50 cfs of attraction flow into the two downstream bypass weirs in the main powerhouse intakes, to serve as a backup in the event of a pump failure.

Continued implementation of the Fish Passage O&M Plan for the Project fishways promotes satisfactory operations of the fishways for use by Atlantic salmon passing upstream or downstream of the Project. This plan will be revised in consultation with the agencies when the upstream and downstream passage measures described above are implemented to ensure proper maintenance and operations of new or modified fishways to support the future recovery of the Atlantic salmon in the Downeast Coastal SHRU and overall GOM DPS.

6.4 Sturgeon Handling Plan

Black Bear has developed and will implement, as part of its SPP, a sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations or in the event of stranding during periodic dewatering of the draft tubes (Appendix A of the SPP). Implementation of this plan promotes the protection of Atlantic and shortnose sturgeon in the event they are encountered at the Project. This plan may be revised in consultation with the agencies when the upstream and downstream passage measures described above are implemented at the Project to ensure continued protection of Atlantic and shortnose sturgeon.

7.0 Determination of Effect

Based on the analyses contained in this Draft BA, the Determination of Effect of the Project and SPP measures, including the proposed SPP measures for Atlantic salmon (and its designated critical habitat), shortnose sturgeon, and Atlantic sturgeon is provided below:

7.1 Atlantic Salmon

Based on the existence of the Project, implementation of the proposed actions and protection measures outlined in the proposed SPP, and on the information regarding the likely presence of GOM DPS Atlantic salmon in the Project area, their biology and habitat requirements, this Draft BA concludes that the action is likely to adversely affect (LAA) a small proportion of GOM DPS Atlantic salmon at the Project.

The LAA determination for the Ellsworth Project is based on the likelihood that injury or mortality could occur to a small proportion of downstream migrating GOM DPS Atlantic salmon smolts, if a managed smolt stocking program is initiated upstream of the Project in the future. Black Bear will continue to manage the Project to avoid or minimize this effect through the continued implementation of fish protection and enhancement measures outlined in this document and the SPP.

Black Bear foresees no overall destruction or adverse modification of critical habitat, though there will be continued effects to the migratory primary constituent elements (PCEs) of the critical habitat designated for Atlantic salmon (see discussion in Section 1). The measures to promote restoration of GOM DPS Atlantic salmon in the Union River, as reflected in this document, have resulted in improvements to upstream and downstream fish passage measures at the Project over the years. Additional measures proposed in the SPP, including continued improvements, monitoring, consultation, and adaptive management, will lead to improvement of migratory PCEs for GOM DPS Atlantic salmon. In turn, the migratory PCE for migrating adults and smolts will also be improved as a direct result of the relicensing of the Ellsworth Project by enhancing safe access to spawning and rearing habitat, minimizing migratory delay, and providing safe passage to spawning and rearing habitat for other native anadromous species such as river herring that may serve as a predation buffer for Atlantic salmon.

The Proposed Action developed herein, including development and implementation of an SPP, is expected to minimize adverse effects to Atlantic salmon and its critical habitat.

7.2 Shortnose Sturgeon and Atlantic Sturgeon

Due to the uncommon occurrence of sturgeon species at the Project, normal operations and modifications described in the proposed SPP to protect Atlantic salmon would have minimal or no effect on shortnose sturgeon or Atlantic sturgeon. There is a possibility that sturgeon could be captured in the fish trap and handled during the sorting process, or during planned dewatering of the draft tubes for turbine inspection or maintenance activities. If this occurs, Black Bear staff would take the steps specified in the sturgeon handling plan (Appendix A of the SPP) to return the sturgeon to the river downstream of the Project. Implementation of the sturgeon handling plan will provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations or maintenance activities. However, the handling of any sturgeon collected in the fishway would constitute a take under ESA. Therefore, the Proposed Action is likely to adversely affect (LAA) a small number of sturgeon at the Project.

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ATTACHMENT A

SPECIES PROTECTION PLAN

SPECIES PROTECTION PLAN
ELLSWORTH PROJECT

September 2018

SPECIES PROTECTION PLAN
ELLSWORTH PROJECT

Table of Contents

1.0 Background and Purpose of Protection Measures

1.1 Species Protection Plan Overview

Black Bear Hydro Partners, LLC (Black Bear) owns and operates the Ellsworth Hydroelectric Project (Federal Energy Regulatory Commission [FERC] No. 2727) ("Ellsworth Project" or "Project") on the Union River pursuant to the license issued by the FERC on January 1, 1988.

As discussed in the Draft Biological Assessment (BA), Gulf of Maine (GOM) Distinct Population Segment (DPS) Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon are fish species listed under the Endangered Species Act (ESA) that do or could occur in the Project area. FERC is, therefore, required to engage in endangered species consultation with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) pursuant to Section 7 of the ESA for the relicensing (Section 7 of the ESA mandates that federal agencies consult with the Secretaries of Commerce [through NMFS] and Interior [through the USFWS] to determine whether a pending federal action [issuance of a new FERC license for the Project] is likely to result in adverse effects to listed species and/or designated critical habitat). Endangered species consultation has been an important part of the relicensing process.

As discussed in the Draft BA, the occurrence of either sturgeon species is very uncommon in the vicinity of the Project, and the Project is not likely to significantly affect sturgeon but may adversely affect a small number of sturgeon if any are collected in the fishway. However, implementing the proposed sturgeon handling plan (Appendix A) will help to minimize any incidental take of sturgeon should they be incidentally trapped in the fishway or otherwise encountered at the Project facilities.

In 2017 and 2018, Black Bear held six meetings with the agencies to identify measures to minimize potential adverse effects of Project operation on listed Atlantic salmon and designated critical habitat at the Ellsworth Project. Black Bear developed this proposed Species Protection Plan (SPP) to present the measures agreed to during these meetings to avoid and minimize potential adverse effects of Project operation of the Ellsworth Project on Atlantic salmon and designated critical habitat. Provisions of this SPP will require Black Bear to implement several proposed actions and conduct studies to evaluate the effectiveness of existing and any new upstream and downstream fish passage measures for passing Atlantic salmon.

Black Bear anticipates that in 2018, NMFS will issue a Biological Opinion (BO), based on the Draft BA and SPP with protective measures and monitoring, which also will include an Incidental Take Statement related both to the continued operation of the Project and conduct of further studies related to fish passage at the Project that may affect Atlantic salmon. It is expected that FERC will then incorporate protective measures and monitoring as outlined in the BO into the new license for the Project.

The following section outlines the proposed actions for upstream passage at the Ellsworth Dam and Graham Lake Dam, followed by the proposed actions for downstream passage at the Ellsworth Dam and Graham Lake Dam.

2.0 Protection Measures and Monitoring Studies

The Ellsworth Project already includes a number of measures for the protection and enhancement of Atlantic salmon, such as providing upstream[1] and downstream passage facilities and maintaining minimum flows (summarized in the Draft BA). In this section, Black Bear proposes additional actions and monitoring studies to further protect and enhance the GOM DPS of Atlantic salmon. The proposed actions and monitoring studies are intended to develop the site-specific information needed to determine the adequacy of proposed protection measures and to inform estimates of incidental take of GOM DPS Atlantic salmon.

2.1 Proposed Actions for Upstream Passage

2.1.1 Ellsworth Dam

The following outlines the measures and actions proposed for upstream fish passage at the Ellsworth Dam:

1) Maintain and operate the existing upstream fish passage facility at the Ellsworth Project (fishway and trap) for alosines and salmon unless new or modified fish passage measures are provided.

[1] The upstream fish passage facility is designed to trap Atlantic salmon and other anadromous fish and to transport fish by truck to upstream suitable habitat located above the Project facilities.

a) Conduct effectiveness testing of upstream adult Atlantic salmon attraction into and passage at the existing fish trap facility subsequent to (i) below:

i) Coordinate with resource agencies to stock uniquely marked Atlantic salmon smolts upstream of Ellsworth Dam to serve as a source of imprinted adult fish (target of 40 marked returning adults annually) for studying upstream passage once downstream passage improvements have been implemented and downstream passage testing is completed;

b) In annual consultation with the agencies, modify the existing fishway entrance or location and/or attraction water system or other changes, if necessary, to meet the required performance standard (see Section 3 below). Effectiveness testing is anticipated to occur for 1 to 3 years, beginning in the fish passage season following each modification.

2) Design and install new upstream Atlantic salmon passage measures 15 years following FERC license issuance. The Licensee may consult with the resource agencies prior to the specified dates/time frames to determine whether changes in management and/or restoration priorities would warrant a delay in construction of new fish passage measures.

a) Conduct effectiveness testing of new upstream Atlantic salmon passage measures (also requires stocking of smolts with a target of 40 returning adults annually, as detailed above). Effectiveness testing is anticipated to occur for 1 to 3 years, beginning in the second fish passage season after each fish passage measure is operational to allow for one season of commissioning.

3) Performance Standard – design modifications to the existing fish passage measures, and any new fish passage measures, to meet a performance standard of 90% passage effectiveness for upstream passage.[2] Performance standards shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

2.1.2 Graham Lake Dam

The following outlines the measures and actions proposed for upstream passage at the Graham Lake Dam:

[2] The 90% upstream fish passage performance standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive); measured as fish passing when the river temperature is at or below 23°C.

1) Design and install upstream passage measures for Atlantic salmon concurrent with, but not later than, any new upstream Atlantic salmon passage measure at the Ellsworth Dam. The Licensee may consult with the resource agencies prior to the specified dates/time frames to determine whether changes in management and/or restoration priorities would warrant a delay in construction of new fish passage measures.
    a) Conduct effectiveness testing of upstream Atlantic salmon passage concurrent with the Ellsworth Dam upstream passage effectiveness testing (also requires stocking of smolts with a target of 40 returning adults annually, as described above). Effectiveness testing is anticipated to occur for 1 and 3 years, beginning in the second fish passage season after each fish passage measure is operational to allow for one season of commissioning.
2) Performance standard – any new fish passage measures to meet a performance standard of 90% effectiveness for upstream passage[3]. Performance standard shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

2.2 Proposed Actions for Downstream Passage

2.2.1 Ellsworth Dam

The following outlines the measures and actions proposed for downstream passage at the Ellsworth Dam:

1) Install a fish guidance system (Worthington boom or similar technology) with rigid panel depths between 10 to 15-feet, where water depths are adequate, by May 1 of the third year following license issuance.
2) Install 1-inch, clear-space, full-depth trashracks or overlays at the existing trashracks for Units 2, 3, and 4[4] by May 1 of the third year following license issuance, as well as implement unit prioritization during critical downstream passage seasons, determined in consultation with the agencies.
3) Improve the existing downstream fish passage system by May 1 of the third year following license issuance, as follows:

[3] The 90% upstream fish passage performance standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive); measured as fish passing when the river temperature is at or below 23°C.
[4] Trashracks at Unit 1 cannot be 1-inch due to trashrack raking restrictions.

   a) Modify the existing spillway downstream fish passage weir entrance to increase the depth to a minimum of 3 feet, install tapered walls similar to an Alden weir, and increase the spillway downstream fish passage weir capacity to pass up to 5 percent of station hydraulic capacity.
   b) Increase the height of the flume sides to improve containment of fish passing through the flume. Flume height increase to be determined in consultation with the resource agencies.
   c) Modify the existing fish transport pipe to improve its discharge angle into the flume to limit potential injury to fish at this transition point.
   d) Prioritize Units 1 and 4 over Units 2 and 3 for operations during critical downstream passage seasons, determined in consultation with the agencies.
4) Starting one year after the new downstream passage measures (fish guidance boom, 1-inch trashracks, and improvements to the existing spillway downstream fish passage weir) are operational, conduct downstream Atlantic salmon smolt passage effectiveness testing (anticipated to occur for 1 to 3 years).
5) If necessary to further improve fish passage effectiveness to meet the performance standard, implement, in consultation with the agencies, the following additional downstream passage Adaptive Management Measures. Such measures may include, in no particular order:
   a) Additional panels/curtains to deepen the fish guidance boom,
   b) Increased flows over the spillway through reduced generation or turbine shut-downs at night for two weeks[5] during May for Atlantic salmon smolts,
   c) Modify the ledge/plunge pool and spillway surface, if necessary, to reduce injury to fish passing over the spillway.
6) Conduct downstream Atlantic salmon smolt passage effectiveness testing. Effectiveness testing is anticipated to occur for 1 to 3 years following implementation of the additional downstream passage Adaptive Management Measure(s).
7) Performance Standard - any design modifications to the existing measures, and any new measures, to meet a performance standard of 90% effectiveness for downstream passage[6].

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[5] As noted in Section 3.1, the majority of smolts migrate in a short period of time, as demonstrated by NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005. These data show that 74 percent of the downstream run occurs in 15 days in mid-May, and that the majority of the smolt migration appears to take place after water temperatures rise to 10°C (USFWS unpublished cited in Black Bear 2012).

[6] The 90% downstream passage standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive).

Performance standard shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

2.2.2 Graham Lake Dam

The following items outline the measures and actions proposed for downstream passage at the Graham Lake Dam:

1) By May 1 of the third year following issuance of a new license, modify the invert elevation of the existing downstream passage weir to accommodate a 3-foot depth of flow over the full range of lake elevations allowed in the new license, and implement structural modifications of the Alden weir, if necessary, to accommodate changes in headpond elevation.
2) Starting one year after modified measures are operational, conduct downstream Atlantic salmon smolt passage effectiveness testing (anticipated to occur for 1 to 3 years).
3) Within three years of issuance of a new license, conduct 1-year study to investigate the potential cause(s) of smolt losses in the downstream most reaches of the impoundment to continue the research of existing downstream passage conditions at Graham Lake Dam.
4) Implement additional downstream passage Adaptive Management Measures, if necessary, through agency consultation following effectiveness testing of any modified downstream passage conditions to further improve fish passage to meet the performance standard.
5) Conduct downstream Atlantic salmon smolt passage effectiveness testing. Effectiveness testing is anticipated to occur for 1 to 3 years following implementation of any additional downstream passage Adaptive Management Measure(s).
6) Performance Standard - any design modifications to the existing measures, and any new measures, to meet a performance standard of 90% effectiveness for downstream passage[7]. Performance standard shall be demonstrated for two of the test years following implementation of a given measure.

[7] The 90% downstream fish passage standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive).

2.3 Fish Passage Facility Management

Black Bear has developed and implemented a site-specific Fish Passage O&M Plan for the fishways for the Ellsworth Project. The plan includes a daily checklist that has been employed throughout each fish passage season since 2015; the O&M Plan will continue to be utilized in future seasons to ensure that the upstream and downstream fishways are operating properly. The site-specific Fish Passage O&M Plan for the fishways includes both a list of spare parts critical to fishway operations and a checklist of proper fishway operating characteristics. Black Bear will continue providing dedicated staff to implement the site-specific Fish Passage O&M Plan for the fishways each year. The staff are dedicated to fishway operations, oversight, fish trap tending, and trucking of fish upriver at the Project. Black Bear maintains a spare recovery pump, which provides 50 cfs of attraction flow into the two downstream bypass weirs in the main powerhouse intakes, to serve as a backup in the event of a pump failure.

3.0 Implementation Provisions of Proposed Actions

3.1 Effective Date and Schedule

Several of the proposed actions to protect GOM DPS Atlantic salmon at the Ellsworth Project are currently being implemented. These include execution of the Fish Passage O&M Plan developed and approved through agency consultation, and the hiring and training of dedicated staff annually to ensure that all fishway facilities are operated as designed and any issues that develop are corrected. In addition, Black Bear continues to prioritize unit operations to favor Units 1 and 4 during downstream fish migratory periods, as well as maintain the bypass modifications (e.g., Alden weir, resurfaced spillway, etc.) at both dams that showed improved downstream passage movement and survival rates.

The implementation schedule for the additional proposed actions for upstream and downstream passage improvement at the Ellsworth Dam and Graham Lake Dam are described above in Section 2.

3.2 Funding of Proposed Actions

Black Bear has and shall continue to provide funding for the fishway maintenance, dedicated fishway staff, new fish passage facilities, improvements to existing fish passage facilities, and monitoring studies described in Section 2.

3.3 Adaptive Management

The proposed fish passage activities and GOM DPS Atlantic salmon enhancements, which have been developed in consultation with the agencies, will be implemented within an adaptive management framework, with integration of management and research in order to provide feedback and the ability to adapt these measures, as necessary, for further protection and enhancement of GOM DPS Atlantic salmon in the Union River. Adaptive Management Measures are described in Section 2. Since the proposed SPP process is intended to be adaptive, Black Bear will be coordinating and consulting with NMFS throughout implementation of all measures, which will also be adopted as license requirements.

Black Bear shall prepare annual reports by March 31 each year to review the previous year's fish passage activities and/or applicable study results with resource agencies, and assess the need to continue or modify monitoring studies or implement Adaptive Management Measures described in Section 2.

Appendix A
Sturgeon Handling Plan

Sturgeon Handling Plan for the Ellsworth Development

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*) have the potential to occur in the Union River immediately downstream of the Ellsworth Project. Black Bear will implement the following sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during operations of the fish trap or during maintenance of the Project facilities.

<u>Fish Trap Operations</u>

If sturgeon are found in the Project's fish trap, the following procedures will be implemented:

- For each sturgeon detected, the licensee shall:
  - Record the weight, length and condition of the fish.
  - The species of sturgeon should be determined by the ratio of mouth width to interorbital distance (method described in Damon-Randall et al. 2010 - see worksheet attached below).
  - Each sturgeon should also be scanned for PIT (passive integrated transponder) tags.
  - Collect a 1 cm^2 fin clip from one of the pelvic fins (the pelvic fin is regarded as the least intrusive, particularly for small individuals) from living sturgeon should be taken and placed in a labeled vial fitted with an O-ring cap containing 95% non-denatured ethyl alcohol (EtOH) for genetic analysis (following the procedures described in Damon-Randall et al. 2010). Fin clips of mortalities must be taken prior to preservation of other fish parts or whole bodies. All fin clips taken will be submitted to the National Oceanic and Atmospheric Administration (NOAA) for further analysis. At the time of capture, river flow, bypass reach flow, and water temperature will be recorded. All relevant information will be recorded on the reporting sheet (i.e., Sturgeon Reporting Sheet, a copy of which is attached hereto).

- Black Bear shall follow the contact procedure outlined below that was developed in coordination with the National Oceanic and Atmospheric Administration (NOAA) to obtain a contact with the appropriate Endangered Species Act (ESA) representative for handling shortnose and Atlantic sturgeon.

- If alive and uninjured, the sturgeon will be immediately returned downstream. A long-handled net outfitted with non-abrasive knotless mesh will be used to place the sturgeon back into the river downstream of the dam. The fish should be properly supported during transport in the net to ensure that it is not injured.

- If any injured sturgeon are found, Black Bear shall report immediately to NOAA Fisheries (see contact information below). Injured fish must be photographed and measured, if possible, and the reporting sheet must be submitted to NOAA Fisheries within 24 hours. If the fish is badly injured, the fish should be retained by Black Bear, if possible, until obtained by a NOAA Fisheries-recommended facility for potential rehabilitation.

- If any dead sturgeon are found, Black Bear must report the mortality immediately to NOAA Fisheries (see contact information below). Any dead specimens or body parts should be photographed, measured, scanned for tags, and all relevant information should be recorded on the Salvage Form included below. Specimens should be stored in a refrigerator or freezer by Black Bear until they can be obtained by NOAA Fisheries for analysis.

Unit Inspection and Maintenance

On occasion, the Ellsworth Development units are dewatered for inspection or for maintenance activities. Prior to dewatering, the headgate and tailwater gates are closed, and then water is pumped from the unit. Black Bear will follow the protocols outlined here:

- Designated Black Bear employees will conduct a visual check for the presence of any sturgeon in the draft tube area as soon as possible once the water levels allow. If sturgeon are observed in the draft tube, Black Bear will refill the draft tube as necessary and remove the sturgeon. The process of dewatering would be repeated, and a visual check would be conducted to see if any sturgeon remain in the draft tube as it is dewatered.

- If sturgeon are observed in the draft tubes, they will be removed by dip net or other appropriate equipment and placed in the river downstream of the powerhouse.

- Unit dewatering for annual inspections will not be scheduled during April or May unless there is an emergency, in which case consultation with the appropriate resources agencies will take place.

- For each sturgeon removed, Black Bear will record the weight, length, and condition. Fish would also be scanned for PIT tags. All relevant information will be recorded on the reporting sheet (attached Sturgeon Reporting Sheet for the Ellsworth Development).

- If any injured sturgeon are found, Black Bear will report it immediately to NOAA Fisheries (see contact information below). Injured fish must be photographed and measured, if possible, and the reporting sheet will be submitted to NOAA within 24 hours. If the fish is badly injured, the fish shall be retained by Black Bear, if possible, until obtained by a NOAA Fisheries -recommended facility for potential rehabilitation.

- Black Bear shall report any dead sturgeon immediately to NOAA Fisheries (see contact information below). Any dead specimens or body parts should be photographed, measured, scanned for tags, and all relevant information shall be recorded on the Salvage Form included below. Specimens should be stored in a refrigerator or freezer by Black Bear until they can be obtained by NOAA Fisheries for analysis.

<u>Contact Information</u>

In the event a sturgeon is captured in a fish trap or found in the draft tube during maintenance, the following individuals shall be contacted:

Contact information:

- If any sturgeon are detected –
    - Richard Dill (207-852-2993), or
    - Kevin Bernier, (207-951-5006)
- If unavailable, contact – Maine Department of Marine Resources
    - Gail Wippelhauser (207-624-6349), or
    - Mike Brown (207-624-6341)
- NOAA Fisheries (must be contacted within 24 hours)
    - Dan Tierney (207-866-3755), or
    - Julie Crocker (978-282-8480), or
    - NOAA Fisheries Northeast Regional Office – Protected Resources Division Main Number (978-281-9328),
    - and be sure to fax any reporting sheets to 978-281-9394

Reports at End of Season

At the end of the season, copies of all reporting sheets will be send to:

Julie Crocker
Protected Resource Division
NOAA Fisheries
26 Katherine Drive
55 Great Republic Drive
Gloucester, MA 01930-2298

Literature Cited

Damon-Randall K, Bohl R, Bolden S, Fox D, Hager C, Hickson B, Hilton E, Mohler J, Robbins E, Savoy T, Spells A. 2010. Atlantic Sturgeon Research Techniques. NOAA Technical Memorandum NMFS NE 215; 19 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Sturgeon Reporting Sheet for the ____________________________Project

Date:___________________   Time:_____________________________

Physical conditions

Is spill being released over the dam?   YES   NO

What is the approximate river flow?__________________________________ (Ex. 45,000 cfs)

What is the approximate flow in the bypass reach?___________________________

Water temperature (^{o}C): ____________________________

Is the fishway operating (circle) YES NO

Is project generating?   YES NO

If yes, what units are currently operating?

Location from where species was recovered (circle): FISHWAY / LIFT / BYPASS POOLS

OTHER ____

If fish lift, estimate condition of lift: EMPTY / FEW FISH / MODERATE FULL / VERY FULL

Species information:

Total Length__________________ Fork length:__________________ Weight:______________

Condition of fish: ____

Does the sturgeon have visible injuries or abrasions: YES   NO

If Yes, circle and code area of abrasions on sturgeon diagram on back side of sheet.

Comments/other:

____

____

____

____

____

____

____

____

____

____

Name of observer:____

Observer’s Signature:____

Ratio of Interorbital Width to Mouth Width Worksheet

Interorbital Width: Distance between the lateral margins of the bony skull at the midpoint of the orbit (eye socket)
Mouth Width: distance between the left and right inside corners of the mouth (i.e., excluding the lips); this should be measured with the mouth closed.

Mouth Width: __________mm

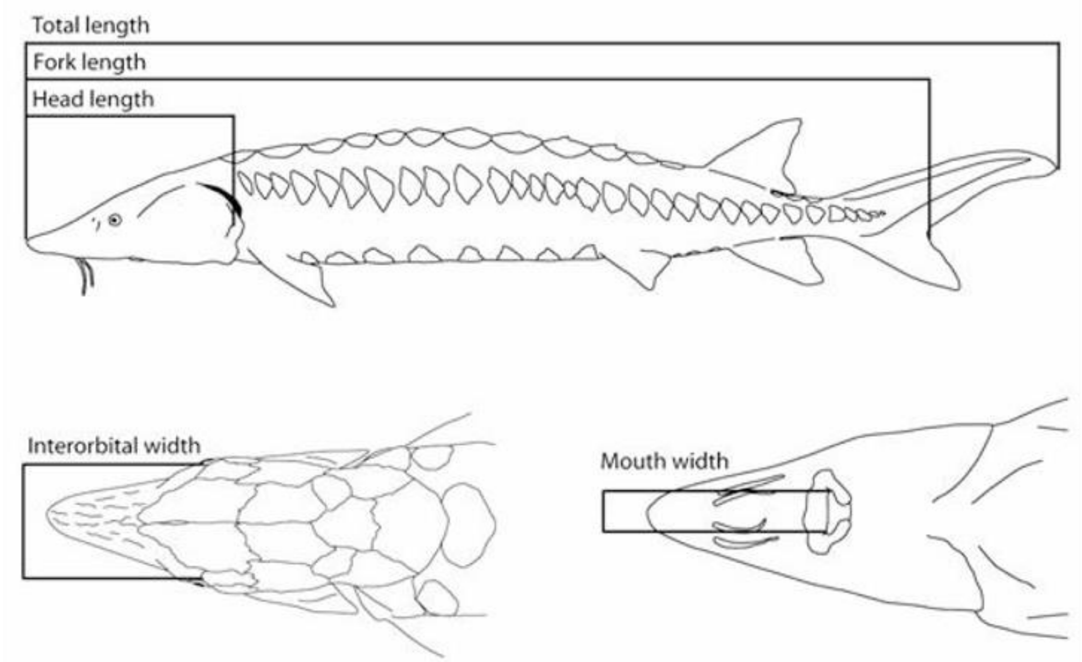


Figure 3. Depiction of the five sturgeon measurements (drawing courtesy of Dr. Eric Hilton, Virginia Institute of Marine Science).

Interorbital Width : __________ mm
Ratio: __________%

Shortnose sturgeon (>62%)
Atlantic sturgeon (<55%)

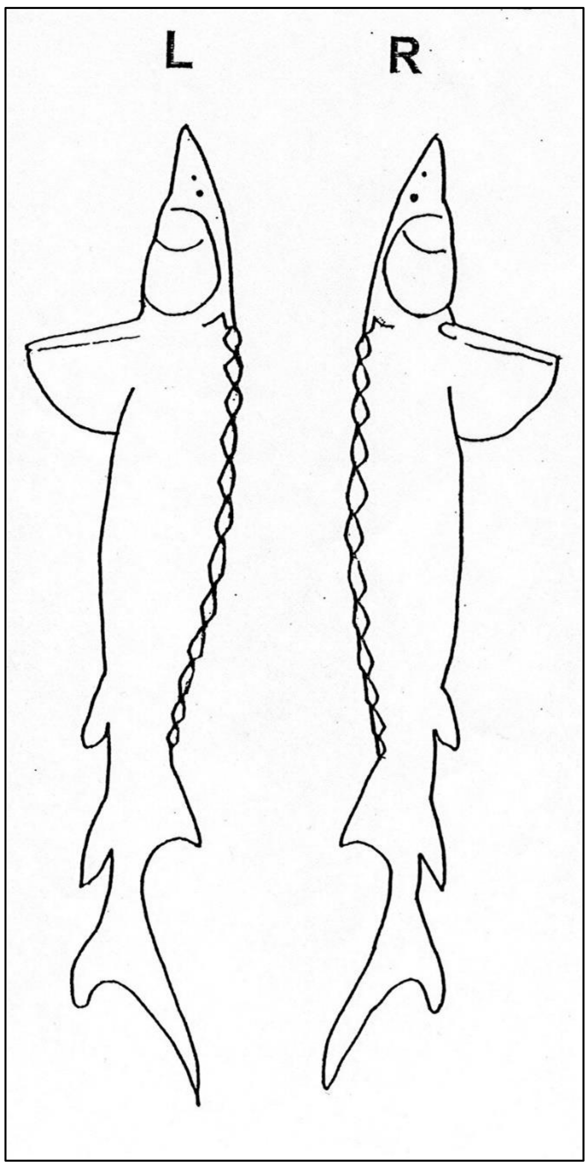
Abrasion Codes

None

Light Whitening or smoothed scutes,
Early sign of skin abrasion.

Moderate Early sign of redness on skin, scutes or fins, Erosion of skin over bony 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.



STURGEON SALVAGE FORM

For use in documenting dead sturgeon in the wild under ESA permit no. 17273-02 (version 7-26-2016)

INVESTIGATORS'S CONTACT INFORMATION

Name: First ________________ Last ______________________

Agency Affiliation ________________ Email______________________

Address ____

____

Area code/Phone number ____

UNIQUE IDENTIFIER (Assigned by NMFS)

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

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

SPECIES: (check one)
- ☐ shortnose sturgeon
- ☐ Atlantic sturgeon
- ☐ Unidentified *Acipenser* species

Check "Unidentified" if uncertain .
See reverse side of this form for aid in identification.

LOCATION FOUND: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)

River/Body of Water________________ City________________________ State ____

Descriptive location (be specific)____

____

____

Latitude ______________N (Dec. Degrees) Longitude ______________ W (Dec. Degrees)

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

SEX:
- ☐ Undetermined
- ☐ Female ☐ Male

How was sex determined?
- ☐ Necropsy
- ☐ Eggs/milt present when pressed
- ☐ Borescope

MEASUREMENTS: **Circle unit**

Fork length _________ cm / in

Total length _________ cm / in

Length ☐ actual ☐ estimate

Mouth width (inside lips, see reverse side) _________ cm / in

Interorbital width (see reverse side) _________ cm / in

Weight ☐ actual ☐ estimate _________ kg / lb

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

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

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

Carcass Necropsied?
☐Yes ☐No

Date Necropsied:____________

Necropsy Lead:

____

PHOTODOCUMENTATION:
Photos/vide taken? ☐ Yes ☐ No

Disposition of Photos/Video:__________

____

____

SAMPLES COLLECTED? ☐ **Yes** ☐ **No**

Sample	**How preserved**	**Disposition (person, affiliation, use)**
____________________	______________________	________________________________
____________________	______________________	________________________________
____________________	______________________	________________________________
____________________	______________________	________________________________
____________________	______________________	________________________________
____________________	______________________	________________________________
____________________	______________________	________________________________
____________________	______________________	________________________________

Comments:

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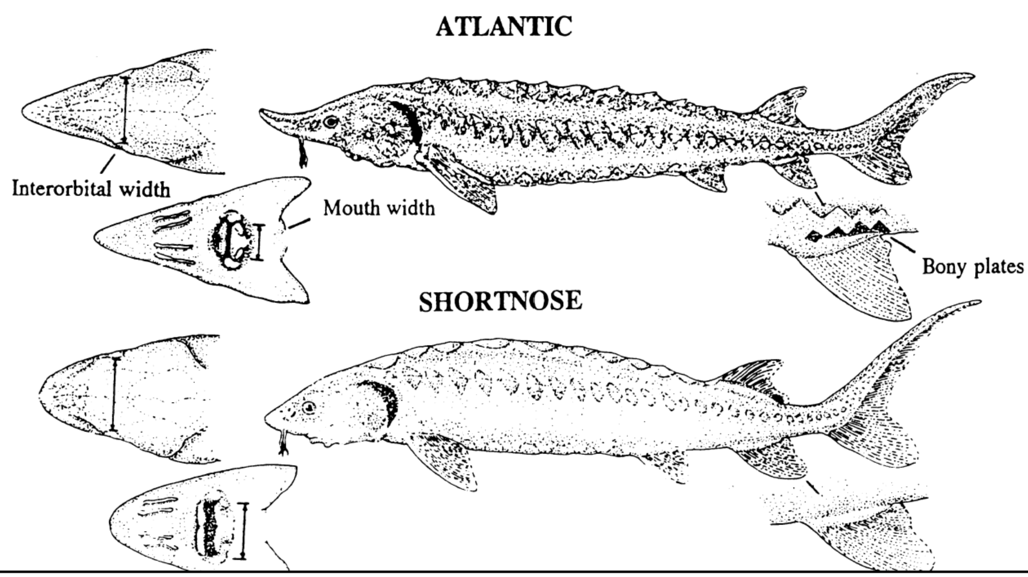
Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 7-26-2016)

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

* From Vecsei and Peterson, 2004



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

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

Submit completed forms (within 30 days of date of investigation) to: **Greater Atlantic Regional Fisheries Office Contacts** – Julie Crocker (Julie.Crocker@noaa.gov, 978-282-8480) or Lynn Lankshear (Lynn.Lankshear@noaa.gov, 978-282-8473); **Southeast Region Contact**- Andrew Herndon (Andrew.Herndon@noaa.gov; 727-824-5312).

ATTACHMENT B

ELLSWORTH PROJECT FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

<u>ELLSWORTH HYDROELECTRIC PROJECT</u>

<u>FERC NO. 2727</u>

FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

May 09, 2018

Operated by:

Black Bear Hydro Partners, LLC

A member of

Brookfield Renewable Energy Group

Milford, ME

Table of Contents

ELLSWORTH FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

1.0 - INTRODUCTION

This Fish Passage Operations and Maintenance Plan (the “Plan”) is intended to define how Black Bear Hydro Partners, LLC (an indirect subsidiary of Brookfield Renewable Energy Group), owner and Licensee of the Ellsworth Hydroelectric Project FERC No. 2727 (“Ellsworth Project” or the “Project”) will operate and maintain the existing fish passage facilities. This Plan is part of Brookfield’s commitment to our environmental principles that are based on the fundamental values of accountability, partnership and open communication. As such, we have accepted the responsibility entrusted to us to manage natural resources in ways to ensure sustainable development.

The Plan will define what fish passage facilities (the “Facilities”) currently exist at the Project, the period in which the Facilities are to be operated, guidance on the annual start-up and shut-down procedures, routine operating guidelines, debris management, and safety rules and procedures that are in place. Along with these defined procedures and guidelines, the Plan includes the necessary supporting information such as contact information, daily inspection forms, drawings, and spare parts on-site.

2.0 - BACKGROUND

The Ellsworth Hydroelectric Project is located on the Union River in the City of Ellsworth and the Towns of Mariaville, Otis, and Waltham, in Hancock County, Maine. The Project consists of two dams; the Ellsworth Dam (also known as Leonard Lake Dam) adjacent to the Ellsworth Powerhouse forms Leonard Lake Reservoir, and the Graham Lake Dam located approximately 3.5 miles upstream forms the storage reservoir known as Graham Lake.

Graham Lake Dam is a flood control and storage facility that does not contain a powerhouse or hydroelectric turbines. Graham Lake Dam is 30 feet high and consists of a 670-foot-long non-overflow earth dike and an 80-foot-long concrete gate structure. The concrete gate structure contains three 20-foot-wide radial gates and an eight-foot-wide bay with a four-foot-wide sluice that is used for downstream fish passage. This sluice empties into a plunge pool which subsequently discharges into the river below the dam structure. There is no upstream fish passage at the Graham Dam.

Ellsworth Dam maintains Leonard Lake at a normal maximum normal water surface elevation of 66.7 feet. Principle water-retaining structures at Ellsworth Dam include a 275-foot-long overflow spillway, a non-overflow section, east and west abutments, and two intake structures. Units 1 and 4 are vertical shaft propeller turbines, and Units 2 and 3 are vertical shaft Kaplan turbines. One concrete intake structure contains intakes for two, eight foot diameter penstocks serving turbine-generator Units No. 2 and 3, and a 12 foot diameter intake serving Unit No. 4. Trashracks and slide gates for each intake are provided. The second intake contains the 10’ diameter penstock for Unit 1. The top of the intake structure is at elevation 74.0 feet. A powerhouse containing four hydroelectric turbine-generator units is located immediately downstream of the dam on the west bank of the river.

The overflow spillway has a permanent crest elevation of 64.5 feet and is equipped with 2.2 foot-high flashboards. The hydraulic capacity of the overflow spillway is approximately 17,000 cfs at a water surface elevation of 71 feet.

Ellsworth Dam provides upstream passage for migratory fish via a vertical slot fishway that is equipped with a trap. Brookfield operates the fish passage facility in accordance with the Union River Fisheries Coordinating Committee’s Comprehensive Fishery Management Plan for the Union River. The Company transports migrating river herring and Atlantic salmon to habitat in the upriver reaches of the Union River drainage. The downstream fish passage facility at Ellsworth Dam consists of three stop-log-controlled surface weirs and a transport pipe and sluice leading to a plunge pool immediately downstream of the dam. The downstream fishway is operated from April 1 to December 31 each year, as river conditions allow.

3.0 - DESCRIPTION OF FISH PASSAGE FACILITIES

3.1 - UPSTREAM FISH PASSAGE - DESCRIPTION

The upstream fish passage at the Project is a vertical slot design with a 3 foot wide entrance and trapping hopper located at the end of the passage. The entrance is located on the west side of the powerhouse near the dam and capable of passing up to 50 cfs of flow. The entrance gate is adjusted, if required, to maintain a wave ripple effect that extends as far as possible out in the tailrace. This usually requires about an 18 inch differential between the fishway and tailrace water levels. The tailwater of the Ellsworth dam is influenced by tidewater. The entrance gate is manually adjusted with a hand wheel or with an electric actuator with local controls. The entrance opens into a single gallery that runs along the driveway of the powerhouse. The first attraction pump is a Worthington Model 20KLD24 pump that is capable of pushing 28 cfs of water through a pipe to the diffusion chamber above the trap. The second pump, a Flygt Model 4451, thrusts approximately 22 cfs of water from the tailrace into a diffuser system located just inside the fishway entrance gate, providing additional attraction flow to the fishway entrance. The head differential between the attraction flow chamber and the tailwater should not exceed five feet.

There are two fish trap hoppers used depending on mode of operation. The “stocking hopper” is mostly solid metal construction which retains water in the hopper tank when lifted for stocking. The “harvest hopper” is constructed with metal screen material and allows for the water to drain when the hopper is lifted. The Town of

Ellsworth, which controls the commercial alewife harvest rights for the Union River, sub-contracts with a “harvesting agent” who catches and sells the alewives to lobster fishermen.

During trap and truck operations, fish are lifted out of the hopper pit in the stocking hopper, and then transferred into a transport tank on a trailer. Alewives are typically transported upstream to Graham Lake in 750 gallon circular tanks, while a smaller 200 gallon rectangular tank is used to transport adult Atlantic salmon upstream to the West Branch Union River where they are released at Goodwin’s Bridge in Mariaville, Maine.

3.2 - DOWNSTREAM FISH PASSAGE - DESCRIPTION

The downstream fish passage has three entrance weirs, each being three feet wide. Entrance weirs #1 and #2 are located above the turbine intake area for Units 2 through 4. Each weir has stop logs that control the flow and are operated at approximately 21 inches of depth conveying approximately 20 cfs through each. Weirs 1 and 2 flow through a gallery into a transition box, and then through a 2 foot diameter pipe that discharges into the downstream sluiceway located on the overflow section of the dam. A Flygt Model 4501 pump located in the downstream migrant pit recirculates approximately 35 cfs from the transition box and back into the headpond. Stop logs (over topped by 12 inches of water depth) is used to control the 5 cfs of conveyance flow needed to transport the downstream migrating fish from the transition box to the downstream sluiceway located on the face of the spillway. Entrance weir #3 is located on the overflow section of the dam beside the turbine intake for Unit No.1 and flows directly into the downstream sluiceway. It is operated at approximately 17 inches of water depth over the stop logs.

4.0 - OPERATION AND MAINTENANCE OF FISH PASSAGE FACILITIES

4.1 - UPSTREAM FISH PASSAGE – OPERATIONS & MAINTENANCE

OPERATIONAL PERIOD

According to the conditions of the 2018 MDMR USFWS Section 10 Sub-Permit, the upstream fish passage will be operated as follows for the 2018 passage season:

- Operational Dates: By May 1 or when river herring are present in reasonable quantities until October 31, Operated Daily
- Operational Hours: Open 7:00 am – close 6:00 pm, or 1 hour before sunset in the spring/fall
- Tending Frequency:
    a. May 1 – July 15
        i. Minimum of at least three times per day (9:00 am, 1:00 pm, and 6:00 pm, or 1 hour before sunset)

    b. July 15 – October 31
        i. Minimum or twice per day (~10:00 am & 1 hour before sunset)
- Brookfield Renewable fish passage staff will be on site *(at all times)* during river herring harvest and stocking operations in May/June
- All persons listed on the MDMR Section 10 sub permit must be familiar with the terms of the permit, trapping protocols, and aquaculture suspect identification protocol.
- All persons listed on the sub permit who will be operating the trapping facility must participate in MDMR training on the proper handling of Atlantic salmon. This shall occur at the Milford fish lift once Atlantic salmon have begun returning
- Salmon handling protocol (see step-wise procedure in *Maine Department of Marine Resources Suspected Aquaculture Origin Atlantic Salmon Identification and Notification Protocol* and *DMR trap* (AQSP) *and Fish Handling Protocol* for a full description of the protocols)
    a. If a visual inspection of fish (step 1of AQSP) indicates restoration fish, then
        i. Collect biological data per the adult salmon handling protocol
        ii. Collect scale samples from every adult Atlantic salmon (step 3 of AQSP).
        iii. Apply an adipose punch if an adipose fin exists; otherwise, apply an upper caudal fin punch
        iv. Transport the Atlantic salmon to the release site above Graham Lake at on the West Branch of the Union River at Goodwin's Bridge in Mariaville

b. If visual inspection of the adult Atlantic salmon (Step 1 of AQSP) suggests aquaculture escapee, then hold the salmon in a suitable tank with appropriate dissolved oxygen levels and call MDMR for further instructions, which could include:

i. Collect scale sample, mount on slide, send picture of scale to MDMR staff and await further instructions
ii. If no response from MDMR, then collect scale, apply punch (retain tissue for genetic analysis), floy-tag, and release fish to the tailwater (see step 4 of AQSP)
iii. If MDMR suspects the Atlantic salmon is an aquaculture escapee (step 6 of AQSP), then hold fish for MDMR. If MDMR believes the scale pattern is inconclusive MDRM will advise that the Atlantic salmon be

OPENING METHODS

- Refer to PM# 17183 & 17184 - Upstream Fish Passage opening method procedure
- Inspect the deck grating over the entrance area. This is done as soon as tailwater levels allow safe access to the entrance areas
- Remove plywood from around Worthington pump, attraction water pump for pipe. (Installed for winter storage)
- Open fishway entrance gate approximately 18 inches, or until there is a wave ripple effect in the tailrace.
- Lower trap into pit and adjust height to allow fish to enter through flume entrance.
- Start the Worthington pump, attraction water pump for pipe.
- Lower the Flygt attraction pump into place with hand crank.
- Start the Flygt attraction pump.
- Raise the trap entrance screen to allow fish to access trap.

SPARE PARTS

- Attraction pump fuses
- Primary 75 HP Attraction Pump
- Secondary 20 HP Attraction Pump

WORKFORCE PLANNING

- <u>Staffing Requirements:</u>
  - Start Up - Crew of 2
  - Routine Operations – Crew of 1
  - Routine Maintenance – Crew of 2 for standard maintenance, crew of 1 for fishway entry for cleaning
  - Shut Down – Crew of 2

- Daily basis:
  - The fishway is visually inspected for debris accumulation. If debris is found, staff will remove debris from fishway. If debris is not manageable by hand, operations crew will shut down pumps, remove deck grate, and remove debris with boom truck.
  - The attraction pumps are inspected for proper operation
  - The Entrance Gates are adjusted for proper outflow
  - The fishway log sheets are completed consistent with Appendices A and C.

- Weekly basis:
  - Facility's lead fishway technician to provide via email a completed Fishway Operations Report consistent with Appendix C to Oliver Cox of MDMR and Jeff Murphy of NMFS by Monday at 0800

- Cleaning process:
  - Inspect fishway for stranded fish.
  - Set up fall arrest/fall retrieval device. Inspect fall harness.
  - Prep chainsaw for operation. Inspect all chainsaw PPE.
  - Inspect access ladder for damage.
  - Inspect rigging for large debris removal with crane.
  - Cut smaller debris to allow removing out of fishway.

  - Preventative Maintenance process:
    - Daily :
      - Fill vegetable oil cup and adjust drip rate

    - Yearly:
      - Refer to PM# 23075 for attraction pump inspection procedure
      - Inspect the attraction pump
      - Inspect hoist for lifting trap (Somatex)
      - Inspect the entrance gates gear drive units

WINTERIZING METHODS

- Refer to PM# 17184 - Upstream Fish Passage winterizing method procedure
- Close the trap entrance screen.
- Stop the Flygt attraction pump.
- Raise the Flygt attraction pump with the hand crank.
- Stop the Worthington pump, attraction water for pipe.
- Remove trap from the pit.
- Add plywood to Worthington pump.
- Remove any debris from fishway.

NOTICE:

- Contact NMFS within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal take
- In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.[1]
- Notify NMFS of any changes in project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)[2]
- The first Brookfield point of contact for all Fishway related issues is the local Supervisor of Operations
- Refer to Section 6.0 for contact information

4.2 - DOWNSTREAM FISH PASSAGE – OPERATIONS & MAINTENANCE

OPERATIONAL PERIOD

- April 1 - December 31.

OPENING METHODS

- Refer to PM# 17181 & 17182 - Downstream Fish Passage opening method procedure
- The downstream fishway, including the downstream pipe entrance, shall be inspected seasonally for damage and debris via divers or video inspection.
- Inspect the downstream pipe entrance and exit for debris and clean.
- Inspect floor screen above recovery pump, clean as necessary.
- Lower the recovery pump to its bottom seat using the rack rake.
- Open 2 weirs by intake racks for Units 2-4 to approximately 21” depth of water over the entrances.
- Open the weir between Unit 1 and overflow dam section to approximately 17” depth of water over the entrance.
- Turn on recovery pump. Set frequency to half speed (30 cycles).
- Adjust weir just before pipe to be approximately 12” going over entrance
- Pipe entrance should be half full when running recirculating pump.

[1]. This would typically include date collected, species, measurements, photographs, etc…

[2]. This does not include typical operational changes such as generator load swings, putting generators online and offline, normal impoundment and flow fluctuations, and opening/closing gates to control spillage. NMFS should be notified for any fishway dewaterings or maintenance issues, problems meeting fishway operational dates, impoundment drawdowns for flashboard or other maintenance, or any other atypical project operations such as dewatering of tunnels, conduits, or penstocks.

SPARE PARTS

- 20 HP Attraction Pump

WORKFORCE PLANNING

- Staffing Requirements:
  - Start Up – Crew of 2
  - Routine Operations – Crew of 1
  - Routine Maintenance – Crew of for standard maintenance, crew of 2 for fishway entry cleaning
  - Shut Down – Crew of 2

- Daily basis:
  - Visually inspect the fishway entrance for debris. If debris is present, operations crew will remove debris. Notify agencies if fishway cannot be cleaned the same day. Fishway shall remain closed during this time frame.
  - Verify proper outflow of fishway. If flow is reduced, clear debris.
  - The fishway log sheets are completed consistent with Appendices A and C.

- Weekly basis:
  - Conduct a thorough inspection of the fishway facility for any debris or damage through the use of cameras. If debris or damage is present, operations crew will remove debris. Notification to the agencies will be conducted if fishway cannot be cleaned or repaired the same day. Fishway shall remain closed during this time frame.
  - Facility's lead fishway technician to provide via email a completed Fishway Operations Report consistent with Appendix C to Oliver Cox of MDMR and Jeff Murphy of NMFS by Monday at 0800

- Cleaning process:
  - De-water fishway (refer to Section 4.2 DOWNSTREAM FISH PASSAGE DE-WATERING METHOD)
  - Inspect fishway for stranded fish
  - Set up fall arrest/fall retrieval device. Inspect fall harness.
  - Prep electric chainsaw for operation. Inspect all chainsaw PPE.
  - Lay out extension cords with GFCI's. Test GFCI prior to use.
  - Inspect all rigging for hoisting debris

- Preventative Maintenance process:
  - Yearly:
    - Refer to PM# 23074 for attraction pump inspection procedure
    - Inspect attraction pump
    - Inspect the trash rake hoist

DOWNSTREAM FISH PASSAGE DE-WATERING METHOD

- Place stoplogs to shut off fishway flow.
- Fish passage may now be dewatered by pumping out fish passage pit.

WINTERIZING METHODS

- Shutoff recovery pump.
- Close all three entrance weirs.
- Remove all weir stoplogs just before pipe entrance.
- Inspect the fishway via divers or video inspection for any damage or debris. Clean any debris from the entrances exits, and pipe.
- Raise recovery pump to winter storage area using the trash rake.

NOTICE:

- Contact NMFS within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal take
- In the event of any lethal takes, any dead specimens or body parts found must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS[3]
- Notify NMFS of any changes in project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)[4]
- The first Brookfield point of contact for all Fishway related issues is the local Supervisor of Operations
- Refer to Section 6.0 for contact information

3. This would typically include date collected, species, measurements, photographs, etc…

4. This does not include typical operational changes such as generator load swings, putting generators online and offline, normal impoundment and flow fluctuations, and opening/closing gates to control spillage. NMFS should be notified for any fishway dewaterings or maintenance issues, problems meeting fishway operational dates, impoundment drawdowns for flashboard or other maintenance, or any other atypical project operations such as dewatering of tunnels, conduits, or penstocks

5.0 - SAFETY

5.1 - SAFETY RULES & PROCEDURES

- Pursuant to Brookfield's Safety Procedure SP9, Job Safety and Environmental Plans are completed prior to, and ideally, well in advance of any work at the various fishways are started. Job Safety and Environmental Plans are to be completed using the standard form which may be updated from time to time. Review of prior Job Safety and Environmental Plans for similar work is encouraged to help capture all safety risks that may be present at the site.

6.0 - CONTACT INFORMATION

6.1 NOTICE:

- The Maine Department of Marine Resources fish lift operating procedure and Atlantic salmon handling procedure is located at the agency webpage (at the bottom of page). http://www.maine.gov/dmr/science-research/searun/programs/trapcounts.html
- Contact NMFS within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal take
- In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS[5]
- Notify NMFS of any changes in project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)[6]

5. This would typically include date collected, species, measurements, photographs, etc…
6. This does not include typical operational changes such as generator load swings, putting generators online.

- The first Brookfield point of contact for all Fishway related issues is the local Supervisor of Operations
- Refer to Section 6.0 for contact information

6.2 CONTACTS

BROOKFIELD

- Robert Brochu, Supervisor Operations, Brookfield
  - (w) 207-827-4067
  - (c) 207-461-3618
  - Robert.Brochu@brookfieldrenewable.com

- James Cole, Senior Operations Manager, Brookfield
  - (w) 207-723-4341 x 127
  - (c) 207-447-1706
  - James.Cole@brookfieldrenewable.com

- Kevin Bernier, Senior Compliance Specialist, Brookfield
  - (w) 207-723-4341 x 118
  - (c) 207-951-5006
  - Kevin.Bernier@brookfieldrenewable.com
  -
- Richard Dill, Biologist, Brookfield
  - (c) 207-852-2993
  - Richard.Dill@brookfieldrenewable.com

AGENCY CONTACTS

- Jeff Murphy, Fishery Biologist, NMFS
  - (w) 207-866-7379
  - (c) 207-299-7339
  - Jeff.Murphy@noaa.gov

- Sean Ledwin, Director MDMR Fisheries and habitat
  - (w) 207-624-6348
  - sean.m.ledwin@maine.gov

- Don Dow, Hydro Engineer, NMFS
    - (w) 207-866-3758
    - (c) 207-416-7510
    - Donald.Dow@noaa.gov

- Dan Tierney, Fishery Biologist, NMFS
    - (w) 207-866-3755
    - (c) 207-416-7676
    - Dan.Tierney@noaa.gov

- Antonio Bentivoglio, Fishery Biologist, USFWS
    - (w) 207-866-3344 x151
    - (c) 207-974-6965
    - Antonio_Bentivoglio@fws.gov

- Bryan Sojkowski, Fish Passage Engineer, USFWS
    - (w) 413-253-8645
    - Bryan_Sojkowski@fws.gov

- Steve Shepard, Hydro Power Licensing & Fish Passage ,USFWS
    - (w) 207-866-3344 ext. 116
    - (c) 207-949-1288
    - Steven_Shepard@fws.gov

- Gail Wippelhauser, DMR
    - (w) 207-624-6349
    - Gail.Wippelhauser@maine.gov

- Mitch Simpson, DMR
    - (c) 207-941-4464
    - Mitch.Simpson@maine.gov

- John Perry, Environmental Coordinator ,MDIFW
    - (w) 207-287-5254
    - (c) 207-446-5145
    - John.Perry@maine.gov

- Nels Kramer, Fishery Biologist, MDIFW
    - (w) 207-732-4131
    - Gordon.Kramer@maine.gov

- Kathy Howatt, Hydropower Coordinator ,MDEP
    - (w) 207-446-2642
    - Kathy.Howatt@maine.gov

7.0 - APPENDICES

Appendix A: DAILY INSPECTION FORM and DAILY FISH LIFT LOG FORMS

Ellsworth Fish Passage Daily Inspection Form

Date: ____________ Time: ___________ Inspector: ____________________ Spill: **Yes / No**

Head Pond Elevation: ____________ River Flow (cfs): ___________ % Flashboards Down: ______

Tailwater Elevation: ____________ Water Temp °C: ___________

Turbine Operation: ______ ______ ______ ______
(%) 1 2 3 4

<u>Upstream Fish Lift</u> *(Describe maintenance performed in comments below)*

Fishway debris Ok?: ________

Primary Pump On: ________

Auxillary Pump On: ________

Entrance Gate Ok?: ________

Check cables for damage or wear: ________

Check load block wheel for rotation: ________

Check load block hook and latch: ________

Check that limit switches function: ________

Check for proper travel through range:______

<u>Downstream Fish Passages</u> *(Describe maintenance performed in comments below)*

Fishway debris Ok?: ________

Bypass Pump: **On / Off**

Weir Depths (in): _______ _______ _______ _______
1 2 3 Bypass Pit

<u>Comments and Requirements:</u>

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

Ellsworth Fish Lift Daily Log

Date: ___________ Staff: _____________________ # Prev Lifts to Date: _______

Fishway Start Time: _______ Air Temp (°F): _______ # Lifts Today: _______

Fishway Stop Time: _______Water Temp (°C): ______ Weather: __________________________

* For all ATS, add MSW/G, tagged status, and release location to the comments, and fill out DMR Salmon Handling Sheet

Lift #	Time	RIV Trucked	RIV Harvested	ATS*			
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Daily Count:						
Previous Season Total:						
New Season TOTAL:						

Comments:

Page 2 Ellsworth Fish Lift Daily Log
Date:

Lift #	Time	RIV Trucked	RIV Harvested	ATS*		

Appendix B: DRAWINGS

Electronic drawing documents can be found at:

MLT01/Drawings/2015 Ellsworth/

Appendix C: FISHWAY OPERATIONS WEEKLY REPORT

Fishway Operations Weekly Report

Project Name: ______________________
Fishway Facility: ______________________
Date: ______________________

Species	#'s Detected
Atlantic Salmon (MSW):	
Atlantic Salmon (1SW):	
River Herring:	
American Shad:	
Striped Bass:	
Sea Lamprey:	

Weekly Operational Status:

Note:

Weekly Fishway Operations report to be provided to NMFS and MDMR personnel each Monday by 1200.

Appendix D: MORTALITY EVENT PLAN

Alewife

Alewife mortality at the Ellsworth facility occurring outside of normal harvest effort from routine operation is very low. Mortality events of less than 50 alewife in the fish lift get sluiced to the tailrace. Mortality events of more than 50 alewife in a single day will be collected by Alan Atherton (207-460-4940) for immediate disposal as bait.

Atlantic Salmon and Sturgeon

Atlantic salmon or sturgeon mortalities at the Ellsworth fish lift will be handled as follows until the terms of the new operating license for the Project are finalized:

a) Contact NMFS within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal takes (Jeff Murphy: by email **Jeff.Murphy@noaa.gov** or phone (207) 866- 7379 and the Section7 Coordinator **incidentaltake@noaa.gov**)
b) In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.