Brookfield
Renewable

August 31, 2020

VIA E-FILING

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

Pejepscot Hydroelectric Project (FERC No. 4784)
Application for New License

Dear Secretary Bose:

Pursuant to the Commission's regulations at 18 C.F.R. § 5.16(c), Topsham Hydro Partners Limited Partnership (L.P.) (Topsham Hydro) respectfully submits for filing the *Application for New License for Major Project – Existing Dam – Pejepscot Hydroelectric Project*. The application is being filed in accordance with the Integrated Licensing Process (ILP) and consists of the following exhibits:

- Initial Statement
- Exhibit A – Project Description
- Exhibit B – Project Operation and Resource Utilization
- Exhibit C – Construction History
- Exhibit D – Statement of Costs and Financing
- Exhibit E – Environmental Report
- Exhibit F – General Design Drawings and Supporting Design Report
- Exhibit G – Project Maps
- Exhibit H – Description of Project Management and Need for Project Power

Exhibit F contains Critical Energy Infrastructure Information (CEII) and will be filed under separate cover. As part of the National Historic Preservation Act Section 106 consultation process and in accordance with 18 CFR § 4.32(b)(3)(ii), Topsham Hydro is filing the Historic Properties Management Plan (HPMP) with the Commission under separate cover. The HPMP contains privileged cultural resources information and is only being provided to the Maine Historic Preservation Commission, representatives of the area Native American Tribes, and the Commission.

As required by 18 CFR § 5.18, the application discusses Topsham Hydro's proposal for continued maintenance and operation of the Pejepscot Project as well as stakeholder comments submitted in response to the Draft License Application. Topsham Hydro is proposing to continue the fundamental operation of the Project under the new license. In support of this proposal,

Topsham Hydro Partners Limited Partnership
150 Main Street
Lewiston, ME 04240
www.brookfieldrenewable.com
Tel: 207.755.5600
Fax: 207.755.5655

Exhibit E evaluates the potential impacts to environmental and recreational resources that may occur as a result of the continued operation of the Project under a new license. As appropriate, Exhibit E also includes Topsham Hydro's proposals for the protection and mitigation of effects on, or enhancement to, resources that are associated with the continued operation of the Project.

Notification via email that the application has been filed and a link to download associated electronic files through FERC's eLibrary are being provided to entities listed on the attached Distribution List.

If there are any questions or comments regarding this filing, please contact me by phone at (207) 755-6505 or by email at Randy.Dorman@BrookfieldRenewable.com.

Sincerely,

Randall Dorman
Licensing Manager
Brookfield Renewable

Attachment: Application for New License for the Pejepscot Hydroelectric Project

cc: Distribution List

Topsham Hydro Partners Limited Partnership
150 Main Street
Lewiston, ME 04240
www.brookfieldrenewable.com
Tel: 207.755.5600
Fax: 207.755.5655

DISTRIBUTION LIST

Pejepscot Hydroelectric Project (FERC No. 4784)
Final License Application

I, Randall Dorman, Licensing Manager, Brookfield Renewable, hereby certify that a link to the foregoing document on the Commission website have been transmitted to the following parties on August 31, 2020.

Randall Dorman
Licensing Manager

August 31, 2020

One copy, via e-filing to:

Ms. Kimberly D. Bose
Federal Energy Regulatory Commission
888 First Street, N.E.,
Dockets Room
Washington, D.C. 20426

Via email or electronic link, or one copy on compact disc,
Regular mail, postage paid to:

Federal Agencies	
Mr. Ryan Hansen Federal Energy Regulatory Commission 888 First Street, NE Washington, DC 20426	Wendi Weber Regional Director U.S. Fish and Wildlife Service 300 Westgate Center Dr. Northeast Regional Office Hadley, MA 01035
Mr. John Spain Regional Engineer Federal Energy Regulatory Commission Division of Dam Safety and Inspections New York Regional Office 19 W 34th Street, Suite 400 New York, NY 10001	Mr. Antonio Bentivoglio U.S. Fish and Wildlife Service Maine Field Office 4 Fundy Road #R Falmouth, ME 04105

Mr. Nicholas Stasulis Data Section Chief USGS New England Water Science Center 196 Whitten Rd. Augusta, ME 04333	Kenneth Hogan North Atlantic-Appalachian Region Hydropower Program Coordinator U.S. Fish & Wildlife Service New England Field Office 70 Commercial Street, Suite 300 Concord, New Hampshire 03301
Mr. Sean McDermott National Marine Fisheries Service 55 Great Republic Drive Gloucester, MA 01930	Mr. Harold Peterson Bureau of Indian Affairs Eastern Regional Office 545 Marriot Drive, Suite 700 Nashville, TN 37214
Mr. Matt Buhyoff National Marine Fisheries Service Atlantic Salmon Recovery Coordinator 17 Godfrey Drive Orono, ME 04473	Mr. Andrew L. Raddant Regional Environmental Officer U.S. Fish and Wildlife Service Office of Environmental Policy and Compliance Northeast Region 15 State Street, Suite 400 Boston, MA 02109
Mr. Ralph Abele Instream Flow Coordinator Region 1- Office of Ecosystem Protection US Environmental Protection Agency 5 Post Office Square, Suite 100 Mail Code: OEP06-2 Boston, MA 02109-3912	Mr. John T. Eddins Office of Project Review Advisory Council on Historic Preservation 401 F Street NW, Suite 308 Washington, DC 20001-2637
Mr. Bryan Rice Director Bureau of Indian Affairs U.S. Department of the Interior MS 4606 MIB 1849 C Street NW Washington, DC 20240	Mr. Kevin Mendik Hydro Program Manager Northeast Region National Park Service 15 State Street, 10th Floor Boston, MA 02109-3572
Maine Agencies	
Ms. Kathy Howatt Hydropower Coordinator Maine Department of Environmental Protection 17 State House Station 28 Tyson Drive Augusta, ME 04333-0017	Mr. Nick Livesay, Director Bureau of Land Resource Regulation Maine Department of Environmental Protection 17 State House Station 28 Tyson Drive Augusta, ME 04333-0017

Dr. Arthur Spiess Maine Historic Preservation Commission 55 Capitol Street 65 State House Station Augusta, ME 04333-0065	Mr. Jim Vogel Maine Department of Agriculture, Conservation and Forestry Bureau of Parks and Lands 22 State House Station 18 Elkins Lane Augusta, ME 04333-0022
Ms. Kathleen Leyden Maine Coastal Program Department of Marine Resources 21 State House Station Augusta, ME 04333-0021	Mr. John Perry Environmental Coordinator Maine Department of Inland Fisheries and Wildlife 41 State House Station 284 State Street Augusta, ME 04333-0041
Mr. James Pellerin Regional Fisheries Biologist – Region A Maine Department of Inland Fisheries and Wildlife RR1, 358 Shaker Road Gray, ME 04039	Mr. Scott Lindsay Regional Wildlife Biologist – Region A Maine Department of Inland Fisheries and Wildlife RR1, 358 Shaker Road Gray, ME 04039
Ms. Gail Wippelhauser Maine Department of Marine Resources 21 State House Station Augusta, ME 04333-0021	Mr. Paul Christman Maine Department of Marine Resources 21 State House Station Augusta, ME 04333
Mr. Kirk Mohney Director and State Historic Preservation Officer Maine Historic Preservation Commission 55 Capitol Street 65 State House Station Augusta, ME 04333-0065	
Municipal Government	
Town of Topsham 100 Main Street Topsham, ME 04086	Town of Brunswick 85 Union Street Brunswick, ME 04011
Town of Durham 630 Hallowell Road Durham, ME 04222	Town of Lisbon 300 Lisbon Street Lisbon, ME 04250

Cumberland County Government 142 Federal Street Portland, ME 04101	Sagadahoc County Government 752 High Street Bath, ME 04530
Androscoggin County Government 2 Turner Street Auburn, ME 04210	
Non-Government Organizations	
Mr. Brian Graber Director American Rivers Northeast Field Office 516 West Hampton Road Southampton, MA 01062	Ms. Landis Hudson Executive Director Maine Rivers P.O. Box 782 Yarmouth, ME 04096
Mr. John R.J. Burrows Atlantic Salmon Federation Fort Andross, Suite 406 14 Maine Street Brunswick, ME 04011	Mr. Bill Oleszczuk Chair Maine Council of Trout Unlimited 185 Tobey Road New Gloucester, ME 04260
Orman Hines Trout Unlimited Merrymeeting Bay Chapter PO Box 6, Sebasco Est., ME 04565	Mr. Ed Friedman Friends of Merrymeeting Bay PO Box 233 Richmond, ME 04357
Mr. Jeffrey Reardon Maine Brook Trout Program Director Trout Unlimited 9 Union Street Hallowell, ME 04347	
Native American Tribes	
Chief Edward Peter Paul Aroostook Band of Micmacs Micmac Cultural, Community & Educational Center 7 Northern Road Presque Isle, ME 04769	Ms. Jennifer Pictou THPO Aroostook Band of Micmacs 7 Northern Road Presque Island, ME 04769

Chief Kirk Francis Penobscot Indian Nation 12 Wabanaki Way Indian Island, ME 04468	Mr. Christopher Sockalexis THPO Penobscot Indian Nation Cultural & Historic Preservation Department 12 Wabanaki Way Indian Island, ME 04468
Chief William J. Nicholas, Sr. Passamaquoddy Tribe Indian Township P.O. Box 301 Princeton, ME 04668	Mr. Donald Soctomah THPO Passamaquoddy Tribe PO Box 159 Princeton, ME 04668
Chief Brenda Commander Houlton Band of Maliseet Indians 88 Bell Road Littleton, ME 04730	Ms. Susan Young Houlton Band of Maliseet Indians 88 Bell Road Littleton, ME 04730
Licensee	
Mr. Randall Dorman Licensing Manager Brookfield Renewable 150 Main Street Lewiston, ME 04240	Mr. Luke Anderson Licensing Manager Brookfield Renewable 150 Main Street Lewiston, ME 04240
Ms. Kelly Maloney Manager, Compliance - Northeast Brookfield Renewable 150 Main Street Lewiston, ME 04240	Mr. Matthew Leblanc Compliance Specialist Brookfield Renewable 3 Company Road Hollis, ME 04042
Mr. Kirk Smith Gomez and Sullivan Engineers, D.P.C. 41 Liberty Hill Road PO Box 2179 Henniker, NH 03242	Mr. Drew Trested Senior Principal Scientist Normandeau Associates, Inc. 30 International Drive Portsmouth, NH 03801

TOPSHAM HYDRO PARTNERS LIMITED PARTNERSHIP

APPLICATION FOR NEW LICENSE FOR MAJOR WATER POWER PROJECT-EXISTING DAM

PEJEPSCOT HYDROELECTRIC PROJECT

(FERC No. 4784)

Submitted by:

Brookfield Renewable
Topsham Hydro Partners Limited Partnership
150 Main Street
Lewiston, ME 04240

Prepared by:

GOMEZ AND SULLIVAN ENGINEERS

August 2020

Brookfield

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR WATER POWER PROJECT – EXISTING DAM

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This Application for New License for the Pejepscot Hydroelectric Project (FERC No. 4784) consists of the following:

BEFORE THE

UNITED STATES OF AMERICA

FEDERAL ENERGY REGULATORY COMMISSION

Topsham Hydro Partners Limited Partnership	**)**	**FERC Project No. 4784**
	)	**Pejepscot Hydroelectric Project**
	)	

APPLICATION FOR NEW LICENSE

FOR A MAJOR WATER POWER PROJECT – EXISTING DAM

INITIAL STATEMENT

1. Topsham Hydro Partners Limited Partnership (hereinafter "Topsham Hydro" or "Licensee") applies to the Federal Energy Regulatory Commission (FERC or the Commission) for a New License for the Pejepscot Hydroelectric Project (Project), an existing licensed major project, as described in the attached exhibits. The Project is licensed as Project No. 4784. The current license for the Project was issued by order dated September 16, 1982. The effective date of the license was September 1, 1982 for a period of 40 years. The current license expires on August 31, 2022. Topsham Hydro is the only entity that has or intends to obtain and will maintain any proprietary right or interest to construct, operate, or maintain the Project.

2. The location of the Project is:

State	Maine
Counties	Cumberland, Sagadahoc, Androscoggin
Township or nearby towns	Village of Pejepscot, Towns of Topsham, Lisbon, Durham, Brunswick
Stream or other body of water	Androscoggin River

3. The exact name and business address of each person authorized to act as agent for the applicant is:

Mr. Tom Uncher
Vice President
Topsham Hydro Partners Limited Partnership
339B Big Bay Rd
Queensbury, NY 12804
Telephone: 1-518-743-2018
Thomas.Uncher@brookfieldrenewable.com

Copies of all correspondence should also be sent to:

Randall Dorman
Licensing Manager
Brookfield Renewable
150 Main Street
Lewiston, ME 04240
Telephone: (207) 755-6505
Randy.Dorman@BrookfieldRenewable.com

Kirk Smith
Project Manager
Gomez and Sullivan Engineers, D.P.C.
PO Box 2179
Henniker, NH 03242
Telephone: (603) 428-4960
ksmith@gomezandsullivan.com

4. The Applicant is:

   Topsham Hydro Partners Limited Partnership – Licensee for the water power project designated as Project No. 4784 in the records of the Federal Energy Regulatory Commission. The Licensee is not claiming preference under section 7(a) of the Federal Power Act, 16 U.S.C. § 796.

5. (i) The statutory or regulatory requirements of the State of Maine, in which the Project is located, which would, assuming jurisdiction and applicability, affect the Project as proposed with respect to bed and banks and the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power and in any other business necessary to accomplish the purposes of the license under the Federal Power Act are:

   (1) Maine Waterway Development and Conservation Act, Maine Revised Statutes Annotated Title 38, § 630 et. seq.

   (2) Mill and Dam Act, M.R.S.A. Title 38, § 651 et. seq.

   (ii) The steps which the Applicant has taken or plans to take, to comply with each of the laws cited above are:

   (1) The Maine Waterway Development and Conservation Act (MWDCA), enacted in 1983, regulates certain construction or reconstruction of hydropower projects which change water levels or flows above or below a dam. Topsham Hydro is not proposing as part of the relicensing any construction or changes in water levels that would require approval under the MWDCA.

   (2) The Mill Act, essentially enacted in 1821, allows riparian owners to maintain dams and raise water. The statute does not require any permits and has been interpreted

by the Maine Supreme Judicial Court to apply to hydroelectric generating plants. See Veazie v. Dwinel, 50 Me. 479 (1862). Maine case law has also held that owners of the riverbed have the right to the natural flow of a stream as it passes through their land, Wilson & Son v. Harrisburg, 107 Me. 207 (1910). Topsham Hydro either owns or has easement or flowage rights to all Project lands and waters.

6. The Project generally consists of the dam, spillway, fish passage facilities, two powerhouses, a sheet-pile floodwall, ancillary equipment, and a 225-acre impoundment. The original powerhouse contains three rehabilitated horizontal Francis units, with a combined output capacity of 1.588-MW. The new powerhouse (circa 1987) contains one propeller type (Kaplan) turbine-generator unit rated at 12.3-MW. The Project generation facilities tie to the electric grid at the local utility's non-project sub-station located adjacent to the Project boundary. See Exhibit A – Project Description and Exhibit F – General Design Drawings for a complete description of the Project.

7. No lands of the United States are affected by the Project.

8. This is an existing Project and no new construction is planned in association with this relicensing.

9. Topsham Hydro owns or leases, and, as Licensee for the Project, will maintain any proprietary right necessary to construct, operate, and maintain the Project.

10. The names and mailing addresses of:

(i) *Every county in which any part of the project, and in which any federal facility that is used or to be used by the project, is located:*

Androscoggin County Government
2 Turner Street, Unit 2
Auburn, Maine 04210

Cumberland County Government
142 Federal Street
Portland, Maine 04101

Sagadahoc County Government
752 High Street
Bath, Maine 04530

There are no federal facilities used by the project.

(ii) *Every city, town, or similar local political subdivision in which the project is located and in which any federal facility that is used by the project is located, or that is within 15 miles of the project dam and has a population of 5,000 or more people is:*

City of Auburn
60 Court Street

Auburn, Maine 04210

City of Bath
55 Front Street
Bath, Maine 04530

Town of Brunswick
85 Union Street
Brunswick, Maine 04011

Town of Cumberland
290 Tuttle Road
Cumberland, Maine 04021

Town of Freeport
30 Main Street
Freeport, Maine 04032

Town of Gray
24 Main Street
Gray, Maine 04039

City of Lewiston
27 Pine Street
Lewiston, Maine 04240

Town of Lisbon
300 Lisbon Street
Lisbon, Maine 04250

Town of New Gloucester
385 Intervale Road
New Gloucester, Maine 04260

Town of Sabattus
190 Middle Road
Sabattus, Maine 04280

Town of Topsham
100 Main Street
Topsham, Maine 04086

Town of Yarmouth
200 Main Street
Yarmouth, Maine 04096

(iii) *Every irrigation district, drainage district or similar special purpose political subdivision in which any part of the project is located and in which any federal facility that is used by the project is located or that owns, operates, and maintains or uses any project facility:*

There are no irrigation, drainage, or special purpose political subdivisions associated with the Project.

(iv) *Every other political subdivision in the general area of the project that there is some reason to believe would likely to be interested in, or affected by, the notification:*

There are no other political districts or subdivisions that are likely to be interested in or affected by the notification.

(v) *All Indian tribes that may be affected by the project:*

Topsham Hydro is not aware that the Project affects any Native American tribe. The following is a listing of Native American tribes that may have some level of interest in the area surrounding the project:

Aroostook Band of Micmacs
7 Northern Road
Presque Isle, Maine 04769

Penobscot Indian Nation
12 Wabanaki Way
Indian Island, Maine 04468

Passamaquoddy Native American Nation
Pleasant Point Reservation
Tribal Building Office
9 Sakom Road
Perry, Maine 04667

Passamaquoddy Tribe
Indian Township
PO Box 301
Princeton, ME 04668

Houlton Band of Maliseet
88 Bell Road
Littleton, Maine 04730

11. *The Applicant has in accordance with 18 CFR Section 4.32(a)(3) made a good faith effort to notify, by certified mail, the following entities of the filing of this application:*

(a) Every property owner of record of any interest in the property within the bounds of the Project;

(b) The entities identified in paragraph (10) above;

Since this is an application for a new license for an existing project under Section 15 of the FPA, the requirement to provide notification by certified mail of the filing of the application does not apply.

12. *In accordance with 18 C.F.R §4.51 and 16.10 of the Commission's regulations, the following Exhibits are attached to and made a part of this application:*

Exhibit A – Project Description
Exhibit B – Project Operation and Resource Utilization
Exhibit C – Construction History and Proposed Construction Schedule
Exhibit D – Statement of Costs and Financing
Exhibit E – Environmental Report
Exhibit F – General Design Drawings and Supporting Design Report (CEII filed under separate cover)
Exhibit G – Project Map
Exhibit H – Description of Project Management and Need for Power Project

SUBSCRIPTION

This Application for New License for the Pejepscot Hydroelectric Project, FERC No. 4784, is executed in the State of New York, County of Warren, by Thomas Uncher, Vice President of Topsham Hydro Partners Limited Partnership, 339 Big Bay Road, Queensbury, NY 12804, who, being duly sworn, deposes and says that the contents of this application are true to the best of his knowledge or belief and that he is authorized to execute this application on behalf of Topsham Hydro Partners Limited Partnership. The undersigned has signed this application this 26th day of August, 2020.

TOPSHAM HYDRO PARTNERS LIMITED PARTNERSHIP

By [signature]

Thomas Uncher
Vice President
Topsham Hydro Partners L.P.

VERIFICATION

Subscribed and sworn to before me, a Notary Public of the State of New York, this 26th day of August, 2020.

[signature]
(Notary Public)

(My Commission Expires 1|14|2023)/seal

KELLEN L. HAAS
Notary Public, State of New York
Saratoga County #01HA6385815
Commission Expires Jan. 14, 2023

EXHIBIT A
PROJECT DESCRIPTION

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT A
PROJECT DESCRIPTION

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LIST OF ABBREVIATIONS AND DEFINITIONS

cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission
El	elevation
FERC	Federal Energy Regulatory Commission
ft	feet
kV	kilovolts
kW	kilowatts
ME	Maine
mi^2	square miles
MW	megawatt
Project	Pejepscot Hydroelectric Project
Topsham Hydro	Topsham Hydro Partners Limited Partnership

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT A
PROJECT DESCRIPTION

A.1 INTRODUCTION

Topsham Hydro Partners Limited Partnership (L.P.) (Topsham Hydro or Licensee) owns and operates the Pejepscot Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC or the Commission) Project No. 4784. The 13.88-megawatt (MW) Project is located on the Androscoggin River in the village of Pejepscot and the Town of Topsham, Maine (ME) to the east, the Town of Lisbon, ME to the north, and the Town of Durham, ME and the Town of Brunswick, ME to the west. The Project straddles the border between Cumberland and Sagadahoc counties and extends into Androscoggin County.

The Project is the second dam on the Androscoggin River located at approximately river mile (RM) 14. The Project dam is approximately 4 miles upstream of the Brunswick Hydroelectric Project and 3.25 miles downstream of the Worumbo Hydroelectric Project. In total, the Project is the second of 22 hydroelectric projects on the mainstem Androscoggin River. The Androscoggin River basin above the dam has a drainage area of approximately 3,420 square miles (mi^2). The Project boundary extends approximately 3 miles upstream from the Pejepscot Dam.

Table 1-1 provides a summary of pertinent Project information.

Table 1-1: General Project Information

General Information	
Owner	Topsham Hydro Partners, L.P.
FERC Project Number	4784
Current License Term	September 1, 1982 – August 31, 2022
Counties	Sagadahoc, Cumberland, Androscoggin
General	
Nearest Town(s)	Topsham, Brunswick, Durham, Lisbon
River	Androscoggin
Drainage Area	3,420 mi^2
Normal Full Pond Elevation	67.5 ft.
Normal Pond Elevation	67.2 ft.[1]
Normal Tailwater Elevation	43.7 ft.
Impoundment Length	approximately 3 miles
Gross Storage	3,278 acre-ft.
Surface Area at Normal Full Pond	225 acres
Average Annual Inflow at Pejepscot Project	7,000 cfs
Structures	
Dam	Pejepscot
Construction	Timber crib and concrete gravity
Total Length	560 ft.
Spillway Length	480 ft.
Powerhouses	Original (1898) New (1987)
Turbine / Generator Units	4 units
Turbine Manufacturer / Type	Unit 1: Kaplan Units 21/22/23: Horizontal Francis
Turbine Capacities	Unit 1: 7,550 cfs (rated), 7,100 (actual) Unit 21: 350 cfs Unit 22: 350 cfs Unit 23: 350 cfs Total: 8,600 cfs

[1] Programmable Logic Controller setting.

Generator Capacities	Unit 1: Unit 21: Unit 22: Unit 23:	12,300 kW 490 kW 545 kW 545 kW
Total Authorized Installed Capacity	13.88 MW	

A.2 PROJECT STRUCTURES

A.2.1 Existing Structures

Existing Project structures generally consist of a dam, spillway, fish passage facilities, two powerhouses, a sheet-pile floodwall, an interconnection with the local utility's transmission system, and ancillary equipment. Figure 2.1-1 depicts the general Project layout.

A.2.1.1 Dam

The Pejepscot Dam is a 560-foot-long, 47.5-foot-high, rock- and gravel-filled, timber-crib, overflow structure with a sheet-pile cutoff to bedrock along the upstream side (Figure 2.1.1-1). The cribs are topped with a 5-foot-thick reinforced concrete slab to protect the dam from erosion during periods of high river flow. At the right (west) end of the dam where the abutment rock level is high, there is no cribwork, and the dam consists of a low, mass-concrete section. The dam is abutted on the right by a high bedrock outcrop and on the left (east) by a mass-concrete and stone-masonry pier.

Spillway capacity is provided by operating the gates on the crest of the dam. The crest is equipped with five, 96-foot-long by 3-foot-high, hydraulically operated, bascule gates separated by concrete piers. The bascule gates are constructed of steel, and can be operated automatically by the PLC or manually to maintain pond levels. In either mode, the gates can be adjusted to any level between 0-100 percent. The hydraulic pump units that operate the gates are contained in the mass-concrete pier forming the left abutment of the dam. The crest gate seals are heated to permit operation of the gates during cold weather, including movement when subjected to heavy ice pressure. The Project has a spillway discharge capacity of 95,000 cubic feet per second (cfs). Overtopping of the dam does not occur until the headwater reaches elevation (El.) 81 feet (ft.)[2], at which point the spillway discharge is approximately 110,000 cfs.

A.2.1.2 Powerhouses and Intake Structure

The powerhouses at the Project include an original powerhouse (Figure 2.1.2-1) that was constructed in 1898, and a newer powerhouse that was constructed from 1985 to 1987 (Figure 2.1.2-2). The combined FERC-authorized capacity of the four generating units is 13.88-MW.

The original (northerly) powerhouse is integral to the dam and founded on bedrock and constructed of brick masonry and concrete. The powerhouse is approximately 97 ft wide and 146

[2] Unless otherwise noted, all elevations refer to the National Geodetic Vertical Datum of 1929 (NGVD29), U.S. Survey ft – also known as "mean sea level" or MSL.

ft long, and contains three rehabilitated horizontal Francis units (identified as Nos. 21, 22, and 23) with a combined output capacity of about 1.58-MW. Each unit has four 36-inch Francis runners attached to a single turbine shaft, each with a rotational speed of 180 revolutions per minute (rpm). The maximum flow through each turbine is 350 cfs. These units do not have the ability to selectively operate with fewer than four turbine runners. However, one of the Francis units was damaged several years ago and the turbine shaft was cut so that only two runners on that particular unit are now in operation. Each of the units has an intake gate for dewatering, which is operated with a rack-and-pinion gear-type hoist. The tailrace water passage for the three units can be isolated from the downstream tailwater by means of a bulkhead-type gate, which is operated from the new powerhouse intake deck using a mobile crane. Wicket gates are used to adjust the flow settings of the units.

The newer (southerly) powerhouse is integral to the dam and is a 60-foot by 115-foot concrete building with a steel frame superstructure. The powerhouse contains a vertical-shaft, low speed, adjustable-blade, propeller type (Kaplan) turbine-generator unit (identified as Unit No. 1) rated at 12.3-MW, with one runner containing four blades and 18 ft in diameter; it rotates at 81.8 rpm. The minimum and maximum flow through the turbine is 1,170 and 7,550 cfs, respectively. The rated head of the unit is 24 ft. Wicket gates are used to adjust the flow settings of the unit.

The Project has two separate intake structures, the old powerhouse intake and the new powerhouse intake, both of which are integral with the powerhouses. The old powerhouse intake is constructed of concrete, and has 1.5-inch clear spacing on the trashrack. The trashracks have a top elevation of 69.7 ft. and extend down to an elevation of 43.3 ft. The racks are approximately 71.4 ft. wide.

The new powerhouse intake is constructed of concrete and has 1.5-inch clear spacing at the top of the trashrack and 2.5-inch clear spacing at the bottom. The bar racks have a top elevation of 61.35 ft. and extend down to an elevation of 36.0 ft. The racks are approximately 91.6 ft. wide. The 1.5-inch clear spacing extends from elevation 61.35 ft. to elevation 55.1 ft. (total of 6.25 ft.). The remaining portion of the bar rack from elevation 55.1 ft. down to elevation 36.0 ft. (total of 19.1 ft.) has clear spacing of 2.5-inches.

A.2.1.3 Fish Passage Facilities

A2.1.3.1 Upstream Fish Passage Facilities

The upstream fish passage facility is a vertical lift (elevator) that lifts migratory fish in a hopper about 30 ft vertically from near the powerhouse tailrace to the impoundment level (Figure 2.1.3.1-1). The fish lift is designed to pass 85,000 American shad and 1,000,000 river herring annually. The hopper is constructed of steel and is approximately 20 ft long and 7 ft wide with a sloping bottom that assists in removal of the fish from the hopper. The hopper has a capacity of approximately 1,000 gallons. The inlet to the hopper is a V-trap about 8 inches wide by 8 ft high. In front of the entry gate there are four attraction pumps under a grating that create an additional flow up to 160 cfs through the entry channel to attract the fish to the lift. These pumps can be sequenced to change the volume of water passing through the entry channel, depending on the flow out of the powerhouse tailrace. The hopper discharges the fish into a metal flume about 6 ft wide and 8 ft high. The flume is approximately 110 ft long from the lift hopper to the gate at the dam. Along the flume is a viewing window to observe the fish along with a crowding panel that moves the fish closer to the window for viewing. There is a continuous flow of about 30 cfs from the impoundment to the hopper to attract the fish to the impoundment.

The upstream fish passage is operated annually from April 15 to November 15. The lift is operated automatically, except under high water conditions[3] when it is operated manually, to lift the fish hopper every two hours beginning at 8 a.m. for a total of five lifts per day. The four attraction pumps are set by the station operator; the number of pumps operating is determined based on the flow coming through the turbine and out the tailrace. When river flows are less than 1,700 cfs, one pump is operated (total attraction flow 70 cfs). When river flows are between 1,700 and 3,500 cfs, two pumps are operated (total attraction flow 110 cfs). When river flows are between 3,500 and 5,200 cfs, three pumps are operated (total attraction flow 150 cfs). Finally, when river flows are greater than 5,200 cfs, four pumps are operated (total attraction flow 190 cfs). The total of 190 cfs (attraction flow from four pumps (160 cfs) plus an additional 30 cfs provided from the impoundment via the exit trough) represents approximately 2.2% of the Project maximum turbine discharge capacity (8,600 cfs). When river flows are 15,000 cfs (impoundment El. of approximately 69.5-70.0 ft) or higher, the fishway is shut down.

A preset weir in the channel provides an attraction flow through the flume and hopper. The flume from the hopper to the impoundment is opened when the seasonal operation is started for passage of diadromous fish. The gates in the channel that allow fish to be counted through the observation window are left open unless they are being used for counting. Fish within the lift are not actively counted and, historically, the counting facilities have only been used for efficiency tests of the lift.

A2.1.3.2 Downstream Fish Passage Facilities

The downstream fish passage facilities consist of two steel entry weirs, one on either side of the Unit 1 turbine intake (Figure 2.1.3.2-1). Each entry weir has an invert elevation of 65.5 ft. From each weir, an outlet pipe conveys downstream migrating fish in water down to the tailwater. The weir gates are 4 ft wide and are part of an inlet box with the outlet pipe located on the side opposite the weir. The left-side (northerly) weir has a 30-inch diameter steel transport pipe that is approximately 185 ft long. The right-side (southerly) weir has a 24-inch diameter steel transport pipe that is approximately 60 ft long (Figure 2.1.3.2-2). Both pipes have a free discharge to the water below the dam. Each downstream bypass can pass approximately 13 cfs, 29 cfs, and 87 cfs at headpond elevations of 66.5 ft. (low), 67.2 ft. (normal), and 69.0 ft. (high), respectively. This assumes that the entrance gate at each downstream bypass is in the fully opened position. The clear spacing of the grizzly racks at the entrance to the downstream bypasses is approximately 7 inches. There is one horizontal steel member on the grizzly racks at an approximately elevation of 67.3 ft.

[3] At flows above 15,000 cfs, the fish lift is temporarily shut down until flows subside.

The downstream fishway is currently operated from April 1 to December 31, as river conditions allow. The downstream fishways are shutdown when debris loading occurs as a result of high flows. The fishways are cleaned and restored to operation as flow conditions allow.

A.2.1.4 Switchyard / Transmission Lines

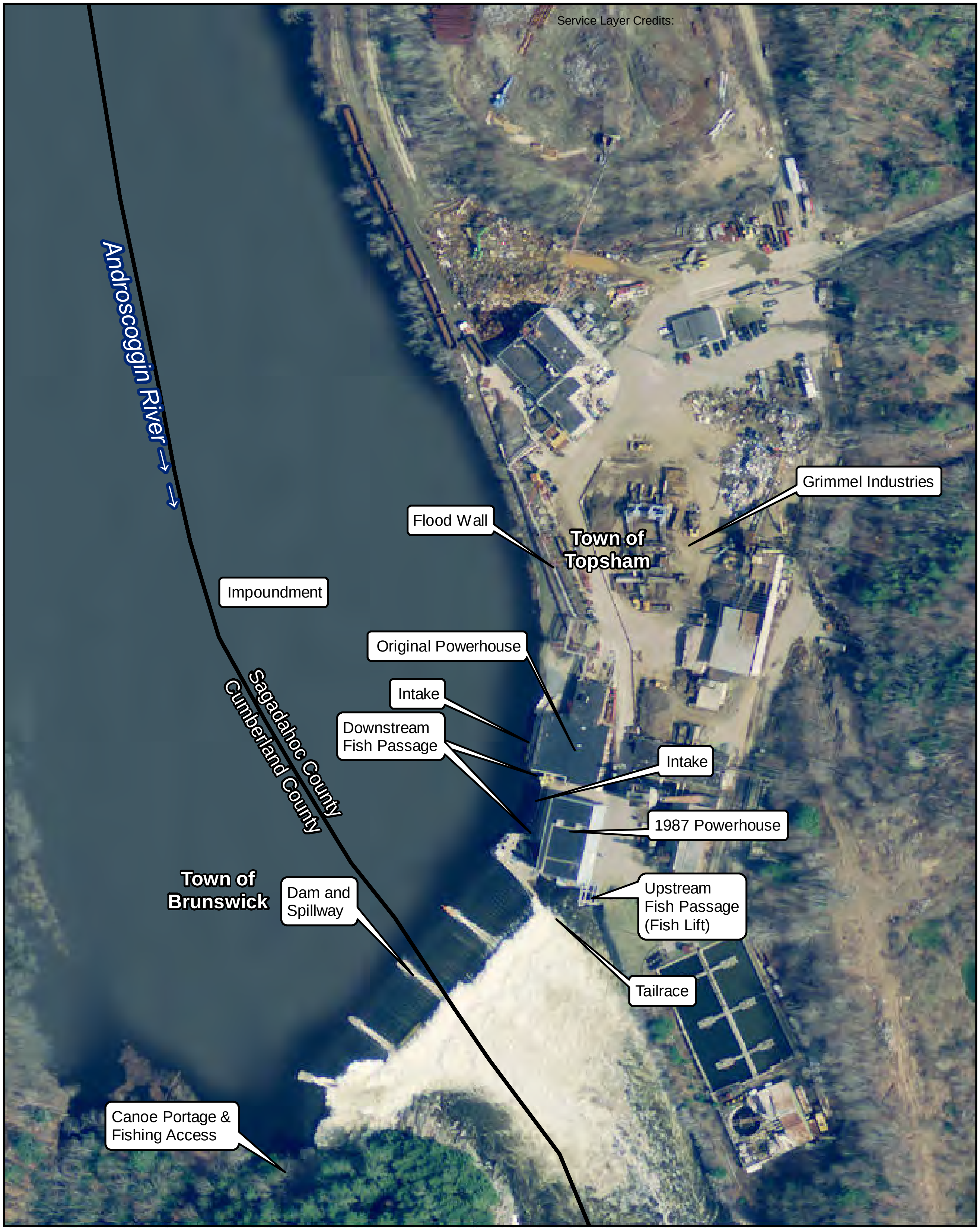
Main and secondary substations are located to the north and south of the powerhouse, respectively. These substations are outside of the Project boundary. However, the Project works do include 900-foot-long, 15-kV cable connections to the substations. An electrical single-line diagram showing the Project's connection to the transmission system is presented in Exhibit H.

A.2.1.5 Project Boundary

The Project boundary generally follows the contour level of El. 75.0, except in the vicinity of the dam and powerhouse, at the upstream limit of the boundary, and downstream of the dam. The Project boundary extends approximately 3 miles upstream from the Pejepscot Dam to the vicinity of the Route 125 bridge. The upstream extent of the Project boundary is approximately 0.25 miles downstream of the Worumbo Dam and 0.3 miles upstream of the Little River confluence. The Project boundary terminates approximately 260 ft downstream of the Pejepscot Dam. Project boundary drawings are presented in Exhibit G.

A.2.2 Proposed Structures

There are no new structures being proposed in this application.



Brookfield

N

Pejepscot Hydroelectric Project
(FERC No. 4784)
Final License Application

0 50 100 200 Feet

Figure 2.1-1.
Project Features

Path: P:\Modeling\Projects\01925\maps\fla\exhibit_a\figure_a_2_1-1_facilities.mxd

Figure 2.1.1-1: Pejepscot Dam

Figure 2.1.2-1: Original Powerhouse and Intake

Figure 2.1.2-2: New Powerhouse and Intake

Figure 2.1.3.1-1: Upstream Fish Passage Facility

Figure 2.1.3.2-1: Downstream Fish Passage Facility Entry Weir

Figure 2.1.3.2-2: Downstream Fish Passage Facility Transport Pipes

A.3 IMPOUNDMENT DATA

A.3.1 Surface Area and Elevation

The Pejepscot Project impoundment encompasses approximately 225 acres at elevation of 67.5 ft.

A.3.2 Storage Capacity

The reservoir has an estimated gross volume of 3,278 acre-ft. The Project impoundment has no significant usable storage capacity due to the Project's run-of-river operational mode.

A.4 TURBINES AND GENERATORS

A.4.1 Existing Turbines and Generators

There are three rehabilitated horizontal Francis units (identified as Nos. 21, 22, and 23) in the original powerhouse (circa 1898). The combined output capacity of these units is approximately 1.58-MW. Units 21, 22, and 23 have generator capacities of 490 kilowatts (kW), 545 kW, and 545 kW, respectively.

The new powerhouse (circa 1987) contains one vertical-shaft, low speed, adjustable-blade, propeller type (Kaplan) turbine-generator unit (identified as Unit No. 1). The unit contains four blades, is 18 ft in diameter, is rated at 17,000 horsepower, and rotates at approximately 82 rpm at a head of 24 ft. The generator capacity of Unit 1 is 13,000 kilovolt-ampere (kVA) at 0.95 power factor. The rated discharge for Unit 1 is 7,000 cfs. The total maximum Project flow is 8,600 cfs. Unit 1 is limited by the authorized generator rating of 12.3-MW.

The total installed capacity of the Project, as limited by the generator nameplates for each unit, is 13.88-MW.

A.4.2 Proposed Turbines and Generators

There are no proposed changes to the existing turbines and generators.

A.5 TRANSMISSION LINES

Main and secondary substations are located to the north and south of the powerhouse, respectively. These substations are outside of the Project boundary. However, the Project works do include 900-foot-long, 15-kV cable connections to the substations. An electrical single-line diagram showing the Project's connection to the transmission system is presented in Exhibit H.

A.6 ADDITIONAL EQUIPMENT

The Project also has appurtenant facilities, such as cranes, trash rakes, and other equipment necessary for day-to-day operations and maintenance.

A.7 LANDS OF THE UNITED STATES

There are no lands of the United States within the Project.

EXHIBIT B
PROJECT OPERATION AND RESOURCE UTILIZATION

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT B
PROJECT OPERATION AND RESOURCE UTILIZATION

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND DEFINITIONS

Commission	Federal Energy Regulatory Commission
El	elevation
FERC	Federal Energy Regulatory Commission
ft	feet
kV	kilovolts
kW	kilowatts
ME	Maine
mi2	square miles
million gallons per day	MGD
MW	megawatt
MWh	megawatt hours
NEPOOL	New England Power Pool
Project	Pejepscot Hydroelectric Project
Topsham Hydro	Topsham Hydro Partners Limited Partnership
USGS	US Geological Survey

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT B
PROJECT OPERATION AND RESOURCE UTILIZATION

B.1 PROJECT OPERATION

B.1.1 Operating Mode

The Pejepscot Hydroelectric Project (Project) is operated as a run-of-river facility. The main turbine generator unit (Unit 1) is operated on pond level control. Unit 1 controls the turbine wicket gates to maintain a preset pond level which is normally at about elevation (El.) 67.2 feet (ft.) or 0.3 feet below the top of the spill gates. When Unit 1 nears its maximum flow capacity of 7,550 cubic feet per second (cfs), one or more of the three small units (Units 21, 22 and 23) is manually started. The small units are mainly operated during high spring runoff and after large storm events that increase river flow. Tables 1.1-1 and 1.1-2 provide a summary of the percentage of time by month that the Francis (Units 21, 22, 23) and Kaplan (Unit 1) units historically operated during the years 2015-2019. Average values for monthly operation of the Pejepscot turbine units presented in Tables 1.1-1 and 1.1-2 are corrected to remove the period July 2018 to April 2019 to account for a major outage associated with a generator rewind for Unit 1.

Inflows in excess of the hydraulic capacity of the units are passed at the dam spillway. Inflows to the Project exceed the maximum capacity of the units approximately 25 percent of the time, on average. When the pond level reaches El. 69.0 (1.5 ft above the spill gates), the gates begin to lower starting with Gate 1, closest to the powerhouse. The gates operate on pond level control and as flow increases, they maintain the pond level of El. 69.0 until all five gates are open. When the flow starts decreasing and the pond level drops to El. 68.0 the gates start to close to maintain a level above El. 68.0. When all five gates are closed, the pond is again on turbine pond level control until the pond level exceeds El. 69.0.

The Project is required to release a continuous minimum flow of 1,710 cfs, as measured immediately downstream from the Project powerhouse, or inflow to the impoundment, whichever is less, minus process water (approximately 5 million gallons per day (MGD) or 9.3 cfs) and 100 cfs for pond level control. Flows may be modified temporarily if required by operating emergencies beyond the control of Topsham Hydro Partners Limited Partnership (Topsham Hydro or Licensee), or for short periods upon mutual agreement between Topsham Hydro, Maine Department of Marine Resources, and Maine Department of Inland Fisheries and Wildlife.

B.2 FUTURE OPERATIONS

Topsham Hydro proposes to maintain a year-round minimum flow of 1,710 cfs or inflow, whichever is less[4], and continue to operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates [5] during the term of the new Project license. Topsham Hydro is not proposing any operational changes at this time.

In addition, Topsham Hydro proposes to reduce the operational setting for Unit 1 (unit turndown) to approximately 3,480 cfs (resulting in intake approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually to enhance downstream eel passage.

B.2.1 Annual Plant Factor

The average annual plant factor is determined using the following equation:

$$\frac{\text{Average Annual Output}}{\text{Licensed Capacity x 8760 hours/year}} = \text{Average Annual Plant Factor}$$

The Project currently has a gross average annual energy production of approximately 68,516 megawatt hours (MWh) a year and an annual plant factor of approximately 56 percent based on its current capacity of 13.88-MW. Table 1.3-1 provides monthly generation for the period 2009 through 2019.

[4] Minimum flow requirements under the current license are described as “continuous,” but Topsham Hydro proposes that the requirement in the new license be instead based on the hourly average. This change would capture the intent of the minimum flow measure, but would avoid unnecessary reporting of very short term excursions due to unplanned events such as extreme weather, equipment failure, and so on. A similar change was adopted in 2011 for the Gulf Island-Deer Rips Hydropower Project (FERC No. 2283).

[5] Topsham Hydro also proposes that, for compliance purposes, the pond level elevation also be based upon hourly average, for similar logic as the minimum flow requirement.

Table 1.1-1: Monthly Percentage of Time Francis Units 21, 22, or 23 Operated for Years 2015-2019

Month	Operation Year					Average[6]
	2015	2016	2017	2018	2019	2015-2019
January	49%	21%	0%	35%	98%	**26%**
February	0%	39%	10%	0%	100%	**12%**
March	0%	85%	7%	30%	100%	**31%**
April	66%	72%	51%	87%	76%	**69%**
May	27%	10%	100%	43%	0%	**36%**
June	52%	6%	14%	35%	0%	**21%**
July	14%	0%	0%	100%	0%	**4%**
August	0%	7%	0%	100%	0%	**2%**
September	40%	39%	19%	99%	19%	**29%**
October	15%	40%	52%	99%	14%	**30%**
November	18%	0%	49%	99%	18%	**21%**
December	30%	11%	0%	98%	0%	**10%**

Table 1.1-2: Monthly Percentage of Time Kaplan Unit 1 Operated for Years 2015-2019

Month	Operation Year					Average[6]
	2015	2016	2017	2018	2019	2015-2019
January	59%	99%	100%	100%	0%	**90%**
February	100%	100%	100%	96%	0%	**99%**
March	100%	99%	93%	100%	0%	**98%**
April	99%	100%	99%	100%	0%	**100%**
May	94%	100%	100%	100%	66%	**92%**
June	100%	94%	100%	64%	98%	**91%**
July	100%	100%	100%	0%	99%	**100%**
August	100%	93%	100%	0%	87%	**95%**
September	62%	61%	81%	0%	79%	**71%**
October	100%	60%	58%	0%	97%	**79%**
November	100%	100%	92%	0%	100%	**98%**
December	100%	99%	100%	0%	100%	**100%**

[6] Average values in Tables 1.1-1 and 1.1-2 are adjusted to exclude the months of July 2018 through April 2019 during which time Unit 1 was offline for a generator rewind.

Table 1.3-1. Annual and Monthly Gross Generation (MWh) for the Project (2009-2019)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2009	7,048	5,736	8,351	8,123	8,606	6,809	7,089	6,874	3,610	6,182	6,966	8,246	83,640
2010	7,833	6,376	8,513	8,412	7,559	5,269	3,792	3,298	2,858	7,624	7,900	7,668	77,102
2011	7,160	5,556	8,232	7,443	8,675	6,693	3,882	3,469	6,316	8,439	7,411	7,846	81,122
2012	6,664	5,282	7,909	5,985	8,704	7,819	4,821	4,775	4,402	6,414	6,636	7,191	76,602
2013	6,786	6,375	8,196	9,141	7,915	8,488	8,164	5,962	5,756	4,164	4,764	5,865	81,576
2014	7,492	5,522	6,084	7,486	9,447	7,400	7,292	6,610	3,023	4,993	5,261	6,660	77,270
2015	4,257	5,359	5,922	7,325	9,265	7,292	7,221	6616	2,967	4,826	5,797	6,660	73,507
2016	6,697	7,182	8,198	8,551	6,983	3,198	3,048	1,905	1,728	2,119	4,741	5,331	59,681
2017	6,244	5,552	6,169	6,161	8,570	6,193	5,538	3,381	2,467	2,157	6,399	5,715	64,546
2018	6,733	6,476	7,548	7,016	6,840	2,298	1,017	777	981	975	788	723	42,172
2019	572	575	747	419	5,224	7,562	4,786	2,246	1,955	5,833	6,540	--	36,459
Mean	**6,135**	**5,454**	**6,897**	**6,915**	**7,981**	**6,275**	**5,150**	**4,174**	**3,278**	**4,884**	**5,746**	**6,191**	**68,516**

B.2.2 Project Operation During Adverse, Mean, and High Water Years

B.2.3 River Basin Operations

The Androscoggin River flow regime is set by the Upper Androscoggin River Storage System, which consists of a series of headwater storage reservoirs located in Maine and New Hampshire. Outflow from the storage reservoirs is set in accordance with various legal agreements. The upper portion of the Androscoggin River contains 16 run-of-river hydroelectric projects until reaching the Gulf Island Hydroelectric Project. The Gulf Island Project then re-regulates downstream flow for the lower Androscoggin River. The lower portion of the Androscoggin River contains 5 run-of-river hydroelectric projects, including the Pejepscot Project which is the second dam upstream of the Androscoggin River's confluence with Merrymeeting Bay.

Given that the Pejepscot Project is operated as a run-of-river facility, the Project impoundment experiences limited fluctuation during normal operations. Annual and monthly flow duration curves for the period January 1987 through December 2019 are provided in Appendix B-1. Daily flow data prorated from the Auburn, ME U.S. Geological Survey (USGS) gage (No. 01059000) were utilized to develop the flow duration curves.[7]

B.2.4 Operation During Adverse Conditions

With the existing regulation of the upstream storage facilities, the reduction in river flows due to adverse water conditions is generally minimal and infrequent. During low inflow conditions, Topsham Hydro operates the Project to maintain the impoundment level near 67.2 ft and to provide the required minimum downstream releases and flows necessary for operation of the fish passage structures. The minimum downstream releases are provided through turbine operations and fish passages when in operation. During the rare occasions when inflows to the impoundment are less than the minimum hydraulic capacity of the Project's turbines, the minimum downstream flow release is provided over the spillway.

B.2.5 Operation During High Water and Flood Conditions

Under higher river flow conditions, water in excess of the hydraulic capacity (8,600 cfs) of the generating units is spilled at the dam. It is estimated that the Project is operated in this manner approximately 25% of the year. High flows in the Androscoggin River Basin occur annually during the spring and fall run-off periods. The magnitude of spring flows may vary considerably depending on the water content of the melting snow cover, the occurrence of coincidental heavy spring rainfall, and warm temperatures.

Under flood conditions, in addition to spillage and maximum unit operation, the spill gates on the dam spillway are lowered to help control upstream water levels. When the pond level reaches El. 69.0 (1.5 ft above the spill gates), the gates begin to lower starting with Gate 1, closest to the powerhouse. The gates operate on pond level control and as flow increases, they maintain the pond level of El. 69.0 until all five gates are open. When the flow starts decreasing and the pond

[7] A proration factor of 1.05 was used as a result of the difference in drainage area at the Project (3,420 mi^2) as compared to the USGS gage (3,263 mi^2).

level drops to El. 68.0 the gates start to close to maintain a level above El. 68.0. When all five gates are closed, the pond is again on turbine pond level control until the pond level exceeds El. 69.0.

B.3 DEPENDABLE CAPACITY AND AVERAGE ANNUAL ENERGY PRODUCTION

B.3.1 Project Hydrology

The Androscoggin River flows about 169 miles from its headwaters at Umbagog Lake in Errol, NH to Merrymeeting Bay. The drainage area at Merrymeeting Bay, where the Androscoggin River ends, is approximately 3,470 mi^2. Conversely, the drainage area at the Project is approximately 3,420 mi^2. The Project impoundment has surface area of approximately 225 acres at the full pond elevation of El. 67.5. While the Project has a gross storage capacity of 3,278 acres at the full pond elevation, the Project has negligible usable storage capacity as a run-of-river Project. The vast majority of the inflow to the Project impoundment is provided by the upstream Worumbo Project, which is located approximately 3.4 miles upstream and has a drainage area of approximately 3,382 mi^2. Inflow is also provided by the Little River, Meadow Brook, and Pinkham Brook, as well as several smaller streams, between the Worumbo and Pejepscot Dams.

Annual and monthly flow duration curves based on prorated data from the Auburn, ME USGS gage are included in Appendix B-1. The mean daily inflow for the period examined is approximately 7,000 cfs. The peak streamflow at the Project during this period was approximately 108,000 cfs on April 2, 1987. The minimum streamflow at the Project during this period was approximately 1,289 cfs on October 9, 1988.

The peak streamflow for the period of record at the USGS gage is approximately 141,500 cfs on March 20, 1936.

B.3.2 Dependable Capacity

The dependable capacity is defined as the load carrying ability of a power plant under adverse load and flow conditions. The dependable capacity (seasonal claimed capability) for the Project is 5.566 MW (summer) and 7.941 MW (winter). These are calculated based on a 5-year average (2013-2017) to determine qualified capacity; for summer (June –September) for the 5 hours between 1 p.m. and 6 p.m.; and for winter (October-May) for the 2 hours between 5 p.m. and 7 p.m.

B.3.3 Area-Capacity and Rule Curve

Because the Project has no useable storage capacity, there is no area capacity curve or formal rule curve for the Project.

B.3.4 Estimated Hydraulic Capacity

The Project has a combined estimated maximum hydraulic capacity of 8,600 cfs.

B.3.5 Tailwater Rating Curve

The normal tailwater elevation at the Project is El. 43.7 ft. Appendix B-2 contains the tailwater rating curve for the Project.

B.3.6 Power Plant Capacity vs. Head

At a net head of 24 ft, the Project has a total authorized nameplate capacity of 13.88-MW. Appendix B-3 contains the plant capability curve for the Project. The minimum net operating head is 19 ft, maximum at full load is 26 ft, maximum with 1,500 cfs discharge is 27 ft, and the normal (rated) head is 24 ft.

B.4 USE OF PROJECT POWER

Topsham Hydro is an independent power producer and does not provide electric service to any particular group or class of customers or prepare and submit load and capability forecasts or resource plans to any regulatory body.

The Project generates renewable power for Maine and the regional power pool administered by ISO New England. Currently, output is sold on the open market through bidding into the New England Power Pool (NEPOOL) market administered by ISO New England, the non-project independent system operator for New England. ISO New England administers all significant aspects of the NEPOOL market.

B.5 PLANS FOR FUTURE DEVELOPMENT

Topsham Hydro has no plans to alter Project operations at this time beyond those environmental measures described in Exhibit E. Nor does Topsham Hydro have any future development plans at the Project.

APPENDIX B-1 – ANNUAL AND MONTHLY FLOW DURATION CURVES

Figure B1-1. Annual Flow Duration Curve (1987-2019)

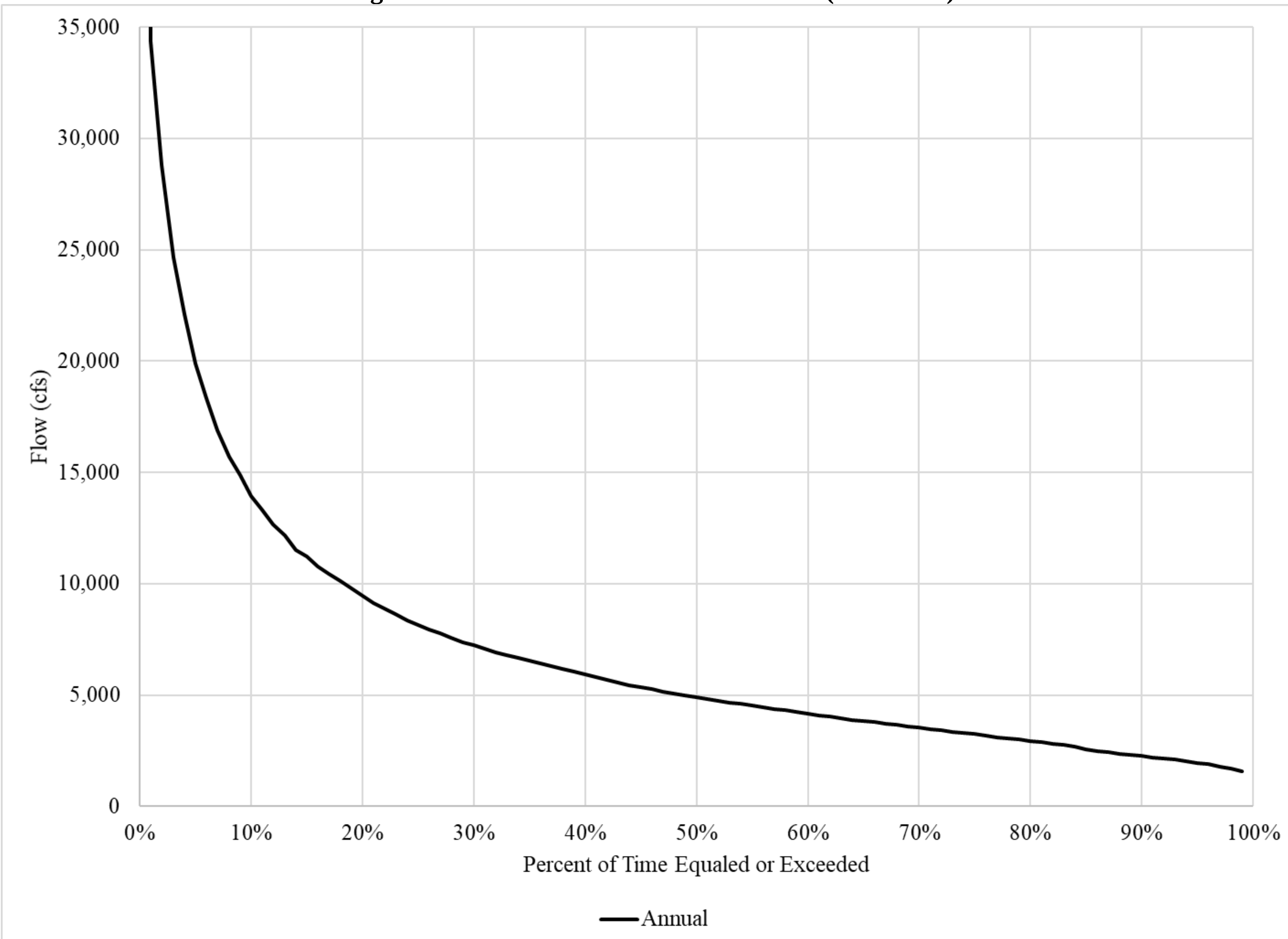


Figure B1-2. January, February, and March Flow Duration Curve (1987-2019)

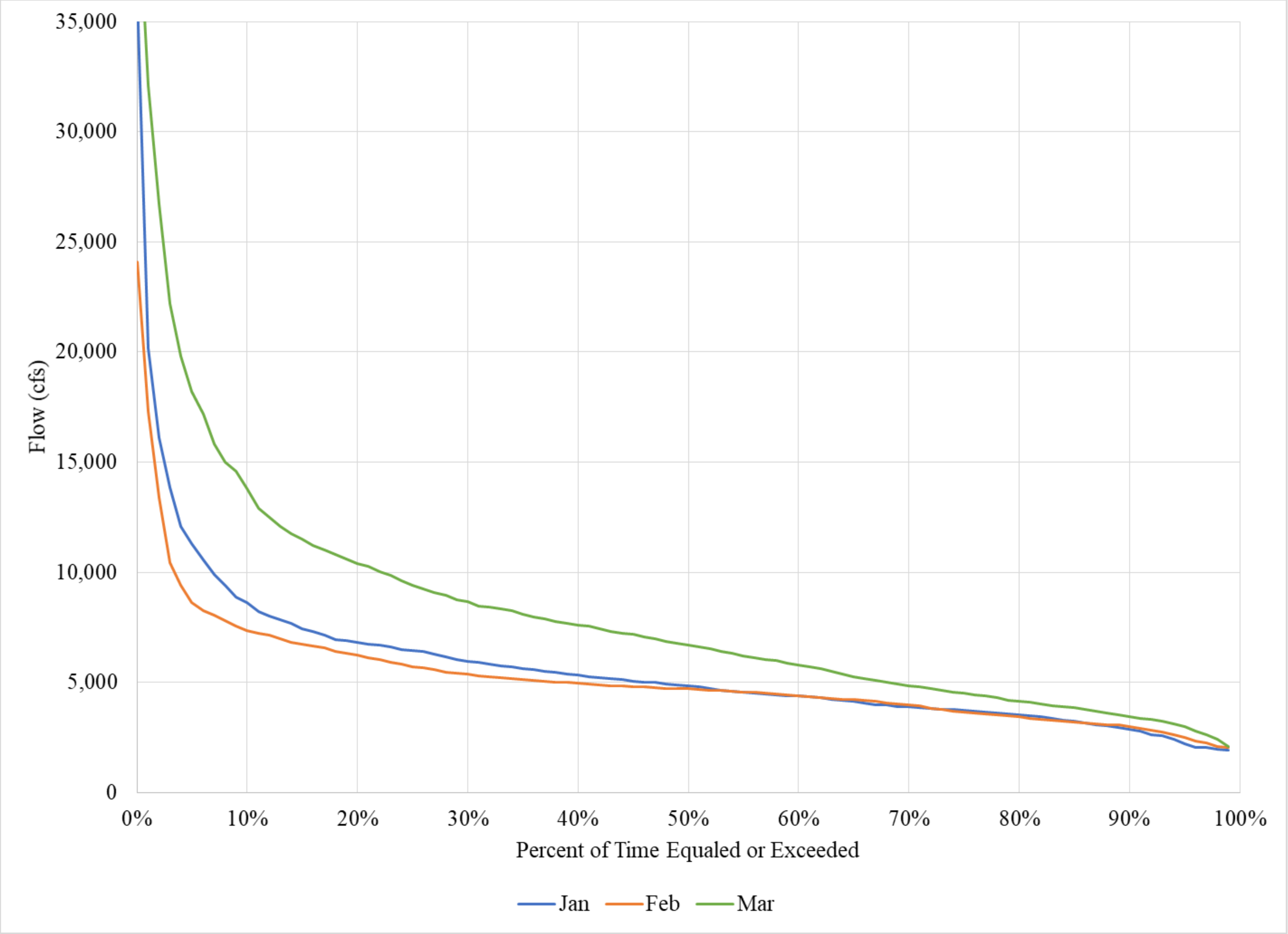


Figure B1-3. April, May, and June Flow Duration Curve (1987-2019)

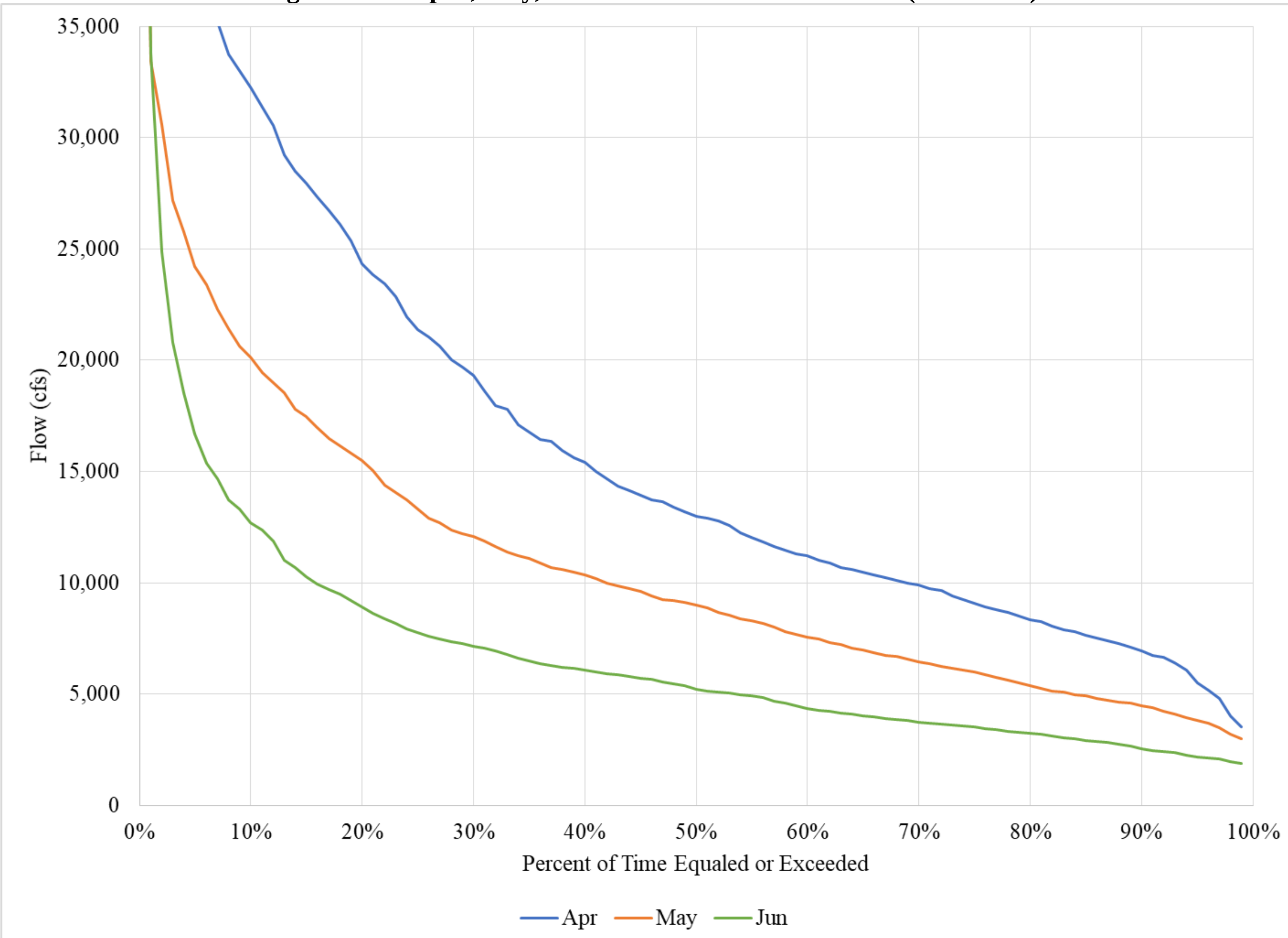


Figure B1-4. July, August, and September Flow Duration Curve (1987-2019)

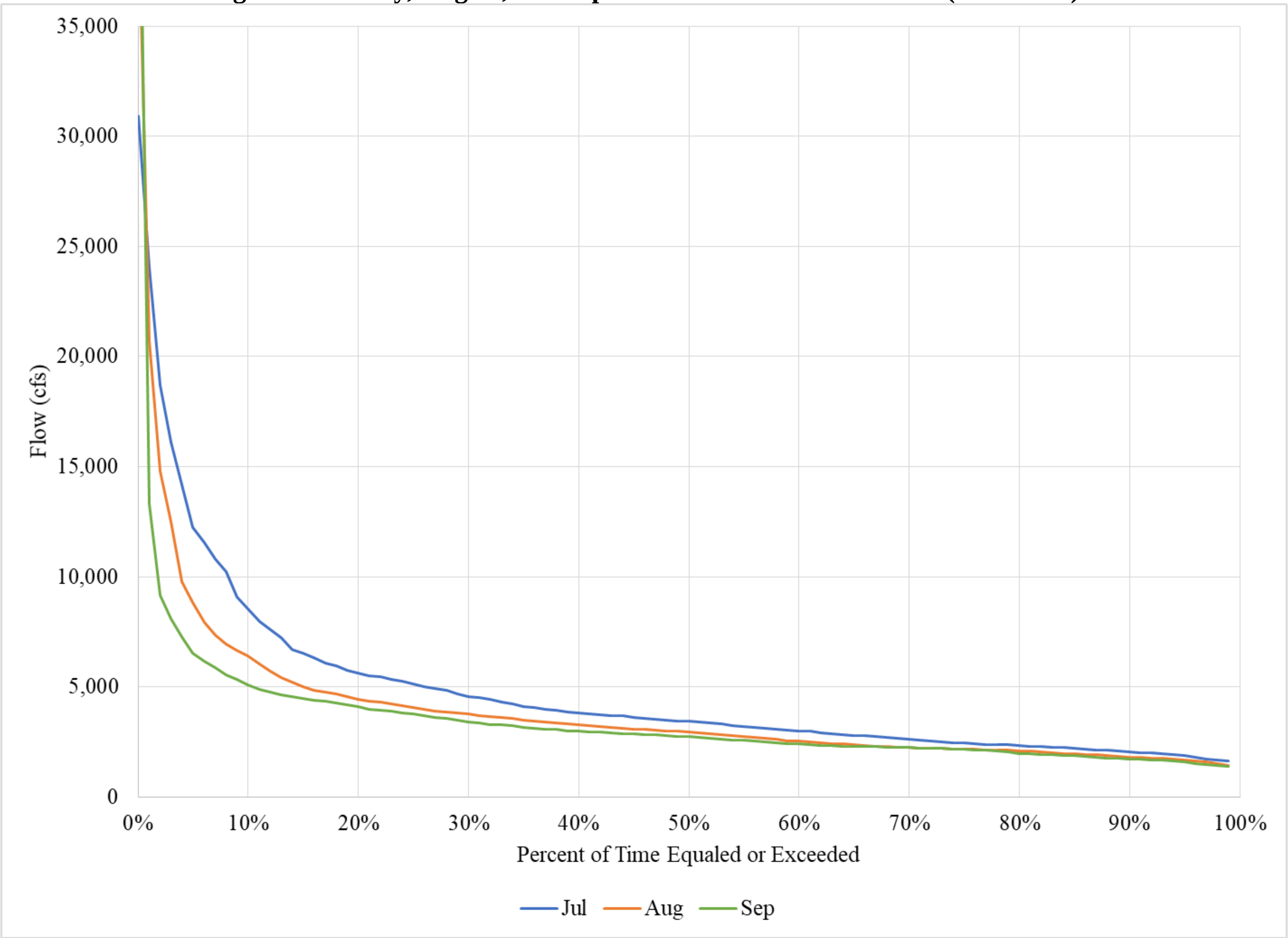
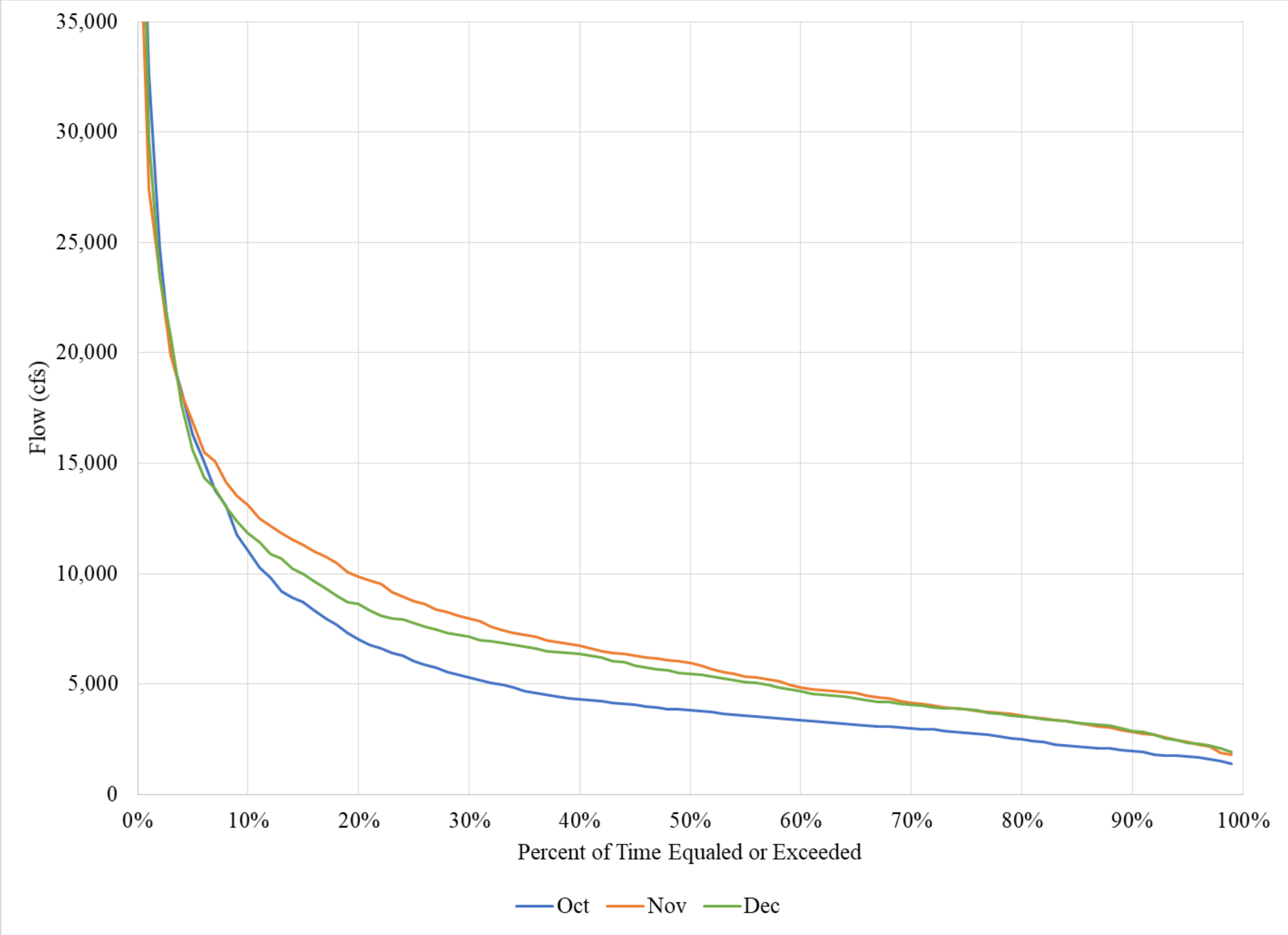
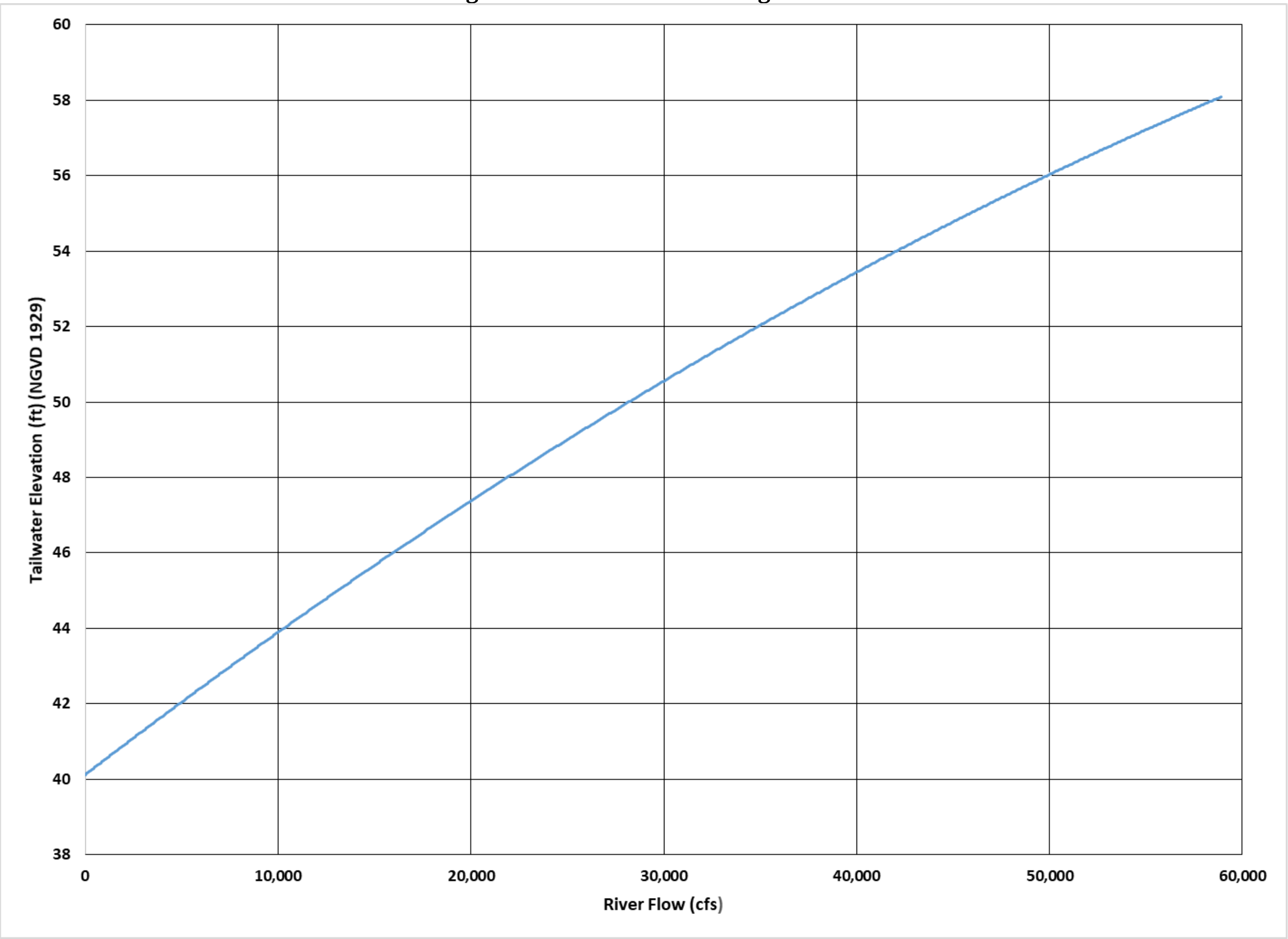


Figure B1-5. October, November, and December Flow Duration Curve (1987-2019)



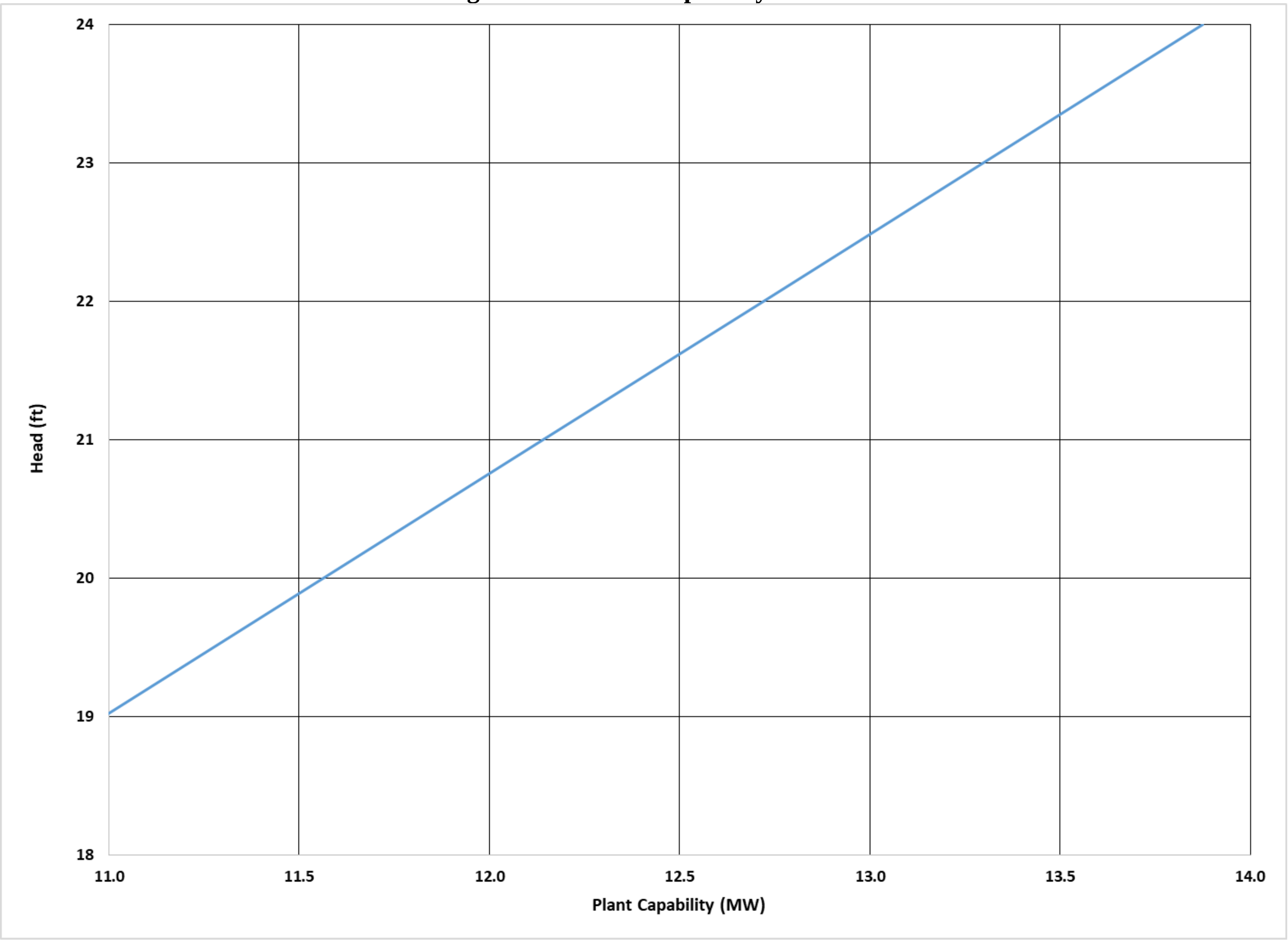
APPENDIX B-2 – TAILWATER RATING CURVE

Figure B2-1. Tailwater Rating Curve

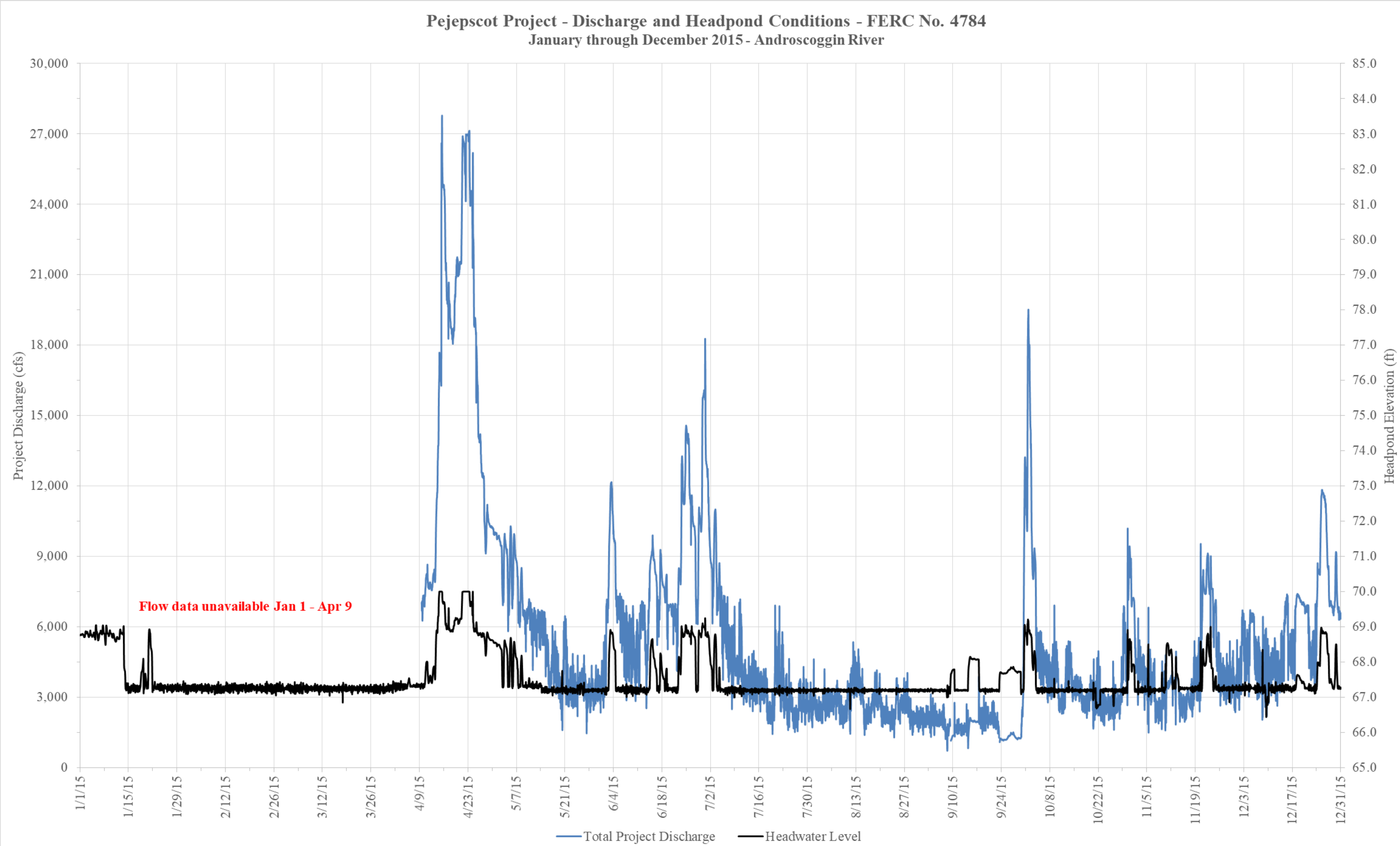


APPENDIX B-3 – PLANT CAPABILITY CURVE

Figure B3-1. Plant Capability Curve



APPENDIX B-4 – FLOW AND IMPOUNDMENT WATER LEVEL DATA (2015-2019)


Pejepscot Project - Discharge and Headpond Conditions - FERC No. 4784
January through December 2015 - Androscoggin River
Project Discharge (cfs)
Headpond Elevation (ft)
30,000
27,000
24,000
21,000
18,000
15,000
12,000
9,000
6,000
3,000
0
85.0
84.0
83.0
82.0
81.0
80.0
79.0
78.0
77.0
76.0
75.0
74.0
73.0
72.0
71.0
70.0
69.0
68.0
67.0
66.0
65.0
Flow data unavailable Jan 1 - Apr 9
1/1/15
1/15/15
1/29/15
2/12/15
2/26/15
3/12/15
3/26/15
4/9/15
4/23/15
5/7/15
5/21/15
6/4/15
6/18/15
7/2/15
7/16/15
7/30/15
8/13/15
8/27/15
9/10/15
9/24/15
10/8/15
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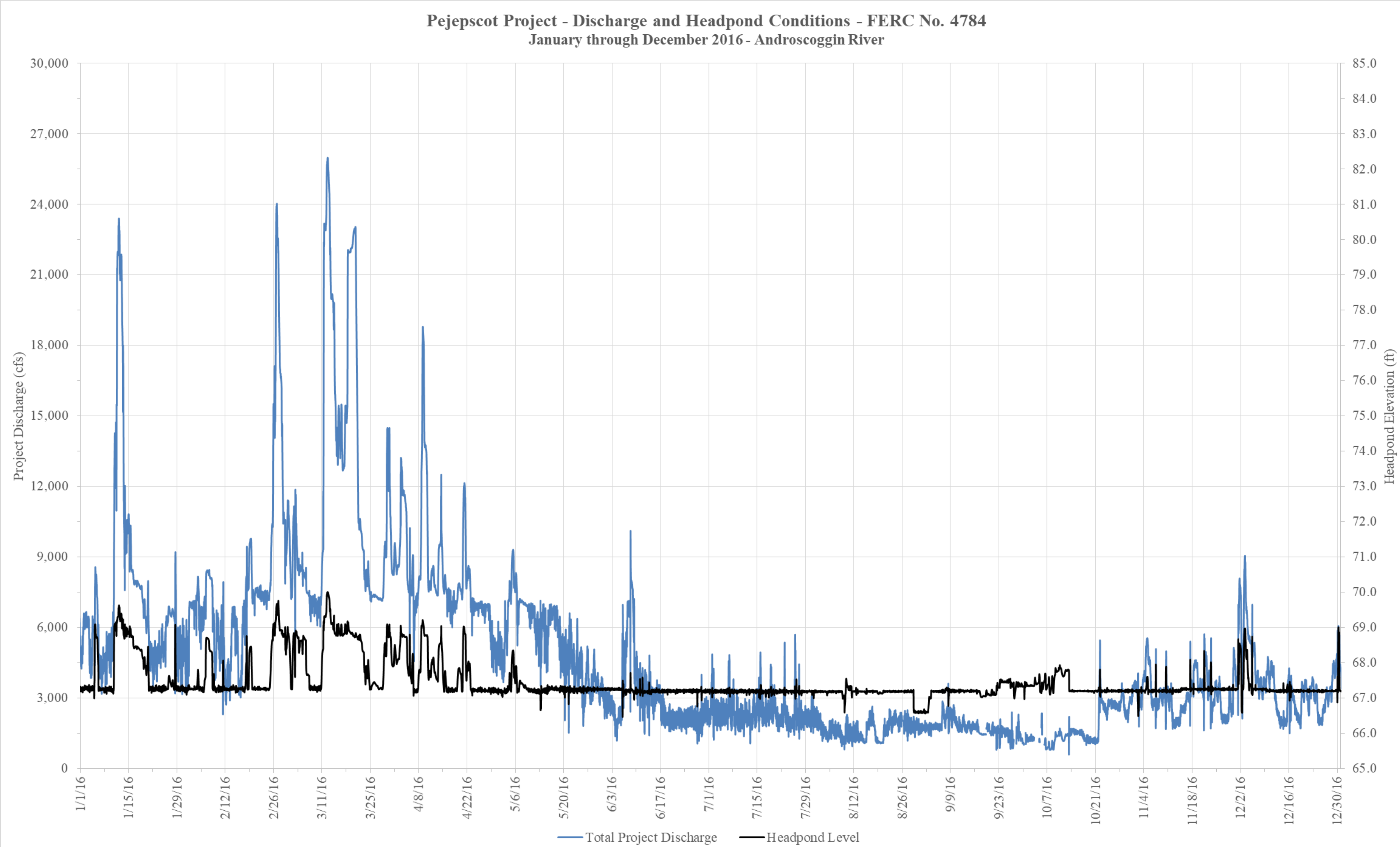
11/5/15
11/19/15
12/3/15
12/17/15
12/31/15
Total Project Discharge
Headwater Level


Pejepscot Project - Discharge and Headpond Conditions - FERC No. 4784
January through December 2016 - Androscoggin River
Project Discharge (cfs)
Headpond Elevation (ft)
30,000
27,000
24,000
21,000
18,000
15,000
12,000
9,000
6,000
3,000
0
85.0
84.0
83.0
82.0
81.0
80.0
79.0
78.0
77.0
76.0
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1/1/16
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3/25/16
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12/2/16
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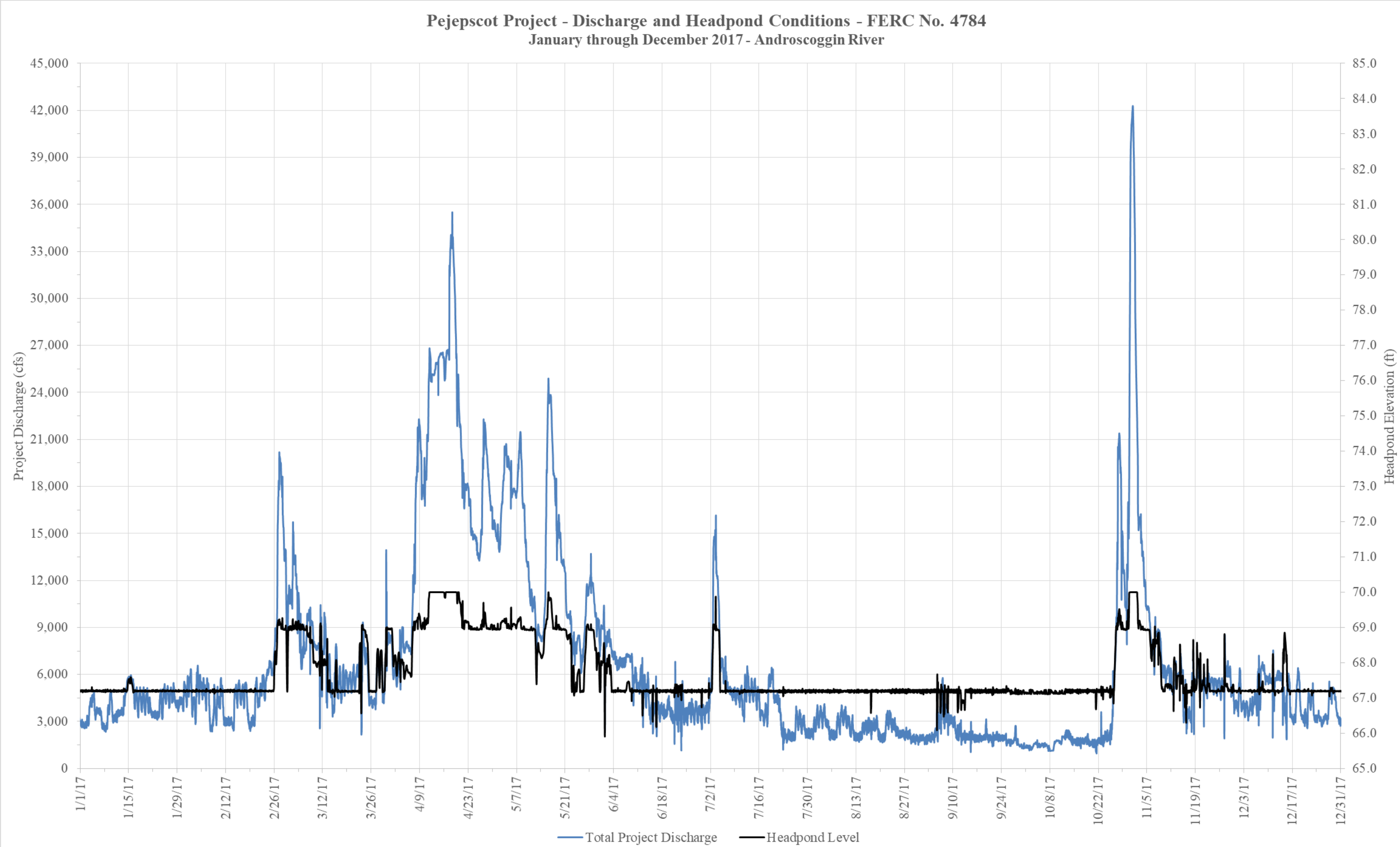
12/30/16
Total Project Discharge
Headpond Level


Pejepscot Project - Discharge and Headpond Conditions - FERC No. 4784
January through December 2017 - Androscoggin River
Project Discharge (cfs)
Headpond Elevation (ft)
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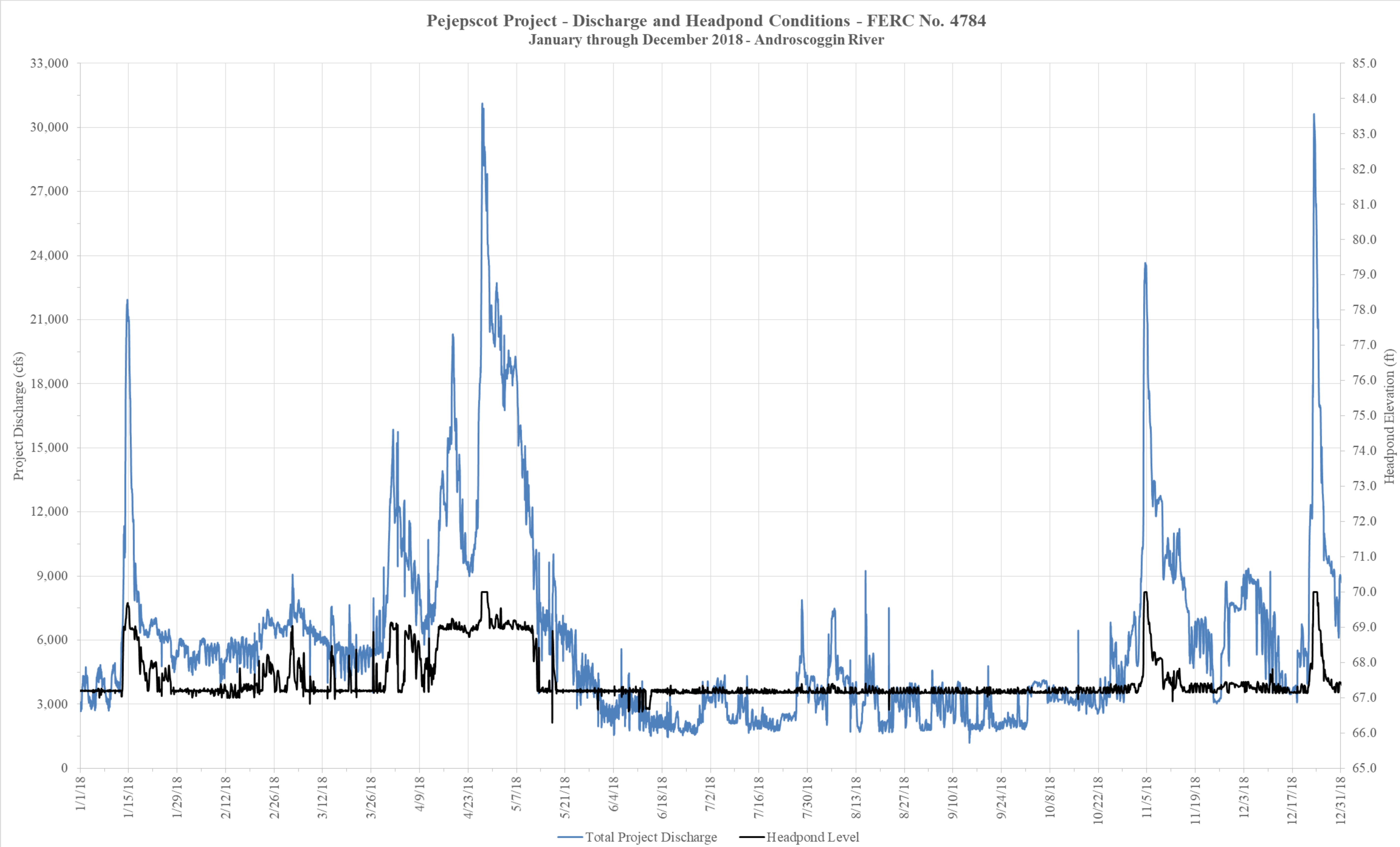
Total Project Discharge
Headpond Level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Total Project Discharge
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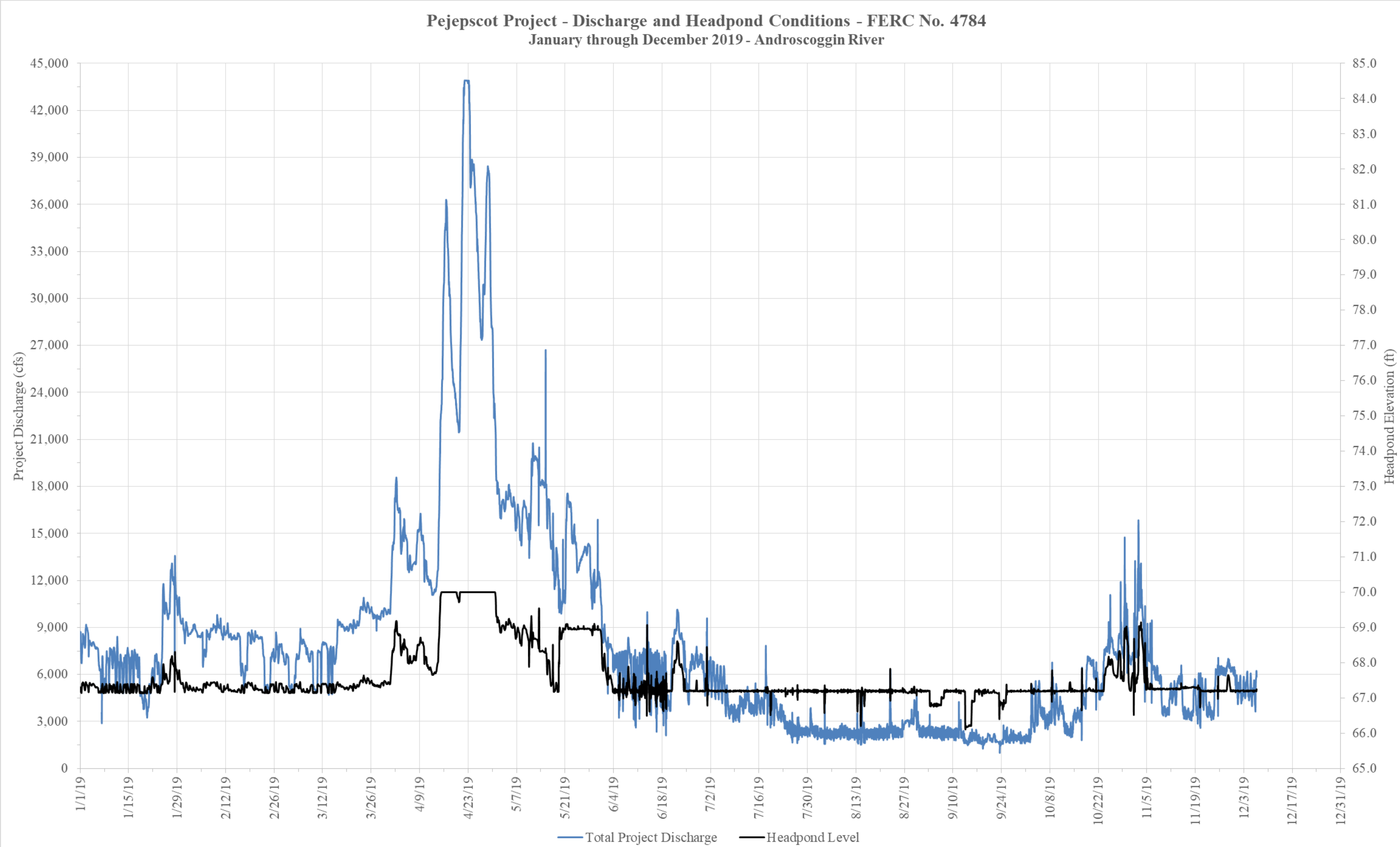
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12/17/19
12/31/19
Total Project Discharge
Headpond Level

EXHIBIT C
CONSTRUCTION HISTORY

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT C
CONSTRUCTION HISTORY

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LIST OF ABBREVIATIONS AND DEFINITIONS

ft	feet
Project	Pejepscot Hydroelectric Project
Topsham Hydro	Topsham Hydro Partners Limited Partnership

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT C
CONSTRUCTION HISTORY

C.1 CONSTRUCTION HISTORY

C.1.1 Original Construction

The Pejepscot Hydroelectric Project (Project) was originally constructed in 1893 as part of a paper mill and consisted of a horseshoe shaped timber crib spillway and grinder room, referred to as the wheel pit. The original timber crib dam failed between 1893 and 1896. The spillway was rebuilt in 1896 on the current straight alignment.

The Project was extensively redeveloped between 1985 and 1987, which included rehabilitation of the dam, the addition of a new powerhouse and fish passage, and modifications to the original powerhouse. Actions taken to rehabilitate the dam included: (1) permanently raising the crest from elevation 62.5 to 64.5 feet (ft); (2) installation of five, 96-foot-long by 3-foot-high spillway crest gates; (3) installation of a steel sheet-pile membrane on the upstream face of the existing dam; (4) the addition of new timber cribbing at the toe of the dam to increase the width of the dam from 68 to 82 ft.; (5) replacing the unreinforced crest and apron with a new reinforced concrete crest supported on H piles, and a 5-foot-thick reinforced concrete apron; and (6) installation of four, reinforced, concrete piers and two reinforced concrete retaining walls at the dam abutments. Start-up and commissioning of Unit 1 commenced on October 16, 1987. Bearing runs were conducted from October 28, 1987 to October 31, 1987 and Unit 1 was placed into commercial operation about 2:00 P.M. Saturday, October 31, 1987.

C.1.2 Modification or Additions to the Existing Project

The Project has remained largely unchanged since its extensive rehabilitation in the mid- to late-1980's. Topsham Hydro Partners Limited Partnership (Topsham Hydro) has made various equipment improvements and upgrades to the Project over the term of the current license, including rebuilding the intake/trash rack structure for the original powerhouse in 2009. Within the last ten years, the Topsham Hydro has completed the major capital projects shown in Table 1.2-1.

Table C.2-1. Major Capital Projects, Pejepscot 2010-2019

Project Name	Cost
Fishway Hopper Repair	$224,000
Topsham Roof Repair	$127,000
Unit 1 Stator Rewind	$2,443,000

C.2 PROJECT SCHEDULE OF NEW DEVELOPMENT

Topsham Hydro proposes no new development (e.g., additional generating units) at the Project.

EXHIBIT D
STATEMENT OF COSTS AND FINANCING

PEJEPSCOT HYDROELECTRIC PROJECT
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APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT D
STATEMENT OF COSTS AND FINANCING

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LIST OF ABBREVIATIONS AND DEFINITIONS

FPA	Federal Power Act
MWh	megawatt hour
Project	Pejepscot Hydroelectric Project
Topsham Hydro	Topsham Hydro Partners Limited Partnership

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT D
STATEMENT OF COSTS AND FINANCING

D.1 ORIGINAL COST OF EXISTING UNLICENSED FACILITIES

This section is not applicable to the Pejepscot Hydroelectric Project (Project) as Topsham Hydro Partners Limited Partnership (Topsham Hydro) is not applying for an initial (original) license.

D.2 ESTIMATED AMOUNT PAYABLE UPON TAKEOVER PURSUANT TO SECTION 14 OF THE FEDERAL POWER ACT

Under Section 14(a) of the Federal Power Act (FPA), the Federal government may take over any project licensed by the Federal Energy Regulatory Commission (FERC or the Commission) upon the expiration of the current license. The Commission may also issue a new license in accordance with Section 15(a) of the FPA. If such a takeover were to occur upon expiration of the current license, Topsham Hydro would have to be reimbursed for the net investment, not to exceed fair value, of the property taken, plus severance damages. To date, no agency or interested party has recommended a federal takeover of the Project pursuant to Section 14 of the FPA.

D.2.1 Fair Value

The fair value of the Project is dependent on prevailing power values and license conditions, both of which are currently subject to change. The best approximation of fair value would likely be the cost to construct and operate a comparable power generating facility. Because of the high capital costs involved with constructing new facilities and the increase in fuel costs associated with operation of such new facilities (assuming a fossil fueled replacement), the fair value would be considerably higher than the net investment amount. If a takeover were to be proposed, Topsham Hydro would calculate fair value based on then-current conditions.

D.2.2 Net Investment

The net book investment for the Project is approximately $28,351,000 as of June 30, 2020.

D.2.3 Severance Damages

Severance damages are determined either by the cost of replacing (retiring) equipment that is “dependent for its usefulness upon the continuance of the License” (Section 14, Federal Power Act), or the cost of obtaining an amount of power equivalent to that generated by the Project from the least expensive alternative source, plus the capital cost of constructing any facilities that would be needed to transmit the power to the grid, minus the cost savings that would be realized by not operating the Project. These values would need to be calculated based on power values and license conditions at the time of project takeover. However, Topsham Hydro believes that potential severances inflicted by a takeover of the Project would be significant. Therefore, given the challenges of estimating damages associated with severance, Topsham Hydro is reserving the right to provide the Commission with such an estimate should the Commission consider federal takeover of the Project.

D.3 ESTIMATED COST OF NEW DEVELOPMENT

D.3.1 Land and Water Rights

Topsham Hydro is proposing no expansion of its land or water rights as a consequence of this license application.

D.3.2 Cost of New Facilities

Topsham Hydro is not proposing any capacity-related developments at the Project at this time.

D.4 ESTIMATED AVERAGE ANNUAL COST OF THE PROJECT

This section describes the annual costs of the Project as proposed. The estimated average cost of the total Project will be approximately $903,000 a year, based on a 5-year period of analysis. This estimate includes costs associated with existing and projected project operations and maintenance[8], as well as local property and real estate taxes, but excludes income taxes, depreciation, and costs of financing.

D.4.1 Capital Costs

Topsham Hydro uses a 12-percent rate to approximate its average cost of capital. Actual capital costs are based on a combination of funding mechanisms that includes stock issues, debt issues, resolving credit lines, and cash from operations.

D.4.2 Taxes

Property taxes for the 2019 fiscal year are expected to be approximately $209,000. Income taxes for the Project are incorporated into costs Topsham Hydro’s consolidated business and are not separated out for the Project.

D.4.3 Depreciation and Amortization

Depreciation for the Project is approximately $618,047 for the last 12 months ending June 30, 2020.

D.4.4 Operation and Maintenance Expenses

The estimated annual operation and maintenance expense at the Project will be approximately $694,000 including corporate support costs.

[8] Including major maintenance costs.

D.4.5 Costs of Proposed Environmental Measures

Topsham Hydro proposes several protection, mitigation, and enhancement (PME) measures for inclusion in the new license for the Project. The PME measures would add capital costs, and increase annual operations and maintenance costs for the Project.

Topsham Hydro estimates that the capital cost associated each PME measure will be approximately $2,530,200 (2020 dollars), and the increased operations and maintenance costs will be approximately $583,600 (2020 dollars).

Table 4.5-1 presents the itemized preliminary costs associated with these PME measures.

Table 4.5-1. Cost Estimate of Proposed PME Measures

Proposed PME Measure	Capital Cost (2020 dollars)	Annual Operations and Maintenance Cost (2020 dollars)
Maintain a minimum flow of 1,170 cfs, or inflow, whichever is less.	$0	$0
Operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates.	$0	$0
Finalize and Implement an Operations Monitoring Plan	$2,500	$5,000
Develop, in consultation with stakeholders, a Stranding Plan to address potential stranding of fish in the bedrock area below bascule gate no. 5. The Plan will detail inspections of the pools by operators following spill events.	$5,000	$5,000
Revise and Implement a Fishway Operations and Maintenance Plan	$2,500	$5,000
Increase the number of lift cycles at the Project fish lift to one lift event per hour (10 lift cycles per day) between the hours of 0800 and 1800, during the peak upstream migration period (May 16 through June 15) for river herring and American Shad.	$0	$10,000
Develop a plan and schedule, in consultation with resource agencies, containing potential physical and/or operational modifications to be constructed/implemented no later than Year 3 of the new license[9], to address issues that may be impacting upstream passage of migratory fish species.	$263,000	$0
Conduct one season of fish lift efficiency testing for adult river herring during the fourth full passage season after the effective date of the new license.	$0	$100,000

[9] During 2020 and 2021 Topsham Hydro will investigate factors associated with the existing fish lift (i.e., internal and external attraction flow hydraulics and acoustics) that may be affecting upstream passage effectiveness.

Proposed PME Measure	Capital Cost (2020 dollars)	Annual Operations and Maintenance Cost (2020 dollars)
Install and operate a temporary portable American Eel ramp for three passage seasons (June 1 through September 15) to identify a suitable location for a permanent upstream American Eel ramp. The temporary portable eel ramp will be installed during the first full passage season after the effective date of the new license.	$0	$7,500[10]
Install and operate a permanent upstream American Eel ramp (June 1 through September 15) based on the results of the temporary portable ramp evaluation. The permanent ramp will be installed when upstream eel passage facilities are constructed at the downstream Brunswick Hydroelectric Project.	$50,000	$5,000
Discontinue the north (left bank) downstream fish bypass beginning in the second full passage season after the effective date of the new license.	$26,000	$0
Install and operate a fish guidance system/debris boom to direct downstream migrants to a new bypass within bascule gate no. 1 beginning in the second full passage season after the effective date of the new license.	$2,075,000	$25,000
Conduct one season of efficiency testing for juvenile alosines once the proposed downstream fish guidance system is installed and the modifications to bascule gate no. 1 have been completed.	$0	$100,000
Reduce the operational setting for Unit 1 (unit turndown) to approximately 3,480 cfs (resulting in intake approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually to enhance downstream eel passage.	$0	$0
Continue video camera monitoring of Atlantic Salmon utilizing the Pejepscot fish lift.	$0	$7,500
Conduct an Atlantic Salmon radio telemetry study, to determine upstream passage effectiveness at the Pejepscot fish lift, when at least 40 adult Atlantic Salmon of Androscoggin River origin are counted at the Brunswick fishway for two consecutive years.	$0	$75,000[11]
Monitor downstream migrating Atlantic Salmon kelts as part of the adult Atlantic Salmon radio telemetry study described above.	$0	$25,000[12]
Open bascule gate No. 1 (closest to the powerhouse) 50% to provide approximately 500 cfs of spill at night (2000 – 0700 hours) during the month of May.	$0	$0

[10] Annual cost for each passage season.
[11] Cost for 1-season telemetry study.
[12] Cost for 1-season telemetry study.

Proposed PME Measure	Capital Cost (2020 dollars)	Annual Operations and Maintenance Cost (2020 dollars)
Conduct one season of efficiency testing for Atlantic Salmon smolts once the proposed downstream fish guidance system/debris boom is installed and the modifications to bascule gate no. 1 have been completed.	$0	$100,000
Finalize and Implement Recreation Management Plan (including annual facility operations and maintenance)[13]	$101,200	$23,600
Finalize and Implement Historic Properties Management Plan	$5,000	$90,000[14]
Total	**$2,530,200**	**$583,600**

D.5 ESTIMATED ANNUAL VALUE OF PROJECT POWER

Power generated by the Project is sold through the Independent System Operator of New England (ISO New England) at prevailing market rates. Topsham Hydro estimates gross annual energy production of approximately 68,516 MWh. The average monthly Day Ahead Locational Marginal Pricing for the Maine Zone was $30.73/MWh for the period January 1, 2019 to December 31, 2019.

With a current average annual generation of 68,516 MWh, the cost of replacement power would be approximately $2,105,497 annually.

D.6 SOURCES AND EXTENT OF FINANCING

Topsham Hydro's current financing needs are generated from internal funds. Topsham Hydro is likely to finance major enhancements through earnings retention, equity contributions, and loans made by the corporate parent or some combination of those mechanisms.

D.7 COST TO DEVELOP THE LICENSE APPLICATION

The approximate cost to date to prepare the application for new license for the Project is $1,300,000.

D.8 ON-PEAK AND OFF-PEAK VALUES OF PROJECT POWER

Topsham Hydro is proposing to operate the Project in a run-of-river mode; therefore, values of on-peak and off-peak Project power are not applicable, per 18 C.F.R. § 4.51(e)(8).

D.9 ESTIMATED AVERAGE ANNUAL INCREASE OR DECREASE IN PROJECT GENERATION

Table 9.0-1 presents the decrease in generation resulting from the proposed PME measures for the Project.

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[13] Itemized cost for each enhancement is detailed within the Recreation Management Plan.
[14] Includes cost ($85,000) of Phase II archaeological investigations in Year 2 of next license term.

Table 9.0-1. Estimate of Reduced Generation of Proposed PME Measures

Proposed PME Measure	Reduced Generation (MWh)	Annual Cost (2020 dollars)
Open bascule gate No. 1 (closest to the powerhouse) 50% to provide approximately 500 cfs of spill at night (2000 – 0700 hours) during the month of May.	307	$9,500
Reduce the operational setting for Unit 1 (unit turndown) to 3,480 cfs (resulting approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually to enhance downstream eel passage.	2,900	$90,000
Total	**3,207**	**$99,500**

EXHIBIT E
ENVIRONMENTAL REPORT

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT E
ENVIRONMENTAL REPORT

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LIST OF ABBREVIATIONS AND DEFINITIONS

°F	Degrees Fahrenheit
°C	Degrees Celsius
ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effect
ASMFC	Atlantic States Marine Fisheries Commission
BA	Biological Assessment
B.P.	Before present
BPL	Maine Bureau of Parks and Lands
Brookfield	Brookfield Renewable LLC
CARMA	Cultural and Architectural Resource Management Archive
C.F.R.	Code of Federal Regulations
cfs	Cubic feet per second
Commission	Federal Energy Regulatory Commission
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DLA	Draft License Application
DMP	Dioxin Monitoring Program
DO	Dissolved oxygen
El.	Elevation
EFH	Essential Fish Habitat
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
FOMB	Friends of Merrymeeting Bay
FPA	Federal Power Act
fps	Feet per Second
GOM DPS	Gulf of Maine Distinct Population Segment
HBI	Hilsenhoff Biotic Index
HPMP	Historic Properties Management Plan
IPaC	Information for Planning and Consultation
ILP	Integrated Licensing Process
ISR	Initial Study Report
Licensee	Topsham Hydro Partners Limited Partnership

MBEP	Maine Bureau of Environmental Protection
MDACF	Maine Department of Agriculture, Conservation, and Forestry
MDDS	Maine Damselfly and Dragonfly Survey
MDEH	Maine Division of Environmental Health
MDEP	Maine Department of Environmental Protection
MDIFW	Maine Department of Inland Fisheries and Wildlife
MDMR	Maine Department of Marine Resources
ME	Maine
MGD	Million gallons per day
mg/L	Milligrams per liter
MHPC	Maine Historic Preservation Commission
mi^2	Square mile
ml	Milliliter
MPN	Most probable number
MRSA	Maine Revised Statute Annotated
MSZA	Maine Mandatory Shoreland Zoning Act
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NGVD29	National Geodetic Vertical Datum of 1929
NH	New Hampshire
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Agency
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	National Rivers Inventory
OPM	Office of Policy and Management
PAD	Pre-Application Document
PCB	Polychlorinated biphenyls
PCU	Platinum cobalt units
Pejepscot Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PME	Protection, mitigation, and enhancement
POTW	Publicly Owned Treatment Works
ppm	Parts per million

Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PSP	Proposed Study Plan
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
RMP	Recreation Management Plan
RSP	Revised Study Plan
SCORP	Maine Statewide Comprehensive Outdoor Recreation Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SHPO	State Historic Preservation Officer
SPP	Species Protection Plan
sqm	Square mile
SWAT	Surface Water Ambient Toxics
TBSA	Turbine Blade Strike Analysis
TE	Threatened and Endangered
TMDL	Total Maximum Daily Load
Topsham Hydro	Topsham Hydro Partners Limited Partnership
UMF ARC	University of Maine at Farmington Archaeology Research Center
U.S.C.	United States Code
us/cm	MicroSiemens per centimeter
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USR	Updated Study Report
VRMP	Volunteer River Monitoring Program

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT E
ENVIRONMENTAL REPORT

E.1 INTRODUCTION

Topsham Hydro Partners Limited Partnership (Topsham Hydro or Licensee) is licensed by the Federal Energy Regulatory Commission (FERC or Commission) to operate the Pejepscot Hydroelectric Project (Pejepscot Project or Project) (FERC No. 4784). The 13.88 megawatt (MW) Project is located on the Androscoggin River in the village of Pejepscot and Town of Topsham, Maine (ME) to the east, the Town of Lisbon to the north, and the Town of Durham and Brunswick to the west (Figure 1-1). The Androscoggin River basin above the Pejepscot Dam has a drainage area of approximately 3,420 square miles (sqm or mi^2). The Project is the second of 28 dams on the mainstem of the Androscoggin River and its headwaters. The Project boundary extends approximately 3 miles upstream from the Pejepscot Dam. The Project does not occupy any federal lands.

E.1.1 Application

FERC issued a new license to operate the Project to the Androscoggin Water Power Company by Order dated September 16, 1982. The license has been transferred, in full and in part, several times since issuance. Most recently, by order dated September 7, 2011, FERC approved partial transfer of the Project license from Brown Bear Power, LLC, Topsham Hydroelectric Generating Facility Trust No. 1, and Topsham Hydro, jointly, to Topsham Hydro, solely. The current license for the Project expires on August 31, 2022.

As required under the Federal Power Act (FPA), Topsham Hydro is filing with the Commission this application for a new license for the Project on or before August 31, 2020. Topsham Hydro prepared this license application for the Project in accordance with FERC's Integrated Licensing Process (ILP). Pursuant to the ILP process and schedule requirements (Code of Federal Regulations (C.F.R.) Chapter 18, Part 5), Topsham Hydro filed a Draft License Application (DLA) with the Commission and other interested parties, including federal and state agencies, tribal organizations, non-governmental organizations (NGOs), local governments, and the public on April 3, 2020.

The purpose of this Environmental Report is to: (1) describe the existing and proposed Project facilities, project lands, and waters; (2) describe existing and proposed Project operations and maintenance; and (3) to provide an analysis of the effects of the proposed relicensing on each environmental resource identified during scoping, including protection, mitigation, and enhancement (PME) measures as appropriate for each resource area potentially affected by the relicensing, including an analysis of cumulative effects. Topsham Hydro used the following guidelines provided by the Commission in preparing this Environmental Report:

- Scoping Document 2 (Issued February 5, 2018)
- 18 CFR § 5.18[b] (content requirements for an Exhibit E)
- Preparing Environmental Documents: Guideline for Applicants, Contractors, and Staff (FERC 2008)

E.1.2 Public Review and Consultation

The Commission requires an applicant for a new license to consult with the appropriate resource agencies, tribes, and other entities before filing the application. The Licensee initiated the relicensing and stakeholder consultation process by submitting a Notice of Intent (NOI) to relicense the Project and a Pre-Application Document (PAD) to state and federal agencies, tribes, NGOs, and other interested parties on August 31, 2017. On October 30, 2017, the Commission began the public scoping process by issuing Scoping Document 1 (SD1) to identify pertinent resource issues related to the relicensing. FERC also used SD1 to solicit comments and suggestions on its preliminary list of resource issues and alternatives to be addressed in the environmental analysis and requested that the stakeholders identify studies needed to provide pertinent information about the resources potentially affected by the relicensing. The Commission then held public scoping meetings and a site visit on November 28 and 29, 2017, to receive input on the scope of the environmental analysis.

Topsham Hydro then received comments on the PAD and/or study requests from the Maine Department of Environmental Protection (MDEP), Maine Department of Marine Resources (MDMR), National Marine Fisheries Service (NMFS), Maine Department of Inland Fisheries and Wildlife (MDIFW), and the U.S. Fish and Wildlife Service (USFWS) on or before January 3, 2018. On February 5, 2018, FERC issued Scoping Document 2 (SD2). In SD2, the Commission identified the potential resource issues to be evaluated during the environmental analysis of the relicensing pursuant to the National Environmental Policy Act (NEPA).

E.1.2.1 Studies

Topsham Hydro developed a Proposed Study Plan (PSP) based on the PAD comments and/or study requests received. Topsham Hydro filed the PSP with FERC on February 12, 2018 and held its study plan meeting on March 22, 2018. The purpose of the meeting was to provide information on the FERC process plan and schedule, provide additional information on Project operations, review the specific study plans contained in the PSP, and provide an opportunity for meeting attendees to ask questions related to the proposed studies. FERC and Stakeholders attended this meeting. Comments on the PSP were received from MDEP, Maine Historic Preservation Commission (MHPC), NMFS, and the USFWS. Based on comments received on the PSP, Topsham Hydro filed a Revised Study Plan (RSP) with FERC on June 12, 2018. Comments on the RSP were filed by MDEP. On July 3, 2018, FERC issued a Study Plan Determination approving the following studies:

- Water Quality Assessment;
- Tailwater Benthic Macroinvertebrate Study;
- Eel Monitoring Survey;
- Evaluation of Spring Migration Season Fish Passage Effectiveness;
- Evaluation of Fall Migration Season Fish Passage Effectiveness;
- Fish Entrainment and Turbine Survival Assessment;
- Desktop Analysis of the Potential Effectiveness of the Fish Lift for passing adult Atlantic Salmon;
- Stranding Evaluation;
- Sediment Storage and Mobility;
- Large Woody Debris;
- Largemouth and Smallmouth Bass Spawning Habitat Survey;
- Wildlife and Botanical Resources Survey;
- Recreation Facilities Inventory and Use Assessment;
- Historic Architectural Survey;
- Historic Archaeological Phase 1 Survey; and
- Precontact Period Archaeological Survey.

Topsham Hydro filed the Initial Study Report (ISR) on July 12, 2019 and held its ISR Meeting on July 23, 2019. Following the meeting, Topsham Hydro filed an ISR Meeting Summary with the Commission on August 11, 2019. No stakeholder comments were received on the ISR filings. The Updated Study Report (USR) was filed with the Commission on July 10, 2020. The USR meeting was held on July 22, 2020. The USR meeting summary was filed on August 11, 2020. Comments from stakeholders on the USR meeting summary are due September 10, 2020.

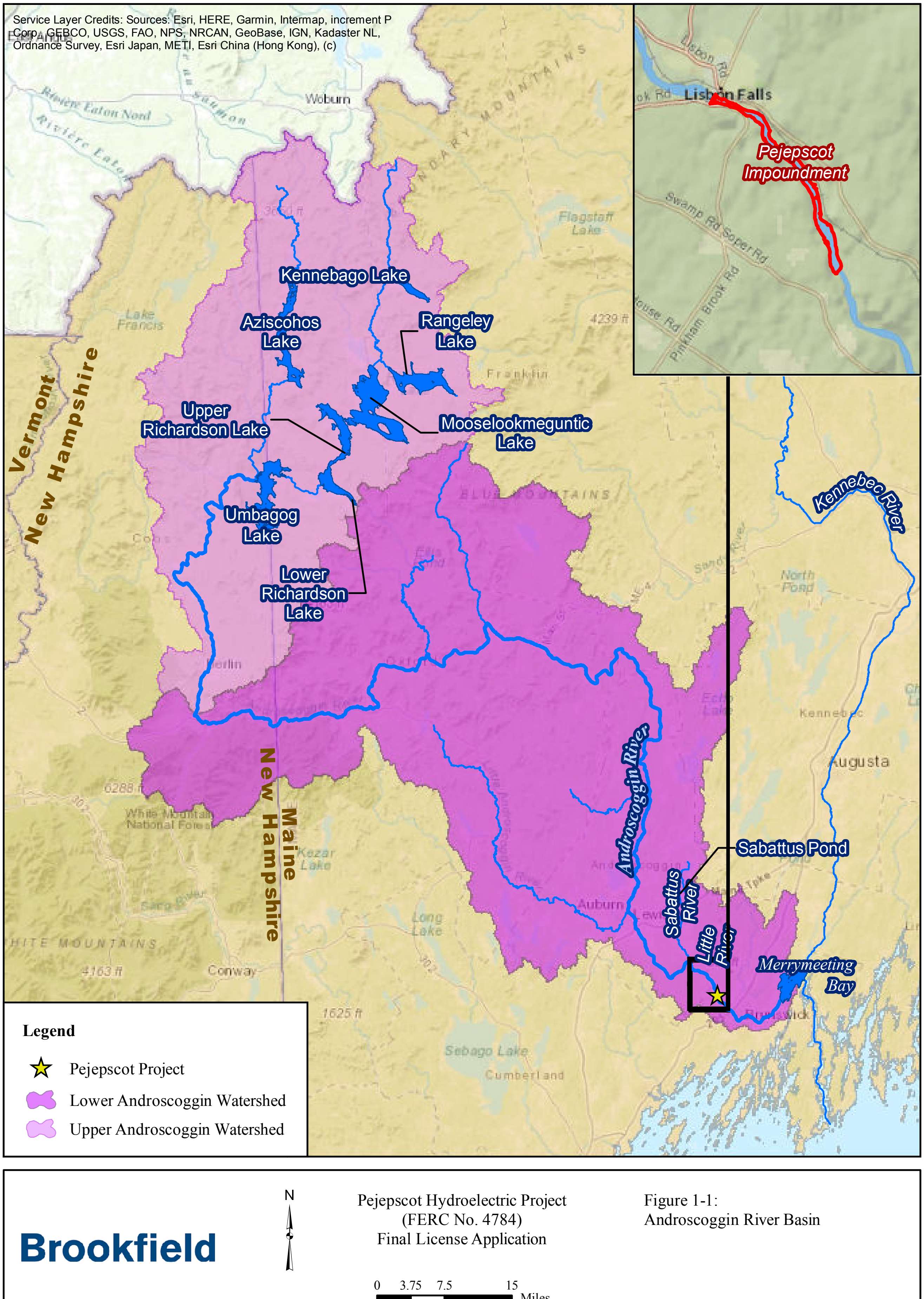
Table 1.2.1-1 identifies the stakeholders that Topsham Hydro consulted during resource issue scoping, study plan development, resource study reporting, and preparation of the license application. Section E.4.0 of Exhibit E summarizes the results of the studies and provides an analysis of the effects of the proposed relicensing on resources and issues that the stakeholders identified during scoping.

A.1.1.1 Comments on the Draft License Application

The DLA was filed with FERC on April 3, 2020, and distributed to stakeholders. Topsham Hydro reviewed the stakeholder's written comments on the DLA and updated the relevant sections in this FLA. A summary of comments received regarding the DLA, and Topsham Hydro's response to the comments, are included in Appendix E-1 of this FLA.

Table 1.2.1-1. List of Consulted Parties

FEDERAL AGENCIES	
ACHP	Advisory Council on Historic Preservation
BIA	Bureau of Indian Affairs
FERC	Federal Energy Regulatory Commission
NMFS	National Marine Fisheries Service
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
STATE AGENCIES	
MDACF	Maine Department of Agriculture, Conservation, and Forestry
MDEP	Maine Department of Environmental Protection
MDIFW	Maine Department of Inland Fisheries and Wildlife
MDMR	Maine Department of Marine Resources
MHPC	Maine Historic Preservation Council
TRIBES	
Aroostook Band of Micmacs	
Houlton Band of Maliseet Indians	
Passamaquoddy Tribe	
Penobscot Indian Nation	
LOCAL GOVERNMENTS	
Androscoggin County Government	
Cumberland County Government	
Sagadahoc County Government	
Town of Brunswick, ME	
Town of Durham, ME	
Town of Lisbon, ME	
Town of Topsham, ME	
NON-GOVERNMENTAL ORGANIZATIONS	
American Rivers	American Rivers
ASF	Atlantic Salmon Federation
FOMB	Friends of Merrymeeting Bay
Maine Rivers	Maine Rivers
TU	Maine Council of Trout Unlimited and Merrymeeting Bay Chapter of Trout Unlimited



Pejepscot Hydroelectric Project
(FERC No. 4784)
Final License Application

Figure 1-1:
Androscoggin River Basin

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E.2 STATUTORY AND REGULATORY REQUIREMENTS

Topsham Hydro, as Licensee for the Project, is subject to the requirements of the FPA as well as other applicable statutes. The major regulatory and statutory requirements are summarized below.

E.2.1 Clean Water Act – Section 401

Topsham Hydro is subject to the Water Quality Certification under Section 401(a)(1) of the federal Clean Water Act of 1977. The MDEP establishes water quality standards consistent with Maine statute 38 MRSA § 464-70. Topsham Hydro will file an application for 401 Water Quality Certification within 60 days of the Commission's Notice of Ready for Environmental Analysis, as required under Commission regulations.

E.2.2 Endangered Species Act

The federal Endangered Species Act (ESA) (16 U.S.C. 1531-1544 - Public Law 93-205) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The lead federal agencies for implementing ESA are the USFWS and National Oceanic and Atmospheric Agency (NOAA) Fisheries. The USFWS maintains a nationwide list of endangered species. Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees. The law requires federal agencies, in consultation with the USFWS or NOAA Fisheries to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. Section 9 of the ESA prohibits taking endangered species of fish and wildlife; the regulations implementing ESA define "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.

On August 31, 2017, with the filing of the NOI, Topsham Hydro requested that FERC designate it as the non-federal representative for purposes of consultation under Section 7 of the ESA. On October 30, 2017, FERC granted this request.

Consultation with federal agencies related to the Project's potential effects on ESA-listed Atlantic Salmon has been ongoing. Consistent with this designation, Topsham Hydro will develop a draft Biological Assessment (BA) for the federally endangered Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic Salmon. Through ongoing consultation with USFWS and NMFS, Topsham Hydro will also develop a Species Protection Plan (SPP), which will include passage performance standards and other protection measures for Atlantic Salmon that avoid, minimize, and mitigate impacts related to Project operation. Topsham Hydro held a series of meetings with USFWS and NMFS, as well as other resource agencies, beginning in March 2020 as part of this consultation process. Notes from these meetings are contained in Appendix E-2. Topsham Hydro expects to continue this informal consultation process and will submit a BA and SPP to the Commission at the culmination of the informal consultation process. Section E.4.7 of Exhibit E provides information on other rare, threatened, and endangered species at the Project.

E.2.3 Coastal Zone Management Act

Under section 307 (c)(3)(A) of the Coastal Zone Management Act (CZMA) (16 U.S.C. §1456), FERC cannot issue a license for a project within or affecting a states' coastal zone unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA program, or unless the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

The Pejepscot Project is located on the Androscoggin River in Cumberland, Sagadahoc, and Androscoggin Counties at river mile (RM) 14. The Project is located in the village of Pejepscot and towns of Topsham, Lisbon, Durham, and Brunswick, Maine. The Project is located approximately 14 miles above the head- of-tide in the Androscoggin River basin and inside of Maine's designated coastal zone (MDMR, 2019). Topsham Hydro will provide MDMR with a request for consistency certification concurrent with the filing of the application for 401 Water Quality Certification with MDEP. Topsham Hydro will file the CZMA consistency certification with the Commission when it is received.

E.2.4 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, requires FERC to take into account the effect of its undertakings on historic properties, which in this case includes the issuance of a federal license for the continued operation of the Project. Section 106 of the NHPA is implemented through the Advisory Council on Historic Preservation (ACHP) Council regulations "Protection of Historic Properties" (36 CFR Part 800). The regulations implementing Section 106 (36 CFR Part 800) define the process for identifying historic properties, assessing effects, and seeking ways to resolve adverse effects on historic properties in consultation with the State Historic Preservation Officer (SHPO), federally recognized Indian tribes, the public, and other appropriate parties.

Specifically, FERC typically completes Section 106 by entering into a Programmatic Agreement with the licensee, the ACHP, and the SHPO and tribes. FERC typically requires the licensee to develop and implement a Historic Properties Management Plan (HPMP) as a license condition. Through an approved HPMP, FERC can require consideration and management of effects on historic properties for the license term, thus meeting the requirements of Section 106 for its undertakings.

On October 30, 2017, FERC designated Topsham Hydro as the non-federal representative for purposes of initiating day-to-day consultation pursuant to Section 106. Topsham Hydro has consulted with MHPC regarding the Project's Area of Potential Effects (APE). In addition, Topsham Hydro conducted historical and cultural resource studies in consultation with the MHPC, which are described in detail in Section E.4.11 of this Exhibit E.

Topsham Hydro prepared a HPMP and it is included in Appendix E-3. The HPMP contains specific steps to be taken by Topsham Hydro to protect and preserve the historic properties identified at the Project over the term of the new license. With the implementation of the final

HPMP, the continued operation of the Project as proposed by Topsham Hydro will have no adverse effects on historical or cultural resources at the Project.

E.2.5 Magnuson-Stevens Fishery Conservation and Management Act

In 1996 the U.S. Congress recognized the increasing pressure on marine fishery resources and addressed these problems in its reauthorization of the Magnuson Fishery Conservation and Management Act, now known as the Magnuson-Stevens Act (16 U.S.C. 1800 – 1891(d)). This act required the eight Regional Fishery Management Councils, in collaboration with NOAA Fisheries, to give heightened consideration to essential fish habitat (EFH) in resource management decisions. Congress defined EFH as "those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity." The designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities.

In 1998, NOAA Fisheries designated 11 rivers in Maine, including the Androscoggin River, as EFH for Atlantic Salmon eggs, larvae, juveniles, and adults. Before a federal agency proceeds with an activity that may adversely affect a designated EFH, the agency must (1) consult with NOAA Fisheries and, if requested, the appropriate council for the recommended measures to conserve EFH, and (2) reply within 30 days of receiving EFH recommendations. The agency's response must include proposed measures to avoid or minimize adverse effects on the habitat or an explanation if the agency cannot adhere to NOAA Fisheries' recommendation.

E.2.6 Wild and Scenic Rivers and Wilderness Acts

Congress created the National Wild and Scenic Rivers System in 1968 (16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Rivers are classified as either wild, scenic, or recreational. No nationally designated wild and scenic rivers or wilderness areas are located within the Pejepscot Project boundary or in the vicinity of the Pejepscot Project (WSR, 2019; NWPS, 2019). The only designated wild and scenic waterway in Maine is a 92.5-mile reach of the Allagash River (WSR, 2019). The Wilderness Act of 1964 [Public Law 88-577 (16 U.S.C. 1131-1136)] was enacted to establish a National Wilderness Preservation System for the permanent good of the whole people and for other purposes. None of the three wilderness areas in Maine are within the Androscoggin River basin (NWPS, 2019).

E.2.7 Federal Lands

There are no federal lands within the Project boundary.

E.2.8 References

Maine Department of Marine Resources. 2019. Coastal Zone Map. https://www.maine.gov/dmr/mcp/about/coastal-zone-map.htm.

National Wilderness Preservation System (NWPS). 2019. Wilderness.net. http://www.wilderness.net/map.

Wild and Scenic Rivers (WSR). 2019. National Wild and Scenic Rivers System – Maine. Available online URL: http://www.rivers.gov/maine.php.

E.3 PROPOSED ACTION AND ALTERNATIVES

E.3.1 No-Action Alternative

The no-action alternative is the baseline from which to compare the proposed action and all action alternatives that are assessed within this document. Under the no-action alternative, the Project would continue to operate under the terms and conditions of the current license, including maintaining the current Project boundary, facilities, and operation and maintenance procedures. No new environmental protection, mitigation, or enhancement measures would be implemented. FERC uses this alternative to establish baseline environmental conditions for comparison with other alternatives.

E.3.2 Existing Project Description

The 13.88-MW Pejepscot Project is located on the Androscoggin River in southern Maine at RM 14. The Project is located in the village of Pejepscot and the Town of Topsham, ME to the east, the Town of Lisbon, ME to the north, and the Towns of Durham and Brunswick, ME to the west. The Project straddles the border between Cumberland and Sagadahoc counties and extends into Androscoggin County. The Androscoggin River basin above the Pejepscot Dam has a drainage area of approximately 3,420 mi^2. The Project is the second of 28 dams on the mainstem of the Androscoggin River and its headwaters. The Project boundary extends approximately 3 miles upstream from the Pejepscot Dam. The FERC Project boundary is depicted in the Exhibit G drawings.

E.3.2.1 Existing Project Facilities

Existing Project structures generally consist of the dam, spillway, fish passage facilities, two powerhouses, a sheet-pile floodwall, an interconnection with the local utility's transmission system, and ancillary equipment. An overview of Project facilities is shown in Figure 3.2.1-1. *Exhibit A – Project Description* provides additional detail about the existing Project facilities.

E.3.2.2 Existing Project Operation

The Pejepscot Project is operated as a run-of-river facility. The main turbine generator unit (Unit 1) is operated on pond level control. Unit 1 controls the turbine wicket gates to maintain a preset pond level which is normally at about elevation (El.) 67.2 feet (ft.) or 0.3 ft below the top of the spill gates. When Unit 1 nears its maximum flow capacity of 7,550 cubic feet per second (cfs), one or more of the three small units (Units 21, 22 and 23) is manually started. The small units are mainly operated during high spring runoff and after large storm events that increase river flow.

Inflows in excess of the hydraulic capacity of the units are passed at the dam spillway. Inflows to the Project exceed the maximum capacity of the units approximately 25 percent of the time, on average. When the pond level reaches El. 69.0 (1.5 ft above the spill gates), the gates begin to lower starting with Gate 1, closest to the powerhouse. The gates operate on pond level control and as flow increases, they maintain the pond level of El. 69.0 until all five gates are open. When the flow starts decreasing and the pond level drops to El. 68.0 the gates start to close to maintain a level above El. 68.0. When all five gates are closed, the pond is again on turbine pond level control until the pond level exceeds El. 69.0.

The Project is required to release a continuous minimum flow of 1,710 cfs, as measured immediately downstream from the Project powerhouse, or inflow to the impoundment, whichever is less, minus process water (approximately 5 million gallons per day (MGD) or 9.3 cfs) and 100 cfs for pond level control. Flows may be modified temporarily if required by operating emergencies beyond the control of Topsham Hydro, or for short periods upon mutual agreement between Topsham Hydro, MDMR, and MDIFW.

E.3.2.3 Existing Project Boundary

The Project boundary follows the contour level of 75.0 ft. above mean sea level, except in the vicinity of the dam and powerhouse and at the upstream limit of the reservoir. The Project boundary extends approximately 3 miles upstream from the Pejepscot Dam to the site of the old Route 125 Bridge, which is located approximately 0.25 miles downstream of the Worumbo Dam and 0.3 miles upstream of the Little River confluence. The Project boundary terminates approximately 260 ft downstream of the Pejepscot Dam. The Project boundary encompasses a total of approximately 305 acres. Figure 3.2.3-1 depicts the existing Project boundary.

E.3.2.4 Existing Environmental Measures

Topsham Hydro currently implements the following environmental measures at the Project.

- Operate the Project in a run-of-river mode, whereby water flowing into the Project impoundment approximates water flowing out in order to protect water resources.
- Maintain a continuous minimum flow of 1,170 cfs, or inflow, whichever is less.
- Fishway Operations and Maintenance Plan.
- Provide public access and use of Project lands and waters; and provide for and maintain the existing Project recreation sites including the Pejepscot Boat Ramp, Pejepscot Fishing Park, and the Lisbon Falls Fishing Park.
- Provide upstream passage for Atlantic Salmon, American Shad, river herring, and other diadromous fish species past the Project via the fish lift.
- Provide downstream passage for diadromous fish via the Project’s downstream fish passage facilities, through spillage, or through the units.
- Species Protection Plan for ESA-listed Atlantic Salmon.

E.3.3 Proposed Action

The Proposed Action is to continue to operate and maintain the Project and continue the existing environmental measures, as described above, and implement certain environmental PME measures as described in the license application over the term of the new license.

E.3.3.1 Proposed Project Facilities

Topsham Hydro is proposing no power-related modifications of the existing Project facilities. The existing dam, powerhouse, and appurtenant features are all well maintained and in good working order. No changes to these facilities that are outside normal maintenance practices or the Commission's safety requirements are required or proposed.

E.3.3.2 Proposed Project Operation

Topsham Hydro proposes to maintain a year-round minimum flow of 1,710 cfs or inflow, whichever is less[15], and continue to operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates [16] during the term of the new Project license. Topsham Hydro is also proposing seasonal night-time turndowns of Unit 1 to facilitate eel passage.

E.3.3.3 Proposed Project Boundary

Topsham Hydro is proposing to modify the Project boundary, as reflected in Figure 3.2.3-1, to make several corrections and modifications as listed below.

- The Project boundary has been adjusted to fully enclose the Project transmission lines.
- The Project boundary has been adjusted to include the access road to the Pejepscot Fishing Park recreation area located on the western shore of the Androscoggin River.
- The Project boundary generally follows elevation 75 ft, NGVD 1929, along the shoreline of the impoundment. More recent LIDAR data has been used to delineate the 75-foot contour shown for the proposed Project boundary. As such, the location of the contour may differ slightly in some areas, compared to the contour shown for the current Exhibit G drawings on file with the Commission, which were presumably developed with older less accurate mapping technology.
- At the upstream end of the Pejepscot Project impoundment is an area of approximately 0.95 acres where the Project boundary overlaps the project boundary for the Worumbo Project (No. 3428), which is owned by Eagle Creek Renewable Energy (Eagle Creek). The area of overlapping Project boundaries is depicted on Figure 3.2.3-1. Topsham Hydro and Eagle Creek have agreed to clarify licensee responsibility for the overlapping area by seeking Commission approval to revise the boundaries of both projects to eliminate the overlap. The decision to revise the project boundaries for both Pejepscot and Worumbo reflects both licensees' belief that eliminating the overlap will make administration of the licenses easier, and will simplify the relicensing process for the Pejepscot Project, as well as the Worumbo Project, whose Notification of Intent to seek a new license and Preliminary Application Document are due to be filed with the Commission no later than November 30, 2020. The proposed boundary change in this area will have no impact on power generation, fish and wildlife, water quality, recreation, or cultural resources. All of the area that currently is within either the boundary for Pejepscot or Worumbo will remain within the boundary of one or the other project and be

[15] Minimum flow requirements under the current license are described as "continuous," but Topsham Hydro proposes that the requirement in the new license be instead based on the hourly average. This change would capture the intent of the minimum flow measure, but would avoid unnecessary reporting of very short term excursions due to unplanned events such as extreme weather, equipment failure, and so on. A similar change was adopted in 2011 for the Gulf Island-Deer Rips Hydropower Project (FERC No. 2283).

[16] Topsham Hydro also proposes that, for compliance purposes, the pond level elevation also be based upon hourly average, for similar logic as the minimum flow requirement.

subject to the requirements of the applicable license. The Lisbon Falls Fishing Park, which is currently connected to the Pejepscot Project license, is located on this land. Topsham Hydro currently operates and maintains the facility; however, the lands are leased from Eagle Creek. The term of the lease ends at the expiration of the current Pejepscot license. This facility is proposed to be removed from the Pejepscot Project boundary, but would continue to be encompassed with the Worumbo Project boundary with the exception of the parking area for this facility. To alleviate this discrepancy, Eagle Creek proposes to modify the Worumbo Project boundary to include the parking area. With the modifications of the boundary for each Project, Eagle Creek would assume responsibility for the continued operation and maintenance of the Lisbon Falls Fishing Park.

E.3.3.4 Proposed Environmental Measures

In addition to continuing the existing environmental measures summarized in Section E.3.2.4, Topsham Hydro proposes the following PME measures over the term of the Project's new license.

- Maintain a minimum flow of 1,170 cfs, or inflow, whichever is less[17].
- Operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates[18].
- Finalize and Implement an Operations Monitoring Plan.
- Develop, in consultation with stakeholders, a Stranding Plan to address potential stranding of fish in the bedrock area below bascule gate no. 5. The Plan will detail inspections of the pools by operators following spill events.
- Revise and Implement a Fishway Operations and Maintenance Plan (Appendix E-4).
- Operate the existing fish lift on the following lift cycle frequency beginning in the first full passage season after the effective date of the new license:
    - April 15 to May 15 and following passage of the first fish at the downstream Brunswick Project, the lift will be operated once every two hours.
    - May 16 through June 15, the lift will be operated once every hour.
    - June 16 through July 1, the lift will be operated every 2 hours.
    - July 2 through November 15, the lift will be operated once a day following passage of salmon at Brunswick if not already identified passing though Pejepscot.
- Develop a plan and schedule, in consultation with resource agencies, containing potential physical and/or operational modifications to be constructed/implemented no later than Year 3 of the new license[19], to address factors (i.e., internal and external attraction flow

[17] Minimum flow requirements under the current license are described as "continuous," but Topsham Hydro proposes that the requirement in the new license be instead based on the hourly average. This change would capture the intent of the minimum flow measure, but would avoid unnecessary reporting of very short term excursions due to unplanned events such as extreme weather, equipment failure, and so on. A similar change was adopted in 2011 for the Gulf Island-Deer Rips Hydropower Project (FERC No. 2283).

[18] Topsham Hydro also proposes that, for compliance purposes, the pond level elevation also be based upon hourly average, for similar logic as the minimum flow requirement.

[19] During 2020 and 2021 Topsham Hydro will investigate factors associated with the existing fish lift (i.e., internal and external attraction flow hydraulics and acoustics) that may be affecting upstream passage effectiveness.

hydraulics and acoustics) that may be impacting upstream passage of migratory fish species.

- Conduct one season of fish lift efficiency testing for adult river herring during the fourth full passage season after the effective date of the new license.

- Install and operate a temporary portable American Eel ramp for three passage seasons (June 1 through September 15) to identify a suitable location for a permanent upstream American Eel ramp. The temporary portable eel ramp will be installed during the first full passage season after the effective date of the new license.
- Install and operate a permanent upstream American Eel ramp (June 1 through September 15) based on the results of the temporary portable ramp evaluation. The permanent ramp will be installed when upstream eel passage facilities are constructed at the downstream Brunswick Hydroelectric Project.
- Discontinue the north (left bank) downstream fish bypass beginning in the second full passage season after the effective date of the new license; continue operation of south (right bank) downstream fish bypass.
- Install and operate a fish guidance system/debris boom to direct downstream migrants to a new bypass within bascule gate no. 1 beginning in the second full passage season after the effective date of the new license.
    - Conduct one season of efficiency testing for juvenile alosines once the proposed downstream fish guidance system is installed and the modifications to bascule gate no. 1 have been completed.
- Reduce the operational setting for Unit 1 (unit turndown) to approximately 3,480 cfs (resulting in intake approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually to enhance downstream eel passage.
- Implement the following measures for ESA-listed Atlantic Salmon.
    - Continue video camera monitoring of Atlantic Salmon utilizing the Pejepscot fish lift.
    - Conduct an Atlantic Salmon radio telemetry study, to determine upstream passage effectiveness at the Pejepscot fish lift, when at least 40 adult Atlantic Salmon of Androscoggin River origin are counted at the Brunswick fishway for two consecutive years.
    - Monitor downstream migrating Atlantic Salmon kelts as part of the adult Atlantic Salmon radio telemetry study described above.
    - Open bascule gate No. 1 (closest to the powerhouse) 50% to provide approximately 500 cfs of spill at night (2000 – 0700 hours) during the month of May.
    - Conduct one season of efficiency testing for Atlantic Salmon smolts once the proposed downstream fish guidance system/debris boom is installed and the modifications to bascule gate no. 1 have been completed.
- Finalize and Implement a Recreation Management Plan.
- Finalize and Implement a Historic Properties Management Plan.

E.3.4 Alternatives Considered but Eliminated from Detailed Analysis

E.3.4.1 Federal Government Takeover of Project Facilities

In accordance with 18 C.F.R. § 16.14 of the Commission's regulations, a federal department or agency may file a recommendation that the United States exercise its right to take over a hydroelectric power project with a license that is subject to sections 14 and 15 of the FPA.

FERC indicated in SD2 that it did not consider federal takeover to be a reasonable alternative. Federal takeover of the project would require congressional approval. While that fact alone would not preclude further consideration of this alternative, there is currently no evidence showing that federal takeover should be recommended by Congress. No party has suggested that federal takeover would be appropriate, and no federal agency has expressed interest in operating the project.

E.3.4.2 Issuance of Non-Power License

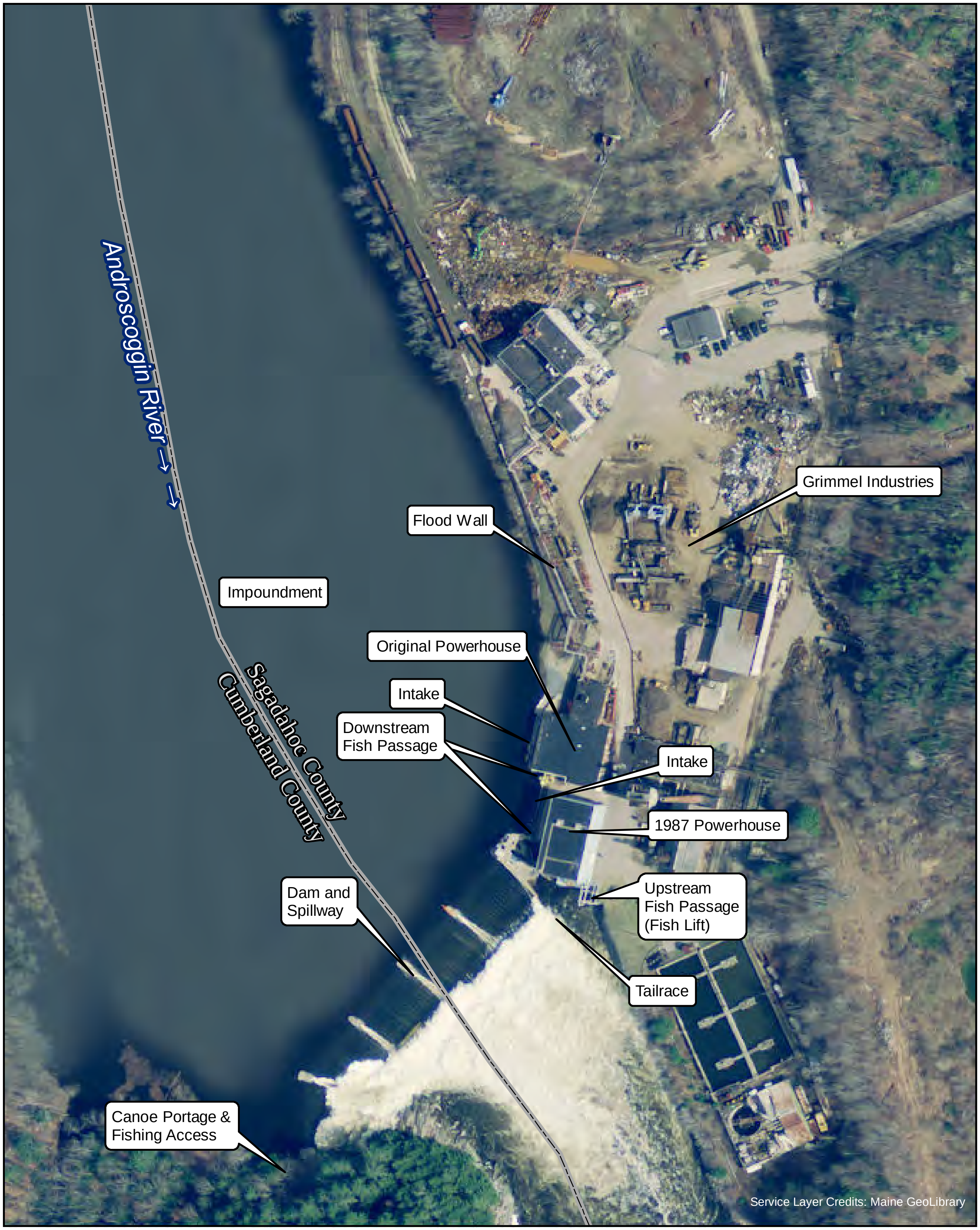
A non-power license is a temporary license the Commission would terminate whenever it determines that another governmental agency is authorized and willing to assume regulatory authority and supervision over the lands and facilities covered by the non-power license.

FERC indicated in SD2 that no governmental agency has suggested a willingness or ability to take over the project. No party has sought a non-power license, and FERC has no basis for concluding that the Project should no longer be used to produce power. Therefore, FERC does not consider a non-power license a reasonable alternative to relicensing the Project.

E.3.4.3 Decommissioning

Decommissioning of the Project could be accomplished with or without dam removal. Either alternative would require denying the relicense application and surrender or termination of the existing license with appropriate conditions. There would be significant costs involved with decommissioning the Project and/or removing any Project facilities. The Project provides a viable, safe, and clean renewable source of power to the region. With decommissioning, the Project would no longer be authorized to generate power.

FERC indicated in SD2 that no party has suggested Project decommissioning would be appropriate in this case, and FERC has no basis for recommending it. Thus, FERC does not consider Project decommissioning a reasonable alternative to relicensing the Project with appropriate environmental measures.



Brookfield

N

0 50 100 200 Feet

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Figure 3.2.1-1:
Project Facilities

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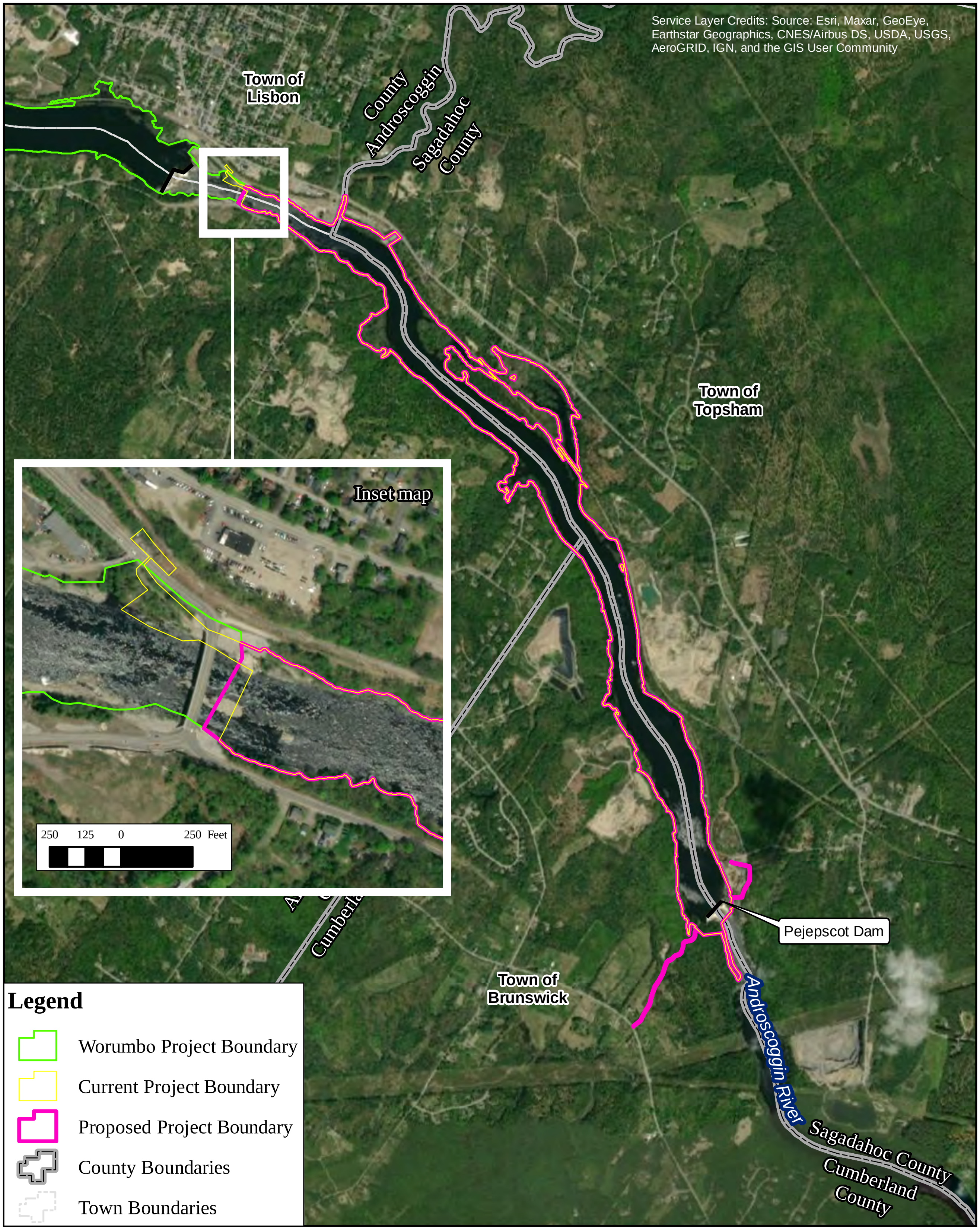

Brookfield

N

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Pejepscot Hydroelectric Project
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Figure 3.2.3-1.
Existing and Proposed
Project Boundary

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E.4 ENVIRONMENTAL ANALYSIS

This section of Exhibit E (1) provides a general description of the Androscoggin River basin, (2) identifies resources that have the potential to be cumulatively affected and identifies the geographic and temporal scope of the cumulative effects analysis, (3) provides a description of the environment for resources that have the potential to be affected by the proposed action, (4) provides an environmental analysis of the effects (positive or negative) of the proposed action and proposed PME measures, and (5) describes any unavoidable adverse effects that may still remain after implementation of PME measures. The Commission defines unavoidable adverse effects as “any adverse environmental effects that cannot be avoided should the proposal be implemented, including effects of protection, mitigation, and enhancement measures”.

As noted in Section E.1.2.1, Topsham Hydro completed 16 individual comprehensive studies that were developed in consultation with the active stakeholders to address specific resource issues and to collect up-to-date baseline information on resources in the Pejepscot Project area. In addition to updating baseline resource information, Topsham Hydro performed the studies to aid in evaluating the effects, if any, of continued project operation and maintenance on the human and natural environment. The resource descriptions in the following sections summarize the existing conditions and results of the studies. The environmental analysis is based largely upon the information that Topsham Hydro collected during study implementation in 2018- 2019, supplemented with information originally reported in the PAD.

E.4.1 Cumulative Effects

According to the Council on Environmental Quality’s regulations for implementing NEPA (40 C.F.R. 1508.7), an action may cause cumulative effects if its effects overlap in space and or time with the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

E.4.1.1 Resources that could be Cumulatively Affected

In SD2, the Commission identified water quality and aquatic organisms (to include migratory and resident fisheries) as resources that could be cumulatively affected by the continued operation and maintenance of the Pejepscot Project in combination with other hydroelectric projects and other activities in the Androscoggin River Basin. The effects analyses for the resources identified as having the potential to be cumulatively affected appear in the applicable resource area sections.

E.4.1.2 Geographic Scope of Cumulative Effects Analysis

The geographic scope of analysis for cumulatively affected resources is defined by the physical limits or boundaries of: (1) the proposed action’s effect on the resources, and (2) contributing effects from other hydropower and non-hydropower activities within the Androscoggin River Basin. In SD2, FERC identified the geographic scope for water quality to include the Androscoggin River from the upstream extent of the Pejepscot impoundment to the Brunswick

Dam. FERC noted that this geographic scope was chosen due to the operation and maintenance of the Pejepscot Project in combination with other developments in the Androscoggin River Basin that may affect water quality of this segment of the river. This reach of the Androscoggin River contains the Pejepscot Project, a metal recovery and recycling facility, several active rock and gravel pits, and the Brunswick Hydroelectric Project approximately 4.7 miles downstream of the Pejepscot Project, all of which may cumulatively affect water quality conditions below the Pejepscot Dam.

FERC identified the geographic scope for aquatic organisms to include the Androscoggin River Basin. FERC chose this geographic scope because the operation and maintenance of the Pejepscot Project, in combination with other hydroelectric projects and other types of development in the Androscoggin River Basin may affect aquatic organisms in the Androscoggin River Basin. There are no less than 28 dams on the mainstem Androscoggin River from its headwaters to the point where it flows into Merrymeeting Bay.

E.4.1.3 Temporal Scope of Cumulative Effects Analysis

The temporal scope of the cumulative effects analysis will include a discussion of past, present, and reasonably foreseeable future actions and their effects on each resource that could be cumulatively affected. Based on the potential term of a new license, the temporal scope will look 30 to 50 years into the future[20], concentrating on the effect on the resources from reasonably foreseeable future actions. The historical discussion will, by necessity, be limited to the amount of available information for each resource. The quality and quantity of information, however, diminishes as FERC analyzes resources further away in time from the present.

E.4.2 Resource Issues

FERC identified a list of environmental issues to be addressed in the Environmental Assessment in their SD2. This list is not intended to be exhaustive or final, but contains those issues raised to date that could have substantial effects. Issues denoted with an asterisk [*] are to also be considered for cumulative effects.

E.4.2.1 Geology and Soils Resources

- None

E.4.2.2 Aquatic Resources

- Effects of continued Project operation on water quality from the Project headwaters downstream to the Brunswick Dam.*
- Effects of continued Project operation on aquatic habitat in the Project area for aquatic organisms.*

[20] SD2 identifies a temporal scope of 30-50 years, however, a 2017 Policy Statement (161 FERC ¶ 61,078) sets the default license term for hydropower projects at 40 years.

- Effects of continued Project operation on passage of migratory fish species in the Androscoggin River including upstream passage of adult fish and downstream passage of smolts and juveniles.*

E.4.2.3 Terrestrial Resources

- Effects of continued Project operation and maintenance on riparian, littoral, and wetland habitats and associated wildlife.

E.4.2.4 Threatened and Endangered Species

- Effects of continued Project operation on the federally endangered Atlantic Salmon and its critical habitat and the northern long-eared bat.

E.4.2.5 Recreation and Land Use

- Effects of continued Project operation on recreational use in the Project area, including the adequacy of existing recreational access.

E.4.2.6 Cultural Resources

- Effects of continued Project operation on historic properties and archaeological resources.

E.4.2.7 Developmental Resources

- Effects of proposed environmental measures and associated costs on Project economics.

E.4.3 General Description of the River Basin

E.4.3.1 Androscoggin River Basin

The Androscoggin River Basin (Figure 1-1) has a total drainage area of 3,470 sqm and is generally bounded on the west by the Connecticut, Saco, and Presumpscot River Basins and on the east by the Kennebec River Basin. The Androscoggin River originates at the outlet of Umbagog Lake in northern New Hampshire and flows south and east in New Hampshire and Maine about 169 miles to the tidal portion of the Kennebec River in Merrymeeting Bay along the coast of Maine (FERC, 1996). The Pejepscot Dam is about 155 river miles downstream of Umbagog Lake and has a drainage area of 3,420 sqm. The Project impoundment extends about 3 miles upstream from the dam to just downstream of the Worumbo Dam tailrace. The river can be tidally influenced up to the Brunswick Project's tailwater, which is located approximately 4.7 miles downstream of the Pejepscot Project.

The river basin at Umbagog Lake has a drainage area of about 1,045 sqm and includes portions of the rugged and heavily forested northeastern New Hampshire and northwestern Maine. Upstream of Umbagog Lake, are large reservoirs including Kennebago, Mooselookmeguntic, Upper and Lower Richardson, and Aziscohos which are primarily operated as storage reservoirs. Umbagog Lake and these reservoirs have a combined storage capacity of about 644,000 acre-ft and account for most of the regulated storage in the basin. Major tributaries to the Androscoggin River include the Swift, Little Androscoggin, Ellis, and Nezinscot rivers (USGS, 1985). There are approximately 16 tributaries within the Androscoggin watershed that have drainage areas ranging from 60 to 470 sqm each (ENSR, 2007). Figure 1-1 presents a map of the Androscoggin River watershed.

E.4.3.2 Topography

The Project is located within the New England physiographic province, which is part of the Appalachian Highlands physiographic division. More specifically, the Project lies within the Seaboard Lowland section of the New England province. The Seaboard Lowland section encompasses most of the coastal region of Maine, up to the St. Croix River bordering Canada. This section is lower in elevation and less hilly than the bordering New England Upland physiographic section. Elevations found throughout the Seaboard Lowland section can range from 0 to 500 ft.; however, topographic relief is limited to less than approximately 200 ft. in most places. The Seaboard Lowlands are often considered as the sloping margin of the New England Uplands and coincide with the area inundated by the ocean and areas of large pro-glacial lakes during the last glacial retreat (Flanagan *et al.*, 1999).

Although the Androscoggin River in the vicinity of the Project is located in the Seaboard Lowlands, the topography of the river basin varies greatly from its headwaters at Lake Umbagog (El. 1250) to the Project (El. 67.5) before continuing to the river mouth at Merrymeeting Bay at sea level. Consistent with the characteristics of the Seaboard Lowlands, elevations surrounding the Pejepscot Impoundment typically remain below El. 200 and decrease gradually to the impoundment shoreline (full pool elevation 67.5 ft). The general topography of the Androscoggin River watershed in the vicinity of the Project is shown in Figure 4.3.2-1.

N

0 0.1 0.2 0.4
Miles

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Figure 4.3.2-1.
Topography in the Vicinity of the Project

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E.4.3.3 Climate

The Androscoggin River basin has mild and humid summers and cold and snowy winters. At Durham, ME, near the Project, July temperatures range from a daily average maximum of 78°F to a daily average minimum of 57°F. January temperatures range from a daily average maximum of 28°F to a daily average minimum of 7°F. The upper part of the watershed has generally lower temperatures, especially during the winter with January temperatures in Rangeley, ME ranging from a daily average maximum of 22°F to a daily average minimum of -1°F. The basin averages between 40 and 50 inches of precipitation per year, which is, on average, relatively evenly disturbed throughout the year. Much of the precipitation falls as snow in the colder months, with the total average annual snowfall at Durham, ME about 70 inches per season. Annual snowfall in the northern part of the watershed exceeds 120 inches (NOAA, 2017).

E.4.3.4 Major Land Uses

The Androscoggin River watershed is primarily undeveloped. Based on review of the available land-use data, approximately 74% of the watershed upstream of the Project is classified as mixed forest (30%), deciduous forest (24%), or evergreen forest (21%). Woody wetlands, shrub/scrub, and open water collectively account for 16% of the upstream land. The remaining 9% is a mix of various categories (e.g., developed/open space, pasture/hay, etc.), none of which individually account for greater than 3% of the land area (USGS, 2019). Table 4.3.4-1 provides a breakdown of the various land-use classifications found throughout the Androscoggin River watershed upstream of the Project, while Figure 4.3.4-2 shows the location of the various land-use classifications in relation to the Project.

Within 1,000 ft (ft) of the Project boundary, the land-use is dominated by various forest classifications (i.e., mixed (27%), evergreen (25%), or deciduous (3%)), open water (27%) (i.e., the Pejepscot Impoundment), barren land composed of rock, sand, or clay (4%), and land with various degrees of development (5%). Significant commercial and industrial land uses in the Project vicinity include a metal recovery and recycling facility immediately adjacent to the Project powerhouses, and several active rock and gravel pits in proximity to the Project. The remaining land use classifications found within 1,000 ft of the Project boundary are shrub/scrub, types of wetlands, pasture/hay fields, cultivated crops, and grassland/herbaceous land (USGS, 2019).

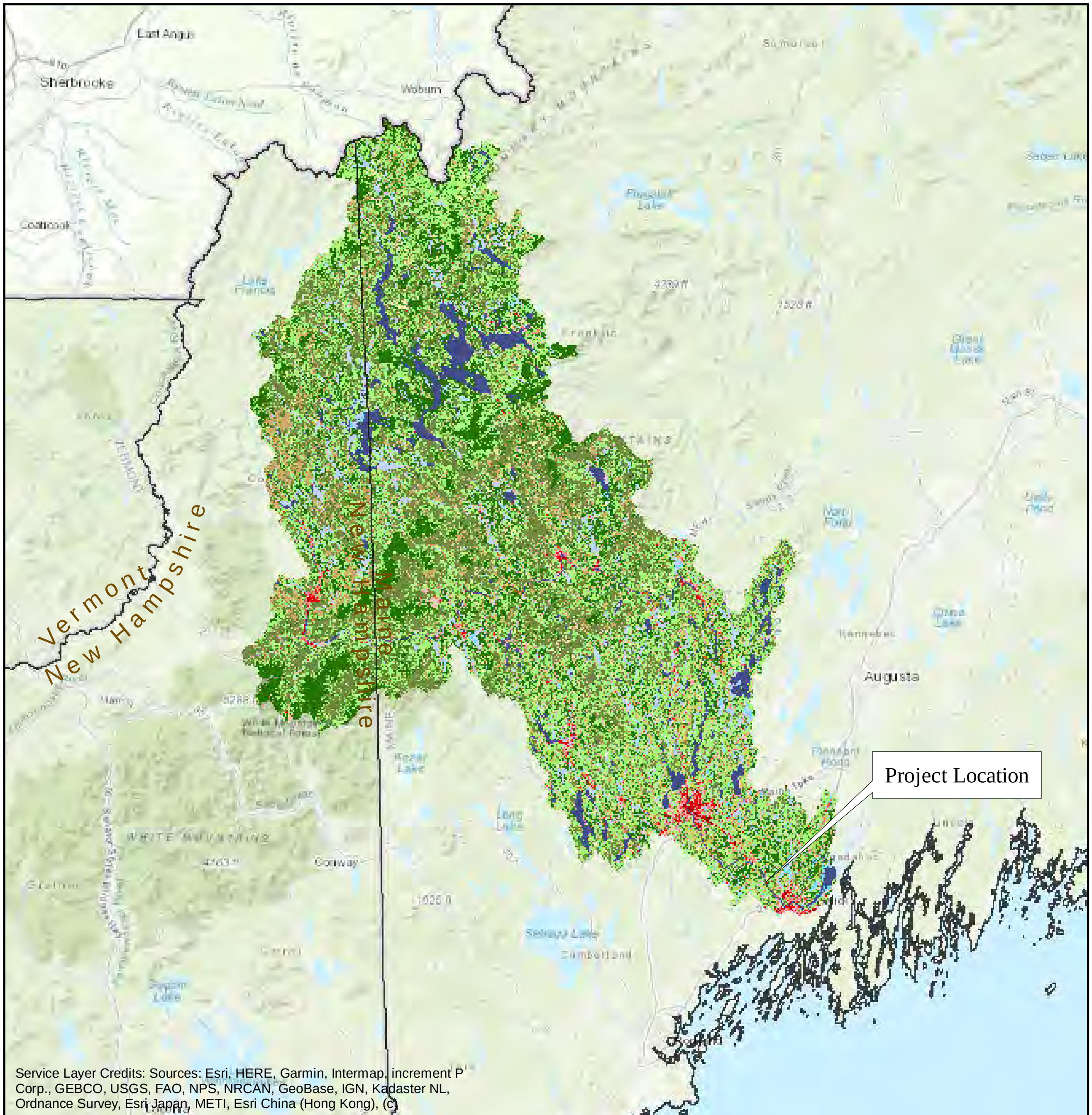
Table 4.3.4-2 provides a breakdown of the land-use classifications found within 1,000 ft of the Project boundary, and Figure 4.3.4-2 shows the location of the land-use classifications in this same area. Additional information pertaining to land use near the Project is discussed in Section E.4.9.

Table 4.3.4-1. Androscoggin River Watershed Land-Use Upstream of the Project

Land Use Classification	Area (acres)	Total (%)
Mixed Forest	671,618.0	30%
Deciduous Forest	538,698.0	24%
Evergreen Forest	464,595.9	21%
Woody Wetlands	140,031.9	6%
Shrub/Scrub	109,753.9	5%
Open Water	104,963.1	5%
Developed, Open Space	64,295.0	3%
Pasture/Hay	56,851.1	3%
Grassland/Herbaceous	37,639.0	2%
Developed, Low Intensity	30,180.3	1%
Developed, Medium Intensity	11,935.1	1%
Emergent Herbaceous Wetlands	11,925.1	1%
Barren Land (Rock/Sand/Clay)	6,148.2	0%
Cultivated Crops	4,332.2	0%
Developed High Intensity	4,120.1	0%
Mixed Forest	671,618.0	30%
Source: USGS 2019		

Table 4.3.4-2. Land-Use within 1,000 ft. of the Project Boundary

Land Use Classification	Area (acres)	Total (%)
Open Water	1298.1	28%
Mixed Forest	1282.8	27%
Evergreen Forest	1162.9	25%
Pasture/Hay	242.0	5%
Barren Land (Rock/Sand/Clay)	209.1	4%
Deciduous Forest	153.9	3%
Developed, Open Space	94.7	2%
Developed, Medium Intensity	71.4	2%
Developed, Low Intensity	68.3	1%
Grassland/Herbaceous	49.6	1%
Woody Wetlands	43.4	1%
Developed High Intensity	20.9	0%
Shrub/Scrub	15.8	0%
Emergent Herbaceous Wetlands	10.5	0%
Source: USGS 2019		



NCLD 2016 Land Use

- Barren Land (Rock/Sand/Clay)
- Cultivated Crops
- Deciduous Forest
- Developed High Intensity
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, Open Space
- Emergent Herbaceous Wetlands
- Evergreen Forest
- Grassland/Herbaceous
- Mixed Forest
- Open Water
- Pasture/Hay
- Shrub/Scrub
- Woody Wetlands

Brookfield

N

0 10 20 40 Miles

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Figure 4.3.4-1:
Androscoggin River Watershed
Land Use Classifications

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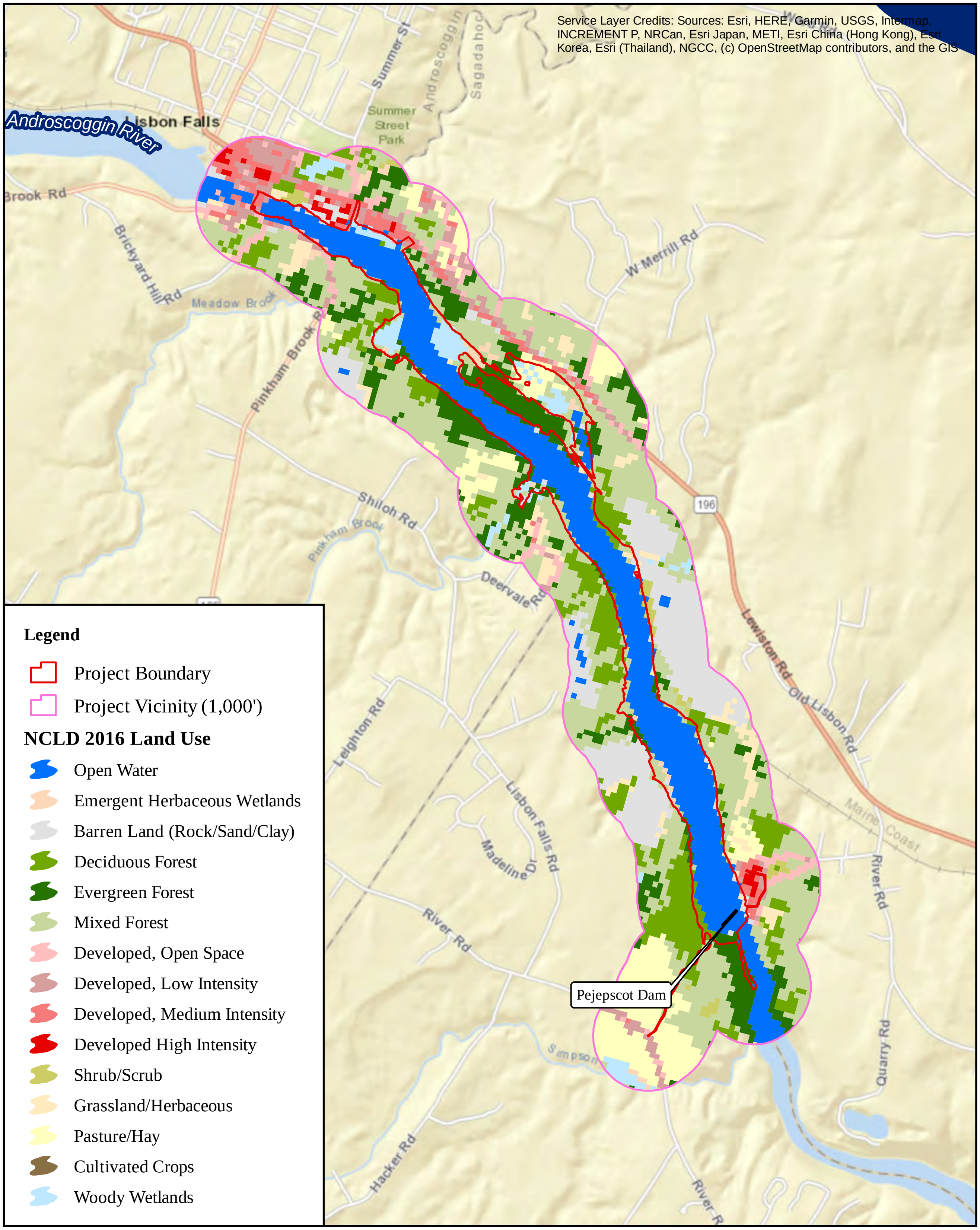

Brookfield

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0 0.125 0.25 0.5 Miles

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Figure 4.3.4-2:
Land Use Classifications
within 1,000 Feet of the
Project Boundary

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E.4.3.5 Major Water Uses

Historically, the Androscoggin River served as Maine's primary industrial river with industries being developed along the river in towns such as Gorham, NH, Bethel, Rumford, Jay, Topsham and Mechanic Falls, ME (Turkel, 1977). In the early 1800's, mill dams had been constructed in Brunswick, Topsham and Lisbon Falls. By the 1930's Central Maine Power had completed several large hydroelectric dams on the river. Like other rivers in Maine, the Androscoggin River historically had been used for log conveyance of pulp and timber which was used at pulp and lumber mills for processing. The Androscoggin River had some of the largest paper mill companies in the world by the end of the 19th century (McFarlane, 2012), with other industries including lumber and textile mills. Today, there are very few paper mills still operating along the river. Discharging of pollutants to the river became regulated with the passage of the Clean Water Act of 1972, with significant improvements to and recovery of water quality in the ensuing period.

Along the Androscoggin River, there are numerous facilities that hold individual National Pollutant Discharge Elimination System (NPDES) permits allowing them to discharge treated wastewater. In the vicinity of the Project, the Town of Lisbon has a permit to discharge 2.025 MGD (3.8 cfs) of secondary treated municipal sanitary wastewater to the Little River, of which the confluence with the Androscoggin River is located in the upper reaches of the Project impoundment. There are no Drinking Water Treatment Plants along the river (EPA, 2016a & 2016b).

In 2015, approximately 62.35 million gallons of Combined Sewer Overflows (CSO) were discharged into the Androscoggin River from the watershed (MDEP, 2016). CSO's discharge untreated wastewater from municipal sewage systems and may include a mixture of sanitary sewage, storm water, and industrial waste.

The mean annual daily flow into the Project is estimated to be 7,000 cfs, pro-rated from the USGS Gage No. 01059000 Androscoggin River near Auburn, ME (USGS, 2017). The maximum peak flow recorded during the period of record (January 1987 to December 2016), as measured at the USGS Gage No. 01059000 upstream of the Project, was approximately 103,000 cfs, which occurred in April 1987. The lowest annual water year peak flow recorded during that time period was approximately 17,800 cfs, which occurred in March 1995 (USGS, 2017).

E.4.3.6 Basin Dams

The Androscoggin River basin contains over 200 dams according to a combination of data from the NH GRANIT and Maine GIS dams' layers. While many of these dams are on tributaries, there are 21 dams on the mainstem of the river below Errol, NH.

The Pejepscot Hydroelectric Project is the second dam upstream on the Androscoggin River, with the Brunswick Hydroelectric Project (FERC No. 2284) approximately 4.7 miles downstream. The Worumbo Hydroelectric Project (FERC No. 3428) is located approximately

3.4 miles upstream of the Pejepscot Project. Both the Worumbo and Brunswick Projects are operated as run-of-river.

The FERC licensed hydroelectric projects on the mainstem of the Androscoggin River and the headwater storage dams are provided in Table 4.3.6-1. This table does not include the six developments on the Lewiston Canal System which are part of Lewiston Falls, nor numerous dams and FERC licensed hydropower projects on tributaries to the Androscoggin River. Figure 4.3.6-1 provides a map of the hydroelectric projects and key features within the vicinity of the Project along the lower mainstem of the Androscoggin River.

Table 4.3.6-1. Dams on the Mainstem of the Androscoggin River and the headwaters above Umbagog Lake (Upstream to Downstream)

Project Name	State	FERC No.
Mahaney	ME	4413
Kennebago Falls	ME	4413
Rangeley	ME	N/A
Upper Dam	ME	11834
Middle Dam	ME	11834
Aziscohos	ME	4026
Errol	NH	3133
Pontook	NH	2861
Sawmill	NH	2422
Riverside	NH	2423
J. Brodie Smith	NH	2287
Cross Power	NH	2326
Cascade	NH	2327
Gorham	NH	2311
Gorham (Eversource)	NH	2288
Shelburne	NH	2300
Upper Rumford Falls	ME	2333
Lower Rumford Falls	ME	2333
Riley	ME	2375
Jay	ME	2375
Otis	ME	8277
Livermore Mills	ME	2375
Gulf Island	ME	2283
Deer Rips / Androscoggin No.3	ME	2283
Lewiston Falls	ME	2302
Worumbo	ME	3428
Pejepscot	ME	4784
Brunswick	ME	2284

Notes: 1) Headwater Storage Reservoirs include: Umbagog, Aziscohos, Middle Dam, and Upper Dam.
2) This list does not include the developments on the Lewiston Canal System which are currently part of the Lewiston Falls Project.

Source: (FERC, 2017)

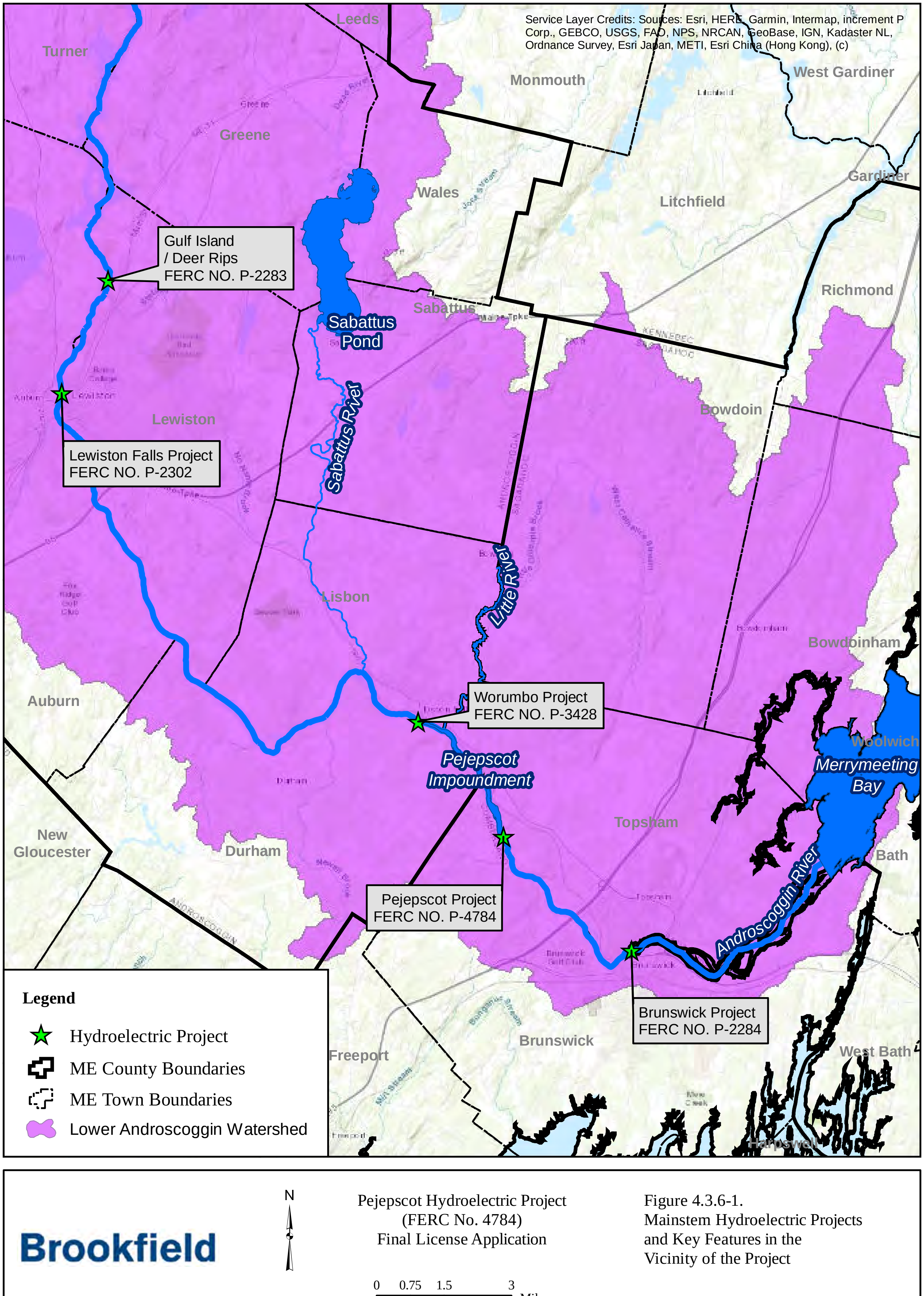

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Figure 4.3.6-1.
Mainstem Hydroelectric Projects and Key Features in the Vicinity of the Project

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E.4.3.7 References

ENSR Corporation (ENSR). 2007. Historic Flooding in Major Drainage Basins, Maine. The Maine River Basin Report: Document No.:12092-003-B. October 2007

Environmental Protection Agency (EPA). 2016a. NPDES Permits in New England: Maine Final Individual Permits. Last Updated: 12/13/2016. https://www3.epa.gov/region1/npdes/permits_listing_me.html. Date Accessed: 12/16/16

Environmental Protection Agency (EPA). 2016b. NPDES Permits in New England: New Hampshire Final Individual Permits. Last Updated: 10/6/2016. https://www3.epa.gov/region1/npdes/permits_listing_nh.html. Date Accessed: 12/16/16

Federal Energy Regulatory Commission (FERC). 1996. Final Environmental Impact Statement: Lower Androscoggin River Basin Hydroelectric Projects Maine (FERC 2283-005, 11482-000). July 1996.

Federal Energy Regulatory Commission (FERC). 2017. Complete List of Active Hydropower Licenses. https://www.ferc.gov/industries/hydropower.asp. Date Accessed 4/4/2016

Flanagan, S. M., Nielsen, M.G., Robinson, K.W., and Coles, J.F. 1999. Water-Quality Assessment of the New England Coastal Basin in Maine, Massachusetts, New Hampshire, and Rhode Island: Environmental Settings and Implications for Water Quality and Aquatic Biota. U.S. Geological Survey. 1999.

United States Geological Survey (USGS). 2019. NLCD 2016 Land Cover (2016 Edition): U.S. Geological Survey, Sioux Falls, SD.

Maine Geographic Information Systems (MEGIS). 1987. Last updated 2004. The information provided in this coverage is a subset of spatial databases developed by NHDES.

Maine Department of Environmental Protection (MDEP). 2015. Volunteer River Monitoring Reports. 2015: Androscoggin River – Friends of Merrymeeting Bay. Online: http://www.maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/reports.html. Date Accessed: 12/20/16

Maine Department of Environmental Protection (MDEP). 2016. Maine Combined Sewer Overflow 2015 Status Report. Document No. DEPLQ0972H-2016. May 2016. Available online: http://www.maine.gov/dep/water/cso/2015_status_report.pdf. Date Accessed: 12/20/2016

McFarlane, Wallace S. 2012. Environmental History, Defining a Nuisance: Pollution, Science and Environmental Politics on Maine’s Androscoggin River, 8 March 2012; largest paper-producing companies in the world: Bethel Historical Society, A River’s Journey: The Story of the Androscoggin. Online: www.bethelhistorical.org/A_River's_Journey.html, 11 September 2014. Date Accessed: 12/15/16

National Oceanic and Atmospheric Administration (NOAA). 2017. Climate Data Online. Data Tools: 1981-2010 Normals. Retrieved from: https://www.ncdc.noaa.gov/cdo-web/datatools/normals. Date Accessed: 4/4/17

NH GRANIT. 2014 GIS layer. Layers by data category: Utilities and Communication: National Pollutant Discharge Elimination System (NPDES). Retrieved from: http://www.granit.unh.edu/data/downloadfreedata/category/databycategory.html#. Date Accessed: 12/14/16

Turkel, Tux. 1977. "Something Else Important On Nov. 5 Ballot." Lewiston Evening Journal. Vol 117. November 8, 1977. Online: https://news.google.com/newspapers?nid=1913&dat=19771108&id=16VGAAAAIBAJ&sjid=fvMMAAAAIBAJ&pg=5242,1202559. Date Accessed: 12/14/16

U.S. Army Corp of Engineers (USACE). 1987. 1987 Dam Survey. Additional points were added by Maine Department of Environmental Protection (MDEP), Bureau of Land (BL) & Water Quality (WQ) staff for use with BL&WQ projects. Accessed online: http://www.maine.gov/megis/catalog/. Date accessed: 12/12/16

United States Census Bureau (USCB). 2016. Quick Facts: United States. Online: http://www.census.gov/quickfacts/. Date Accessed: 1/12/17

United States Geological Survey (USGS). 1999. Water-Quality Assessment of the New England Coastal Basins in Maine, Massachusetts, New Hampshire, and Rhode Island: Environmental Settings and Implications for water Quality and Aquatic Biota. Available online: https://pubs.usgs.gov/wri/wri984249/. Date Accessed: 12/15/16

United States Geological Survey (USGS). 1986. National Water Summary 1985 – Hydrologic Events and Surface-Water Resources. Water-Supply Paper 2300. United States Government Printing Office. p. 260. Available on Google Reads Online. Date Accessed: 12/19/16

United States Geological Survey (USGS). 2017. National Water Information System: Web Interface. Peak Streamflow for Maine; USGS Gage No. 01059000 Androscoggin River near Auburn, Maine. https://nwis.waterdata.usgs.gov/me/nwis/peak?site_no=01059000&agency_cd=USGS&format=html. Date Accessed: 8/18/2017

E.4.4 Geology and Soils

E.4.4.1 Affected Environment

E4.4.1.1 Existing Geological Features

E4.4.1.1.1 Bedrock Geology

The bedrock geology found at the Project and surrounding area consists of the Silurian-Ordovician Vassalboro Formation. The geologic age of the formation ranges from Silurian (443 million years old) to Ordovician (488 million years old). The Vassalboro formation is usually made up of sandstone, is massive in size, and bluish-gray in color. It is locally quartzite with shaly layers that have been transformed to pyritiferous mica schists and contains numerous calcareous beds. The lithologic constituents include sandstone (major), limestone (minor), and quartzite and schist (incidental) (USGS, 2016).

E4.4.1.1.2 Surficial Geology

The surficial characteristics observed near the Project Area are dominated by the Presumpscot foundation, thin-drift areas, and Marine nearshore deposits, which collectively account for 67% of the total area analyzed. The remaining 33% is composed of a variety of surficial classifications. Summary statistics for all surficial characteristics found near the Project are provided below; descriptions of the dominant classifications (i.e., accounting for greater than 10% of the area) are also provided. Figure 4.4.1.1.2-1 depicts the surficial characteristics which exist near the Project and surrounding area.

- Presumpscot foundation (Pp): 31%
- Thin-drift areas (Ptd): 27%
- Marine nearshore deposits (Pmn): 9%
- Stream alluvium (Ha): 7%
- Braided-stream alluvium (Pa): 8%
- Pejepscot fan (Pmfp): 8%
- Cox pinnacle fan (pmfcp): 4%
- Artificial fill (af): 3%
- Freshwater wetlands (Hw): 2%
- Eolian deposits (Pe): 1%
- Cox pinnacle moraines (Pemcp): 1%

Presumpscot foundation: Presumpscot foundation, also known as the Presumpscot formation or "blue clay," is a glacial marine mud containing ground-up minerals that make up bedrock found in Maine (MGS, 2000). It can be a massive to laminated layer with occasional shelly horizons that lie over rock and till. It is interbedded with marine fan deposits as well as end moraines.

Thin-drift areas: Thin drift areas generally have less than ten ft of drift over the bedrock it covers and can be found on ridge crests and hillslopes (MGS, 1997).

Marine nearshore deposits: Marine nearshore deposits are composed of Pleistocene gravel, mud and sand deposits resulting from wave activity in nearshore or shallow-marine environments. It is unrelated to beach morphology (MGS, 1997).

E4.4.1.1.3 Soils

Adams loamy sand, 0 to 30 percent slopes, is the dominant soil type found in the vicinity of the Project Boundary. Other prominent soil types found in this area include: Hartland very fine sandy loam; Hinckley gravelly sandy loam; Suffield silt loam; and Windsor loamy sand. Collectively, these five soil types account for 75% of the area analyzed. The remaining 25% is comprised of a combination of 25 other soil types. Summary statistics and descriptions of the prominent soil types found in the Project Area (i.e., those soils which account for greater than 5% of the area analyzed) are provided below. Figure 4.4.1.1.3-1 depicts the soil types near the Project.

- Adams loamy sand, 0 to 30 percent slopes (AaB-AaD): 34%
- Hartland very fine sandy loam, 2 to 25 percent slopes; eroded (HfB, HfC2, HfD2): 9%
- Hinckley gravelly sandy loam, 0 to 25 percent slopes (HkB, C, D): 6%
- Suffield silt loam, 8 to 15 percent and 25 to 45 percent slopes, eroded (SuC2, SuE2): 8%
- Windsor loamy sand, 0 to 8 percent and 15 to 35 percent slopes (WmB & D): 5%

Adams: The Adams series slopes between 0 and 30 percent within the vicinity of the Project but may slope up to 70 percent elsewhere. It is formed in glacial-fluvial or glacio-lacustrine sand and can be found within Northern New York and New England. It is an excessively drained soil series present on outwash planes, kames, terraces, eskers and lake planes. The thickness of upper layer ranges from 16 to 35 inches. The depth to bedrock is over 72 inches (NRCS, 2016).

Hartland: The Hartland series slopes between 2 and 25 percent within the vicinity of the Project but may slope up to 50 percent elsewhere. It consists of coarse to silty mix of well drained soils that can be found very deep in glacial lake plains and terraces. The upper layer ranges in thickness from 14 to 40 inches and has a depth to bedrock greater than 60 inches (NRCS, 2016).

Hinckley: The Hinckley series slopes between 0 and 25 percent within the vicinity of the Project but may slope up to 60 percent elsewhere. It consists of mixed sandy to skeletal sand excessively drained soils that were formed very deep in glaciofluvial materials. They can be found on outwash deltas, outwash planes, outwash terraces, kames, kame terraces and eskers. The upper layer ranges in thickness from 12 to 34 inches (NRCS, 2016). The depth to bedrock is over 10 inches (USDA et. al, 1974).

Suffield: The Suffield series are gently sloping to very steep soils on tops and sides of ridges in dissected marine and lacustrine plains. Slope gradients are commonly 8 to 20 percent, but they may range from 3 to 45 percent or more on ridge sides and escarpment margins. The soils are formed in marine or lacustrine sediments consisting of a silt loam mantle over silty clay loam or silty clay materials (NRCS, 2016).

Windsor: The Windsor series slopes between 0 and 35 percent within the vicinity of the Project but may slope up to 60 percent elsewhere. It consists of a mixed, excessively drained soil and can be found very deep in sandy outwash or eolian deposits. The upper layer ranges in thickness from 10 to 36 inches. Areas associated with this series may be forested or used for agriculture (NRCS, 2016). Depth to bedrock is 5 ft or more (USDA et. al, 1974).

Soil Erodibility

Erosion factors for the soils identified above were gathered from the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS, 2017). The erosion factor, or K factor, indicates the susceptibility of a soil to sheet and rill erosion by water and is one of several factors used in the Universal Soil Loss Equation and the Revised Universal Soil Loss Equation to predict the average annual rate of soil loss. K factor values range from 0.02 to 0.69, with the higher the K factor value typically indicating a higher susceptibility to erosion (NRCS, 2017). Table 4.4.1.1.3-1 shows the K factor for the fine-earth fraction of the prominent soils found in the vicinity of the Project (also referred to as the Kf factor). As shown in the table, these soils are characterized as having low to moderate erodibility. The Adams series, the most common soil type found in the Project Area, was found to have the lowest erodibility, while the Hartland and Suffield series were found to have moderate erodibility.

E4.4.1.1.4 Impoundment Shoreline and Streambanks

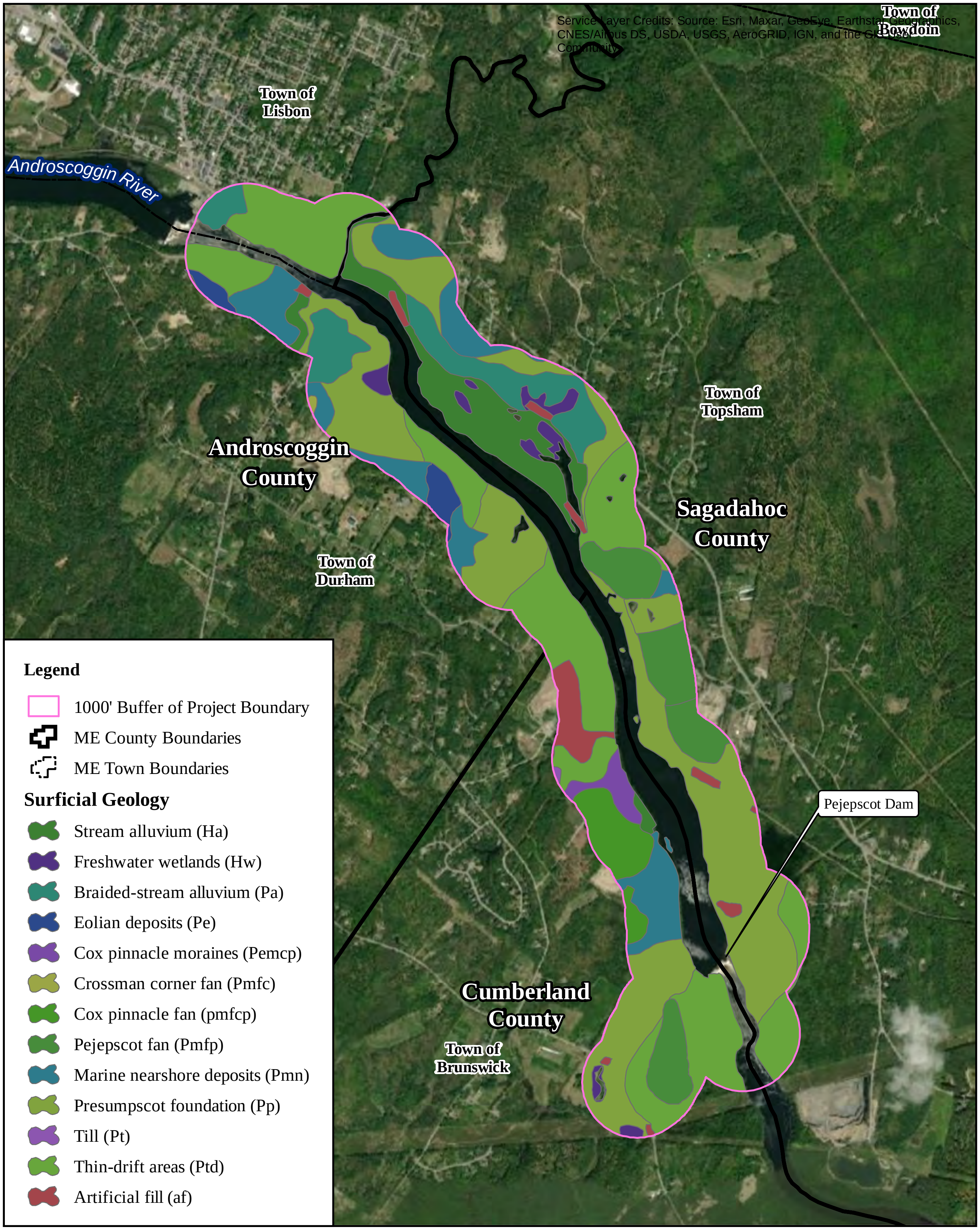
The Project impoundment extends approximately 3 miles upstream of the Pejepscot Dam and includes approximately 6.6 miles of shoreline. In general, the shoreline is mostly forested with a mixture of evergreen and deciduous trees; however, shoreline characteristics, including sediment composition, topography, and vegetative cover, tend to vary. Shoreline soils found in the upper portion of the impoundment are dominated by the Adams series, which has a low erodibility factor. Shoreline soils found throughout the middle and lower portions of the impoundment are a combination of the Adams, Hartland, Hinckley, Windsor, and Suffield series, which have low to moderate erodibility factors (Table 4.4.1.1.3-1). In general, erosion is not a concern along the impoundment.

The area from the Pejepscot Dam to the downstream extent of the Project boundary includes approximately 475 ft of shoreline, which consists almost entirely of rock outcrops, ledge, or stone masonry and concrete walls.

Table 4.4.1.1.3-1. Erodibility of Soils in the Vicinity of the Project

Soil Series	Kf Factor
Adams	0.10
Hartland	0.32-0.37
Hinckley	0.17
Suffield	0.28-0.32
Windsor	0.15

Source: NRCS, 2017



Brookfield

N

0 0.125 0.25 0.5 Miles

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Figure 4.4.1.1.2-1.
Surficial Geology in the Vicinity of the Project

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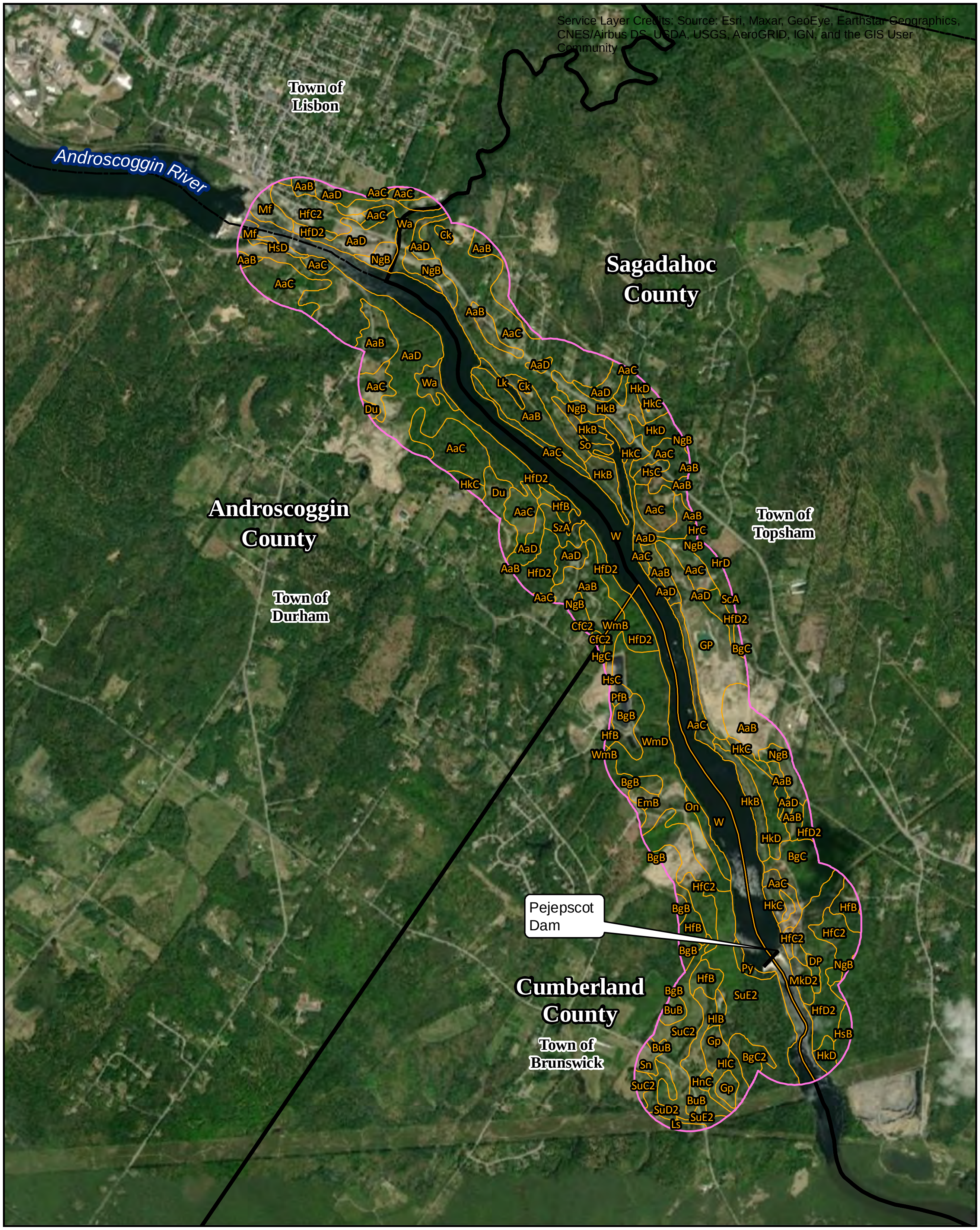

Brookfield

N

0 0.25 0.5 1 Miles

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Figure 4.4.1.1.3-1.
Soils in the
Vicinity of the Project

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Soil Symbol, Soil Description

- AaB:Adams loamy sand, 0 to 8 percent slopes
- AaC:Adams loamy sand, 8 to 15 percent slopes
- AaD:Adams loamy sand, 15 to 30 percent slopes
- BgB:Nicholville very fine sandy loam, 0 to 8 percent slopes
- BgC2:Nicholville very fine sandy loam, 8 to 15 percent slopes
- BgC:Nicholville very fine sandy loam, 8 to 15 percent slopes
- BuB:Lamoine silt loam, 3 to 8 percent slopes
- CfC2:Charlton fine sandy loam, 8 to 15 percent slopes, eroded
- Ck:Coastal beach
- DP:Dumps
- Du:Dune land
- EmB:Elmwood fine sandy loam, 0 to 8 percent slopes
- GP:Sand and gravel pits
- Gp:Gravel pits
- HfB:Hartland very fine sandy loam, 2 to 8 percent slopes
- HfB:Hartland very fine sandy loam, 3 to 8 percent slopes
- HfC2:Hartland very fine sandy loam, 8 to 15 percent slopes, eroded
- HfD2:Hartland very fine sandy loam, 15 to 25 percent slopes, eroded
- HgC:Hermon sandy loam, 8 to 15 percent slopes
- HkB:Hinckley gravelly sandy loam, 0 to 8 percent slopes
- HkC:Hinckley gravelly sandy loam, 8 to 15 percent slopes
- HkD:Hinckley gravelly sandy loam, 15 to 25 percent slopes
- HlB:Hinckley loamy sand, 3 to 8 percent slopes
- HlC:Hinckley loamy sand, 8 to 15 percent slopes
- HnC:Hinckley-Suffield complex, 8 to 15 percent slopes
- HrC:Lyman-Tunbridge complex, 8 to 15 percent slopes, rocky
- HrD:Lyman-Tunbridge complex, 15 to 35 percent slopes, rocky
- HsB:Lyman-Abram complex, 0 to 8 percent slopes, very rocky
- HsC:Lyman-Abram complex, 8 to 15 percent slopes, very rocky
- HsD:Lyman-Abram complex, 15 to 35 percent slopes, very rocky
- Lk:Charles silt loam, 0 to 2 percent slopes, occasionally flooded
- Ls:Limerick-Saco silt loams
- Mf:Made land, sanitary fill
- MkD2:Merrimac fine sandy loam, 15 to 25 percent slopes, eroded
- NgB:Ninigret fine sandy loam, 0 to 8 percent slopes
- On:Ondawa fine sandy loam, 0 to 3 percent slopes, occasionally flooded
- PfB:Paxton very stony fine sandy loam, 3 to 8 percent slopes
- Py:Podunk fine sandy loam, 0 to 3 percent slopes, occasionally flooded
- ScA:Scantic silt loam, 0 to 3 percent slopes
- Sn:Scantic silt loam, 0 to 3 percent slopes
- So:Scarboro fine sandy loam
- SuC2:Suffield silt loam, 8 to 15 percent slopes, eroded
- SuD2:Suffield silt loam, 15 to 25 percent slopes, eroded
- SuE2:Suffield silt loam, 25 to 45 percent slopes, eroded
- SzA:Swanton fine sandy loam, 0 to 3 percent slopes
- W:Water
- Wa:Walpole fine sandy loam
- WmB:Windsor loamy sand, 0 to 8 percent slopes
- WmD:Windsor loamy sand, 15 to 35 percent slopes

Brookfield

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Figure 4.4.1.1.3-1.
Soils in the
Vicinity of the Project

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E.4.4.2 Environmental Analysis

FERC's SD2 did not identify any specific resource issues relating to geologic or soil resources. Project operations appear to have limited impacts to geology and soils. Erosion is to be expected along the shoreline of any dynamic river system regardless of whether it is dam-controlled or not. The rates of active erosion observed, as part of other relicensing studies, in the vicinity of the Project do not appear to exceed background rates that would be anticipated to occur in the absence of the Project. Topsham Hydro operates the Project in run-of-river mode and has maintained stable impoundment levels during normal operations, outside of maintenance and high flow situations. It appears that the stable impoundment levels and the slowing of the water velocity caused by the impoundment helps to lessen potential riverbank erosion. Downstream of the Project, the past and proposed run-of-river operation does not alter flow or velocity in the river, or their effects on erosion.

E.4.4.3 Proposed Environmental Measures

Topsham Hydro is proposing to maintain the run-of-river mode of operating the Project, which targets stable headpond elevations. No other specific environmental measures are proposed for geological and soil resources.

E.4.4.4 Unavoidable Adverse Effects

Some small amounts of erosion and sedimentation may occur within the Project boundary or in downstream reaches as a result of the normal river flows.

E.4.4.5 References

Maine Geological Survey (MGS). 1997. Surficial geology of the Lisbon Falls South Quadrangle, Maine. Open File Map 97-49: Lisbon-Falls-South. Online: https://www1.maine.gov/dacf/mgs/pubs/online/surficial/97-64-lisbon-falls-south-surficial.pdf. Date accessed: 12/12/16

Maine Geological Survey (MGS). 2000. A General Introduction to the Presumpscot Formation Maine's "Blue Clay." Geological Site of the Month. October 2000. Obtained online: https://www1.maine.gov/dacf/mgs/explore/surficial/facts/oct00.pdf. Date Accessed: 12/20/16

Natural Resources Conservation Service (NRCS). 2016. NRCS Official Soil Series Description: Search. Online: https://soilseries.sc.egov.usda.gov/osdname.aspx. Date Accessed: 12/21/16.

Natural Resources Conservation Service (NRCS). 2017. Web Soil Survey. [Online] URL: https://websoilsurvey.nrcs.usda.gov/app/ [Accessed February 15, 2017].

United States Department of Agriculture (USDA) in cooperation with Maine Agricultural Experiment Station. 1974. Soil Survey: Cumberland County, Maine. Issued August 1974. Online: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/maine/cumberlandME1974/cumberland.pdf. Date Accessed: 12/21/16.

United States Geological Society (USGS). 2016. Mineral Resources On-Line Spatial Data: Silurian-Ordovician Vassalboro Formation. Online: https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=MESOv%3B0. Date Accessed: 12/21/16

E.4.5 Water Resources

E.4.5.1 Affected Environment

E4.5.1.1 Water Quantity

The Androscoggin River flows about 169 miles from its headwaters at Umbagog Lake in Errol, NH to Merrymeeting Bay (FERC, 1996). Approximately one-fifth of the watershed (approximately 716 sqm) is in New Hampshire (NHDES, 2008). The Androscoggin watershed is surrounded by the Kennebec River watershed to the east, the Upper Connecticut, Saco, and the Presumpscot River watersheds to the west. The northern edge of the watershed lies on the international boundary between the United States and Canada. The drainage area at Merrymeeting Bay where the Androscoggin River ends is 3,470 sqm (FERC, 1996). The following sections discuss the hydrology and hydraulics of the Pejepscot Project including its drainage area, flow statistics, and operations.

E4.5.1.1.1 Drainage Area

The Pejepscot Project has a reservoir of approximately 225 acres at the full pond elevation of 67.5 ft. The drainage area of the Project is approximately 3,420 sqm. The normal tailwater elevation is about 43.7 ft. While the Project has a gross storage capacity of 3,278 acres at the full pond elevation, the Project has negligible usable storage capacity as a run-of-river Project.

E4.5.1.1.2 Streamflow, Gage Data, and Flow Statistics

The vast majority of the inflow to the Pejepscot impoundment is provided by the Worumbo Project approximately 3.4 miles upstream. The Worumbo Project has a drainage area of approximately 3,382 sqm. Between the Worumbo and Pejepscot Dams, inflow is also provided by the Little River, Meadow, and Pinkham Brooks as well as several smaller streams.

The USGS operates a streamflow gaging station (No. 01059000 Androscoggin River near Auburn, ME) approximately 17 miles upstream of the Pejepscot Dam. This gage has a drainage area of 3,263 sqm and has been in operation since 1928. Annual and monthly flow duration curves are presented in Figures 4.5.1.1.2-1 thru 4.5.1.1.2-5. Daily flow data from the Auburn gage was prorated by the ratio of drainage areas[21]. Table 4.5.1.1.2-1 shows an annual and monthly summary of this data. The mean annual daily inflow for this period is approximately 7,038 cfs. The peak streamflow at the Project during this period was approximately 108,000 cfs on April 2, 1987. The minimum streamflow at the Project during this period was approximately 1,289 cfs on October 9, 1988. The peak streamflow for the period of record at the USGS gage is about 141,500 cfs on March 20, 1936. Streamflow is normally at its peak throughout the spring freshet during snowmelt, while short-term inflow depends in part upon upstream hydropower project storage operations and in part upon numerous intervening tributary river and stream inflows to the mainstem of the river.

[21] The proration factor is 1.05 as a result of the drainage area of Pejepscot Dam (3,420 sqm) divided by the drainage area of the gage (3,263 sqm).

E4.5.1.1.3 Existing and Proposed Uses of Water

The Project is operated as a run-of-river facility and does not have a bypass reach. As discussed in Section 3.2.2, the Kaplan unit is operated on pond level control and controls the turbine wicket gates to maintain a normal pond elevation. The Francis units are operated when the river flow is near or above the capacity of the Kaplan, typically during large flow events or during maintenance of the Kaplan (NMFS, 2012). The required minimum flow is 1,710 cfs, or inflow, whichever is less (FERC, 2016). There are no currently documented withdrawals of water within the impoundment.

E4.5.1.1.4 Existing Water Rights

Topsham Hydro holds all of the flowage rights necessary to operate the Project. There is no development within the Project boundary other than the Project facilities. There are no streams located within the Project boundary or within the vicinity of the Project that are significantly affected by headpond operations or by generation releases.

Table 4.5.1.1.2-1. Daily Average Streamflow (cfs) at Pejepscot Dam January 1987 – December 2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Min	1,667	1,782	1,897	2,861	1,782	1,708	1,342	1,331	1,321	1,289	1,646	1,604	1,289
Max	36,160	24,107	41,401	104,392	64,878	61,210	30,919	40,667	47,899	48,108	42,449	51,043	104,392
Median	4,863	4,706	6,697	12,997	9,003	5,225	3,427	2,945	2,736	3,826	5,953	5,450	4,916
Average	5,603	5,133	8,006	16,601	10,774	6,887	4,681	3,842	3,331	5,614	7,204	6,808	7,039

Figure 4.5.1.1.2-1. Annual Flow Duration Curve (1987-2019)

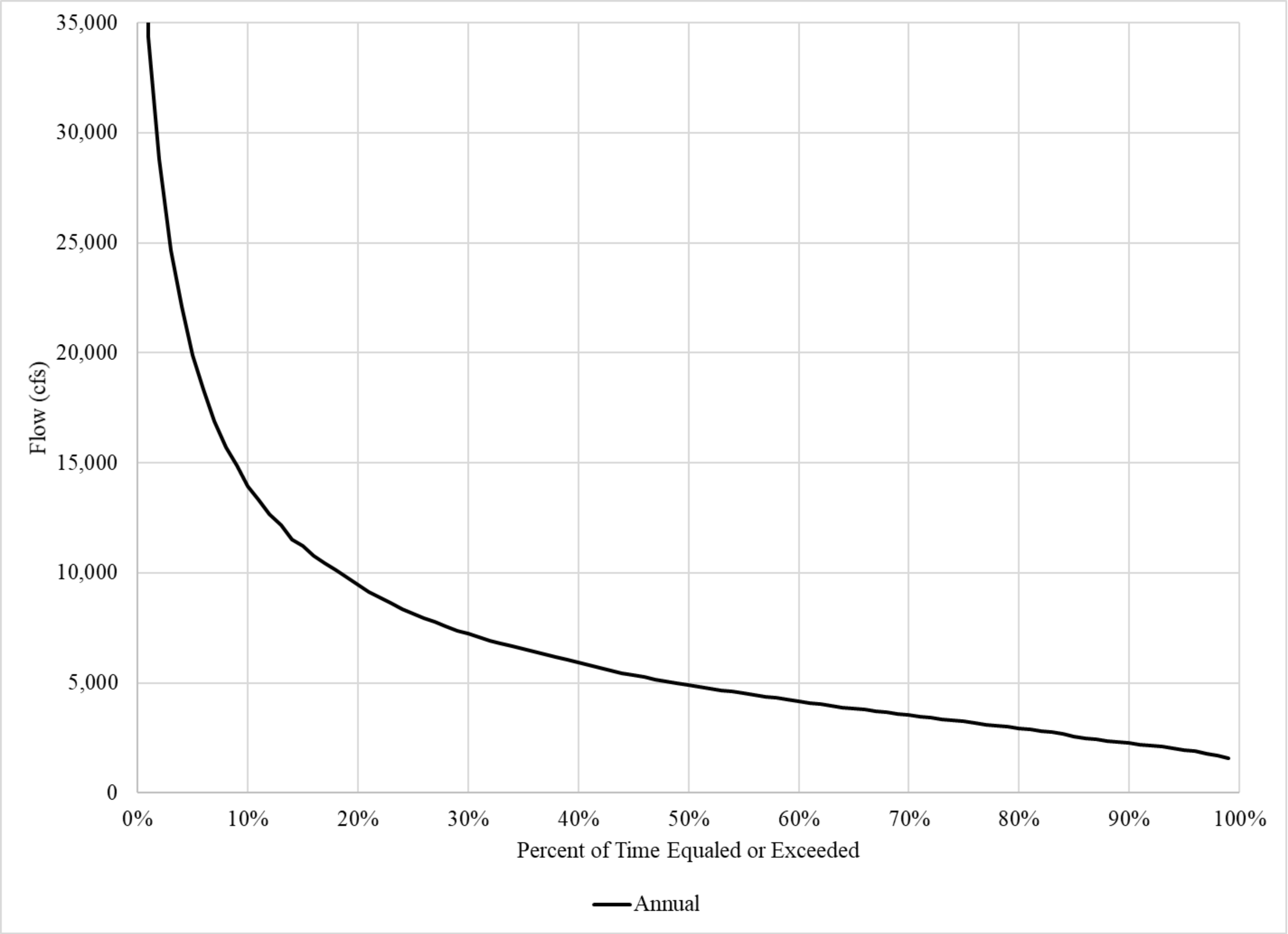


Figure 4.5.1.1.2-2. January, February, and March Flow Duration Curve (1987-2019)

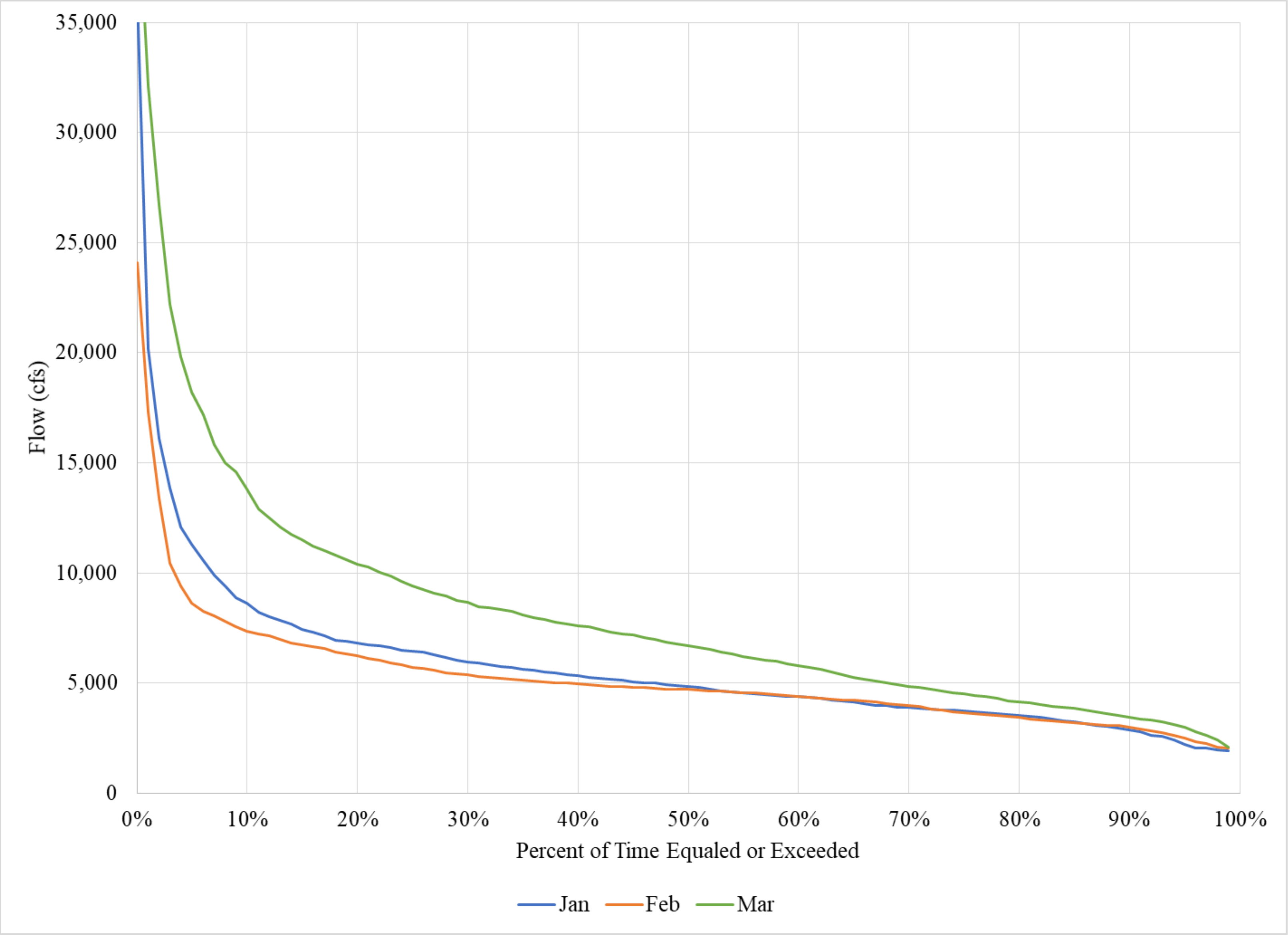


Figure 4.5.1.1.2-3. April, May, and June Flow Duration Curve (1987-2019)

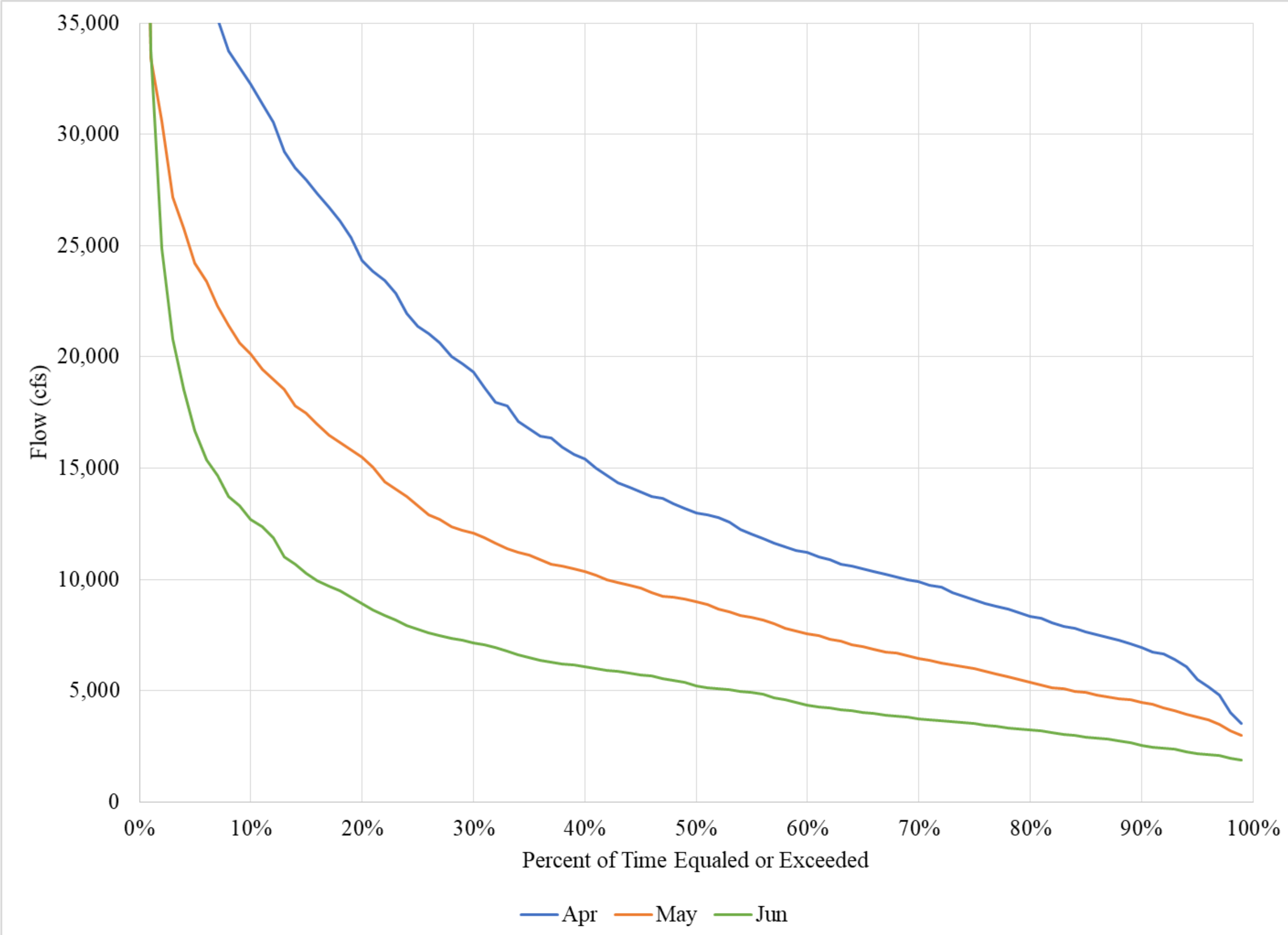


Figure 4.5.1.1.2-4. July, August, and September Flow Duration Curve (1987-2019)

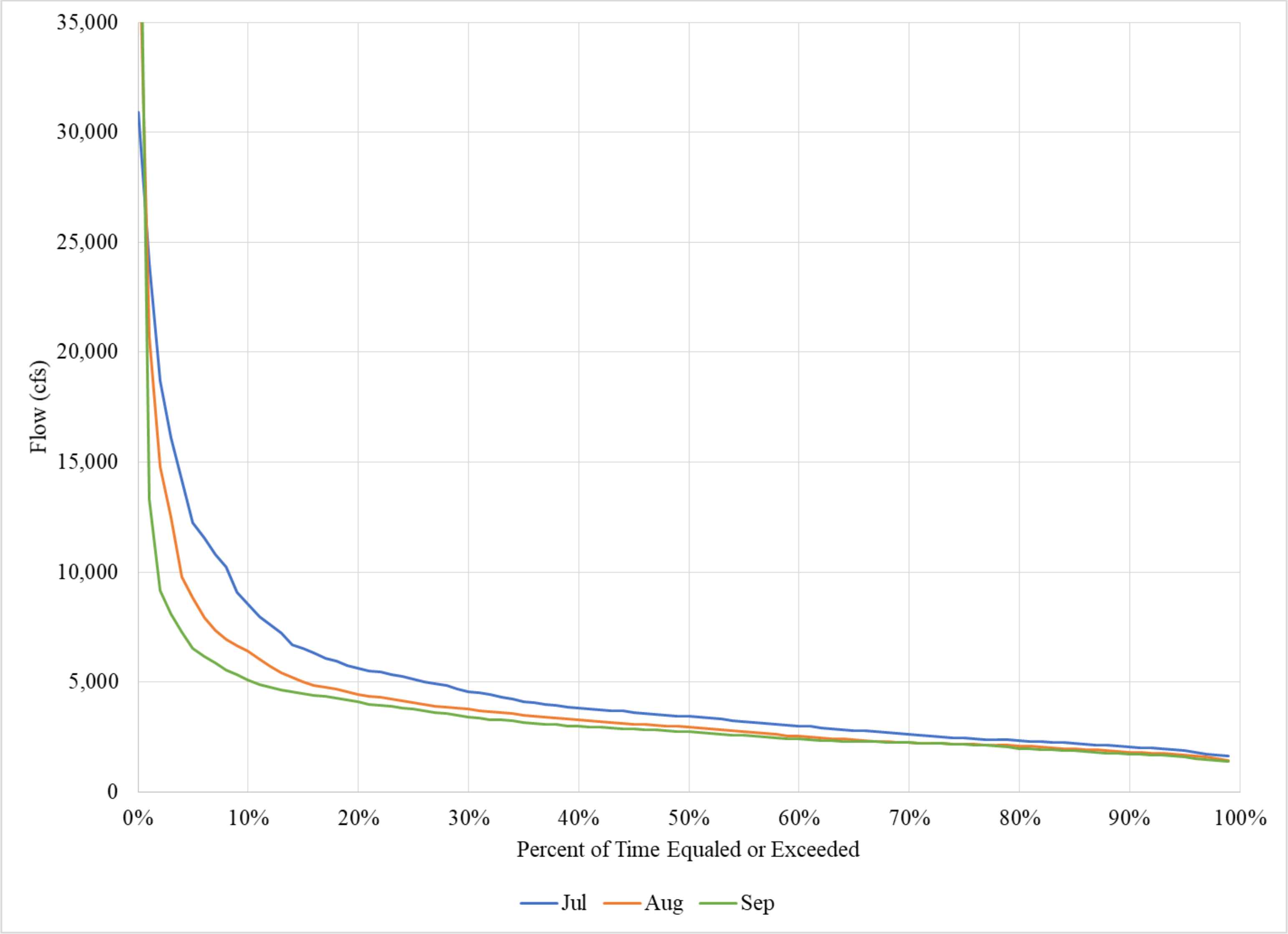
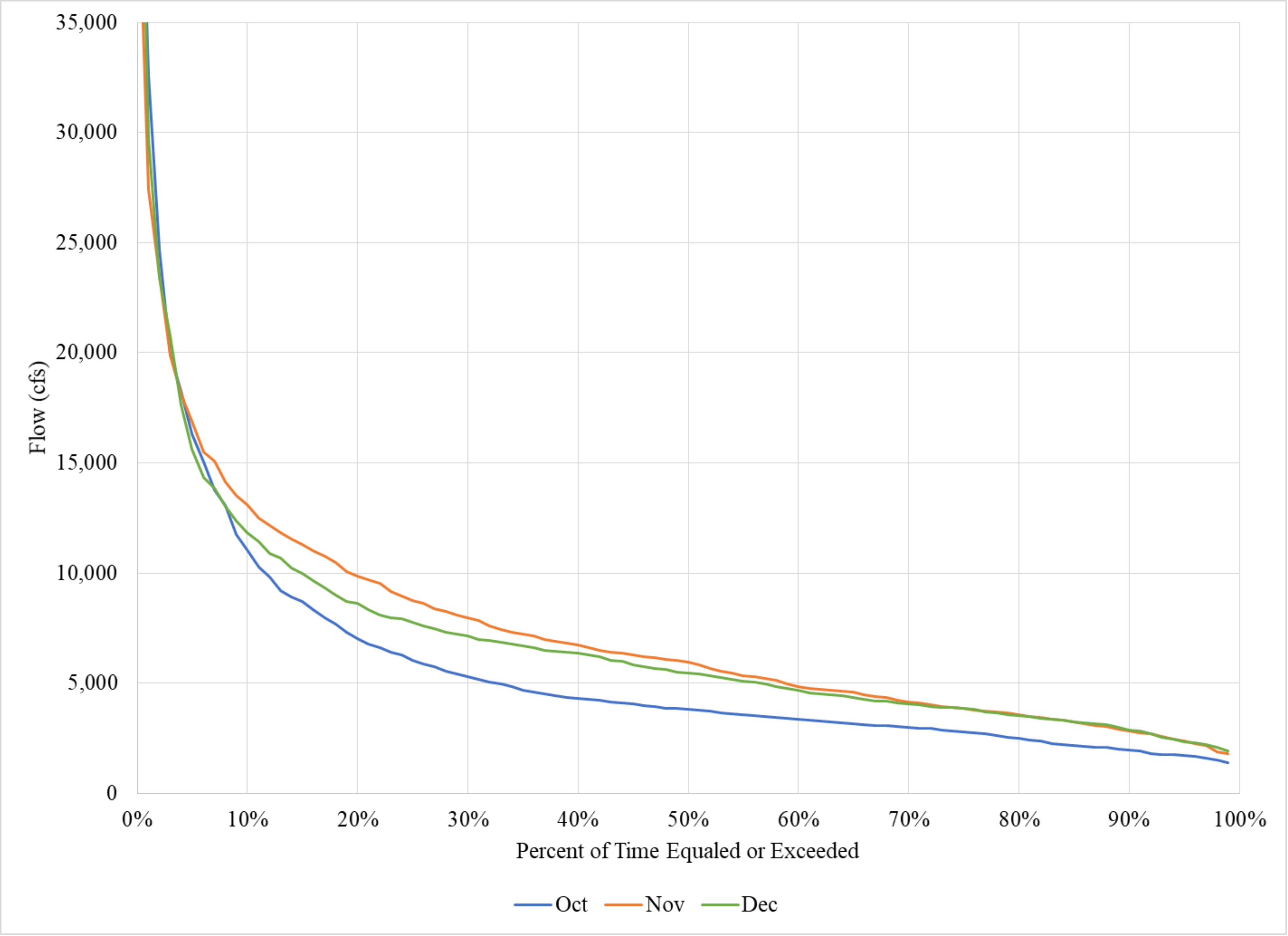


Figure 4.5.1.1.2-5. October, November, and December Flow Duration Curve (1987-2019)



E4.5.1.2 Water Quality

The following sections discuss water quality standards and classifications applicable to waterbodies in the Project vicinity. The results from water quality investigations that pertain to the waterbodies at the Project area also discussed.

E4.5.1.2.1 Water Quality Standards

Federal Clean Water Act

In 1972, the Federal Water Pollution Control Act Amendments established the Clean Water Act (CWA) as the foundation of modern surface water quality protection in the United States. Sections 303 and 305 of the CWA guide the national program on water quality. Three subparts of Section 303 are relevant to this water quality discussion – Sections 303(a-c), which discuss the process by which all states are to adopt and periodically review water quality standards. Section 305(b) directs states to periodically prepare a report that assesses the quality of waters in the state.

State Water Quality Standards

Maine statute 38 MRSA §464-470 establishes the State's classification system of surface waters. The classifications and details of major river basins are covered in §467. The mainstem of the Androscoggin River is a Class C waterbody from its confluence with the Atlantic Ocean at Merrymeeting Bay, through Project waters, upstream until its confluence with the Ellis River about 100 miles upstream of the Project at Rumford Point in Maine. The Androscoggin becomes Class B from its confluence above the Ellis River until the ME/NH border (Maine, 2016a). The upper drainage of the Androscoggin River in Maine, above Umbagog Lake are classified as Class A or AA. Most minor tributaries to the Androscoggin River are Class B waters with some exceptions. A water quality certificate under Section 401 of the CWA was issued by MDEP for the Pejepscot Project in 1982.

The waters on the mainstem of the Androscoggin River in the vicinity of the Project are classified as Class C. Class C waters must meet standards ensuring suitability for the following: drinking after treatment, agriculture, fishing, recreation in and on water, industrial process and cooling water supply, navigation, as habitat for fish and other aquatic life, and hydroelectric power generation, except as prohibited under Title 12, section 403. Dissolved oxygen (DO) must meet a minimum of 5 ppm (mg/L) or 60% saturation, whichever is greater. Table 4.5.1.2.1-1 details standards of Class C waterbodies.

Waterbodies that fail to meet water quality standards are placed on the 303(d) impaired waterbodies list as required under the CWA. The 303(d) list assesses the attainment criteria of water bodies and determines whether designated uses are threatened, or the waterbody is impaired by bacteria, mercury, or a legacy pollutant such as polychlorinated biphenyls (PCBs), dioxins, dichloro-diphenyl-trichloroethane (DDT), and others (MDEP, 2014). The CWA requires Total Maximum Daily Loads (TMDL), the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards, be calculated for identified pollutants. There are no waterbodies within the Project boundary, or that feed directly into the Project impoundment, currently on the 303(d) list of impaired waters under the CWA that require a TMDL (MDEP, 2014). However, several waterbodies in the vicinity of the Project are listed as impaired under Section 305(b) of the CWA. Section 305(b) of the CWA requires states to assess the condition of their waters toward meeting designated uses, as well as TMDLs, and to prepare a report biannually to Congress. Table 4.5.1.2.1-2 defines the various categories used to describe the status of waterbodies as stated in the biannual “Integrated Water Quality Monitoring and Assessment” reports.

Based on the most recent water quality assessment, several sections of the Androscoggin River watershed in the vicinity of the Project are listed under Category 4 (some impaired use) and Category 5 (uses are attained but one or more uses may be impaired) (Table 4.5.1.2.1-2). The mainstem Androscoggin River from the Little Androscoggin confluence (located about 18 miles upstream of the Pejepscot Dam) to the Pejepscot Dam is listed under Category 5-D for being impaired due to legacy PCBs found in fish tissue and Category 4-B for dioxin contamination (MDEP, 2014). Downstream of the Project, the mainstem Androscoggin River from the Pejepscot Dam to the Brunswick Dam is listed as Category 4-B river due to dioxins, Category 5-D for legacy PCBs, and Category 4-C for aquatic life impairment due to inadequate fish passage for American Shad at Brunswick Dam (MDEP, 2014).

Table 4.5.1.2.1-1. MDEP Water Quality Standards for Class C Waterbodies

Parameter	Standard
Dissolved oxygen	Minimum of 5 ppm (mg/l) or 60% saturation, whichever is greater, except in identified salmonid spawning areas
E. coli (human and domestic origin)	May not exceed a geometric mean of 126 per 100 milliliters or an instantaneous level of 236 per 100 milliliters between May 15th and September 30th. There must be provisional periodic review of designated salmonid spawning areas.
Discharges	Discharges to Class C waters may cause some changes to aquatic life, except that the receiving waters must be "of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community."

Source: Maine, 2016b

Table 4.5.1.2.1-2. Integrated Water Quality Report category definitions

Category	Definition
Category 1	Rivers and streams fully attaining all designated uses
Category 2	Rivers and streams attaining some designated uses - insufficient information for other uses
Category 3	Rivers and streams with insufficient data or information to determine if designated uses are attained (one or more uses may be impaired)
Category 4-A	Rivers and streams with impaired use other than mercury, TMDL completed
Category 4-B	Rivers and streams impaired by pollutants - pollution control requirements reasonably expected to result in attainment
Category 4-C	Rivers and streams with impairment not caused by a pollutant
Category 5-A	Rivers and streams impaired by pollutants other than those listed in 5-B through 5-D, TMDL required
Category 5-B	Rivers and streams impaired for bacteria only, TMDL required
Category 5-C	Waters impaired by atmospheric deposition of mercury
Category 5-D	Rivers and streams impaired by legacy pollutants

Source: MDEP, 2014

E4.5.1.2.2 Historic Water Quality Data

In the recent past, many segments of the Lower Androscoggin River near the Project have been monitored by several organizations (including water quality data collection) as part of the following programs:

- MDEP 2010 Lower Androscoggin River Basin Water Quality Study Modeling Report;
- Volunteer River Monitoring Program (VRMP); and
- Dioxin Monitoring Program (DMP) fish toxic information and Surface Water Ambient Toxics (SWAT).

The existing water quality monitoring data indicates that the Project Area meets the Class C water quality classification. Figure 4.5.1.2.2-1 provides a map of the water quality monitoring locations. The water quality data from these monitoring programs is summarized below.

MDEP 2010 Lower Androscoggin River Basin WQ Study Modeling Report

In 2010, MDEP implemented a water quality sampling program for the Lower Androscoggin River to determine if the section of river from Worumbo Dam to Merrymeeting Bay could be expected to meet criteria for reclassification from Class C to Class B. Waters were sampled during low flow, high temperature conditions in 2010 on July 13 to 16 and August 2 to 5 (MDEP, 2011).

This data was used to help develop a Water Quality Analysis Simulation Program[22] water quality model for the freshwater section of the river from a location just downstream of the Little Androscoggin River in Auburn, through the Project Area, to below the Brunswick Project. Sampling locations were chosen to also incorporate point source discharges from Publicly Owned Treatment Works (POTWs); Lewiston-Auburn Water Pollution Control Authority, and the Lisbon Wastewater Treatment Facility. The model was used to simulate effects of nutrients and other pollutants on the Androscoggin River during low river flow and maximum licensed discharge from the POTWs to predict water quality conditions during a 7Q10 low flow (occurring 7 consecutive days, once every 10 years) (MDEP, 2011).

Sampling locations near the Project included:

- S-858, 3.15 miles upstream of the Pejepscot Dam in the Little River 0.2 miles from Androscoggin mainstem;
- S-956, 0.45 miles upstream from the Pejepscot Dam in the impoundment;
- S-A47, just upstream of the Pejepscot Dam in the impoundment; and
- S-954, about 0.15 miles downstream of the Pejepscot Dam.

[22] The Water Quality Analysis Simulation Program was developed by the EPA and is a commonly used model to interpret and predict water quality responses to natural phenomena and manmade pollution.

Macroinvertebrates were analyzed at S-956 and S-954 in July and August of 2010 (MDEP, 2011 & MDEP, 2016b). Field collected water quality data from the macroinvertebrate analysis deployment indicated water temperatures between 22.3 and 25.2°C, DO levels between 7.2 and 7.9 mg/L, and specific conductivity between 79 and 103 us/cm.

Based on field sampling and modeling, MDEP stated that the Pejepscot Dam river segment exhibits DO concentrations that met the Class C criterion. Due to the increased depth and volume, MDEP stated that the impoundment creates a slower moving body of water, decreasing reaeration rates and potentially allowing organic sediment to accumulate. MDEP stated that a narrow diurnal range is the result of greater depths and lower oxygen (MDEP, 2011).

The Aquatic Life Classification Attainment study, also performed by MDEP for the 2011 model report, indicated that the upstream Worumbo Impoundment, and the Pejepscot Impoundment itself, had aquatic communities that met Class C criterion, as indicated by communities of macroinvertebrates collected at these locations. Alternatively, at the sampling location downstream of the Project, aquatic communities attained Class B aquatic life criteria due to the majority of organism's present being sensitive to organic pollution (MDEP, 2011).

Volunteer River Monitoring Program 2010 - 2015

DO, temperature, pH, specific conductance, and *E. coli* are currently monitored along the Androscoggin River by the VRMP. Friends of Merrymeeting Bay (FOMB) joined the VRMP in 2009. Monitoring is generally performed once a month from May to September or October at 8 different locations (MDEP, 2016c).

Sample locations which the FOMB monitor regularly within the Project Area include the Pejepscot boat launch and Fish Park Upstream, data is also occasionally monitored at Fish Park Downstream:

- Pejepscot Boat Launch is in the impoundment about 850 ft downstream of the Little River confluence and half a mile below the Worumbo Project;
- Fish Park Upstream is in the impoundment, just upstream of the Pejepscot Dam; and
- Fish Park Downstream is about 330 ft downstream from the Pejepscot Dam.

Water quality data for each of these locations, from 2010 to 2015 were obtained from Mary-Ellen Dennis (VRMP Program Coordinator). Figure 4.5.1.2.2-1 shows each of the 3 the locations in relation to the Project.

Based on the monitoring by the VRMP for Pejepscot Boat Launch, Fish Park Upstream, and Fish Park Downstream the lowest DO measurements observed for all 2010 and 2015 VRMP monitoring were 6.3 mg/L and 72.2%. Both *E. coli* criteria (instantaneous geometric mean concentration of 236 Most Probable Number (MPN)/100 ml, or 126 MPN/100 ml maximum average between May 15 and September 30) were met for 2010 through 2015 data at Fish Park Upstream and Fish Park Downstream. The Pejepscot Boat Launch exceeded the 236 MPN/100 ml instantaneous maximum on May 18, 2014 with a sample concentration of 435 MPN/100 ml. However, the duplicate concentration for this sample was 48 MPN/100 ml (Dennis, 2017). The water quality samples were usually collected 3 ft below the surface of the water but were also collected at 1.5 ft or mid-depth from the bank (if non-wadeable) or via wading (Dennis, 2017).

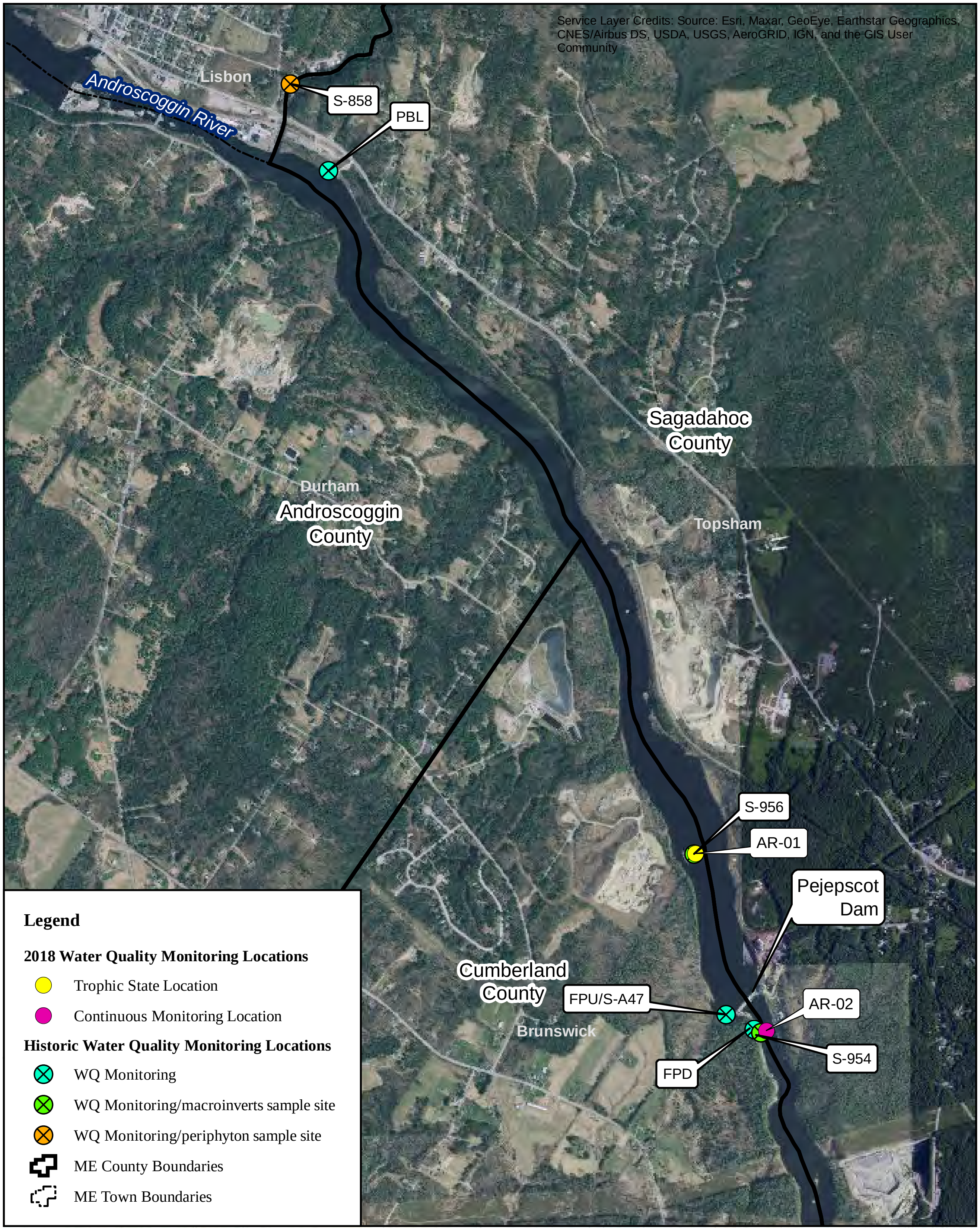
At the Fish Park Upstream location, vertical profiles were recorded twice a day, once in the morning and once in the afternoon during each of the July and August 2010 field sampling events. The depth of the Fish Park Upstream profile location ranged from 13 to 18 ft with measurements taken roughly every 3 ft, starting near the water's surface. Recorded parameters include specific conductivity, pH, DO concentration, and DO saturation. A secchi depth was also recorded during each profile. Results of the Fish Park Upstream vertical profiles indicate that the water column is well-mixed with little, if any variation in temperature, pH, DO or specific conductivity for July and August. Specific conductivity remained the most consistent for each profile with no change in concentration over depth. DO concentration remained above 7 mg/L and DO saturation remained above 87.9% in each profile. Temperature ranged from 24.3 to 27^{o}C and pH ranged from 7.0 to 7.5. Secchi depths ranged from approximately 9.8 ft. to 12.5 ft. (MDEP, 2016c).

Dioxin Monitoring Program fish toxic information and Surface Water Ambient Toxics

The DMP has been in place since 1987 (as per 38 MRSA §420-A). It was merged with the SWAT monitoring program in 2007 for dioxin monitoring. Dioxins and furon congeners have been monitored in fish tissue where rivers have been suspected to receive dioxin-related discharge pollution. Fish sampling locations along the Androscoggin River that have been monitored under this program include locations between Gilead, ME (near the border of NH) downstream to Lisbon, ME (bordering the northern end of the Pejepscot Impoundment) (MDEH, 2008).

Sources of dioxin contamination within the Androscoggin River watershed include industrial discharges from paper mills, other municipal and industrial effluents, and nonpoint sources such as landfill leaches, runoff and spills (MDEP, 1990). Re-suspending sediments may affect dioxin levels as dioxins tend to associate with solids and may accumulate in soil.

The Maine Center for Disease Control and Prevention Division of Environmental Health (MDEH) advises eating just 6 to 12 fish meals a year if the fish have been caught in the Androscoggin River from Gilead (ME/NH border) to Merrymeeting Bay due to chemical contamination that may include high levels of PCBs, Dioxins, or DDT (MDEH, 2013). They also recommend limiting or eliminating the consumption of fish, especially older fish or fish higher in the food chain, due to mercury contamination in all of Maine's freshwater bodies.



Brookfield

Pejepscot Hydroelectric Project
(FERC No. 4784)
Final License Application

Figure 4.5.1.2.2-1.
Historic and 2018
Water Quality
Monitoring Locations

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E4.5.1.2.3 2018 Water Quality Monitoring

In 2018 as part of the relicensing of the Pejepscot Project, Topsham Hydro conducted the following water quality assessments: (1) trophic state study of the Pejepscot impoundment, and (2) riverine sampling of the Project tailwater. The objectives of the water quality study was to (1) collect periodic water quality data in the Project impoundment, and (2) collect continuous water temperature and DO data in the Androscoggin River downstream of the Project dam during low flow, warm water temperature conditions (Topsham Hydro, 2019a). Figure 4.5.1.2.2-1 shows each of the two sampling locations in relation to the Project.

The results of the 2018 study indicate that water quality at the Project was within MDEP's state water quality standards (Topsham Hydro, 2019a).

Impoundment Sampling

Water temperatures and dissolved oxygen were relatively uniform throughout the water column within the Project impoundment, which resulted in no summer stratification (Figure 4.5.1.2.3-1 – 4.5.1.2.3-3). Over the study period, water temperature within the Project impoundment ranged from 12.0ºC (October) to 26.9ºC (August). DO concentrations ranged from 7.0 mg/L (July) to 9.9 mg/L (October) and were above the minimum state standard for Class C waters (5.0 mg/L). The DO percent saturation in the Project impoundment ranged from 82.2 percent (July) to 103.6 percent (September) throughout the monitoring period. The DO percent saturation in the Project impoundment exceeded the established state standard of 60 percent saturation for Class C waters.

Total phosphorus ranged from 13 to 23 ug/L with an average 19 ug/L. Total phosphorus levels were below the proposed state standards upper limit of 33 ug/L for Class C waters. Color ranged from 28 to 46 platinum cobalt units (PCU), with an average of 35 PCU suggesting that the impoundment was slightly colored. Chlorophyll-a ranged from 0.001 mg/L to 0.004 mg/L, with an average of 0.003 mg/L. Chlorophyll-a was below the proposed state standard upper limit of 0.008 mg/L. Total alkalinity ranged from 14 mg/L to 22 mg/L, with an average of 18 mg/L. Water bodies with alkalinity values less than 10 mg/L are considered poorly buffered. pH ranged from 6.9 to 7.2, with an average of 7.1. All pH values were within the recommended range of 6.0 to 8.5 for Class C waters. Secchi disk transparency ranged from 2.42 to 4.66 meters, with an average of 3.98 meters. The secchi disk transparency was above the proposed standards of 2.0 meters throughout the sampling period (Table 4.5.1.2.3-1).

Total phosphorus, chlorophyll-a, and secchi disk transparency are often used as indicators of trophic state, or the biological productivity in a water body, particularly a lake. An oligotrophic lake is characterized as having low productivity, a mesotrophic lake has medium productivity, and a eutrophic lake is highly productive. The Project impoundment has relatively low levels of nutrients and does not support high densities of algal populations. Sampling data suggest that the Project impoundment is mesotrophic (Maine Trophic State Index of 36).

Table 4.5.1.2.3-2 lists the concentrations of metals and nutrients from the August 21, 2018 sampling event within the Project impoundment. Iron (0.27 mg/l) and chloride (9.1 mg/l) concentrations were below the established state standards, which are 1 mg/l and 230 mg/l, respectively. Aluminum (0.050 mg/l) was below the standard of 0.087 mg/l. All other parameters do not have an established standard.

Riverine Sampling

The water temperature in the Project tailwater ranged from 16.8ºC (October) to 27.3ºC (August) with an average of 23.5ºC. DO concentrations in the Project tailwater ranged from 7.8 (August) to 9.7 mg/L (October) with an average of 8.5 mg/L. Observed concentrations were above the minimum state standard for Class C waters (5.0 mg/L). DO percent saturation ranged from 94.3 to 106.2 percent with an average of 99.6 percent. These values were above the minimum state standard of 60 percent saturation for Class C waters.

Table 4.5.1.2.3-1: Epilimnetic Core Sample Results

Sample Date	Sample Time	Total Phosphorus (ug/l)	Chlorophyll-a (mg/l)	Total Alkalinity (mg/l)	Color (PCU)	pH	Secchi Disk (meters)
6/27/2018	11:50	19	0.004	18	28	7.1	3.91
7/13/2018	12:07	23	0.003	22	32	7.1	3.89
7/24/2018	13:55	19	0.003	20	32	7.0	4.11
8/7/2018	10:04	19	0.002	14	42	6.9	3.55
8/21/2018	10:27	20	0.002	14	46	6.9	4.30
9/4/2018	11:05	19	0.002	17	30	7.2	4.63
9/17/2018	11:11	13	0.001	18	29	7.2	4.66
10/2/2018	13:25	20	0.002	22	34	7.0	4.34
10/18/2018	12:25	21	0.004	17	40	7.1	2.42
Average		**19**	**0.003**	**18**	**35**	**7.1**	**3.98**
Median		**19**	**0.002**	**18**	**32**	**7.1**	**4.11**
Minimum		**13**	**0.001**	**14**	**28**	**6.9**	**2.42**
Maximum		**23**	**0.004**	**22**	**46**	**7.2**	**4.66**

Table 4.5.1.2.3-2: Late Summer Sampling Parameter Concentrations in the Project Impoundment, August 21, 2018

Parameter	Units	Value
Nitrate	mg/l	0.14
Dissolved Organic Carbon	mg/l	7.1
Specific conductance	µS/cm	83
Chloride	mg/l	9.1
Sulfate	mg/l	7.6
Total dissolved aluminum	mg/l	0.05
Total Calcium	mg/l	4.6
Total Iron	mg/l	0.27
Total Magnesium	mg/l	0.87
Total Potassium	mg/l	1.0
Total Silica (calculated)	mg/l	4.8
Total Sodium	mg/l	9.8

Figure 4.5.1.2.3-1. Water Temperature Profiles at the Pejepscot Impoundment - 2018

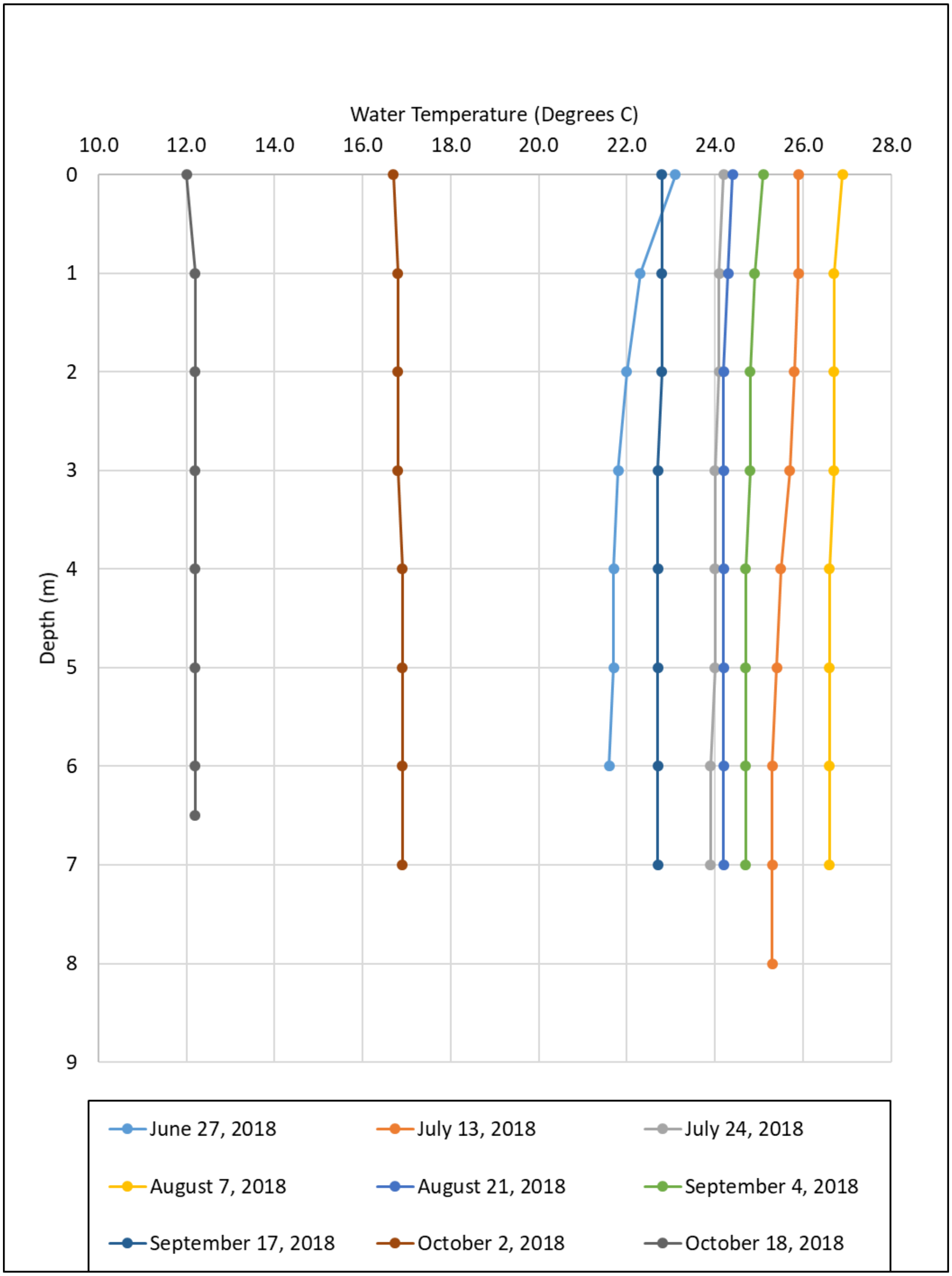


Figure 4.5.1.2.3-2. Dissolved Oxygen Profiles at the Pejepscot Impoundment - 2018

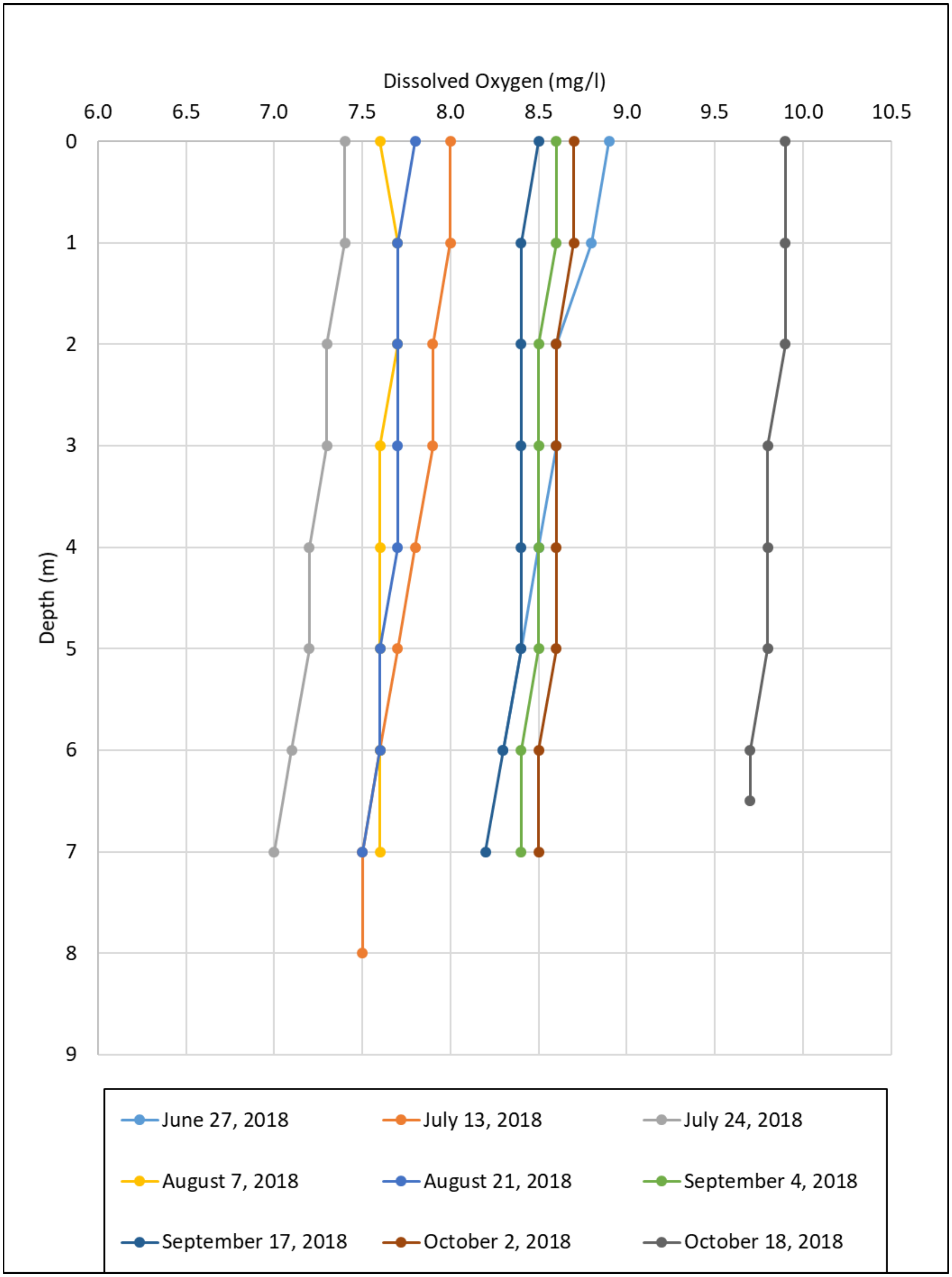
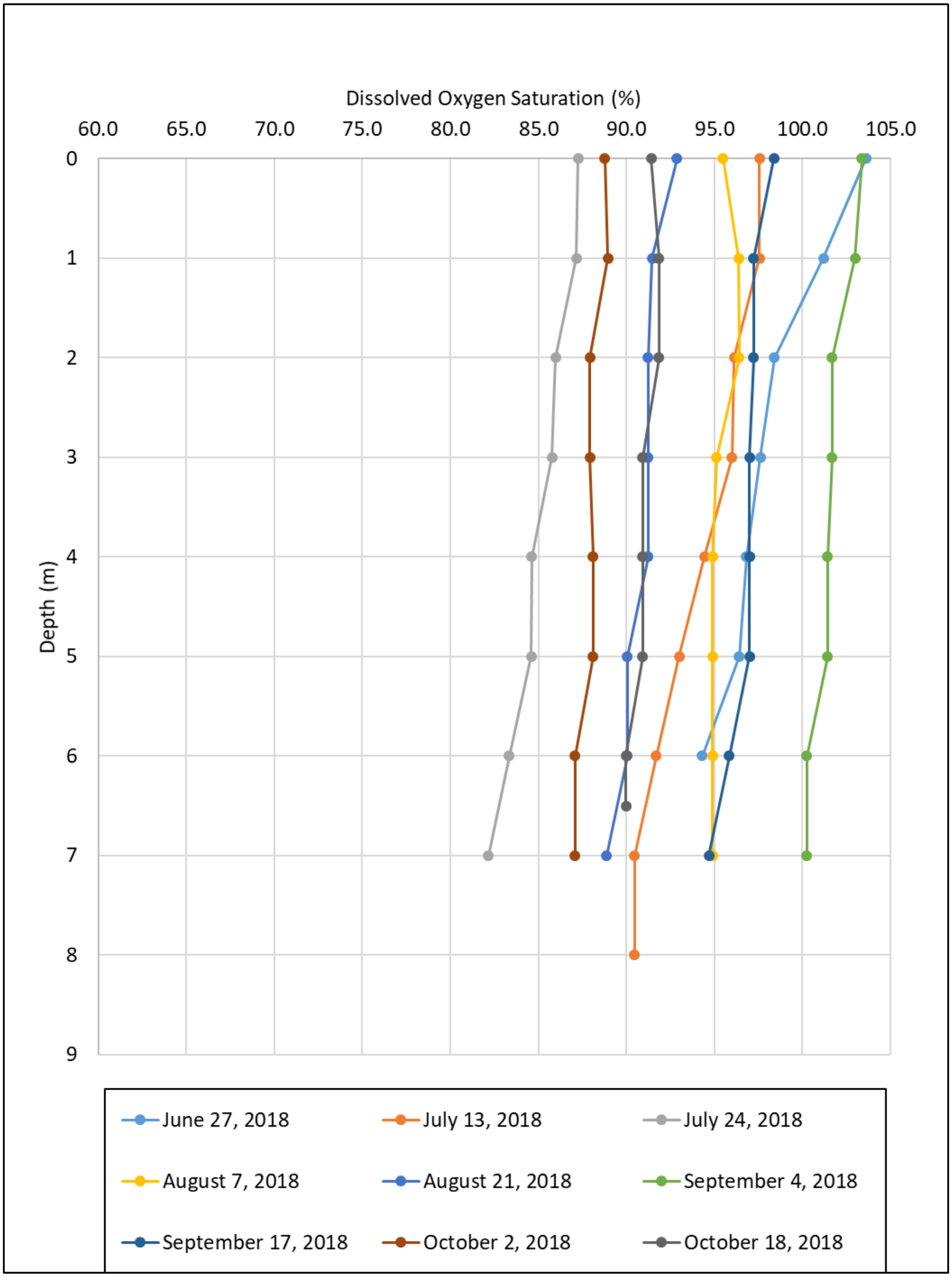


Figure 4.5.1.2.3-3. Dissolved Oxygen Percent Saturation Profiles at the Pejepscot Impoundment - 2018



E4.5.1.2.4 2018 Benthic Macroinvertebrate Study

In 2018 as part of the relicensing of the Pejepscot Project, Topsham Hydro conducted a survey of benthic macroinvertebrates in the tailwater of the Project. The goal of the study was to determine if the attainment of Class C habitat and aquatic life criteria is being met in the river reach below the Project dam. The survey objective was to determine the composition of the benthic macroinvertebrate community within the tailrace reach of the dam in accordance with MDEP protocols (Topsham Hydro, 2019b).

Macroinvertebrate samplers were installed at the sampling location downstream of the Pejepscot Dam on August 2, 2018 and were retrieved 27 days later on August 29, 2018. In general, aquatic habitat in the area approximately 660 ft downstream of the Project was primarily a mix of boulder (<10 inch) and rubble (3-10 inch) substrates. Areas of filamentous algae were present on the substrate at the sampling location during both deployment and retrieval of the samplers.

A total of 1,707 individuals representing 43 taxonomic classifications were collected from the three samplers deployed downstream of Pejepscot (Table 4.5.1.2.4-1). Caddisfly species (genus *Hydropsyche*) and the black fly (genus *Simulium*) were the two most dominant members of the benthic macroinvertebrate community and combined to make up approximately 50% of the total number of specimens.

Metrics evaluating community tolerance/intolerance revealed that sensitive genera comprised a measurable proportion of the macroinvertebrate community downstream of Pejepscot. Members of the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) are considered particularly sensitive to pollution and can provide information important to the condition of the benthic macroinvertebrate community. Individuals from the EPT assemblage were present at the downstream sampling location, comprising 66.3% of the total number of specimens collected.

In addition to evaluation of the EPT contribution to the community, each taxonomic group was assigned a value of tolerance using classifications provided by MDEP. Tolerance values (range = 0-10) were further classified as Intolerant (i.e., sensitive to water quality; values = 0-3), Semi-tolerant (i.e., intermediate in their tolerance to water quality; values = 4-6) or Tolerant (i.e., low sensitivity to water quality; values 7-10). Genera classified as Intolerant to poor water quality comprised 27% of the total number of genera observed at the downstream sampling location (replicates 1-3, combined). Individuals belonging to taxonomic groups considered to be tolerant of low water quality represented only 2.6% of all specimens enumerated at from the samplers located downstream of Pejepscot.

The Hilsenhoff Biotic Index (HBI) rating provides an estimate of the overall tolerance of the community in the sample area. For the sampling location downstream of Pejepscot this value was estimated at 4.19. Values for the HBI index range from 0 to 10 with lower values reflecting a higher abundance of sensitive groups. The estimate for the Pejepscot macroinvertebrate community is supportive of a water quality rating of “very good”.

Taxonomic and habitat information were provided to MDEP on November 28, 2018 after which MDEP returned a Classification Attainment Report on November 30, 2018. The final determination indicated that the macroinvertebrate community sampled downstream of Pejepscot during August 2018 exceeded Class C standards.

Table 4.5.1.2.4-1. Summary of Macroinvertebrate Metrics for Replicates Collected Downstream of Pejepscot, August 2018

Metric	Sample Location 1			
	Rep. 1	Rep. 2	Rep. 3	All
Total Number of Individuals	576	191	940	**1,707**
Total Number of Taxa	29	29	35	**43**
Number of EPT Taxa	16	20	20	**22**
Number of Ephemeroptera Taxa	5	7	8	**9**
Number of Plecoptera Taxa	1	2	2	**2**
Number of Trichoptera Taxa	10	11	10	**11**
Percent EPT	73.4%	85.3%	58.1%	**66.3%**
Percent Ephemeroptera	24.0%	30.9%	10.5%	**17.3%**
Number of Intolerant Taxa	7	10	10	**12**
Percent Tolerant Organisms	3.7%	3.1%	1.9%	**2.6%**
Percent Dominant Taxon	30.9%	23.6%	31.8%	**30.6%**
Hilsefhoff Biotic Index (HBI)	4.24	4.25	4.14	**4.19**
HBI Water Quality Rating	Very Good	Very Good	Very Good	**Very Good**
Shannon Diversity (base e)	2.58	2.71	2.29	**2.55**

E4.5.1.2.5 Historical Macroinvertebrate Data

The macroinvertebrate community plays an important role in the composition of an aquatic ecosystem. Macroinvertebrates are a food source for the fishery and other aquatic resources that may be present. Benthic macroinvertebrates are aquatic insects, mollusks, arthropods, snails and other organisms that reside on the bottom of waterbodies. Various taxa groups have wide ranges of pollution tolerances, resulting in macroinvertebrate community composition used as an indicator of water quality. Seventeen common taxa groups of benthic macroinvertebrates have been documented in Maine as part of water quality biomonitoring (Table 4.5.1.2.5-1).

For the majority of benthic macroinvertebrates, there is limited distribution data available, however, dragonflies, damselflies, and freshwater mussels have had specific surveys completed for the creation of a statewide atlas. Other benthic macroinvertebrate data was collected by the Maine Department of Environmental Protection's Biological Monitoring Program, which assess the health of rivers, streams, and wetlands as part of the Water Classification Program. In the vicinity of the Project, the most recent sampling effort was performed in 2010 at two locations.

Table 4.5.1.2.5-1: Common Types of Benthic Macroinvertebrates in Maine

Common Name	Order
Flatworms	Tubellaria
Aquatic Earth Worms	Oligochaeta
Leeches	Hirudinea
Snails	Gastropoda
Clams & Mussels	Bivalvia
Mites	Acariformes
Aquatic Sow Bugs	Isopoda
Scuds	Amphipoda
Crayfish & Shrimps	Decapoda
Mayfly Larvae	Ephemeroptera
Dragonfly & Damselfly Larvae	Odonata
Stonefly Larvae	Plectopera
True Bugs	Hemiptera
Dobsonfly & Alderfly Larvae	Megaloptera
Water Beetles	Coleoptera
Caddisfly Larvae	Trichoptera
True Fly Larvae	Diptera

Aquatic Insects

Within the Project Area, recent MDEP sampling efforts focused on a location in the Project Impoundment and a riverine location downstream of the Project (S-956 and S-954, respectively). The impoundment and downstream sampling locations had diversity indices that were similar, though the overall macroinvertebrate abundance at the downstream location was considerably higher (Table 4.5.1.2.5-2). Additionally, the downstream location also exhibited higher EPT tolerance, and dominant taxa included *Chimarra, Macrostemum, Maccaffertium, Hydropsyche,* and *Acerpenna*. In the impoundment, the dominant taxa included *Stenacron, Oecetis, Amnicola, Tribelos, and Maccaffertium*. Generic richness, which was defined as "the number of different genera found in all replicates from one sampling site", was similar between the impoundment and downstream locations.

Though the samples were collected as part of water quality biomonitoring, the differences in the macroinvertebrate community between the impoundment and downstream locations is also a function of habitat. The sampling location in the impoundment was deeper, with slow or imperceptible flow and primarily sand substrate. Alternatively, the downstream sampling location was characterized by swift flow and primarily rubble/cobble substrate.

Table 4.5.1.2.5-2: Macroinvertebrate Reported Variables

Variable	Impoundment (S-956)	Downstream (S-954)
Total Mean Abundance	75.33	956.0
Generic Richness	36.0	37.0
Ephemeroptera Mean Abundance	18.0	278.0
Shannon-Wiener Generic Diversity	4.16	3.91
EPT Generic Richness	10.0	21.0
Top Five Dominant Taxa	Stenacron Oecetis Amnicola Tribelos Maccaffertium	Chimarra Macrostemum Maccaffertium Hydropsyche Acerpenna
Dominate Substrate	Sand	Rubble/Cobble

Source: Maine DEP 2010

Dragonflies and Damselflies

Damselflies (Zygoptera) and Dragonflies (Anisoptera) have aquatic and terrestrial life stages. Eggs are deposited in or close to water and several larval growth stages occur before the final metamorphosis into adults. In the 2010 biomonitoring macroinvertebrate surveys discussed above, four genera (Argia, Enallagma, Gomphus, Boyeria) of dragonflies or damselflies were identified in the vicinity of the Project. A Maine Damselfly and Dragonfly Survey (MDDS) was formally conducted between 1999 and 2005, with additional volunteer records added between 2006 and 2016. This dataset provides a county level overview of Damselflies and Dragonflies that may be present in the Project Area. The Maine Damselfly and Dragonfly Survey identified a total of 158 species in 58 genera present in the state. Of the 158 species, 94 species are found in Androscoggin County, 106 species are found in Cumberland County, and 68 species are found in Sagadahoc County. Sixty-three species are found in all three counties. Of the 63 species, there are a total of ten species listed on the Maine Species of Special Concern List, and only one is present in all three counties (MDDS, 2016). Table 4.5.1.2.5-3 displays the ten Species of Special Concern odonates that may be present in the Project Area.

Table 4.5.1.2.5-3: Odonate Species of Special Concern Present in Counties Adjacent to the Project

Common Name	*Scientific Name*	Odonate Type	County
New England bluet	*Enallagma laterale*	Damselfly	Androscoggin/Cumberland
Scarlet bluet	*Enallagma pictum*	Damselfly	Androscoggin/Cumberland
Swamp darner	*Epiaeschna heros*	Dragonfly	Cumberland
Lilypad clubtail	*Arigomphus furcifer*	Dragonfly	Cumberland
Cobra clubtail	*Gomphus vastus*	Dragonfly	Cumberland
Southern pygmy clubtail	*Lanthus vernalis*	Dragonfly	Cumberland
Extra-striped snaketail	*Ophiogomphus anomalus*	Dragonfly	Androscoggin/Cumberland/ Sagadahoc
Pygmy snaketail	*Ophiogomphus howei*	Dragonfly	Androscoggin/Cumberland
Common sanddragon	*Progomphus obscurus*	Dragonfly	Cumberland
Arrowhead spiketail	*Cordulegaster obliqua*	Dragonfly	Cumberland

Freshwater Mussels

Freshwater mussels are considered a conservation priority by state and federal agencies due to their role in aquatic food webs, water quality, and nutrient cycling (Nedeau *et al*., 2000). Distribution data was provided by the mussel surveys that were conducted between 1992 and 1997 for the statewide atlas. Freshwater mussels, which are sedentary and found in shallow or shoreline benthic habitats, are dependent on specific freshwater fish species that act as hosts during their larval developmental stage. Mussel larvae (glochidia) are released into the water column and attach to the host (Nedeau *et al*., 2000).

In the Lower Androscoggin River, eight native freshwater mussel species were documented during the statewide mussel atlas surveys (Nedeau *et al*., 2000). These species include: eastern pearlshell, triangle floater, creeper, eastern floater, alewife floater, eastern elliptio, eastern lampmussel, and tidewater mucket. The tidewater mucket is listed as threatened in Maine, and the Creeper is considered a Species of Special Concern. Table 4.5.1.2.5-4 provides detailed information for the species that may exist in the Project Area.

Table 4.5.1.2.5-4: Project Area Freshwater Mussels

Common Name	Scientific Name	Host	County	Substrate	Aquatic Environment	Status
Eastern pearlshell	*Margaritifera margaritifera*	Atlantic Salmon, Landlocked Salmon, Brook Trout, Brown Trout	Androscoggin	Firm sand/ gravel/cobble	Cool fast-flowing mountain streams, small rivers	Not Listed
Triangle floater	*Alasmidonta undulata*	Common Shiner, Blacknose Dace, Longnose Dace, Pumpkinseed Sunfish, Fallfish, Largemouth Bass, Slimy Sculpin, White Sucker	Androscoggin / Sagadahoc	Sand/gravel	Streams, rivers, lakes, ponds Tolerates standing water	Not Listed
Creeper	*Strophitus undulatus*	Largemouth Bass, Creek Chub, Fathead Minnow, Bluegill, Longnose Dace, Fallfish, Golden Shiner, Common Shiner, Yellow Perch, Slimy Sculpin, two-lined salamander, Atlantic Salmon	Androscoggin / Sagadahoc	Sand/fine gravel	Streams, rivers and sometimes impounded river sections	Special Concern
Eastern floater	*Pyganodon cataracta*	White Sucker, Pumpkinseed Sunfish, Threespine Stickleback, carp, Bluegill	All Maine Counties	Sand/mud/deep silt/soft substrates	Slow-moving portions of riverine environments, small streams, ponds, lakes	Not Listed

Common Name	Scientific Name	Host	County	Substrate	Aquatic Environment	Status
Alewife floater	*Anodonta implicata*	Alewife, American Shad, Blueback Herring	Androscoggin / Sagadahoc	Silt/sand/gravel	Streams, rivers, lakes	Not Listed
Eastern elliptio	*Elliptio complanata*	Yellow Perch, Banded Killifish, Largemouth Bass	All Maine Counties	Clay/mud/sand/ gravel/cobble	Small streams, large rivers, freshwater tidal, ponds, lakes	Not Listed
Eastern lampmussel	*Lampsilis radiate radiata*	Yellow Perch, Largemouth Bass, Smallmouth Bass, Black Crappie, Pumpkinseed Sunfish	Androscoggin / Sagadahoc	Sand/gravel	Small streams, large rivers, ponds, lakes	Not Listed

Source: Nedeau et al., 2000; Pers. Comm. Ethan Nedeau, 8/18/2017

E.4.5.2 Environmental Analysis

FERC's SD2 identified one potential resource issue relating to water resources, which is discussed in greater detail below.

Effects of continued project operation on water quality from the project headwaters downstream to the Brunswick dam (issues denoted with an asterisk [*] are to also be considered for cumulative effects).

Based on available data, the Project has no adverse impacts on river water quality in either the impoundment or the tailwater area and is currently meeting Class C water quality standards both upstream and downstream of the dam and powerhouse. Profile data indicated that the Project impoundment does not stratify; DO concentrations were well above the minimum state criterion (5.0 mg/L) throughout the water column. Trophic data indicated that the impoundment is mesotrophic; therefore, it is unlikely to experience water quality problems typically associated with more productive systems (i.e., algal blooms and oxygen depletion). Similarly, tailwater monitoring demonstrates that the Androscoggin River downstream of the Project dam and powerhouse meets Class C water quality standards for temperature and DO.

Macroinvertebrate community sampling in the Project tailwater further demonstrated that the Project and its operation have little or no impact on the aquatic community. Macroinvertebrate community indices demonstrate that the structure and function of the aquatic community is well maintained and indicative of a healthy aquatic community expected to occur in areas of natural habitat. These results were supported by MDEP's macroinvertebrate community model, which determined the aquatic community exceeded Class C waters standards.

E4.5.2.1 Cumulative Effects

In SD2, water quality was identified as a resource that could be cumulatively affected by the proposed continued operation and maintenance of the Project. The geographic scope for water quality was identified as the reach from the Project headwaters downstream to the Brunswick dam.

Based on data from the 2018 water quality study, Project operations do not adversely affect dissolved oxygen concentrations and other water quality parameters in the Androscoggin River upstream or downstream of the Project dam. Topsham Hydro's proposal to operate the Project in a run-of-river mode and provide the minimum downstream flow is not expected to result in cumulative impacts to water resources.

The Project does not result in local impacts to the water quality of the Lower Androscoggin River and, therefore, does not impact the Androscoggin River Basin downstream of the Project. The Proposed Actions of the Project, in combination with other activities within the watershed, will not alter this condition for the reasonably foreseeable future.

E.4.5.3 Proposed Environmental Measures

Topsham Hydro is proposing the following PME measures to protect water resources.

- Maintain a minimum flow of 1,170 cfs, or inflow, whichever is less downstream of the Project[23].
- Operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates[24].
- Implement an Operations Monitoring Plan (Appendix E-4).

Studies conducted by Topsham Hydro demonstrated that the Project and its continued operation do not adversely affect water resources. Therefore, Topsham Hydro is not proposing additional PME measures specific to water resources within the Project.

E.4.5.4 Unavoidable Adverse Effects

The continued operation of the Project will not result in new impacts to water resources.

E.4.5.5 References

Dennis, Mary-Ellen (VRMP Program Coordinator of MDEP). Correspondence on 1/4/17. VRMP water quality data from 2010 to 2015 received via email.

Federal Energy Regulatory Commission (FERC). 1996. Final Environmental Impact Statement: Lower Androscoggin River Basin Hydroelectric Projects Maine (FERC 2283-005, 11482-000). July 1996.

Federal Energy Regulatory Commission (FERC). 2015. FERC Form 80: Licensed Hydropower Development Recreation Report (OMB No. 1902-0106). March 2015.

Federal Energy Regulatory Commission (FERC). 2016. Letter informing Topsham Hydro Partners L.P. that the minimum flow deviations that occurred on June 5-6 *et al* will not be considered violations of Article 32 re the Pejepscot Project under P-4784. September 22, 2016

Maine Damselfly and Dragonfly Survey (MDDS). 2016. Maine Damselfly and Dragonfly Survey Data. http://mdds.umf.maine.edu/ Accessed 12/6/16.

[23] Minimum flow requirements under the current license are described as "continuous," but Topsham Hydro proposes that the requirement in the new license be instead based on the hourly average. This change would capture the intent of the minimum flow measure, but would avoid unnecessary reporting of very short term excursions due to unplanned events such as extreme weather, equipment failure, and so on. A similar change was adopted in 2011 for the Gulf Island-Deer Rips Hydropower Project (FERC No. 2283).

[24] Topsham Hydro also proposes that, for compliance purposes, the pond level elevation also be based upon hourly average, for similar logic as the minimum flow requirement.

Maine Department of Environmental Health (MDEH). 2008. Evaluation of the Health Implications of Levels of Polychlorinated Dibenzo-p-Dioxins (dioxins) and Polychlorinated Dibenzofurans (furans) in Fish from Maine Rivers: 2008 Update. January 2008. Online: https://www1.maine.gov/dhhs/mecdc/environmental-health/eohp/fish/documents/finaldraft-eval-of-pcdd.pdf. Date Accessed: 12/29/16

Maine Department of Environmental Health (MDEH). 2013. Freshwater Fish Safe Eating Guidelines. Online: http://www.maine.gov/dhhs/mecdc/environmental-health/eohp/fish/2kfca.htm. Date Accessed: 12/29/16

Maine Department of Environmental Protection (MDEP). 1990. State of Maine 1990 water quality assessment, a report to Congress pursuant to section 305(b) of the Federal Water Pollution Control Act as amended. Augusta, Maine. 103pp + appendices

Maine Department of Environmental Protection (MDEP). 2011. Lower Androscoggin River Basin Water Quality Study Modeling Report. Prepared by Peter Newkirk. March 2011. Online: http://www.maine.gov/dep/water/monitoring/rivers_and_streams/modelinganddatareports/androscoggin/2011/lowerandromodelreport_final_march_2011.pdf. Date Accessed: 12/28/16

Maine Department of Environmental Protection (MDEP). 2014. Draft State of Maine Department of Environmental Protection 2014 Integrated Water Quality Monitoring and Assessment Report. Online: http://www.maine.gov/dep/water/monitoring/305b/2014/draft-report.pdf

Maine Department of Environmental Protection (MDEP). 2016. GIS Maps and Other Data Files. Wastewater Facilities and Outfalls (MEPDES) (Data Under Development). 2016 Online: http://www.maine.gov/dep/gis/datamaps/. Date Accessed: 12/28/16

Maine Department of Environmental Protection (MDEP). 2016b. GIS Maps and Other Data Files. Biomonitoring Stream and Wetland Sampling Data GIS layer (3/3/2016). Online: http://www.maine.gov/dep/gis/datamaps/. Date Accessed: 12/28/16

Maine Department of Environmental Protection (MDEP). 2016c. Volunteer River Monitoring Report: 2015 Data Report. Online: http://www.maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/reports.html. Date Accessed: 1/3/17

New Hampshire Department of Environmental Services (NHDES). 2008. New Hampshire Water Resources Primer. Online: http://www.des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/primer_chapter2.pdf. Date Accessed: 1/13/16

National Marine Fisheries Service (NMFS). 2012. NMFS Endangered Species Act Biological Opinion for Emergency Spillway Repair and Proposed Amendment of the License for the Worumbo Project (FERC No. 2428).

Nedeau, E.J., McCollough, M.A., and B.I. Swartz. 2000. *The Freshwater Mussels of Maine*. Maine Department of Inland Fisheries and Wildlife: Augusta Maine, 2000.

The State of Maine (Maine). 2016a. Maine Revised Statutes. Title 38 Waters and Navigation, §467: Classification of major river basins. Online: http://legislature.maine.gov/statutes/38/title38sec467.html. Date Accessed: 11/1/16

The State of Maine (Maine). 2016b. Maine Revised Statutes. Title 38 Waters and Navigation, §465: Standards for classification of fresh surface waters. Online: http://legislature.maine.gov/statutes/38/title38sec465.html. Date Accessed: 12/28/16

Topsham Hydro. 2019a. Initial Study Report – Water Quality Study Pejepscot Hydroelectric Project FERC No. 4784.

Topsham Hydro. 2019b. Initial Study Report – Tailwater Benthic Macroinvertebrate Survey Pejepscot Hydroelectric Project FERC No. 4784.

United States Geological Survey (USGS). 2016. National Water Information System: Web Interface. USGS Surface-Water Daily Data for Maine; USGS Gage No. 01059000 Androscoggin River near Auburn, Maine. https://waterdata.usgs.gov/me/nwis/dv? Date Accessed: 12/27/2016.

E.4.6 Aquatic Resources

E.4.6.1 Affected Environment

E4.6.1.1 Fish Assemblage

The fish assemblage in the Androscoggin River reflects natural and anthropogenic gradients from its upper reaches in New Hampshire to the tidal waters near Brunswick, Maine (Yoder *et al*., 2006). Upstream of Rumford Falls (approximately 75 miles upstream of the Project), the river is referred to as the Upper Androscoggin. This section is managed for recreational cold-water salmonid fishing by the States of Maine and New Hampshire within their respective borders. Though wild populations of Brook Trout (*Salvelinus fontinalis*) and Rainbow Trout (*Oncorhynchus myskiss*) contribute to the fishery, it is dependent upon annual stocking of Brook Trout, Rainbow Trout, Brown Trout (*Salmo trutta*), and landlocked Atlantic Salmon (*Salmo salar sebago*) (Brautigam and Pellerin, 2014).

Downstream of Rumford Falls, including the Project Area, the fish assemblage consists primarily of a warmer-water community, with a greater prevalence of lentic species. Additionally, American Eel (*Anguilla rostrata*) were documented at most locations downstream of Gulf Island Dam, including areas in the vicinity of the Project (Yoder *et al*., 2006). Anadromous migrants such as Atlantic Salmon (*Salmo salar*), American Shad (*Alosa sapidissima*), Alewife (*Alosa pseudoharengus*), Blueback Herring (*Alosa aestivalis*), Striped Bass (*Morone saxatilis*), and Sea Lamprey (*Petromyzon marinus*) are seasonally present in the lower reaches, as a result of fish passage facilities, stocking, and trap and transport programs (Brown *et al*., 2006). The historic extent of upstream passage for herring has been reported to be Lewiston Falls (approximately 17.5 miles upstream of the Project), with some American Eel, Atlantic Salmon, and possibly Sea Lamprey having passed as far upstream as Rumford Falls. Although Atkins, 1887 stated that American Shad spawned in the main river below Lewiston, Taylor, 1951, qualifies this by noting that the Androscoggin River may never have been an important shad river because of the 41-foot high falls at Brunswick, which is located 4.7 miles downstream of the Project.

Electrofishing surveys were performed along 1.0 km of shoreline at each of three sites in the vicinity of the Pejepscot Project by Yoder *et al*., (2006) in late July of 2003. Because of the timing of the surveys, data would primarily be representative of the resident fish assemblage. Overall, 16 species were captured from the areas downstream of Worumbo Dam to the areas downstream of Pejepscot Dam, and relative abundance varied between the sites sampled (Table 4.6.1.1-1). Overall, the catch was dominated by cyprinids and/or centrarchids. The highest abundance was observed in the impoundment, primarily due to large numbers of Spottail Shiner (*Notropis hudsonius*) captured there. All alosines captured in the surveys were young-of-the-year. Because many individuals collected during the surveys were small or juvenile fish, biomass by species shows a different pattern, with Smallmouth Bass (*Microperus dolomieu*) and White Sucker (*Catostomus commersonii*) dominating the overall fish biomass in the riverine areas upstream of the Project Impoundment and below the Project. Smallmouth Bass and Yellow

Perch (*Perca flavescens*), followed by Redbreast Sunfish (*Lepomis auritus*) dominated the fish biomass in the Project Impoundment (Table 4.6.1.1-2).

Though Northern Pike (*Esox lucius*) were not represented in high abundance during the 2003 survey, they have become established in the main-stem Androscoggin River downstream of Turner, ME, and also within many lakes in the watershed over the last 20 years (Brown *et al*., 2006; B. Lewis, MDIFW, pers. comm., 12/13/2016). As a top predator, they have the potential to alter the fish community in the Androscoggin River and also provide recreational fishing opportunities. Fishing reports from message boards and guide services would indicate that populations have expanded such that they provide recreational open water and ice fishing opportunities in the lower main-stem Androscoggin River. According to MDIFW, Northern Pike are well-established, with the river producing some trophy-sized fish (B. Lewis, MDIFW, pers. comm. 12/13/2016). Black Crappie (*Pomoxis nigromaculatus*) are another non-native species that has expanded populations within the Lower Androscoggin (B. Lewis, MDIFW, pers. comm. 12/13/2016); though this species is not a top predator, it may also provide additional recreational fishing opportunities. Additionally, White Catfish (*Ameiurus catus*) have been documented in the fishway at Brunswick Dam, and if populations expand in the Lower Androscoggin, changes to the fish community may occur.

The presence of most diadromous species at the Project can be inferred from passage at the Brunswick Project downstream (Table 4.6.1.1-3), though not all individuals that pass at Brunswick may reach the Project. Diadromous fish that have been captured and counted at the Brunswick Fishway are typically passed upstream into the Brunswick headpond or are transported to a number of areas within the watershed upstream of the Pejepscot Project, depending on the species. Approximately 20,000 river herring are trapped and trucked to upstream locations at the Brunswick Project. The remaining balance of river herring and all other species are passed upstream to the headpond, where they can ascend to the Pejepscot Project Area. Abundance of diadromous fish at the Brunswick Fishway varies from year-to-year.

Currently, fisheries within the Project Area are limited to recreational fishing. River herring are harvested in some areas of Maine for use by the commercial lobster fishery as bait in lobster traps but no directed municipal commercial harvest areas for alosines are present on the Androscoggin River (ASMFC, 2016a). American Eel commercial harvest, in the form of glass eel and elver fisheries, are operating in the State of Maine, but would typically be focused on tidal water areas and would not occur at the Project.

Table 4.6.1.1-1: Abundance of Fish in the Androscoggin River in the Vicinity of the Pejepscot Project

Species	Number of Fish (n/km)				Relative Abundance		
	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)		Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)
Alewife (*Alosa pseudoharengus*)	288	21	91		44.9%	1.8%	13.9%
American Eel (*Anguilla rostrata*)	2	-	3		0.3%	-	0.5%
American Shad (*Alosa sapidissima*)	-	-	33		-	-	5.0%
Chain Pickerel (*Esox niger*)	2	9	-		0.3%	0.8%	-
Common Shiner (*Luxilus cornutus*)	1	10	-		0.2%	0.8%	-
Fallfish (*Semotilus corporalis*)	5	25	303		0.8%	2.1%	46.2%
Golden Shiner (*Notemigonus crysoleucas*)	-	15	-		-	1.3%	-
Largemouth Bass (*Microperus salmoides*)	1	5	-		0.2%	0.4%	-
Northern Pike (*Esox lucius*)	-	1	-		-	0.1%	-
Pumpkinseed Sunfish (*Lepomis gibbosus*)	5	4	-		0.8%	0.3%	-
Redbreast Sunfish (*Lepomis auritis*)	110	112	111		17.1%	9.5%	16.9%
Smallmouth Bass (*Micropterus dolomieu*)	189	47	95		29.4%	4.0%	14.5%
Spottail Shiner (*Notropis hudsonius*)	2	773	4		0.3%	65.5%	0.6%

Species	Number of Fish (n/km)			Relative Abundance		
	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)
White Perch (*Morone americana*)	1	-	-	0.2%	-	-
White Sucker (*Catostomus commersonii*)	25	4	16	3.9%	0.3%	2.4%
Yellow Perch (*Perca flavescens*)	11	154	-	1.7%	13.1%	-
All Species	**642**	**1180**	**656**	**100.0%**	**100.0%**	**100.0%**

Source: Yoder et al. (2006)

Table 4.6.1.1-2: Biomass of Fish in the Androscoggin River in the Vicinity of the Pejepscot Project

Species	Biomass of Fish (kg/km)			Relative Biomass		
	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)
Alewife (*Alosa pseudoharengus*)	0.5	0.04	0.15	2.0%	0.2%	0.4%
American Eel (*Anguilla rostrata*)	1.24	-	1.4	5.1%	-	4.0%
American Shad (*Alosa sapidissima*)	-	-	0.01	-	-	0.0%
Chain Pickerel (*Esox niger*)	0.01	2.43	-	0.0%	9.6%	-
Common Shiner (*Luxilus cornutus*)	0	0.02	-	0.0%	0.1%	-
Fallfish (*Semotilus corporalis*)	0.01	0.62	2.98	0.0%	2.4%	8.6%
Golden Shiner (*Notemigonus crysoleucas*)	-	0.25	-	-	1.0%	-
Largemouth Bass (*Microperus salmoides*)	0	0.01	-	0.0%	0.0%	-

Species	Biomass of Fish (kg/km)			Relative Biomass		
	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)
Northern Pike (*Esox lucius*)	-	0.08	-	-	0.3%	-
Pumpkinseed Sunfish (*Lepomis gibbosus*)	0.12	0.23	-	0.5%	0.9%	-
Redbreast Sunfish (*Lepomis auritis*)	2.22	4.27	4.85	9.1%	16.8%	13.9%
Smallmouth Bass (*Micropterus dolomieu*)	13.08	6.93	10.56	53.3%	27.3%	30.3%
Spottail Shiner (*Notropis hudsonius*)	0	1.21	0.03	0.0%	4.8%	0.1%
White Perch (*Morone americana*)	0	-	-	0.0%	-	-
White Sucker (*Catostomus commersonii*)	7.08	2.77	14.83	28.9%	10.9%	42.6%
Yellow Perch (*Perca flavescens*)	0.27	6.56	-	1.1%	25.8%	-
All Species	**24.53**	**25.42**	**34.81**	**100.0%**	**100.0%**	**100.0%**

Source: Yoder et al. *(2006)*

Table 4.6.1.1-3: Adult Diadromous Fish Captured at the Brunswick Fishway, 2000-2019.

Year	Atlantic Salmon	American Shad	River Herring	Striped Bass	Sea Lamprey	American Eel
2000	4	88	9,551	95	0	3
2001	5	26	18,196	0	0	5
2002	2	11	104,520	8	3	2
2003	3	7	53,732	4	6	0
2004	12	12	113,686	1	8	2
2005	10	0	25,896	18	0	0
2006	6	3	34,239	75	0	9
2007	21	6	60,662	2	10	4
2008	18	1	92,359	3	19	2
2009	24	0	44,725	0	15	0
2010	9	22	39,689	0	28	0
2011	44	0	54,886	1	19	2
2012	0	11	170,191	3	125	108
2013	2	16	69,104	103	26	100
2014	4	0	55,678	1	45	201
2015	2	53	71,887	1	129	1
2016	7	1,123	121,010	46	132	-
2017	0	1	49,923	2	21	3
2018	0	32	179,040	9	13	1
2019	1	63	81,025	25	48	1

E4.6.1.2 Diadromous Species and Fish Passage

E4.6.1.2.1 Diadromous Species

Diadromous is a term for describing a species that utilizes both saltwater and freshwater habitats to complete their life cycle. Of the diadromous fish, most are anadromous, meaning that they mature in saltwater but return to freshwater to spawn. Alternatively, catadromous describes a life cycle whereby spawning occurs in saltwater and progeny grow to maturity in freshwater. Further, when all individuals die after spawning, the species is considered to be semelparous; when individuals may survive and return to spawn again, the species is considered to be iteroparous.

Recent fish passage records for the Brunswick Dam indicate that Atlantic Salmon, American Shad, river herring (Alewife and Blueback Herring), Striped Bass, Sea Lamprey, and American Eel utilize the lower Androscoggin River (BWPH, 2016). Though no formal fish passage exists for American Eel at the Brunswick Dam, they have been documented at the Brunswick Fishway and throughout much of the Lower Androscoggin during fisheries surveys (Yoder *et al*., 2006). Atlantic Sturgeon (*Acipenser oxyrhynchus*) and Shortnose Sturgeon (*Acipenser brevirostrum*) are present below the Brunswick Dam, but are not to be passed upstream if captured at the Brunswick Fishway and are therefore not expected to be found at the Pejepscot Project.

Atlantic Salmon

Atlantic Salmon are native to the North Atlantic Ocean; in the western Atlantic, they range from Iceland, southern Greenland, and Ungava Bay, Quebec to the Connecticut River (Danie *et al*., 1984). In the U.S., they historically ranged from Maine to Long Island Sound, but the Central New England and Long Island Sound Distinct Population Segments have been extirpated (NMFS, 2012a). They are an anadromous, iteroparous species. After two years at sea, they average approximately 28-30 inches in length and 8-12 pounds, and can reach 30 pounds (DSF, 2015). Spawning adults return home to their natal rivers and stream, from the spring through fall with peak upstream migration from May through mid-July in Maine (NMFS, 2012a). They spawn in the late fall, and will build nests in suitable substrate. The most suitable substrate is highly permeable gravel and cobble (NMFS, 2012a). Those that return to freshwater after only one year at sea are called “grilse,” and are considered 1-sea-winter fish. Older fish are referred to by the number of winters they have been at sea (i.e. 2-sea-winter, 3 sea-winter). They build nests (redds) in gravel/cobble areas of moving water, and the eggs overwinter, hatching in March/April. After fry emerge from the substrate, they disperse from the redds and feed and grow, developing into a juvenile salmonid (parr). The parr will typically grow for 1-3 years in freshwater, and undergo a physiological transformation that prepares them for life in saltwater, known as smoltification, after which they develop into smolts and emigrate to the ocean during the springtime (NMFS, 2012a). They will reach Newfoundland and Labrador by mid-summer, and spend their first winter at sea to the south of Greenland (DSF, 2015). Some will return to Maine rivers as grilse the following spring, but the majority will continue migrating and feeding to the south of Greenland and along the Labrador coast (DSF, 2015). Most fish will return to

Maine to spawn after their second winter at sea. Post-spawn fish will overwinter in the river as "kelts," and will emigrate the following spring.

Atlantic Salmon are a federally endangered species. The Project Area is within the Gulf of Maine Distinct Population Segment (GOM DPS) as part of the Merrymeeting Bay Salmon Habitat Recovery Unit. The critical habitat designation for the Androscoggin River extends from its confluence with the Kennebec River upstream to Lewiston, with the Lower Androscoggin and Little Rivers designated as sub-basins. Historically, Atlantic Salmon may have passed upstream as far as Rumford Falls. Most of the highest quality habitat for Atlantic Salmon in the Androscoggin River watershed is currently inaccessible, and low quality habitat scores have been assigned to the Lower Androscoggin River areas where the Pejepscot Project is located, though the area is considered an important migration corridor (NMFS, 2012a; NASCO, 2009). No spawning or rearing habitat is expected to occur in the Project impoundment or tailwater areas (NMFS, 2012a; NASCO, 2009).

The numbers of Atlantic Salmon returning to the Androscoggin River have been very low in recent years, and Atlantic Salmon are considered extirpated in waters to the south of the Androscoggin River watershed (NMFS, 2012a). However, returns are currently so low, and the prevalence of hatchery origin fish so high, that the wild population of Atlantic Salmon in the Androscoggin River are essentially no longer present as well.

Atlantic Salmon stocking in the Androscoggin River watershed has been very limited relative to many other large river systems in the GOM DPS, with approximately 18,000 fry stocked since 2001 (USASAC, 2015), the majority of which were stocked into the Little River annually by school groups. Other than this limited stocking, there are no stocking programs or active restoration programs for Atlantic Salmon on the Androscoggin River. The fish entering the fishway at Brunswick are often assumed to be strays from other coastal rivers such as the Penobscot (ASRP, 2015). Since the year 2000, salmon returns at the Brunswick Fishway have ranged from 0 to 44 fish per season, with only 16 salmon captured there from 2012 through 2019 (Table 4.6.1.1-3). The majority of fish returning have typically been 2-sea-winter fish of hatchery origin (Figure 4.6.1.2-1). No 3-sea-winter fish or repeat spawners have been documented since 1999.

Atlantic Salmon passage numbers at the Worumbo Fishway, as reported from years 2003 through 2015, indicate that Atlantic Salmon are passing through the Pejepscot Project (Table 4.6.1.2.1-1). The counts at the Worumbo Fishway do not, however, include fish that may have remained in the Project Impoundment, Worumbo tailwater, or migrated into spawning tributaries such as the Little River. Passage was evaluated at the Project by Maine Department of Marine Resources (MDMR) in 2011; this study found that 43% of the adult Atlantic Salmon passed at the Brunswick Project successfully migrated beyond the Pejepscot Project (MDMR, 2012, as cited in NMFS, 2012b). Nine out of 12 fish that approached the Pejepscot Project passed upstream, for an estimated 75% passage efficiency during that study.

American Shad and River Herring

American Shad are North America's largest species of herring, with spawning populations native to the Atlantic coast from the St. John's River in Florida to the St. Lawrence River in Canada. They are anadromous and iteroparous, though the level of iteroparity varies by latitude with greater survival after spawning and a greater chance of repeat spawning in the northern parts of their range (Limburg *et al*., 2003). In Maine, iteroparity is likely high. They swim into natal rivers to spawn in May and June, and broadcast spawn over suitable substrates, primarily sand, gravel, or a mixture (Limburg *et al*., 2003). Shad will typically make their first spawning run when they are 4-5 years old (Weiss-Glanz *et al*., 1986). Juvenile shad will feed and grow in freshwater habitats until they are triggered primarily by decreasing temperatures to emigrate downstream into estuaries in the late summer and fall (Weiss-Glanz *et al*., 1986). Upon entering the ocean, they will become long-range coastal migrants, with fish originating from different spawning stocks mixing in distinct winter and summer areas. In the summer and fall, they congregate in the Gulf of Maine and the Bay of Fundy (Weiss-Glanz *et al*., 1986). While in the ocean, American Shad filter feed on plankton. Immature shad may also enter estuaries seasonally to feed.

The numbers of American Shad passed at the Brunswick Fishway have ranged from zero to 1,123 fish from 2000-2019 (Table 4.6.1.1-3). Although Atkins, 1887 notes that American Shad were reported spawning in the main river below Lewiston, Taylor, 1951 characterizes the Androscoggin as not an important shad river. The 41-foot high falls at Brunswick may have been a significant barrier for American Shad and as such, only limited numbers may have passed the falls at Brunswick and even then only opportunistically under certain flow conditions when the hydraulics and tide were suitable. Merrymeeting Bay below Brunswick represents such a fertile spawning area for shad that few fish would likely have the incentive to venture above Brunswick except in years when the flow and temperature allowed.

River herring is a collective term for anadromous Alewife and Blueback Herring (Fay *et al*., 1983a), both of which are native to Maine, but alewife are typically the most abundant of the two species in Maine waters. Alewife range from Newfoundland to northern South Carolina, whereas Blueback Herring range from Nova Scotia to the St. Johns River in Florida (Fay *et al*., 1983a). They are anadromous, and swim into rivers in the spring to spawn in May and June, with peak spawning of Alewife occurring approximately 2-3 weeks prior to Blueback Herring (Fay *et al*., 1983a). Alewife spawn in a variety of habitats, from mid-river sites to ponds and lakes, whereas Blueback Herring prefer to spawn in areas with current and hard substrates (Fay *et al*., 1983a). River herring are iteroparous, and after spawning, surviving adults migrate back to the ocean relatively quickly. Repeat spawners will return to the same river to spawn again (Fay *et al*., 1983a). Most Alewives have spawned for the first time by four years of age, and mature female Alewives typically produce 60,000 – 100,000 eggs (Fay *et al*., 1983a). After the eggs hatch, the progeny will feed and grow in freshwater habitats before emigrating to estuarine rearing areas in the late summer and fall. Eventually, they will migrate to the ocean where they will mature before returning to freshwater to spawn.

River herring are, by far, the most abundant anadromous fish captured at the Brunswick Fishway (Table 4.6.1.1-3). After being captured, they are transported to locations within the Androscoggin River watershed; during recent years, the number captured at Brunswick has exceeded the MDMR stocking rate targets of 27,358 river herring into 4,562 acres of habitat. Passage facilities are also present at the Pejepscot and Worumbo Projects, allowing fish passed at Brunswick to migrate as far as Lewiston Falls. Stocking programs of hatchery-reared fish into the watershed since 1983 have also affected abundance and run returns. Based on an Atlantic States Marine Fisheries Commission (ASMFC) estimate, the Androscoggin River could yield 2.3 million fish to the coastal stocks, but only 1/3 of the historic habitat for river herring is currently accessible due to dams without fish passage facilities (ASMFC, 2016a; ASMFC, 2012). The status of the Alewife stock from the Androscoggin River was classified by the ASMFC as stable, with a recent increasing trend, though the status relative to historic levels was classified as unknown (ASMFC, 2012). There is currently no commercial river herring fishery in the Androscoggin River above the head-of-tide. Coast-wide, the Alewife stock is considered depleted (ASMFC, 2016b). Little stock-specific information on Blueback Herring was found, likely due to higher prevalence of alewife in Maine waters.

American Eel

American Eel is the only representative of the family Anguillidae in North America, ranging from the southern areas of Greenland, including all of the U.S. Atlantic coast, and the Gulf of Mexico, southward to the northern portions of the east coast of South America (Facey and Van Den Avyle, 1987). They are catadromous, having been spawned in an oceanic environment in the Sargasso Sea but often living most of their life in freshwater (Facey and Van Den Avyle, 1987). Unlike many of the anadromous species, for which spawning stocks are often segregated by river system, the American Eel population is panmictic, meaning a single population within which individuals from many different areas mix for random mating (Shepard, 2015). Little is known about the exact location of spawning, and is based primarily on the observed distribution of larvae. After hatching, larvae will drift in oceanic currents as planktonic leptocephali before metamorphosing into juvenile eels, commonly known as glass eels due to their lack of pigmentation (Facey and Van Den Avyle, 1987). Glass eels actively swim toward coastal waters, where they will enter estuarine and riverine areas. Some will remain in estuarine waters, but many will swim upstream into freshwater where they may occupy a variety of habitats (Facey and Van Den Avyle, 1987). As they swim upstream, they become pigmented and are typically termed “elvers” when they are still small. As the elvers grow, they are commonly referred to as “yellow eels”. They will reside in freshwater habitats until maturity, which can begin as early as three years, but can take as long as 30 years (Shepard, 2015). When they mature, their body morphology changes to become suited to an oceanic migration, including becoming more robust with a dark gray/silver coloration and enlarged eyes. The spawning migration typically occurs in the late summer or fall in New England and eastern Canada, though migration from lakes that are far inland may occur sooner, such as June – August from Lake Champlain (Facey and Van Den Avyle, 1987). Migration of eels can be initiated by a wide combination of environmental factors (i.e. changing water temperatures, moon phase, photoperiod, atmospheric pressure, turbidity), though runs with the greatest abundance typically occur during periods of increased discharge and low light conditions (Bruijs and Durif 2009). Silver eels may revert back to yellow eels if environmental conditions are not ideal for migration, if migration becomes delayed, or if the fat content of the eel is too low (Shepard, 2015). This species is assumed to be semelparous, with eels dying at sea after spawning given that post-spawn eels have never been observed (Facey and Van Den Avyle, 1987).

The fish assemblage assessment by Yoder *et al*., (2006) found that American Eel were most abundant in the tidal river downstream of Brunswick Dam. Though eels have been captured in the fishway at Brunswick Dam (Table 4.6.1.1-3), no specific eel passage facilities are operated there, and the existing fishway is not likely to be successful in capturing large numbers of juvenile eel due to their very small size. Eels may also pass the Brunswick Dam by climbing over the spillway, as they often do at many low-head dams. Most eels captured further upstream by Yoder *et al*., (2006) on the Androscoggin River were large specimens. Upstream eel passage measures were installed at the Worumbo Fishway in 2012, after which 17 eels were captured in 2012, 131 eels in 2013, and 25 eels in 2018 according to annual fish passage reports filed with FERC (Miller Hydro, 2013; Miller Hydro, 2014; Brown Bear, 2019); more recent reports were not found.

In 2010, the American Eel was petitioned for listing as threatened under the Endangered Species Act due to coast-wide declines. It was determined that a listing was not warranted in 2015 due to stable populations as a whole (USFWS, 2015a). The stock status of American Eel is considered to be depleted, and quotas restrict the glass eel fishery in Maine (ASMFC, 2016b). Maine has one of the only operating glass eel fisheries remaining in the U.S., with the only other fishery currently in operation in South Carolina (Shepard, 2015).

Striped Bass

Striped Bass range from the St. Lawrence River in Canada to the St. Johns River in Florida along the Atlantic coast, and in areas of the Gulf of Mexico (Fay *et al*., 1983b). They have also been introduced to the North American Pacific coast, and landlocked populations persist in many freshwater impoundments in North America (Fay *et al*., 1983b). On the Atlantic coast, they range from Canada to Florida, but are most prevalent from Maine to North Carolina. They are anadromous and iteroparous. They are a large predatory species, commonly 2-3 ft long and between 10 and 30 pounds, but growing as large as 125 pounds. They swim into rivers and estuaries to spawn in the late spring and early summer. The only known spawning population in Maine occurs in the Kennebec system, due to the large estuarine area in Merrymeeting Bay. After spawning, the eggs drift in currents until they hatch in 1.5 to 3 days. Juveniles will feed and grow in estuaries, typically for at least three years before migrating in the ocean to mature. Females mature in approximately 4 to 6 years (Fay *et al*., 1983b), after which they will return to freshwater to spawn for the first time. Larvae are considered the most important life stage for the future of Striped Bass abundances, given their sensitivity to environmental conditions. High rates of larval success in any given year will yield occasional dominant year classes of adult fish (Fay *et al*., 1983b). After spawning, many fish will leave the spawning grounds and emigrate back to the coastal area, though some may also remain in riverine and estuarine areas through the summer. In the fall, most Striped Bass from New England will migrate south to warmer-water areas off of the mid-Atlantic coast.

Striped Bass are captured at the Brunswick Fishway in relatively low but varying abundance, with zero to 103 individuals counted per season since the year 2000 (Table 4.6.1.1-3). No information was found with regard to stock status in the Androscoggin River specifically, though oceanic stocks as a whole have rebounded from extreme lows in the 1980's. Female spawning stock biomass peaked around 2003 followed by a slow, steady decline, though it remained within the ASMFC targets and the population was classified as "not overfished and overfishing is not occurring" (ASMFC, 2016b). Striped Bass are not currently passed upstream at the Brunswick Project due to concerns about a lack of safe downstream passage for these fish, therefore they would not be currently reaching the tailwaters of the Pejepscot Project.

Sea Lamprey

Sea Lamprey are found on both sides of the Atlantic Ocean, in North America and Europe, including the entire U.S. Atlantic coast as far south as northern Florida, along with areas in the Gulf of Mexico (Kircheis, 2004). They have also become landlocked in many inland waters around the Great Lakes, where they are considered invasive. Sea Lamprey, with respect to the sea-run fish observed at the Project, are anadromous, but unlike the other anadromous species entering the river system, are semelparous and will all die after spawning (Kircheis, 2004). In the ocean, they are predatory and parasitic, latching onto and extracting nutrients and fluids from other fish; however, during their migration into freshwater, they do not feed. Mature adults swim into freshwater habitats in the spring, and typically spawn in late May through early summer in the State of Maine (Kircheis, 2004). They prefer to spawn in areas with flowing water and cobble/gravel substrate, where they modify habitat and build large nests out of gravel and small rocks (Kircheis, 2004). After spawning, the adults die, and the eggs will take approximately 10-13 days to hatch. Larval lamprey (ammocoetes), which lack eyes and teeth, burrow into soft sediments, where they reside and grow, filter feeding for 4-8 years (Kircheis, 2004). They then transform into a juvenile lamprey, developing eyes and working mouth parts, and emigrate to the ocean where they will grow to maturity before returning to spawn after 1.5-2 years at sea (Kircheis, 2004).

Sea Lamprey are passed at the Brunswick Fishway in relatively low but varying abundance, with zero to 132 individuals passed per season since the year 2000 (Table 4.6.1.1-3), with the highest numbers observed during 2015 and 2016. No information on stock status was found, likely because this species has not been important commercially and often received a bad reputation due to its parasitic nature and tendency to become invasive when landlocked in freshwater systems.

Table 4.6.1.2.1-1: Adult Diadromous Fish Passed at the Worumbo Fishway (Brown Bear, 2019)

Year	Atlantic Salmon Passed	Alewife Passed	American Shad Passed
2003	1*		
2004	1		
2005	0		
2006	2		
2007	7	19,078	0
2008	2	46,746	0
2009	1	14,961	0
2010	5	11,952	0
2011	3	136	0
2012	1	58,654	0
2013	1*	28,714	0
2014	2*	37,113	0
2015	0	59,200	18
2016	0	12,807	45
2017	0	11,200	0
2018	0	73,073	1
2019	1	10,326	9

*Reported as landlocked salmon

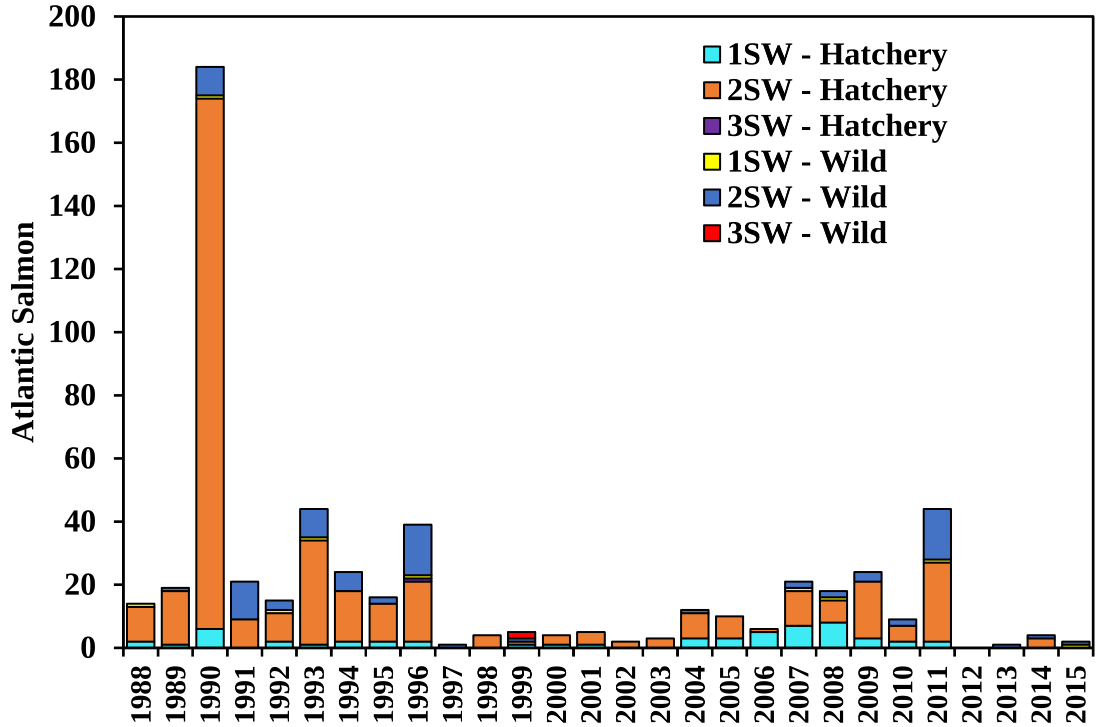


Figure 4.6.1.2.1-1: Atlantic Salmon Captured at the Brunswick Fishway, 1988-2015

E4.6.1.2.2 Fish Passage

Several studies have been conducted at the Project to assess both upstream passage effectiveness and downstream passage effectiveness, route of passage, and survival for various diadromous species. These studies were conducted in the early 1990's, shortly after the Project fish lift was constructed, and more recently as part of Topsham Hydro's ESA consultation with resource agencies related to Atlantic Salmon, as well as during the FERC relicensing process. These studies are discussed in more detail below.

E4.6.1.2.2.1 Upstream Fish Passage

Atlantic Salmon Upstream Passage Evaluation

Despite low returns to the Androscoggin River, small numbers of adult Atlantic Salmon captured at Brunswick Dam were implanted with radio tags by MDMR for subsequent tracking within the river. This tagging effort was performed in 2013 and 2014.

2013 – Only two adult Atlantic Salmon were captured at the Brunswick Dam. These fish were tagged by MDMR, and were released downstream of Brunswick Dam to evaluate their approach to that fishway. Both fish left the Androscoggin River, migrated to the Kennebec River, and were not available for evaluating passage at the Project (Topsham Hydro, 2014).

2014 – Four adult Atlantic Salmon were radio-tagged by MDMR staff and released upstream of the Brunswick Dam in 2014 (Topsham Hydro, 2015). MDMR performed mobile tracking of these fish, and Topsham Hydro maintained telemetry stations in the forebay and tailrace of the Pejepscot Project to monitor adult upstream passage through the Project. Of the four fish tagged, three were detected in the Project tailrace and one passed upstream of the Pejepscot Project. After release above Brunswick Dam on June 26, 2014, this male salmon spent a considerable amount of time below the Project, milling between the Brunswick and Pejepscot projects prior to passage at Pejepscot on October 3, 2014. It then milled in the upper Pejepscot Project Impoundment and downstream of the Worumbo Project before being tracked into the Little River, where it was observed spawning with an un-tagged female salmon that had passed the Brunswick and Pejepscot fishways undetected. It was confirmed to be in the Project Impoundment by MDMR on December 1, 2014, when this fish was last detected. Two tagged female salmon that were released above Brunswick Dam milled in between Brunswick Dam and Pejepscot, including many movements into and out of the Pejepscot tailrace, but did not pass. One of these fish abandoned migration in the Androscoggin River and swam to the Kennebec River, where it was captured at Lockwood Dam.

Desktop Evaluation of Upstream Passage Effectiveness for Adult Atlantic Salmon

In 2019 as part of the FERC relicensing process, Topsham Hydro conducted a desktop evaluation of upstream passage effectiveness for adult Atlantic Salmon. Studies detailing the timeliness and effectiveness of fish lifts in operation elsewhere in Atlantic Salmon critical habitat in Maine were reviewed. Projects considered included Milford, the first mainstem hydroelectric on the Penobscot River, and Lockwood, the first mainstem hydroelectric on the Kennebec River. In general, the operation and configuration of the existing Pejepscot fish lift is most similar to the fish lift in operation at Milford. Both structures have 10 foot wide entrances which are located on the shoreline side of the powerhouse and are oriented parallel to the adjacent competing flow. The dam and powerhouse structure at Milford and Pejepscot are positioned linearly with one another. In addition, both structures operate following criteria presented in the most recent USFWS guidelines with regards depth over the entrance weir and entrance/hopper velocities. The lift and project layout at Lockwood differs somewhat from the other two project locations in that the entrance width is slightly narrower. However, the largest difference separating Lockwood from Milford and Pejepscot is the presence of the 1,300 foot long bypassed reach. As a result, the dam and powerhouse structure do not sit linearly across the river but are offset allowing for approaching fish to move past the lift entrance and move upstream into the bypassed reach (Topsham Hydro, 2020).

In general, the fish lift assessments conducted to date for adult Atlantic Salmon at the Milford and Lockwood Projects demonstrate a high overall passage rate coupled with relatively long duration of time from arrival at the Project until recapture. When all adults released at Milford during 2014 and 2015 are considered, 96% of the radio-tagged adults were successfully recaptured at the fish lift. However, values for the median period of residence downstream of the Milford dam following return to the Project area ranged from 1.1 days to 7.8 days depending on the year and investigator (i.e., licensee or the University of Maine). At the Lockwood Project, recapture rates were somewhat lower (79%) and the median period of residence prior to recapture was longer (9.8-16 days) for adult salmon. Based on observations of radio-tagged adult salmon movements within the downstream project area at Lockwood, those rates are very likely a function of false attraction to competing flows present in the extended bypassed reach at that location.

Based on consideration of adult salmon passage study results from elsewhere in Maine as well as the review of the physical and operational designs for those fish lifts relative to the structure at Pejepscot, it is most likely that the Pejepscot fish lift will have a rate of effectiveness for passing adult salmon between that estimated at Milford and Lockwood. Due to the lack of an extended downstream bypass reach it is likely that salmon approaching Pejepscot will pass at a higher rate and in less time than was observed over the two study years at Lockwood. Similarities in entrance width, operating flows, and the spatial layout of the entrance, powerhouse discharge and downstream face of the dam suggest the overall ability of adult salmon to pass at Pejepscot could be similar to the rate observed at Milford. However, it is likely that the time from initial arrival downstream of the Project until recapture in the fish lift at Pejepscot could be longer than durations observed at Milford due to the relative infrequency with which the fish lift is run. The Milford lift runs in an automated mode from 0400 to 2200 with a minimum of two lift events per hour (approximately 36 lift cycles per day). As presently programmed, the lift at Pejepscot runs a total of five lift cycles per day between the hours of 0800 and 1800.

Upstream Passage Evaluation of Alewife

Studies to determine the effectiveness of the Pejepscot fish lift for Alewife were conducted in 1991 and 1992 during non-spill or very limited spill conditions (Charles Ritzi Associates, 1992).

Passage rates were determined for five release cohorts based on the success of marked (floy-tagged) Alewife that were tagged at the Brunswick Project, which were then tallied as they passed the Pejepscot fish lift viewing window. Four of the cohorts released were considered suitable for analysis, at an average passage efficiency of 87%. This number was determined to be an underestimate, and resource agencies concluded that the efficiency of the upstream passage facility at the Pejepscot Project was close to the resource agency goal of 90% for Alewife. Rapid passage at Pejepscot was noted, with 90% or greater of the fish passing within 2-6 days of being passed at the Brunswick Project. One of the cohorts exhibited 66% passage from Brunswick through Pejepscot on the first fish lift after release at Brunswick, which was over a span of 20 hours after release.

A similar visual quantification of externally marked adult herring was conducted at Pejepscot during the 2004 upstream passage season under spill conditions (DTA 2005). Passage efficiency for the 2004 study was estimated at 11.5%.

Upstream Passage Effectiveness of Adult River Herring and American Shad

In 2019, Topsham Hydro evaluated the effectiveness of the existing upstream passage facilities for adult American Shad and river herring. Following the release of radio-tagged individuals into the Androscoggin River, their movements were monitored using a series of stationary radio-telemetry receivers in place at the Project as well as at several additional stationary monitoring stations installed at bank-side locations upstream and downstream of the Project to inform on general movements and Project passage success (Topsham Hydro, 2020a).

A total of 102 adult river herring were radio-tagged following collection at the Brunswick fishway during May 2019 and were released into the Androscoggin River for the purposes of evaluating upstream passage at Pejepscot. Four groups of radio-tagged adult herring were released downstream of the Project at the Mill Street boat launch, located approximately 4.35 miles downstream of the Project, over an eight day period from May 22 to May 29. The tagging and release of radio-tagged adult herring downstream of Pejepscot encompassed the range of dates representing the peak of herring returns counted at Brunswick for the 2019 passage season. Each release group of radio-tagged individuals was accompanied by approximately 200 untagged adult river herring. Of the 102 radio-tagged herring released, 79% (81 of the 102) were determined to have approached Pejepscot Dam and were available to assess passage effectiveness of the fish lift.

River herring releases downstream of the Project occurred over four dates between May 22 and May 29, 2019. Ascent from the release location upstream to the Project occurred quickly for most tagged herring (median duration = 10 hours). Spill conditions were present at Pejepscot throughout the tagging and release period with river flows not coming under operational control until early June (June 2, 2019). Tailwater elevation downstream of Pejepscot during that spill period ranged from 43.2-46.4 ft (median = 45.3 ft). Due to the high tailwater elevations, the upstream fish lift was operated manually as conditions permitted. Regardless of tailrace conditions, 93% of radio-tagged adult herring which were determined to have approached the Project were detected on at least one occasion within the entrance to the fish lift. Detections at the Pejepscot lift entrance showed a bimodal distribution with peaks during the hours of 1000 and 1600. The current operational window from 0800 to 1800 encompassed 85% of all detections of radio-tagged river herring at the lift entrance during the 2019 evaluation.

Radio-tagged herring passed upstream of Pejepscot, via the fish lift, over a range of dates from May 25 through June 10 with the majority of those passage events between May 25 and May 30. As a result, spill was present for the duration of the “time at large” for the majority of the river herring which successfully passed upstream. When the cumulative residence duration of tagged river herring downstream of Pejepscot is examined, the competing spill flow attracted most individuals away from the fish lift side for some proportion of time. Radio-tagged adult herring successfully passing upstream at Pejepscot were detected in the tailrace area immediately downstream of the powerhouse and in proximity to the fish lift for an average of 62% of their cumulative residence time, and within the region downstream of the dam spillway for an average of 38% of the time. Radio-tagged adult herring failing to successfully pass upstream at Pejepscot were detected in the tailrace area for an average of 30% of their cumulative residence time, and downstream of the spillway for an average of 70% of the time.

The overall effectiveness of the Pejepscot fish lift for adult river herring passage was estimated at 19.8% (75% CI = 14.8-24.9%). Despite spill conditions during the period of arrival for most radio-tagged river herring at the Project, location and entry into the lower flume of the existing fishway was good (93%).

A total of 129 adult American Shad were radio-tagged following rod and reel collection downstream of the Brunswick Project during June 2019. Tagged shad were trucked and released into the Androscoggin River for the purposes of evaluating upstream passage at Pejepscot. Five groups of radio-tagged adult shad were released downstream of Pejepscot at the Mill Street boat launch, located approximately 4.35 miles downstream of the Project, over a seven day period from June 12 to June 19. Of the 129 radio-tagged adult shad released, 28% (36 of the 129 individuals) were determined to have approached Pejepscot Dam and were available to assess passage effectiveness of the fish lift. The majority of radio-tagged shad released downstream of Pejepscot either partially ascended the approximately four mile reach between release and the Project (22%) or dropped downstream to Brunswick (45%). It is suspected that the extensive handling and transport associated with the use of adult shad from the Androscoggin River downstream of Brunswick negatively affected upstream motivation of test fish during this evaluation.

Releases of radio-tagged American Shad downstream of the Project occurred between June 12 and June 19, 2010. Ascent from the release location upstream to the Project was slower for shad (median duration = 3.3 days) than was observed for river herring (median duration = 10 hours). With the exception of a few relatively short duration spill events, Androscoggin River flows were mostly under operational control during the tagging and release period for shad downstream of Pejepscot. Spill conditions were present at Pejepscot over an approximately four day period immediately following the last release group of adult shad downstream of the Project (June 21-24). During the spring monitoring period, only seven radio-tagged adult shad were determined to have approached the Project and be detected on at least one occasion within the entrance to the fish lift. The current operational window from 0800 to 1800 encompassed 90% of all detections of radio-tagged adult shad at the lift entrance.

There were no recorded upstream passage events for radio-tagged shad during the study period. When the cumulative residence duration of tagged shad downstream of Pejepscot is examined, radio-tagged adult shad were detected in the tailrace area for an average of 1% (range = 0 – 5%) of their cumulative residence time, and downstream of the spillway for an average of 99% (range = 95-100%) of the time. Location and entry into the lower flume of the existing fishway was low for radio-tagged adult shad during this study with only 32% of the individuals detected in the nearfield/tailrace region being subsequently detected at the fish lift entrance. Estimates of internal (i.e., the probability of an adult shad to move from the lift entrance to the lift exit) and overall (i.e., the probability of an adult shad to move from the tailrace/nearfield region to the upstream exit from the fish lift) fish lift effectiveness are 0% due to the lack of observed upstream passage for this species.

2019 Eel Monitoring Surveys

In 2019 as part of the FERC relicensing process, Topsham Hydro conducted juvenile eel monitoring surveys to evaluate the need and potential location for an upstream eel passage facility at the Project.

The study area was restricted to the portion of the Androscoggin River immediately downstream of the Project powerhouse and dam (Figure 4.6.1.2.2.1-1). Areas of specific focus included (1) the spillway as viewed from the east side of the river, (2) the spillway as viewed from the west side of the river (3) the area near the entrance to the upstream fish lift, (4) the wetted area adjacent to the spillway as viewed from the entrance to the counting room, (5) the portion of the upper exit flume associated with the upstream fish lift as viewed from the counting room, and (6) the western shoreline accessed via the Pejepscot Fishing Park canoe portage trail (Topsham Hydro, 2020b).

A total of 14 surveys were conducted over the period from June 17 to August 26, 2019. There were no juvenile eels observed during the visual searches conducted at the Project on any of the survey dates. Survey events were limited to observations of search areas made at distance from several shoreline locations. It is likely that the lack of access within the areas immediately downstream of the Project dam by boat or foot limited the ability to visually detect juvenile eels (Topsham Hydro, 2020b).

As juvenile eels have been documented passing upstream at the Worumbo Project, juvenile eels are present downstream of the Pejepscot Project and some degree of upstream passage at the Project is occurring (Topsham Hydro, 2020b).

E4.6.1.2.2.2 Downstream Fish Passage

Atlantic Salmon Smolt Downstream Passage Evaluation (2013-2015)

Radio telemetry tracking studies of Atlantic Salmon smolts were completed in 2013, 2014, and 2015 with the primary goal of evaluating whole-station survival (Topsham Hydro (2014); (Topsham Hydro, 2015); BWPH and BBHP (2016)). The studies incorporated test fish, released upstream of the Project, and control fish, which were released downstream of the Project. Whole-station survival estimates in 2013, 2014, and 2015 were 100%, 91.3%, and 86.3%, respectively; with a 3-year estimate of 92.5%. Passage occurred via different routes, including spill, the downstream fishway, the upstream fishway, and through the powerhouse. The 2014 and 2015 studies differed in the relative number passed through each route, with the majority passing via spill in 2014, and most passing via the powerhouse in 2015 (Tables 4.6.1.2.2.2-1 and 4.6.1.2.2.2-2). Estimated survival was lower through the downstream bypass, but higher through the powerhouse in 2015 relative to 2014. In addition to passage routes and survival, other aspects of migration through the Project were evaluated in 2015, including findings for:

- Temporal Distribution and Diel Timing – Smolts typically passed the Project within 1-2 days after release, primarily during the evening, night, and early morning hours.
- Project Approach Times – Median approach time of 5.3 hours, ranging between 1.9 to 83.8 hours from initial release (2.6 miles upstream of the Project) to detection approximately 656 ft upstream of the dam.
- Project Residence Times – Median residence time of 0.3 hours (ranging from 0.1 to 35.4 hours) from peak signal detection approximately 656 ft upstream of the dam to the last detection through passage routes available. There was no significant difference between residence times for fish passing the Project via Unit 1 versus the downstream bypass fishway.
- Downstream Transit Times – Transit times downstream of the Project for fish passed via different routes did not differ significantly from control fish that were released directly into the tailrace.
- Rates of Movement – Passage did not significantly affect the rate of movement of downstream travel after passage when compared to control fish.

2018 Atlantic Salmon Smolt Downstream Passage Study

During consultation with NMFS after the initial three year (2013-2015) downstream passage study program described above, Topsham Hydro agreed to evaluate downstream passage survival for Atlantic Salmon smolts under modified operational conditions to determine if those operational changes result in project survival estimates which conform to existing take limits. Under the existing SPP period (2017-2022) Topsham Hydro is permitted up to 8% take at the Project (Topsham Hydro, 2019).

Downstream passage survival for Atlantic Salmon smolts at the Pejepscot Project was assessed during spring 2018 using radio-telemetry. Multiple release groups were used to ensure that the study captured a range of Androscoggin River conditions (i.e., flows and temperatures) such that it is representative of the variable conditions that would be faced by naturally-migrating, non-study smolts.

A total of 250 hatchery-reared Atlantic Salmon smolts were surgically tagged and released at two locations on the Androscoggin River during May, 2018. Releases were conducted at the boat launch just downstream of the Lewiston Falls Project, as well as at the Pejepscot boat launch located near the upper extent of the Pejepscot impoundment. Each smolt was equipped with a uniquely coded Lotek radio transmitter. Downstream movements of tagged smolts were monitored via a series of radio receivers installed at fixed locations ranging from the section of the Androscoggin River just downstream of Lewiston Falls to a point approximately 1.9 mi. downstream of Brunswick Dam. Releases were initiated on May 4 and completed on May 14, 2018. (Topsham Hydro, 2019).

During the study, spill flows were provided during the nighttime hours of 2000 to 0700 by opening the bascule gate closest to the powerhouse approximately 50% (~500 cfs). Spill in excess of the 500 cfs was available for nearly the entire downstream passage period at Pejepscot.

Detection information for radio-tagged smolts moving through the Androscoggin River was used to provide information on residence duration within the project area as well as duration and rate of travel through downstream reaches. During the 2018 field study, 92% of smolts that approached Pejepscot passed downstream of the Project within 24 hours of their arrival (Topsham Hydro, 2019). Residence duration values at the Project are comparable to rates observed during previous evaluations (Normandeau 2014; 2015; 2016). During the 2015 study at Pejepscot, 97% of radio-tagged smolts approaching the dam passed within a 24 hour period.

Table 4.6.1.2.2.2-3 summarizes the passage routes radio-tagged Atlantic Salmon smolts used at Pejepscot. Following arrival at the Project during this study, the majority of radio-tagged smolts passed via spill at Pejepscot (41%). The presence of spill flows during the 2018 study likely influenced the probability of smolts passing via that route. Radio-tagged smolts not passing the project on spill utilized Kaplan Unit 1 (31.8%) and the downstream bypass system (14.5%) (Topsham, Hydro 2019).

A paired release-recapture study design was previously used to evaluate Project survival during 2014-2015 and resulted in estimates of 91.3% (2014) and 86.3% (2015) at Pejepscot (Normandeau 2016). The analysis approach was modified for the 2018 study from a paired release-recapture model to a CJS model approach which corrected for background (i.e., natural mortality) in the project reach by incorporating an estimate from radio-tagged Atlantic Salmon smolts passing through an upstream representative reach. Prior to the 2018 study, it was agreed that this representative reach would be located in the stretch of the Androscoggin River downstream of Lewiston Falls and upstream of the Worumbo impoundment. The baseline CJS model relying on the full set of radio-tagged smolts released at all points upstream of the Project is the most robust model as it maximizes the total sample size by relying on all releases and release locations. The point estimates for the adjusted Project survival model were 95.3% (95% Confidence Interval = 90.0-99.8%) (Topsham Hydro, 2019).

Downstream Passage Effectiveness of Adult River Herring and American Shad

In 2019, Topsham Hydro evaluated the effectiveness of the existing downstream fish passage facilities at the Pejepscot Project via radio-telemetry. This effort focused on the downstream passage of radio-tagged adult American Shad and river herring at the Project. Following the release of radio-tagged individuals into the Androscoggin River, their movements were monitored using a series of stationary radio-telemetry receivers in place at the Project as well as at several additional stationary monitoring stations installed at bank-side locations upstream and downstream of the Project to inform on general movements and Project passage success (Topsham Hydro, 2020c).

A total of 99 radio-tagged adult herring were released upstream of the Project at the Pejepscot boat ramp and were monitored for evaluation of downstream passage. In addition to the 99 radio-tagged adult river herring released upstream of the Project, another 16 tagged adult herring released downstream of Pejepscot at the Mill Street boat launch successfully ascended the fish lift and were included in the downstream analysis. When the full time series of detections for all 115 fish was reviewed, a total of 95 radio-tagged adult river herring were determined to have approached the Pejepscot dam and had an opportunity to pass downstream.

Outmigration of radio-tagged adult river herring was observed over a range of dates from May 25 to June 15 with a peak number of events occurring on May 30. The median project residence time prior to downstream passage was 0.9 hours. Of the radio-tagged adult herring that approached Pejepscot Dam, 80% passed in fewer than 24 hours after initial detection and 86% in fewer than 2 days after initial detection. The majority of individuals passed downstream of the dam via Unit 1 (51%) or during periods of spill flow at the bascule gates (27%). Use of the downstream bypass system was observed for 11% of radio-tagged adult river herring. Downstream passage survival for the entire project reach (~650 ft upstream of the dam to the first downstream receiver) was estimated at 80.9% (75% CI = 76.3-85.7%). This estimate of downstream passage survival for adult herring at Pejepscot includes background mortality (i.e., natural mortality) for the species in the project reach, along with any tagging-related mortalities or tag regurgitations. As a result, this estimate should be viewed as a minimum estimate of total project survival (i.e., due solely to project effects) for adult river herring at Pejepscot.

When specific passage routes for adult river herring at Pejepscot are considered, 100% (10 of 10), 85% (22 of 26), and 88% (42 of 48) of individuals respectively passing the dam via the downstream bypass, spill, and Unit 1 were determined to have reached the first receiver below the project. Radio-tagged adult herring which approached Pejepscot but failed to pass downstream (n = 8) represented nearly half of the individual herring lost during the study within the Project reach from the point 650 ft upstream of the dam to the first downstream receiver.

A total of 42 adult American Shad were obtained from the Saco River (Cataract fish lift) and released upstream of the Project at the Pejepscot boat ramp to evaluate downstream passage. Outmigration of radio-tagged adult shad was observed over a range of dates from July 11 to July 22 with a peak number of events occurring on July 17/18. Downstream passage events for radio-tagged shad during those two dates were a function of spill conditions triggered by a brief outage at Unit 1. The median project residence time prior to downstream passage was 5.3 days. Of the radio-tagged adult shad which approached Pejepscot Dam, 9% passed in fewer than 24 hours after initial detection and 26% in fewer than 2 days after initial detection. The majority of adult shad (34%) failed to pass downstream of the Project following their initial detection at the dam. Downstream passage of radio-tagged adult shad which did pass downstream occurred via Unit 1 (31%), spill (26%) and the downstream bypass (9%). Downstream passage survival for the entire project reach (~650 ft upstream of the dam to the first downstream receiver) was estimated at 51.4% (75% CI = 41.6-61.1%). This estimate of downstream passage survival for adult shad at

Pejepscot includes background mortality (i.e., natural mortality) for the species in the project reach, along with any tagging-related mortalities or tag regurgitations. As a result, this estimate should be viewed as a minimum estimate of total project survival (i.e., due solely to project effects) for adult shad at Pejepscot.

When specific passage routes for adult shad at Pejepscot are considered, 33% (1 of 3), 89% (8 of 9), and 82% (9 of 11) of individuals respectively passing the dam via the downstream bypass, spill, and Unit 1 were determined to have reached the first receiver below the project. Radio-tagged adult shad which approached Pejepscot but failed to pass downstream (n = 12) accounted for more losses within the Project reach than did mortality during dam passage.

Downstream Passage Effectiveness of Juvenile Alosines

In 2019, Topsham Hydro conducted an evaluation of the downstream passage effectiveness for juvenile alosines using radio-telemetry during the 2019 fall migration season (October 1 to November 31, 2019). Monitoring of juvenile alosines focused on evaluation of residence time upstream of the project prior to passage and determination of the proportional distribution of use among available passage routes. The study area included the section of the Androscoggin River from RM 6.0 (i.e., the Brunswick Hydroelectric Project (FERC No. 2284) to the upper end of the Pejepscot impoundment located approximately 3.5 miles upstream of the dam (Topsham Hydro, 2020c).

Of the 98 radio-tagged juvenile alosines, 97% continued downstream following handling and tagging and were determined to have approached the Pejepscot Dam. Of those individuals, only one did not pass downstream, resulting in a total of 94 individuals with which to estimate the proportional use of downstream passage routes at the Project. Based on Androscoggin River flows and operational conditions at the station, radio-tagged juvenile alosines approaching Pejepscot during this study were limited to passage via the downstream bypass system, upstream fishway or the operating turbine unit (Unit 1). Although there was spill present during a portion of the overall monitoring period (October 23 to November 5), the onset of that period of spill did not overlap with the presence of any tagged juvenile alosines in the upstream Project area. Under the operational conditions at the Project at the time of arrival for radio-tagged juvenile alosines, the majority passed downstream via the Unit 1 turbine. Downstream bypass effectiveness was estimated at 31% with a nearly even split in entry locations (i.e., entrances adjacent to the Unit 1 intake area to the left or right). Table 4.6.1.2.2.2-4 depicts the distribution of passage routes used by juvenile alosines. Downstream movement for juvenile alosines tagged as part of this study was relatively quick. When the full duration of time from release until arrival at Brunswick (~4.7 miles) is considered, tagged juvenile alosines did so in a median time of 32.4 hours (25^{th} percentile = 21.5 hours; 75^{th} percentile = 50.3 hours).

Downstream bypass effectiveness during the 2019 study was estimated at 31% with a nearly even split in entry locations (i.e., entrances adjacent to the Unit 1 intake area to the left or right). The downstream fish passage facility was previously assessed for juvenile alosines in 1996 (Northrup, Devine & Tarbell, Inc.et al 1997). The 1996 assessment relied on juvenile alosines marked using elastomer injections, released into the impoundment and recaptured at the downstream fishway. Releases were staggered from mid-August through early October. Fishway efficiencies ranged from 13.0% to 40.9% among eight release groups with an overall average of 21.8%. Similar to observations made for the distribution of radio-tagged individuals during the 2019 study, total catch in the sampler boxes at the left and right bypass entrances was nearly even for the 1997 sampling season.

Downstream Passage Effectiveness of Adult American Eel

In 2019, Topsham Hydro conducted an evaluation of the downstream passage effectiveness for adult American Eel using radio-telemetry during the 2019 fall migration season (October 1 to November 31, 2019). Adult eel monitoring focused on residence time prior to passage, passage route selection and estimation of downstream passage survival at the Project. The study area included the section of the Androscoggin River from RM 6.0 (i.e., the Brunswick Hydroelectric Project (FERC No. 2284) to the upper end of the Pejepscot impoundment located approximately 3.5 miles upstream of the dam (Topsham Hydro, 2020c).

A total of 50 adult silver eels were obtained from a commercial vendor operating on the St. Croix River, Maine and were transported for evaluation of downstream passage at Pejepscot. All 50 individuals were surgically radio-tagged and were released upstream of the Project on one of two release dates in early October to assess downstream passage. Downstream passage was observed for each of the radio-tagged eels and occurred over a range of dates from October 3 to October 23. The median period of residence for radio-tagged eels upstream of the dam was 2.1 hours with 65% passing downstream within the first 24 hours of their initial detection. Based on Androscoggin River flows and operational conditions at the station, passage route opportunities for radio-tagged adult eels tagged during this study were limited to the downstream bypass system, spillway, upstream fishway or the operating turbine unit (Unit 1). Although there was spill present during a portion of the overall monitoring period (October 23 to November 5), the onset of that period of spill overlapped with the presence of a single tagged eel in the upstream Project area. That individual passed downstream via the spillway shortly after spill flow became available. During the non-spill conditions which characterized the majority of the eel passage period, most radio-tagged eels passed downstream via Unit 1 (Table 4.6.1.2.2.2-5). There were no observations of adult eels passing downstream via the bypass system. Five of the 50 radio-tagged eels which passed downstream at Pejepscot failed to reach the first downstream monitoring station (Station F8). Of the silver eels failing to reach the downstream station, four of the five passed the Project via Unit 1 and the fifth was detected using the upstream fishway. The route-specific estimate of passage survival for silver eels via Unit 1 is 91.7% (75% CI = 87.5-95.8%).

Downstream passage survival for the entire project reach (~650 ft upstream of the dam to the first downstream receiver) was estimated at 90.0% (75% CI =86.0-94.0%). This estimate of downstream passage survival for adult eels at Pejepscot includes any background (i.e., natural) or tagging-related mortality for the species in the reach from the approach receiver to the first downstream receiver. As a result, this estimate should be viewed as a minimum estimate of total project survival (i.e., due solely to project effects) for adult eels at the Project.

Proportional Distribution of Inflow among Downstream Passage Routes during 2019 Fall Downstream Passage Effectiveness Studies

The proportional distribution of inflow among available downstream passage routes was estimated for each radio-tagged adult American eel and juvenile alosine using the set of known downstream passage times and hourly operational records. The average flow distribution at the time of downstream passage was predominantly through Kaplan Unit 1 for both species (Table 4.6.1.2.2.2-6). Table 4.6.1.2.2.2-7 provides the percentage of flow among available passage routes on an individual basis.

Francis Turbine Operation during 2019 Spring and Fall Downstream Passage Effectiveness Studies

The extent of operation for the Francis units during the 2019 spring diadromous fish passage effectiveness study was examined using the hourly operations records for the Project for the period from initial release of radio-tagged adult alosines upstream (i.e., May 22) through the final known downstream passage event for a radio-tagged adult alosine (i.e., July 22). Figure 4.6.1.2.2.2-1 provides the temporal distribution of Francis unit operation during the active monitoring period as expressed as a percentage of the total hourly Project generation. Francis units were not in operation at Pejepscot during the spring 2019 downstream passage study.

To provide context for the operation of the Francis units at Pejepscot during the 2019 study period, hourly operational records for the years 2015, 2016, and 2017 were assessed for the same period of time (May 22 through July 22). Operational records for the spring 2018 season were not considered as Unit 1 was in the midst of a prolonged outage and operation of the Francis units was not representative of a "normal" year. One or more Francis units were in operation during 35%, 3%, and 23% of the 2015, 2016, and 2017 "active" monitoring periods. Similar to operations during the 2019 study period, Francis unit operation during 2015 coincided with periods of river flow near or in excess of station capacity (Figure 4.6.1.2.2.2-2). Operation of the Francis units coincided completely (2016; Figure 4.6.1.2.2.2-3) or partially (2017; Figure 4.6.1.2.2.2-4) with outage periods for the Unit 1 Kaplan.

The extent of operation of the Francis units during the 2019 fall diadromous fish passage effectiveness study was also evaluated using the hourly operations records for the Project during the period of active telemetry monitoring from the time of the first eel release on October 3 through the end of monitoring on November 30. One or more Francis units were in operation during 14% of the 2019 active monitoring period. Figure 4.6.1.2.2.2-5 provides the temporal distribution of Francis unit operation during the active monitoring period as expressed as a percentage of the total hourly Project generation. Operation of the Francis units during fall 2019 downstream passage study coincided with a period when total river flow was at or in excess of station capacity.

To provide context for the operation of the Francis units during the 2019 study period, hourly operational records for the years 2015, 2016, and 2017 were assessed for the same period of time (i.e., October 3-November 30). Operational records for the 2018 fall season were not considered as Unit 1 was in the midst of a prolonged outage and operation of the Francis units was not representative of a "normal" year. One or more Francis unit was in operation during 13%, 16%, and 48% of the 2015, 2016, and 2017 "active" fall outmigration monitoring periods. Similar to operations during the 2019 study period, Francis unit operation during 2015 coincided with periods of river flow near or in excess of station capacity (Figure 4.6.1.2.2.2-6). Operation of the Francis units coincided completely (2016; Figure 4.6.1.2.2.2-7) or partially (2017; Figure 4.6.1.2.2.2-8) with outage periods for the Unit 1 Kaplan.

E4.6.1.2.2.3 Desktop Entrainment and Impingement Study

In 2019 as part of the FERC relicensing process, Topsham Hydro conducted a desktop evaluation of fish entrainment and turbine survival. Target species included American Eel, American Shad, Atlantic Salmon, and river herring. Interactions with the Project for each of the target species and life stages considered during this assessment are unavoidable based on their obligatory seasonal movements (Topsham Hydro, 2020d).

When the calculated minimum exclusion lengths for the target species are considered, all but individuals towards the upper end of the size range for adult Atlantic Salmon, American Eel, and American Shad are susceptible to entrainment based on their ability to fit through trash rack spacing. Intake velocities, a factor impacting involuntary entrainment and impingement, vary depending on the specific unit. The horizontal Francis units have an intake velocity of 0.6 feet per second (fps). At this velocity all target species, regardless of life stage are capable of avoiding involuntary entrainment or impingement. The vertical Kaplan (Unit 1) has an intake velocity of 3.25 fps. Juvenile alosines, unable to produce burst swimming speeds greater than this velocity, are vulnerable to entrainment while all other target species/ life stages are strong enough swimmers to avoid entrainment or impingement.

Survival of entrained fish primarily depends on the size of the individual. A Turbine Blade Strike Analysis (TBSA) assessment was run for fish lengths representative of (1) the size range of target species likely to be present at the Project, and (2) body lengths less than the minimum exclusion length which would be subject to entrainment. The TBSA analysis produced a range of survival estimates for turbine survival through Unit 1. Within that range of estimates, survival increased with decreasing body size, a trend also identified in a review of the 1997 EPRI database by Winchell et al. (2000). TBSA estimates were considered as representative for alosines and Atlantic Salmon but not for American Eel. Desktop estimates of eel passage survival through Unit 1 were performed using a multiple regression equation developed by Alden Labs. Similar to the TBSA, the eel regression analysis also identified a pattern of higher survival with decreasing body size.

A number of radio telemetry studies conducted at Pejepscot have evaluated survival through Unit 1. These studies have included Atlantic Salmon smolts, adult American Shad, adult river herring and adult American Eels. Survival estimates from those studies are presented in Table 4.6.1.2.2.3-1. Passage survival at Unit 1 was higher for eels observed during the 2019 field telemetry evaluation than estimates calculated for similar sized eels using the multiple regression analysis. Adult American Shad and river herring survival rates for Unit 1 estimated during the 2019 spring telemetry study were lower than those calculated during the desktop TBSA assessment. It should be noted that the sample size of adult shad passing downstream via Unit 1 was limited to 11 individuals. The range of estimates for Atlantic Salmon smolt passage downstream through Pejepscot Unit 1 was comparable between the TBSA assessment and previously conducted radio-telemetry evaluations.

A qualitative assessment of entrainment potential and turbine survival was performed for each target species. In general, susceptibility to entrainment is high based on the migratory life histories for each of the target species. However, juvenile alosines were the only species/life stage potentially incapable of avoiding entrainment at the Unit 1 intake due to their relatively limited swim speeds and size relative to the existing trash rack spacing. Although the majority of the target species possess the ability to avoid impingement or entrainment based on burst swim speed estimates, the obligatory migratory requirements for these species may result in voluntary entrainment, particularly during periods of limited to no spill.

Table 4.6.1.2.2.2-1: Summary of Atlantic Salmon Smolt Passage Survival via Different Downstream Passage Routes at the Pejepscot Project, 2014, for all Three Release Groups (Adapted from Table 4, Topsham Hydro (2015))

Passage Route	N	Proportion Passed (%)	Minimum Survival (%)	Portion of River Flow (%)*
Upstream Fishway	1	1.1	100	0.2
Spillway	61	64.9	95.1	32.5
Downstream Fish Bypass	12	12.8	100	0.6
Powerhouse	20	21.3	85	66.7

*Based on average flows recorded at the Project during the study period (May 14 – June 5, 2015)

Table 4.6.1.2.2.2-2: Summary of Atlantic Smolt Passage Survival via Different Downstream Passage Routes at the Pejepscot Project, 2015 (Adapted from BWPH and BBHP, (2016))

Passage Route	Detected (n)	Passed Downstream (n)	Test Survival	Paired-Release Survival (%)*
Upstream Fishway	1	0	0.00	0
Spillway	2	2	1.00	100
Downstream Fish Bypass	15	11	0.73	80
Powerhouse (Unit 1) **	60	51	0.85	92.7

*Calculated as the test survival divided by the tailrace release group survival (0.917) multiplied by 100.
**Reported survival estimate was through Unit 1 only. In total, 76 smolts were reported to have passed through the powerhouse.

Table 4.6.1.2.2.2-3: Summary of Passage Routes at Pejepscot for Radio-tagged Atlantic Salmon Smolts Released at Lewiston Falls and the Pejepscot Boat Launch During Spring, 2018.

Release Group*	Release Date	No. Released	No. Detected	Passage Route					
				Spill	Downstream Bypass	Francis Unit	Unit 1	Unknown Route	No Pass
LF1	4-May	17	10	4	-	-	2	3	1
LF2	6-May	17	12	5	-	-	4	3	-
LF3	8-May	17	14	2	2	-	5	5	-
LF4	10-May	17	11	1	1	-	9	-	-
LF5	12-May	17	11	5	5	-	1	-	-
LF6	14-May	15	10	2	5	-	3	-	-
PJ1	4-May	25	19	13	-	-	5	1	-
PJ2	6-May	25	23	14	-	2	6	1	-
PJ3	8-May	25	18	9	-	1	6	2	-
PJ4	10-May	25	15	8	1	-	5	-	1
PJ5	12-May	25	16	4	6	-	6	-	-
PJ6	14-May	25	14	4	5	1	3	1	-
All Lewiston Falls		**100**	**68**	**19**	**13**	**0**	**24**	**11**	**1**
All Pejepscot Launch		**150**	**108**	**52**	**12**	**4**	**31**	**5**	**1**
All Releases		**250**	**179**	**71**	**25**	**4**	**55**	**16**	**2**
Percentage of Detected			**100.0%**	**41.0%**	**14.5%**	**2.3%**	**31.8**	**9.2%**	**1.2%**

Table 4.6.1.2.2.2-4: Summary of Downstream Passage Route Distribution for Radio-Tagged Juvenile Alosines at Pejepscot during Fall 2019

Passage Route	No. of Individuals	Percentage
Did not approach	3	-
Did not pass	1	1.1%
Right Bypass	13	13.7%
Left Bypass	16	16.8%
Fishway	0	0.0%
Francis Units	0	0.0%
Unit 1	65	68.4%
Spillway	0	0.0%

Table 4.6.1.2.2.2-5: Summary of Downstream Passage Route Distribution for Radio-Tagged Adult Eels at Pejepscot during Fall 2019

Passage Route	No. of Individuals	Percentage
Fishway	1	2.0%
Unit 1	48	96.0%
Spillway	1	2.0%

Table 4.6.1.2.2.2-6: Mean Percent Distribution of River Flow among available Downstream Routes at the Time of Passage for Radio-Tagged juvenile alosines and adult American Eel during the Fall 2019 Downstream Passage Assessment

	No. Individuals	Francis Units	Kaplan Unit	DS Bypasses	US Fishway	Spill
Juvenile Alosines						
Left Bypass	16	0.0%	94.3%	1.7%	0.8%	3.2%
Right Bypass	13	0.0%	94.0%	1.8%	0.9%	3.3%
Unit 1	65	0.0%	94.7%	1.6%	0.8%	2.9%
All	**94**	**0.0%**	**94.5%**	**1.6%**	**0.8%**	**3.0%**
Adult American Eels						
US Fishway	1	0.0%	96.5%	1.1%	0.5%	1.9%
Spillway	1	0.0%	96.8%	1.0%	0.5%	1.7%
Unit 1	48	1.7%	86.8%	1.5%	0.7%	9.3%
All	**50**	**1.6%**	**87.2%**	**1.4%**	**0.7%**	**9.0%**

Table 4.6.1.2.2.2-7: Percent Distribution of River Flow among available Downstream Routes at the Time of Passage for Radio-Tagged juvenile alosines and adult American Eel during the Fall 2019 Downstream Passage Assessment

Species	Frequency	ID	Route	Pass Date	Pass Hour	Francis	Kaplan	DSB	US Fishway	Spill
Juvenile Alosine	149.420	187	Right Bypass	10/11/2019	20:00:00	0.0%	94.8%	1.6%	0.8%	2.8%
Juvenile Alosine	149.420	156	Right Bypass	10/11/2019	20:00:00	0.0%	94.8%	1.6%	0.8%	2.8%
Juvenile Alosine	149.420	159	Unit 1	10/11/2019	20:00:00	0.0%	94.8%	1.6%	0.8%	2.8%
Juvenile Alosine	149.420	196	Right Bypass	10/11/2019	20:00:00	0.0%	94.8%	1.6%	0.8%	2.8%
Juvenile Alosine	149.340	167	Unit 1	10/11/2019	21:00:00	0.0%	94.1%	1.7%	0.9%	3.4%
Juvenile Alosine	149.420	180	Unit 1	10/11/2019	21:00:00	0.0%	94.1%	1.7%	0.9%	3.4%
Juvenile Alosine	149.340	184	Right Bypass	10/11/2019	21:00:00	0.0%	94.1%	1.7%	0.9%	3.4%
Juvenile Alosine	149.340	198	Unit 1	10/11/2019	21:00:00	0.0%	94.1%	1.7%	0.9%	3.4%
Juvenile Alosine	149.420	189	Right Bypass	10/11/2019	22:00:00	0.0%	93.8%	1.9%	0.9%	3.4%
Juvenile Alosine	149.340	197	Right Bypass	10/11/2019	22:00:00	0.0%	93.8%	1.9%	0.9%	3.4%
Juvenile Alosine	149.340	200	Unit 1	10/11/2019	22:00:00	0.0%	93.8%	1.9%	0.9%	3.4%
Juvenile Alosine	149.420	200	Right Bypass	10/11/2019	22:00:00	0.0%	93.8%	1.9%	0.9%	3.4%
Juvenile Alosine	149.340	189	Unit 1	10/11/2019	22:00:00	0.0%	93.8%	1.9%	0.9%	3.4%
Juvenile Alosine	149.340	204	Unit 1	10/11/2019	22:00:00	0.0%	93.8%	1.9%	0.9%	3.4%
Juvenile Alosine	149.340	163	Unit 1	10/11/2019	23:00:00	0.0%	93.1%	1.9%	1.0%	4.1%
Juvenile Alosine	149.340	164	Unit 1	10/12/2019	1:00:00	0.0%	94.1%	1.7%	0.9%	3.3%
Juvenile Alosine	149.420	185	Unit 1	10/12/2019	1:00:00	0.0%	94.1%	1.7%	0.9%	3.3%
Juvenile Alosine	149.340	172	Unit 1	10/12/2019	2:00:00	0.0%	92.7%	2.2%	1.1%	4.0%
Juvenile Alosine	149.420	203	Unit 1	10/12/2019	4:00:00	0.0%	93.1%	2.0%	1.0%	3.8%
Juvenile Alosine	149.340	201	Unit 1	10/12/2019	4:00:00	0.0%	93.1%	2.0%	1.0%	3.8%
Juvenile Alosine	149.420	157	Unit 1	10/12/2019	4:00:00	0.0%	93.1%	2.0%	1.0%	3.8%
Juvenile Alosine	149.420	182	Unit 1	10/12/2019	5:00:00	0.0%	92.8%	2.2%	1.1%	4.0%
Juvenile Alosine	149.420	184	Unit 1	10/12/2019	6:00:00	0.0%	93.0%	2.1%	1.0%	3.8%
Juvenile Alosine	149.420	183	Left Bypass	10/12/2019	6:00:00	0.0%	93.0%	2.1%	1.0%	3.8%
Juvenile Alosine	149.340	203	Unit 1	10/12/2019	18:00:00	0.0%	93.0%	2.1%	1.1%	3.8%
Juvenile Alosine	149.340	174	Unit 1	10/14/2019	18:00:00	0.0%	93.5%	2.0%	1.0%	3.5%
Juvenile Alosine	149.340	187	Unit 1	10/14/2019	18:00:00	0.0%	93.5%	2.0%	1.0%	3.5%
Juvenile Alosine	149.420	191	Unit 1	10/14/2019	18:00:00	0.0%	93.5%	2.0%	1.0%	3.5%
Juvenile Alosine	149.340	195	Unit 1	10/14/2019	18:00:00	0.0%	93.5%	2.0%	1.0%	3.5%
Juvenile Alosine	149.420	186	Unit 1	10/14/2019	18:00:00	0.0%	93.5%	2.0%	1.0%	3.5%

Species	Frequency	ID	Route	Pass Date	Pass Hour	Francis	Kaplan	DSB	US Fishway	Spill
Juvenile Alosine	149.340	160	Right Bypass	10/14/2019	19:00:00	0.0%	94.1%	1.8%	0.9%	3.2%
Juvenile Alosine	149.340	194	Unit 1	10/14/2019	19:00:00	0.0%	94.1%	1.8%	0.9%	3.2%
Juvenile Alosine	149.340	162	Unit 1	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.340	188	Unit 1	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.340	193	Right Bypass	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.420	174	Unit 1	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.420	177	Unit 1	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.340	176	Right Bypass	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.420	195	Left Bypass	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.420	170	Right Bypass	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.420	181	Unit 1	10/14/2019	20:00:00	0.0%	93.1%	2.0%	1.0%	4.0%
Juvenile Alosine	149.340	168	Left Bypass	10/14/2019	22:00:00	0.0%	94.3%	1.7%	0.9%	3.1%
Juvenile Alosine	149.420	172	Unit 1	10/14/2019	22:00:00	0.0%	94.3%	1.7%	0.9%	3.1%
Juvenile Alosine	149.420	205	Unit 1	10/14/2019	22:00:00	0.0%	94.3%	1.7%	0.9%	3.1%
Juvenile Alosine	149.420	188	Unit 1	10/14/2019	23:00:00	0.0%	94.1%	1.7%	0.9%	3.3%
Juvenile Alosine	149.420	171	Right Bypass	10/14/2019	23:00:00	0.0%	94.1%	1.7%	0.9%	3.3%
Juvenile Alosine	149.340	199	Left Bypass	10/15/2019	0:00:00	0.0%	94.6%	1.7%	0.9%	2.9%
Juvenile Alosine	149.420	190	Unit 1	10/15/2019	1:00:00	0.0%	94.2%	1.7%	0.8%	3.3%
Juvenile Alosine	149.340	196	Left Bypass	10/15/2019	3:00:00	0.0%	94.2%	1.7%	0.8%	3.3%
Juvenile Alosine	149.420	168	Unit 1	10/16/2019	19:00:00	0.0%	94.0%	1.8%	0.9%	3.3%
Juvenile Alosine	149.340	161	Unit 1	10/16/2019	19:00:00	0.0%	94.0%	1.8%	0.9%	3.3%
Juvenile Alosine	149.420	202	Unit 1	10/16/2019	19:00:00	0.0%	94.0%	1.8%	0.9%	3.3%
Juvenile Alosine	149.420	160	Unit 1	10/16/2019	19:00:00	0.0%	94.0%	1.8%	0.9%	3.3%
Juvenile Alosine	149.340	178	Unit 1	10/16/2019	19:00:00	0.0%	94.0%	1.8%	0.9%	3.3%
Juvenile Alosine	149.340	185	Unit 1	10/16/2019	20:00:00	0.0%	94.7%	1.7%	0.8%	2.8%
Juvenile Alosine	149.420	197	Unit 1	10/16/2019	20:00:00	0.0%	94.7%	1.7%	0.8%	2.8%
Juvenile Alosine	149.340	190	Left Bypass	10/16/2019	20:00:00	0.0%	94.7%	1.7%	0.8%	2.8%
Juvenile Alosine	149.420	179	Left Bypass	10/16/2019	20:00:00	0.0%	94.7%	1.7%	0.8%	2.8%
Juvenile Alosine	149.340	173	Unit 1	10/16/2019	21:00:00	0.0%	94.6%	1.6%	0.8%	3.0%
Juvenile Alosine	149.340	158	Left Bypass	10/16/2019	21:00:00	0.0%	94.6%	1.6%	0.8%	3.0%
Juvenile Alosine	149.420	192	Right Bypass	10/16/2019	21:00:00	0.0%	94.6%	1.6%	0.8%	3.0%
Juvenile Alosine	149.340	186	Left Bypass	10/16/2019	22:00:00	0.0%	94.4%	1.7%	0.9%	3.1%
Juvenile Alosine	149.340	171	Unit 1	10/16/2019	22:00:00	0.0%	94.4%	1.7%	0.9%	3.1%

Species	Frequency	ID	Route	Pass Date	Pass Hour	Francis	Kaplan	DSB	US Fishway	Spill
Juvenile Alosine	149.340	191	Unit 1	10/16/2019	22:00:00	0.0%	94.4%	1.7%	0.9%	3.1%
Juvenile Alosine	149.420	164	Unit 1	10/16/2019	23:00:00	0.0%	94.9%	1.6%	0.8%	2.7%
Juvenile Alosine	149.340	166	Unit 1	10/16/2019	23:00:00	0.0%	94.9%	1.6%	0.8%	2.7%
Juvenile Alosine	149.340	175	Left Bypass	10/16/2019	23:00:00	0.0%	94.9%	1.6%	0.8%	2.7%
Juvenile Alosine	149.420	198	Unit 1	10/16/2019	23:00:00	0.0%	94.9%	1.6%	0.8%	2.7%
Juvenile Alosine	149.420	161	Left Bypass	10/16/2019	23:00:00	0.0%	94.9%	1.6%	0.8%	2.7%
Juvenile Alosine	149.340	192	Unit 1	10/17/2019	0:00:00	0.0%	94.7%	1.6%	0.8%	2.9%
Juvenile Alosine	149.420	176	Left Bypass	10/17/2019	0:00:00	0.0%	94.7%	1.6%	0.8%	2.9%
Juvenile Alosine	149.420	175	Unit 1	10/17/2019	0:00:00	0.0%	94.7%	1.6%	0.8%	2.9%
Juvenile Alosine	149.340	182	Unit 1	10/22/2019	18:00:00	0.0%	96.1%	1.3%	0.6%	2.1%
Juvenile Alosine	149.420	194	Unit 1	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.340	170	Unit 1	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.340	177	Unit 1	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.420	165	Unit 1	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.340	181	Left Bypass	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.340	180	Left Bypass	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.340	205	Unit 1	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.420	158	Unit 1	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.340	169	Left Bypass	10/22/2019	19:00:00	0.0%	95.8%	1.3%	0.6%	2.3%
Juvenile Alosine	149.420	193	Left Bypass	10/22/2019	20:00:00	0.0%	96.4%	1.1%	0.6%	2.0%
Juvenile Alosine	149.420	199	Unit 1	10/22/2019	20:00:00	0.0%	96.4%	1.1%	0.6%	2.0%
Juvenile Alosine	149.420	204	Unit 1	10/22/2019	20:00:00	0.0%	96.4%	1.1%	0.6%	2.0%
Juvenile Alosine	149.420	166	Unit 1	10/22/2019	20:00:00	0.0%	96.4%	1.1%	0.6%	2.0%
Juvenile Alosine	149.340	157	Unit 1	10/22/2019	20:00:00	0.0%	96.4%	1.1%	0.6%	2.0%
Juvenile Alosine	149.420	162	Unit 1	10/22/2019	20:00:00	0.0%	96.4%	1.1%	0.6%	2.0%
Juvenile Alosine	149.340	183	Unit 1	10/22/2019	21:00:00	0.0%	96.4%	1.1%	0.6%	1.9%
Juvenile Alosine	149.420	201	Unit 1	10/22/2019	21:00:00	0.0%	96.4%	1.1%	0.6%	1.9%
Juvenile Alosine	149.420	163	Unit 1	10/22/2019	22:00:00	0.0%	96.4%	1.1%	0.6%	1.9%
Juvenile Alosine	149.420	169	Unit 1	10/23/2019	0:00:00	0.0%	96.5%	1.1%	0.6%	1.8%
Juvenile Alosine	149.420	173	Unit 1	10/23/2019	2:00:00	0.0%	96.4%	1.1%	0.6%	1.9%
Juvenile Alosine	149.340	202	Unit 1	10/23/2019	12:00:00	0.0%	96.8%	1.0%	0.5%	1.7%
Adult Eel	150.680	56	Unit 1	10/3/2019	18:00:00	0.0%	95.2%	1.4%	0.7%	2.8%
Adult Eel	150.600	70	Unit 1	10/3/2019	19:00:00	0.0%	95.0%	1.3%	0.6%	3.1%

Species	Frequency	ID	Route	Pass Date	Pass Hour	Francis	Kaplan	DSB	US Fishway	Spill
Adult Eel	150.600	74	Unit 1	10/3/2019	19:00:00	0.0%	95.0%	1.3%	0.6%	3.1%
Adult Eel	150.680	51	Unit 1	10/3/2019	20:00:00	0.0%	95.5%	1.3%	0.6%	2.6%
Adult Eel	150.680	53	Unit 1	10/3/2019	20:00:00	0.0%	95.5%	1.3%	0.6%	2.6%
Adult Eel	150.600	72	Unit 1	10/3/2019	20:00:00	0.0%	95.5%	1.3%	0.6%	2.6%
Adult Eel	150.600	73	Unit 1	10/3/2019	21:00:00	0.0%	96.2%	1.1%	0.6%	2.1%
Adult Eel	150.680	54	Unit 1	10/3/2019	21:00:00	0.0%	96.2%	1.1%	0.6%	2.1%
Adult Eel	150.600	65	Unit 1	10/3/2019	21:00:00	0.0%	96.2%	1.1%	0.6%	2.1%
Adult Eel	150.680	50	Unit 1	10/3/2019	22:00:00	0.0%	96.2%	1.1%	0.5%	2.2%
Adult Eel	150.680	55	Unit 1	10/4/2019	4:00:00	0.0%	94.3%	1.7%	0.9%	3.2%
Adult Eel	150.680	58	Unit 1	10/4/2019	18:00:00	0.0%	95.5%	1.3%	0.6%	2.5%
Adult Eel	150.680	57	Unit 1	10/4/2019	18:00:00	0.0%	95.5%	1.3%	0.6%	2.5%
Adult Eel	150.600	64	Unit 1	10/4/2019	18:00:00	0.0%	95.5%	1.3%	0.6%	2.5%
Adult Eel	150.600	68	Unit 1	10/4/2019	19:00:00	0.0%	96.1%	1.2%	0.6%	2.1%
Adult Eel	150.600	62	Unit 1	10/4/2019	20:00:00	0.0%	96.2%	1.1%	0.6%	2.1%
Adult Eel	150.600	71	Unit 1	10/4/2019	20:00:00	0.0%	96.2%	1.1%	0.6%	2.1%
Adult Eel	150.680	59	Unit 1	10/7/2019	20:00:00	0.0%	92.4%	2.1%	1.0%	4.5%
Adult Eel	150.600	69	Unit 1	10/8/2019	2:00:00	0.0%	92.9%	1.9%	0.9%	4.3%
Adult Eel	150.600	66	Unit 1	10/8/2019	10:00:00	0.0%	92.5%	2.1%	1.0%	4.4%
Adult Eel	150.680	84	Unit 1	10/8/2019	20:00:00	0.0%	96.2%	1.1%	0.5%	2.2%
Adult Eel	150.600	99	Unit 1	10/9/2019	4:00:00	0.0%	94.9%	1.5%	0.8%	2.8%
Adult Eel	150.600	97	Unit 1	10/9/2019	19:00:00	0.0%	95.5%	1.4%	0.7%	2.5%
Adult Eel	150.600	95	Unit 1	10/9/2019	19:00:00	0.0%	95.5%	1.4%	0.7%	2.5%
Adult Eel	150.600	92	Fishway	10/9/2019	19:00:00	0.0%	95.5%	1.4%	0.7%	2.5%
Adult Eel	150.600	100	Unit 1	10/9/2019	20:00:00	0.0%	96.2%	1.1%	0.6%	2.2%
Adult Eel	150.680	61	Unit 1	10/9/2019	21:00:00	0.0%	95.4%	1.3%	0.7%	2.6%
Adult Eel	150.600	96	Unit 1	10/9/2019	22:00:00	0.0%	96.3%	1.2%	0.6%	2.0%
Adult Eel	150.680	80	Unit 1	10/10/2019	0:00:00	0.0%	96.2%	1.2%	0.6%	2.0%
Adult Eel	150.680	75	Unit 1	10/10/2019	3:00:00	0.0%	95.2%	1.4%	0.7%	2.6%
Adult Eel	150.680	78	Unit 1	10/10/2019	4:00:00	0.0%	95.0%	1.5%	0.8%	2.7%
Adult Eel	150.600	91	Unit 1	10/10/2019	15:00:00	0.0%	94.3%	1.7%	0.9%	3.2%
Adult Eel	150.680	86	Unit 1	10/11/2019	1:00:00	0.0%	95.2%	1.5%	0.7%	2.6%
Adult Eel	150.600	89	Unit 1	10/11/2019	10:00:00	0.0%	94.8%	1.6%	0.8%	2.8%
Adult Eel	150.680	85	Unit 1	10/11/2019	20:00:00	0.0%	94.8%	1.6%	0.8%	2.8%

Species	Frequency	ID	Route	Pass Date	Pass Hour	Francis	Kaplan	DSB	US Fishway	Spill
Adult Eel	150.600	94	Unit 1	10/12/2019	0:00:00	0.0%	94.5%	1.7%	0.9%	2.9%
Adult Eel	150.600	93	Unit 1	10/13/2019	20:00:00	0.0%	83.3%	2.4%	1.2%	13.2%
Adult Eel	150.680	83	Unit 1	10/15/2019	1:00:00	0.0%	94.2%	1.7%	0.8%	3.3%
Adult Eel	150.680	81	Unit 1	10/15/2019	5:00:00	0.0%	94.6%	1.6%	0.8%	3.0%
Adult Eel	150.680	79	Unit 1	10/16/2019	4:00:00	0.0%	94.8%	1.6%	0.8%	2.8%
Adult Eel	150.680	76	Unit 1	10/16/2019	18:00:00	0.0%	94.8%	1.6%	0.8%	2.8%
Adult Eel	150.600	98	Unit 1	10/16/2019	22:00:00	0.0%	94.4%	1.7%	0.9%	3.1%
Adult Eel	150.680	60	Unit 1	10/17/2019	4:00:00	0.0%	95.1%	1.5%	0.8%	2.6%
Adult Eel	150.680	87	Unit 1	10/17/2019	6:00:00	0.0%	81.8%	2.0%	1.0%	15.2%
Adult Eel	150.600	63	Unit 1	10/17/2019	8:00:00	0.0%	93.2%	1.6%	0.8%	4.4%
Adult Eel	150.600	88	Unit 1	10/17/2019	9:00:00	0.0%	93.8%	1.1%	0.6%	4.5%
Adult Eel	150.680	82	Unit 1	10/17/2019	17:00:00	0.0%	95.5%	1.3%	0.7%	2.5%
Adult Eel	150.600	67	Unit 1	10/18/2019	21:00:00	0.0%	97.2%	0.9%	0.4%	1.5%
Adult Eel	150.680	52	Unit 1	10/23/2019	11:00:00	0.0%	96.9%	1.0%	0.5%	1.7%
Adult Eel	150.680	77	Spillway	10/23/2019	17:00:00	0.0%	93.4%	0.8%	0.4%	5.4%

Table 4.6.1.2.2.3-1: Survival (%) of Target Species from Radio Telemetry Studies at Pejepscot and from TBSA and Multiple Regression Analysis from Desktop Study

Species	Life Stage	From Pejepscot Telemetry Studies (2015-2019)			Based on TBSA or Multiple Regression	
		# of Fish	Size Range (in)	Survival (%)	Size Range (in)	Survival (%)
American Eel	Adult (silver)	48	26 to 39[1]	91.7% (75% Cl = 87.5-95.8%)	26 to 39	68.2% to 82.9%
American Shad	Adult	11	14 to 23[2]	82%	14 to 23[3]	91.3% to 95.6%
Atlantic Salmon	Juvenile	55/60[4]	6 to 9	92.7% to 100%	6 to 9[5]	96.8% to 97.6%
River Herring	Adult	48	11 to 13[2]	88%	11 to 13[6]	95.5% to 95.6%

1 – From 2019 American Eel fall telemetry study at Pejepscot Project – length range includes all radio tagged fish, not specific to those using U1 for downstream passage.
2 – From 2019 adult American Shad and river herring spring telemetry study at Pejepscot Project – length range includes all radio tagged fish, not specific to those using U1 for downstream passage.
3 – Used TBSA range calculated for 12 and 24 inch fish
4 – Two studies provided survival estimates (2015/2018). The 2015 study estimate used a paired release model while the 2018 study used a CJS model.
5 – Used TBSA range calculated for 6 and 8 inch fish
6 – Used TBSA range calculated for 12 and 14 inch fish.

Brookfield

N

0 37.5 75 150 Feet

Pejepscot Hydroelectric Project
(FERC No. 4784)
Final License Application

Figure 4.6.1.2.2.1-1.
2019 Locations of Areas Surveyed
During Eel Monitoring Surveys
at the Pejepscot Project

Path: P:\Modeling\Projects\01925\maps\fla\exhibit_e\figure_4_6_1_2_2_1-1.mxd

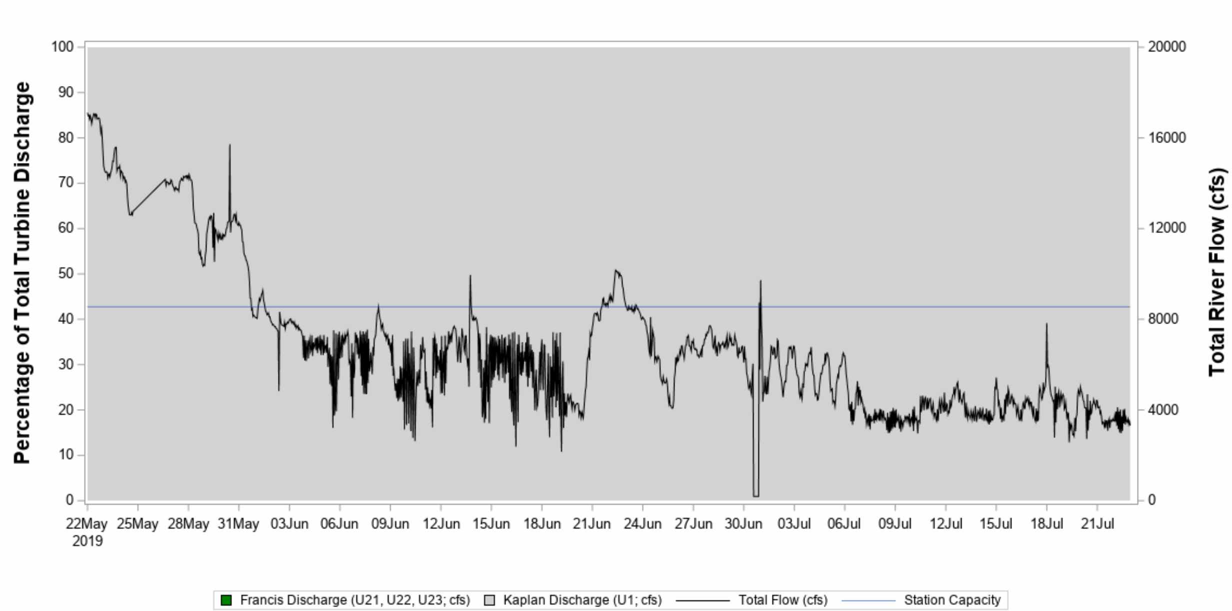


Figure 4.6.1.2.2.2-1: Percentage of Turbine Flow (Kaplan versus Francis units) relative to Total River Flow for the period May 22 through July 22, 2019

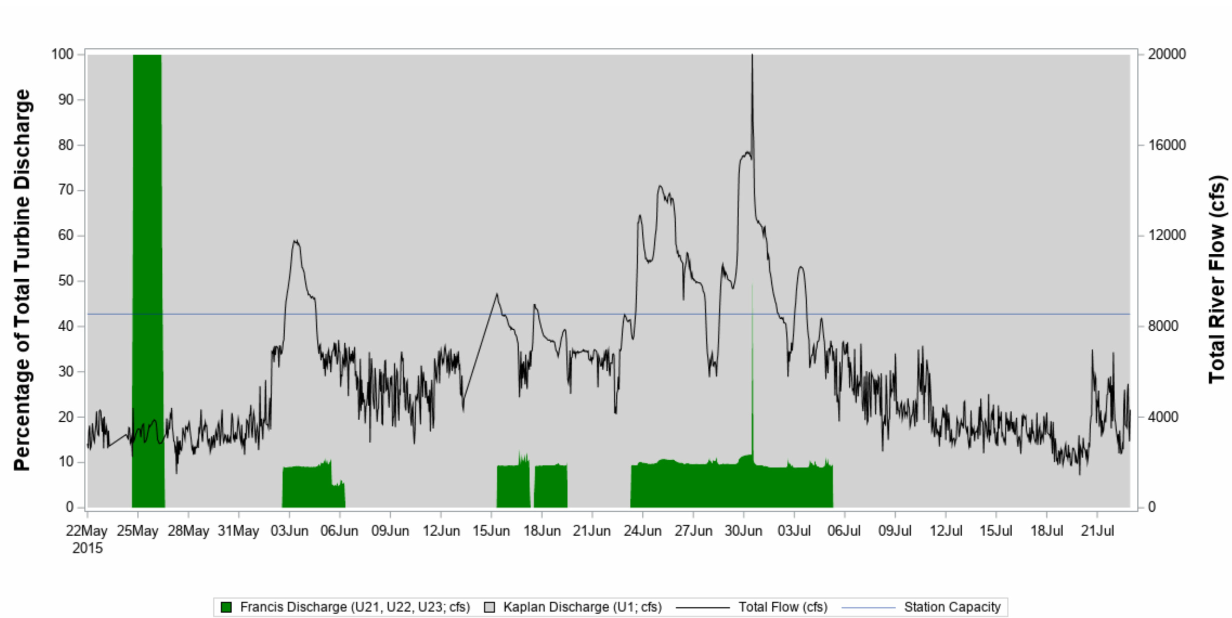


Figure 4.6.1.2.2.2-2: Percentage of Turbine Flow (Kaplan versus Francis units) relative to Total River Flow for the period May 22 through July 22, 2015

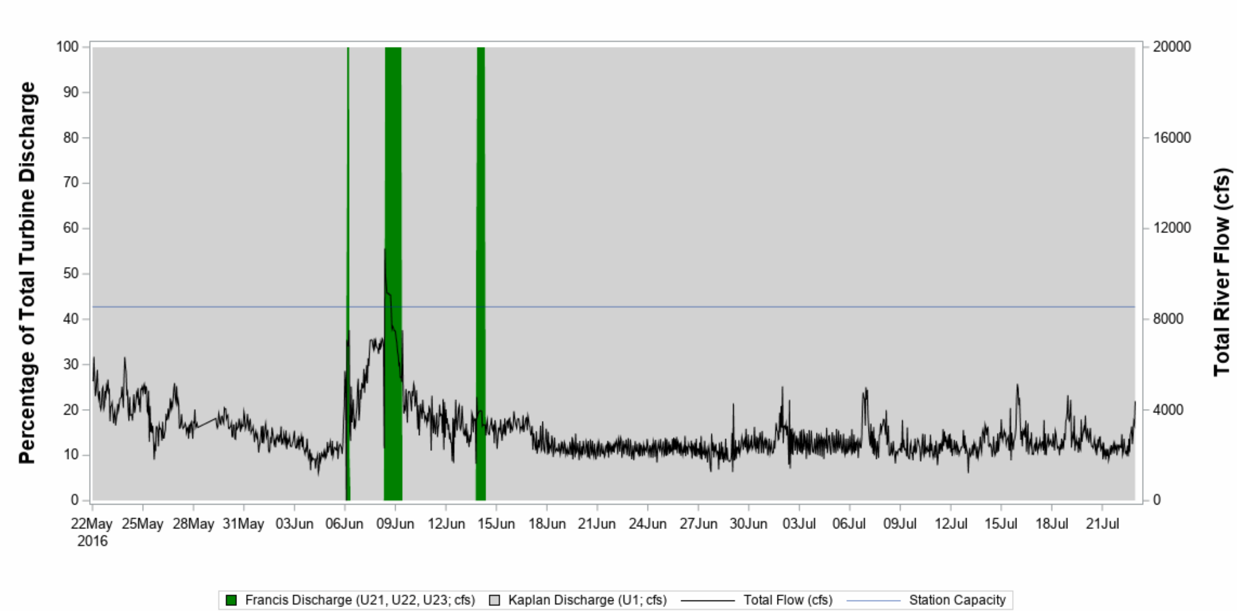


Figure 4.6.1.2.2.2-3: Percentage of Turbine Flow (Kaplan versus Francis units) relative to Total River Flow for the period May 22 through July 22, 2016

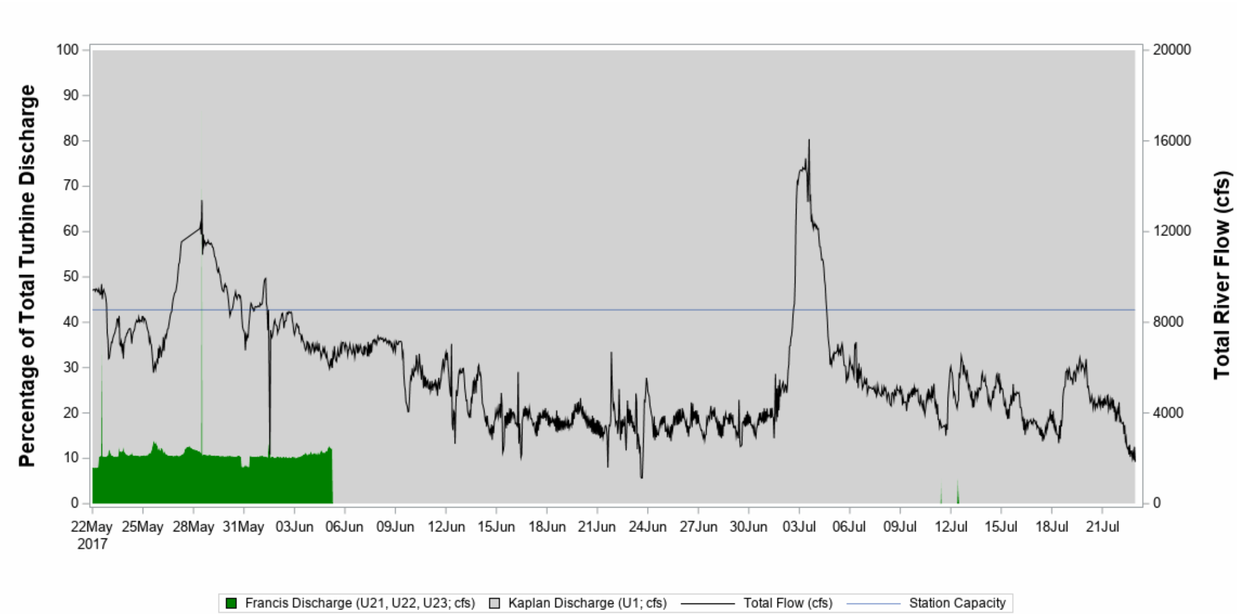


Figure 4.6.1.2.2.2-4: Percentage of Turbine Flow (Kaplan versus Francis units) relative to Total River Flow for the period May 22 through July 22, 2017

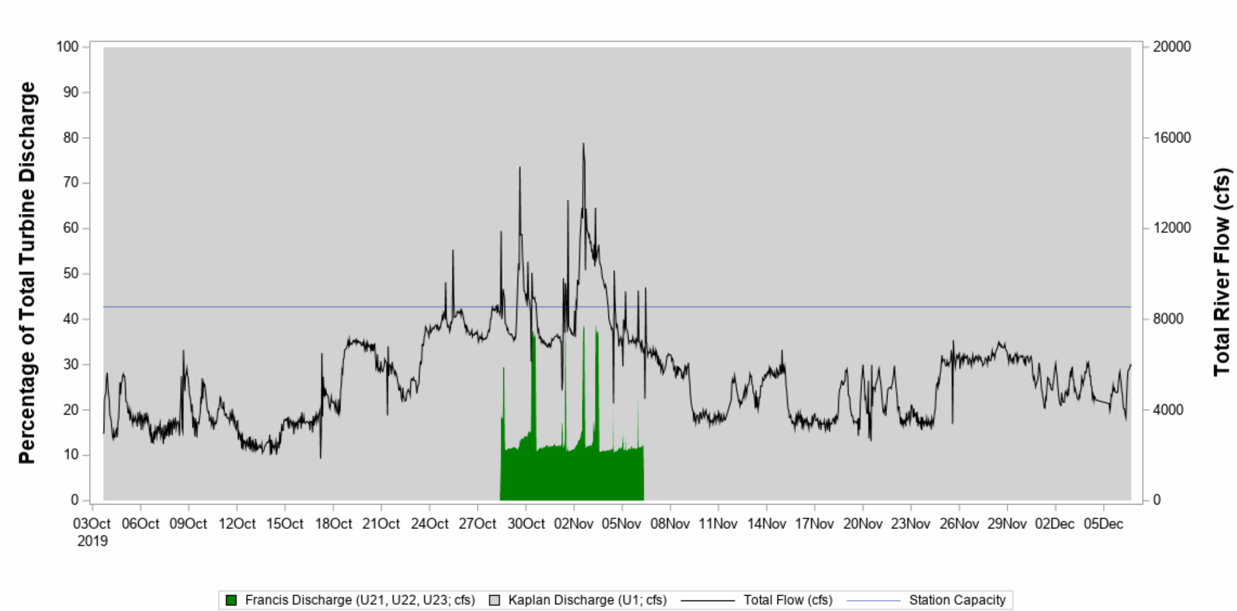


Figure 4.6.1.2.2.2-5: Percentage of Turbine Flow (Kaplan versus Francis units) relative to Total River Flow for the period October 3 to November 30, 2019

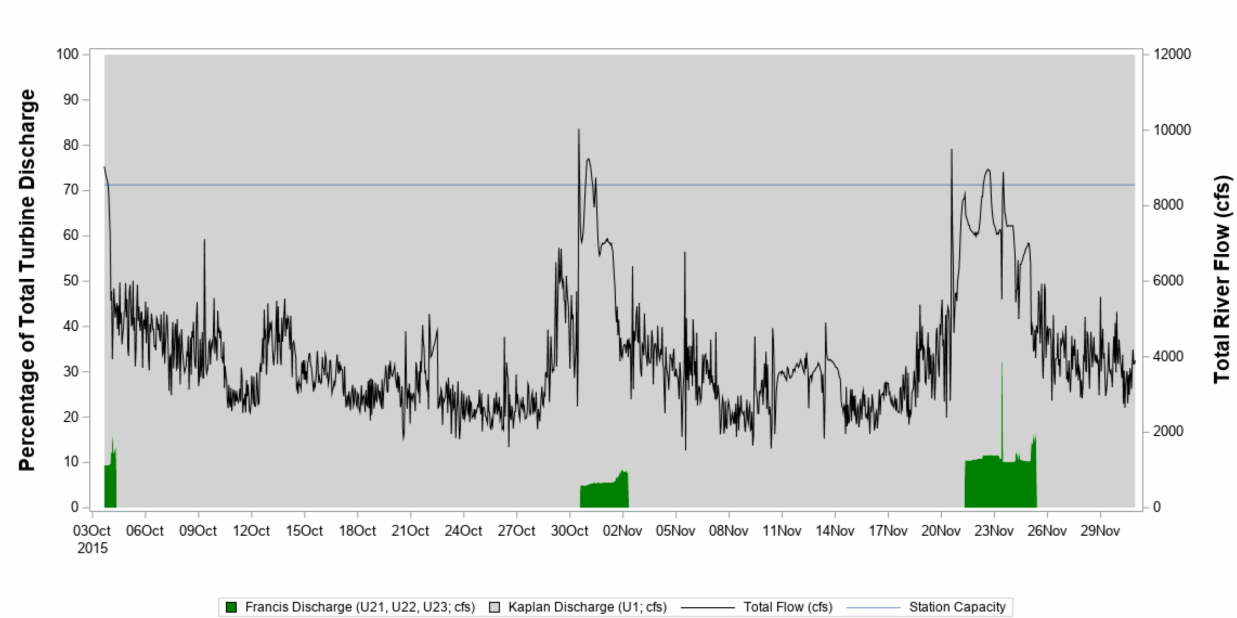


Figure 4.6.1.2.2.2-6: Percentage of Turbine Flow (Kaplan versus Francis units) relative to Total River Flow for the period October 3 to November 30, 2015

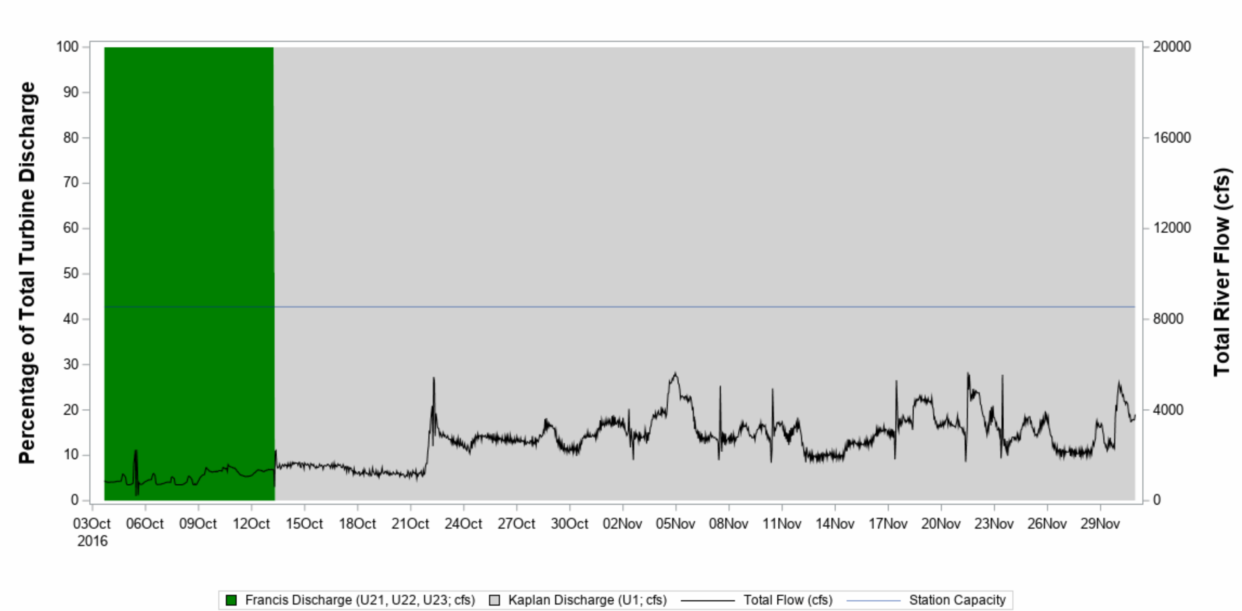


Figure 4.6.1.2.2.2-7: Percentage of Turbine Flow (Kaplan versus Francis units) relative to Total River Flow for the period October 3 to November 30, 2016

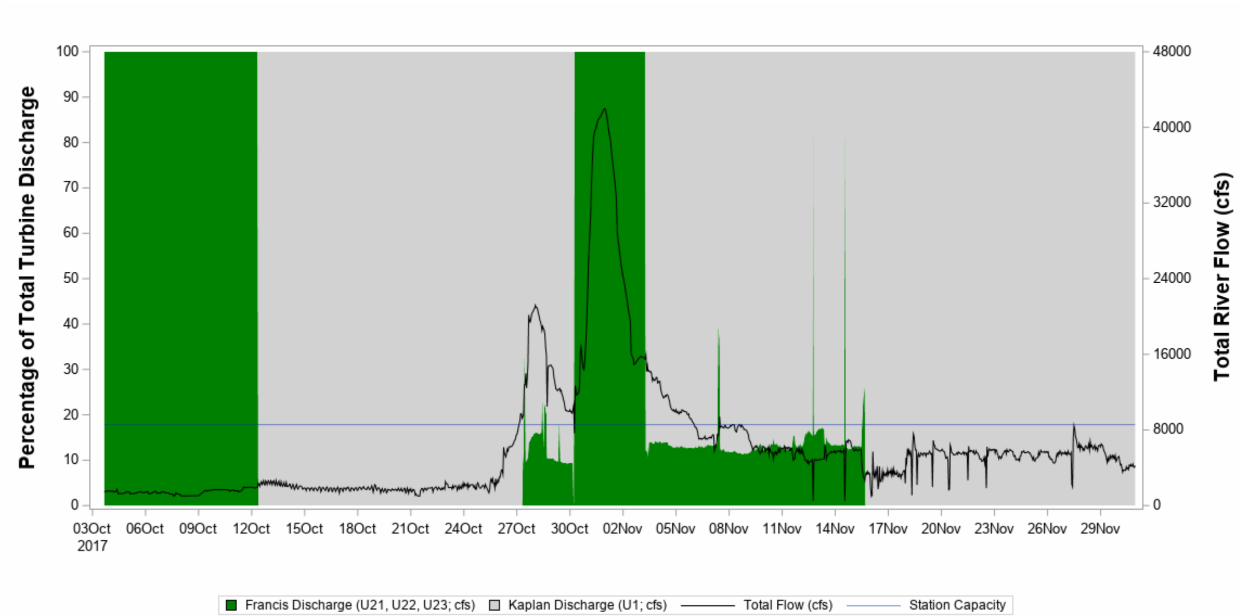


Figure 4.6.1.2.2.2-8: Percentage of Turbine Flow (Kaplan versus Francis units) relative to Total River Flow for the period October 3 to November 30, 2017

E4.6.1.3 Aquatic Habitat

E4.6.1.3.1 Impoundment

The Project boundary upstream of the Pejepscot Dam includes approximately three miles of the Androscoggin River. Upstream of the Project Area, the river flows through the Worumbo Project prior to entering the impoundment. The Pejepscot impoundment has a surface area of 225 acres, and gross storage of 3,278 acre-ft at full pool elevation (El. 67.5 ft.).

The Little River enters the Androscoggin in the furthest upstream areas of the Project Impoundment and is the only major tributary in the vicinity of the Project. The remaining streams (Meadow Brook, Pinkham Brook, two unnamed streams, and an unnamed intermittent stream) entering the Androscoggin River within the Project Area are relatively small and have not been evaluated for habitat suitability.

E4.6.1.3.2 Tailwater

The Project does not have a bypass reach. Depending on the river flow and the headpond elevation of the downstream Brunswick Project (which may occasionally backwater to the Pejepscot Dam), the habitat downstream of the dam likely reflects that of a free-flowing section of river until it reaches the Brunswick Impoundment. The river immediately downstream of the dam is approximately 400 ft wide, but quickly narrows downstream to 250-300 ft wide, and is constrained by steep banks. Most of the right bank in the vicinity of the dam is bounded by steep bedrock ledges, and the first ~360 ft of the left bank downstream of the powerhouse consists of bedrock topped with nearly vertical constructed rock walls and concrete walls. Depending on the flow and backwatering effect from the Brunswick Project, most of the downstream areas appear to consist of pool and run habitat, though some shallower riffle areas may be present during certain flow and water level conditions.

Stranding Evaluation Study

In 2018, Topsham Hydro conducted a stranding evaluation study in support of relicensing. The study area for the field survey was focused upon the exposed bedrock area on the right side (looking downstream) of the Project dam, below bascule gate No. 5 (Topsham Hydro, 2019a). The goal of the evaluation was to provide information regarding the potential for fish stranding below the Project spillway. The study objective was to determine if potential stranding pools are present in the ledges immediately below the western end of the Project spillway, after spill operations cease.

The field survey consisted of lowering bascule gate No. 5 to convey all streamflow through the gate, onto the exposed bedrock area below it. After completion of this operation and bascule gate No. 5 was fully lowered, the operation was reversed. Once the reverse operation was complete, the exposed bedrock area on river right was investigated for the occurrence of potential stranding pools. The field survey was photo-documented and videotaped. Figures 4.6.1.3.2-1 through 4.6.1.3.2-4 show the stages of the bascule gate operation (Topsham Hydro, 2019a). Several potential stranding pools were noted in the bedrock outcrop on the right side of the Project dam, below bascule gate no. 5 (Figure 4.6.1.3.2-4).

Figure 4.6.1.3.2-1: Initiation of Bascule Gate Operation

Figure 4.6.1.3.2-2: Bascule Gate No. 5 in Fully Lowered Position

Figure 4.6.1.3.2-3: Exposed Bedrock Area below Bascule Gate No. 5 as Viewed from River Left

Figure 4.6.1.3.2-4: Exposed Bedrock Area below Bascule Gate No. 5 as Viewed from River Right

E4.6.1.3.3 Aquatic Habitat Surveys

Habitat in the main-stem river was evaluated by Yoder *et al*., (2006) during the fish assemblage survey in 2003. Each of the sites sampled was assessed using a Qualitative Habitat Evaluation Index (QHEI), whereby the habitat was visually evaluated and based on “good” and “modified” characteristics of lotic habitat. QHEI results from Yoder *et al*., (2006) for the three sites in the vicinity of the Project are shown in Tables 4.6.1.3.3-1 and 4.6.1.3.3-2.

Yoder *et al*., (2006) performed QHEI evaluations at two locations between the Pejepscot and Worumbo Projects and one location in the riverine area downstream of the Pejepscot Project. Of these sites, the furthest upstream location was approximately 3.3 miles upstream of the Pejepscot Project, and was characterized as having all good QHEI attributes, and no modified attributes; as such, this was considered a free-flowing location with good riverine qualities based on the QHEI evaluation. Approximately 2.3 miles upstream of the Pejepscot Project, Yoder *et al*., (2006) evaluated a location that was classified as within the Pejepscot Impoundment; this location was classified as impounded, having slow flow, and no riffle/run habitats, but also possessed good habitat attributes such as extensive to moderate cover, low/normal embeddedness of substrate, and max depths greater than one meter (Tables 4.6.1.3.3-1 and 4.6.1.3.3-2). Approximately 0.4

miles downstream of the Project, Yoder *et al*., (2006) characterized the habitat as riverine, with most of the good habitat attributes and no modified attributes.

Topsham Hydro and Miller Hydro Group completed a habitat survey in the Little River. Most of the lower reach (~6.5 miles) of the Little River was deemed accessible to Atlantic Salmon, though suitable spawning habitat appears to be limited there (HDR, 2011). The area was considered suitable for survival and habitation by Atlantic Salmon, and may provide resting areas in pools for salmon migrating upstream along with rearing habitats, particularly in tributaries. Barriers on the Little River may prevent Atlantic Salmon from migrating to potential spawning areas further upstream (HDR, 2011).

2019 Tailrace Aquatic Habit Study

In 2019 as part of the FERC relicensing process, Topsham Hydro conducted a tailrace aquatic habitat mapping study. The goal of this survey was to gather information on the quality of habitat in the un-impounded river section downstream of the Project dam. The objective included characterizing the aquatic habitat and substrate in the un-impounded downstream reach (Topsham Hydro, 2020e).

The survey was conducted on August 13, 2019 at a river flow of approximately 1,990 cfs, as measured at the Androscoggin River near Auburn, ME USGS streamflow gage (No. 01059000). The aquatic habitat in the un-impounded reach downstream of the Project dam was characterized by mesohabitat types (i.e., riffle, run, pool, etc.) Substrate data (i.e., primary, secondary, and tertiary component types) within the study area were collected based on visual assessment, and delineated using a field computer equipped with GPS and ArcGIS. Areas too deep to evaluate visually, either while wading or using an AquaScope from a boat, were surveyed with probing rods that allowed for substrate identification by feel (Topsham Hydro, 2020e).

Six major mesohabitat categories were identified during the field survey, including backwater, glide, pool, riffle, run, and other. Other was used to denote habitats that were out of the water at the time of the survey. A total of thirty-five individual mesohabitat units were delineated during the field survey. Figure 4.6.1.3.3-1 is a map displaying the location of mesohabitats identified during the field survey. Table 4.6.1.3.3-3 provides information on the percentage breakdown of each mesohabitat type. When possible, maximum and mean depths of each mesohabitat unit were recorded. Maximum depths ranged from less than one foot to fifty ft. (Table 4.6.1.3.3-3)

Primary, secondary, and tertiary substrates for each mesohabitat unit were identified (Table 4.6.1.3.3-4). Of the thirty-five total mesohabitat units, five were unable to have substrate identified (14.3%) due to depth of the mesohabitat unit not allowing for visual observation or probing. Of the remaining thirty mesohabitat units, primary substrates (Figure 4.6.1.3.3-2) were identified: eight were gravel medium (22.9%), seven were cobble (20.0%), six were sand (17.1%), three were complex bedrock (8.6%), three were boulder small (8.6%), two were rubble (5.7%), and one was boulder large (2.9%).

Evidence of potential Sea Lamprey spawning activity was recorded at three locations during the study. All three locations were listed as other, due to being out of water during the summer low-flow period when the survey was conducted (mesohabitat units IDs: 4, 6, and 21). Depressions and mounds of mixed substrates typically cobble, large gravel, small gravel and fine gravel were observed.

Backwaters, pools, and runs made up the majority of mesohabitat identified in the tailrace aquatic habitat survey area. The top three primary substrates identified in the survey area were gravel medium, cobble and sand. Some areas of fine sediments were identified as were areas of mounds and depressions that may represent potential spawning areas.

2019 Largemouth and Smallmouth Bass Spawning Habitat Survey

In 2019 as part of the FERC relicensing process, Topsham Hydro conducted a Largemouth and Smallmouth Bass spawning habitat survey. The goal of the evaluation was to provide information regarding the spawning activities of Largemouth and Smallmouth Bass in the Project impoundment. The study objective was to document bass spawning habitat, and nesting areas with differentiation by species within the Project impoundment. The study area for the field survey was the Project impoundment from the Pejepscot dam boat barrier upstream to the Route 125 Bridge (approximately 600 ft downstream of Worumbo dam) (Topsham Hydro, 2020f).

The field survey took place on June 18, 2019, and visual observations were made by systematically traversing the littoral zone via boat and wading to identify any Largemouth and Smallmouth Bass nests, egg masses/deposits, and spawning habitat (Topsham Hydro, 2020f). A total of 19 individual areas were identified in the Project impoundment as potential bass spawning habitat locations; six of these spawning habitat locations contained nest sites within them. Areas with potential spawning habitat were identified based on habitat suitability criteria such as cover and substrate. Figure 4.6.1.3.3-3 displays the map of recorded nest and potential spawning habitat locations identified during the survey. Thirteen potential spawning habitat locations were located on the left bank (assumes looking downstream) of the Project impoundment and six potential spawning habitat locations were located on the right bank.

There are several suitable spawning habitats in the Project impoundment for bass species, some of which appear to be actively used for spawning. The majority of nest and habitat identified during the survey are presumed to be for Largemouth Bass based on habitat preference. The placement of nests in soft bottom substrate areas (mud, sand, vegetation) are indicators of Largemouth Bass habitat. Only one nest was identified as a possible Smallmouth Bass nest due to the presence of gravel and its location along the impoundment shoreline (as opposed to backwater areas). No bass were observed on the nests, making full identification difficult.

2019/2020 Large Woody Debris Study

In 2019 and 2020 as part of the FERC relicensing process, Topsham Hydro conducted a Large Woody Debris (LWD) study. The goal of the LWD Study was to determine the quantity and quality of LWD typically collected at the dam and determine whether opportunities exist to improve downstream aquatic habitat by altering management of LWD at the Project (Topsham Hydro, 2020g).

Most debris in the Project headpond congregates near the powerhouse intakes, settling on the trashracks. Topsham Hydro generally inspects and cleans the trashracks at the Project on a weekly basis. Frequency of cleaning may increase to daily during the higher debris month loads of April, May, June, October, and November.

The MDEP's rules at CMR 06-96, Ch. 450(4)(C) (DEP rules Ch. 450) explicitly describe removal of "materials collected on trash racks" (3) and "woody debris and other accumulated materials" (4) from a hydropower project as "normal maintenance and repair activities" not requiring a permit. There is no corresponding allowance to return or replace such materials back into the waterway.

Therefore, debris removed is temporarily located to a laydown area until transported by a contractor to a licensed solid waste disposal facility. LWD that is not removed by Topsham Hydro either remains in the Project impoundment or is passed over the spillway during high flow events.

From July 2019 to June 2020, Topsham Hydro removed approximately 150 cubic yards of debris from the Project. This material included LWD along with smaller debris. Topsham Hydro did not record individual logs removed from the Project but instead estimated the total volume of debris by analyzing the number of containers removed from the site in one year. As much of this debris would be smaller than the targeted LWD, Topsham Hydro's estimate should be considered conservative and the actual amount of LWD somewhat less.

Due to the current constraints of the site configuration, the study determined that there were no existing measures available to keep LWD in the river system. However, Topsham Hydro's proposed trash boom, to be installed as part of the proposed downstream fish guidance system, will facilitate the sluicing of a greater proportion of this debris downstream past the Project, resulting in benefits to aquatic habitat in the Project tailwater.

Table 4.6.1.3.3-1: QHEI Results for Good Habitat Attributes at Sites Evaluated on the Androscoggin River in the Vicinity of the Pejepscot Project (Yoder *et al*., 2006)

Good Habitat Attributes	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)
No Channelization/Recovered	X	-	X
Boulder, Cobble, Gravel Substrates	X	-	-
Silt Free Substrates	X	-	-
Good/Excellent Development	X	-	X
Five or More Substrate Types	X	-	X
Extensive-Moderate Cover	X	X	X
Fast Current/Eddies	X	-	X
Low-Normal Overall Embeddedness	X	X	X
Max Depth > 1m	X	X	X
Low-Normal Riffle/Run Embeddedness	X	-	X

Table 4.6.1.3.3-2: QHEI Results for Modified Habitat Attributes at Sites Evaluated on the Androscoggin River in the Vicinity of the Pejepscot Project (Yoder *et al*., 2006)

Modified Habitat Attributes	Upstream of Project (~3.3 miles upstream)	Project Impoundment (~2.3 miles upstream)	Downstream of Project (~0.4 miles downstream)
Impounded	-	X	-
Channelized or No Recovery	-	X	-
Silt/Muck Substrates	-	-	-
Sparse or No Cover	-	-	-
Max Depth < 70 cm	-	-	-
Recovering Channel	-	-	-
High/Moderate Silt Cover	-	-	-
Fair-Poor Development	-	X	-
Only 1-2 Cover Types	-	-	-
Slow or No Flow	-	X	-
High-Mod Overall Embeddedness	-	-	-
High-Mod Riffle-Run Embeddedness	-	-	-
No Riffle/Run	-	X	-

Table 4.6.1.3.3-3: Distribution of Mesohabitats Types in the Study Area

Mesohabitat Type	Percentage of Total Habitat Area	Total Area (sq. ft.)
Backwater	28.6	390,312
Pool	38.1	520,073
Glide	1.0	14,180
Riffle	6.1	83,136
Run	20.1	274,363
Other	6.1	83,817

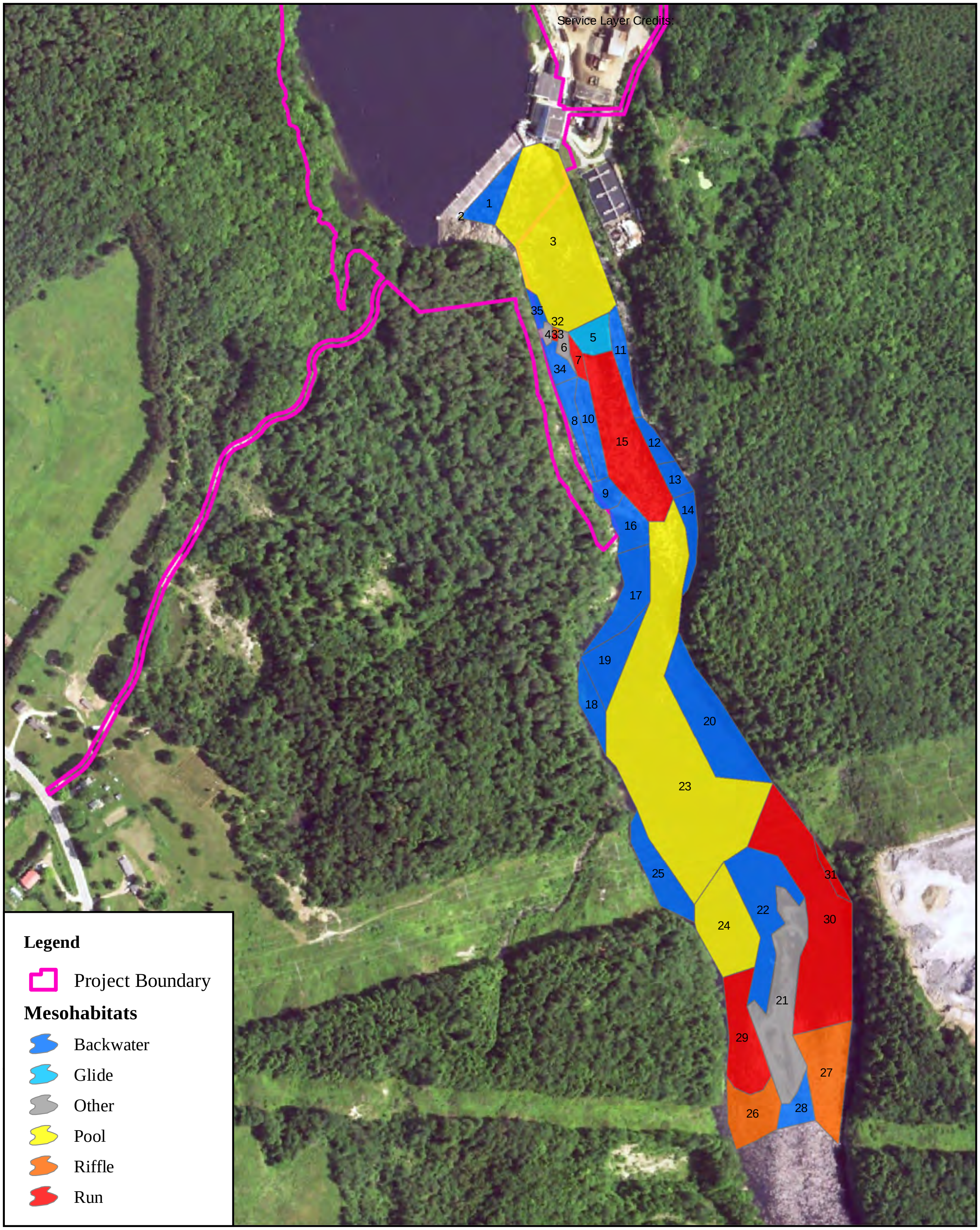
Table 4.6.1.3.3-4: Primary, Secondary, Tertiary Substrate by Mesohabitat Unit

Mesohabitat Unit ID	Mesohabitat Type	Primary Substrate	Secondary Substrate	Tertiary Substrate	Total Area (sq. ft.)	Max Depth (ft)	Mean Depth (ft)
1	Backwater	Sand	Complex Bedrock	Boulder large	18,147	--	12
2	Pool	Complex Bedrock	Boulder large	Sand	153	8	5
3	Pool	--	--	--	157,312	27	15
4	Other	Cobble	Gravel medium	Rubble	2,628	0	0
5	Glide	Cobble	Sand	Boulder small	14,180	8	6
6	Other	Boulder small	Rubble	Boulder large	4,234	--	--
7	Run	Boulder small	Sand	Boulder large	5,226	4	2
8	Backwater	Rubble	Cobble	Boulder small	14,049	5	3
9	Backwater	Complex Bedrock	--	--	8,725	7	3
10	Backwater	Sand	Boulder large	Rubble	18,393	8	6
11	Backwater	Complex Bedrock	Rubble	--	15,979	5	1
12	Backwater	Gravel medium	Cobble	Rubble	9,280	10	6

Mesohabitat Unit ID	Mesohabitat Type	Primary Substrate	Secondary Substrate	Tertiary Substrate	Total Area (sq. ft.)	Max Depth (ft)	Mean Depth (ft)
13	Backwater	Sand	Silt	Cobble	9,211	10	6
14	Backwater	Boulder large	Complex Bedrock	Gravel small	13,661	11	8
15	Run	Boulder small	Sand	--	82,596	16	10
16	Backwater	Rubble	Gravel small	Boulder small	17,924	12	10
17	Backwater	Sand	Silt		33,933	--	10
18	Backwater	Cobble	Gravel small	Sand	16,282	6	3
19	Backwater	--	--	--	27,910	26	15
20	Backwater	--	--	--	68,909	30	15
21	Other	Cobble	Gravel medium	Gravel small	76,956	0	0
22	Backwater	Gravel medium	Cobble	Gravel small	61,292	2	1
23	Pool	--	--	--	306,713	50	35
24	Pool	Cobble	Sand	Gravel medium	55,896	8	6
25	Backwater	Sand	Gravel medium	Cobble	29,239	8	3
26	Riffle	--	--	--	32,814	2	0.5
27	Riffle	Cobble	Gravel medium	Gravel small	49,864	4	1
28	Backwater	Gravel medium	Cobble	Gravel small	13,557	2	0.5
29	Run	Gravel medium	Cobble	Gravel small	44,711	5	3
30	Run	Cobble	Sand	Gravel medium	135,107	8	4
31	Run	Sand	Gravel medium	--	6,095	--	--
32	Riffle	Gravel medium	Cobble	Gravel small	457	1.5	1

Mesohabitat Unit ID	Mesohabitat Type	Primary Substrate	Secondary Substrate	Tertiary Substrate	Total Area (sq. ft.)	Max Depth (ft)	Mean Depth (ft)
33	Run	Gravel medium	Cobble	Gravel small	627	2	1
34	Backwater	Gravel medium	Cobble	Gravel small	9,195	2	1
35	Backwater	Gravel medium	Gravel small	Cobble	4,618	1	0.5

Blanks: Not recorded



Brookfield

N

0 125 250 500 Feet

Pejepscot Hydroelectric Project
(FERC No. 4784)
Final License Application

Figure: 4.6.1.3.3-1:
Delineated Mesohabitats

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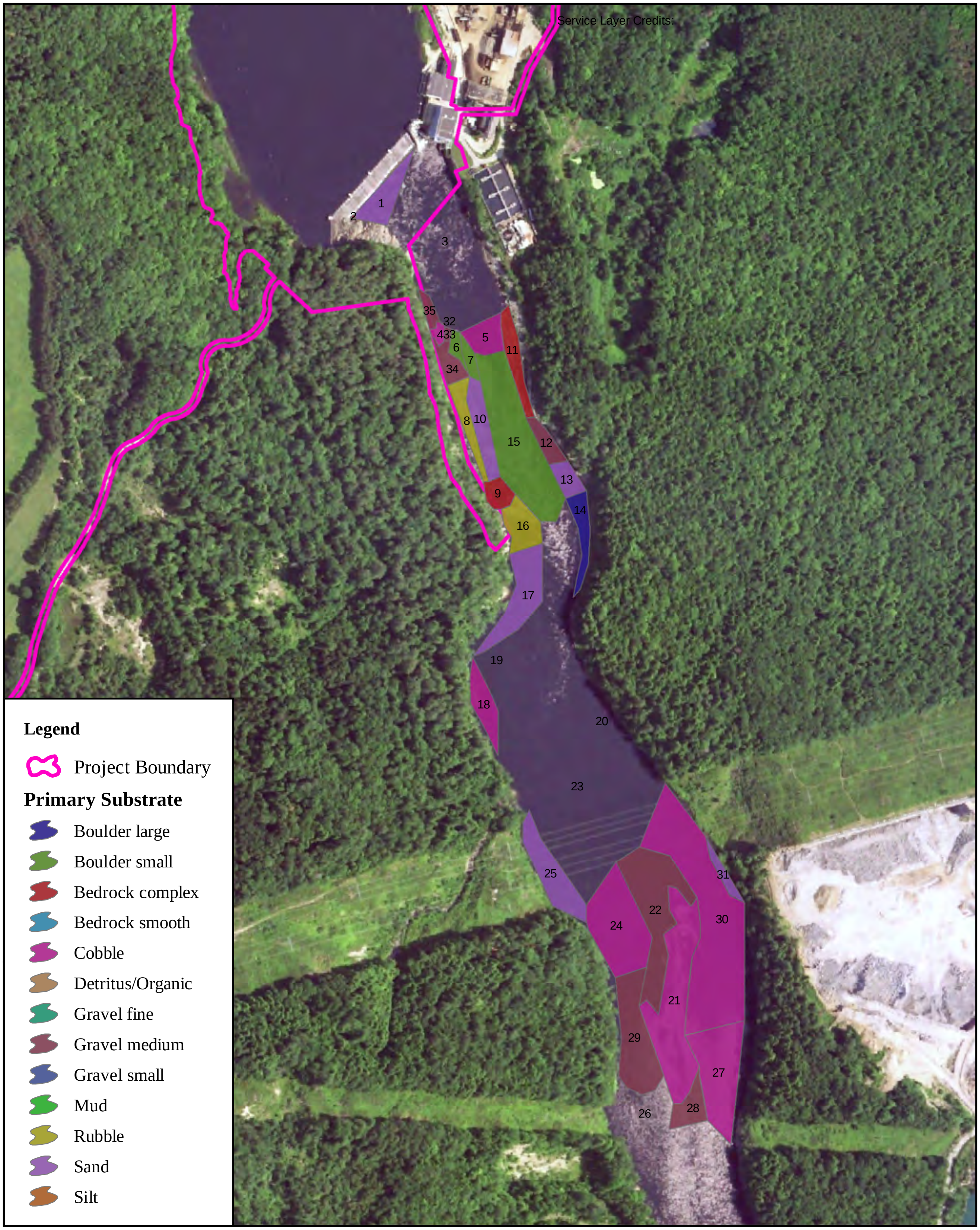

Brookfield

N

0 125 250 500 Feet

Pejepscot Hydroelectric Project
(FERC No. 4784)
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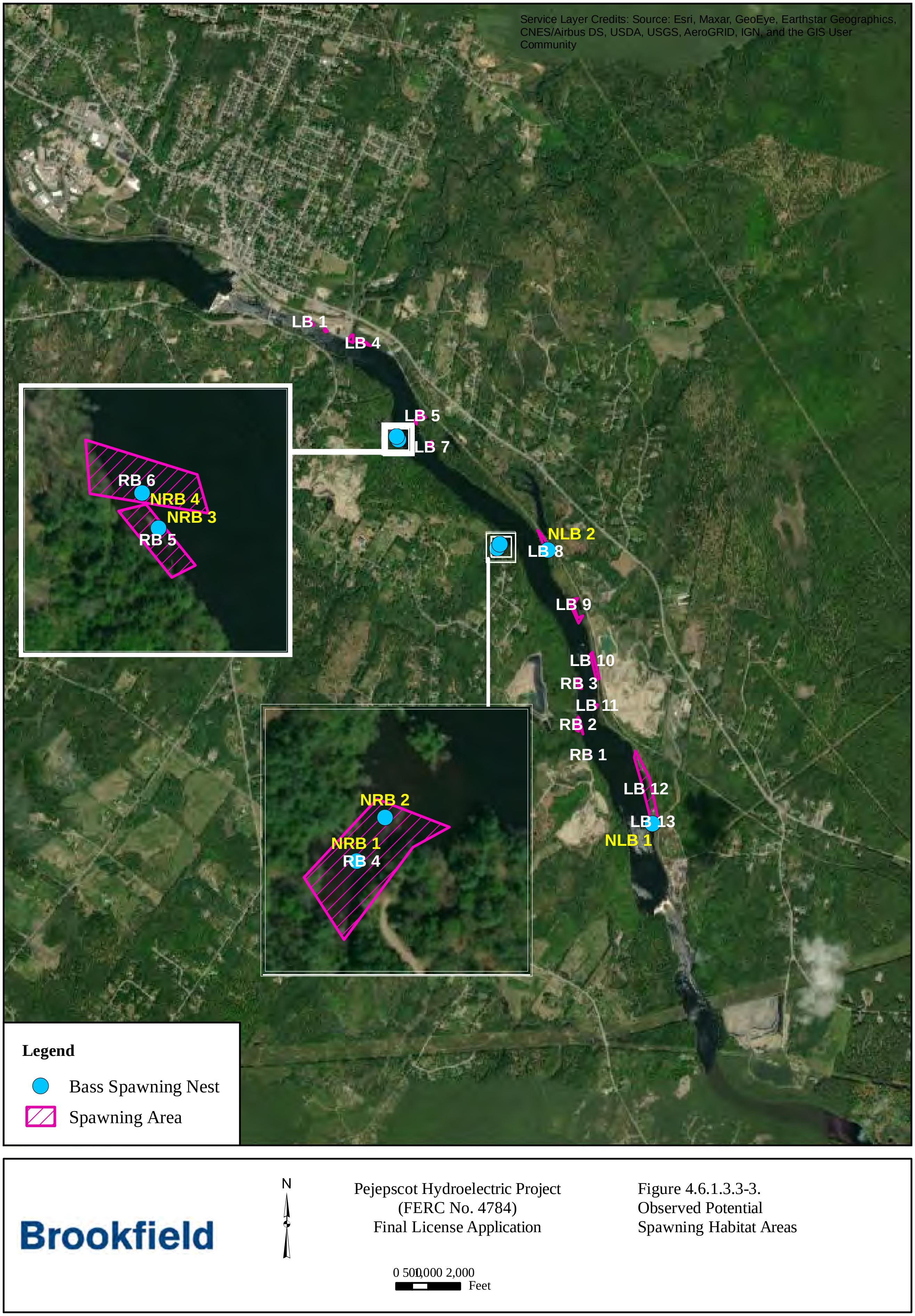
Figure 4.6.1.3.3-2:
Mesohabitat Primary Substrates



Pejepscot Hydroelectric Project
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Figure 4.6.1.3.3-3.
Observed Potential
Spawning Habitat Areas

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E4.6.1.3.4 Special Fish Habitats

Critical habitat is designated by the NMFS for the survival and recovery of species listed as threatened or endangered under the Endangered Species Act (ESA), including Atlantic Salmon. Critical habitat includes areas occupied by ESA-listed species and those areas that may require special management considerations or protection or that have been determined to be essential for the conservation of the species. Atlantic Salmon in the Androscoggin are part of the Merrymeeting Bay Salmon Habitat Recovery Unit and portions of the Androscoggin River, downstream of the Lewiston Falls Dam is classified as critical habitat (i.e., critical to the recovery of the species), including the waters of the Pejepscot Project (NMFS, 2009).

The Magnuson-Stevens Fishery Conservation and Management Act and is defined EFH for species managed in Fishery Management Plans as the habitat necessary for managed fish to complete their life cycle such that the fishery can be harvested sustainably. Habitats of particular concern are EFHs that are judged to be particularly important to the long-term productivity of populations of one or more managed species, or to be particularly vulnerable to degradation (NEFMC, 1998). EFH for Atlantic Salmon is described as all waters currently or historically accessible to Atlantic Salmon within the streams, rivers, lakes, ponds, wetlands and other water bodies of Maine, New Hampshire, Vermont, Rhode Island and Connecticut and is defined for each Atlantic Salmon life stage (NEFMC, 1998) as follows:

- Eggs: Bottom habitats with a gravel or cobble riffle (redd) above or below a pool of rivers. Generally, the following conditions exist in the egg pits (redds): water temperatures below 10°C, and clean, well-oxygenated fresh water. Atlantic Salmon eggs are most frequently observed between October and April.

- Larvae: Bottom habitats with a gravel or cobble riffle (redd) above or below a pool of rivers. Generally, the following conditions exist where Atlantic Salmon larvae, or alevins/fry, are found: water temperatures below 10°C, and clean, well-oxygenated fresh water. Atlantic Salmon alevins/fry are most frequently observed between March and June.

- Juveniles: Bottom habitats of shallow gravel / cobble riffles interspersed with deeper riffles and pools in rivers and estuaries. Generally, the following conditions exist where Atlantic Salmon parr are found: clean, well-oxygenated fresh water, water temperatures below 25°C, water depths between 10 cm and 61 cm, and water velocities between 30 and 92 cm per second. As they grow, parr transform into smolts. Atlantic Salmon smolts require access downstream to make their way to the ocean. Upon entering the sea, "postsmolts" become pelagic and range from Long Island Sound north to the Labrador Sea.

- Adults: For adult Atlantic Salmon returning to spawn, habitats with resting and holding pools in rivers and estuaries. Returning Atlantic Salmon require access to their natal streams and access to the spawning grounds. Generally, the following conditions exist where returning Atlantic Salmon adults are found migrating to the spawning grounds: water temperatures below 22.8°C, and dissolved oxygen above 5 ppm. Oceanic adult

Atlantic Salmon are primarily pelagic and range from the waters of the continental shelf off southern New England north throughout the Gulf of Maine.

- Spawning Adults: Bottom habitats with a gravel or cobble riffle (redd) above or below a pool of rivers. Generally, the following conditions exist where spawning Atlantic Salmon adults are found: water temperatures below 10°C, water depths between 30 cm and 61 cm, water velocities around 61 cm per second, and clean, well-oxygenated fresh water. Spawning Atlantic Salmon adults are most frequently observed during October and November. Atlantic Salmon EFH includes all aquatic habitats in the watersheds of the identified rivers, including all tributaries, to the extent that they are currently or were historically accessible for salmon migration. Atlantic Salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

Atlantic Salmon EFH for eggs and larvae, juvenile and adults is designated for the Androscoggin River, including Project waters (NMFS, 2012a).

E4.6.1.4 Benthic Macroinvertebrates

Benthic macroinvertebrates are discussed in Sections 4.5.1.2.4 and 4.5.1.2.5.

E4.6.1.5 Amphibian and Aquatic Reptile Resources, Habitats, and Temporal/Life History

Examination of available species distribution maps have determined that there are approximately seventeen amphibian species and approximately thirteen reptile species that may be present in the Project Area (Table 4.6.1.5-1). Based on their life history requirements, the salamander, frog/toad, and turtle species have the potential to utilize the aquatic habitat within the Project Area. Snake species, while not primarily aquatic, may utilize riparian areas for feeding and shelter (MDIFW, 2013).

Table 4.6.1.5-1: Amphibian and Reptile Species Documented in Androscoggin, Cumberland, and Sagadahoc Counties, Maine

Type	Common Name	Scientific Name	Aquatic Habitat Use	Riparian Habitat Use	Status in Maine
Salamanders	Eastern red-backed salamander	*Plethodon cinereus*	Breeding/Larvae	Juvenile/Adult	Not Listed
	Yellow spotted salamander	*Ambystoma maculatum*	Breeding/Larvae	Juvenile/Adult	Not Listed
	Northern dusky salamander	*Desmognathus fuscus*	Breeding/Larvae Juvenile/Adult	Juvenile/Adult	Not Listed
	Northern two-lined salamander	*Eurycea bislineata*	Breeding/Larvae Juvenile/Adult	Juvenile/Adult	Not Listed
	Northern spring salamander	*Gyrinophilus porphyriticus*	Breeding/Larvae Juvenile/Adult	Juvenile/Adult	Special Concern
	Four-toed salamander	*Hemidactylium scutatum*	Breeding/Larvae	Juvenile/Adult	Not Listed
	Eastern newt (red-spotted newt)	*Notophthalmus viridescens*	Breeding/Larvae/ Adult	Juvenile	Not Listed
	Blue-spotted salamander	*Ambystoma laterale*	Breeding/Larvae	Juvenile/Adult	Special Concern
Frogs and Toads	American toad	*Anaxyrus americanus*	Breeding/Larvae	Juvenile/Adult	Not Listed
	American bullfrog	*Lithobates catesbeianus*	All Stages	Adult (breeding movements)	Not Listed
	Gray tree-frog	*Hyla versicolor*	Breeding/Larvae	Juvenile/Adult	Not Listed
	Green frog	*Rana clamitans melanota*	All Stages	Adult (wintering)	Not Listed
	Mink frog	*Lithobates septentrionalis*	All Stages	Juvenile/Adult - occasionally	Special Concern
	Northern leopard frog	*Lithobates pipiens*	All Stages	Juvenile/Adult	Special

Type	Common Name	Scientific Name	Aquatic Habitat Use	Riparian Habitat Use	Status in Maine
					Concern
	Pickerel frog	*Lithobates palustris*	Breeding/Larvae Wintering Adult	Juvenile/Adult (summer)	Not Listed
	Spring peeper	*Pseudacris crucifer*	Breeding/Larvae	Juvenile/Adult	Not Listed
	Wood frog	*Lithobates sylvaticus*	Breeding/Larvae	Juvenile/Adult	Not Listed
Snake	Eastern milk snake	*Lampropeltis triangulum trangulum*	NA	All Stages	Not Listed
	Northern brown snake	*Storeria d. dekayi*	NA	All stages	Special Concern
	Northern water snake	*Nerodia sipedon*	Adult (feeding)	Juvenile/Adult	Not Listed
	Garter snake	*Thamnophis sirtalis*	NA	Juvenile/Adult	Not Listed
	Eastern ribbon snake	*Thamnophis sauritus*	NA	Juvenile/Adult	Special Concern
	Redbelly snake	*Storeria occipitomaculata*	NA	Juvenile/Adult	Not Listed
	Ring-neck snake	*Diadophis punctatus*	NA	Juvenile/Adult	Not Listed
	Smooth green snake	*Opheodrys vernalis*	NA	Juvenile/Adult	Not Listed
Turtles	Eastern painted turtle	*Chrysemys picta*	Juvenile/Adult	Breeding/Nesting Juvenile/Adult (sunning)	Not Listed
	Snapping turtle	*Chelydra serpentina*	Juvenile/Adult	Breeding/Nesting	Not Listed
	Spotted turtle	*Clemmys guttata*	Juvenile/Adult	Breeding/Nesting	Special Concern
	Musk turtle	*Sternotherus odoratus*	Juvenile/Adult	Juvenile/Adult	Not Listed

Type	Common Name	Scientific Name	Aquatic Habitat Use	Riparian Habitat Use	Status in Maine
				(hibernation)	
	Wood turtle	*Glyptemys insculpta*	Juvenile/Adult	Juvenile/Adult (summer)	Special Concern

E4.6.1.5.1 Salamanders

Eight species of salamander could potentially use aquatic or terrestrial habitats in the Project Area. Of these, the blue-spotted salamander and the northern spring salamander are listed as Species of Special Concern in Maine (MDIFW, 2013). The other six species are: eastern newt (also known as the red-spotted newt), eastern red-backed salamander, four-toed salamander, northern dusky salamander, northern two-lined salamander, and yellow spotted salamander.

The Northern spring salamander, northern dusky salamander, and northern two-lined salamander share similar habitat, reproduction and diet requirements. All three species inhabit terrestrial and aquatic habitats including: clear upland streams, caves, shaded seepages, rocky brooks, springs, seepages, and associated riparian areas. Occasionally they are also found in swamps and lake margins or forested wet areas. They are often found under rocks, logs, leaves, or moss in or around water. Reproduction occurs at various times of the spring, summer, or fall depending on environmental conditions (NatureServe Explorer, 2016).

The eastern red-backed salamander, the four-toed salamander, the yellow spotted salamander, and the blue-spotted salamander share similar habitat, reproduction and diet requirements. These species can inhabit lakes, ponds, swamps, and quiet stream pools, forested wetland, scrub-shrub wetland, riparian zones, and multiple forest types containing damp microhabitats under leaf litter, surface objects, or inside logs. Breeding migration timing varies depending on local conditions and may occur in both spring and fall, with egg laying typically occurring in late winter to mid-summer (NatureServe Explorer, 2016).

The eastern newt, also known as the red-spotted newt, requires both terrestrial and aquatic habitat throughout its life cycle. With the exception of the red eft stage (juvenile), it is primarily aquatic. Aquatic habitats include lakes, ponds, swamps, pools, shallow water, and wetlands. In the red eft stage, the eastern newt is terrestrial. Terrestrial habitats include riparian areas wetlands, forests, and grasslands or herbaceous areas. The red eft stage burrows in soil, under fallen logs, leaf litter, and other forest debris (NatureServe Explorer 2016).

E4.6.1.5.2 Frogs and Toads

There are nine species of frog and toad that may utilize habitats within the Project Area. The American toad, spring peeper, wood frog, pickerel frog, gray tree-frog, green frog, and American bullfrog are common species throughout Maine. Two species, the mink frog and the northern leopard frog, are listed as Species of Concern in the State of Maine (MDIFW, 2013).

The mink frog, green frog, and American bullfrog are highly aquatic species that venture onto land if conditions are suitable. They can inhabit ponds, swamps, lakes, reservoirs, marshes, stream margins and are found mainly in waterbodies with abundant floating, emergent, or submerged vegetation along shorelines. During winter, hibernation typically takes place under land objects, underground, or under flowing water. Breeding for all species occurs between May and August. Metamorphosis varies between species, with both the mink frog and American bullfrog developing into the adult stage one to two years after the eggs hatch (NatureServe Explorer, 2016).

The northern leopard frog, pickerel frog, spring peeper, wood frog, and gray tree frog share similar habitat, reproduction, and diet requirements. All of these species utilize both terrestrial and aquatic habitats at various life stages. They can inhabit springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, lakes, multiple wetland types, and riparian zones. They are usually found near permanent water with rooted aquatic vegetation. During winter, hibernation may take place either underwater or underground. Breeding occurs in the spring (NatureServe Explorer, 2016).

With the exception of the breeding season, the American toad occupies primarily terrestrial areas. They prefer areas with sufficient moisture, food and a suitable breeding location nearby. Common habitats include, but are not limited to, forests of multiple compositions, forested wetlands, herbaceous wetlands, scrub-shrub wetlands, cropland/hedgerows, and riparian zones. Breeding occurs in the spring when they migrate to temporary or permanent pools, or in shallow areas of slow moving waterbodies. Eggs hatch approximately a week after breeding and metamorphosis occurs within two months of hatching (usually June or July) (NatureServe Explorer, 2016).

E4.6.1.5.3 Turtles

There are five species of turtle that may utilize habitats within the Project Area. The snapping turtle, eastern painted turtle, and musk turtle are considered common turtle species in Maine. The wood turtle and the spotted turtle are listed as Species of Special Concern in the State of Maine.

Wood turtles can be found in a variety of habitats including creeks, rivers, forested and herbaceous wetlands, and forests. During summer months, they may roam overland in terrestrial habitats alongside streams, such as woodland bogs and marshy fields. Overwintering occurs in bottoms or banks of streams where water flows all winter, even under ice. This species has a wide diet, and could be considered carnivorous, frugivorous, and insectivorous (NatureServe Explorer, 2016).

The spotted turtle is a semi-aquatic turtle species that inhabit woodland streams, wet meadows, creeks, and rivers. They move seasonally between different wetland types and spend time on land. Hibernation occurs in muddy bottoms of waterways or bogs. Breeding occurs between March and May and egg hatching occurs late August to September (NatureServe Explorer, 2016).

The snapping turtle, eastern painted turtle, and musk turtle are aquatic turtles that can inhabit a wide range of waterbody types including: shallow bodies of water with soft bottom and aquatic vegetation, lake margins, vernal pools, swamps, woodland streams, fens, bogs, small marshes and marshy pastures. During winter, hibernation occurs in bottom mud, debris, or bank holes. During breeding season, overland travel may occur (Fuller, 2016, Warner Nature Center, 2016, NatureServe Explorer, 2016).

E4.6.1.5.4 Snakes

There are eight species of snakes that may utilize habitats within the Project Area, including the northern water snake, northern brown snake, eastern milk snake, garter snake, eastern ribbon snake, redbelly snake, ring-neck snake and smooth green snake. The northern water snake requires aquatic habitat while the other snake species may make limited use of aquatic environments, primarily riparian zones and immediate shorelines. Two species, the northern brown snake and eastern ribbon snake, are listed as a Species of Special Concern in Maine.

The northern water snake inhabits creeks, rivers, lakes, oxbows, canals, reservoirs, ponds, marshes, bogs, swamps, forested wetlands, herbaceous wetlands, scrub-shrub wetlands, and riparian zones. Basking areas include flood debris piles, logs, or rocks at the water's edge. Hibernation occurs in burrows, rocks or deep crevices either at the water's edge or in upland areas near water. The breeding season typically occurs from late April to early June (NatureServe Explorer, 2016).

The northern brown snake, eastern ribbon snake, garter snake, and redbelly snake inhabit terrestrial and wetland habitats. They hibernate underground or beneath buildings and other structures. These snakes give "live" birth, and therefore do not require habitat for egg protection and development. Their diet includes earthworms, slugs, snails, insects, and small amphibians. (NatureServe Explorer, 2016).

The eastern milk snake, ring-neck snake, and smooth green snake share similar habitat, reproduction, and diet requirements. These snakes inhabit a wide variety of areas including open country, road cuts, powerline rights-of-way, rocky hillsides, grasslands, riparian zones, wetland borders, deciduous forests, and human dwellings. They may be found under objects such as rocks, logs, boards, tin, or building debris. Eggs require a well-drained, protected area with external heat to hatch (MDIFW, 2013, NatureServe Explorer, 2016).

E.4.6.2 Environmental Analysis

FERC's SD2 identified two potential resource issues relating to aquatic resources, which are discussed in greater detail below.

Effects of continued project operation on aquatic habitat in the project area for aquatic organisms.

Topsham Hydro operates the Project in a run-of-river mode, resulting in limited man-made fluctuation in the Project impoundment, and the operation of the Project has no effect on overall river flow in the lower Androscoggin River. The Project waters are composed of a variety of aquatic habitats that provide nursery, spawning, and rearing opportunities for resident and migratory fish species, including Smallmouth and Largemouth Bass, Yellow Perch, American Eel, river herring, American Shad, suckers, and other important minnow and forage species. The Project waters are also designated as critical habitat for Atlantic Salmon. In addition, several species of amphibians, reptiles, and macroinvertebrates inhabit the Project waters during their life cycles.

Existing information for the Project, along with the results of the studies completed by Topsham Hydro, demonstrate that the current operation of the Project is maintaining and supporting habitat for aquatic species in the Androscoggin River both upstream and downstream of the Project dam.

Topsham Hydro is proposing to continue to operate the Project in a run-of-river mode, which will maintain existing aquatic habitat and angling opportunities in the Project area. Continued operation of the Project is not expected to adversely affect aquatic habitat, including EFH for Atlantic Salmon.

The results of Topsham Hydro's stranding evaluation identified several potential stranding pools in the bedrock outcrop on the right side of the Project dam below bascule gate No. 5. The pools only form when the gate is closed after the cessation of spill events, so their occurrence is relatively rare (i.e., less than 25% of the time annually at least one of the five spill gates is operated). Topsham Hydro will develop, in consultation with stakeholders, a mitigation measure to address the potential for stranding in pools below bascule gate no. 5. The measure will generally consist of Operations staff visually inspected these pools following spill events and as necessary taking remediation action should stranded fish be identified.

Topsham Hydro's LWD study indicated that approximately 150 cubic yards of debris, consisting of various sizes, is removed from the Project impoundment on an annual basis. The study also determined that there were no existing measures available to keep LWD in the river system. Topsham Hydro's proposed trash boom, to be installed as part of the proposed downstream fish guidance system, will facilitate the sluicing of a greater proportion of this debris downstream past the Project, resulting in benefits to aquatic habitat in the Project tailwater.

<u>Effects of continued project operation on passage of migratory fish species in the Androscoggin River including upstream passage of adult fish and downstream passage of smolts and juveniles.</u>

Upstream Fish Passage

Topsham Hydro conducted several radio telemetry studies and desktop analyses to determine the effectiveness of the existing upstream passage facilities at the Project.

Topsham Hydro's desktop evaluation of the fish lift's effectiveness for adult Atlantic Salmon indicated that passage rates could range between 79% and 96%, based on a comparison to similar fish lifts (i.e., Milford and Lockwood Projects) in the area that conducted field-based upstream passage effectiveness testing for this species. Moreover, it is likely that the passage effectiveness would be closer to the higher end of this range, since Pejepscot was more similar in terms of its physical layout to the Milford Project, which had a 96% passage effectiveness for Atlantic Salmon. Topsham Hydro proposes 1) continued video camera monitoring for Atlantic Salmon utilizing the Pejepscot fish lift, and 2) conducting a Atlantic Salmon radio telemetry study, to determine upstream passage effectiveness at the Pejepscot fish lift, when at least 40 adult Atlantic Salmon of Androscoggin River origin are counted at the Brunswick fishway for two consecutive years.

Topsham Hydro's 2019 study results indicate that the overall effectiveness of the fish lift for adult river herring passage is 19.8% (75% CI = 14.8-24.9%). However, 93% of the radio-tagged adult river herring that were determined to have approached the Project were detected on at least one occasion within the entrance to the fish lift. Studies completed in the early 1990's under more typical spring flow conditions, showed that the overall effectiveness for alewife was greater than 87%. Historic adult river herring counts at the Brunswick and Worumbo fishways also provide information on the passage effectiveness at the Pejepscot fish lift for this species (Table 4.6.2-1). The 2019 study results appear to indicate that the majority of adult river herring were entering the fish lift entrance; however, many were not completing passage through the fish lift. Higher than average flow conditions resulted in a less frequent lift cycle during the study, which may have impacted overall effectiveness. In addition, the internal hydraulics of the attraction water system or some other related internal factor such as underwater sound could be affecting behavior of adult river herring within the fish lift.

Radio telemetry study results showed that few upstream migrating American Shad neither approached the Project area nor entered the fish lift. Only 28% of the tagged sample fish approached the Project area, as many fell back after release, or only partially ascended the river reach to the Project. It is possible that the extensive handling and transport of the test specimens, which were caught via rod and reel downstream of the Brunswick Project, may have negatively affected the desire of test fish to migrate upstream during the study. For adult American Shad that approached the study area, nearfield attraction effectiveness was estimated at 32%, while overall fish lift effectiveness was 0%. Most shad that did approach the Project area spent the majority of their residence time downstream of the Project spillway, rather than in the vicinity of the fish lift, even though the potential for false attraction from spillage was low due to the limited spill events. Very low numbers of American Shad pass at the Brunswick Fishway, located downstream of Pejepscot. Since 1983, a total of 1,428 American Shad have been observed passing the fishway at the Brunswick Project, with most (1,123 individuals) passing in 2016, and zero passing the fishway in most of the other years during this period. At the Worumbo Project, 45 American Shad were observed passing the fishway in 2016. Historic American Shad counts at the Brunswick and Worumbo fishways also provide some information on the passage effectiveness at the Pejepscot fish lift for this species (Table 4.6.2-2). Under current conditions, very few shad are present in the Pejepscot tailrace.

The Pejepscot fish lift currently cycles every two hours during the typical daily operation period of 0800 to 1800 hours (total of five cycles per day) during the peak upstream migration period for river herring and American Shad. In order to enhance passage effectiveness of river herring and American Shad that may be entering the fish lift and congregating within the entrance channel, Topsham Hydro proposes to increase the number of lift cycles to one lift event per hour (10 lift cycles per day) between the hours of 0800 and 1800, during the peak upstream migration period (May 16 through June 15) for river herring and American Shad. Topsham Hydro also proposes to investigate factors associated with the existing fish lift (i.e., internal and external attraction flow hydraulics and acoustics) that may be affecting upstream passage effectiveness, and develop a plan and schedule, in consultation with resource agencies, containing potential physical and/or operational modifications to be constructed/implemented no later than Year 3 of the new license[25], to address issues that may be impacting upstream passage of migratory fish species.

Regarding American Eels, upstream migrating juveniles (elvers and yellow eels) are affected by the presence of the Project. Juvenile eels were not observed during the nighttime eel surveys conducted in 2019 by Topsham Hydro. However, a relatively small number of juvenile eels have been documented passing upstream at the Worumbo Project eel ladder. Annual counts for the 2012 to 2017 period, showed a low of 17 eels passed in 2012 and a high of 541 eels passed in 2014, indicating that some degree of upstream passage at the Pejepscot Project is occurring. In addition, Yoder et al, 2006 found eels in relatively low abundance both upstream and downstream of Pejepscot. Topsham Hydro is proposing a study to install and operate an interim trap structure to further investigate upstream migrating American Eel passage at the Project. A temporary, portable eel trap will be installed at one location downstream of the Project Dam during the first full passage season (June 1 through September 15) after the effective date of the new license. Interim eel trap sampling will be continued for a total of three full passage seasons. The results of the upstream juvenile American Eel passage study will be used to identify a suitable location for a permanent upstream American Eel trap. Due to the relatively low number of eels currently in the system, Topsham Hydro is proposing that the permanent ramp be installed and operational when upstream eel passage facilities are constructed at the downstream Brunswick Hydroelectric Project, as part of its upcoming FERC licensing proceeding. Figure 4.6.2-1 provides a conceptual design drawing of the proposed interim upstream American Eel passage facility.

Downstream Fish Passage

Topsham Hydro conducted radio tag telemetry studies and desktop analyses to determine route of passage and survival of diadromous fish that may migrate downstream past the Project.

Based on previous studies conducted by Topsham Hydro from 2013-2015, and 2018, whole-station survival of Atlantic Salmon smolts is expected to meet the specified take limitation of 92 percent survival. To ensure the take limitations are met, Topsham Hydro is proposing to provide approximately 500 cfs of spill at night (2000 – 0700 hours) during the month of May, by opening bascule gate No. 1 (closest to the powerhouse). While some entrainment of salmon smolts may still occur during normal operations, Topsham Hydro expects, based on the results of the 4 years of effectiveness testing, that the SPP take limits will be met over the course of the next license. Topsham Hydro proposes to monitor downstream migrating Atlantic Salmon kelts as part of the aforementioned adult Atlantic Salmon study described above, which will be conducted when at least 40 adult Atlantic Salmon of Androscoggin River origin are counted at the Brunswick fishway for two consecutive years.

[25] During 2020 and 2001 Topsham Hydro will investigate factors associated with the existing fish lift (i.e., internal and external attraction flow hydraulics and acoustics) that may be affecting upstream passage effectiveness.

Topsham Hydro's study results indicate that juvenile alosines (American Shad and river herring) experience very little delay when migrating past the Project. The preferred routes of passage at the Project for these fish are Unit 1 (68.4%) and the downstream bypasses (30.5%). Estimated turbine survival based on a desktop evaluation ranged from 97.6 to 98.5% (TBSA predicted survival for 4 to 6-inch fish).

Downstream migrating adult river herring experience little or no delay in passing the Project. The preferred routes of passage are via Unit 1 (51%), spill (27%) and the downstream bypasses (11%), with passage effectiveness estimated at 80.9% (75% CI = 76.3-85.7%). Turbine survival was estimated at 88% based on the field based telemetry results. Estimated turbine survival based on a desktop evaluation was approximately 95.5% (TBSA predicted survival for 11 to 13-inch fish).

Study results showed that Adult American Shad experienced some delay when migrating past the Project. The preferred routes of passage are via Unit 1 (31%), spill (26%) and the downstream bypasses (9%), with passage effectiveness estimated at 51.4% (75% CI = 41.6-61.1%). Shad were present in the upstream Project area for extended periods of time (most greater than 96 hours) prior to either passing downstream via Unit 1 or the bypass system. Nearly one third of all observed downstream passage events happened when spill flows were present at the bascule gates. The test specimens were taken from the Saco River during the later portion of the migratory run and transported to the Project for the study. Some of the handling and the overall condition of the test fish may have impacted their passage behavior during the study. Turbine survival was estimated at 82% based on the field based telemetry results. Estimated turbine survival based on a desktop evaluation ranged from 91.3 to 95.6% (TBSA predicted survival for 14 to 23-inch fish).

For American Eel, Topsham Hydro's study results indicate that this species migrates very quickly past the Project, and does not experience significant delay. The preferred route of passage for adult eels is Unit 1, which resulted in a high estimated passage survival of 91.7% (75% CI = 87.5-95.8%). The estimated whole-station survival for adults eels at the Project is high as well at 90.0% (75% CI =86.0-94.0%).

To enhance downstream passage at the Project, Topsham Hydro, in consultation with resource agencies, is proposing to install and operate a fish guidance system/debris boom to direct downstream migrants to a new bypass within bascule gate no. 1 beginning in the second full passage season after the effective date of the new license. Figure 4.6.2-2 provides a conceptual design drawing of the proposed downstream passage facility. Topsham Hydro will also discontinue the north (left bank) downstream fish bypass beginning in the second full passage season after the effective date of the new license, but continue operation of the south (right bank) downstream fish bypass from April 1 to December 31 annually.

In addition, to enhance downstream passage for American Eel, Topsham Hydro proposes to reduce the operational setting for Unit 1 (unit turndown) to approximately 3,480 cfs (resulting in intake approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually.

Table 4.2.6-1: Adult River Herring Passage at the Brunswick and Worumbo Fishways

Year	Total River Herring Catch at Brunswick	River Herring Transported from Brunswick	River Herring Released into Brunswick Pond	River Herring Passed at Worumbo[26]
2007	60,662	23,369	33,344	19,078
2008	92,359	24,684	59,400	46,746
2009	44,725	22,057	20,702	14,961
2010	39,689	11,800	20,564	11,952
2011	54,886	20,907	25,737	136
2012	170,191	20,758	118,178	58,654
2013	69,104	21,442	38,369	28,714
2014	55,678	19,402	24,952	37,113
2015	71,887	22,983	28,638	59,200
2016	114,874	22,612	74,471	12,807
2017	49,923	21,360	19,695	11,200
2018	179,040	20,849	136,987	73,073
2019	81,025	20,714	44,501	10,326
Total	**1,084,043**	**272,937**	**645,538**	**383,960**

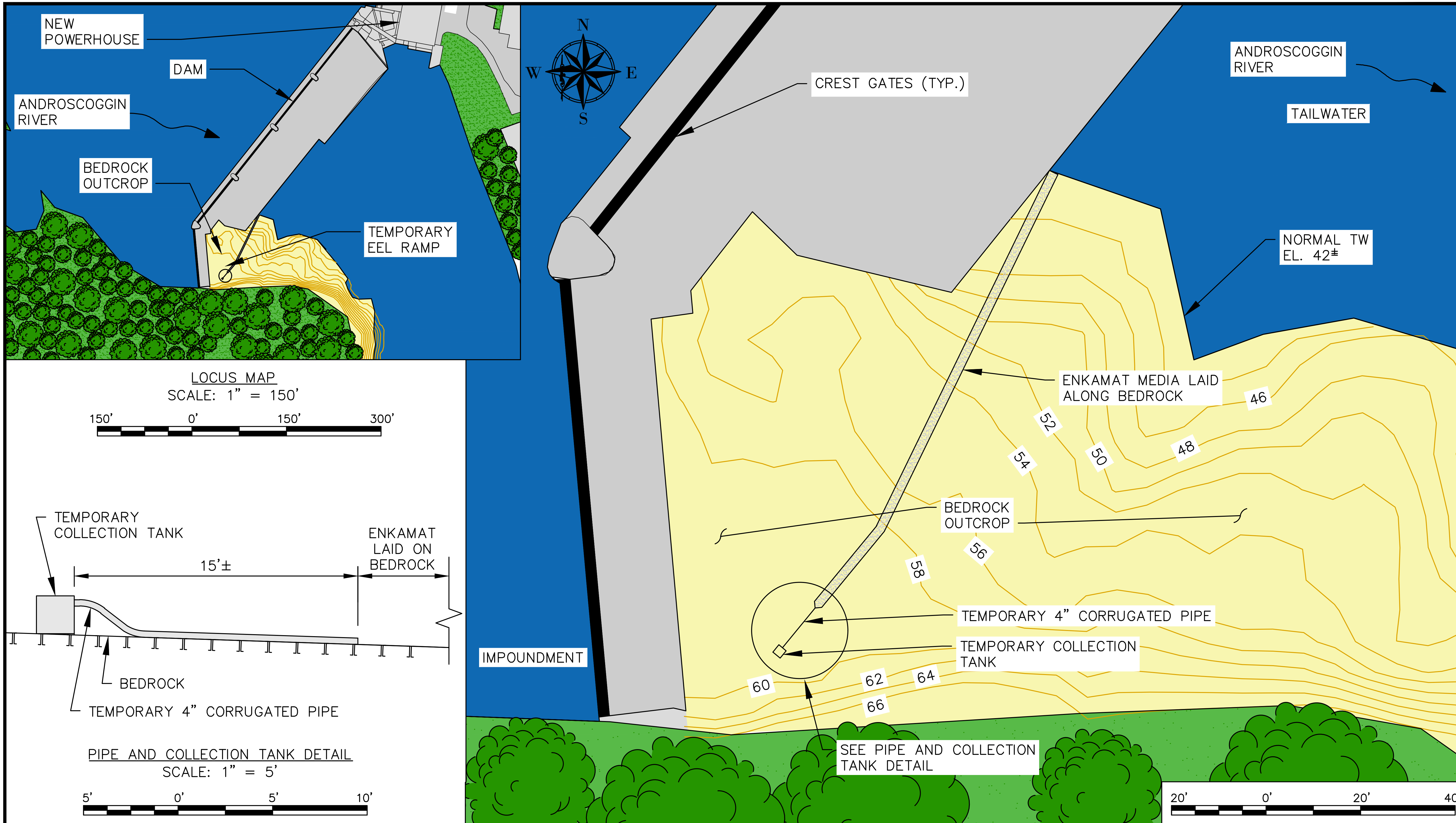
Source: Final Environmental Assessment, Barker's Mill Hydroelectric Project, FERC Project No. 2808-017, February 2019, and Brookfield Annual Fishway Reports for the Brunswick Hydroelectric Project.

[26] In some instances counts at Worumbo are higher than the number of river herring released into Brunswick Pond. The reason for the discrepancy could not be determined.

Table 4.2.6-2: American Shad Passage at the Brunswick and Worumbo Fishways

Year	Total American Shad Passed at Brunswick	Total American Shad Passed at Worumbo
2007	6	0
2008	1	0
2009	0	0
2010	22	0
2011	0	0
2012	11	0
2013	16	0
2014	0	0
2015	53	18
2016	1,096	45
2017	1	0
2018	32	1
2019	63	9
Total	**1,301**	**73**

Source: Final Environmental Assessment, Barker's Mill Hydroelectric Project, FERC Project No. 2808-017, February 2019, and Brookfield Annual Fishway Reports for the Brunswick Hydroelectric Project.



NO.	DATE	DESCRIPTION	BY	APP
0	8/10/20	TEMPORARY EEL RAMP CONCEPT	KJC	-

FOR: Brookfield

BY: GOMEZ AND SULLIVAN ENGINEERS
Williamsville, NY • Utica, NY • Albany, NY • Henniker, NH
www.gomezandsullivan.com

DESIGNED BY:	-
DRAWN BY:	KJC
CHECKED BY:	-
APPROVED BY:	-
PROJECT NO.:	1925
DATE:	

PEJEPSCOT AMERICAN EEL
TEMPORARY UPSTREAM TRAPPING FACILITY - RIGHT BANK

PLAN VIEW

SCALE: 1" = 20' (11" X 17")

DRAWING NO.: 1

Figure 4.6.2-1

Topsham Hydro Partners Limited Partnership
PEJEPSCOT HYDROELECTRIC PROJECT
FERC NO. 4784

PROPOSED FISH GUIDANCE AND DEBRIS BOOM

30' 0 30' 60'
SCALE:1"=30'

Figure 4.6.2-2

E.4.6.3 Proposed Environmental Measures

Topsham Hydro is proposing the following PME measures to protect aquatic resources.

- Maintain a minimum flow of 1,170 cfs, or inflow, whichever is less[27].
- Operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates[28].
- Develop, in consultation with stakeholders, a Stranding Plan to address potential stranding of fish in the bedrock area below bascule gate no. 5. The Plan will detail inspections of the pools by operators following spill events.
- Revise and Implement a Fishway Operations and Maintenance Plan (Appendix E-4).
- Develop a plan and schedule, in consultation with resource agencies, containing potential physical and/or operational modifications to be constructed/implemented no later than Year 3 of the new license[29], to address factors (i.e., internal and external attraction flow hydraulics and acoustics) that may be impacting upstream passage of migratory fish species.
    - Conduct one season of fish lift efficiency testing for adult river herring during the fourth full passage season after the effective date of the new license.
- Install and operate a temporary portable American Eel ramp for three passage seasons (June 1 through September 15) to identify a suitable location for a permanent upstream American Eel ramp. The temporary portable eel ramp will be installed during the first full passage season after the effective date of the new license.
- Install and operate a permanent upstream American Eel ramp (June 1 through September 15) based on the results of the temporary portable ramp evaluation. The permanent ramp will be installed when upstream eel passage facilities are constructed at the downstream Brunswick Hydroelectric Project.
- Discontinue the north (left bank) downstream fish bypass beginning in the second full passage season after the effective date of the new license; continue operation of south (right bank) downstream fish bypass.
- Install and operate a fish guidance system/debris boom to direct downstream migrants to a new bypass within bascule gate no. 1 beginning in the second full passage season after the effective date of the new license.
    - Conduct one season of efficiency testing for juvenile alosines once the proposed downstream fish guidance system is installed and the modifications to bascule gate no. 1 have been completed.

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[27] Minimum flow requirements under the current license are described as "continuous," but Topsham Hydro proposes that the requirement in the new license be instead based on the hourly average. This change would capture the intent of the minimum flow measure, but would avoid unnecessary reporting of very short term excursions due to unplanned events such as extreme weather, equipment failure, and so on. A similar change was adopted in 2011 for the Gulf Island-Deer Rips Hydropower Project (FERC No. 2283).

[28] Topsham Hydro also proposes that, for compliance purposes, the pond level elevation also be based upon hourly average, for similar logic as the minimum flow requirement.

[29] During 2020 and 2001 Topsham Hydro will investigate factors associated with the existing fish lift (i.e., internal and external attraction flow hydraulics and acoustics) that may be affecting upstream passage effectiveness.

- Reduce the operational setting for Unit 1 (unit turndown) to 3,480 cfs (resulting approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually to enhance downstream eel passage.
- Implement the following measures for ESA-listed Atlantic Salmon.
  - Continue video camera monitoring of Atlantic Salmon utilizing the Pejepscot fish lift.
  - Conduct an Atlantic Salmon radio telemetry study, to determine upstream passage effectiveness at the Pejepscot fish lift, when at least 40 adult Atlantic Salmon of Androscoggin River origin are counted at the Brunswick fishway for two consecutive years.
  - Monitor downstream migrating Atlantic Salmon kelts as part of the adult Atlantic Salmon radio telemetry study described above.
  - Open bascule gate No. 1 (closest to the powerhouse) 50% to provide approximately 500 cfs of spill at night (2000 – 0700 hours) during the month of May.
  - Conduct one season of efficiency testing for Atlantic Salmon smolts once the proposed downstream fish guidance system/debris boom is installed and the modifications to bascule gate no. 1 have been completed.

E.4.6.4 Cumulative Effects

In SD2, aquatic habitat and passage of migratory fish species are identified as resources that could be cumulatively affected by the proposed continued operation and maintenance of the Project. The geographic scope for these resources was identified as the entire Androscoggin River basin.

Topsham Hydro’s proposal to continue to operate the Project in a run-of-river mode with no storage or flood control capacity, would continue to have a beneficial cumulative effect on streamflow, aquatic habitat and fisheries in the Lower Androscoggin River by eliminating any impoundment and flow fluctuations associated with the Project. Any other hydropower projects in the Androscoggin River watershed that have peaking operations would continue to influence streamflow, aquatic habitat and fishery resources.

Activities within Androscoggin River basin that may cumulatively affect migratory fish species include the construction and operation of dams within the river basin, which have resulted in migratory barriers and loss of spawning habitat. The resource agencies and Licensees of hydropower projects within the Androscoggin River basin have been addressing upstream and downstream fish passage in the lower Androscoggin River basin within various regulatory proceedings (i.e., ESA consultation, development of SPPs, and FERC licensing proceedings) over the recent years.

Upstream fish passage facilities at the Project are already in place for Atlantic Salmon, river herring, and American Shad. For upstream migrating American Eel, Topsham Hydro is proposing enhancements in the form of an upstream eel ramp, which should help reduce any cumulative effects to this species in the Androscoggin River basin resulting from operation of the Project.

Operation of the Pejepscot Project may, to a limited degree, cumulatively affect adult silver American Eel, adult and juvenile alosines, and Atlantic Salmon smolts and kelts that are migrating to the Atlantic Ocean. Downstream fish passage is currently provided at the Project and Topsham Hydro is proposing enhancements in the form of a fish guidance system and downstream bypass, which should help reduce any cumulative effects resulting from operation of the Project. Kelt passage will be evaluated when returning numbers of Atlantic Salmon increase so that a sufficient number of kelts can be radio-tagged.

E.4.6.5 Unavoidable Adverse Effects

Proposed continued operation of the upstream fish passage facilities will provide access to upstream habitat, while continued operations of the existing and proposed downstream passage facilities will reduce the potential for entrainment, and thereby facilitate the safe, timely, and effective passage of migratory fish species. Operation of the Project may continue to result in some level of upstream passage delay or entrainment of individual fish, but these effects are expected to be limited in scope and will not have an effect at the population level.

E.4.6.6 References

Atkins, C.G. 1887. The River Fisheries of Maine. Page 673-788 in G.B Goode and a staff of associates, eds. The Fisheries and Fishery Industries of the United States, Volume I Section V. History and Methods of the Fisheries. Government Printing Office, Washington DC.

Atlantic States Marine Fisheries Commission (ASMFC). 2010. Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management). Prepared by ASMFC Shad and River Herring Plan Development Team.

Atlantic Salmon Recovery Project (ASRP). 2015. Draft SHRU Specific Recovery Implementation Strategy. http://kyoto.zentraal.com/atlantic-salmon-recovery-project/resources/documents/atlantic-salmon-recovery-plan-2015/recovery-plan-pages/shru-based-recovery/shru-specific-implementation-strategy-2015/index_html

Atlantic States Marine Fisheries Commission (ASMFC). 2016a. Maine ASMFC River Herring Sustainable Fishing Plan. September 2016. http://www.asmfc.org/files/Shad%20SFMPs/ME_RiverHerring_SFMP_Sept2016.pdf

Atlantic States Marine Fisheries Commission (ASMFC). 2016b. ASMFC Stock Status Overview. January 2016.

Atlantic States Marine Fisheries Commission (ASMFC). 2012. Stock Assessment Report No. 12-02: River Herring Benchmark Stock Assessment Volume I. Accepted for management use May 2012.

Brautigam, F. and J. Pellerin. 2014. Upper Androscoggin Fishery Management Plan. Maine Department of Inland Fisheries and Wildlife. January 2014.

Brown Bear II Hydro, Inc. (Brown Bear). 2016. Draft Biological Assessment for Gulf of Maine Distinct Population Segment of Atlantic Salmon. Prepared July 2016.

Brown Bear II Hydro, Inc. (Brown Bear). 2019. 2018 Annual Species Protection Plan Report. Prepared November 2019

Brookfield White Pine Hydro (BWPH). 2016. 2015 Brunswick Project Fishway Report (FERC No. 2284) Article 30. Submitted to FERC on May 12, 2016.

Brown, M.E., Maclaine, J., and L. Flagg. 2006. Annual Report: Anadromous Alosid Restoration in the Androscoggin River Watershed. State of Maine Department of Marine Resources, Augusta, ME. September 15, 2006.

Brookfield White Pine Hydro (BWPH) and Black Bear Hydro Partners (BBHP). 2016. Evaluation of Atlantic Salmon Passage, Spring 2015 – Weston, Shawmut, and Lockwood Projects, Kennebec River, and Pejepscot and Brunswick Projects, Androscoggin River. Prepared for Brookfield White Pine Hydro, LLC and Black Bear Hydro Partners, LLC by Normandeau Associates, Inc. March 2016.

Bruijs, M.C.M. and C.M.F. Durif. 2009. Silver eel migration and behaviour. Thillart, G., Dufour, S., and J. Rankin (eds.). Spawning Migration of the European Eel – Reproduction Index, a Useful Tool for Conservation Management. Springer, Netherlands. 477pp.

Charles Ritzi Associates. 1992. Pejepscot Hydroelectric Project, FERC Project No. 4784-ME – Evaluation of Upstream Fish Passage Facility. Report No. 2. Prepared for Topsham Hydro Partners.

Danie, D.S., Trial, J.G, and J.G. Stanley. 1984. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) – Atlantic Salmon. U.S. Fish and Wildlife Service FWS/OBS-82/11.22. U.S. Army Corps of Engineers, TR EL-82-4. 19pp.

Davies, S.P., and L. Tsomides. 2014. Methods for Biological Sampling and Analysis of Maine’s Rivers and Streams. DEP LW0387-C2014.

Downeast Salmon Federation (DSF). 2015. Atlantic Salmon Overview. https://mainesalmonrivers.org/atlantic-salmon-overview/ Accessed 12/16/2016.

DTA (Devine, Tarbell & Associates). 2005. Pejepscot Hydro Project, FERC No. 4784-ME Summary of Annual Agency Consultation. Meeting Minutes Filed with FERC May 10, 2005.

Electric Power Research Institute (EPRI). 1997. Turbine entrainment and survival database - field tests. EPRI Report No. TR-108630.

Facey, D.E. and M.J. Van Den Avyle. 1987. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) – American Eel. U.S. Fish and Wildlife Service Biological Report 82(11.74). U.S. Army Corps of Engineers, TR EL-82-4. 28pp.

Fay, C.W., Neves, R.J., and G.B. Pardue. 1983a. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic)– Alewife and Blueback Herring. U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS-82/11.9. U.S. Army Corps of Engineers, TR EL-82-4. 25pp.

Fay, C.W., Neves, R.J., and G.B. Pardue. 1983b. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) – Striped Bass. U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS-82/11.8. U.S. Army Corps of Engineers, TR EL-82-4. 36pp.

Fuller, P., Foster, A., and L.A. Somma. 2016. *Chelydra serpentina*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. https://nas.er.usgs.gov/queries/factsheet.aspx?speciesID=1225 Revision Date: 1/30/2015

HDR Engineering (HDR). 2011. Little River Habitat Assessment Report. Prepared for Topsham Hydro. December 2011.

Kircheis, F.W. 2004. Sea Lamprey – *Petromyzon marinus*. Prepared by F.W. Kircheis L.L.C., Marmel, Maine.

Limburg, K.E., Hattala, K.A., and A. Kahnle. 2003. American Shad in its Native Range. Pages 125-140 in K.E. Limburg and J.R. Waldman, editors. Biodiversity, status, and conservation of the world's shads. American Fisheries Society, Symposium 35, Bethesda, MD.

Maine Department of Marine Resources (MDMR). 2012. Androscoggin River Atlantic Salmon Tagging and Tracking Project 2011. Prepared by M. Pasterczyk, G. Wippelhauser, and M. Brown.

Maine Department of Marine Resources (MDMR). 2017. Draft Fisheries Management Plan for the Lower Androscoggin River, Little Androscoggin River and Sabattus River

Maine Department of Inland Fisheries & Wildlife (MDIFW). 2013a. Species of Special Concern. Maine Department of Inland Fisheries & Wildlife 2011. http://www.maine.gov/ifw/wildlife/endangered/specialconcern.htm Accessed 12/5/16.

Maine Department of Inland Fisheries & Wildlife (MDIFW). 2013b. Snakes. Maine Department of Inland Fisheries & Wildlife. http://www.maine.gov/ifw/wildlife/human/lww_information/snakes.html Accessed 12/7/16.

Miller Hydro Group (Miller Hydro). 2014. Worumbo Project (FERC No. 3428-ME) Annual Fish Passage Report. Submitted to FERC July 1, 2014.

Miller Hydro Group (Miller Hydro). 2013. Worumbo Project (FERC No. 3428-ME) Annual Fish Passage Report. Submitted to FERC July 29, 2013.

New England Fishery Management Council. 1998. Final Amendment for Essential Fish Habitat, Incorporating the Environmental Assessment. Saugus, MA: New England Fishery Management Council in Consultation with National Marine Fisheries Service.

National Marine Fisheries Service (NMFS). 2009. Endangered and Threatened Species. Designation of critical habitat for Atlantic Salmon (Salmo salar) Gulf of Maine Distinct Population Segment. Final rule. Federal Register, Vol. 74, No. 117. June 19, 2009.

National Marine Fisheries Service (NMFS). 2012a. NMFS Endangered Species Act Biological Opinion for the Proposed Amendment of License for the Pejepscot Project (FERC No. 4784).

National Marine Fisheries Service (NMFS). 2012b. NMFS Endangered Species Act Biological Opinion for Emergency Spillway Repair and Proposed Amendment of the License for the Worumbo Project (FERC No. 2428).

NatureServe Explorer. 2016. Comprehensive Report Species. NatureServe Explorer: An Online Encyclopedia of Life. Ver. 7.1. http://explorer.netureserve.org Accessed 12/6/16-12/9/16.

Normandeau (Normandeau Associates, Inc.). 2014. Evaluation of Atlantic Salmon passage at the Weston, Shawmut, Hydro Kennebec, and Lockwood Projects, Kennebec River and the Brunswick Project, Androscoggin River, Maine, spring 2013. Report prepared for Brookfield White Pine Hydro LLC, The Merimil Limited Partnership, and Hydro Kennebec, LLC. March 2014.

Normandeau (Normandeau Associates, Inc.). 2015. Evaluation of Atlantic Salmon passage at the Weston, Shawmut, Hydro Kennebec, and Lockwood Projects, Kennebec River and the Brunswick Project, Androscoggin River, Maine, spring 2014. Report prepared for Brookfield White Pine Hydro LLC, The Merimil Limited Partnership, and Hydro Kennebec, LLC. March 2015.

Normandeau (Normandeau Associates, Inc.). 2016. Evaluation of Atlantic Salmon passage at the Weston, Shawmut, and Lockwood Projects, Kennebec River and the Pejepscot and Brunswick Projects, Androscoggin River, Maine, spring 2015. Report prepared for Brookfield White Pine Hydro LLC, The Merimil Limited Partnership, and Black Bear Hydro Partners, LLC. March 2016.

North Atlantic Salmon Conservation Organization (NASCO). 2009. IP(09)07: Protection, Restoration, and Enhancement of Salmon Habitat Focus Area Report – USA. http://www.nasco.int/pdf/far_habitat/HabitatFAR_USA.pdf

Northrup, Devine & Tarbell, Inc., Charles Ritzi Associates, Lakeside Engineering, Inc., and Aqua-Bio Tech. 1997. Evaluation of Downstream Fish Passage Facility for Juvenile Clupeids 1991 through 1996. Prepared for Topsham Hydro Partners.

Shepard, S.L. 2015. American Eel Biological Species Report. U.S. Fish and Wildlife Service, Hadley, Massachusetts. xii +120 pages.

Taylor, C.C. 1951. A Survey of Former Shad Streams in Maine. U.S. Department of the Interior. Special Scientific Report: Fisheries No. 66, August, 1951.

Topsham Hydro. 2012a. Investigation of Potential Additional Protection and Enhancement Measures for Listed Species. Attachment B in the Draft Biological Assessment for Gulf of Maine DPS of Atlantic Salmon. April, 2012.

Topsham Hydro. 2012b. Species Protection Plan – Topsham Project. Attachment A in the Draft Biological Assessment for Gulf of Maine DPS of Atlantic Salmon. April, 2012.

Topsham Hydro. 2014. Atlantic Salmon Passage Study Report – Topsham Hydroelectric Project. Prepared for Topsham Hydro Partners Limited Partnership by HDR Engineering, March 2014.

Topsham Hydro. 2015. 2014 Atlantic Salmon Passage Study Report – Pejepscot Project. Prepared for Topsham Hydro Partners Limited Partnership by HDR Engineering, March 2015.

Topsham Hydro. 2019. Evaluation of Atlantic Salmon Smolt Downstream Passage at the Pejepscot (FERC No. 4784) and Brunswick (FERC No. 2284) Projects on the Androscoggin River, Maine.

Topsham Hydro. 2019a. Initial Study Report Stranding Evaluation Pejepscot Hydroelectric Project (FERC No. 4784).

Topsham Hydro. 2020. Updated Study Report Atlantic Salmon Upstream Fish Lift Evaluation Pejepscot Hydroelectric Project (FERC No. 4784).

Topsham Hydro. 2020a. Updated Study Report Spring Anadromous Fish Passage Effectiveness Pejepscot Project (FERC No. 4784).

Topsham Hydro. 2020b. Updated Study Report Eel Monitoring Surveys Pejepscot Hydroelectric Project (FERC No. 4784).

Topsham Hydro. 2020c. Updated Study Report Fall Diadromous Fish Passage Effectiveness Pejepscot Project (FERC No. 4784).

Topsham Hydro. 2020d. Updated Study Report Fish Entrainment and Turbine Survival Assessment Pejepscot Hydroelectric Project (FERC No. 4784).

Topsham Hydro. 2020e. Updated Study Report Tailrace Aquatic Habitat Study Pejepscot Hydroelectric Project (FERC No. 4784).

Topsham Hydro. 2020f. Updated Study Report Largemouth and Smallmouth Bass Spawning Habitat Survey Pejepscot Hydroelectric Project (FERC No. 4784).

Topsham Hydro. 2020g. Updated Study Report Large Woody Debris Assessment Pejepscot Hydroelectric Project (FERC No. 4784).

U.S. Atlantic Salmon Assessment Committee (USASAC). 2015. Annual Report of the U.S. Atlantic Salmon Assessment Committee. Report No. 28 – 2015 Activities. Prepared for the U.S. Section to NASCO.

U.S. Fish and Wildlife Service (USFWS) and NOAA-Fisheries. 2016. Draft Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*). 61 pp.

U.S. Fish and Wildlife Service (USFWS). 2015. Press Release – American Eel Population Remains Stable – Does not Need ESA Protection. October 7, 2015.

Warner Nature Center. 2016. Painted Turtle. https://www.warnernaturecenter.org/animals/paintedturtle. Accessed 12/7/16.

Weiss-Glanz, L.S., J.G. Stanley, and J.R. Morning. 1986. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) – American Shad. U.S. Fish and Wildlife Service Biological Report 82(11.59). U.S. Army Corps of Engineers, TR EL-82-4. 16pp.

Winchell, F., S. Amaral, and D. Dixon. 2000. Hydroelectric turbine entrainment and survival database: an alternative to field studies. In: Hydrovision 2000: New Realities, New Responses. HCI Publications, Kansas City, MO.

Yoder, C.O., B.H. Kulik, J.M. Audet, and J.D. Bagley. 2006. The Spatial and Relative Abundance Characteristics of the Fish Assemblages in Three Maine Rivers. Technical Report MBI/12-05-1. September 1, 2006.

E.4.7 Wildlife and Botanical Resources

E.4.7.1 Affected Environment

E4.7.1.1 Regional Setting

Per the U.S. Forest Service ecoregion classification system, the Pejepscot Project is located in the Laurentian Mixed Forest Province and, more specifically, the Central Maine Coastal and Interior Section. The Laurentian Mixed Forest Province lies between the boreal forest and broadleaf deciduous forest zones and, as such, is considered transitional (Bailey, 1995). The Central Maine Coastal and Interior Section is also regionally described as a transitional zone; from both west to east as well as from south to north. From west to east, the forest transitions from mixed hardwoods typical of the southern New England coastal plain to northern coastal spruce-fir and spruce-fir northern hardwood communities. From south to north, coastal communities typically transition to northern hardwood communities (Bailey, 1995). Within the Central Maine Coastal and Interior Section, the Project lies within the interior transitional zone.

E4.7.1.2 Botanical Resources

In 2018, Topsham Hydro conducted a botanical and wildlife resources survey in support of relicensing. The study area included areas enclosed in the current Project boundary as well as adjacent areas within 200 ft of the El. 75 contour. In total, the study area encompassed approximately 514 acres (Topsham Hydro, 2019).

As part of the 2018 survey, existing land use information (Section 4.3.4) was reviewed and confirmed in the field in order to develop cover type maps of the Project Area (Table 4.7.1.2-1 and Figure 4.7.1.2-1). Twenty different cover types were mapped within the study area. The dominant cover types were open water (219.7 acres, 43%), mixed forest (129.4 acres, 25%), and deciduous forest (65.8 acres, 13%). The plant communities were identified using Maine's Natural Heritage Plant Community Classification Index (MDACF, 2018b). The major plant communities found in the mixed forest cover type were hemlock forest (55.8 acres) and oak-pine woodland (47.7 acres) vegetation. The deciduous forest cover type was mostly comprised of oak-pine woodland (26.5 acres) and birch-oak talus woodland (16.5 acres). Common species observed in these forest areas included red maple (*Acer rubrum*), red oak, (*Quercus rubra*), white ash (*Fraxinus americana*), paper birch (*Betula papyrifera*), red pine (*Pinus resinosa*), and eastern hemlock (*Tsuga canadensis*) (Topsham Hydro, 2019).

Emergent wetland plant communities occupied 25.6 acres (5%) and were primarily pickerelweed macrophyte aquatic beds (MDACF, 2018b). The most abundant species in these communities were pickerelweed *(Pontederia cordata*), American bur-reed (*Sparganium americanum),* and broadleaf arrowhead *(Sagittaria latifolia)*. Forested wetland accounted for 5.3 acres (<1%) of the study area. Other vegetated areas covered 13.8 acres (3%) of the study area (Topsham Hydro, 2019).

The remaining area was comprised of non-vegetated or developed cover types covering 54.4 acres (11%) of the study area (Topsham Hydro, 2019).

The upland vegetation found throughout the study area was dense. Within upland cover types, areal vegetation cover was approximately 80%. The herbaceous plant community found in the more open areas was growing vigorously and included several species of native and naturalized wildflowers such as Joe-pye weed (*Eutrochium purpureum*), common bone-set (*Eupatorium perfoliatum*), and grasses (*Poa* sp.) as well as small populations of reed canary grass (*Phalaris arundinacea*), which is considered invasive by the Maine Department of Agriculture, Conservation, and Forestry (MDACF). Most mature forested areas had well-developed understories with intact shrub and herbaceous layers. Plant species identified during the survey are listed in Table 4.7.1.2-2 (Topsham Hydro, 2019).

E4.7.1.2.1 Invasive Plant Species and Noxious Weeds

Invasive species noted within the study area included: flowering rush (*Butomus umbellatus*) purple loosestrife (*Lythrum salicaria)*, Morrow's or Tartarian honeysuckle (*Lonicera morrowii or L. tatarica*), reed canary grass, Japanese knotweed (*Reynoutria japonica*), common buckthorn (*Rhamnus cathartica*), and glossy buckthorn (*Frangula alnus*) (Topsham Hydro, 2019). Each of these species is listed as currently invasive in Maine by the Maine Natural Areas Program (MDACF, 2018a).

Table 4.7.1.2-1. Summary of Cover Type Polygons Mapped During 2018 Botanical Resources Survey

Cover Type	Total Acres	Percent of Study Area	Associated Land Uses	Habitat Type
Open Water	219.7	42.8%	Open Water	Water
Mixed Forest	129.4	25.2%	Deciduous Forest and Mixed Forest	Upland
Deciduous Forest	65.8	12.8%	Deciduous Forest, Mixed Forest, and Shrub/Scrub	Upland
Wetland	25.6	5.0%	Emergent Herbaceous Wetland	Wetland
Railroad	14.6	2.8%	Railroad	Other
Dam and Related Facilities	11.4	2.2%	Developed, High and Low Density	Other
Sand	10.5	2.0%	Barren Land (Rock/Sand/Clay)	Other
Parking	7.2	1.4%	Barren Land (Rock/Sand/Clay) and Developed, Low Intensity	Other
Shrub	6.7	1.3%	Deciduous Forest and Shrub/Scrub	Other
Forested Wetland	5.3	1.0%	Woody Wetland	Upland
Young woods	4.5	0.9%	Deciduous Forest and Mixed Forest	Wetland
Paved/road	3.6	0.7%	Developed, Low Intensity	Other
Rock	2.3	0.4%	Barren Land (Rock/Sand/Clay)	Upland
Residential	2.2	0.4%	Developed, Low Intensity	Other
Quarry	1.7	0.3%	Barren Land (Rock/Sand/Clay)	Other

Cover Type	Total Acres	Percent of Study Area	Associated Land Uses	Habitat Type
Old field	1.2	0.2%	Barren Land (Rock/Sand/Clay) and Shrub/Scrub	Upland
Agriculture	0.9	0.2%	Cultivated Crops	Upland
Water structure	0.7	0.1%	Developed, Medium Intensity	Other
Conifer Plantation	0.6	0.1%	Evergreen Forest	Upland
Boat launch	0.2	<0.1%	Developed, Open Space	Other
TOTAL	**513.9**	**100%**		

Source Topsham Hydro, 2019

Table 4.7.1.2-2. Plant Species Observed in Pejepscot Study Area - 2018

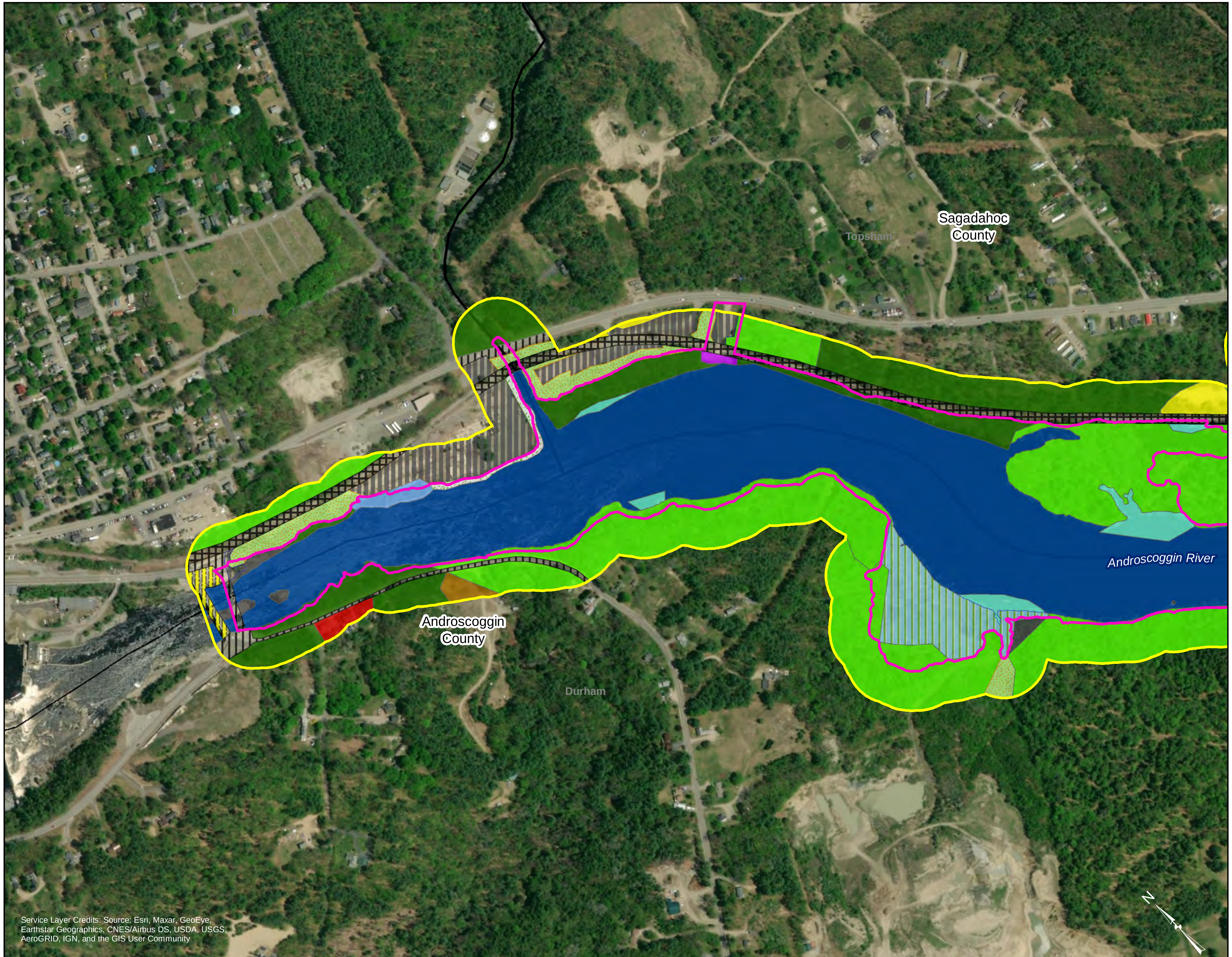
Common Name	Scientific Name	Status[30]
Red maple	*Acer rubrum*	Native
Silver maple	*Acer saccharinum*	Native
Sugar maple	*Acer saccharin*	Native
Mountain maple	*Acer spicatum*	Native
Alder	*Alnus sp.*	Native
Sweet birch	*Betula lenta*	Native
Paper birch	*Betula papyrifera*	Native
Flowering rush	*Butomus umbellatus*	Invasive
Longhair sedge	*Carex comosa*	Native
Hop sedge	*Carex lupulina*	Native
American hornbeam	*Carpinus caroliniana*	Native
Buttonbush	*Cephalanthus occidentalis*	Native
Sweetfern	*Comptonia peregrina*	Native
Silky dogwood	*Cornus amomum*	Native
Red osier dogwood	*Cornus sericea*	Native
Yellow nutsedge	*Cyperus esculentus*	Native and Introduced
Wild carrot	*Daucus carota*	Introduced
Cockspur grass	*Echinocloa crus-galli*	Native and Introduced
Common boneset	*Eupatorium perfoliatum*	Native
Joe-Pye-weed	*Eutrochium purpureum*	Native
Japanese knotweed	*Reynoutria japonica*	Invasive
Glossy buckthorn	*Frangula alnus*	Invasive
White ash	*Fraxinus americana*	Native
Honey locust	*Gleditsia triacanthos*	Native
American witch-hazel	*Hamamelis virginiana*	Native
Woodland sunflower	*Helianthus divaricatus*	Native
Soft rush	*Juncus effusus*	Native
Rice cutgrass	*Leersia oryzoides*	Native
Cardinal flower	*Lobelia cardinalis*	Native
Morrow's honeysuckle	*Lonicera morrowii*	Invasive
Tatarian honeysuckle	*Lonicera tatarica*	Invasive

30 Sources: (MDACF, 2018 a)

Common Name	Scientific Name	Status[30]
Purple loosestrife	*Lythrum salicaria*	Invasive
Sweet clover	*Melilotus officinalis*	Introduced
Fragrant water-lily	*Nymphaea odorata*	Native
Sensitive fern	*Onoclea sensibilis*	Native
Deer-Tongue Grass	*Panicum clandestinum*	Native
Reed canary grass	*Phalaris arundinacea*	Invasive
Norway spruce	*Picea abies*	Introduced
White spruce	*Picea alba*	Native
Blue spruce	*Picea pungens*	Introduced
Red pine	*Pinus resinosa*	Native
Pitch pine	*Pinus rigida*	Native
White pine	*Pinus strobus*	Native
Meadow-grass, bluegrass, tussock, and speargrass	*Poa* spp.	Native and Introduced
Pickerelweed	*Pontederia cordata*	Native
Quaking aspen	*Populus tremuloides*	Native
Broad-leaved pondweed	*Potamogeton natans*	Native
Black cherry	*Prunus serotina*	Native
Red oak	*Quercus rubra*	Native
White oak	*Quercus alba*	Native
Common buckthorn	*Rhamnus cathartica*	Invasive
Staghorn sumac	*Rhus typhina*	Native
Broadleaf arrowhead	*Sagittaria latifolia*	Native
Black willow	*Salix nigra*	Native
Willow	*Salix* spp.	Native and Introduced
Woolgrass	*Scirpus cyperinus*	Native
Late goldenrod	*Solidago altissima*	Native
Goldenrod	*Solidago* spp.	Native
American bur-reed	*Sparganium americanum*	Native
Prairie cordgrass	*Spartina pectinata*	Native
White meadowsweet	*Spirea alba*	Native
Basswood	*Tilia americana*	Native
Eastern hemlock	*Tsuga canadensis*	Native
Broadleaf cattail	*Typha latifolia*	Native

Common Name	Scientific Name	Status[30]
American elm	*Ulmus americana*	Native
Common nettle	*Urtica dioica*	Native and Introduced
Blueberry	*Vaccinium* spp.	Native
Blue vervain	*Verbena hastata*	Native
Arrowwood viburnum	*Viburnum dentatum*	Native
Downy arrowwood	*Viburnum rafinesquianum*	Native
Unidentified grass	not available	not available

Source Topsham Hydro, 2019



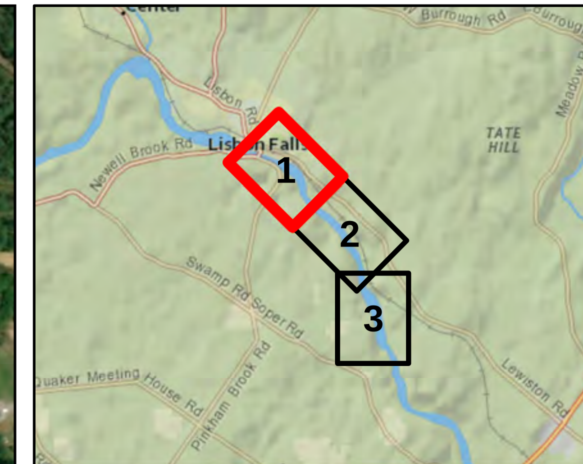


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Figure 4.7.1.2-1: Botanical Resources Cover Types
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Legend

- Project Boundary
- Study Area

Cover Type

- Old field
- Shrub
- Deciduous forest
- Mixed forest
- Sand
- Residential
- Boat launch
- Rock
- Parking
- Paved/road
- Railroad
- Dam and related facilities
- Young woods
- Wetland
- Forested wetland
- Water structure
- Open water
- ME County Boundaries
- ME Town Boundaries

0 250 500 1,000 Feet

Brookfield

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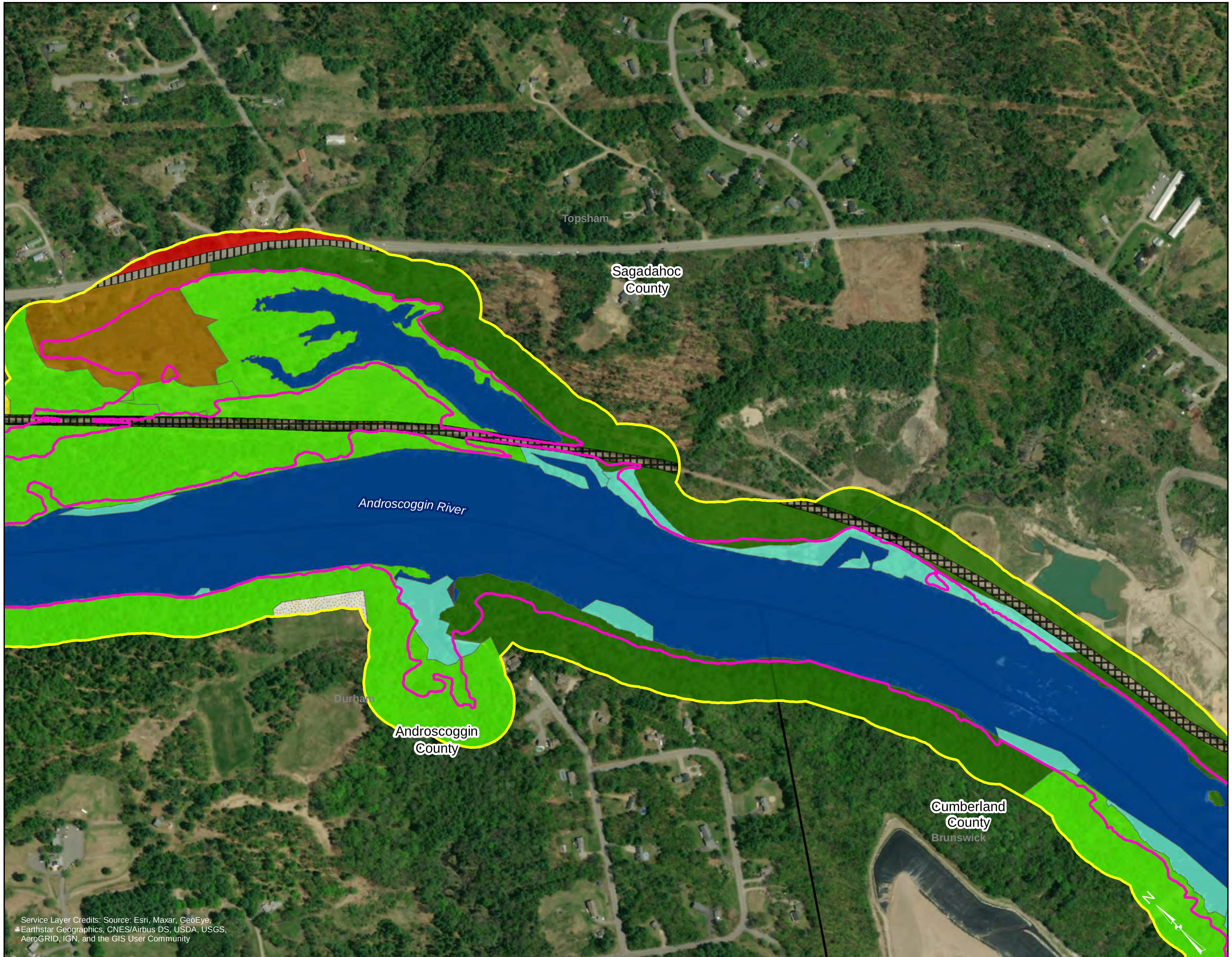

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Figure 4.7.1.2-1: Botanical Resources Cover Types
Page 2 of 3

Legend

- Project Boundary
- Study Area

Cover Type

- Agriculture
- Old field
- Deciduous forest
- Mixed forest
- Sand
- Residential
- Rock
- Paved/road
- Railroad
- Wetland
- Open water
- ME County Boundaries
- ME Town Boundaries

0 250 500 1,000 Feet

Brookfield

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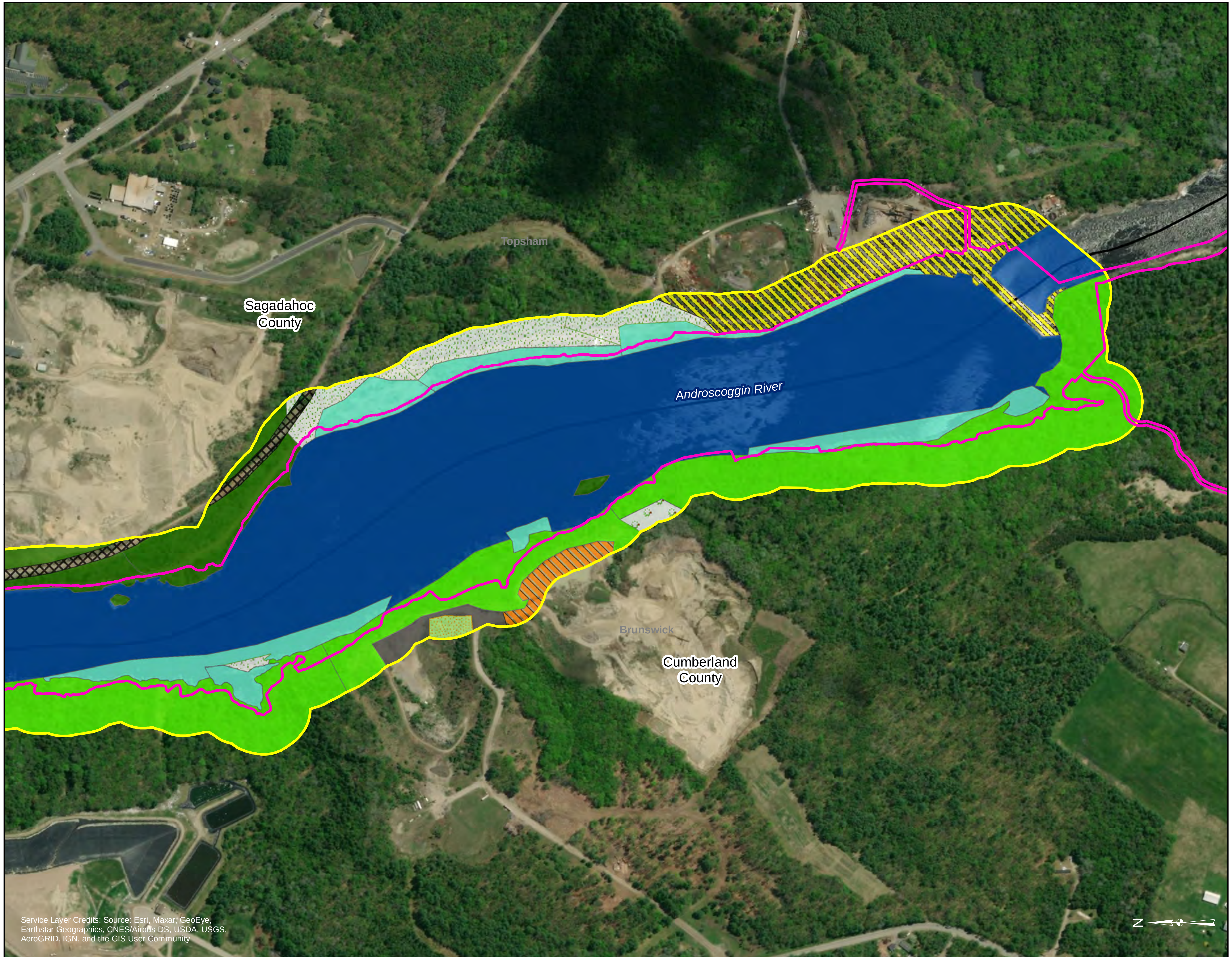

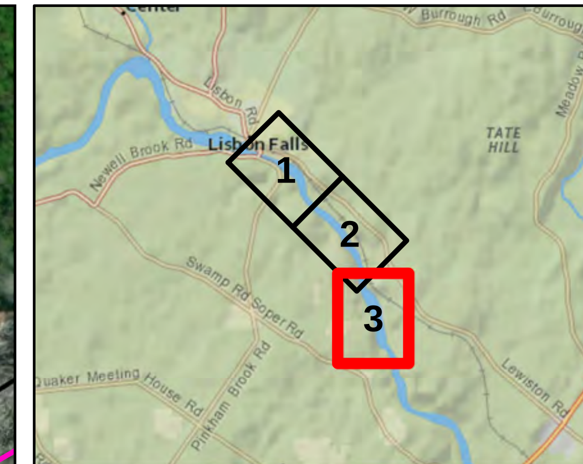

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Figure 4.7.1.2-1: Botanical Resources Cover Types
Page 3 of 3

Legend

- Project Boundary
- Study Area

Cover Type

- Conifer plantation
- Shrub
- Deciduous forest
- Mixed forest
- Rock
- Quarry
- Railroad
- Dam and related facilities
- Young woods
- Wetland
- Open water
- ME County Boundaries
- ME Town Boundaries

0 250 500 1,000
Feet

Brookfield

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E4.7.1.3 Terrestrial Wildlife Resources

Along the Project impoundment, the habitat is mostly forested with a mix of conifer and hardwood species. Because of the limited habitat, animals are likely transient individuals that may derive from resident populations in lands surrounding the Project.

Mammals that may utilize forested habitat include Short-tailed Shrew (*Blarina brevicauda*), Star-nosed Mole (*Condylura cristata*), New England Cottontail (*Sylvilagus transitionalis*), Snowshoe Hare (*Lepus americanus*), Southern Flying Squirrel (*Glaucomys volans*), Woodland Vole (*Microtus pinetorum*), Striped Skunk (*Mephitis mephitis*), Northern Raccoon (*Procyon lotor*), North American Porcupine (*Erethizon dorsatum*), Coyote (*Canis latrans*), Red Squirrel (*Sciurus vulgaris*), and Gray Squirrel (*Sciurus carolinensis*). Habitats bordering or close to the Project boundary include developed or agricultural. Many mammals that utilize forested habitats may also utilize these developed or agricultural spaces. Some examples of mammals that may utilize the developed or agricultural areas include: Gray Fox (*Urocyon cinereoargenteus*), Red Fox (*Vulpes vulpes*), Virginia Opossum (*Didelphis virginiana)*, Eastern Cottontail (*Sylvilagus floridanus)* (non-native to Maine), Meadow Vole (*Microtus pennsylvanicus*), Woodchuck (*Marmota mona*x), and White-footed Deermouse (*Peromyscus leucopus*).

Furbearers that may utilize the Project impoundment and the various terrestrial habitats include: American Mink (*Neovison vison*), American Marten (*Martes americana)*, Fisher (*Martes pennanti*), North American Beaver (*Castor canadensis*), Common Muskrat *(Ondatra zibethicus*), and Northern River Otter (*Lontra canadensis*). Larger mammals may also utilize the Project Area including White-tailed Deer (*Odocoileus virginianus*), Moose (*Alces alces*), and American Black Bear (*Ursus americanus*). Due to varying forms of development present in this area, as well as other habitat considerations, it is unlikely that large mammals like Moose and Black Bear would be permanent residents and are likely instead limited to transient individuals (Bailey, 1995). However, it is likely that White-tailed Deer have established permanent populations in or around the Project Area. MDIFW has identified deer wintering areas within two-miles of the Project location, indicating that the White-tailed Deer populations may be present year-round (MDIFW, 2016).

There are several bat species that have the potential to occur in the Project Area. These species include the state endangered and federally threatened Northern Long-Eared Myotis (*Myotis septentrionalis*), the State Endangered Little Brown Bat (*Myotis lucifugus*), the state threatened Eastern Small-Footed Myotis (*Myotis leibii*), as well as five species of special concern: Big Brown Bat (*Eptesicus fuscus*), Silver Haired Bat (*Lasionycteris noctivagans)*, Eastern Red Bat (*Lasiurus borealis*), Hoary Bat (*Lasiurus cinereus*), and the Tri-Colored Bat (*Perimyotis subflavus*). The Northern Long-Eared, Little Brown, Silver Haired, Hoary And Tri-Colored Bats all utilize a diversity of forest habitats for roosting, foraging and raising young. The results of the 2018 wildlife survey indicated that habitats for several bat species do exist in the Project Area (Topsham Hydro, 2019). Table 4.7.1.3-1 lists the non-bird wildlife species identified during the 2018 survey.

Regarding bird species, there are multiple avian species that may utilize the Project Area seasonally or year-round. Associated bird species common to the Laurentian-Acadian Pine-Hemlock-Hardwood Forest include: Black-and-White Warbler (*Mniotilta varia*), Blackburnian Warbler (*Setophaga fusca*), Black-Throated Blue Warbler (*Setophaga caerulescens*), Eastern Wood-Pewee (*Contopus virens*), Hermit Thrush (*Catharus guttatus*), Northern Saw-Whet Owl (*Aegolius acadicus*), Northern Waterthrush (*Parkesia noveboracensis*), Ovenbird (*Seiurus aurocapilla*), Pine Warbler (*Setophaga pinus*), Ruffed Grouse (*Bonasa umbellus*), Scarlet Tanager (*Piranga olivacea*), Veery (*Catharus fuscescens*), Wood Thrush (*Hylocichla mustelina*), and Yellow-Bellied Sapsucker (*Sphyrapicus varius*) (Ferree and Anderson, 2013). In addition, the Pejepscot Impoundment and surrounding areas provide habitat for migrating bird species (IPaC, 2016).

During the 2018 survey, a total of 26 bird species were observed during the field survey, including three Species of Special Concern. The Species of Special Concern observed during the survey included Great Blue Heron (*Ardea herodias*), Eastern Towhee (*Pipilo erythrophthalmus*), and Tree Swallow (*Tachycineta bicolor*). Bald Eagles were also observed, which are protected by the federal Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). No threatened or endangered bird species were observed during survey (Topsham Hydro, 2019). Table 4.7.1.3-2 provides a list of bird species identified during the 2018 survey.

E4.7.1.3.1 Invasive Wildlife Species

A number of exotic wildlife species are known to occur in Maine. These include bird species such as the Rock Pigeon (*Columba livia*), European Starling (*Sturnus vulgaris*), and House Sparrow (*Passer domesticus*), as well as mammal species such as the House Mouse and Norway Rat (MISN, 2017). Based on the habitat found within and surrounding the Project, invasive insects with the potential to occur within the Project Area and immediate vicinity include the European Fire Ant (*Myrmica rubra*), Gypsy Moth (*Lymantria dispar dispa*r), and Winter Moth (*Operophtera brumata*). The European Fire Ant has been identified in coastal Kennebec County and is known to inhabit areas with urban development. Gypsy Moth infestations are most prevalent in central and southern Maine and generally prefer hardwood trees (i.e., oak, aspen, and birch) for feeding. The Winter Moth occurs along the Maine coast, although may be more widespread and prefers to feed on hardwoods including oak, maple, ash, cherry, and apple trees (MISN, 2017).

Table 4.7.1.3-1. Non-bird Terrestrial Animal Species Observed in the Pejepscot Project Area – 2018

Common Name	Scientific Name	Observation Type		Status[31]
		Seen	Heard	
Bumble Bee	*Bombus* sp.	X		TE and SC
Monarch Butterfly	*Danaus plexippus*	X		Under review
White-tailed Deer (tracks)	*Odocoileus virginianus*	X		No status
Eastern Milk Snake	*Lampropeltis triangulum*	X		No status
Eastern Gray Squirrel	*Sciurus carolinensis*	X		No status
Red Squirrel	*Sciurus vulgaris*	X		No status
Yellow Jacket	*Vespinae* sp.	X		No status

Source Topsham Hydro, 2019

[31] Source: MDIFW, 2015

Table 4.7.1.3-2. Bird Species Observed in the Pejepscot Project Area

Common Name	Scientific Name	Observation Type		Maine Status[32]
		Seen	Heard	
Wood Duck	*Aix sponsa*	X		No status
Mallard	*Anas platyrhynchos*	X		No status
American Black Duck	*Anas rubripes*	X		No Status
Common Egret	*Ardea alba*	X		No Status[33]
Great Blue Heron	*Ardea herodias*	X		Special Concern
Red-tailed Hawk	*Buteo jamaicensis*	X	X	No status
Turkey Vulture	*Cathartes aura*	X		No status
American Crow	*Corvus brachyrhynchos*	X	X	No status
Common Raven	*Corvus corax*	X	X	No status
Blue Jay	*Cyanocitta cristata*	X		No status
Gray Catbird	*Dumetella carolinensis*	X	X	No status
Bald Eagle	*Haliaeetus leucocephalus*	X		Delisted 2009, protected by the federal Bald and Golden Eagle Protection Act
Pileated Woodpecker	*Hylatomus pileatus*	excavation	X	No status
Ring-billed Gull	*Larus delawarensis*	X		No status
Song Sparrow	*Melospiza melodia*		X	No status
Osprey	*Pandion haliaetus*	X		No status
Double-crested Cormorant	*Phalacrocorax auritas*	X		No status
Eastern Towhee	*Pipilo erythrophthalmus*		X	Special Concern
Prothonotary Warbler	*Protonotaria citrea*	X		No status
Common Grackle	*Quiscalus quiscula*	X		No status
Eastern Phoebe	*Sayornis phoebe*		X	No status

32 Source: MDIFW, 2015
33 Removed from MDIFW, 2015

Common Name	Scientific Name	Observation Type		Maine Status[32]
		Seen	Heard	
White-breasted Nuthatch	*Sitta carolinensis*	X		No status
Common Eider	*Somateria mollissima*	X		No status
Tree Swallow	*Tachycineta bicolor*	X		Special Concern
American Robin	*Turdus migratorius*		X	No status
Mourning Dove	*Zenaida macroura*	X		No status

Source Topsham Hydro, 2019

E4.7.1.4 Wetlands, Riparian, and Littoral Habitat

E4.7.1.4.1 Wetland Habitat and Vegetation

Wetlands are defined by the USFWS as "lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water." For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of the year" (USFWS, 2016).

Review of the USFWS National Wetland Inventory coverage found that, within 1,000 ft of the Project boundary, there are approximately 291 acres categorized as wetlands (Figure 4.7.1.4.1-1). Of these, 258 acres are considered open water and are split between riverine, lake, and freshwater pond. The remaining 33 acres are considered either freshwater emergent or freshwater forested/shrub wetlands, which are further defined by the MDEP. This is consistent with the results of the 2018 botanical and wildlife survey conducted by the Licensee, which found that emergent wetlands occupy approximately 25.6 acres of the area investigated. As noted in Section 4.7.1.2, emergent wetlands were primarily pickerelweed macrophyte aquatic beds. The most abundant species in these communities were pickerelweed *(Pontederia cordata*), American bur-reed (*Sparganium americanum),* and broadleaf arrowhead *(Sagittaria latifolia)* (Topsham Hydro, 2019).

In addition, forested wetland accounted for 5.3 acres of the survey area (Topsham Hydro, 2019). In general, freshwater forested/shrub wetlands are forested swamp, or wetland, shrub, or bog. In Maine, they may be characterized as deciduous or evergreen, and include: red maple, larch (*Larix laricina*), black ash (*Fraxinus nigra*), yellow birch (*Betula alleghaniensi*s), gray birch (*Betula populifolia*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), white pine (*Pinus strobu*s), black willow (*Salix nigra*), northern white cedar (*Thuja occidentalis*), hemlock (*Tsuga canadensis*), balsam fir (*Abies balsamea*), and black spruce (*Picea mariana*). Associated shrubs include highbush blueberry (*Vaccinium corymbosum*), sheep laurel (*Kalmia angustifolia*), maleberry (*Lyonia ligustrina*), black chokeberry (*Aronia melanocarpa*), mountain holly (*Ilex mucronata*), common elderberry, common winterberry (*Sambucus nigra*), and silky dogwood (*Cornus amomum*). Herbs include skunk cabbage (*Symplocarpus foetidus*), Jack-in-the-pulpit (*Arisaema triphyllum*), Canada mayflower (*Maianthemum canadense*), royal fern (*Osmunda regalis*), cinnamon fern (*Osmundastrum cinnamomeum*), sensitive fern (*Onoclea sensibilis*), and marsh fern (*Thelypteris palustris*) (MDEP, 2017).

E4.7.1.4.2 Riparian Habitat and Vegetation

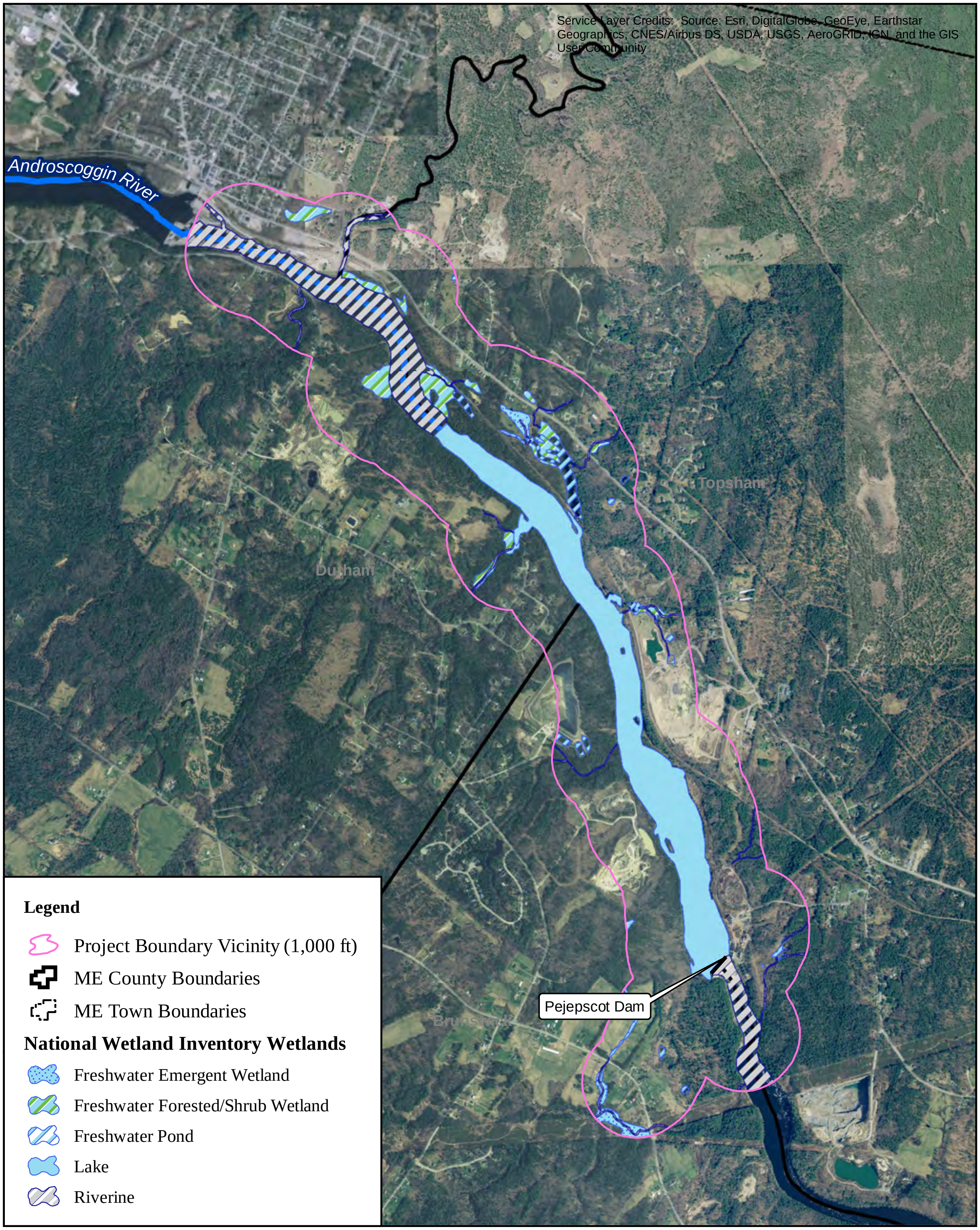
Riparian habitat is the specialized zone of vegetation that serves as the interface between the upland vegetation community and the riverine environment. This zone provides numerous valuable functions such as maintaining streambank stability, sediment filtration, and floodplain processes. Riparian zone habitat and vegetation adjacent to the Pejepscot Impoundment is, in general, comprised of forested areas of varying width. In some developed locations, the riparian zone is limited by the presence of roads, railroads, barren areas, and/or industrial and residential areas. In addition, there are relatively small, localized wetlands scattered throughout the Project Area. At the dam, there is little to no riparian zone due to the presence of bedrock and riprap on the west side (right side looking downstream) and the powerhouse, railroad bed, and industrial area on the east side (left side looking downstream). Habitat and vegetation found in the forested or wetland riparian areas are consistent with those discussed in the previous sections.

E4.7.1.4.3 Littoral Habitat and Vegetation

The littoral zone is considered to be the transitional area between deepwater, aquatic habitat and the terrestrial wetlands or uplands. It is often comprised of permanently flooded wetlands such as marshes and other shallow water areas that are permanently water covered. The Project impoundment upstream of the Pejepscot Dam includes approximately three miles of the Androscoggin River. The impoundment has a surface area of 225 acres, and gross storage of 3,278 acre-ft at a pond elevation of 67.5 ft. Google Earth images over time did not provide visual information of grass beds or other littoral zone habitat elements. Habitat and vegetation found in the littoral zone is consistent with those discussed in the previous sections.

E4.7.1.4.4 Wetland, Littoral, and Riparian Wildlife

Wetland and riparian areas serve as transition zones between aquatic and terrestrial systems, and, as such, support many mammal, bird, reptile, and amphibious species that depend on both habitat types to survive. Sections 4.7.1.3 provides additional information on wildlife that may exist in the Project Area.



Pejepscot Hydroelectric Project
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Figure 4.7.1.4.1-1.
National Wetlands Inventory
Wetlands within 1,000 feet
of the Project Boundary

Path: P:\Modeling\Projects\01925\maps\fla\exhibit_e\Figure_4_7_1_4_1-1.mxd

E.4.7.2 Environmental Analysis

FERC's SD2 identified one potential resource issue relating to wildlife and botanical resources, which is discussed in greater detail below.

Effects of continued project operation on riparian, littoral, and wetland habitat and associated wildlife

The Project operates in a run-of-river mode, with Project outflows approximately matching inflows. The Project impoundment has no significant storage capacity. As a result of this operating regime, the Project has no significant effect on the overall river flow of the Androscoggin River. Therefore, impacts that are commonly associated with impoundment water level fluctuations are minimal to non-existent. For these reasons, botanical resources and wildlife habitat within the Project area are not adversely impacted by Project operations.

The occurrence and distribution of terrestrial vegetation cover types in the study area is generally unrelated to Project operations. Based on the results of the 2018 botanical surveys, the wetland communities associated with the Project were found to be healthy, and appeared to be in a state of equilibrium with the current Project operations. The species richness and diversity of all wetland types bordering the Project impoundment generally reflect natural community expectations for this area.

The operation of the Project has limited to no impact on the wildlife resources within and bordering the Project area. Based on the 2018 wildlife surveys and an assessment of habitat conditions within the Project area, there is no evidence of any on-going adverse effects.

E.4.7.3 Proposed Environmental Measures

Topsham Hydro is proposing no fundamental change in the operation of the Project and proposes to continue:

- Maintaining a minimum flow of 1,170 cfs, or inflow, whichever is less downstream of the Project[34]; and
- Operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates[35].

Studies conducted by Topsham Hydro demonstrated that the Project and its continued operation do not adversely affect wildlife and botanical resources. Therefore, Topsham Hydro is not proposing additional PME measures specific to wildlife and botanical resources at the Project.

[34] Minimum flow requirements under the current license are described as "continuous," but Topsham Hydro proposes that the requirement in the new license be instead based on the hourly average. This change would capture the intent of the minimum flow measure, but would avoid unnecessary reporting of very short term excursions due to unplanned events such as extreme weather, equipment failure, and so on. A similar change was adopted in 2011 for the Gulf Island-Deer Rips Hydropower Project (FERC No. 2283).

[35] Topsham Hydro also proposes that, for compliance purposes, the pond level elevation also be based upon hourly average, for similar logic as the minimum flow requirement.

E.4.7.4 Unavoidable Adverse Effects

Continued operation of the Project, as proposed, will have no significant unavoidable adverse impacts to Project wildlife and botanical resources.

E.4.7.5 References

Bailey, Robert G. March 1995. *Ecoregions of the United States*. United States Department of Agriculture: Forest Service. Rocky Mountain Research Station. https://www.fs.fed.us/land/ecosysmgmt/colorimagemap/images/212.html. Accessed December 2016

Ferree, C and M. G. Anderson. 2013. A Map of Terrestrial Habitats of the Northeastern United States: Methods and Approach. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/habitatmap/Pages/default.asp

Maine Department of Agriculture, Conservation and Forestry (MDACF) (2018a). Maine Invasive Plant Fact Sheets. Retrieved from https://www.maine.gov/dacf/mnap/features/invasive_plants/invsheets.htm

Maine Department of Agriculture, Conservation and Forestry (MDACF) (2018b). Natural Community Classification Key. Retrieved from https://www.maine.gov/dacf/mnap/features/communitykey.htm

Maine Department of Environmental Protection. 2017. Wetland types. http://www.maine.gov/dep/water/wetlands/types.html

Maine Department of Inland Fisheries and Wildlife. (2015). Maine's Wildlife Action Plan. Augusta, ME: Author. Retrieved from http://www.maine.gov/ifw/docs/2015%20ME%20WAP%20All_DRAFT.pdf

Maine Department of Inland Fisheries & Wildlife. 2016. *Wildlife*. http://www.state.me.us/ifw/wildlife/index.html. Accessed December 2016.

Maine Invasive Species Network. 2017. *Maine Invasives Mapping and Other Data* https://extension.umaine.edu/invasivespecies/home/maps/ Accessed July 2017.

Topsham Hydro. 2019. Initial Study Report Botanical and Wildlife Resources Survey Pejepscot Hydroelectric Project.

United States Department of Agriculture. (2018). National Resources Conservation Service Plants Database. Retrieved from https://plants.usda.gov/adv_search.html

United States Fish & Wildlife Service. 2016. *IPaC Trust Resources Report*. https://ecos.fws.gov/ipac/ Accessed December 2016.

United States Fish & Wildlife Service. 2016. National Wetlands Inventory. https://www.fws.gov/wetlands/index.html Accessed December 2016.

E.4.8 Threatened and Endangered Species

E.4.8.1 Affected Environment

Threatened or endangered (TE) species have the potential to utilize both aquatic and terrestrial habitats located in or around the Project Area. The State of Maine also identifies species of special concern; which are species that do not meet the criteria established for being state or federally listed but are considered vulnerable and could become threatened or endangered. Several database searches were performed to assess the TE species that may utilize the Project Area. These databases included USFWS Information for Planning and Consultation (IPaC) and Maine Natural Areas Program. The species discussed in the sections below were determined based on their known species distribution and the potential presence of the species in the vicinity of the Project Area as well as the results of the 2018 botanical and wildlife survey conducted as part of relicensing.

E4.8.1.1 Critical and Special Status Habitats

Atlantic Salmon are a federally endangered fish species. Their life history and habitat requirements are discussed extensively in Section E.4.6.1. The critical habitat listing for Atlantic Salmon was finalized in June 2009 and includes the Project location as well as areas above and below it and is discussed in Section E.4.6.1.2. Likewise, EFH for Atlantic Salmon is discussed Section E.4.6.1.3.5.

E4.8.1.2 Threatened and Endangered Fish and Freshwater Aquatic Species

Atlantic Salmon are the only federally endangered fish or freshwater aquatic species found in the Project Area. Salmon would typically be found migrating through the Project Area, primarily when pre-spawn adults pass upstream in the spring through the fall, when post-spawn kelts pass downstream in the early spring, and when juveniles (smolts) pass downstream through the area in the spring. Consultation with federal agencies related to the Project’s potential effects on ESA-listed Atlantic Salmon has been ongoing. Topsham Hydro will develop a draft BA for the federally endangered GOM DPS of Atlantic Salmon. Through ongoing consultation with USFWS and NMFS, Topsham Hydro will also develop a SPP, which will include passage performance standards and other protection measures for Atlantic Salmon that avoid, minimize, and mitigate impacts related to Project operation. Topsham Hydro held a series of meetings with USFWS and NMFS, as well as other resource agencies, beginning in March 2020 as part of this consultation process. Notes from these meetings are contained in Appendix E-2. Topsham Hydro expects to continue this informal consultation process and will submit a BA and SPP to the Commission at the culmination of the process.

There are four species of amphibian and four species of reptile that are state-listed species of special concern, which may be present in the Project Area as well as one mussel species (Creeper) that is state-listed as a species of special concern that may be present in the Project Area. In addition, there are ten odonate species of special concern that may be present in the Project Area. They may be present year-round as juveniles in aquatic habitats or as adults after emerging during the warmer months. Table 4.5.1.5.2-3 provides additional information pertaining to the odonate species of special concern, while Table 4.8.1.2-1 provides a summary of the non-odonate fish and freshwater aquatic species of special concern that may be present in the Project Area. Information on these species can be found in Sections E.4.5.1.2.3, E.4.5.1.2.4 and E.4.6.1.5.

Table 4.8.1.2-1. TE and Special Concern Fish and Aquatic Species

Common Name	Scientific Name	Status
Atlantic Salmon	*Salmo salar*	Federally Endangered
Northern spring salamander	*Gyrinophilus porphyriticus*	State Special Concern
Blue-spotted salamander	*Ambystoma laterale*	State Special Concern
Mink frog	*Lithobates septentrionalis*	State Special Concern
Northern leopard frog	*Lithobates pipiens*	State Special Concern
Northern brown snake	*Storeria d. dekayi*	State Special Concern
Eastern ribbon snake	*Thamnophis sauritus*	State Special Concern
Spotted turtle	*Clemmys guttata*	State Special Concern
Wood turtle	*Glyptemys insculpta*	State Special Concern
Creeper	*Strophitus undulatus*	State Special Concern

E4.8.1.3 Threatened and Endangered Wildlife Species

There are several terrestrial species identified by USFWS and MDIFW as TE or Special Concern. The USFWS identified the northern long-eared bat, a threatened species as potentially occurring in the Project Area (USFWS, 2016). In addition, MDIFW has identified nine mammal species that are classified as TE or Special Concern (Table 4.8.1.3-1). The majority of this group is comprised of various bat species. Bat species' populations have been declining due to White Nose Syndrome, a fungal disease. Furthermore, MDIFW has identified 32 bird species that meet Maine's TE or Special Concern requirements (Table 4.8.1.3-2). Several of these bird species are also considered to be Birds of Conservation Concern by the USFWS and are protected under the Migratory Bird Treaty Act.

TE or species of special concern that may be found near the Project can be grouped into two categories; those that may be found in the Project Area year-round (i.e., the mammal species) or those that may be found in the Project Area for shorter periods of time (e.g., migratory birds). The big brown bat, little brown bat, and northern long-eared bat are species that hibernate in Maine during the winter. The silver-haired bat is a tree bat that migrates to warmer locations during winter (MDIFW, 2017). These bat species have the potential to utilize lands around the Project Area seasonally.

Table 4.8.1.3-1. Mammals Identified as State TE or Special Concern that May Occur Near the Project

Common Name	Scientific Name	State Status
Big Brown Bat	*Eptesicus fuscus*	Special Concern
Silver-Haired Bat	*Lasionycteris noctivagans*	Special Concern
Eastern Red Bat	*Lasiurus borealis*	Special Concern
Hoary Bat	*Lasiurus cinereus*	Special Concern
Eastern Small-Footed Myotis	*Myotis leibii*	Threatened
Little Brown Bat	*Myotis lucifugus*	Endangered
Northern Long-Eared Myotis	*Myotis septentrionalis*	Endangered (Federally Threatened)
Tri-Colored Bat	*Perimyotis subflavus*	Special Concern
New England Cottontail	*Sylvilagus transitionalis*	Endangered
Source: SWAP, 2015		

Table 4.8.1.3-2. Birds Identified as State TE or Special Concern that May Occur Near the Project

Common Name	Scientific Name	State Status
Northern Harrier	*Circus cyaneus*	Special Concern
Harlequin Duck	*Histrionicus histrionicus*	Threatened
Chimney Swift	*Chaetura pelagica*	Special Concern
Upland Sandpiper	*Bartramia longicauda*	Threatened
Black Tern	*Chlidonias niger*	Endangered
Whimbrel	*Numenius phaeopus*	Special Concern
Common Tern	*Sternula hirundo*	Special Concern
Yellow-Billed Cuckoo	*Coccyzus americanus*	Special Concern
Peregrine Falcon	*Falco peregrinus*	Endangered
American Coot	*Fulica americana*	Special Concern
Grasshopper Sparrow	*Ammodramus savannarum*	Endangered
Canada Warbler	*Cardellina candensis*	Special Concern
Sedge Wren	*Cistothorus platensis*	Endangered
Olive-Sided Flycatcher	*Contopus cooperi*	Special Concern

Common Name	Scientific Name	State Status
Eastern Wood-Pewee	*Contopus virens*	Special Concern
Least Flycatcher	*Empidonax minimus*	Special Concern
Horned Lark	*Eremophila alpestris*	Special Concern
Barn Swallow	*Hirundo rustica*	Special Concern
Wood Thrush	*Hylocichla mustelina*	Special Concern
Orchard Oriole	*Icterus spurius*	Special Concern
Eastern Towhee	*Pipilo erythrophthalmus*	Special Concern
Prairie Warbler	*Setophaga discolor*	Special Concern
Yellow Warbler	*Setophaga petechia*	Special Concern
Northern Rough-Winged Swallow	*Stelgidopteryx serripens*	Special Concern
Eastern Meadowlark	*Sturnella magna*	Special Concern
Tree Swallow	*Tachycineta bicolor*	Special Concern
Brown Thrasher	*Toxostoma rufum*	Special Concern
White-Throated Sparrow	*Zonotrichia albicollis*	Special Concern
Great Blue Heron	*Ardea herodias*	Special Concern
Least Bittern	*Ixobrychus exilis*	Endangered
Black-Crowned Night-Heron	*Nycticorax nycticorax*	Endangered
Great Cormorant	*Phalacrocorax carbo*	Threatened
Source: SWAP, 2015		

E4.8.1.4 Threatened and Endangered Botanical Resources

Several state-listed plant species were identified in the PAD as potentially occurring in or near the Project area (Table 4.8.1.4-1); however, no TE species were observed during the 2018 botanical survey (Topsham Hydro, 2019). Aquatic species listed in the PAD included comb-leaved mermaid-weed (*Proserpinaca pectinata*, Endangered) and spotted pondweed (*Potamogeton pulcher*, Threatened). Comb-leaved mermaid-weed is an aquatic perennial, with highly dissected leaves and axial flowers with four separate carpels. It flowers and fruits from July through September and may be found in ponds, lakes, and impoundments. No individuals of the species were found during the 2018 survey, but habitat for the plant does exist within the wetlands that lie along impoundment. Spotted pondweed is an aquatic perennial with narrow, lance-shaped submerged leaves, oval floating leaves and black spotted stems. It is found in peaty, tannic waters, and flowers from June to September. No individuals of this species were observed, and the waters within the Project Area do not occur over peaty substrates nor are they particularly tannic. Habitat for this species does not exist within the Project Area.

Two listed species normally found in bogs and fens that were listed in the PAD include showy lady's slipper (*Cypripedium reginae,* Special Concern) and white adder's mouth (*Malaxis monophyllos,* Endangered). Showy lady's slipper is an orchid found in more neutral bogs, edges of mossy forests and open wetlands. The species flowers from June through July. White adder's mouth is a small orchid found in wet gravel deposits, calcareous bogs and fens. The plant has a single leaf from which comes a flower stalk with a raceme of greenish-white flowers, which generally appear in July. Neither of these orchids were noted during the 2018 field survey, and there are no bogs, fens or wet gravel deposits within the Project Area (Topsham Hydro, 2019).

Several state-listed species that occur in wetlands or moist woods were listed in the PAD. These included hollow Joe-pye weed (*Eutrochium fistulosum,* Special Concern), smooth winterberry holly (*Ilex laevigata,* Special Concern), spicebush (*Lindera benzoin,* Special Concern), and sweet pepper-bush (*Clethra alnifolia,* Special Concern). Hollow Joe-pye weed is a tall member of the *Asteraceae* found in wet areas. The plant has a hollow, purplish stem with a whitish bloom, and flowers from July through September. A con-generic species, sweet Joe-pye weed (*Eutrochium purpureum*), was found in the Project Area. Sweet Joe-pye weed tends to occur on drier sites than hollow Joe-pye weed and has a solid stem with no whitish bloom. No individuals of hollow Joe-pye weed were found, but habitat for the species does exist within the Project Area in the open wetlands (Topsham Hydro, 2019).

Smooth winterberry is a deciduous holly shrub with shiny leaves. It is found in swamps and dense thickets. Flowers appear from May to June, with berries appearing on female plants in late June. No members of the genus *Ilex* were found, but habitat for the species does exist within the forested and marsh and shrub wetlands of the Project Area. Sweet pepper-bush grows as a small tree or shrub. The plant has alternate, ovate, toothed leaves on short pedicels. Terminal racemes of white flowers with protruding stamens appear in July through August. No individuals were found, but habitat for sweet pepper-bush does exist within the forested and marsh and shrub wetlands in the Project Area (Topsham Hydro, 2019).

Finally, three species found in moist or mesic woods were listed in the PAD. These were spicebush (*Lindera benzoin,* Special Concern), mountain-laurel (*Kalmia latifolia,* Special Concern) and broad beech fern (*Phegopteris hexagonoptera,* Special Concern). Spicebush is an understory tree or shrub found along brooks, in swamps and in the understories of moist forests. Its leaves are ovoid with entire margins. The tree flowers from late April to May but is easily identifiable by the lemony-spicy scent given off from bruised leaves and twigs. Mountain laurel is an evergreen flowering shrub found in rocky or gravelly woods and clearings, clearings in or edges of mesic woods and occasionally swamps. The pink and white flowers have five petals fused into a disc or saucer shape and appear from May through July. Broad beech fern is a large fern with a triangular leaf arrangement, hairy stems, yellowish scales, winged axis and lobed sub leaflets. The fern occurs in sunny openings in moist woods. No individuals of these three species were found in the Project Area, but habitat for each of them does exist within the mesic woods mapped (Topsham Hydro, 2019).

Table 4.8.1.4-1. State-listed Plants Listed in the PAD

Common Name	Species Name	Status	Found in Project Area?	Habitat in Project Area?
Sweet pepperbush	*Clethra alnifolia*	Special Concern	No	Yes, in forested and marsh and shrub wetlands
Showy lady's slipper	*Cypripedium reginea*	Special Concern	No	No
Hollow Joe-pye weed	*Eutrotrichium fistulosum*	Special Concern	No	Yes, in open (non-wooded) wetlands
Smooth winterberry holly	*Ilex laevigatum*	Special Concern	No	Yes, in forested and marsh and shrub wetlands
Mountain laurel	*Kalmia latifolia*	Special Concern	No	Yes, in mesic woods
Spicebush	*Lindera benzoin*	Special Concern	No	Yes, in mesic woods
White adder's mouth	*Malaxis monophyllus*	Endangered	No	No
Broad beech fern	*Phegopteris hexagonoptera*	Special Concern	No	Yes, in mesic woods
Spotted pond weed	*Potamogeton pulcher*	Threatened	No	No
Comb-leaved mermaid weed	*Prosperinaca pectinata*	Endangered	No	Yes, in wetlands along the impoundment

Source: Topsham Hydro, 2019

E.4.8.2 Environmental Analysis

FERC's SD2 identified one potential resource issue relating to wildlife and botanical resources, which is discussed in greater detail below.

Effects of continued project operation on the federally endangered Atlantic Salmon and its critical habitat and the northern long-eared bat

Northern long-eared bat

The northern long-eared bat may occur within the Project area. This aerial insectivore may forage adjacent to Project waters in forested habitats in the summer, but is not expected to be adversely affected as a result of Project operations. The northern long-eared bat roosts in upland areas (live or snag trees, caves, etc.), spends winter months in hibernacula, and is not expected to be adversely affected by Project operations. There are no planned changes in current operating conditions or maintenance activities that would affect this species. There is no indication from field observations that Project operations cause any adverse impacts on northern long-eared bat breeding, roosting, or habitat in the vicinity of the Project.

Atlantic Salmon

The potential effects of the proposed action on Atlantic Salmon and Atlantic Salmon critical habitat are discussed in Section E.4.6.2.

E.4.8.3 Proposed Environmental Measures

Proposed PME measures related to Atlantic Salmon are discussed in Section E.4.6.3.

The operation of the Project has no effect on the remaining TE species; therefore, the Topsham Hydro is not proposing PME measures for those TE resources.

E.4.8.4 Unavoidable Adverse Effects

Continued operation of the Project, as proposed, will have no significant unavoidable adverse impacts on TE species.

E.4.8.5 References

Maine Department of Agriculture, Conservation and Forestry. 2016. *Natural Communities and Ecosystems.* Maine Natural Areas Program. http://www.maine.gov/dacf/mnap/features/community.htm Accessed December 2016

Maine Department of Inland Fisheries & Wildlife. 2015. *Maine's State Wildlife Action Plan* (SWAP). http://www.state.me.us/ifw/wildlife/reports/wap.html. Accessed January 2017.

Maine Department of Inland Fisheries & Wildlife. 2017. *Small Mammals.* http://www.maine.gov/ifw/wildlife/species/mammals/small.html. Accessed April 2017.

Topsham Hydro. 2019. Initial Study Report Botanical and Wildlife Resources Survey Pejepscot Hydroelectric Project.

United States Fish & Wildlife Service. 2016. *IPaC Trust Resources Report*. https://ecos.fws.gov/ipac/ Accessed December 2016.

E.4.9 Recreation and Land Use

E.4.9.1 Affected Environment

Recreational and non-recreational land use in the Project vicinity reflects the generally rural, forested, riverine location. Recreation along the Androscoggin River and surrounding area typically includes hiking, cross-country skiing, snowshoeing, snowmobiling, and mountain biking, as well as fishing, boating, hunting, picnicking, and wildlife watching. Selected recreation parameters for each of the three counties abutting the Project are discussed in Section E.4.9.1.1.

Major land use classifications of the river basin and within the immediate Project vicinity are discussed in Section E.4.3.4. As previously noted, the Project boundary is within four towns – the Towns of Durham and Lisbon in Androscoggin County, the Town of Topsham in Sagadahoc County, and the Town of Brunswick in Cumberland County (see Figure 3.2.3-1). Non-recreational land uses in the area include industrial, commercial, residential, and agricultural uses. Commercial and residential development is concentrated within town centers and along transportation corridors, industrial development is concentrated near the eastern shore of the Androscoggin River, and agricultural uses are set back from both banks of the river.

No Project lands are included in, or under study for inclusion in, the National Trails System or the National Wilderness Preservation System (UM, 2016). The Project site is not located within or adjacent to any river segment that is designated as a part of, or under study for inclusion in, the National Wild and Scenic River System (NWSRS, 2016) or included in the Nationwide Rivers Inventory (NRI) (NPS, 2009). The downstream tidewater section of the Androscoggin River from Merrymeeting Bay to Brunswick is listed in the NRI for outstanding fish, wildlife, botanical, hydrologic, recreational, and historic values. The river segment roughly 100 miles upstream of the Project in Oxford County, from south of Rumford Center to Hastings Island, is listed in the NRI as “a sparsely developed high order river” with an historic Atlantic Salmon fishery (NPS, 2009).

E4.9.1.1 Regional Recreation Opportunities

The Project Area lies within three of Maine’s tourism regions: Mid-coast and Islands, Greater Portland and Casco Bay, and Lakes and Mountains (MOT, 2016). The three regions span a large portion of the state and offer an array of recreational opportunities. The Maine Office of Tourism identifies commercial recreational opportunities downstream of the Project in Brunswick, including Thomas Point Beach & Campground and Brunswick Golf Course. Other opportunities listed in the immediate area include Bradbury Mountain State Park (located approximately 9 miles southwest of the Project), Pineland Public Reserved Land (located approximately 11 miles southeast of the Project), Androscoggin Riverlands State Park (located approximately 16 miles northeast of the Project), Outlet Beach (located approximately 16 miles east of the Project), and several private campgrounds. The Merrymeeting Bay area provides numerous recreation opportunities on and off the water, including at John L. Baxter State Forest and the Steve Powell Wildlife Management Area on Swan Island (MOT, 2016).

Bradbury Mountain State Park provides over 800 acres of forested land for camping, hiking, picnicking, horseback riding, biking, snowshoeing, wildlife viewing, and snowmobiling. The park is situated off Route 9 in Pownal and open year-round. There is a small fee for admission to the park. Facilities include a campground, picnic area, group picnic shelter, playground, and showers (MOT, 2016).

Pineland Public Reserved Land, located on both sites of Route 231 in New Gloucester, Gray and North Yarmouth, contains over 600 acres of undeveloped land. Activities include cross country skiing, fishing, hiking, biking, snowshoeing, and wildlife viewing (MOT, 2016).

Outlet Beach is a family-owned beach on the north shore of Sabbathday Lake in New Gloucester. The beach is open for swimming and boating from Memorial Day through mid-September, and offers two floating docks, a floating diving board, an offshore slide, a snack bar, a picnic area, bathhouses, and restrooms. There is a small fee for admission to the beach and boat launch area. Canoes, paddleboats, kayaks and tubes are available for rent (MOT, 2016).

Located north of Lewiston, the 2,675-acre Androscoggin Riverlands State Park offers trails for hiking, cross-country skiing, snowshoeing, snowmobiling, and mountain biking, as well as opportunities for fishing, motorized and non-motorized boating, hunting, picnicking, and wildlife watching. The park has 12 miles of river frontage and is part of the larger Androscoggin Greenway (the southernmost section of the river) and the Androscoggin River Trail (MDACF, 2013). The Androscoggin River Trail connects public river access points along the river from Shelburne, NH, to Rumford, ME, allowing for boating trips of varying lengths along mostly flat water. The Androscoggin Greenway section of the trail provides access sites in the Project vicinity, including in the Towns of Lisbon, Durham, Topsham and Brunswick (ARWC, 2012).

Several smaller parks in the towns surrounding the Project Area provide hiking, biking, snowshoeing and cross-country skiing trails, including Summer Street Park in the Town of Lisbon, Durham River Park in the Town of Durham, and Foreside Trails in the Town of Topsham. Table 4.9.1.1-1 provides an overview of select recreation parameters broken down by county.

Table 4.9.1.1-1. Select Recreation Parameters by County

	Androscoggin County	Cumberland County	Sagadahoc County
Boat Launches – Hand Carry Only	3	6	3
Boat Launches	13	39	11
Trails – ATV (mi.)	67	102	65
Trails – Snowmobile (mi.)	589	640	160
Conservation Land (acres)	9,189	38,163	18,502
Conservation Land - % of County	2.9%	6.5%	11.3%

Source: MDOC, 2009

E4.9.1.2 Existing Project Area Recreation Facilities

Topsham Hydro currently operates the following three FERC-approved Project recreation facilities:

- **Pejepscot Boat Ramp**: located in Topsham off Route 196 on the eastern shore of the Androscoggin River just downstream from Lisbon Falls. The site provides Project impoundment access for trailered and hand-carry boats via a concrete ramp with an asphalt approach.
- **Pejepscot Fishing Park**: located off River Road in Brunswick, on the western shore of the Androscoggin River. The site provides access to the river above and below the dam, as well as a boat landing, trail, and metal staircase for portaging around the dam.
- **Lisbon Falls Fishing Park**: located adjacent to the Route 125 Bridge approximately 600 ft downstream of Worumbo Dam. The Fishing Park includes a parking area on the north side of Route 125 as well as a footpath and a staircase leading to the Androscoggin River.

Figure 4.9.1.2-1 depicts existing Project recreation facilities. The following subsections describe each site in greater detail.

E4.9.1.2.1 Pejepscot Boat Ramp

The Pejepscot Boat Ramp is operated by Topsham Hydro and is located approximately 2.5 miles upstream of the dam directly off Lisbon Street/Route 196 in the Town of Topsham. The facility consists of a large gravel parking area, a gated gravel access lane that crosses a railroad track, a gravel turnaround area, and a boat ramp providing access to the Project impoundment. The site is comprised of two parcels divided by the railroad right of way: one parcel holds the parking area and the other holds the boat ramp and gravel turnaround area. Topsham Hydro holds easements on the parking and boat ramp parcels and a private railroad crossing permit to connect them.

Access to the site consists of an approximately 25 foot wide gravel driveway off Lisbon Street/Route 196. The gravel parking area is approximately 115 ft long and 40 ft wide, with space for approximately 12 vehicles with trailers. The access road leading from the parking area to the turnaround area and boat launch is gated; the gate is closed during high flow conditions or as needed for safety considerations based on the discretion of Project operating and safety staff. The access road leads to a gravel turnaround area, large enough to allow for vehicles with trailers to pivot in order to back down the boat ramp. The approach to the boat ramp is a nearly 15 foot wide asphalt road. The ramp itself is composed of two sets of concrete planks each 7.5 ft wide. The total ramp length, including the asphalt approach, is approximately 45 ft.

During the USR meeting, MDIFW noted that members of the public had reported unexpected closures of the boat ramp; Topsham Hydro staff in attendance were unfamiliar with such closures but speculated that they might be associated with high flow events. Upon subsequent review of the record, Topsham Hydro determined that flow-related closures are extremely rare and could not identify any recent closures for any reason. The boat launch is typically closed in the fall when boat barriers are removed and reopened in the spring, once boat barriers are installed. In 2019, for example, the launch was open until November 20.

E4.9.1.2.2 Pejepscot Fishing Park

The Pejepscot Fishing Park, also known as the Pejepscot Dam Recreation Area, is located off River Road in the Towns of Topsham and Brunswick. The site is accessed via a long gravel access road and consists of a small parking area with capacity for three vehicles, angler access above and below the dam, and a portage facility. The site is situated on three parcels; the Licensee owns one of the parcels and holds easements on the remaining two.

A large wooden sign at the top of the access road off River Road identifies the site as the Pejepscot Fishing Park. Attached signage indicates that the park is open for public use from one hour before sunrise to one hour after sunset. The access road leads to a small gravel parking area; vehicular access beyond the parking area is blocked by a cable strung between two posts. A trash receptacle is provided near the parking area. Beyond the parking area and adjacent to the portage trail is a flat, open area overlooking the Project dam. Access to and views of the Project are restricted by fencing.

The portage facility consists of an unimproved boat landing area above the dam, a 600-foot-long trail leading around the dam, and a put-in below the dam. The take-out landing is located just above the dam along a steep boulder wall. To access the take-out, boaters pass around the western edge of the upstream boat barrier (installed from May 15 through October 15) and follow the inner canoe barrier along the shore. From the take-out, boaters follow the edge of the fence along an unimproved dirt path indicated by a canoe portage sign. The trail continues up the hill to the dam overlook area and continues along the edge of the fence downhill to a set of steel stairs descending a steep exposed ledge face. Along the stairs is a ramp upon which canoes and kayaks can be slid down. At the bottom of the stairs is a flat rock landing with handrails guiding users down a steep section of ledge to a lower shelf. The lower shelf runs for approximately 55 ft to an area where the slope to water’s edge is more gradual. The put-in is located in a gentle backwater with a gradual rocky slope into the water.

Anglers access the shoreline above and below the dam using the portage trail. In addition, there is an informal footpath leading from the parking area to the shoreline approximately 1,300 ft downstream from the dam.

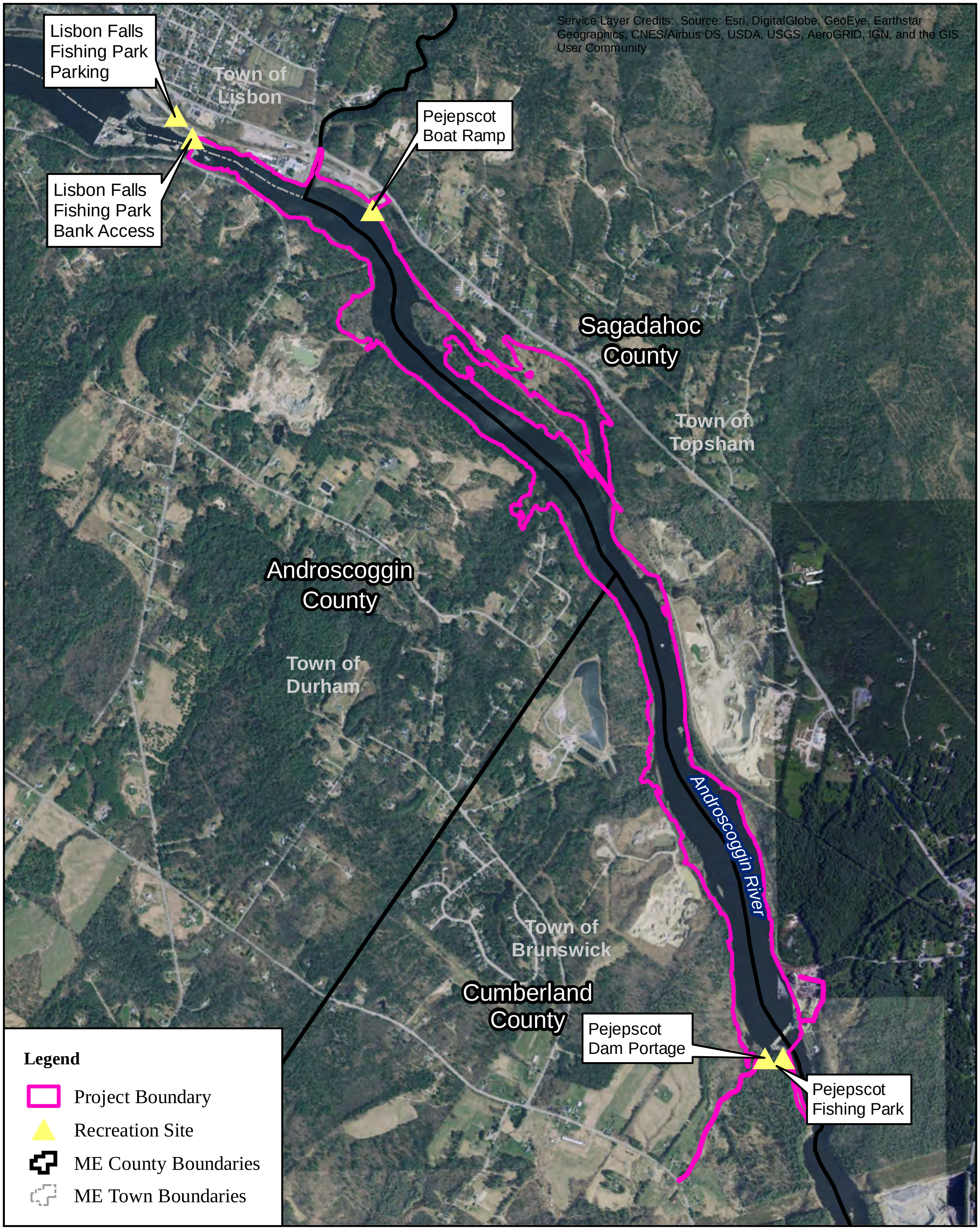
E4.9.1.2.3 Lisbon Falls Fishing Park

The Lisbon Falls Fishing Park, operated by Topsham Hydro, is located in the Town of Lisbon off Canal Street/Route 125. The site provides angler access to the Androscoggin River approximately 3.2 miles upstream of the Project and immediately downstream from the Worumbo Project (FERC No. 3428). Topsham Hydro holds easements on the parcels comprising the site, which are owned by Eagle Creek; these leases expire with the termination of the current license. The site consists of a parking area, a gravel access path leading to the shoreline, and informal access along the shoreline. Canal Street/Route 125 separates the parking area from the recreation area, which is fenced and gated.

The gravel parking area measures approximately 95 by 23 ft, providing space for 10 vehicles without trailers, and is bordered by a large boulder wall approximately 20 ft high. A large sign at the east end of the parking area identifies the site as the Lisbon Falls Fishing Park. A smaller attached sign indicates that the park is open for public use from one hour before sunrise to one hour after sunset.

A crosswalk leads from the parking area to the gated path entrance. The site is also accessible by pedestrians using the sidewalk on the south side of Canal Street/Route 125. A large sign affixed to the fencing identifies Topsham Hydro as the site owner, provides a map of recreation sites in the Pejepscot Recreation Area, provides contact information and the FERC project number, includes hours of operations, and prohibits overnight camping. The approximately 10 foot wide access path runs on top of the bank along the shoreline downstream to the Route 125 Bridge. The access path ends near the upstream bridge abutment, but informal footpaths continue to the top of the rocks downstream from the bridge.

Approximately 70 ft along the access path from the gated entrance, a set of wooden stairs leads down to a narrower trail extending to the shoreline. Several informal footpaths lead along the river to provide angler access to approximately 300 ft of shoreline.



Brookfield

N

0 0.1 0.2 0.4 Miles

Pejepscot Hydroelectric Project
(FERC No. 4784)
Final License Application

Figure 4.9.1.2-1.
Recreation Sites
in the Vicinity of the
Pejepscot Project

Path: P:\Modeling\Projects\01925\maps\fla\exhibit_e\Figure_4_9_1_2-1.mxd

E4.9.1.3 Project Recreation Use

Recreational use of Project recreation facilities was evaluated as part of the *Recreation Facilities Inventory and Public Recreation Use Assessment*. Overall use during the study period was estimated at 5,890 recreation days. Table 4.9.1.3-1 presents recreation use over the study period by site and month, along with estimated average daily use for each site. Figure 4.9.1.3-1 depicts monthly use, with use in May and October extrapolated based on average daily use for those months. As shown, use for all facilities increased as summer progressed, peaked in July, and decreased through October. The Pejepscot Boat Ramp saw the highest use of the three facilities, with an average daily use of 23.1 recreation days. Lisbon Falls Fishing Park and Pejepscot Fishing Park had similar use over the study period, with average daily uses of 10.0 and 8.1 recreation days, respectively. Figure 4.9.1.3-2 depicts use by primary activity at each Project recreation facility, shown as the percentage of total Project recreation use. As shown, fishing was the most popular activity at the Project, accounting for approximately 40 percent of combined use. Hiking was the next most popular activity, accounting for roughly 32 percent of use. Sightseeing and motorized boating are significantly less popular, at 11 and nine percent, respectively. Picnicking, non-motorized boating, and other uses combined comprise less than 10 percent of use at the Project. The following sections discuss use by site, including the primary activities participated in at each facility.

E4.9.1.3.1 Pejepscot Boat Ramp

Use at the Pejepscot Boat Ramp over the study period was estimated at 3,299 recreation days. Although on average 35.0 vehicles accessed the site per day, only around 45 percent of these accessed the site for recreational purposes. The remaining 55 percent used the parking area as a turnaround area or for a brief rest stop. On average, 15.9 vehicles accessed the site per day for recreational purposes, with an average of 1.5 people per vehicle. The average duration for recreational visits was 1.8 hours. Table 4.9.1.3.1-1 depicts the percentage of users observed engaged in each activity over the study period. As shown, fishing was the most popular activity at the site, accounting for 30 percent of site use. Anglers were observed fishing along the shoreline at the site as well as walking along the railroad track to offsite locations. Hiking, generally along the railroad track, was the next most popular activity at 25 percent. Boating accounted for 20 percent of overall site use (16 percent of use was attributed to motorized boating and four percent to non-motorized boating).

Based on parking area utilization, the site was used at approximately 25 percent capacity on average non-peak weekends over the study period. Peak use observed was on the Monday of Labor Day weekend, when six vehicles were observed in the lot at one time, for a peak utilization of 50 percent of parking capacity. Table 4.9.1.3.1-2 presents parking area capacity utilization over the study period.

E4.9.1.3.2 Pejepscot Fishing Park

Use at the Pejepscot Fishing Park over the study period was estimated at 1,164 recreation days. On average, 4.7 vehicles accessed the site per day for recreational purposes, with an average of 1.7 people per vehicle. The average duration for recreational visits was 2.1 hours.

Table 4.9.1.3.2-1 depicts the percentage of users observed engaged in each activity over the study period. As shown, fishing was the most popular activity at the site, accounting for 49 percent of use. The majority of anglers were observed using the portage trail to access the shoreline. A small percentage of anglers were observed using the informal footpath near the parking area for shoreline access. The next most popular activity at the site was hiking, accounting for 36 percent of use. Sightseeing accounted for the remaining 15 percent of use.

Based on parking area utilization, the site was used at approximately 33 percent capacity on average non-peak weekends over the study period. Peak use observed was two vehicles in the lot at one time, for a peak utilization of 67 percent of parking capacity; this occurred during five of the 14 calibration counts. Table 4.9.1.3.2-1 presents parking area capacity utilization over the study period.

Although the portage trail was observed to be used for non-boating activities throughout the study period, only four instances of use for portaging boats around the dam were captured by the trail camera. Three of these occurred in June and one in August. In total, seven people were observed portaging; three were kayaking and four were canoeing.

E4.9.1.3.3 Lisbon Falls Fishing Park

Use at the Lisbon Falls Fishing Park over the study period was estimated at 1,427 recreation days. On average, 4.2 vehicles accessed the site per day for recreational purposes, with an average of 2.4 people per vehicle. The average duration for recreational visits was 1.4 hours. Table 4.9.1.3.3-1 depicts the percentage of users observed engaged in each activity over the study period. As shown, fishing was the most popular activity at the site, accounting for 55 percent of use. The remaining 45 percent of users were hiking.

Based on parking area utilization, the site was used at approximately 10 percent capacity on average non-peak weekends over the study period. Peak use observed was on the Saturday of Memorial Day weekend, when three vehicles were observed in the lot at one time, for a peak utilization of 30 percent of parking capacity. Table 4.9.1.3.3-2 presents parking area capacity utilization over the study period.

Table 4.9.1.3-1: Estimated Use, Project Recreation Facilities, May 25 to October 14, 2019

Site	May*	June	July	Aug.	Sept.	Oct.*	Average Daily Use	Total
Pejepscot Boat Ramp	142	741	832	803	566	215	23.1	3,299
Pejepscot Fishing Park	58	270	321	284	167	64	8.1	1,164
Lisbon Falls Fishing Park	82	358	400	334	211	42	10.0	1,427
							Total	**5,890**

*Months with partial data.

Table 4.9.1.3.1-1: Use by Activity, Pejepscot Boat Ramp, May 25 to October 14, 2019

Activity	Percent of Total Use	Estimated Recreation Days
Fishing	30%	994
Hiking	25%	835
Boating (motorized)	16%	517
Sightseeing	14%	477
Other Use[1]	6%	199
Picnicking	5%	159
Boating (non-motorized)	4%	119
	Total	**3,299**

[1]"Other" use includes use that was not identified; this may include both recreational and non-recreational use

Table 4.9.1.3.1-2: Parking Area Capacity Utilization, Pejepscot Boat Ramp, May 25 to October 14, 2019

Available Spaces	Average Non-Peak Weekend		Peak Use Observed	
	Spaces in Use[1]	Percent Capacity	Spaces in Use	Percent Capacity
12	3	25%	6	50%

[1]Rounded up to nearest whole number.

Table 4.9.1.3.2-1: Use by Activity, Pejepscot Fishing Park, May 25 to October 14, 2019

Activity	Percent of Total Use	Estimated Recreation Days
Fishing	49%	567
Hiking	36%	418
Sightseeing	15%	179
	Total	**1,164**

Table 4.9.1.3.2-2: Parking Area Capacity Utilization, Pejepscot Fishing Park, May 25 to October 14, 2019

Available Spaces	Average Non-Peak Weekend		Peak Use Observed	
	Spaces in Use[1]	Percent Capacity	Spaces in Use	Percent Capacity
3	1	33%	2	67%

[1]Rounded up to nearest whole number.

Table 4.9.1.3.3-1: Use by Activity, Lisbon Falls Fishing Park, May 25 to October 14, 2019

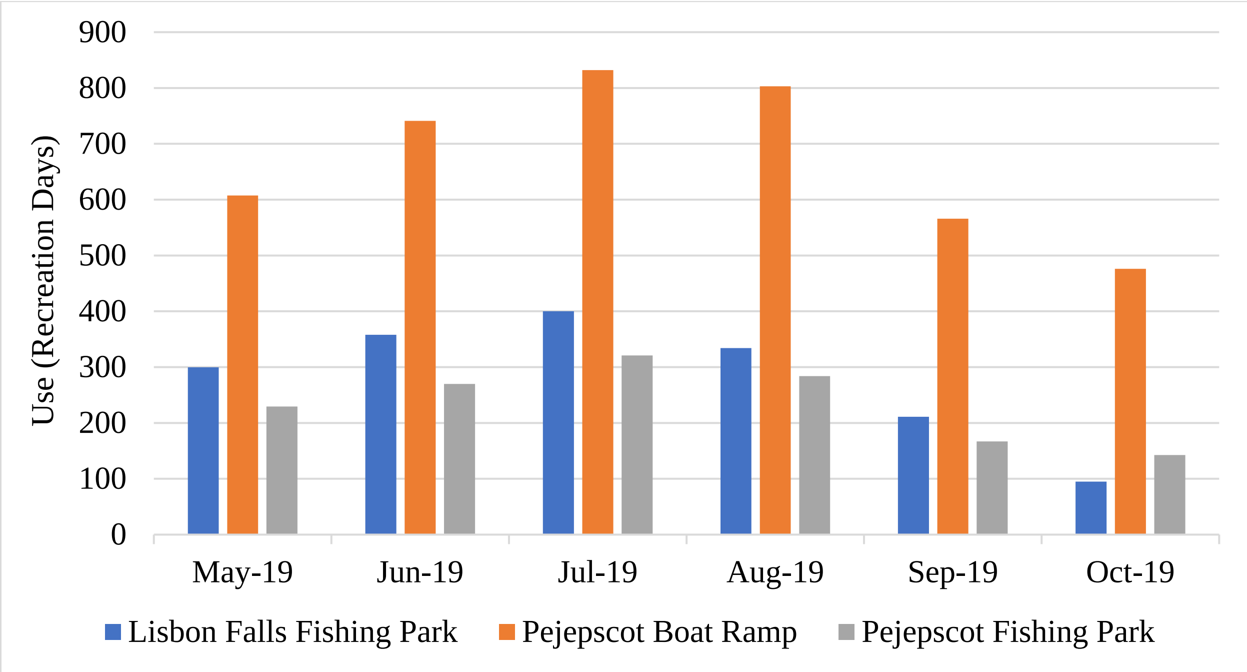
Activity	Percent of Total Use	Estimated Recreation Days
Fishing	55%	786
Hiking	45%	641
	Total	**1,427**

Table 4.9.1.3.3-2: Parking Area Capacity Utilization, Lisbon Falls Fishing Park, May 25 to October 14, 2019

Available Spaces	Average Non-Peak Weekend		Peak Use Observed	
	Spaces in Use[1]	Percent Capacity	Spaces in Use	Percent Capacity
10	1	10%	3	30%

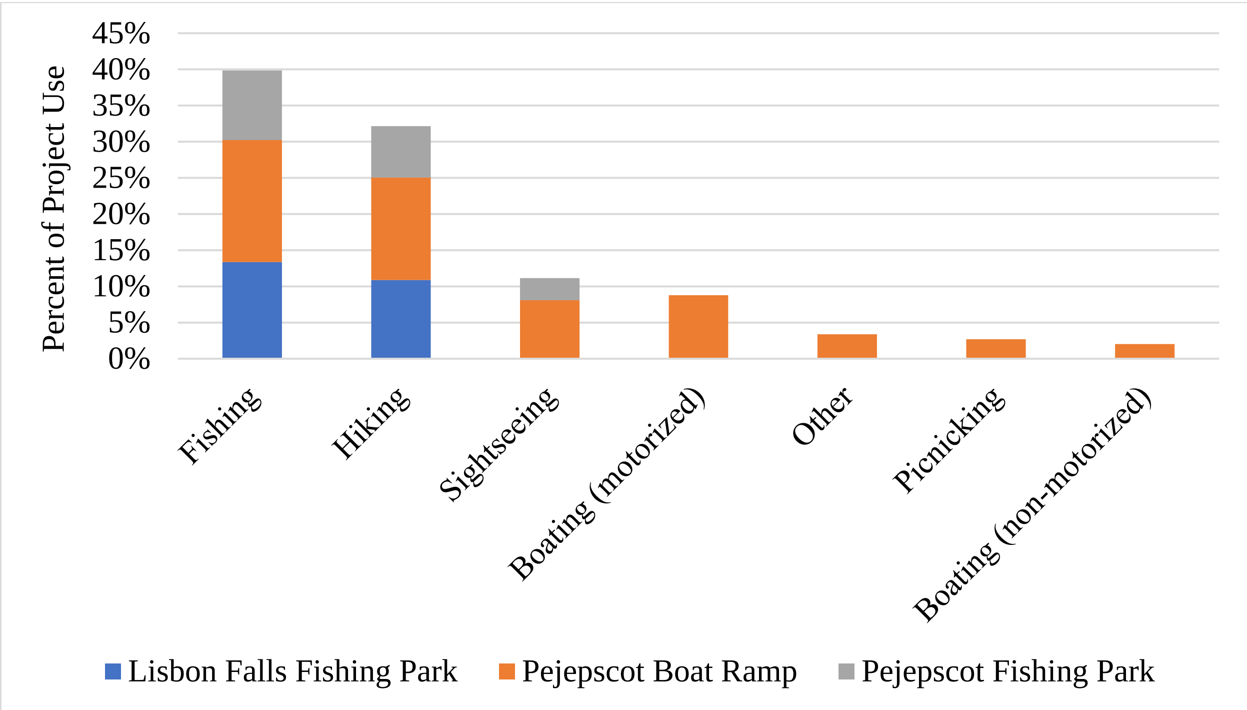
[1]Rounded up to nearest whole number.

Figure 4.9.1.3-1: Estimated Monthly Use* at Project Recreation Facilities, May through October, 2019



*Estimated use for May and October based on average daily use.

Figure 4.9.1.3-2: Use by Facility and Activity, May 25 to October 14, 2019



E4.9.1.4 Project Vicinity Recreation Needs Identified in Management Plan

Two statewide plans serve as management plans for recreational needs in the Project vicinity: the Maine Statewide Comprehensive Outdoor Recreation Plan (SCORP) and the Strategic Plan for Providing Public Access to Maine Waters for Boating and Fishing. In addition, each of the towns surrounding the Project has a Comprehensive Plan for the lands within their jurisdiction. A discussion of recreation needs and goals identified in each of these plans follows.

E4.9.1.4.1 Maine Statewide Comprehensive Outdoor Recreation Plan

The Maine Bureau of Parks and Lands (BPL) reviews statewide recreational needs at five-year intervals. The most recent review is reported in the 2020-2024 SCORP. Within the SCORP, BPL examines the supply and demand for outdoor recreational opportunities; identifies opportunities, constraints and trends; and devises strategies for implementing statewide recreation priorities. Priority areas for the current SCORP are to support active, engaged communities, address workforce attraction and retention through outdoor recreation, sustain and grow tourism, promote ecological and environmental resilience, and invest in maintenance and stewardship. According to the SCORP, the US Forest Service forecasts that the activities in the northern United States that will see the largest number of new participants are visiting interpretive sites, nature viewing, visiting developed sites, swimming, and motorized water activities. The SCORP did not identify any strategies specific to the Project or in the vicinity of the Project. (BPL, 2019).

E4.9.1.4.2 Boating Facilities Strategic Plan

The Maine Department of Agriculture, Conservation and Forestry, in cooperation with MDIFW, produced the Strategic Plan for Providing Public Access to Maine Waters for Boating and Fishing in 1995 (updated in 2000). This plan guides the two agencies in directing their water access programs. The plan does not identify the Androscoggin River in the Project vicinity as needing guaranteed public access or additional access (BPL, 2013).

E4.9.1.4.3 Town Comprehensive Plans

The Comprehensive Planning and Land Use Act, adopted by the State of Maine in 1988, requires that towns in Maine have a comprehensive plan consistent with the state Growth Management Act to impose certain ordinances or qualify for certain grant and loan programs.

The Town of Brunswick 2008 Comprehensive Plan Update contains key policies to meet the Town’s overall needs, including a policy to protect open space and natural resources and to provide outdoor recreational opportunities. The Town anticipates needing additional recreational facilities to accommodate population growth. The Comprehensive Plan refers to the Town’s 2002 Parks, Recreation, and Open Space Plan, which includes policies for improving recreation opportunities within the Town, including acquisition and development of additional recreational facilities and provision of water access. A key objective of the Comprehensive Plan is to implement the policies in the Parks, Recreation and Open Space Plan (Town of Brunswick, 2008).

The Town of Durham 2002 Comprehensive Plan establishes methods to strengthen land use and zoning ordinance categories that protect certain areas from new development, allowing for open space and limited recreational use. One of the Town's goals as established by the Plan is to "protect and promote the availability of recreational opportunities for all Durham residents." The corresponding Town policies include creating access to rivers and ponds for minimal-impact uses, with implementation measures specific to the Androscoggin River: (1) support the town's membership in the Androscoggin River Watershed Council; (2) ensure that Durham residents have access to the Androscoggin River by maintaining the existing public boat launch facility and river park; and (3) encourage improved access to rivers, ponds and trails (Town of Durham, 2002).

The Town of Lisbon Comprehensive Plan Update, adopted in 2007 and amended in 2011, identifies a need for additional formal recreation facilities and programs. Policies to meet this need include providing access to the Androscoggin River; encouraging the practice of allowing public access to private lands; and creating a recreation/open space/ball field on the waterfront above the Worumbo Dam. The Plan also recommends a regional approach to water resource management in the Androscoggin River basin (Town of Lisbon, 2011).

The 2005 Town of Topsham Comprehensive Plan acknowledges that the recreational needs of the community are changing; as the population ages, participation in recreational activities has increased. The Plan identifies an adequate supply of outdoor recreation space, but a need for increased indoor recreation space and a recreation master plan to accommodate shifting recreation trends. Specific actions related to recreation include exploring partnership opportunities with private and nonprofit recreation providers to expand the variety of recreation opportunities, creating a Downtown Waterfront Park along the Androscoggin River, and ensuring that existing and new facilities are maintained (Town of Topsham, 2005).

E4.9.1.5 Land Use and Management within the Project Vicinity

Land use classifications found throughout the Androscoggin River watershed upstream of Pejepscot Dam as well as within 1,000 ft. of the Project boundary were discussed in Section E.4.3.4 and depicted in Figure 4.3.4-2. The majority of land surrounding the Project is privately owned. As previously noted, land adjacent to and within the Project boundary is primarily forested, with limited development within the boundary except Project facilities. Within the Project vicinity, land use is mixed, with significant commercial development concentrated near the centers of the Towns of Lisbon, Topsham, and Brunswick and along the Maine Route 196 corridor. The town of Durham is mainly residential and sparsely developed. There are, however, significant commercial and industrial land uses in the Project vicinity including a metal recovery and recycling facility immediately adjacent to the Project powerhouses, an active railroad line along the eastern side of the impoundment, and several active rock and gravel pits in proximity to the Project. Alternatively, the majority of the southwest Project shoreline within the Town of Brunswick as well as the southeast shoreline of Little River is in conservation (Maine Office of GIS, 2016).

Management of lands external to the Project boundary fall under the jurisdiction of the town in which they are located. The State of Maine's Mandatory Shoreland Zoning Act (MSZA) requires that land within 250 ft of any river be subject to zoning and land use controls, allowing local municipalities authority, with State oversight, to establish shoreline buffer zones and regulations. The Maine Board of Environmental Protection (MBEP) is required to set, and update as needed, minimum guidelines for these municipal zoning and land use controls. The Towns of Lisbon, Durham, Topsham, and Brunswick have adopted Shoreland Zoning Ordinances with shoreline buffer zones meeting MBEP minimum requirements, including setbacks for new construction and vegetation removal (MBEP, 2016).

As required per the MSZA, lands within 250 ft of the Androscoggin River are zoned with a Resource Protection overlay within all four towns abutting the Project boundary; however, the base zoning varies between towns. Only a small portion of the Project boundary is within the Town of Lisbon; these lands are zoned Industrial along the Androscoggin shoreline and Resource Protection along Little River (Town of Lisbon, 2012). Lands in the Town of Brunswick, along the southwestern portion of the Project boundary, are zoned County Residential 1 (Town of Brunswick, 2009). The northwestern portion of the Project boundary, within the Town of Durham, is zoned Rural (Town of Durham, 2004). Within the Town of Topsham, the northeastern portion of the Project boundary is zoned Rural Residential and the southeastern portion is zoned Industrial (Town of Topsham, 2015).

E4.9.1.6 Land Use and Management of Project Lands

Topsham Hydro possesses the necessary title, right, or interest to operate the Project on the lands within the Project boundary. These lands are managed in accordance with federal, state, and local regulations. In general, Project operations and maintenance, along with recreation, are the primary activities that occur on Project lands.

E.4.9.2 Environmental Analysis

FERC's SD2 identified one potential resource issue relating to recreation resources, which is discussed in greater detail below.

Effects of continued Project operation on recreational use in the Project area, including the adequacy of existing recreational access.

Topsham Hydro proposes to continue to operate and maintain the following existing formal recreation sites and their associated facilities and amenities; 1) Pejepscot Fishing Park and the portage trail, and the 2) Pejepscot Boat Ramp. Topsham Hydro also proposes to implement a Recreation Management Plan (RMP) for the Project, which will address management of Project recreation sites over the term of a license (Appendix E-6).

As described in Section E.3.3.3, the upstream end of the Pejepscot Project boundary overlaps the project boundary for the Worumbo Project (No. 3428), which is owned by Eagle Creek. Topsham Hydro and Eagle Creek have agreed to seek Commission approval to revise the boundaries of both projects to eliminate the overlap. The Lisbon Falls Fishing Park, which is currently connected to the Pejepscot Project license, is located within this area of overlap. As described above, Topsham Hydro currently operates and maintains the facility; however, the lands are leased from Eagle Creek. The term of the lease ends at the expiration of the current Pejepscot license. This facility is proposed to be removed from the Pejepscot Project boundary, but would continue to be encompassed with the Worumbo Project boundary with the exception of the parking area for this facility. To alleviate this discrepancy, Eagle Creek proposes to modify the Worumbo Project boundary to include the parking area. With the modifications of the boundary for each Project, Eagle Creek would assume responsibility for the continued operation and maintenance of the Lisbon Falls Fishing Park.

As discussed in Section E.4.9.1, the Project recreation facilities provide an array of recreational opportunities, including access to the Androscoggin River both above and below the dam for fishing, boating, hiking, and sightseeing. The results of the *Recreation Facilities Inventory and Public Recreation Use Assessment* (Topsham Hydro 2020) demonstrate that there is ample access and capacity for recreational demand in the Project area: all existing Project recreation facilities were used at 33 percent or less of capacity on average non-peak weekends. The facilities were found to be in fair condition, although maintenance issues were identified at each site. These maintenance issues are discussed in the RMP. Measures to address maintenance issues and to enhance recreation at Project recreation facilities are proposed in the RMP and summarized below.

E.4.9.3 Proposed Environmental Measures

As part of the RMP, Topsham Hydro proposes the following measures to enhance recreation at the Project. These measures are discussed in greater detail in the RMP, as is the proposed plan for facility operations and maintenance.

Pejepscot Boat Ramp:

- Re-grade the driveway and parking area, including placing and compacting gravel fill to level driveway and provide a safe turnout onto Lewiston Road.
- Clear sediment and vegetation from the surface of the boat ramp in order to restore the full width for use.
- Replace the entrance sign with a similarly sized sign identifying the site.

Pejepscot Fishing Park:

- Re-grade the access road, including placing and compacting gravel fill to repair areas with significant erosion.

- Consult with the Town of Brunswick to secure an easement to utilize the existing informal footpath beginning at the back of the facility's parking area. Should negotiations with Town officials be successful, Topsham Hydro will:
    - Reroute the portage trail to this less steep put-in area;
    - Remove the steel staircase and extend the existing chain link fence to discourage access to the steep section of ledge;

- Clear the downed trees and other debris from the section of informal trail between the parking area and the shoreline access downstream of the dam; and
- Add directional signage leading boaters along the rerouted portage trail.

- Erect an upstream sign indicating the location of the portage take-out.

Lisbon Falls Fishing Park:

- Remove facility from the Pejepscot Project boundary, allowing Eagle Creek to assume operation and maintenance of the facility.

E.4.9.4 Unavoidable Adverse Impacts

Continued Project operation will not result in unavoidable adverse impacts to recreation resources.

E.4.9.5 References

Androscoggin River Watershed Council (ARWC). 2012. Androscoggin River Trail Access Sites: Lower Androscoggin – Riverlands. August 2012. [Online] URL: http://arwc.camp7.org/Resources/Documents/Lower%20Androscoggin_Riverlands.pdf. Accessed 12/14/2016.

Maine Department of Environmental Protection (MBEP). 2016. Mandatory Shoreland Zoning. [Online] URL: http://www.maine.gov/dep/land/slz/. Accessed on 12/16/2016.

Maine Bureau of Parks & Lands (BPL). 2019. Maine State Comprehensive Outdoor Recreation Plan 2020-2024. December 2019. [Online] URL: https://www.maine.gov/dacf/parks/publications_maps/docs/2020_ME_SCORP_final_1_2_2020.pdf. Accessed 2/14/2020.

Maine Bureau of Parks and Lands (BPL). 2013. Boating Facilities Program Priorities. [Online] URL: http://www.maine.gov/dacf/parks/about/boating_facilities_program/strategic_plan/priorities.html. Accessed on 12/8/2016.

Maine Department of Agriculture, Conservation and Forestry (MDACF). 2013. Androscoggin Riverlands. [Online] URL: http://www.maine.gov/cgi-bin/online/doc/parksearch/index.pl?search_radio=1&state_park=98&historic_site=&public_reserved_land=&shared_use_trails=&town=&distance=&submit=Go+%BB. Accessed on 12/14/2016.

Maine Department of Conservation, Boating Facilities Division (MDOC). 1995. Boating Facilities Strategic Plan. [Online] URL: https://www1.maine.gov/dacf/parks/about/boating_facilities_program/strategic_plan/Strategic%20Plan.pdf. Accessed 12/8/2016.

Maine Office of GIS. 2016. Maine Office of GIS Data Catalog: Conserved Lands. July 18, 2016. [Online] URL: http://www.maine.gov/megis/catalog/. Accessed 12/16/2016.

Maine Office of Tourism (MOT). 2016. Interactive Map. [Online] URL: https://visitmaine.com/interactive-map/. Accessed 12/14/2016.

National Park Service (NPS). 2009. Nationwide Rivers Inventory: Maine Segments. [Online] URL: https://www.nps.gov/ncrc/programs/rtca/nri/states/me.html. Accessed 12/7/2016.

National Wild and Scenic Rivers System (NWSRS). 2016. Explore Designated Rivers/Maine. [Online] URL: https://www.rivers.gov/maine.php. Accessed 12/7/2016.

The University of Montana (UM). 2016. Wilderness.net. [Online] URL: http://www.wilderness.net/map.cfm. Accessed on 12/7/2016.

Topsham Hydro. 2020. Recreation Facilities Inventory and Public Recreation Use Assessment, Pejepscot Hydroelectric Project.

Town of Brunswick. 2008. Comprehensive Plan Update. September 15, 2008. [Online] URL: http://www.brunswickme.org/wp-content/uploads/2013/06/Comp-Plan-Final-for-State-Review-091508rev.pdf. Accessed 8/18/2017.

Town of Brunswick. 2009. Zoning Map. August 19, 2009.

Town of Durham. 2002. Comprehensive Plan. [Online] URL: https://www.durhamme.com/sites/durhamme/files/uploads/durham_2002_compplan.pdf. Accessed August 8/18/2017.

Town of Durham. 2004. Zoning Map. March 2004.

Town of Lisbon. 2011. Comprehensive Plan Update. Amended April 19, 2011. [Online] URL: http://www.maine.gov/dacf/municipalplanning/comp_plans/Lisbon%202007%20(Amended%2011-04-19).pdf. Accessed 8/18/2017.

Town of Lisbon. 2012. Zoning Map. May 1, 2012.

Town of Topsham. 2005. Comprehensive Plan. May 19, 2005. [Online] URL: http://www.topshammaine.com/vertical/sites/%7B95A28B10-4485-4BEC-B8FC-5E8BF056A147%7D/uploads/%7BBA5D4C3D-82E3-45DA-9683-C9811D6C8253%7D.PDF. Accessed August 8/18/2017.

Town of Topsham. 2015. Zoning Map. May 20, 2015.

E.4.10 Aesthetic Resources

E.4.10.1 Affected Environment

The Project vicinity is primarily forested and rural, with interspersed areas of industrial, residential and agricultural development. Medium and high intensity development occurs within the centers of the four towns abutting the Project boundary. Forested areas and low hills surround the Project Area. Section E.4.3.4 examines land use types and coverage in the Project vicinity and greater Androscoggin River watershed.

Route 196 traverses the eastern side of the Project vicinity, offering limited views of the upper reaches of the impoundment. Route 125 on the western side of the embankment also provides limited views of the upper impoundment area as well as an industrial mill site on the opposite bank. A bridge spanning the river on Route 125 offers views of the Worumbo dam upriver and the Project Area downstream. Industrial development east of the river can also be seen from the Route 125 Bridge. Minor roads serving residential areas in the Project vicinity also offer limited views of the impoundment.

E4.10.1.1 Visual Character of Project Lands and Water

The Androscoggin River in the Project vicinity has a history of industrial use. Mill sites line the northeastern portion of the Project boundary, several quarry and gravel pits border the eastern and western Project boundaries, and Grimmel Industries operates a metal recycling facility on Pejepscot Village Main Street just upstream of the dam on the east bank. The Town of Brunswick operates a landfill on Graham Road just west of the Project boundary. A railroad track runs the length of the impoundment on the east bank of the river, splitting upstream of the dam. One track continues southeast into the Town of Brunswick, while the other continues along the river and actively services Grimmel Industries. Transmission lines span the river within the Project boundary downstream of Worumbo Dam and just below the southern Project boundary (Google Earth, 2016). Section E.4.4.1.1.4 further characterizes the Project Area shoreline.

Within the Project boundary, the river is wide and calm, with several small islands mid-river. There are no whitewater features (Town of Topsham, 2016a). The shoreline is composed of ledge and rock outcrops immediately above and below the dam.

The Pejepscot Dam and Project facilities are visible from the Pejepscot Dam Recreation Area and from the Grimmel Industries facility. The dam, spillway, fish passage facilities, and powerhouses are described in Section E.3.2.1 and depicted in Figure 3.2.1-1. Figures 4.10.1.1-1 through 4.10.1.1-3 provide photos of the area in the vicinity of the Project.

E4.10.1.2 Scenic Attractions

Several trails in the area, including the Androscoggin Riverwalk, offer scenic views of the river downstream of the Project, but no official trails provide views of the Project Area (Maine Trail Finder, 2017). The Androscoggin Riverwalk also offers views of the Bowdoin Mill and a swinging pedestrian bridge spanning the river upstream from the Brunswick Dam (Town of

Topsham, 2016b). See Section E.4.9 for a discussion of recreational opportunities offering scenic views in the Project vicinity.

There are no State or Federal Scenic Byways in the Project vicinity (FHA, 2016). Scenic attractions within a 20-30 minute drive of the Project include Bradbury Mountain State Park, Cathance River Nature Preserve, and numerous parks and features in and around the surrounding bays.

Figure 4.10.1.1-1. View Looking Downstream from Pejepscot Dam

Figure 4.10.1.1-2. View Looking Upstream from Pejepscot Dam

Figure 4.10.1.1-3. View of Powerhouses and Grimmel Industries

E.4.10.2 Environmental Analysis

FERC's SD2 did not identify any potential resource issues related to aesthetic resources.

Continued operation of the Project is not expected to adversely affect aesthetic resources in the Project vicinity. The existing Project operations and facilities are part of the current aesthetic context of the Project vicinity. No material changes to existing Project operations or facilities are proposed, and as such, Topsham Hydro does not expect any adverse effects of the Project on aesthetic resources.

E.4.10.3 Proposed Environmental Measures

Topsham Hydro is not proposing any PME measures related to aesthetic resources.

E.4.10.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts are expected to aesthetic resources at the Project.

E.4.10.5 References

Federal Highway Administration (FHA). 2016. American Byways. [Online] URL: http://byways.org/explore/byways/11510. Accessed 1/13/2017.

Google Earth. 2016. Imagery Date: 5/9/16. Accessed 1/13/2017.

Maine Department of Transportation (MaineDOT). 2014. Maine State Rail Plan. July 2014. [Online] URL: http://maine.gov/mdot/ofbs/docs/Rail_Plan_7-9-2015.pdf. Accessed 1/13/2017.

Maine Trail Finder. 2017. Interactive Map. [Online] URL: http://www.mainetrailfinder.com/trails. Accessed 1/13/17.

Town of Topsham. 2016a. A Guide to Paddling Topsham's Waterways: Androscoggin River. [Online] URL: http://www.topshammaine.com/index.asp?Type=B_BASIC&SEC={0C9ED500-3153-44A1-B370-02AD7F3100F0}. Accessed 1/12/2017.

Town of Topsham. 2016b. A Guide to Topsham's Trails. [Online] URL: http://www.topshammaine.com/index.asp?SEC=110F5165-62BE-4EA4-BA45-2FD9CDBB42D2&Type=B_BASIC. Accessed 1/12/2017.

E.4.11 Cultural Resources

E.4.11.1 Affected Environment

The Androscoggin River is Maine's third largest river and was one of its more important waterways historically. While portions of this river valley have been archaeologically investigated, there are still large areas that have received little to no archaeological study. What is known is that the river was a major waterway for Native Tribes throughout much of the Precontact period and continued to be for both them and Euroamerican settlers after contact. In the Post-Contact period, the river served as a means of travel and trade and soon became a source of industrial focus. The Pejepscot area of the Androscoggin River experienced much of this history.

E4.11.1.1 Archaeological Resources

E4.11.1.1.1 Pre-Contact Period History

Maine's archaeological record dates back more than 11,000 years before the present. Archaeologists have divided the Pre-Contact segment of this record into three major cultural periods: the Paleoindian, Archaic, and Ceramic cultural periods. Traditions within these cultural periods represent subdivisions that can be made based on similarities in artifact forms and cultural adaptations (Spiess, 1990, 1994). Post-Contact history can also be divided into broad time periods reflecting the cultural integration of Euroamerican cultural lifeways and practices into the history of the state. These cultural periods, as displayed in Table 4.11.1.1.1-1, form the basis of archaeological context.

Paleoindian Period (11,500-8,000 B.P.)

As is the case throughout the Northeast, evidence for the earliest period of human occupation in Maine is extremely rare. Most sites of this period have been identified from isolated diagnostic artifact types in the collections of amateur archaeologists, with excavations of Paleoindian sites limited to only a handful in the state. The Paleoindian Cultural Period is the first known period in which humans inhabited the Northeast region.

Evidence from the greater Northeast indicates that Paleoindians first settled in the area not long after the retreat of the Late Pleistocene Wisconsin glacial ice, which vacated New England by around 13,000 B.P. A tundra environment succeeded the Wisconsin glacier, and was, in turn, replaced by a spruce-parkland community (Davis and Jacobsen, 1985; Gaudreau, 1986; Jacobsen *et al*., 1987). They entered the region around 11,500 B.P. Paleoindians living in these post-glacial ecological contexts have traditionally been characterized as hunters and gatherers who subsisted primarily on several large species of animals known to herd in the Northeast, including the mastodon and mammoth. Little evidence of human interaction with these "megafauna" has been forthcoming, however, and more recent interpretations have focused on smaller species, such as caribou and elk as primary food sources (Curran, 1987; Curran and Dincauze, 1977; Dincauze and Curran, 1984; Gramly, 1982). This generalization may over-emphasize the reliance placed on these herding species when a wider range of resources was almost certainly important to Paleoindian peoples. Fluted projectile points are lanceolate in shape and possess a long, groove-like scar caused by a flake struck from their base; they are considered the diagnostic artifact type of this period**.** Archaeological evidence indicates that during the later Paleoindian period, fluted spear points were replaced by smaller, unfluted points or by long, slender lanceolate points with a distinctive parallel flaking technology (Doyle *et al*., 1985; Cox and Petersen, 1997; Will and Moore, 2002). These changes appear to coincide with the succession towards a closed forest environment.

Little has been confirmed concerning the social structures, family life, and religion among the Paleoindians. No house features, burials, or ceremonial objects have been recovered from Paleoindian sites in the Northeast. Based on ethnographic analogy, it is assumed that peoples of this time were seasonally nomadic, following the movement of game with the changing weather conditions of the year. Similarities in artifact forms among Paleoindians all across North America argue for a generalized character of adaptation, with few specializations to local conditions evident (Haynes, 1980:119). A correlate of this fact is that population densities among Paleoindians were almost certainly low. Raw materials utilized by these first inhabitants come from only a few sources, often from relatively distant locations (Spiess and Wilson, 1989). This may indicate a high degree of mobility, established trade networks, and/or a high frequency of interaction among units of population. Sites of this period are sometimes found on hilltops, possibly because of their vantage points, which would have been useful for locating game.

Archaic Period (10,000-3000 B.P.)

The time period following the Paleoindian occupation, but predating the use of pottery and horticulture, has been designated the Archaic period by North American archaeologists. During the Early Archaic Period, profound environmental changes continued in New England, as the landscape adjusted to warmer post-glacial conditions. Lasting effects of melting glaciers included rising sea levels which inundated low-lying coastal plain areas. The regional climate became warmer and drier, and a mixed pine-hardwood forest came to dominate the landscape. Research indicates that Early Archaic social groups moved within smaller territories than their Paleoindian ancestors, practicing an increasingly generalized subsistence strategy based on river and lake systems and particularly wetland mosaic physiographic zones. The megafauna of the late Pleistocene had disappeared, leaving smaller mammalian species, such as moose and beaver. Deer were not likely abundant until the middle of the Archaic period when oak and other mast-producing trees became more numerous. Environmental conditions would have made seasonally available natural food resources somewhat more predictable and abundant than they had been during the Ice Age, allowing human populations to exploit a wider range of territories.

While bifurcate base projectile points are the traditional hallmark artifact of the Early Archaic period in southern New England, cultural adaptations in the region of Maine focused on the manufacture of simple unifacial tools from quartz, crude “chopping tools” of other local stone, and the development of ground stone technology. This early culture is referred to as the Gulf of Maine Archaic tradition, based on its initial association with deeply-buried sites in Maine (Peterson and Putnam, 1992). Robinson (1992) has documented a complex burial ceremonial aspect of this culture. The Gulf of Maine Archaic tradition continued to develop in northern and eastern Maine through the Middle Archaic period.

Late Archaic Period sites in New England are much more numerous than sites in previous periods and a significant diversity in site type and function is documented. Modern environmental conditions were present by then and the wild resources available were the same as those observed by the early European settlers and explorers. Population densities may have been sufficient to result in the development of multiple ethnic groups in the Northeast (Dincauze, 1974). Three cultural traditions have been identified based on artifact materials: the Laurentian, Susquehanna, and Small Stemmed. Along with the development of multiple traditions, increased specialization and the exploitation of a broad spectrum of resources are interpreted for this time period.

The relationship between the three recognized Late Archaic traditions has been the subject of extensive debate over several decades (Dincauze, 1974, 1975; Ritchie, 1971). It was hypothesized that the three traditions represent different populations, with the Laurentian and Susquehanna consisting of intrusive groups that peacefully coexisted with the indigenous Small Stemmed population for possibly thousands of years (Dincauze, 1974, 1975). However, after many years of research, no documentation of isolated Laurentian or Susquehanna sites has been found in New England, casting doubt that these traditions could therefore represent the existence of communities. Rather more likely is that these traditions represent the use of particular tool types, with technological precedents to the west for the Lake Forest tradition, and towards the southeastern United States for the Susquehanna. Small Stemmed, or Narrow Point tradition, artifacts are widely viewed as a pan-Northeastern phenomenon, probably deriving from the indigenous people of the northeastern Middle Archaic. Therefore, this characterization of the Late Archaic is undergoing a shift away from the idea of three cultural traditions, towards one Algonquian ancestral population of Small Stemmed peoples, with some technological borrowings from neighboring areas.

It is thought that people of the Late Archaic period in New England developed a more locally focused subsistence economy than during previous times. This may be due to increasing population levels, requiring groups to remain in more confined territories to avoid encroaching on others. Some degree of sedentism is suggested by at least the end of the period, based on changes in subsistence strategy. Shell middens dating to this cultural period begin to appear in some coastal locations, indicating increased use of shoreline resources (Bourque, 1976, 1995, 2001).

Woodland Period (3000-500 B.P.)

The cultural period following the Archaic Period and before the Contact Period is generally referred to as the Woodland Period throughout most of the eastern United States. However, in Maine, the same time period is called the Ceramic Cultural Period (Sanger, 1979). While both of these contemporaneous cultural adaptations are signified by the advent of ceramic technology around 3,000 years ago, they differ in their subsistence strategies. Woodland cultures developed a reliance on horticulture and a tendency toward larger, more permanent settlement patterns, while the Ceramic culture continued a hunting and gathering lifestyle.

Ceramic period sites are found along both the coast and in the Maine interior (Sanger, 1979); however, the coast may have been the main area of occupation as the diet of this period indicates a heavy reliance on marine fish (Bourque, 2001). Coastal shell midden sites of this period have long been identifiable due to their highly visible nature. These shell midden sites contain not only discarded marine shells, but also a wealth of data concerning terrestrial and marine animals utilized, pottery technology and sequencing, and stone and bone tools. Preservation of artifacts that in most other environmental locations in Maine would not survive, is a notable feature of these midden sites (Bourque, 2001; Sanger, 1979). Sites in the interior are commonly found close to both moving and non-moving water bodies. The abundance of sites and the intensification of faunal exploitation may indicate population growth over the course of this time period. In addition, artifacts recovered from Ceramic period sites indicate trade and communication with peoples from different regions far outside of Maine (Bourque, 2001). By the end of this period, historical accounts and archaeological evidence suggests horticulture was practiced in southern Maine at least.

The synthesis of the archaeological data from Ceramic period sites appears to indicate cultural adaptations of a people that had lived in an area long enough to exhibit a diversified use of local resources (Bourque, 2001; Sanger, 1979). The Ceramic period ends with European contact around 500-450 years ago, after which many of the artifacts attributable to the Precontact inhabitants of Maine disappear from the archaeological record, replaced instead with European trade goods. While the Native artifacts disappeared, the historical descendants of these cultural peoples remained.

Table 4.11.1.1.1-1. Cultural Period Contexts in Maine, after Spiess 1990, 1994

Cultural Period	Time Period (RCYBP)	Tradition	Time Period (RCYBP)
Paleoindian	11,500 – 8,000	Fluted Point Paleoindian Tradition	11,500 - 10,200
		Late Paleoindian Tradition	10,200 – 8,000
Archaic	10,000 - 3,000	Early and Middle Archaic Traditions	10,000 - 6,000
		Laurentian Tradition	6,000 - 4,200
		Small-Stemmed Point Tradition	6,000 - 2,000
		Moorehead Phase	4,500 - 3,700
		Susquehanna Tradition	3,900 - 3,000
Ceramic Period	3,000 – 500		
Early Contact	500 - 325		
Later Contact and Colonization	325 - 240		
Integration with Euroamerican Life	240 - Present		

E4.11.1.1.2 Contact and Post-Contact Period (500-Present B.P.)

European contact with the peoples of the North American continent occurred as early as the 11th century with the Norse exploration of the Canadian maritime provinces. The Norwegian penny recovered at the Precontact Goddard site is evidence that this earliest contact, while not conclusively reaching Maine, had an effect on the peoples of the region (Bourque, 2001). After the European "discovery" of the "New World" in 1492, the coast of Maine was explored as early as 1524 by Giovanni da Verrazano, who made contact with local inhabitants. The same year, Estevan Gomez kidnapped and sold into slavery 58 Maine natives. After this, a long period of Native and European contact occurred off the Maine coast between natives and Basque fishermen, initiating a trade system. European exploration continued into the early 17th century including early attempts by the French in 1604 and the English in 1607 to establish settlements in the region of Maine (Maine History Online, 2017). However, the European introduction of epidemic diseases to the Native people, who had no natural resistance to them, began to take a sudden and terrible toll on the Native population of Maine and New England. This dramatic decrease in the Native population of the region lead the way for European colonization of Maine and New England. The surviving Native populations were too few to be able to resist European settlement. European and Native groups forged trading partnerships, allowing Europeans to acquire furs and Natives to gain European goods which often replaced many of their traditional tools.

Relations with the Native inhabitants and the European explorers alternated between civil partnership and open hostility. By the late 17th century, open hostilities between the predominantly English settlers of the New England region and the remaining Native groups took a toll on both populations, resulting in the English near abandonment of the region of Maine. Hostilities continued off and on until the conclusion of the Seven Years War in 1763. Many of the Native groups in Maine had allied themselves with the French, so with their defeat they were forced to sign treaties with the English settlers that were unfavorable to them. After this period, Native groups in Maine and New England became increasingly marginalized by the European settlers and were either forced onto reservations or to emigrate out of the region. The groups that remained in the Maine region persisted, gaining more political recognition in the latter 20th century (Bourque, 2001). Federally recognized tribes within the State of Maine include the Aroostook Band of Micmac, the Houlton Band of Maliseets, the Passamaquoddy Tribes (Pleasant Point and Princeton), and the Penobscot Indian Nation.

E4.11.1.1.3 Identification of Historic and Archaeological Sites in the Vicinity of the Project

Site documentary information was obtained from the MHPC, which is located in Augusta. The MHPC maintains archaeological site files for both Precontact period and Euroamerican (Post-contact) archaeological sites. Use of these files is restricted to archaeologists who are either approved to undertake cultural resources management in Maine or who have legitimate archaeological research projects. Local repositories of historic documents (historical societies and libraries) were also consulted; however, no additional resources have been identified from this information at this time.

Precontact Period Sites

MHPC archaeological site files indicate very few Precontact archaeological sites have been identified within the region of the Androscoggin River watershed in which the Pejepscot Project Area is located. Only three sites have been identified to date within or near to the Project Area, one of which falls within the Project boundary (Table 4.11.1.1.3-1).

The Pejepscot site (ME 14-108) was identified during a 1985 survey of the Pejepscot Dam impoundment and falls within the current Project Area. Phase I and II research was undertaken on the Pejepscot Project by the University of Maine at Farmington Archaeology Research Center (UMF ARC) in 1989 and 1992 (Hamilton et. al., 1985; Hamilton et. al., 1986). This site was found to be either a small camp site or an ancillary activity area of a larger site. Importantly, it was identified as relating to a single occupation belonging to the late Ceramic Period.

Site ME 14-138 is located upstream of the Project Area and consists of a small scatter of Late Ceramic Period ceramic sherds, possibly buried below the ground surface. Site ME 14-152 is located downstream of the Project Area and consists of a small scatter of lithic debitage, from an unknown Precontact cultural period, located at or near the ground surface.

Historical records of the area of Lisbon Falls indicate that there was a Native American village located somewhere close to the present location of the village of Lisbon Falls (Hamilton et. al., 1985). To date, no official record has been made for a possible location of this site, which may span the Precontact to Contact periods.

Euroamerican Sites

While the previous survey within the Pejepscot Project Area did identify 19th and 20th century artifacts, no Euroamerican sites have yet been identified within the Project Area or within a half mile study radius of the Project Area.

Table 4.11.1.1.3-1. Precontact Archaeological Sites within the Project Vicinity

Site Number	Site Name	UTM		Time Period	National Register of Historic Places Status
		East	North		
Topsham, Sagadahoc County					
ME 14-108	Pejepscot Site	416280	4870400	Late Ceramic Period	Insufficient information
ME 14-152		414300	4872000	Unknown Precontact	Insufficient information
Lisbon, Androscoggin County					
ME 14-138		419600	4864800	Late Ceramic Period	Insufficient information

E4.11.1.1.4 Prior Cultural Resource Investigations within the Project Area

Prior to relicensing, only one prior cultural resource investigation has taken place within the Project Area, the above-mentioned Phase I investigation of the Pejepscot Dam impoundment by UMF ARC in 1985 (Hamilton et. al., 1985), followed by a Phase II investigation of the only site identified during that previous survey. The Project Area for this investigation was slightly smaller than the current Project Area, totaling only 4.8 kilometers (3 miles) on both banks of the Androscoggin River. The Phase I investigation involved an initial walk-over of the Project Area, through which the investigators looked for surface evidence of archaeological sites and determined areas to test. A total of 135 shovel test pits were excavated on 16 sampling transects. The Phase I survey found a wide scatter of historical artifacts from the 19^{th} and 20^{th} century, which were deemed historically unimportant, and identified the Pejepscot site (ME 14-108) that was later investigated for the Phase II.

E4.11.1.1.5 Historic and Precontact Archaeological Resource Surveys Conducted for Relicensing

Phase 0 Archaeological Survey

In August 2018, Topsham Hydro conducted a Phase 0 archaeological sensitivity assessment as part of relicensing. The survey evaluated areas throughout the Project's APE for historic and precontact period archaeological resources and to make recommendations about whether any additional archaeological sites were eligible, or potentially eligible, for listing to the National Register of Historic Places (NRHP) (Gray & Pape, 2019).

As noted in the preceding sections, background research indicated that at least one Native American archaeological site is located within the Project area – site ME 14.108. During the Phase 0 survey, at least one additional previously unidentified Native American archaeological resource was also identified. At the time of the survey, it was unclear if the newly identified site was associated with site ME 14.108 or a standalone site. No Historical Period archaeological resources were identified during the reconnaissance survey; however, the western terminus of the ferry crossing at Lisbon Falls was identified as needing further investigation to determine if it exists in an intact context (Gray & Pape, 2019).

Based on the review of historical documentation and the surface reconnaissance conducted of the Project area during the Phase 0 survey, a series of archaeologically sensitive sites were identified. Further subsurface archaeological testing was recommended at the highest probability areas; specifically, at those areas located at the confluence of tributary streams with the Androscoggin River. Additional survey was also recommended to relocate and map to current standards site ME 14.108 and to investigate the newly identified Pre-Contact resource (Gray & Pape, 2019).

Phase 1 Archaeological Survey

Based on the results and recommendations of the Phase 0 survey, a Phase 1 survey was conducted in September 2019 (Gray & Pape, 2020). The Phase 1 survey included a total of 31 shovel test pits and seven excavation units within seven testing areas. The investigation included previously tested areas that had the potential for deeply buried cultural deposits, relocation of previously identified site ME 14.108, and delineations of the artifacts recovered during the Phase 0 investigation at newly identified site ME 14.174. Only the testing involved in the relocation of site ME 14.108 and those for the delineation of site ME 14.174 recovered cultural artifacts. Observation of the stratigraphic record presented in these excavations confirms that the areas investigated were alluvial in sedimentary origin, likely having been deposits in the Holocene Epoch. Some sediment was able to be identified as historic to recent sedimentation, occurring in the last 200 years or less.

Previously identified site ME 14.108 was successfully relocated. Newly identified site ME 14.174 was found to include two distinct occupations related to Pre-Contact Native American cultures, one of which includes a cultural feature. The two occupations of this site are stratigraphically separated from one another. The exact ages of these two occupations is currently unknown. Artifacts related to each of the two occupations appear to indicate differences between the activities that may have occurred at the site during these occupations. The upper, younger occupation appears to center around limited activities relating to food production, tool creation, hunting and/or gathering, and thermal production. This site appears well preserved with little to no disturbance to the stratigraphic profile observed.

E4.11.1.2 Historic Structures Overview

E4.11.1.2.1 Historic Period (Exploration to Present)

The Project Area extends from Pejepscot Village in Topsham, Sagadahoc County, upstream along the Androscoggin River to Lisbon Falls in Androscoggin County. Maine’s rivers were vital to the economic success of industry in the state. As Maine’s third largest river, the Androscoggin River played a major role in Maine’s industrial history. The mainstem of the Androscoggin was too large and powerful to permit the construction of dams and their associated mills prior to improvements in construction technology in the mid-nineteenth century. Prior to that period, development occurred along the river’s tributaries and at locations, such as Lisbon Falls and Topsham, where natural rock ledges simplified the task of damming the river.

Within the Project Area, industrial development began in Lisbon Falls, the second falls from the sea, where between 1790 and 1800 six sawmills, a grist mill, and a carding mill operated. These mills largely closed during the period of the War of 1812. Large scale industrial development in Lisbon Falls began in 1864, with the establishment of the Worumbo Manufacturing Company’s woolen mill. By the late-nineteenth century, a network of dams, water conveyance systems, and mills lined the length of the Androscoggin where a fall of water offered development potential.

Industrial development at the lower end of the Project Area, at Pejepscot Village, began in the mid-1890s, with the construction of a pulp and paper mill owned by the Pejepscot Paper Company. Owned by F.C. Whitehouse, the Pejepscot Paper Company operated three paper mills on the river with “daily capacity of three hundred and twenty tons of news and wrappers, and three pulp mills able to produce daily three hundred tons of ground-wood and seventy tons of sulphite-fibre” (Weeks, 1916: 321). The mills were located in Topsham, Pejepscot Village, and

Lisbon Falls. Construction began on the mill at Pejepscot, located on the north bank of the river between the firm's Topsham and Lisbon Falls mills, in 1893. The Pejepscot Mill supplied pulp to the firm's Bowdoin Mill in Topsham and was capable of producing seventy tons of ground wood per day. Eventually the mill was expanded to produce paper. The Pejepscot Paper Company mill opened in 1896. Following the ownership of F.C. Whitehouse, the company changed hands several times. The mill at Lisbon Falls closed during the Depression. The Hearst Corporation bought the company in 1947, eventually selling it to the St. Raymond Corporation, which went bankrupt.

A large population of Hungarian-Slovak and Austrian immigrants migrated to the Pejepscot area to work in the mills. At the height of production, in 1898, the mill employed about 180 men. The mill was the backbone of the community, providing housing, education, recreation, and water/sewer systems. The Pejepscot Paper Company constructed all twenty-five of the buildings that constituted Pejepscot Village. Eighteen of these buildings were industrial structures. Between 1896 and 1898, the Pejepscot Paper Company built worker housing near the mill. The Colonial Revival style boarding house, built in 1896, included, "a dining room, parlor, smoking room, barber shop, living room, store room, washroom, 22 bedrooms and a bath" (Proud Pejepscot Village, MHPC vertical files). When the boarding house closed, the building was converted into a Community Hall. The building is currently used as storage.

E4.11.1.2.2 Identification of Historic Sites in the Vicinity of the Project

Since the closing of the Pejepscot Paper Company in 1985, the population of Pejepscot Village has dramatically decreased. Today only five mill worker buildings exist, all of which have been significantly altered. The majority of the buildings have been demolished, and those that survive have been converted into storage or function as a scrap metal recycling facility. There are no significant historic resources extant in close proximity to the site. The nearest property noted in the NRHP is the Pejepscot Village School, about 0.5 miles from the river. The Pejepscot Village School was built in 1899 by Joseph Philbrook of Brunswick on land deeded to the town by the Pejepscot Paper Company on November 9, 1899. In addition, the Pejepscot Paper Company donated $400 to the school. The historic schoolhouse is the only remaining community building in the village (Maine Historic Preservation Commission 2007).

MHPC's Cultural and Architectural Resource Management Archive (CARMA) was used to identify historic properties within a half-mile vicinity of the Project Area. Table 4.11.1.2.2-1 below summarizes the historic resources reported in the CARMA database.

Table 4.11.1.2.2-1. Reported Historic Resources within 0.5-mile of the Project Area

Resource Name	Resource Type	Description	Location (Town)	NRHP Status	Notes
823 Newell Brook Road, Route 9	Building	Barn	Durham	Not eligible	One-story connected barn c.1920-1940 located on the south side of the Androscoggin River, outside of the Project boundary.
823 Newell Brook Road, Route 9	Building	1-story residential home	Durham	Not eligible	Single family home with connected barn located on the south side of the Androscoggin River, outside of the Project boundary.
21 Pinkham Brook Road, Route 125	Building	2-story residential home	Durham	Not Determined	The Federal style multi-family home c. 1810-1825 is located on the south side of the Androscoggin River outside of Project boundary.
17 Pinkham Brook Road, Route 125	Building	Garage	Durham	Not eligible	One-story garage c. 1930-1960 is located on the south side of the Androscoggin River outside of Project boundary.
17 Pinkham Brook Road, Route 125	Building	1 ½ story residential home	Durham	Not eligible	Single family home c. 1930-1960 located on the south side of the Androscoggin River outside of Project boundary.
835 Newell Brook Road, Route 9	Building	1 ½ story residential home	Durham	Not eligible	Single-family home c. 1920-1930 is located on the south side of the Androscoggin, outside of the Project boundary.

Resource Name	Resource Type	Description	Location (Town)	NRHP Status	Notes
Durham Bridge	Structure	Bridge	Durham	Not eligible	Steel bridge c. 1937 (Note: was scheduled to be replaced in 2013) on Canal Street crossing over the Androscoggin at the Project boundary line.
Lisbon Falls Fiber Company	Building	2 1/2 -story industrial building	Lisbon	Not eligible	Two-and-a-half industrial building c. 1880-1920. Little is left to the original mill due to significant alterations c. 1960-1980. Building is located on the north side of the Androscoggin River, just outside of the Project boundary.
Worumbo Mill Complex Bridge #2	Structure	Bridge	Lisbon	Listed	Concrete arch bridge c. 1920 on the north side of the Androscoggin River outside of the Project boundary.
Worumbo Mill Bridge Complex, Bridge #1	Structure	Bridge	Lisbon	Listed	Concrete arch bridge c. 1920 on the north side of the Androscoggin River outside of the Project boundary.
Worumbo Mill Complex, Building #1	Building	2-story industrial building	Lisbon	Listed	Built c. 1864-1920, this building is one of four buildings on the NR listing that survived the 1987 fire. Building is located on the north side of the Androscoggin, outside of the Project boundary.
Worumbo Mill Complex, Building #4	Building	3-story industrial building	Lisbon	Listed	Built c. 1920, this Art Deco mill building is on the north side of the Androscoggin River, outside of the Project boundary.

Resource Name	Resource Type	Description	Location (Town)	NRHP Status	Notes
Worumbo Mill Complex	Building	1 ½-story industrial building	Lisbon	Listed	Art Deco mill building c. 1920. that the canal runs under. Located on the north side of the Androscoggin River, outside of the Project boundary.
Worumbo Mill Complex, Office Building	Building	2-story office building	Lisbon	Listed	The 2-story brick Italianate building c. 1864 is on the north side of the Androscoggin River, outside of the Project boundary.

E4.11.1.2.3 Historic Architectural Survey Conducted for Relicensing

In August 2018, Topsham Hydro conducted a *Historic Architectural Survey* as part of relicensing. The survey was intended to identify, locate, and evaluate any historic architectural resources within the Project's APE. The results of the survey indicated that no properties eligible for listing on the NRHP were identified within the Project's APE. Survey results were submitted to MHPC via their standard Architectural Survey Report in June 2019. By letter dated June 28, 2019, MHPC concurred with Topsham Hydro's determination that no properties are eligible for listing on the NRHP.

E.4.11.2 Environmental Analysis

FERC's SD2 identified one potential resource issue relating to cultural resources, which is discussed in greater detail below.

<u>Effects of continued project operation on historic properties and archaeological resources.</u>

To protect cultural resources at the Project during the term of a new license, Topsham Hydro is proposing to implement a Historic Properties Management Plan (HPMP), which will provide background information on cultural resources at the Project, including maps of the APE and archaeological and historic sites, preservation goals and priorities, project effects, and consultation requirements. A HPMP is attached as Appendix E-3.

One (1) Pre-Contact archaeological site, the Pejepscot Site (ME 14.108), is listed on the NRHP, and one (1) Pre-Contact site, ME 14.174, with undetermined NRHP-eligibility is located within the Project APE. These sites have been incorporated into the HPMP. Topsham Hydro intends to conduct a Phase II Archaeological Site Evaluation of Site ME 14.174 within two (2) years of license issuance to determine its NRHP-eligibility, as described in the HPMP. The site has been identified as being potentially eligible and will be managed accordingly in the interim period before the Phase II survey is conducted. The continued operation of the Project, as proposed, will not have an effect on the site, since the proposed Project would not involve any new construction or ground disturbing activities near the area. The Maine SHPO concurred with this approach following their review of the draft HPMP (see Attachment A to HPMP for SHPO consultation). No Post-contact archaeological sites or historic properties are located within the APE.

The continued operation of the Project, as proposed, will not have an effect on the identified archaeological resources (ME 14.108 and ME 14.174) since the proposed Project would not involve any new construction or ground disturbing activities that would impact these sites. However, in order to protect the sites from the effects of any future modification or activities that could potentially take place at the Project, the HPMP would be implemented in accordance with the conditions of a new license. Therefore, pursuant to the National Historic Preservation Act, Section 106 (16 U.S.C. § 470f), the proposed relicensing of the Project would not have any adverse effects on historic properties and archaeological resources located at the Project.

E.4.11.3 Proposed Environmental Measures

Topsham Hydro has developed a HPMP for the Project. The HPMP will ensure that appropriate consultation occurs prior to any future activity that may affect the eligible historic properties associated with the Project. In addition, the HPMP contains specific measures related to known archaeological sites ME 14.108 and ME 14.174. Within two (2) years of license issuance, Topsham Hydro is proposing to conduct a Phase II Archaeological Site Evaluation of Site ME 14.174 to determine its NRHP-eligibility. At site ME 14.108, Topsham Hydro is proposing to conduct streambank erosion monitoring at regular intervals over the course of the license term. The measures are described in more detail within the HPMP (Appendix E-3).

The HPMP is being filed with the MHPC and FERC under separate covers as “privileged,” because it contains confidential archaeological site location information.

E.4.11.4 Unavoidable Adverse Effects

Continued operation of the Project will not result in any unavoidable adverse impacts to cultural resources.

E.4.11.5 References

Bourque, Bruce J. 1995. Diversity and Complex Society in Prehistoric Maritime Societies: A Gulf of Maine Perspective. Plenum Press, New York.

Cox, Belinda and James Petersen. 1997. The Varney Farm (ME 36-57): A Late Paleoindian Encampment in Western Maine. Bulletin of the Maine Archaeological Society 37(2):25-48.

CRM Archaeology and Hydro Relicensing in Maine. 1994. In Cultural Resource Management: Archaeological Research, Preservation Planning, and Public Education in the Northeastern United States, pp 155-190. Edited by Jordan E. Kerber. Bergin & Garvey, Westport, CN.

Curran, M.L. 1987. *The Spatial Organization of Paleoindian Populations in the Late Pleistocene of the Northeast*. Ph.D. dissertation, Department of Anthropology, University of Massachusetts, Amherst.

Curran, M.L., and D.F. Dincauze. 1977 Paleo-Indians and Paleo-Lakes: New Data from the Connecticut Drainage. *Annals of the New York Academy of Sciences* 288:333–348.

Davis, R., and G. Jacobsen, Jr. 1985. Late Glacial and Early Holocene Landscapes in Northern New England and Adjacent Areas of Canada. *Quaternary Research* 23:341–368.

Dincauze, Dena F. 1974. An Introduction to Archaeology in the Greater Boston Area. *Archaeology of Eastern North America* 2:39–67.

Dincauze, Dena F., and M.L. Curran. 1984. Paleoindians as Flexible Generalists: An Ecological Perspective. Paper presented at the 24th Annual Meeting of the Eastern States Archaeological Federation, Hartford, Connecticut.

Doyle, Richard, Jr., Nathan Hamilton, James Petersen, and David Sanger 1985 Late Paleo-Indian Remains from Maine and their Correlations in Northeastern Prehistory. Archaeology of Eastern North America 13:1-34.

Gramly, R. Michael 1982. The Vail Site: A Palaeo-Indian Encampment in Maine. Buffalo Museum of Science.

Gray & Pape Heritage Management. 2019. Phase 0 Pre-Contact and Historical Period Archaeological Sensitivity Assessment for the Pejepscot Hydroelectric Project Relicensing, Cumberland, Sagadahoc, and Androscoggin Counties, Maine.

Gray & Pape Heritage Management. 2020. Phase 1 Pre-Contact and Historical Period Archaeological Reconnaissance Survey for the Pejepscot Hydroelectric Project Relicensing, Cumberland, Sagadahoc, and Androscoggin Counties, Maine

Gaudreau, D. 1986. Late-Quaternary Vegetational History of the Northeast: Paleoecological Implications of Topographic Patterns in Pollen Distributions. Ph.D. dissertation, Yale University. University Microfilms, Ann Arbor.

Haynes, C.V. 1980 The Clovis Culture. *Canadian Journal of Anthropology* 1:115–121

Jacobsen, G., T. Webb and E. Grimm. 1987. Patterns and Rates of Vegetation Change during the Deglaciation of Eastern North America. In *North America and Adjacent Oceans during the Last Deglaciation*, pp. 277–288. Edited by W. Ruddiman and H. E. Wright, Jr. The Geology of North America, V. K-3, Geological Society of America

Maine Historic Preservation Commission. 2007 Pejepscot Village School National Register Nomination

Maine History Online. 2017. 1500-1667 Contact and Conflict. [Online] URL: https://www.mainememory.net/sitebuilder/site/895/page/1306/display [Accessed August, 2017].

Petersen, J. and D. Putnam. 1986. Archaeological Phase II Testing in the Williams Hydroelectric Dam Increased Pool Project, Somerset County, Maine. Report on file with the Maine Historic Preservation Commission, Augusta.

Proud Pejepscot Village, MHPC vertical files 2017

Ritchie, William. 1971. The Archaic in New York. New York State Archaeological Association Bulletin 52:2–12.

Robinson, Brian S. 1992. Early and Middle Archaic Occupation in the Gulf of Maine Region: Mortuary and Technological Patterning. In Early Holocene Occupation in Northern New England, edited By B. S. Robins, J. B. Petersen, and A. K. Robinson. Occasional Publications in Maine Archaeology, no. 9. The Maine Historic Preservation Commission, Augusta.

Sanger, David. 1979. The Ceramic Period in Maine. In Discovering Maine's Archaeological Heritage, edited by D. Sanger. Maine Historic Preservation Commission, Augusta.

Spiess, Arthur. 1990. Maine's Unwritten Past: State Plan for Prehistoric Archaeological. Second Draft. Maine Historic Preservation Commission Augusta.

Spiess, Arthur, D. Wilson, J. Bradley. 1998. Paleoindian Occupation in the New England-Maritimes Region: Beyond Cultural Ecology. In Archaeology of Eastern North America 26:41-54.

The Late Archaic Period in Southern New England. 1975. *Arctic Anthropology* 12(2):23–34.

The Turner Farm Site: A Preliminary Report. 1976. *Man in the Northeast* 22:21–30.

Twelve Thousand Years: American Indians in Maine. 2001. University of Nebraska Press. Lincoln, NB.

Weeks, Lyman Horace, 1916 *A History of Paper-Manufacturing in the United States, 1690-1916*. The Lockwood Trade Journal Company, New York.

Will, Richard, and Edward Moore. 2002. Recent Late Paleoindian Finds in Maine. Maine Archaeological Society Bulletin 42:1:1-14.

E.4.12 Socio-Economic Resources

E.4.12.1 Affected Environment

The Pejepscot Project boundary is within three counties (see Figure 3.2.3-1). Nearly the entire eastern portion of the Project boundary is within Sagadahoc County, which, at 370 square miles, is the smallest county in Maine (Census, 2010). Cumberland County, which encompasses the southwestern portion of the Project boundary, is the most populated county in the state despite a relatively small area of 1,217 square miles (Census, 2010). The remainder of the Project boundary, including the northwestern portion, is within the relatively small 497-square-mile Androscoggin County (Census, 2010). The following sections summarize socioeconomic conditions of the municipalities abutting the Project boundary, including the aforementioned counties and the Towns of Durham, Lisbon, Brunswick, and Topsham.

E4.12.1.1 General Land Use Patterns

The municipalities abutting the Project vary from 100% rural to 82% urban, with population densities ranging from just over 100 persons per square mile to well over 434 persons per square mile. Census data depicting general land use patterns for the abutting municipalities are presented in Table 4.12.1.1-1 and discussed below. Land use types and coverage are discussed in Section E.4.3.4.

The majority of Androscoggin County is rural, with a population density of around 230 persons per square mile. The urban centers of the County are the Cities of Auburn, which is the County seat, and Lewiston; both are located upriver from the Project. The Town of Durham by contrast is entirely rural, with a much lower density of roughly 100 persons per square mile. The Town of Lisbon, with a density of roughly 395 persons per square mile, is much more urban than either the County as a whole or the neighboring Town of Durham.

Cumberland County is nearly 70 percent urban. The Cities of Portland (the County seat), South Portland, and Westbrook contribute to the County’s relatively high density of around 337 persons per square mile. The mostly urban Town of Brunswick also contributes with a density of 434 persons per square mile, nearly 400 persons per square mile more than the state as a whole.

Sagadahoc County is mostly rural and has a low density of 139 persons per square mile. The Town of Topsham, however, is mainly urban with a higher density of 273 persons per square mile. The City of Bath, roughly 10 miles southeast of the Project, is the only city in Sagadahoc and serves as the County seat.

Table 4.12.1.1-1. Place of Residence and Density, 2010

	Androscoggin County	Town of Durham	Town of Lisbon	Cumberland County	Town of Brunswick	Sagadahoc County	Town of Topsham	State of Maine
Place of residence: Urban[1]	42%	0%	75%	68%	82%	43%	59%	42%
Place of residence: Rural[1]	58%	100%	25%	32%	18%	57%	41%	58%
Population[2]	107,702	3,848	9,009	281,674	20,278	35,293	8,784	1,328,361
Persons per square mile[2]	230.2	100.5	394.8	337.2	434.0	139.1	272.8	43.1
Housing units[2]	49,090	1,548	3,948	138,657	9,599	18,288	4,167	721,830
Housing units per square mile[2]	104.9	40.4	173.0	166.0	205.4	72.1	129.4	23.4

Source[1]: Census, 2000b

Source[2]: Census, 2010

E4.12.1.2 Population Patterns

Current and historical populations for the municipalities abutting the Project are presented in Table 4.12.1.2-1. Growth projections from the State of Maine Office of Policy and Management (OPM) are presented in Table 4.12.1.2-2. While cumulative growth rates of the municipalities varied widely from 2000 to 2015, recent data show populations of all four abutting Towns along with Androscoggin County declined slightly, while Cumberland and Sagadahoc Counties continued to grow at very slow rates. OPM projections from 2014 to 2034 show all abutting municipalities growing by a little over 2 percent, with the exceptions of the Town of Durham, which is expected to experience a much higher growth rate, and the Towns of Lisbon and Brunswick, which are expected to experience population declines.

Androscoggin County experienced a 3.8 percent growth rate from 2000 to 2010, followed by a 0.4 percent decline from 2010 to 2015. The County's population is projected to grow slightly and then decline between 2014 and 2034, resulting in zero net growth. The Town of Durham had a much higher growth rate than that of the County, at 12.6 percent from 2000 to 2010, followed by 2.4 percent growth from 2010 to 2015. The Town is projected to grow by 8.1 percent by 2034, which is the largest projected growth rate for all municipalities abutting the Project Area by nearly 6 percent. The Town of Lisbon grew by a modest 0.2 percent from 2000 to 2010, followed by a 2.2 percent decline from 2010 to 2015. The Town's population is projected to decline steadily between 2014 and 2034, with an overall 5.5 percent population decline.

Cumberland County grew by 6 percent from 2000 to 2010, followed by a slower 2.9 percent growth rate from 2010 to 2015. The County's growth is projected to slow and eventually decline from 2014 to 2034, for a total growth rate of 2.3 percent. The Town of Brunswick experienced a 2.9 percent decline from 2000 to 2010, and a slightly lower 0.9 percent decline from 2010 to 2015. Overall, the Town's population declined by 3.9 percent from 2000 to 2015 and is projected to continue declining through 2034.

Sagadahoc County experienced very slight growth at 0.2 percent from 2000 to 2010 followed by a slight decline of 0.4 percent from 2010 to 2015. The County population is projected to grow a total of 2.3 percent between 2014 and 2034. The Town of Topsham's population declined by 1.8 percent from 2000 to 2010 and by 2.3 percent from 2010 to 2015. However, the Town is projected to grow by 2.1 percent between 2014 and 2034.

Table 4.12.1.2-1. Population - 2000 to 2015

Municipality	Census		Population Estimate				
	2000[1]	2010[2]	2011[2]	2012[2]	2103[2]	2014[2]	2015[2]
Androscoggin County	103,793	107,702	107,403	107,558	107,365	107,408	107,233
Change		3.8%	-0.3%	0.1%	-0.2%	0.0%	-0.2%
Cumulative from 2000		3.8%	3.4%	3.5%	3.3%	3.4%	3.2%
Town of Durham	3,381	3,808	3,821	3,853	3,867	3,879	3,902
Change		12.6%	-0.3%	0.1%	-0.2%	0.0%	-0.2%
Cumulative from 2000		12.6%	11.5%	12.3%	12.6%	12.8%	13.4%
Town of Lisbon	9,077	9,092	9,065	9,023	8,957	8,936	8,895
Change		0.2%	-0.3%	0.1%	-0.2%	0.0%	-0.2%
Cumulative from 2000		0.2%	-0.1%	-0.6%	-1.3%	-1.6%	-2.0%
Cumberland County	265,612	281,674	282,758	284,103	285,882	287,875	289,977
Change		6.0%	0.4%	0.5%	0.6%	0.7%	0.7%
Cumulative from 2000		6.0%	6.1%	6.5%	7.1%	7.7%	8.4%
Town of Brunswick	21,172	20,557	20,457	20,376	20,319	20,329	20,378
Change		-2.9%	-0.3%	0.1%	-0.2%	0.0%	-0.2%
Cumulative from 2000		-2.9%	-3.5%	-3.9%	-4.2%	-4.1%	-3.9%
Sagadahoc County	35,214	35,293	35,102	35,114	35,033	35,063	35,149
Change		0.2%	-0.5%	0.0%	-0.2%	0.1%	0.2%
Cumulative from 2000		0.2%	-0.3%	-0.3%	-0.5%	-0.4%	-0.2%
Town of Topsham	9,100	8,938	8,869	8,819	8,750	8,728	8,734
Change		-1.8%	-0.3%	0.1%	-0.2%	0.0%	-0.2%
Cumulative from 2000		-1.8%	-2.6%	-3.2%	-4.0%	-4.3%	-4.2%
State of Maine	1,274,923	1,328,361	1,328,257	1,328,888	1,328,778	1,330,256	1,329,328
Change		4.2%	0.0%	0.0%	0.0%	0.1%	-0.1%
Cumulative from 2000		4.2%	4.0%	4.1%	4.1%	4.2%	4.1%

Source[1]: Census, 2000a

Source[2]: Census, 2015a

Table 4.12.1.2-2. Population Projections to 2034

	Observed	Projected				Percent change from previous period				Total Percent Change
	2014	2019	2024	2029	2034	2014-2019	2019-2024	2024-2029	2029-2034	2014-2034
Androscoggin County	107,408	108,061	108,304	108,118	107,433	0.6%	0.2%	-0.2%	-0.6%	0.0%
Town of Durham	3,906	4,011	4,099	4,172	4,224	2.7%	2.2%	1.8%	1.2%	8.1%
Town of Lisbon	8,880	8,808	8,706	8,568	8,392	-0.8%	-1.2%	-1.6%	-2.1%	-5.5%
Cumberland County	287,875	291,783	294,589	295,441	294,431	1.4%	1.0%	0.3%	-0.3%	2.3%
Town of Brunswick	20,425	20,370	20,207	19,906	19,479	-0.3%	-0.8%	-1.5%	-2.1%	-4.6%
Sagadahoc County	35,063	35,598	35,926	36,005	35,869	1.5%	0.9%	0.2%	-0.4%	2.3%
Town of Topsham	8,720	8,844	8,924	8,942	8,906	1.4%	0.9%	0.2%	-0.4%	2.1%
State of Maine	1,330,256	1,332,944	1,330,903	1,322,023	1,305,910	0.2%	-0.2%	-0.7%	-1.2%	-1.8%

Source: OPM, 2016

E4.12.1.3 Households / Family Distribution and Income

Household, income and poverty status data for the municipalities abutting the Project Area are presented in Table 4.12.1.3-1. The data show that all municipalities are comparable to the State of Maine's average household size of 2.32, with the Town of Durham coming in slightly larger at 2.57 and the Town of Brunswick slightly smaller at 2.19 persons per household. All municipalities except Androscoggin County have a higher median household income than the State, with the Town of Durham's coming in over $20,000 higher at $71,908. Androscoggin County's median household income is less than $2,000 lower than that of the State. Each abutting municipality comes within 10 percent of the statewide per capita income with the exception of the Town of Durham and Cumberland County, which come in at roughly 146 and 122 percent of the State's, respectively. With the exception of Androscoggin County, the overall poverty status in each municipality is lower than that of the State, with the Towns of Durham, Lisbon and Topsham at nearly 4 percentage points lower than the statewide percentage of 13.9.

Table 4.12.1.3-1. Income and Poverty, 2015

	Androscoggin County	Town of Durham	Town of Lisbon	Cumberland County	Town of Brunswick	Sagadahoc County	Town of Topsham	State of Maine
Total households	44,315	1,496	3,696	117,339	8,469	15,088	3,720	557,219
Average household size	2.37	2.57	2.43	2.32	2.19	2.32	2.32	2.32
Median household income	$47,537	$71,908	$52,702	$60,051	$53,737	$53,298	$62,404	$49,331
Percentage of State	96.4%	145.8%	106.8%	121.7%	108.9%	108.0%	126.5%	100.0%
Percentage of U.S.[1]	88.2%	133.4%	97.8%	111.4%	99.7%	98.9%	115.8%	91.5%
Per capita income	$25,011	$33,000	$24,676	$34,081	$31,338	$30,062	$32,869	$27,655
Percentage of State	90.4%	119.3%	89.2%	123.2%	113.3%	108.7%	118.9%	100.0%
Percentage of U.S.[2]	86.5%	114.1%	85.3%	117.8%	108.3%	103.9%	113.6%	95.6%
Poverty Status: All People	15.7%	8.4%	8.0%	11.6%	11.4%	12.1%	8.1%	13.9%
Poverty Status: Under 18 yrs.	23.5%	15.2%	6.8%	14.9%	12.4%	19.9%	13.0%	18.6%

	Androscoggin County	Town of Durham	Town of Lisbon	Cumberland County	Town of Brunswick	Sagadahoc County	Town of Topsham	State of Maine
Total households	44,315	1,496	3,696	117,339	8,469	15,088	3,720	557,219
Average household size	2.37	2.57	2.43	2.32	2.19	2.32	2.32	2.32
Poverty Status: 18-64 years	14.3%	6.5%	8.4%	11.6%	13.4%	11.8%	8.0%	14.0%
Poverty Status: 65 yrs. & over	10.0%	6.4%	7.5%	7.6%	5.4%	4.6%	4.6%	8.6%

[1]US Median Household Income: $53,889

[2]US Per Capita Income: $28,930

Source: Census, 2015b

E4.12.1.4 Project Vicinity Employment Sources

Labor force and unemployment data for each municipality abutting the Project Area are presented in Table 4.12.1.4-1. Roughly 23 percent of Maine's labor force resides in Cumberland County. Androscoggin County contains 8 percent and Sagadahoc contains under 3 percent of the State's labor force. Androscoggin County has the highest unemployment rate of all the municipalities abutting the Project Area, although at 6.8 percent, the County is still over one percentage point lower than the statewide rate.

Table 4.12.1.4-2 presents industry and occupation statistics for the abutting municipalities. For each of the municipalities, the largest industry sector is educational, health and social services, with retail trade coming in as second largest. Manufacturing is the third largest industry sector for all municipalities except Cumberland County, where professional, scientific, management, administrative and waste management services comes in third, and the Town of Brunswick, where arts, entertainment, recreation, accommodation and food services is the third largest sector.

The two most common occupational categories in all abutting municipalities are management, business, science and arts, which is the most common category for all municipalities except the Town of Lisbon, where sales and office is the most common category. Service occupations are the third most common in all abutting municipalities. The 25 largest employers for each of the abutting counties are presented in Tables 4.12.1.4-3 to 4.12.1.4-5.

Table 4.12.1.4-1. Labor Force and Unemployment, 2015

	Androscoggin County	Town of Durham	Town of Lisbon	Cumberland County	Town of Brunswick	Sagadahoc County	Town of Topsham	State of Maine
Labor Force	57,139	2,385	4,624	161,178	10,915	18,835	4,941	697,913
Unemployment	6.8%	2.6%	5.7%	5.4%	6.3%	5.7%	3.7%	8.3%

Source: Census, 2015b

Table 4.12.1.4-2. Industry and Occupation for Civilian Population 16 years and over, 2015

	Androscoggin County	Town of Durham	Town of Lisbon	Cumberland County	Town of Brunswick	Sagadahoc County	Town of Topsham	State of Maine
Occupation								
Management, business, science, & arts	31.5%	44.4%	26.0%	43.3%	43.9%	36.7%	36.4%	35.4%
Service	18.5%	13.1%	19.8%	16.6%	19.0%	19.4%	19.2%	18.5%
Sales & office	25.7%	22.8%	29.6%	24.4%	19.9%	22.9%	22.1%	23.9%
Natural resources, construction, maintenance	10.1%	8.0%	9.9%	7.7%	9.4%	10.4%	7.6%	10.7%
Production, transportation, material moving	14.2%	11.8%	14.7%	8.0%	7.8%	10.6%	11.7%	11.4%
Industry								
Agriculture, forestry, fishing, hunting, mining	1.3%	1.1%	0.5%	1.2%	1.4%	1.8%	0.2%	2.5%
Construction	6.5%	4.3%	6.1%	5.5%	5.8%	6.2%	3.9%	6.9%
Manufacturing	11.8%	12.5%	10.9%	7.2%	5.9%	14.0%	12.2%	9.3%
Wholesale trade	2.0%	1.2%	0.7%	2.6%	1.6%	2.4%	3.0%	2.3%
Retail trade	14.8%	18.5%	19.5%	13.0%	13.5%	15.5%	15.8%	13.4%
Transportation & warehousing, & utilities	4.1%	3.1%	4.2%	3.2%	2.7%	2.7%	2.8%	3.8%
Information	2.3%	5.4%	2.8%	2.2%	1.1%	1.1%	1.3%	1.8%

	Androscoggin County	Town of Durham	Town of Lisbon	Cumberland County	Town of Brunswick	Sagadahoc County	Town of Topsham	State of Maine
Finance, insurance, real estate & rental	6.9%	8.6%	6.8%	9.2%	5.6%	4.4%	4.8%	6.2%
Professional, scientific, management, administrative, & waste management services	7.9%	11.6%	7.4%	11.8%	8.6%	8.2%	8.9%	8.6%
Educational, health & social services	27.0%	25.1%	24.7%	27.5%	33.9%	25.0%	28.2%	27.5%
Arts, entertainment, recreation, accommodation & food services	7.7%	4.6%	5.4%	9.4%	11.1%	9.1%	7.5%	8.9%
Other services (except public administration)	4.0%	2.9%	5.1%	4.5%	5.7%	4.4%	3.9%	4.4%
Public administration	3.7%	1.1%	5.8%	2.7%	3.0%	5.2%	7.6%	4.4%

Source: Census, 2015b

Table 4.12.1.4-3. Top 10 Private Employers in Androscoggin County by Average Monthly Employment (1st Quarter 2016)

Rank	Name	Employment Range	Business Description
1	Central Maine Healthcare Corp	2,501 to 3,000	General medical and surgical hospitals
2	TD Bank N A	1,501 to 2,000	Commercial banking
3	St Mary's Regional Medical Ctr	1,501 to 2,000	General medical and surgical hospitals
4	Wal-Mart / Sam's Club	1,001 to 1,500	Warehouse clubs and supercenters
5	Bates College	501 to 1,000	Colleges and universities
6	Murphy Homes Inc, John F	501 to 1,000	Residential developmental disability homes
7	L.L. Bean, Inc.	501 to 1,000	Mail-order houses
8	Pioneer Plastics Corporation	1 to 500	Laminated plastics plate, sheet, and shapes
9	Tambrands Inc.	1 to 500	Sanitary paper product manufacturing
10	P.S.T. Services, Inc.	1 to 500	Other accounting services

Source: MaineDOL, 2016

Table 4.12.1.4-4. Top 10 Private Employers in Cumberland County by Average Monthly Employment (1st Quarter 2016)

Rank	Name	Employment Range	Business Description
1	MaineHealth	8,001 to 8,500	General medical and surgical hospitals
2	L.L. Bean, Inc.	3,501 to 4,000	Mail-order houses
3	Unum Provident	3,001 to 3,500	Direct life insurance carriers
4	Hannaford Bros Co	2,501 to 3,000	Supermarkets and other grocery stores
5	Mercy Hospital	1,501 to 2,000	General medical and surgical hospitals
6	Mid Coast Hospital	1,001 to 1,500	General medical and surgical hospitals
7	Wal-Mart / Sam's Club	1,001 to 1,500	Warehouse clubs and supercenters
8	T D Bank N A	1,001 to 1,500	Commercial banking
9	Bowdoin College	1,001 to 1,500	Colleges and universities
10	Idexx Laboratories Inc.	1,001 to 1,500	Pharmaceutical preparation manufacturing

Source: MaineDOL, 2016

Table 4.12.1.4-5. Top 10 Private Employers in Sagadahoc County by Average Monthly Employment (1st Quarter 2016)

Rank	Name	Employment Range	Business Description
1	Bath Iron Works Corporation	5,501 to 6,000	Ship building and repairing
2	Grace Management Inc.	1 to 500	Continuing care retirement communities
3	Reed & Reed Inc.	1 to 500	Highway, street, and bridge construction
4	Hannaford Bros Co	1 to 500	Supermarkets and other grocery stores
5	Crooker Construction LLC	1 to 500	Highway, street, and bridge construction
6	Target Corporation	1 to 500	Discount department stores
7	Shaw's Supermarkets Inc.	1 to 500	Supermarkets and other grocery stores
8	Bath Area Family YMCA	1 to 500	Civic and social organizations
9	Home Depot USA Inc.	1 to 500	Home centers
10	Computer Sciences Corporation	1 to 500	Computer facilities management services

Source: MaineDOL, 2016

E.4.12.2 Environmental Analysis

FERC's SD2 did not identify any potential resource issues related to socioeconomic resources. As a generator of electric power, an employer, and a taxpayer in the region, Topsham Hydro contributes to socioeconomic resources of the region. In addition, the Project provides recreational facilities on the Androscoggin River. Topsham Hydro is not proposing any changes to Project operations and the socioeconomic benefits associated with the Project will continue.

E.4.12.3 Proposed Environmental Measures

Topsham Hydro is not proposing any PME measures related to socioeconomic resources.

E.4.12.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts to socioeconomic resources are expected to occur as a result of the continued operation of the Project.

E.4.12.5 References

Maine Department of Labor (MaineDOL). 2016. Top 25 Private Employers in Maine by Average Monthly Employment by County (1st Quarter 2016). [Online] URL: https://www1.maine.gov/labor/cwri/publications/pdf/MaineCountyTop25Employers.pdf. Accessed 1/16/2017.

State of Maine Office of Policy and Management (OPM). 2016. Maine Demographic Projections. [Online] URL: http://maine.gov/economist/projections/index.shtml. Accessed 1/17/2017.

United States Census Bureau (Census). 2000a. Profile of General Demographic Characteristics: 2000. [Online] URL: https://factfinder.census.gov/bkmk/table/1.0/en/DEC/00_SF1/DP1/0400000US23. Accessed 1/16/2017.

United States Census Bureau (Census). 2000b. Urban and Rural - 2000 Census Summary File 2. [Online] URL: https://factfinder.census.gov/bkmk/table/1.0/en/DEC/00_SF2/HCT001/0400000US23. Accessed 1/16/2017.

United States Census Bureau (Census). 2010. Population, Housing Units, Area, and Density: 2010 - State -- Place and (in selected states) County Subdivision. [Online] URL: https://factfinder.census.gov/bkmk/table/1.0/en/DEC/10_SF1/GCTPH1.CY07/0500000US23001|0500000US23005|0500000US23023. Accessed 1/16/2017.

United States Census Bureau (Census). 2015a. Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2015. [Online] URL: https://factfinder.census.gov/bkmk/table/1.0/en/PEP/2015/PEPANNRES/0500000US23001. Accessed 1/16/2017.

United States Census Bureau (Census). 2015b. Selected Economic Characteristics: 2011-2015 American Community Survey 5-Year Estimates. [Online] URL: https://factfinder.census.gov/bkmk/table/1.0/en/ACS/15_5YR/DP03/0100000US|0400000US23|0500000US23001|0500000US23005|0500000US23023|0600000US2300119105|0600000US2300140035|0600000US2300508430|0600000US2302376960. Accessed 1/16/2017.

E.5 ECONOMIC ANALYSIS

This section presents the estimated annual value of developmental resources associated with the Project under the current license, the cost of operating and maintaining the Project under the existing license, the cost of each PME measure, and the reduction in the value of the developmental resources of the Project attributed to proposed PME measures.

E.5.1 Costs and Value of Developmental Resources Associated with the Project

Under its approach to evaluating the economics of hydropower projects as articulated in Mead Corporation, Publishing Paper Division (72 FERC §61,027, July 13, 1995), the Commission employs an analysis that uses current costs to compare the costs of a project and likely alternative power with no consideration for potential future inflation, escalation, or deflation beyond the license issuance date. The Commission's economic analysis provides a general estimate of the potential power benefits and costs of a project and reasonable alternatives to project-generated power. The estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. Table 5-1 presents the value of power for the Project based New England-ISO energy costs for the period January 1, 2019 to December 31, 2019.

Table 5-1: Valuation of the Annual Output of the Project

Description	Energy (MWH)	Average Monthly Day Ahead Locational Marginal Pricing (Maine Zone) January 1, 2019 thru December 31, 2019 ($/MWh)	Average Gross Annual Revenue ($)
Average Annual Generation	68,516	$30.73	$2,105,497

Table 5-2 shows the estimated annual operations and maintenance for the Project.

Table 5-2: Annual Operating Costs of the Project

	Cost
Operation and Maintenance (interim replacements, insurance, administrative and general costs)	$694,000
Property Taxes	$209,000
Total	**$903,000**

E.5.2 Costs of Proposed PME Measures

Topsham Hydro proposes several environmental measures (Table 5.2-1) for inclusion in the new license for the Project. The measures would add capital costs, and increase annual operations and maintenance costs for the Project.

Table 5.2-1: Cost Estimate of Proposed Environmental Measures

Proposed PME Measure	Capital Cost (2020 dollars)	Annual Operations and Maintenance Cost (2020 dollars)
Maintain a minimum flow of 1,170 cfs, or inflow, whichever is less.	$0	$0
Operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates.	$0	$0
Finalize and Implement an Operations Monitoring Plan	$2,500	$5,000
Develop, in consultation with stakeholders, a Stranding Plan to address potential stranding of fish in the bedrock area below bascule gate no. 5. The Plan will detail inspections of the pools by operators following spill events.	$5,000	$5,000
Revise and Implement a Fishway Operations and Maintenance Plan	$2,500	$5,000
Increase the number of lift cycles at the Project fish lift to one lift event per hour (10 lift cycles per day) between the hours of 0800 and 1800, during the peak upstream migration period (May 16 through June 15) for river herring and American Shad.	$0	$10,000
Develop a plan and schedule, in consultation with resource agencies, containing potential physical and/or operational modifications to be constructed/implemented no later than Year 3 of the new license[36], to address issues that may be impacting upstream passage of migratory fish species.	$263,000	$0
Conduct one season of fish lift efficiency testing for adult river herring during the fourth full passage season after the effective date of the new license.	$0	$100,000
Install and operate a temporary portable American Eel ramp for three passage seasons (June 1 through September 15) to identify a suitable location for a permanent upstream American Eel ramp. The temporary portable eel ramp will be installed during the first full passage season after the effective date of the new license.	$0	$7,500[37]
Install and operate a permanent upstream American Eel ramp (June 1 through September 15) based on the results of the temporary portable ramp evaluation. The permanent ramp will be installed when upstream eel passage facilities are constructed at the downstream Brunswick Hydroelectric Project.	$50,000	$5,000
Discontinue the north (left bank) downstream fish bypass beginning in the second full passage season after the effective date of the new license.	$26,000	$0

[36] During 2020 and 2021 Topsham Hydro will investigate factors associated with the existing fish lift (i.e., internal and external attraction flow hydraulics and acoustics) that may be affecting upstream passage effectiveness.
[37] Annual cost for each passage season.

Proposed PME Measure	Capital Cost (2020 dollars)	Annual Operations and Maintenance Cost (2020 dollars)
Install and operate a fish guidance system/debris boom to direct downstream migrants to a new bypass within bascule gate no. 1 beginning in the second full passage season after the effective date of the new license.	$2,075,000	$25,000
Conduct one season of efficiency testing for juvenile alosines once the proposed downstream fish guidance system is installed and the modifications to bascule gate no. 1 have been completed.	$0	$100,000
Reduce the operational setting for Unit 1 (unit turndown) to approximately 3,480 cfs (resulting in intake approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually to enhance downstream eel passage.	$0	$0
Continue video camera monitoring of Atlantic Salmon utilizing the Pejepscot fish lift.	$0	$7,500
Conduct an Atlantic Salmon radio telemetry study, to determine upstream passage effectiveness at the Pejepscot fish lift, when at least 40 adult Atlantic Salmon of Androscoggin River origin are counted at the Brunswick fishway for two consecutive years.	$0	$75,000[38]
Monitor downstream migrating Atlantic Salmon kelts as part of the adult Atlantic Salmon radio telemetry study described above.	$0	$25,000[39]
Open bascule gate No. 1 (closest to the powerhouse) 50% to provide approximately 500 cfs of spill at night (2000 – 0700 hours) during the month of May.	$0	$0
Conduct one season of efficiency testing for Atlantic Salmon smolts once the proposed downstream fish guidance system/debris boom is installed and the modifications to bascule gate no. 1 have been completed.	$0	$100,000
Finalize and Implement Recreation Management Plan (including annual facility operations and maintenance)[40]	$101,200	$23,600
Finalize and Implement Historic Properties Management Plan	$5,000	$90,000[41]
Total	**$2,530,200**	**$583,600**

[38] Cost for 1-season telemetry study.
[39] Cost for 1-season telemetry study.
[40] Itemized cost for each enhancement is detailed within the Recreation Management Plan.
[41] Includes cost ($85,000) of Phase II archaeological investigations in Year 2 of next license term.

E.6 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2) of the FPA, 16 U.S.C. § 803(a)(2)(A), requires FERC to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the Project. A list of existing FERC-approved State of Maine and federal plans was obtained from the Commissions website as of April 2019. FERC currently lists 38 comprehensive plans for the State of Maine. Of the 38 plans listed, 12 are potentially relevant to the Project. Exhibit H provides a review of the proposed relicensing in consideration of any existing FERC approved comprehensive management plans.

APPENDIX E-1: DRAFT LICENSE APPLICATION COMMENT RESPONSIVENESS SUMMARY

This section summarizes the Topsham Hydro's responses to comment letters that were received on the DLA, which was distributed to stakeholders on April 3, 2020. Comment letters were received from the following entities.

- June 24, 2020 Comment Letter from FERC on the DLA.
- July 1, 2020 Comment Letter from MDEP on the DLA.
- July 2, 2020 Comment Letter from NMFS on the DLA.
- July 10, 2020 Comment Letter from MDMR on the DLA.

Agency Comment	Comment	How Addressed
FERC-1	Section 4.61(c)(1)(viii) of the Commission's regulations require that the Exhibit A include the general configuration, sizes, capacities, and construction materials, as appropriate, of pipelines, ditches, flumes, canals, intake facilities, powerhouses, dams, transmission lines, and other appurtenances. The draft Exhibit A does not describe the material of the bascule gates; the general configuration, sizing, or materials of the old powerhouse; the material of the old powerhouse intake; the general configuration, sizing, or materials of the new powerhouse; the material of the new powerhouse intake; the material of the hopper and basket of the fish lift; or the length and material of the downstream fish passage facility. Please revise your application to include this information.	The requested information has been included in Section A.2.1 of Exhibit A.
FERC-2	Section 4.51(c)(2) of the Commission's regulations require that the licensee provide the minimum river flow observed in the project area, as well as a curve showing powerplant capability versus head and specifying maximum, normal, and minimum heads. While you provided a curve showing powerplant capability versus head and stated that the "rated" or "gross" head of the plant is 24 feet, you did not specify the maximum, normal, or minimum head. Please include this information in the FLA.	The minimum streamflow at the impoundment for the period 1987-2019 was approximately 1,289 cfs on October 9, 1988. Minimum net operating head is 19 ft, maximum at full load is 26 ft, maximum with 1,500 cfs discharge is 27 ft, and the normal (rated) head is 24 ft. This information has been included in Section B.2.6 of Exhibit B.
FERC-3	Section 4.51(d)(1) of the Commission's regulations require that the licensee provide the date of commencement of commercial operation for the project. Please include this information in the FLA.	The Project commenced commercial operation on October 31, 1987. This information has been included in Section C.1.1 of Exhibit C.

Agency Comment	Comment	How Addressed
FERC-4	Section 5.18(b)(iii)(A)-(C) of the Commission's regulations require that the Exhibit E include functional design drawings that conform to the specifications in Section 4.39 and depict any fish passage and collection facilities or any other facilities necessary for implementation of environmental measures, indicating whether the facilities depicted are existing or proposed; a description of maintenance procedures for the proposed project facilities; and a construction schedule for the facilities, showing the intervals following issuance of a license when construction of the facilities would be commenced and completed. Additionally, Section 5.18(b)(5)(iii)(E) of the Commission's regulations require that the Exhibit E include a map or drawing that conforms to the size, scale, and legibility requirements of Section 4.39 showing by the use of shading, cross-hatching, or other symbols, the identity and location of any measures or facilities, and indicating whether each measure or facility is existing or proposed. Section 4.39(c)(2) requires that the drawings must have a scale in full-sized prints no smaller than: (1) one inch equals 50 feet for plans, elevations, and profiles; and (2) one inch equals 10 feet for sections. While the draft application contained functional design drawings and a description of maintenance procedures for the fish lift, it did not include functional design drawings for the downstream fish passage facility, nor did it not include either of these items for the proposed eel ramp. Exhibit E did not contain a map or drawing conforming to Section 4.39 showing the locations of the proposed eel ramp. Additionally, sections A-A, B-B, and C-C on Sheet 1 of the functional drawings of the fish lift do not conform to Section 4.39(c)(2) as they are drawn to a scale smaller than one inch equal to 10 feet. Please update your Exhibit E accordingly.	Functional design drawings of the existing downstream fish passage facility have been included in Appendix E-5: Fishway Operations and Maintenance Plan. Functional design drawings for the proposed upstream eel ramp have been included in Section E.4.6.2 of Exhibit E. The functional design drawings for the fish lift have been revised and are included in Appendix E-5: Fishway Operations and Maintenance Plan.
FERC-5	You state on page E-200 of the draft license application that a newly identified archaeological site, ME 14.174 within the project Area of Potential Effect (APE), has not been evaluated for eligibility for listing on the National Register of Historic Places (National Register). You propose to conduct a	This approach is consistent with how similar situations have been handled in other FERC licensing proceedings (e.g., Conowingo Hydroelectric Project, P-405). Also, the site has

Agency Comment	Comment	How Addressed
	Phase II survey during year two of a new license to determine the site's eligibility as part of your proposed Historic Properties Management Plan (HPMP). The draft application does not explain why you propose to delay the eligibility evaluation. Typically, eligibility determinations with the concurrence of the Maine SHPO are needed in the final license application for Commission staff to fulfill its responsibilities under section 106 of the National Historic Preservation Act.	been identified as being potentially eligible and will be managed accordingly in the interim period before the Phase II survey is conducted. The continued operation of the Project, as proposed, will not have an effect on the site since the proposed Project would not involve any new construction or ground disturbing activities near the area. Most importantly, the Maine SHPO concurred with this approach following their review of the draft HPMP (see Attachment A to the HPMP for SHPO consultation).
FERC-6	Section 4.61(f) of the Commission's regulations require an Exhibit G conforming to section 4.41(h). Section 4.41(h) also requires that Exhibit G maps conform to the specifications of section 4.39 of the Commission's regulations, which require Exhibit G maps to be stamped by a registered land surveyor. Your Exhibit G maps do not have a stamp from a registered land surveyor. Please correct this deficiency in the Exhibit G of your FLA. We remind you that section 4.41(h) requires that all applications for licenses include the project boundary data in a georeferenced electronic file format.	The Exhibit G maps have been stamped by a license surveyor, and Topsham Hydro has filed the project boundary data in electronic format with the FLA submittal.
FERC-7	Section 5.18(c)(1)(i)(F)(3) of the Commission's regulations require that the Exhibit H include a detailed single-line electrical diagram. The single-line electrical diagram was filed as part of your Exhibit F as Critical Energy Infrastructure Information (CEII). Please revise your FLA to include this information in Exhibit H, which does not need to be filed as CEII.	The single line diagram has been filed as public material in Exhibit H of the FLA.
MDEP-1	The Applicant performed trophic state sampling in the Pejepscot impoundment twice per month from June through October 2018 in accordance with the Lake Trophic State Sampling Protocol for Hydropower Studies (MEDEP 2017). Water quality samples were collected in the deepest location in the impoundment. Analysis of sampling results indicates that the Pejepscot impoundment is mesotrophic, with a trophic state index of 36; a trend analysis requires ten years of data and so it is not possible to evaluate	Topsham Hydro provided the requested water level and outflow data to MDEP on July 1, 2020 to demonstrate the Project operates in a run-of-river mode.

Agency Comment	Comment	How Addressed
	whether or not the trophic state is improving. Impoundment water temperature and dissolved oxygen (DO) profiles indicate that the Pejepscot impoundment does not stratify thermally and that dissolved oxygen in the impoundment is in attainment with Maine's water quality standards throughout the sampling period. Based on results provided by the Applicant in the Initial Study Reports (ISR) and DLA, the Department concludes that the applicant has provided sufficient information regarding the trophic state of the impoundment to determine that the Project impoundment is in attainment of Maine's water quality standards. Electrical generation facilities are in line with the Project Dam and there is no bypass reach associated with this Project. In lieu of an impoundment habitat study and aquatic habitat cross-section flow study the Applicant must provide sufficient information to establish that the Project operates in run-of-river mode that water level fluctuations in the impoundment are limited, and that outflow from the impoundment is essentially equal to inflow. Pending receipt of water the requested three years of impoundment water level and flow data, aquatic habitat studies in the impoundment and in the Project tailwater may be necessary.	
MDEP-2	Water temperature and DO measurements were collected downstream of the Pejepscot Dam in the project tailrace between August 2 and October 2 °C , 2018, in accordance with the River and Stream Sampling Protocol for Hydropower Studies (MEDEP 2017). DO measurements ranged from 7.8 to 9.7 mg/L, with percent saturating ranging from 94.3 to 106.2%. Instantaneous DO concentrations averaged 8.5 mg/L (percent saturation averaged 99.6%) over the monitoring period; measurements never fell below Maine's water quality standard. Water temperature in the tailwater reach ranged from 16.8°C to 27.3°C (water temperature averaged 23.5°C) throughout the sampling period. Based on the results and information contained in the ISR and DLA, the Department concludes that the Applicant has provided sufficient information to demonstrate that the Pejepscot Project meets applicable Class C DO criteria downstream of the Project Dam.	Comment noted.

Agency Comment	Comment	How Addressed
MDEP-3	The Applicant collected benthic macroinvertebrate samples approximately 600-700 feet downstream of the Pejepscot Dam following Maine's Methods for Biological Sampling and Analysis of Maine Rivers and Streams (Tsomides and Davies 2014). Rock baskets were placed at the sample site on August 2, 2018 and allowed to colonize for 28 days (+/- 4 days) and retrieved August 28, 2018. Results indicate that the benthic macroinvertebrate community downstream of the Pejepscot Project is abundant, with 43 species represented, including some sensitive species. Data collected was analyzed by the Department's Division of Environmental Assessment, applying a linear discriminate model and was found to exceed applicable Class C criteria. Based on the study results and information contained in the ISR and DLA, the Department concludes that the Applicant has provided sufficient information to demonstrate that the Pejepscot Project meets, at a minimum, Maine's applicable Class C aquatic life and habitat criteria.	Comment noted.
MDEP-4	The Applicant conducted a Tailrace Aquatic Habitat Study in the tailrace reach of the Androscoggin River downstream of the Pejepscot Dam to characterize physical habitat and substrates in the unimpounded reach, downstream of the Project. The study identified six major mesohabitat categories, including backwater habitat (28% of total habitat area), pool habitat (38.1% of total habitat area), riffle habitat (6.1 % of total habitat area), run habitat (20.1% of total habitat area), glide habitat (1.0% of total habitat area), and an "other" category (6.1% of total habitat area). Primary, secondary, and tertiary substrates were then identified within each mesohabitat (gravel, cobble, sand, mixed bedrock, small boulder, rubble, and large boulder). Finally, fine substrate (sand, silt, mud, etc.) was recorded, found to be associated with backwater, pool, and (one) run habitat. The Applicant was requested to submit three years of impoundment water level and flow data to demonstrate the run-of-river operations of the facility, to show that water levels in the impoundment do no fluctuate more than an unimpounded river, and that inflow is equal to outflow, showing that	Topsham Hydro provided the requested water level and outflow data to MDEP on July 1, 2020 to demonstrate the Project operates in a run-of-river mode.

Agency Comment	Comment	How Addressed
	downstream habitats remain watered in the same manner as an undammed river. Those data remain outstanding at this time and should be submitted for Department review as quickly as possible. Based on the results and information contained in the ISR and DLA, at this time the Department cannot conclude that the Applicant has provided sufficient information to demonstrate that the Pejepscot Project meets applicable Class C aquatic life and habitat criteria, and the designated use of habitat for fish and other aquatic organisms; however, submission of water level and flow data may allow the Department to make such a determination.	
NMFS-1	We find that the DLA is incomplete. We note that the applicant has not yet filed its Updated Study Report (USR) with FERC. We expect that this USR will contain information crucial to the evaluation of project effects on diadromous fish passage and habitat and therefore, the development of appropriate protection, mitigation, and enhancement measures. Outstanding studies include, but are not limited to: o Eel Monitoring Survey o Evaluation of Spring Migration Season Fish Passage Effectiveness o Evaluation of Fall Migration Season Fish Passage Effectiveness o Fish Entrainment and Turbine Survival Assessment o Sediment Storage and Mobility o Large Woody Debris Topsham Hydro has been working with us and other resource agencies to share and discuss preliminary results of several of these studies. The preliminary results of diadromous fish passage studies performed by Topsham Hydro were, at the least, concerning. As such, we expect that additional information and studies will be needed to suitably evaluate the Project's effects and determine the necessity and scope of any potential protection, mitigation, and enhancement measures. Considering that the significant information is still pending in this proceeding, we are not providing specific comments on the environmental analyses or proposed environmental	Topsham Hydro filed its USR on July 10, 2020, and continues to work with resource agencies. In particular, Topsham Hydro has held several meeting with resource agencies to discuss study results, provide additional information, and develop various aspects of the Biological Assessment and Species Protection Plan. Notes from these meetings are included in Appendix E-2.

Agency Comment	Comment	How Addressed
	measures included in the DLA at this time. We expect to continue to work collaboratively with Topsham Hydro to develop that information and to provide FERC any comments relevant to Topsham Hydro's study results and need for additional information and/or studies after the USR is filed.	
NMFS-2	Section 6 of the licensee's Exhibit E details the application's consistency with comprehensive plans. On April 15, 2020, we filed the Androscoggin River Watershed Comprehensive Plan for Diadromous Fishes (2020). On June 18, 2020, the Commission determined that this document qualified as a comprehensive plan under section 10(a)(2)(A) of the Federal Power Act and was added to the Commission's list of approved comprehensive plans for the State of Maine. As such, we expect that the Final License Application will include an evaluation of its consistency with this comprehensive plan.	An evaluation of the Project's consistency with the Androscoggin River Watershed Comprehensive Plan for Diadromous Fishes has been included in Section H.2.8 of Exhibit H.
MDMR-1	We have reviewed the DLA and find that it is incomplete, because the applicant has not yet filed an Updated Study Report with the Commission. We note that during a meeting with the agencies on May 12, 2020, the applicant provided preliminary results of the following studies: 1. Eel Monitoring Survey 2. Evaluation of Spring Migration Season Fish Passage Effectiveness 3. Evaluation of Fall Migration Season Fish Passage Effectiveness 4. Fish Entrainment and Turbine Survival Assessment 5. Sediment Storage and Mobility 6. Large Woody Debris However, MDMR and the other resource agencies had concerns about the results of the studies (particularly studies 1-4) and requested additional information (e.g. gate settings during upstream migration season) and discussed potential additional studies. These discussions continued during a follow-up meeting on July 2, 2020. We expect that additional studies will be needed to evaluate the Project's effects and determine the necessity and scope of any potential protection, mitigation, and enhancement measures.	See response to NMFS-1.

Agency Comment	Comment	How Addressed
MDMR-2	The DLA contains the following statements in Exhibit E, 4.6.1.1 Fish Assemblage (Page E-75) and 4.6.1.2.1 Diadromous Species (Page E-83) regarding the historic range of American shad in the Androscoggin River: "*The historic extent of upstream passage for shad and herring has been reported to be Lewiston Falls (approximately 17.5 miles upstream of the Project), with some American Eel, Atlantic Salmon, and possibly Sea Lamprey having passed as far upstream as Rumford Falls. However, according to Taylor, 1951, the Androscoggin River may never have been a shad river because of impassable falls at Brunswick, which is located 4.7 miles downstream of the Project.*" "*The numbers of American Shad passed at the Brunswick Fishway have ranged from zero to 1,123 fish from 2000-2019 (Table 4.6.1.1-3). It should be noted that the falls at Brunswick may have been an impassible barrier for American Shad, and the Androscoggin River may not have been historically considered a shad river (Taylor, 1951).*" A more authoritative citation than Taylor (1951) is Atkins (1887) who stated on page 723 that "*Alewives used to breed in Sabattus pond, and shad in the main river below Lewiston*."	It would be mistaken to assume that Atkins and Taylor contradict each other on shad in the Androscoggin, and actually much more informative to consider their perspectives as complementary. Clyde C. Taylor, writing for the USFWS, with the benefit of over 50 additional years of research and comment, was clearly familiar with and respected the 19th century works of Charles Atkins, who is extensively cited his 1951 *Survey of Former Shad Streams in Maine*. The two sources can be interpreted consistently by reading them to say that the 41-foot high falls at Brunswick likely presented a significant barrier to shad and, thus only limited numbers were able to pass them opportunistically and then potentially only under certain flow conditions when the hydraulics and tide were suitable. This perspective is supported by Atkins (1887) himself: *The original range of shad in Maine included almost if not quite every river in the State; but in the smaller rivers it does not appear from the scanty evidence attainable that they were ever very plenty. From nearly the whole extent of some of the larger rivers they were excluded by impassable falls, and from many of second size they were shut out by mill-dams at so early a date that their former presence is attested only by a dim, tradition. In short, there are only three rivers in the State in which it is quite certain that there ever existed an*

Agency Comment	Comment	How Addressed
		important shad-fishery. These are the Saint Croix, Penobscot, and Kennebec, and in the Kennebec alone has the fishery continued to be of considerable importance to the present time, while in but three other rivers and a few salt bays is there now any attempt to fish for shad (684). Taylor's statement that the Androscoggin was "never a shad river" is not the same as categorically saying that shad did not historically occur there. Taylor writes from a fisheries management perspective, so his comments likely are meant to convey that the run there was never large or consistent enough to warrant supporting a fishery: the limited shad that were able to pass the falls at Brunswick were not able to go above Lewiston Falls and so bred in the river in that general vicinity. Together, Taylor and Atkins both point toward the fact that Merrymeeting Bay below Brunswick was a fertile spawning area for shad, so few fish would likely have the incentive to venture above the falls except on years when the flow and temperature allowed. Information contained in Atkins (1887) has been added to Section 4.6.1.1 and 4.6.1.2.1 of Exhibit E.

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
June 24, 2020

OFFICE OF ENERGY PROJECTS

Project No. 4784-095 – Maine
Pejepscot Hydroelectric Project
Topsham Hydro Partners Limited Partnership

VIA FERC Service

Randy Dorman
Brookfield Renewable
Topsham Hydro Partners Limited Partnership
150 Main Street
Lewiston, ME 04240

Subject: Comments on Draft License Application for the Pejepscot Hydroelectric Project

Dear Mr. Dorman:

Pursuant to 18 CFR § 5.16(e), this letter contains staff comments on your draft license application for the Pejepscot Hydroelectric Project No. 4784, filed on April 3, 2020.

In general, your draft license application describes the proposed project facilities and operation. However, it does not provide sufficient supporting documentation. Specific comments on the draft license application are discussed in Schedule A.

If you have any questions, please contact Ryan Hansen at (202) 502-8074.

Sincerely,

David Turner, Chief
Northwest Branch
Division of Hydropower Licensing

Enclosure: Schedule A

Schedule A
Comments on Draft License Application

Exhibit A

1. Section 4.61(c)(1)(viii) of the Commission's regulations require that the Exhibit A include the general configuration, sizes, capacities, and construction materials, as appropriate, of pipelines, ditches, flumes, canals, intake facilities, powerhouses, dams, transmission lines, and other appurtenances. The draft Exhibit A does not describe the material of the bascule gates; the general configuration, sizing, or materials of the old powerhouse; the material of the old powerhouse intake; the general configuration, sizing, or materials of the new powerhouse; the material of the new powerhouse intake; the material of the hopper and basket of the fish lift; or the length and material of the downstream fish passage facility. Please revise your application to include this information.

Exhibit B

2. Section 4.51(c)(2) of the Commission's regulations require that the licensee provide the minimum river flow observed in the project area, as well as a curve showing powerplant capability versus head and specifying maximum, normal, and minimum heads. While you provided a curve showing powerplant capability versus head and stated that the "rated" or "gross" head of the plant is 24 feet, you did not specify the maximum, normal, or minimum head. Please include this information in the FLA.

Exhibit C

3. Section 4.51(d)(1) of the Commission's regulations require that the licensee provide the date of commencement of commercial operation for the project. Please include this information in the FLA.

Exhibit E

General Comments

4. Section 5.18(b)(iii)(A)-(C) of the Commission's regulations require that the Exhibit E include functional design drawings that conform to the specifications in Section 4.39 and depict any fish passage and collection facilities or any other facilities necessary for implementation of environmental measures, indicating whether the facilities depicted are existing or proposed; a description of maintenance procedures for the proposed project facilities; and a construction schedule for the facilities, showing the intervals following issuance of a license when construction of the facilities would be commenced and

completed. Additionally, Section 5.18(b)(5)(iii)(E) of the Commission's regulations require that the Exhibit E include a map or drawing that conforms to the size, scale, and legibility requirements of Section 4.39 showing by the use of shading, cross-hatching, or other symbols, the identity and location of any measures or facilities, and indicating whether each measure or facility is existing or proposed. Section 4.39(c)(2) requires that the drawings must have a scale in full-sized prints no smaller than: (1) one inch equals 50 feet for plans, elevations, and profiles; and (2) one inch equals 10 feet for sections.

While the draft application contained functional design drawings and a description of maintenance procedures for the fish lift, it did not include functional design drawings for the downstream fish passage facility, nor it did not include either of these items for the proposed eel ramp. Exhibit E did not contain a map or drawing conforming to Section 4.39 showing the locations of the proposed eel ramp. Additionally, sections A-A, B-B, and C-C on Sheet 1 of the functional drawings of the fish lift do not conform to Section 4.39(c)(2) as they are drawn to a scale smaller than one inch equal to 10 feet. Please update your Exhibit E accordingly.

Specific Comments

Cultural Resources

5. You state on page E-200 of the draft license application that a newly identified archaeological site, ME 14.174 within the project Area of Potential Effect (APE), has not been evaluated for eligibility for listing on the National Register of Historic Places (National Register). You propose to conduct a Phase II survey during year two of a new license to determine the site's eligibility as part of your proposed Historic Properties Management Plan (HPMP). The draft application does not explain why you propose to delay the eligibility evaluation. Typically, eligibility determinations with the concurrence of the Maine SHPO are needed in the final license application for Commission staff to fulfill its responsibilities under section 106 of the National Historic Preservation Act.

<u>Exhibit G</u>

6. Section 4.61(f) of the Commission's regulations require an Exhibit G conforming to section 4.41(h). Section 4.41(h) also requires that Exhibit G maps conform to the specifications of section 4.39 of the Commission's regulations, which require Exhibit G maps to be stamped by a registered land surveyor. Your Exhibit G maps do not have a stamp from a registered land surveyor. Please correct this deficiency in the Exhibit G of your FLA. We remind you that section 4.41(h) requires that all applications for licenses include the project boundary data in a georeferenced electronic file format.

Georeferenced electronic file format includes ArcView shape files, GeoMedia files, MapInfo files, or a similar GIS format. The filing should include both polygon data and all reference points shown on the individual project boundary drawings. An electronic boundary polygon data file(s) is required for each project development. Depending on the electronic file format, the polygon and point data can be included in single files with multiple layers. The georeferenced electronic boundary data file must be positionally accurate to ±40 feet in order to comply with National Map Accuracy Standards for maps at a 1:24,000 scale. The file name(s) must include: the FERC Project Number, data description, and file extension in the following format [P-1234, boundary polygon/or point data, MM-DD-YYYY.SHP]. The data must be accompanied by a separate text file describing the spatial reference for the georeferenced data: map projection used (i.e., UTM, State Plane, Decimal Degrees, etc.), the map datum (i.e., North American 27, North American 83, etc.), and the units of measurement (i.e., feet, meters, miles, etc.). The text file name must include: the FERC Project Number, data description, and file extension in the following format [P-1234, project boundary metadata, MM-DD-YYYY.TXT]. Each map sheet must contain a minimum of three known reference points. The latitude and longitude coordinates, or state plane coordinates, of each reference point must be shown.

<u>Exhibit H</u>

7. Section 5.18(c)(1)(i)(F)(3) of the Commission's regulations require that the Exhibit H include a detailed single-line electrical diagram. The single-line electrical diagram was filed as part of your Exhibit F as Critical Energy Infrastructure Information (CEII). Please revise your FLA to include this information in Exhibit H, which does not need to be filed as CEII.

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANET T. MILLS
GOVERNOR

GERALD D. REID
COMMISSIONER

June 30, 2020

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

RE: FERC 4784, Pejepscot Hydroelectric Project
Draft License Application Comments

Dear Secretary Bose:

The Maine Department of Environmental Protection (Department) reviewed the Draft License Application (DLA) submitted to FERC on April 3, 2020 by the Topsham Hydro Partners (Applicant) for the Pejepscot Hydroelectric Project (FERC 4784), located on the Androscoggin River in the towns of Topsham, Durham, Lisbon, and Brunswick, located in Cumberland, Sagadahoc, and Androscoggin Counties, Maine.

The existing Pejepscot Hydroelectric facilities consist of a 560-foot-long, 48-foot-high, rock and gravel filled timber crib overflow structure that is topped with a 5-foot-thick reinforced concrete slab; a spillway consisting of five 96-foot-long by 3-foot -high bascule gates; a 225-acre impoundment at full pool elevation of 67.5 feet; a powerhouse containing three horizontal Francis turbine-generator units with a combined rated capacity of approximately 1,580 kW and maximum hydraulic capacity of approximately 1,050 cfs; a powerhouse containing a vertical-shaft propeller type (Kaplan)turbine rated at 17,000 hp with a maximum hydraulic capacity of approximately 7,100 cfs and a generator rated at approximately 12,300 kW; an upstream fish passage facililty consisting of a vertical fish lift; a downstream fish passage facility consisting of two-four-foot wide entry weirs that pass fish through 30-inch and 24-inch outlet pipes respectively; and appurtenant facilities.

Formal and informal recreation facilities associated with the Project include impoundment boat launches and fishing access; parking for the recreational facilities is limited.

The Department understands that there are no proposed changes in facilities or operations of the Pejepscot Project at this time.

Water Quality Study Comments

The Department requested certain water quality studies, conducted in substantial conformance with established sampling protocols that were provided to the Applicant, to evaluate current water quality conditions and to determine whether current and proposed project operations meet the designated uses, including recreation in and on the water and habitat for fish and other aquatic life among others, as well as numeric standards for dissolved oxygen and narrative criteria, demonstrating attainment of Maine's water quality standards. Requested studies included:

1. Impoundment Trophic State Study
2. Impoundment Aquatic Habitat Study and Aquatic Habitat Cross-Section flow Study, or at least three years of impoundment elevation and inflow/outflow data to demonstrate run-of-river operations
3. Downstream Temperature and Dissolved Oxygen Study
4. Benthic Macroinvertebrate Study

The DLA presents methodologies, data results, analysis and discussions on each of the studies completed. The Department reviewed the information submitted by the Applicant and has the following comments on the completed studies:

1. . <u>Trophic State Study in the Pejepscot Impoundment</u>

The Applicant performed trophic state sampling in the Pejepscot impoundment twice per month from June through October 2018 in accordance with the *Lake Trophic State Sampling Protocol for Hydropower Studies (MEDEP 2017).* Water quality samples were collected in the deepest location in the impoundment. Analysis of sampling results indicates that the Pejepscot impoundment is mesotrophic, with a trophic state index of 36; a trend analysis requires ten years of data and so it is not possible to evaluate whether or not the trophic state is improving. Impoundment water temperature and dissolved oxygen (DO) profiles indicate that the Pejepscot impoundment does not stratify thermally and that dissolved oxygen in the impoundment is in attainment with Maine's water quality standards throughout the sampling period.

Based on results provided by the Applicant in the Initial Study Reports (ISR) and DLA, the Department concludes that the applicant has provided sufficient information regarding the trophic state of the impoundment to determine that the Project impoundment is in attainment of Maine's water quality standards.

Electrical generation facilities are in line with the Project Dam and there is no bypass reach associated with this Project. In lieu of an impoundment habitat study and aquatic habitat cross-section flow study the Applicant must provide sufficient information to establish that the Project operates in run-of-river mode, that water level fluctuations in the impoundment are limited, and that outflow from the impoundment is essentially equal to inflow. Pending receipt of water the requested three years of impoundment water level and flow data, aquatic habitat studies in the impoundment and in the Project tailwater may be necessary.

2. <u>Water Temperature and Dissolved Oxygen Study</u>

Water temperature and DO measurements were collected downstream of the Pejepscot Dam in the project tailrace between August 2 and October 2 ˚C , 2018, in accordance with the *River and*

Stream Sampling Protocol for Hydropower Studies (MEDEP 2017). DO measurements ranged from 7.8 to 9.7 mg/L, with percent saturating ranging from 94.3 to 106.2%. Instantaneous DO concentrations averaged 8.5 mg/L (percent saturation averaged 99.6%) over the monitoring period; measurements never fell below Maine's water quality standard. Water temperature in the tailwater reach ranged from 16.8˚C to 27.3˚C (water temperature averaged 23.5˚C) throughout the sampling period.

Based on the results and information contained in the ISR and DLA, the Department concludes that the Applicant has provided sufficient information to demonstrate that the Pejepscot Project meets applicable Class C DO criteria downstream of the Project Dam.

3. Benthic Macroinvertebrate Study

The Applicant collected benthic macroinvertebrate samples approximately 600-700 feet downstream of the Pejepscot Dam following Maine's *Methods for Biological Sampling and Analysis of Maine Rivers and Streams (Tsomides and Davies 2014)*. Rock baskets were placed at the sample site on August 2, 2018 and allowed to colonize for 28 days (+/- 4 days) and retrieved August 28, 2018. Results indicate that the benthic macroinvertebrate community downstream of the Pejepscot Project is abundant, with 43 species represented, including some sensitive species. Data collected was analyzed by the Department's Division of Environmental Assessment, applying a linear discriminate model and was found to exceed applicable Class C criteria.

Based on the study results and information contained in the ISR and DLA, the Department concludes that the Applicant has provided sufficient information to demonstrate that the Pejepscot Project meets, at a minimum, Maine's applicable Class C aquatic life and habitat criteria.

4. Tailrace Aquatic Habitat Study

The Applicant conducted a Tailrace Aquatic Habitat Study in the tailrace reach of the Androscoggin River downstream of the Pejepscot Dam to characterize physical habitat and substrates in the unimpounded reach, downstream of the Project. The study identified six major mesohabitat categories, including backwater habitat (28% of total habitat area), pool habitat (38.1% of total habitat area), riffle habitat (6.1 % of total habitat area), run habitat (20.1% of total habitat area), glide habitat (1.0% of total habitat area), and an "other" category (6.1% of total habitat area). Primary, secondary, and tertiary substrates were then identified within each mesohabitat (gravel, cobble, sand, mixed bedrock, small boulder, rubble, and large boulder). Finally, fine substrate (sand, silt, mud, etc.) was recorded, found to be associated with backwater, pool, and (one) run habitat.

The Applicant was requested to submit three years of impoundment water level and flow data to demonstrate the run-of-river operations of the facility, to show that water levels in the impoundment do no fluctuate more than an unimpounded river, and that inflow is equal to outflow, showing that downstream habitats remain watered in the same manner as an undammed river. Those data remain outstanding at this time and should be submitted for Department review as quickly as possible.

Based on the results and information contained in the ISR and DLA, at this time the Department cannot conclude that the Applicant has provided sufficient information to demonstrate that the Pejepscot Project meets applicable Class C aquatic life and habitat criteria, and the designated use of habitat for fish and other aquatic organisms; however, submission of water level and flow data may allow the Department to make such a determination.

Topsham Hydro Partners must demonstrate compliance with all designated uses as well as all numeric and narrative criteria in order for the Department to issue a water quality certification for the Pejepscot Project.

Thank you for the opportunity to comment. Please contact me by telephone at (207) 446-2642 or by email at Kathy.Howatt@maine.gov if you have questions.
Sincerely,

Kathy Davis Howatt
Hydropower Coordinator
Bureau of Land Resources

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

July 2, 2020

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

RE: NMFS comments on the Draft License Application for the Pejepscot Hydroelectric Project (FERC No. 4784-095)

Dear Ms. Bose,

On April 3, 2020, Topsham Hydro Partners Limited Partnership (Topsham Hydro or applicant) submitted its Draft License Application (DLA) for the Pejepscot Hydroelectric Project (FERC No. 4784-095 or Project) to the Federal Energy Regulatory Commission (FERC or Commission). The Project is located on the Androscoggin River near the town of Topsham, Maine.

We are submitting comments on the DLA in accordance with the Commission's Integrated Licensing Process (ILP).

<u>NMFS Comments on the DLA</u>

- We find that the DLA is incomplete. We note that the applicant has not yet filed its Updated Study Report (USR) with FERC. We expect that this USR will contain information crucial to the evaluation of project effects on diadromous fish passage and habitat and therefore, the development of appropriate protection, mitigation, and enhancement measures. Outstanding studies include, but are not limited to:

  - Eel Monitoring Survey
  - Evaluation of Spring Migration Season Fish Passage Effectiveness
  - Evaluation of Fall Migration Season Fish Passage Effectiveness
  - Fish Entrainment and Turbine Survival Assessment
  - Sediment Storage and Mobility
  - Large Woody Debris

  Topsham Hydro has been working with us and other resource agencies to share and discuss preliminary results of several of these studies. The preliminary results of diadromous fish passage studies performed by Topsham Hydro were, at the least, concerning. As such, we expect that additional information and studies will be needed to suitably evaluate the

Project's effects and determine the necessity and scope of any potential protection, mitigation, and enhancement measures. Considering that the significant information is still pending in this proceeding, we are not providing specific comments on the environmental analyses or proposed environmental measures included in the DLA at this time. We expect to continue to work collaboratively with Topsham Hydro to develop that information and to provide FERC any comments relevant to Topsham Hydro's study results and need for additional information and/or studies after the USR is filed.

- Section 6 of the licensee's Exhibit E details the application's consistency with comprehensive plans. On April 15, 2020, we filed the *Androscoggin River Watershed Comprehensive Plan for Diadromous Fishes (2020)*. On June 18, 2020, the Commission determined that this document qualified as a comprehensive plan under section 10(a)(2)(A) of the Federal Power Act and was added to the Commission's list of approved comprehensive plans for the State of Maine. As such, we expect that the Final License Application will include an evaluation of its consistency with this comprehensive plan.

Please contact Matt Buhyoff by phone at 207-866-4238, or by email at matt.buhyoff@noaa.gov if you have questions regarding this correspondence.

Sincerely,

Julia E. Crocker

Julia E. Crocker
Endangered Fish Recovery Branch Chief
Protected Resources Division

STATE OF MAINE
DEPARTMENT OF MARINE RESOURCES
21 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0021

JANET T. MILLS
GOVERNOR

PATRICK C. KELIHER
COMMISSIONER

July 7, 2020

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

RE: NMFS comments on the Draft License Application for the Pejepscot Hydroelectric Project (FERC No. 4784-095)

Dear Ms. Bose,

These are the comments of the Maine Department of Marine Resources (MDMR) on the Draft License Application (DLA) for the Pejepscot Hydroelectric Project (Project) that was submitted to the Federal Regulatory Commission (Commission) by Topsham Hydro Partners Limited Partnership (applicant) on April 3, 2020. The Project is located on the Androscoggin River near the town of Topsham, Maine.

General comments
We have reviewed the DLA and find that it is incomplete, because the applicant has not yet filed an Updated Study Report with the Commission. We note that during a meeting with the agencies on May 12, 2020, the applicant provided preliminary results of the following studies:

1. Eel Monitoring Survey
2. Evaluation of Spring Migration Season Fish Passage Effectiveness
3. Evaluation of Fall Migration Season Fish Passage Effectiveness
4. Fish Entrainment and Turbine Survival Assessment
5. Sediment Storage and Mobility
6. Large Woody Debris

However, MDMR and the other resource agencies had concerns about the results of the studies (particularly studies 1-4) and requested additional information (e.g. gate settings during upstream migration season) and discussed potential additional studies. These discussions continued during a follow-up meeting on July 2, 2020. We expect that additional studies will be needed to evaluate the Project's effects and determine the necessity and scope of any potential protection, mitigation, and enhancement measures.

OFFICES AT 32 BLOSSOM LANE, MARQUARDT BUILDING, AUGUSTA, MAINE
http://www.Maine.gov/dmr
PHONE: (207) 624-6550 FAX: (207) 624-6024

Specific comments

The DLA contains the following statements in Exhibit E, 4.6.1.1 Fish Assemblage (Page E-75) and 4.6.1.2.1 Diadromous Species (Page E-83) regarding the historic range of American shad in the Androscoggin River:

> "The historic extent of upstream passage for shad and herring has been reported to be Lewiston Falls (approximately 17.5 miles upstream of the Project), with some American Eel, Atlantic Salmon, and possibly Sea Lamprey having passed as far upstream as Rumford Falls. However, according to Taylor, 1951, the Androscoggin River may never have been a shad river because of impassable falls at Brunswick, which is located 4.7 miles downstream of the Project."

> "The numbers of American Shad passed at the Brunswick Fishway have ranged from zero to 1,123 fish from 2000-2019 (Table 4.6.1.1-3). It should be noted that the falls at Brunswick may have been an impassible barrier for American Shad, and the Androscoggin River may not have been historically considered a shad river (Taylor, 1951)."

A more authoritative citation than Taylor (1951) is Atkins (1887)[1] who stated on page 723 that "Alewives used to breed in Sabattus pond, and shad in the main river below Lewiston."

If you have any questions, please contact Gail Wippelhauser at 207-904-67962 or by email at gail.wippelhauser@maine.gov.

Sincerely,

Patrick C. Keliher, Commissioner

cc: Sean Ledwin, Casey Clark, Paul Christman, DMR
John Perry, Jim Pellerin, DIFW
Kathy Howatt, DEP
Anna Harris, Antonio Bentivoglio, USFWS
Sean McDermott, Jeff Murphy, Don Dow, NMFS

[1] Atkins, C. G. 1887. The river fisheries of Maine. Pages 673-728 in G. B. Goode, editor. The fisheries and fishing industries of the United States, Section V, Volume 1. Government Printing Office, Washington, D.C.

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APPENDIX E-2: DIADROMOUS SPECIES PASSAGE AND ATLANTIC SALMON INFORMAL SECTION 7 CONSULTATION MEETING NOTES

Topsham - Androscoggin River Diadromous Species Passage and Atlantic Salmon Informal Section 7 Consultation Meeting

Meeting Date/Time/Location: March 3, 2020; 1:00 pm; KA, Pittsfield, Maine

Meeting Attendees:

A.) National Marine Fisheries Service: Matt Buhyoff, Don Dow
B.) Brookfield Renewable: Randy Dorman, Kelly Maloney, Matt LeBlanc
C.) ME Dept. of Environmental Protection: Chris Sferra
D.) Environmental Consultants: Gomez and Sullivan, Kirk Smith and Normandeau, Drew Trested

Discussion Schedule Strategy: To hold topic specific monthly meetings (n=6).

1) <u>Meeting 1: Introductory/Kick Off Meeting (March)</u>
    a. Discussed development of proposed action as Species Protection Plan
    b. Discussed studies conducted to date:
        i. Downstream Atlantic Salmon Studies – 2013 – 2015 smolt passage (paired release) and smolt passage (representative reach)
        ii. Upstream Alewife and Shad – 2019 spring upstream adult shad and adult river herring study (effectiveness of existing lift)
        iii. Downstream Alewife and Shad - 2019 spring downstream adult shad and adult river herring study (passage route/passage survival); 2019 juvenile alosine study (route selection and desktop survival analysis)
        iv. Downstream Eel Passage - 2019 fall adult eels (route selection and downstream passage survival)
        v. Upstream Eel Passage – night-time visual surveys for upstream passage siting; did not yield much in the way of useful results;
    c. Discussed that additional studies to inform refinement of fish passage improvements could be done post-licensing; but if there are data gaps that are necessary to inform the environmental analysis, there may be additional studies post-FLA
    d. Discussed that the timing of the Study Plan Determination precluded effective study planning for Year 1 studies; all studies were conducted in Year 2
    e. Schedule / Deadlines
        i. Meetings (n=5; March – August)
        ii. Draft of the Licensee Proposed Action (mid-July, 2020)
        iii. Comments (mid-August, 2020)
            1. Optional meeting to discuss (early August, 2020)?
        iv. Final Licensee Proposed Action (August 31, 2020)
2) <u>Meeting 2: Review of existing Upstream Passage Performance/discussion of potential Proposed Measures (April); will schedule after study reports/DLA is submitted</u>
3) <u>Meeting 3: Review of existing Downstream Passage Performance/discussion of Proposed Measures (May)</u>

4) Meeting 4: Performance Standards and Timing Goals; Final Proposed Actions (June)
5) Draft Licensee Proposed Action/BA (for ESA species) to Agencies for review – mid-July, 2020
6) Meeting 5, if necessary or requested: Discussion of draft Licensee Proposed Action/BA – early August, 2020
7) File Final Licensee Proposed Action/BA with Topsham FLA – August 31, 2020

Topsham - Androscoggin River Diadromous Species Passage and Atlantic Salmon Informal Section 7 Consultation Meeting 2

Review of existing Upstream Passage Performance/discussion of potential Proposed Measures

Meeting Date/Time/Location: April 29, 2020; 1:00 pm; Via Conference Call

Meeting Attendees:

A.) National Marine Fisheries Service: Matt Buhyoff, Don Dow, Dan Tierney
B.) US Fish and Wildlife Service: Ken Hogan, Anna Harris
C.) Brookfield Renewable: Randy Dorman, Kelly Maloney, Matt LeBlanc
D.) Environmental Consultants: Gomez and Sullivan, Kirk Smith and Tim Sullivan, and Normandeau, Drew Trested

Discussion Schedule Strategy: To hold topic specific monthly meetings (n=6).

1) Discussed development of proposed action for the Final License Application
2) Discussed studies conducted to date for upstream passage:
   a. Upstream Alewife and Shad – 2019 spring upstream adult shad and adult river herring study (effectiveness of existing lift)
      i. Alewife Study - Alewife taken from Brunswick; 102 river herring tagged; released in four groups in May between 22 and 29 – monitored May through mid-August; put in at Mill Street boat launch area; approximately 80% moved upstream; had arrays at 200 m above and below the dam; median time at large was approximately 2.5 days in the project area (first detection to passage or last detection at Project); average residence was split 1/3 of time in tailrace area and 2/3 of time in the area of the spillway; high flows in May in excess of station capacity (17,000 cfs+) with flows dropping in early June; 93% found entrance (median of 8 entrance visits, timing peaked at around 10 am and 3 or 4 pm); passage occurred during the latter part of May; 40%+ passed within 24 hours of arrival and 60%+- within 48 hours; overall effectiveness 20%
      ii. Shad Study – caught by hook and line downstream of Brunswick in June; river flows during tagging and releases were more in line with normal flows (4,500 to 8,000 cfs); 45% of shad dropped back; residence time across project area was at spillway largely; approximately 25% of shad that made it into the tailrace entered the lift entrance; no shad were passed
   b. Upstream Eel Passage – night-time visual surveys for upstream passage siting; surveys occurred during June, July, and August; limited to observations that could be made from safe viewing points; no eels observed
   c. Upstream Atlantic salmon passage effectiveness desktop study – not enough salmon to collect empirical data; summarized adult studies for other rivers in Maine (Lockwood and Milford); comparison of the physical and operational characteristics; ranged between 79% and 96%

3) Discussed study results and possible improvements to upstream fish passage that agencies might suggest
   a. Matt B. commented that the studies were well done and it was noticed that the flows were high
   b. Donnie discussed that Lockwood is probably not a good comparison for the upstream Atlantic salmon passage study because it's not operated in automatic mode; Drew also noted that Lockwood has a very long bypass and is operationally different and Milford is more comparable
   c. Donnie asked about shad; Drew pointed out that shad passage study is always challenging especially since they were caught at Brunswick and trucked; 45% of adults didn't even try to move upstream likely from the handling stress and others didn't even make it into the project area; shad were more congregated on spillway side even though there wasn't spill
   d. Donnie asked about acoustics study; we aren't getting any shad and possibility could be the frequency off the pumps; Donnie would like an acoustic study done to check on the frequency of the pumps
   e. Kelly indicated that couldn't really be done ahead of the Final License Application but could be done as part of post-licensing – investigating issues with the lift and working on improvements especially in light of the fact that there are no shad in the area (don't generally pass Brunswick)
   f. Donnie and Bryan have noticed that the entrance gate has too much head loss; found that it was dropped to try to keep the trash from circling back in; fact that trash gets into the entrance is an issue; Donnie indicated that otherwise the fishway looks good engineering wise; check to see if there is recirculation which means that the flow is not strong enough at the entrance
   g. Matt L. indicated that typical agency visits are not always indicative of conditions at the Project and that shad handling effects likely had a very big effect on whether we were able to pass shad during the study
   h. Kelly asked in the absence of understanding the issues with passage what Section 18 prescriptions might be; Donnie suggested moving pumps out and implementing a gravity fed system would be something his prescription would have to include
   i. Ken asked about conducting studies and submitting them as part of an amended application
   j. Donnie doesn't want to reserve authority; Donnie would prefer to get it right now; Ken concurred
   k. Kirk indicated that there are other resources and conditions that would go into the license; buying time and filing an amended license application will push off implementation of the other PME measures
   l. Matt indicated that there are only two measures that don't pertain to fish passage – recreation and cultural – that would suffer from a delay; Kirk stated that even the other fish passage measures – such as eel passage – would be delayed
   m. Donnie suggested that backflow could be from the turbines or the spillway

n. Matt L. indicated that there is good laminar flow going out and down the ledge but the acoustics could be an issue; early spring, high water is likely more of the cause
o. Donnie would ask for an acoustics study; sound could be from the pumps or from the turbines; 3D model of the tailrace or live test of spills and scenarios through turbines and spill flows; Randy indicated that we could likely do the latter ahead of the August 31, 2020 deadline
p. Donnie indicated we could put cameras out to see where the fish are going
q. Kirk indicated that we could circulate the 1990s upstream alewife studies
r. Ken asked if there have been changes to the operation of the fishway since the study has been done; Randy indicated that we could research that

4) Schedule/Deadlines
   a. Meetings (n=5; March – August)
   b. Draft of the Licensee Proposed Action (mid-July, 2020)
   c. Comments (mid-August, 2020)
      i. Optional meeting to discuss (early August, 2020)?
   d. Final Licensee Proposed Action (August 31, 2020)

5) Anticipated next meetings:
   a. Meeting 3: Review of existing Downstream Passage Performance/discussion of Proposed Measures (May 12 at 3 pm)
   b. Meeting 4: Performance Standards and Timing Goals; Final Proposed Actions (June)
   c. Draft Licensee Proposed Action/BA (for ESA species) to Agencies for review – mid-July, 2020
   d. Meeting 5, if necessary or requested: Discussion of draft Licensee Proposed Action/BA – early August, 2020
   e. File Final Licensee Proposed Action/BA with Topsham FLA – August 31, 2020

INDEPENDENT HYDRO DEVELOPERS, INC.

473 THIRD STREET
SUITE 301
NIAGARA FALLS, NEW YORK 14301
TELEPHONE: 716-282-6155
TELEFAX: 716-282-0525

March 23, 1993

The Secretary
Federal Energy Regulatory Commission
Mail Code: DPCA, HL-21.1
825 North Capitol Street, NE
Washington, DC 20426

TOP 6617.05
TOP 6620.03.01

ATTN: J. Mark Robinson, Director
Division of Project Compliance and Administration

RE: PEJEPSCOT HYDRO PROJECT
FERC No. 4784-ME
Evaluation of Upstream Fish Passage Facility
Progress Report No. 2

Dear Mr. Robinson:

In compliance with FERC Order No. 4784-030, issued April 30, 1991, Topsham Hydro Partners, Chrysler Capital Corporation, and Utilco Group, Inc., (Licensees), herewith file for approval, its report on the second year's study results of upstream fish passage at the Pejepscot Project for the year 1992. The study results have been reviewed with the U.S. Fish & Wildlife Service, the Maine Department of Marine Resources, the Maine Department of Inland Fish & Game and the Maine Atlantic Sea-Run Salmon Commission.

The agencies have concluded that the efficiency of the Pejepscot upstream fishway has met the goal of 90% with no spill over the dam. The study plan required that the efficiency during a period of spill over the dam also be determined. As there was no spill over the dam in 1991 or 1992 during the fish run, the Licensees request a 2-year extension to study upstream passage during a spill period. To allow time for review and consultation with the agencies, a final report will be filed by May 1, 1995.

Very truly yours,

Olaf M. Erickson, P.E.
Vice President, Operations

OME:kl
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PEJEPSCOT HYDROELECTRIC PROJECT

FERC PROJECT NO. 4784-ME

EVALUATION OF UPSTREAM FISH PASSAGE FACILITY

REPORT NO. 2

<u>1992</u>

PREPARED For:
TOPSHAM HYDRO PARTNERS
(Limited Partnership)
CHRYSLER CAPITAL CORPORATION
UTILCO GROUP, INC. (Licensees)

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PEJEPSCOT HYDROELECTRIC PROJECT
FERC PROJECT NO. 4784-ME
EVALUATION OF UPSTREAM FISH PASSAGE FACILITY
REPORT NO. 2
1992

1.0 INTRODUCTION

1.1 Background

The Federal Energy Regulatory Commission (FERC) Order No. 4784-012 approving the functional design drawings for the Pejepscot fish passage facilities required the Licensees to file a plan for monitoring of the effectiveness of these facilities. The Licensees' study plans were filed with the FERC in March, 1991 and included studies of alewife passage. Effectiveness studies for other species of anadromous fish (American shad and Atlantic salmon) are not required at this time due to the small populations of these species in the Androscoggin River. The FERC issued, on April 30, 1991, Order No. 4784-030 approving the fish passage study plans. A copy of the Order is included in Appendix 1.

The Licensees' approved study plan for monitoring upstream fish passage consists of:

1. For both 1991 and 1992, tagging of three cohorts (200 fish each) of alewives taken from the upstream fishway at the Brunswick Hydro Plant (immediately downstream from Pejepscot) and releasing them into the Brunswick headpond.

2. Counting all tagged and untagged alewife passing through the Pejepscot upstream fishway, as well as species other than alewife.

3. Reviewing the fishway count and study methods annually with the agencies, and preparing a progress report on the 1991 activities and a plan for 1992 studies.

4. Preparing a final report of 1991-1992 study results, and conclusions and recommendations regarding the effectiveness of the upstream passage facility. This final report is to be filed by May 1, 1993.

Progress Report No. 1, which describes the results of the 1991 studies, was filed with the FERC in February, 1992. Report No. 2 describes the results of the 1992 studies and provides final conclusions and recommendations regarding the effectiveness of the upstream facility based on the results of the 1991 and 1992 studies. These studies were conducted by Charles Ritzi Associates and personnel from Topsham Hydro Partners.

1.2 Summary

Studies to determine the effectiveness of the Pejepscot Project upstream fish passage facility were conducted in 1991 and 1992. Five cohorts of tagged alewife captured in the Brunswick fishway were released into the Brunswick impoundment and the numbers of tagged and untagged alewife passing the Pejepscot fishway were counted. In consultation with the agencies, the Pejepscot fishway efficiency (49 percent) for one study cohort in 1991 was considered an unexplained outlier value and has not been included in analysis of study results. The other four study cohorts indicated Pejepscot fishway efficiencies of 73, 84, 90 and 100 percent, which represent an average of 87 percent. For untagged alewife, Pejepscot fishway efficiencies of 67 and 70 percent were indicated. Considering all study variables that could influence determination of fishway efficiency, all these unadjusted

efficiency values must be considered, to some degree, to be underestimates of actual Pejepscot upstream fish passage facility efficiency.

The agencies have concluded that the efficiency of the Pejepscot upstream fishway is close to the agency goal of 90 percent and that the only necessary additional study remaining to be conducted is of efficiency under a spill condition. Therefore, as soon as river flow conditions permit, one study cohort of tagged alewife will be released at Brunswick under spill conditions and counting will be conducted at Pejepscot to monitor this cohort. The agencies are in concurrence that a 2 year extension of the FERC filing schedule for the upstream passage effectiveness studies is necessary to conduct the spill condition study.

Rapid passage through the Pejepscot fishway after release at the Brunswick Dam was documented. Over the two years of study approximately 90 percent or greater of the tagged alewife passed the Pejepscot fishway within 2 to 6 days of passage at Brunswick. As the best illustration of this rapid passage, 66 percent of one study cohort passed the Pejepscot dam on the first fishway lift (20 hours later) after release at Brunswick.

The number and size of species other than alewife using the Pejepscot fishway were also recorded.

2.0 STUDY SCOPE AND GOALS

The scope of the 1991 and 1992 studies was to tag three 200-fish cohorts of alewife at the Brunswick fishway, release them into the Brunswick impoundment and count them passing the observation window at the Pejepscot fishway. Unmarked alewife using the Pejepscot fishway were also to be counted. The study cohorts would be released during the first three weeks of the migration period and with both non-spillage and spillage conditions at the Pejepscot dam. Species other than alewife using the fishway were also to be counted.

The goal of the studies was to determine the efficiency of the Pejepscot upstream fishway for alewife, i.e., of the alewife that reach and remain available at the Pejepscot dam, what percentage pass the dam via the fishway.

3.0 METHODS

Study methods were essentially the same during both 1991 and 1992. The alewife used in these studies were captured ascending the Brunswick fishway at the first dam on the Androscoggin River. The DMR conducts a trap/truck operation from this fishway. A portion of the alewife spawning run is trucked to production waters upstream in the Androscoggin drainage, and to the Kennebec River drainage, and the remainder is released upstream into the approximately 300 acre riverine impoundment. The Pejepscot dam is 4.7 miles upstream of the Brunswick dam.

After capture in the Brunswick fishway trap, study fish were isolated in a holding tank by DMR. A few fish at a time were captured in a dip net and allowed to quiet (while immersed in the holding tank). Then each fish was laid flat on a moist foam pad, held with firm hand pressure, and tagged with a color and number coded Floy Model FD-68B T-Bar Anchor Tag (with 0.75 inch monofilament anchor and 1.25 inch tube) inserted into the left side below the dorsal fin. No anaesthetic was used. After tagging (which required approximately 1.5 hours for each 200 fish cohort), fish were placed in another holding tank and held for 1 to 2.5 hours (after completion of all tagging) to allow recovery and possible loss of any poorly applied tags. The tagged fish were then sluiced as a group into the exit channel of the fishway, where they had free access to the Brunswick impoundment.

As a result of agency consultation regarding the results of the 1991 study, it was agreed that in 1992 each release of tagged fish at Brunswick would be coordinated with the release of a substantial number of untagged alewife. The goal was to maintain a "schooling" behavior for the tagged fish, thus ensuring "normal migratory behavior" to the maximum degree possible. This plan was carried out successfully in 1992.

Alewives and other species passing the Pejepscot fishway viewing window were tallied using a multiple counter with separate keys for tagged and untagged alewives and other species. Alewife counting was conducted from mid-May through June, with the fish lift hopper usually raised and dumped twice a day (usually at 9 A.M. and 3 P.M.) during the most active migration period and less frequently towards the end of the run.

Counting continued after the alewife migration period in order to observe other species, as requested by ASRSC and DIFW. Fish lifts and counts were made daily (or less frequently seasonally) with the exception of a summer shutdown period, which is an annual practice (except for 1990 when there was an exceptional number of Atlantic salmon in the river). The Androscoggin River salmon run is primarily supported by strays from stocking in other rivers, primarily the Penobscot. Only 21 and 15 salmon were passed at the Brunswick fishway in 1991 and 1992, respectively.

The lengths of most fish were estimated. A background board with a 4 inch grid pattern was installed in the fishway opposite the viewing window to provide a reference for estimation of length.

Grilled gates located at either end of the viewing window, and activated from within the viewing room, regulated passage through the fishway. These gates were kept closed (fish passage blocked) except during counting. After the lift hopper was raised and dumped, the blocking gates were opened allowing fish to pass the viewing window and be counted. The gate openings were adjusted to regulate the rate of alewife passage to improve counting accuracy. Counting was continued until all fish movement ceased, usually 15 to 30 minutes. The blocking gates were than closed until the next counting period.

DMR provided data on the number of alewife using the Brunswick fishway each day during the spawning migration period, the number of untagged alewife released into the Brunswick impoundment each day, maximum daily water temperature and USGS river flow records.

4.0 RESULTS OF 1992 STUDY AND COMPARISONS WITH 1991 RESULTS

In 1992, Brunswick fishway operation began on May 19 and continued until June 15. A total of 45,050 alewife were counted by DMR and 7,988 of these (of which 400 were tagged study fish) were released into the Brunswick impoundment. Table 1 (in Appendix 2) shows the daily and cumulative fishway counts.

Two study cohorts of tagged (color and number coded) alewives were released into the Brunswick impoundment on May 22 (orange tags) and May 29 (yellow tags). While the study plan called for three cohorts of study fish, the 1992 alewife run at the Brunswick fishway was very small and the migration period was shorter than in 1991, resulting in the tagging of only two study cohorts.

No alewife tagged in 1992 and released into the impoundment were observed again using the Brunswick fishway, and no tagged fish were reported captured by the alewife gill net fishery below Brunswick Dam; both these circumstances (which documented fallback at the Brunswick Dam) occurred in 1991. One blue and two yellow tagged alewife from the 1991 study were observed on a second spawning run. The blue-tagged fish and one of the yellow-tagged fish were released into the Brunswick impoundment, and this yellow-tagged fish was included as a study fish with the 1992 yellow-tagged cohort.

There was essentially no spillage at the Pejepscot dam during the alewife migration period in 1992. On May 23 and June 8 there were small spills of 1,000 cfs or less for only part of each day. Therefore, no efficiency data were determined for significant spillway discharge conditions.

4.1 Unadjusted Pejepscot Fishway Efficiencies

Alewife were observed and counted at the Pejepscot fishway from May 22 through June 23 in 1992. Table 2 (in Appendix 2) is a summary of daily and cumulative passage of tagged and untagged alewife at the Pejepscot fishway. The following table shows study cohort data, tagged fish counts at the Pejepscot fishway and unadjusted fishway efficiencies:

Date Tagged Cohort Released	Color	Number Released	Number Counted At Pejepscot	Unadjusted % Passage Efficiency
May 22	Orange	200	145	73
May 29	Yellow	200*	180	90

* Includes one repeat spawner tagged in 1991

As a second measure of Pejepscot fishway efficiency, of the 7,588 untagged alewife (total released minus 400 tagged study fish) released into the Brunswick impoundment, 5,567 (73 percent) were counted at Pejepscot.

The 1992 results were quite similar to those from the 1991 study. In 1991, unadjusted passage efficiencies for three cohorts of fish were 49 percent, 84 percent and 100 percent, with the 49 percent efficiency considered (in agency consultation) to be an unexplained outlier value. Of the untagged alewife released at Brunswick in 1991, 67 percent were counted at Pejepscot.

4.2 Time To Pass Pejepscot Fishway

Table 3 (in Appendix 2) is a summary of the timing of the passage of tagged alewife through the Pejepscot fishway after release into the Brunswick impoundment in 1992. All orange (released May 22) and yellow-tagged (released May 29) alewife passing the Pejepscot fishway did so in 17 and 7 days, respectively. The yellow-tagged fish passed the most rapidly, with 16 percent passing in 1 day, 74 percent in 2 days, 91 percent in 4 days and all passing within 7 days. The orange-tagged fish had a somewhat more prolonged passage time with 15 percent in 1 day, 88 percent in 5 days and 98 percent in 10 days. Three of the orange-tagged fish passed Pejepscot between the 13th and 17th day after release at Brunswick.

These rates of passage were very similar to those observed for the 1991 study fish. In 1991, the two cohorts considered to provide valid data had all passed Pejepscot in 13 and 7 days, respectively, with over 90 percent passing in 2 to 6 days.

4.3 Water Temperature And River Flow

Table 1 (in Appendix 2) shows daily maximum water temperatures taken by DMR at the Brunswick fishway in 1992. Water temperatures ranged from 15.3°C to 22.4°C during the period of fishway monitoring with a generally increasing pattern throughout most of the run. No large, short-term changes in temperature occurred during the peak of the run.

Table 4 (in Appendix 2) shows USGS Androscoggin River daily mean discharge records for the period May 1 through June 30, 1992. Mean discharges between May 19 and June 15 were in the range of 1,690 to 9,350 cfs with mean flow differences as great as 3,270 cfs between successive days. Flows during the period when most of the study fish passed the Pejepscot fishway were in the 1,690 to 5,270 cfs range.

4.4 Counts Of Species Other Than Alewife

Table 5 (in Appendix 2) is a summary of 1992 Pejepscot fishway counts of species other than alewife. The upstream fishway was operated from May 20 through July 24 in 1992. Because of the small number (15) of Atlantic salmon passing the Brunswick fishway, the Pejepscot fishway was not operated after the customary summer shutdown. In order of relative abundance, the sport species, numbers and sizes observed were:

SPECIES	NUMBER	SIZE (Inches)
Landlocked Atlantic salmon	1 559	18 8-12
Smallmouth bass	148	7-20
Brown trout	118	6-12
Brook trout	6	8
Sea-run Atlantic salmon	3	24-30

In addition, many suckers and a representation of yellow perch, hornpout, fallfish and sunfish were observed.

Many more brown trout were counted in 1992 than in 1991 (118 v. 3) and most were in the 8 to 10 inch class, which was the predominant size observed in 1991. The large number of 8-12 inch (predominantly 8-10 inch) landlocked salmon counted is the result of stockings by DIFW. On April 30, 1992 a stocking of 6,300 landlocked salmon (7.7 fish per pound) was made at the Rt. 9 bridge just below the Worumbo Project (the next dam upstream of Pejepscot). On May 19, 1992 a stocking of 6,150 salmon (4.2 fish per pound) was made below the Brunswick dam. The first of these fish were not recorded at the Pejepscot fishway until June 1, but it is likely that some passed before this date. It is also possible that there was some confusion in the identification of brown trout and landlocked salmon.

5.0 DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Factors Influencing Fishway Efficiency

While the Pejepscot fishway efficiency studies are not intended to be basic research on study methods and alewife migratory and spawning behavior, it is appropriate to consider all variables that may affect fishway efficiency. This is especially true when estimating potential actual efficiencies using unadjusted (observed) efficiencies, or, as was the case for the blue-tagged cohort in the 1991 Pejepscot study, where one study cohort indicated significantly lower fishway efficiency than all other study cohorts, and was discarded from the study.

Various biological, physical and study-induced factors can influence estimates of fishway efficiency:

- Study-induced mortality of tagged alewife after release into the Brunswick impoundment
- Loss of tags after release into the Brunswick impoundment
- Normal and increased predation on study alewife in the Brunswick impoundment
- Dropback of tagged alewife at the Brunswick and Pejepscot dams
- Accuracy of counting of tagged and untagged alewife at the Pejepscot fishway
- Accuracy of counting of untagged alewife released into the Brunswick impoundment

- Water temperature and river flow

- Study-induced disruption of alewife migratory and/or spawning behavior

Each of these variables or potential study biases is discussed in more detail below.

5.1.1 Study-Induced Mortality Of Tagged Alewife After Release Into The Brunswick Impoundment

Since the definition of fishway efficiency is the percentage of study fish reaching and remaining available at the Pejepscot dam that actually use the fishway, any mortalities after release at Brunswick, and before passage at Pejepscot, should not be considered in computing fishway efficiency. However, since the study method used did not determine how many tagged fish actually were available at the Pejepscot dam, any mortalities would still be considered as study fish and fishway efficiency would be correspondingly reduced.

There were no mortalities of tagged alewife during the 1 to 2.5 hour holding periods before release. However, this does not preclude delayed mortality due to tagging/handling/holding stress. Therefore, while some mortality may be assumed, there is no documentation of mortality, and the only conclusion that can be drawn is that the unadjusted counts at Pejepscot may be somewhat low, and fishway efficiency underestimated, due to potential study-induced mortality.

5.1.2 Loss Of Tags After Release

Loss of tags would result in the same bias as study-induced mortality of tagged alewife, i.e., fewer tagged fish available to pass the Pejepscot fishway and a potential bias towards lower fishway efficiency. Of 600 fish tagged in 1991, two did shed tags during the post-tagging holding periods, and in 1992 one orange tag was found in the Pejepscot lift hopper. Conversely, the counting of virtually 100 percent of the yellow-tagged alewife at Pejepscot in 1991 certainly documents low potential tag loss. And in 1992, one blue-tagged and two yellow-tagged alewife that had been tagged in 1991 were recaptured at Brunswick 1 year later on a second spawning run; thus it is clear that the Floy tag can be retained for long periods if properly applied. All tags were applied by the same person using the same equipment and technique. And the tags were applied early in the migration period when alewife were still firm-fleshed. However, the possibility that there can be at least a small amount of tag loss cannot be dismissed.

5.1.3 Predation On Tagged Alewife In The Brunswick Impoundment

Although the study alewife were large, there may have been some predation by birds or large pickerel. Also the tags themselves may attract predators. If there is predation it would have the potential to bias study results towards lower fishway efficiency, but predation is not considered as likely a source of bias as study-induced mortality and tag loss.

5.1.4 Dropback Of Tagged Alewife At The Brunswick And Pejepscot Dams

Dropback of tagged alewife after release at Brunswick or at Pejepscot after initial fishway passage has the potential to cause study bias, but in opposite directions. The turbine intake at Brunswick is adjacent to the fishway exit and study fish leaving the fishway could be entrained into the turbine. This did occur in 1991, with two orange-tagged alewife subsequently (about 1 week after release) recaptured below the Brunswick dam by gill netters. It would appear likely that more than two orange-tagged fish dropped back and that the other study cohorts also experienced dropback, and perhaps that each cohort was subjected to a different likelihood of dropback because of its condition and/or prevailing turbine operation. Since no alewife tagged in 1991 were observed using the Brunswick fishway to return to the Brunswick impoundment, any dropback fish were lost as study fish and would represent another bias towards lower Pejepscot fishway efficiency.

There were no reports of tagged alewife being taken in the gill net fishery below Brunswick dam in 1992, and no 1992 tagged fish were recaptured in the Brunswick fishway. However, some tagged fish could have been taken in the gill net fishery without reporting.

While dropback with repeat passage at the Pejepscot fishway could not be identified by the counting method used, the tally of 201 yellow-tagged fish in 1991 (with only 199 released at Brunswick) indicates possible dropback and multiple fishway passage (the other possibility is an inaccurate fishway count). Dropback with subsequent multiple counting would result in a study bias towards higher fishway efficiency.

5.1.5 Accuracy Of Counting Of Tagged And Untagged Alewife At The Pejepscot Fishway

The counting accuracy at the Pejepscot fishway is considered high, with the exception of the blue-tagged cohort used in 1991, which for the primary counter caused some difficulty in recognition. The blue-tagged cohort was also the low-efficiency outlier in 1991. Accordingly, blue tags were not used in 1992. On the other hand, there was a possible overcount (if there was no dropback) of the yellow-tagged cohort. Any counting inaccuracy could cause a bias towards either higher or lower fishway efficiency.

It is probably more likely that untagged alewife could have been miscounted, since they were more numerous than the tagged fish. Any miscounts could bias the fishway efficiency estimate determined for untagged alewife in either direction.

Of interest, but perhaps a coincidence only, is the fact that, in both 1991 and 1992, the tag color associated with the highest Pejepscot fishway efficiency was yellow.

5.1.6 Accuracy Of Counting Of Untagged Alewife Released Into The Brunswick Impoundment

Any miscounting by DMR of untagged alewife released into the Brunswick impoundment could bias the untagged fish fishway efficiency estimate in either direction. This potential is complicated by its interaction with untagged alewife counts at the Pejepscot fishway, i.e., if DMR counts were high and Pejepscot counts low, bias towards lower fishway efficiency would be maximized. Conversely, low DMR counts and high Pejepscot counts would cause bias towards a higher fishway efficiency estimate. High counts or low counts at both sites would tend to minimize bias.

5.1.7 Water Temperature And River Flow

These factors were reviewed with DMR and USFWS at an agency consultation meeting held on January 22, 1992 to review the results of the 1991 study. DMR noted a temporary slowdown of Brunswick fishway passage during the period May 22 to May 25, 1991, which DMR though might be related to water temperature. This period coincided with the Pejepscot passage period of the blue-tagged cohort released on May 20, 1991. This cohort had the lowest fishway efficiency. However, the timing of blue-tagged fish passage at Pejepscot did not indicate that the possible temperature-related slowdown at the Brunswick fishway was related to the low Pejepscot fishway efficiency. And the water temperatures at Brunswick during this slowdown did not appear to have varied significantly. There did not appear to be any clear correlation between the low blue-tagged cohort fishway efficiency and water temperature.

Any temperature effects should be most pronounced late in the run when higher temperatures prevail and spawning is imminent. Therefore, the behavior of the untagged fish moving through the Brunswick fishway after all tagged cohorts were released is probably most likely to result in bias towards low fishway efficiency at Pejepscot, since some of these fish might not have moved as far upstream as the Pejepscot dam. Releasing study cohorts during the first half of the spawning run was intended to minimize this potential bias. However, it may be noteworthy that in both 1991 and 1992, the study cohorts showing the highest passage efficiencies at Pejepscot were those released last in the study period.

Similarly, there did not appear to be any obvious correlation between river flow and the low 1991 blue-tagged cohort fishway efficiency.

In 1992 there were no indications that either water temperature or river flow had an influence on Pejepscot fishway efficiency.

5.1.8 Study-Induced Alteration Of Alewife Migratory And/Or Spawning Behavior

In agency consultation, the possibility of alteration of alewife migratory and/or spawning behavior because of disruption of normal schooling was discussed. In 1991, the lowest fishway efficiency cohort was released at Brunswick just before a period when Brunswick alewife passage was low. The total number of untagged alewife (9,877) released into the Brunswick impoundment for the entire 1991 season was also low. While there was no clear correlation, it is possible that tagged cohorts may behave differently depending on the number of fish available to form migrating schools. Perhaps small schools, or even single or small groups of fish, do not migrate intensively and tend to remain and spawn in the Brunswick impoundment, or remain in the vicinity of the Brunswick dam with increased potential for dropback. Accordingly, cohorts of 1,786 and 813 untagged alewife were released with the 1992 orange and yellow-tagged cohorts, respectively.

5.1.9 Influence of Natal Area (Homing)

The natal production area of alewife used in the upstream passage studies could influence study results. If study fish are not "homing" to production areas upstream of the Pejepscot Dam, there could be a bias towards lower fishway efficiencies.

The Brunswick fishway has been monitored since its construction. There is documentation of alewife reproduction downstream of the Brunswick Dam: 601 alewife were counted in 1983 and 2,530 in 1984 (before there were any returns of adults resulting from the trap and trucking operation to upstream production waters), and 23,895 were counted in 1985 (when only 28.5 percent of the run could have originated from fish produced above Brunswick); these fish must have been from reproduction below Brunswick. Therefore, it appears that a significant number of alewife seen at Brunswick during the 1991 and 1992 studies could be of below-Brunswick origin and therefore without a homing instinct to migrate upstream past Pejepscot. Similarly, there could be reproduction in the Brunswick impoundment, and adults from this natal area may not be stongly motivated to pass the Pejepscot fishway. Therefore, it appears that homing should be considered a variable with the potential to cause bias towards lower efficiency determinations (with likely annual differences in potential numbers of fish homing to above the Brunswick and Pejepscot Dams).

5.2 Final 1991 and 1992 Pejepscot Fishway Efficiency Estimates

While the 100 percent fishway efficiency achieved for the yellow-tagged cohort in 1991 indicates that potential study biases may not be realized, considering the lower unadjusted fishway efficiencies for the other two cohorts and for untagged fish, and the potential influences on study results discussed above, it appears that all efficiencies less than 100 percent must be considered as minimal (except perhaps for untagged fish). The 1991 orange-tagged and yellow-tagged cohort unadjusted fishway efficiencies of 84 and 100 percent, respectively, are considered excellent, as is the 1992 yellow-tagged cohort efficiency of 90 percent. The 73 percent unadjusted efficiency of the 1992 orange-tagged cohort is also considered good. The 49 percent 1991 blue-tagged cohort efficiency is significantly lower and, with agency concurrence, is most appropriately considered as an unexplained outlier and discarded from study results. The untagged fish efficiencies are somewhat lower at 67 percent in 1991 and 73 percent in 1992, but are probably most vulnerable to miscounting; most importantly, the late-run untagged fish passing Brunswick after all study cohorts were released probably had the least drive to move any distance upstream. They were most likely to spawn in the Brunswick impoundment, and fish exhibiting this behavior would not be candidates for passage at Pejepscot.

The 1991 yellow-tagged cohort certainly documents rapid passage through the Pejepscot fishway. This cohort was released at Brunswick at 1 P.M. on May 26. The Pejepscot fish lift at 3 P.M. on May 26 did not include any of this cohort, but the next lift, at 9 A.M. on May 27, passed 132 yellow-tagged alewife, or 66 percent of the total study cohort.

Overall, delay in passage at Pejepscot did not appear to be significant, with approximately 90 percent or more of the study cohorts passing the Pejepscot fishway within 2 to 6 days of passage at Brunswick.

The only study goal not accomplished to date is determination of Pejepscot fishway efficiency under conditions of significant spillage.

Therefore, on the basis of these study results, DMR and USFWS have concluded that the efficiency of the Pejepscot upstream fishway is close to the agency goal of 90 percent and that the only necessary additional study remaining to be conducted is of efficiency under a spill condition. Therefore, as soon as river flow conditions permit, one study cohort of tagged alewife will be released at Brunswick under spill conditions and counting will be conducted at Pejepscot to monitor this cohort. The agencies are in concurrence that a 2 year extension of the FERC filing schedule for the upstream passage effectiveness studies is necessary to conduct the spill condition study.

6.0 AGENCY CONSULTATION

The Licensees conducted the first year of upstream passage efficiency studies in 1991. The preliminary results of this study were provided to the agencies on July 24, 1991 and a plan for study in 1992 was submitted to the agencies on January 10, 1992. A consultation meeting was held on January 22, 1992 to review and discuss both downstream and upstream passage studies ongoing at Pejepscot. All concerned agencies were invited to the meeting and DMR and USFWS attended. All agencies were provided with a copy of the report of the January 22, 1992 consultation meeting on January 27, 1992. DIFW, ASRSC and DEP did not provide comments on this report. Agency correspondence and the report of the January 22, 1992 consultation meeting were included in Progress Report No. 1 filed with the FERC in February, 1992.

An agency consultation meeting to discuss the 1992 study results and any necessary future study was held on February 8, 1993 (see Report of Meeting in Appendix 3). DMR and DIFW attended. DMR and USFWS also provided comments on the report and future study (see Appendix 3). DMR provided graphs of 1991 and 1992 Brunswick alewife passage, river temperature and river flow (see Appendix 3).

The agencies are satisfied that the efficiency of the Pejepscot upstream fishway approaches the agency standard of 90 percent. However, efficiency has not been determined for a spill condition. Therefore, the agencies recommend that one more tagged alewife cohort be released at Brunswick and monitored at Pejepscot under a spill condition. The Licensee will conduct this study as soon as possible. The agencies are in concurrence that a 2 year extension of the FERC filing schedule for the upstream passage effectiveness studies is necessary to conduct this spill condition study.

APPENDIX 1

FERC ORDER APPROVING
STUDY PLAN AND SCHEDULE

UNITED STATES OF AMERICA 55 FERC 62,092
FEDERAL ENERGY REGULATORY COMMISSION

Topsham Hydro Partners
Chrysler Capitol Corporation
Utilco Group, Inc.

Project No. 4784-030
Maine

ORDER APPROVING FISH PASSAGE STUDY PLAN
(Issued April 30, 1991)

On March 26, 1991, Topsham Hydro Partners, Chrysler Capitol Corporation, and Utilco Group, Inc. (licensees) filed a fish passage study plan for the Pejepscot Project as required by Commission order dated June 28, 1990. The order required the licensees to consult with federal and state fish resource agencies and develop a plan and schedule for evaluating the efficiency of the upstream and downstream fish passage facilities at the project. The order also required that the licensees develop a plan and schedule for effectuating changes in project structures or operations if the results of the studies indicate that such are needed to provide adequate fish passage.

The licensees' proposed upstream fish passage study would consist of tagging adult alewives at the downstream Brunswick fishway, releasing these fish into the Brunswick impoundment, and counting the fish that pass through the Pejepscot fishway. Fishway efficiency would be determined by comparing total Brunswick and Pejepscot fishway counts and from results of tagged fish counting. All Atlantic salmon, brown trout, other resident salmonids, and smallmouth bass would also be counted. The study would be conducted during May through June of 1991 and 1992. The progress report for the 1991 season and the 1992 study plan would be available in March 1992. In September 1992, a draft report of 1991-1992 studies would be given to the fishery agencies for review. The final report of the upstream fish passage efficiency study would be filed with the agencies and the Commission in March 1993.

The licensees' proposed downstream fish passage study would be more complex due to the small size and fragility of juvenile alewives, the difficulty of sampling in the project's two tailraces, and the need for development of a site specific plan. Thus, the downstream study plan would consist of three phases: (1) a feasibility study to assess site specific practicability of various study methods; (2) method effectiveness studies; and (3) finally, passage efficiency studies. Observations of bird activity in the vicinity of the tailrace would also be recorded. Study methods would be based on studies being conducted at hydropower projects on the Sebasticook River, which to date have investigated video camera monitoring of entrance weirs and floating net pens to capture fish at the fishway discharge. Phase 1 would be conducted during June through November 1991. In February 1992, the licensee would meet with the fishery agencies to review the feasibility of various study methods. Phase 2 effectiveness studies would take place during May through November 1992 and June through November 1993. The licensees would then meet with the fishery agencies to review a draft of the 1992 study results. A final progress report and 1993 study plan would be submitted to the agencies in February 1993. During 1994, similar meetings and report filing would occur after the phase 2 study is completed. Phase 3 efficiency studies would commence in May 1994 and continue through November 1994. A progress report and final 1995 study plan would be available to the fishery agencies in March 1995. The second year of the efficiency study would be conducted during June through November 1995. The final report on downstream passage study would be filed with the agencies in March 1996.

On February 28, 1991, the licensees, the U.S. Fish and Wildlife Service (FWS), and the Maine Department of Marine Resources (DMR) met to review the draft of the study plan. The Maine Atlantic Sea Run Salmon Commission (ASRSC) commented by letter dated February 22, 1991. DMR and FWS provided comments on the February 28th meeting in letters dated March 11, 1991. The licensees' consultant also extracted comments from the Maine Department of Inland Fisheries and Game and the ASRSC via telephone on March 14 and March 11, 1991, respectively. Review of the meeting minutes and agency correspondence on licensees' filing indicates general agreement with the study proposal.

The licensees' upstream fish passage study proposal is reasonable, includes agency requests, and should be approved with additions. The progress report for the first year of study should be filed with the Commission and, for Commission approval, any changes deemed necessary for the second study year. Further, as the agencies have indicated, sufficient numbers of American shad and Atlantic salmon native to the Androscoggin River are not available at this time to assess passage of these species at the project. Thus, the requirement to study fish passage efficiency must be flexible to permit continuation of the study if desired when American shad and Atlantic salmon are available in sufficient numbers. Also, the licensees' schedules do not indicate whether the final report would include plans and schedules for making changes in project structures or operations, if necessary to provide adequate upstream fish passage. The final report for the study should include such plans and schedules as appropriate.

The licensees' downstream fish passage study, on the other hand, is less definitive in delineating the study methods to be used. After each year of each phase of the study, the licensee proposes to meet with the fishery agencies to review the previous year's results and then proffer a plan for the ensuing year of the study. Annual progress reports and explicit plans for each ensuing year of the downstream fish passage study should be filed with the Commission for approval. For phase three of the study, the elected study plan filed for approval should include agency comments on the elected study method. Further, the additions noted above for the upstream passage study should also apply to the downstream passage study.

The Director orders:

(A) The fish passage study plan and schedule filed on March 26, 1991, is approved, except as modified by paragraphs B through C. The licensee shall complete the study and file final reports on the upstream and downstream tasks of the study and, for Commission approval, any recommendations for changes in project structures or operations if needed to provide adequate fish passage, by May 1, 1993 and May 1, 1996, respectively. Plans and schedules for any changes shall be developed after consultation with the U.S. Fish and Wildlife Service, the Maine Department of Marine Resources, the Maine Atlantic Sea Run Salmon Commission, and the Maine Department of Inland Fisheries and Game. If the study results indicate that further studies are needed for alewife, of when Atlantic salmon or American shad are present in sufficient numbers, the reports shall also contain plans and schedules for such, also developed after consultation with the aforementioned agencies. The Commission reserves the right to require changes to the plans and schedules to be provided above.

(B) At least 60 days prior to initiation of the second season of the upstream fish passage study or by March 1, 1992, the licensee shall file the first year's study results, and for Commission approval, any changes deemed necessary for the ensuing study year. The Commission reserves the right to require changes to the plans.

(C) Exclusive of the initial year of phase one of the downstream fish passage study, the licensee shall file an annual progress report of the preceding study year and, for Commission approval, the study plan for the ensuing year by: March 1, 1992; April 1, 1993; March 1, 1994; and April 1, 1995. The Commission reserves the right to require changes to the plans and schedules to be provided above.

(D) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. 385.713.

J. Mark Robinson
Director, Division of Project
Compliance and Administration

APPENDIX 2

TABLE 1:	SUMMARY OF 1992 WATER TEMPERATURE AND ALEWIFE PASSAGE DATA AT BRUNSWICK FISHWAY
TABLE 2:	SUMMARY OF 1992 ALEWIFE COUNTING AT BRUNSWICK AND PEJEPSCOT FISHWAYS
TABLE 3:	SUMMARY OF TIMING OF 1992 TAGGED ALEWIFE COUNTS AT PEJEPSCOT FISHWAY
TABLE 4:	USGS 1992 ANDROSCOGGIN RIVER DISCHARGE RECORDS
TABLE 5:	1992 PEJEPSCOT FISHWAY COUNTS OF SPECIES OTHER THAN ALEWIFE

TABLE 1
SUMMARY OF 1992 MAXIMUM DAILY WATER TEMPERATURE AND ALEWIFE PASSAGE DATA AT BRUNSWICK FISHWAY
(SOURCE: MAINE DEPARTMENT OF MARINE RESOURCES)

Date	Daily Maximum Water Temp (°C)	Alewife Passed	Percent of Total Run	Cumulative Total	Cumulative Percent
5/19	15.3	10	0.02	10	0.02
5/20	16.9	----	----	10	0.02
5/21	17.6	1556	3.45	1566	3.47
5/22	18.8	8886	19.72	10452	23.19
5/23	18.1	5189	11.52	15641	34.71
5/24	18.7	4967	11.03	20608	45.74
5/25	18.3	5026	11.16	25634	56.90
5/26	16.8	5404	12.00	31038	68.90
5/27	18.4	2127	4.72	33165	73.62
5/28	18.3	1567	3.48	34732	77.10
5/29	19.1	2330	5.17	37062	82.27
5/30	19.9	5117	11.36	42179	93.63
5/31	19.4	1186	2.63	43365	96.26
6/1	18.1	----	----	43365	96.26
6/2	18.1	567	1.26	43932	97.52
6/3	19.0	70	0.16	44002	97.68
6/4	20.9	----	----	44002	97.68
6/5	19.4	845	1.88	44847	99.56
6/6	17.1	----	----	44847	99.56
6/7	15.4	----	----	44847	99.56
6/8	18.7	51	0.11	44898	99.67
6/9	----	----	----	44898	99.67
6/10	19.8	----	----	44898	99.67
6/11	20.4	148	0.33	45046	100.00
6/12	20.9	--	----	45046	100.00
6/13	22.4	4	0.01	45050	100.01
6/14	21.7	----	----	45050	100.01
6/15	23.4	----	----	45050	100.01

TABLE 2
SUMMARY OF 1992 ALEWIFE COUNTING AT BRUNSWICK AND PEJEPSCOT FISHWAYS

BRUNSWICK FISHWAY							PEJEPSCOT FISHWAY					
DATE		DAILY	CUM[1]	NO[2]	CUM		UNTAGGED		ORANGE		YELLOW	
DAY	TIME	TOTAL	TOTAL	REL[3]	REL	TAGGED	NO	CUM	NO	CUM	NO	CUM
5/19		10	10	10	10		0	0				
5/20		0	10	10	10		0	0				
5/21		1556	1566	146	156		0	0				
5/22	1310	8886	10452	1786	1942		49	49				
	1600					200	ORANGE					
5/23	0900	5189	15641	1326	3268		110	159	22	22		
	1500						3	162	0	22		
5/24	0900	4967	20608	693	3961		740	902	68	90		
	1500						50	952	3	93		
5/25	0900	5026	25634	787	4748		10	962	0	93		
	1500						5	967	1	94		
5/26	0900	5404	31038	1549	6297		160	1127	4	98		
	1100						0	1127	0	98		
	1500						2	1129	0	98		
5/27	0900	2127	33165	0	6297		591	1720	25	123		
	1500						375	2095	5	128		
5/28	0900	1567	34732	0	6297		880	2975	9	137		
	1500						30	3005	0	137		
5/29	0900	2330	37062	813	7110		50	3055	0	137		
	1500						1	3056	0	137		
	1500					200	YELLOW					
5/30	0900	5117	42179	755	7865		430	3486	2	139	26	26
	1500						20	3506	0	139	2	28
5/31	0900	1186	43365	0	7865		370	3876	0	139	32	60
	1500						700	4576	0	139	74	134
6/1	0900	0	43365	0	7865		90	4666	2	141	8	142
	1500						130	4796	1	142	10	152

1/ CUM = Cumulative
2/ NO = Number
3/ REL = Released

TABLE 2 (Page 2)
SUMMARY OF 1992 ALEWIFE COUNTING AT BRUNSWICK AND PEJEPSCOT FISHWAYS

BRUNSWICK FISHWAY — PEJEPSCOT FISHWAY

DATE		DAILY	CUM[1/]	NO[2/]	CUM		UNTAGGED		ORANGE		YELLOW	
DAY	TIME	TOTAL	TOTAL	REL[3/]	REL	TAGGED	NO	CUM	NO	CUM	NO	CUM
6/2	0900	567	43932	0	7865		290	5086	0	142	12	164
	1500						0	5086	0	142	0	164
6/3	0900	70	44002	11	7876		160	5246	0	142	4	168
	1500						4	5250	0	142	0	168
6/4	0900	0	44002	0	7876		110	5360	2	144	8	176
	1500						2	5362	0	144	0	176
6/5	0900	845	44847	108	7984		90	5452	0	144	4	180
	1500						4	5456	0	144	0	180
6/6	0900	0	44847	0	7984		40	5496	0	144	0	180
	1500						1	5497	0	144	0	180
6/7	0900	0	44847	0	7984		0	5497	0	144	0	180
	1500						1	5498	0	144	0	180
6/8	0900	51	44898	0	7984		5	5503	0	144	0	180
	1500						10	5513	1	145	0	180
6/9	0900	0	44898	0	7984		42	5555	0	145	0	180
	1500						0	5555	0	145	0	180
6/10	1500	0	44898	0	7984		2	5557	0	145	0	180
6/11	1500	148	45046	0	7984		0	5557	0	145	0	180
6/12	1300	0	45046	0	7984		0	5557	0	145	0	180
6/13	1500	4	45050	4	7988		0	5557	0	145	0	180
6/14	1545	0	45050	0	7988		0	5557	0	145	0	180
6/15	1500	0	45050	0	7988		0	5557	0	145	0	180
6/16	1530	0	45050	0	7988		0	5557	0	145	0	180
6/17	1500						0	5557	0	145	0	180
6/18	1500						0	5557	0	145	0	180
6/19	1500						0	5557	0	145	0	180
6/21	1500						0	5557	0	145	0	180
6/22	1500						0	5557	0	145	0	180
6/23	1500						10	5567	0	145	0	180

1/ CUM = Cumulative 2/ NO = Number 3/ REL = Released

TABLE 3

SUMMARY OF TIMING OF 1991 TAGGED ALEWIFE COUNTS AT PEJEPSCOT FISHWAY

TAGGED COHORTS, RELEASE DATE	DAYS AFTER RELEASE OF STUDY COHORT AT BRUNSWICK FISHWAY													
AND COUNTS	1[a]	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
ORANGE (197)														
MAY 15														
DAILY TOTAL	57	60	14	7	3	6	1	0	8	2	4	1	2	165
CUMUL TOTAL	57	117	131	138	141	147	148	148	156	158	162	163	165	165
CUMUL %	35	71	79	84	85	89	90	90	95	96	98	99	100	
BLUE (200)														
MAY 20														
DAILY TOTAL	10	19	12	18	15	13	9	0	0	0	1	1	0	98
CUMUL TOTAL	10	29	41	59	74	87	96	96	96	96	97	98		98
CUMUL %	10	30	42	60	76	89	98	98	98	98	99	100		
YELLOW (199)														
MAY 26														
DAILY TOTAL	150	38	6	4	2	0	1	0	0	0	0	0	0	201
CUMUL TOTAL	150	188	194	198	200	200	201							201
CUMUL %	75	94	97	99	100									

a/ The first day after release means the next day after release

TABLE 4

1992 USGS PROVISIONAL ANDROSCOGGIN RIVER DISCHARGE RECORDS
FOR STATION NO. 01059000 NEAR AUBURN, MAINE
DAILY MEAN DISCHARGE IN CUBIC FEET PER SECOND

DAY	MAY	JUNE
1	12500	2840
2	12000	3140
3	12200	3860
4	12000	3860
5	11300	3910
6	10100	4150
7	9040	7420
8	8210	9350
9	7650	6450
10	7980	6250
11	8350	5900
12	7910	3870
13	8070	2300
14	6910	2150
15	5640	3670
16	5040	3240
17	5140	4250
18	5040	3190
19	4400	3000
20	4920	1730
21	5400	1710
22	5270	5500
23	3060	8250
24	2190	5920
25	2920	5020
26	4560	4580
27	3880	3620
28	5370	3240
29	3520	3980
30	1920	2670
31	1690	----
TOTAL	204180	129020
MEAN	6586	4301
MAXIMUM	12500	9350
MINIMUM	1690	1710

TABLE 5
1992 PEJEPSCOT FISHWAY COUNTS OF
SPECIES OTHER THAN ALEWIFE

DATE	ATLANTIC SALMON		SMALLMOUTH BASS		BROWN TROUT		LANDLOCKED SALMON		BROOK TROUT		OTHER FISH
	NO.	SIZE\a	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	
MAY											
20			4	7-12							Sucker
21											
22			43	---	1	8					Suckers
23			42	12-20	2	8					Suckers Fallfish
24			8	12-20	16	6-8					Suckers Fallfish
25			3	12-16	2	8					
26			1	20	2	9-10					
27			4	16-18	4	8-10					Suckers Fallfish Yellow Perch
28			11	16-20	10	8-10					Suckers Fallfish
29			1	12							
30					5	8-12					Suckers Fallfish
31									5	---	Suckers Fallfish
JUNE											
1					2	8	12	8-10			
2			1	18	6	----	18	8-10			

a/ Size is approximate length in inches

TABLE 5 - Page 2
1992 PEJEPSCOT FISHWAY COUNTS OF SPECIES OTHER THAN ALEWIFE

DATE	ATLANTIC SALMON		SMALLMOUTH BASS		BROWN TROUT		LANDLOCKED SALMON		BROOK TROUT		OTHER FISH
	NO.	SIZE\a	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	
JUNE											
3					2	8	13	8+	1	8	
4			1	20			30	8-10			
5					4	8	49	8-10			
6					3	8	52	8			
7	1	25	1	8							Eel (18")
8			3	10-12	5	10	13	8-10			Suckers Fallfish
9					2	8	13	8+			
10					3	12	12	10			Hornpout Sunfish
11			2	16	6	8-10	15	10			
12			4	8-16	3	10-12	25	10			
13							16	10-12			Sunfish
14			1	12	15	8-12	45	10-12			
15			1	8	3	8	19	8-10			
16			2	8-12	3	10	75	8-10			
17	1	24			3	10	50	8-10			
18			1	12	4	10	18	8-10			Hornpout Sunfish
19					4	10	9	8-10			
20											

a/ Size is approximate length in inches

TABLE 5 - Page 3
1992 PEJEPSCOT FISHWAY COUNTS OF SPECIES OTHER THAN ALEWIFE

DATE	ATLANTIC SALMON		SMALLMOUTH BASS		BROWN TROUT		LANDLOCKED SALMON		BROOK TROUT		OTHER FISH
	NO.	SIZE\a	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	
JUNE											
21					4	10-12	8	8-10			
22					1	10	26	8-10			
23			2	12-14	2	8	4	8			
24							14	8-10			
25			3	12-16			3	10			
26							2	8			
27							6	10			
28			1	16			3	10			
29			1	12							
30							1	8			
JULY											
1											
2			1	8			3 1	8 18			
3											
4											
5											

a/ Size is approximate length in inches

TABLE 5 - Page 4
1992 PEJEPSCOT FISHWAY COUNTS OF SPECIES OTHER THAN ALEWIFE

DATE	ATLANTIC SALMON		SMALLMOUTH BASS		BROWN TROUT		LANDLOCKED SALMON		BROOK TROUT		OTHER FISH
	NO.	SIZE\a	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	
JULY											
6	1	30									
7											
8											
9											
10											
11											
12											
13							5	10-12			
14											
15			4	12-20							
16											
17											
18											
19											
20					1	9					
21											
22											Sunfish
24											

a/ Size is approximate length in inches

APPENDIX 3

AGENCY CONSULTATION

REPORT OF FEBRUARY 8, 1993
AGENCY CONSULTATION MEETING

DMR GRAPHS OF 1991 AND 1992
BRUNSWICK ALEWIFE PASSAGE,
RIVER TEMPERATURE AND RIVER FLOW

DMR AND USFWS COMMENTS ON
1992 REPORT AND 1993 STUDIES

PEJEPSCOT PROJECT (FERC NO. 4784)
REPORT OF AGENCY CONSULTATION MEETING OF FEBRUARY 8, 1993

LOCATION:	Department Of Marine Resources, Augusta, Maine
PURPOSE:	To review 1992 upstream passage study results, results of 1992 effectiveness study of downstream passage facilities and to develop 1993 upstream and downstream passage study plans (draft reports of 1992 study results had been provided to the agencies prior to this meeting).
ATTENDEES:	Lew Flagg - Dept. Of Marine Resources (DMR) Tom Squiers - DMR Mal Smith - DMR Ron Aho - DMR Steve Timpano - Dept. Inland Fisheries & Wildlife (DIFW) Sonny Pierce - DIFW Olaf Erickson - Independent Hydro Developers (IHD) Jon Truebe - Lakeside Engineering (LE) Charles Ritzi - Charles Ritzi Associates (CRA)

The Atlantic Sea Run Salmon Commission (ASRSC), Department of Environmental Protection (DEP) and the U.S. Fish and Wildlife Service (USFWS) were notified of the meeting but did not attend.

Review Of 1992 Upstream Passage Study Results:

The draft 1992 report of evaluation of the upstream passage facility was reviewed and discussed. DMR distributed graphs of 1991 and 1992 Brunswick alewife passage, river temperature and river flow. The two tagged cohorts of alewife released at Brunswick in 1992 passed the Pejepscot fishway with efficiencies of 73 and 90 percent, and untagged alewife passed with an efficiency of 73 percent. These results are similar to those for the 1991 study, when two tagged cohorts had efficiencies of 84 and 100 percent, and the untagged fish had an efficiency of 67 percent. The combined efficiency for the four tagged cohorts is 87 percent.

For both 1991 and 1992, passage at Pejepscot was rapid after release at Brunswick. As high as 66 percent of one cohort has passed Pejepscot within 1 day, and for all cohorts approximately 90 percent or more passed Pejepscot within 2 to 6 days of release at Brunswick.

In 1992 there were no apparent relationships between river temperature or flow and passage at Pejepscot.

As in 1991, resident species observed at Pejepscot included a considerable number of brown trout and smallmouth bass. However, the predominant species was juvenile landlocked Atlantic salmon; these fishway were from the first experimental stockings made above Pejepscot and below Brunswick in the spring of 1992.

DMR stated that the Pejepscot upstream facility passage efficiencies had been relatively consistent for both study years, and the consensus was that any study biases were likely to have underestimated efficiency. Therefore, it was concluded that the Pejepscot upstream facility has been documented as satisfying DMR requirements for passage efficiency.

However, since there was no significant spillage during 1991 and 1992, passage during spill conditions has not been documented. It was agreed that IHD will attempt to release one tagged cohort coincidental with a spill condition in 1993, or as soon as a spill condition is available. Except for study of this cohort, no further monitoring of upstream passage efficiency is indicated.

DMR will coordinate with USFWS regarding unanimous agency concurrence with study results and the future study plan. The agencies will also provide comment letters as appropriate.

<u>Review Of 1992 Downstream Passage Facility Effectiveness Study Results</u>

The draft 1992 Progress Report No 2 for evaluation of the Pejepscot downstream passage facility was reviewed and discussed. In 1992 (the first year of a 2 year effectiveness study period during which study equipment and methods are to be developed for 1994 and 1995 efficiency studies) a monitoring platform was constructed over tailrace B and the south downstream fishway pipe was rigged with a riser box, inclined screen dewatering system and a fish holding tank. The agencies inspected this system in operation and approve of the basic concepts of this equipment.

Plans for 1993 include installing a similar system on the north fishway pipe, developing final sorting and counting systems for the holding tanks, developing an immersion staining system and developing a method of moving stained fish from the platform to a live car mooring area in the impoundment. Use of a small tractor to transport marked fish was discussed and it was agreed that this method should be investigated. Another major goal for 1993 is to conduct at least one "debugging" run in final preparation for 1994 efficiency studies.

There was general agreement that 500 to 1,000 marked juvenile alewife cohorts would be used for the efficiency studies and that small control groups would be held for each released cohort. Study fish should be released far enough upstream of the dam to ensure a "normal" approach to the hydraulic influences of plant operation and the fishway; no specific release point was selected but a location upstream of the trash boom is indicated. The efficiency studies should be conducted during no-spill periods, and the upstream fishway should be blocked, to restrict available passage routes to either the powerhouse intake or the downstream fishway. It was also noted that, if Pejepscot Project and the upstream Worumbo Project efficiency studies are conducted concurrently, there may be the possibility of marked fish released at Worumbo also being observed at Pejepscot; however this is not a potential concern until 1994, when the Pejepscot efficiency studies are scheduled to begin.

DMR requested that it be kept informed of the availability of juvenile clupeids captured in the holding tanks so that these fish can be monitored for the presence of juvenile shad.

A final decision regarding the use of a TV camera for monitoring fishway passage is presently deferred. This equipment is not considered specifically necessary for the conduct of the efficiency studies.

Systematic observations of bird feeding activity downstream of the Pejepscot Dam will be continued. Observations to date indicate a low level of feeding activity compared to some other hydro facilities.

DMR expressed general agreement and satisfaction with the direction and progress of the downstream facility effectiveness studies.

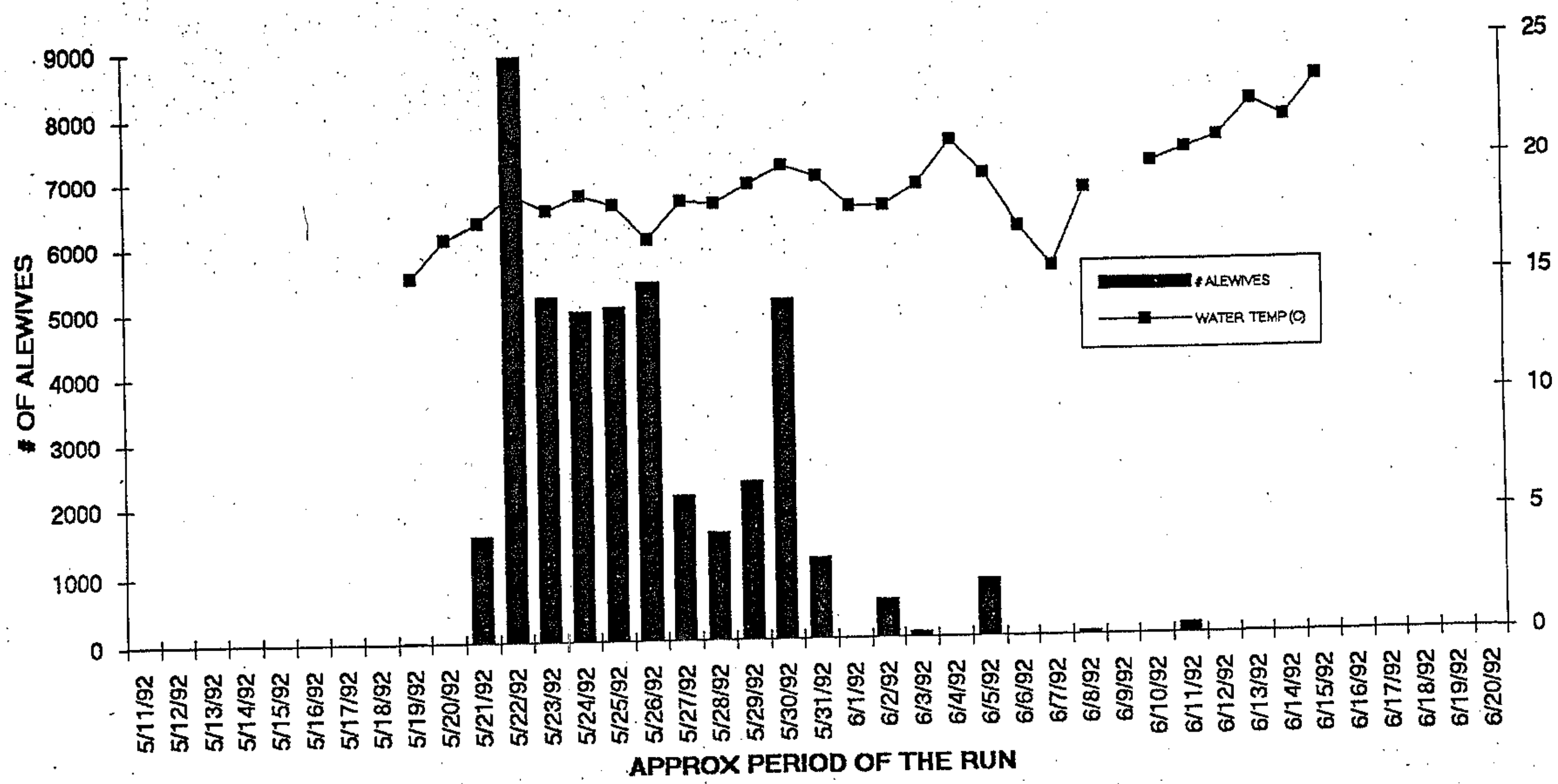
If there should be any corrections or revisions to this report please contact Charles Ritzi by February 26, 1993.

Prepared by Charles Ritzi on February 10, 1993

cc: All attendees, plus:
Baum - ASRSC
Murch - DEP
Russell - USFWS

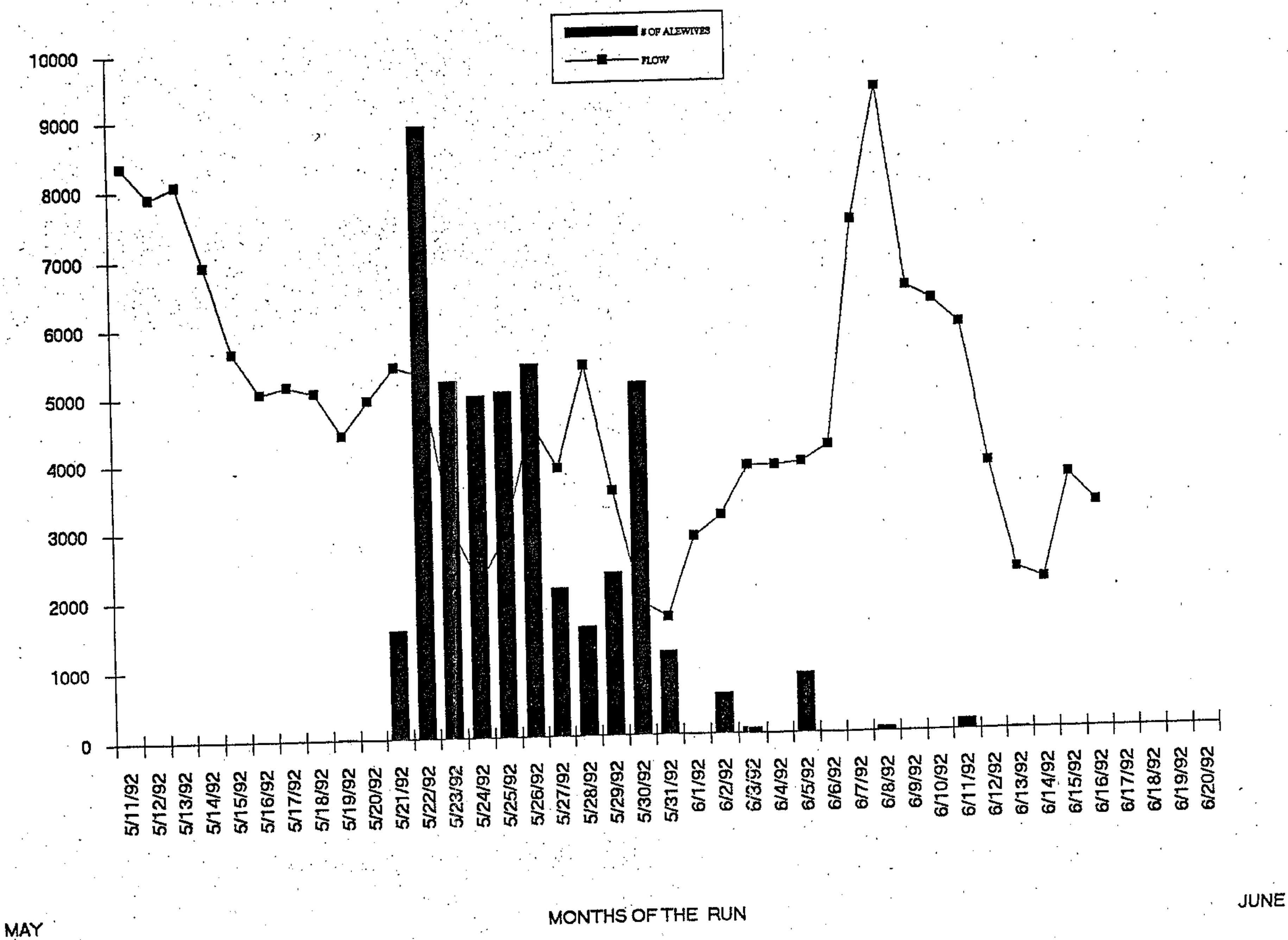
GRAPH I

BRUNSWICK 1992 - # OF ALEWIVES PASSED AND WATER TEMP (C)



GRAPH II

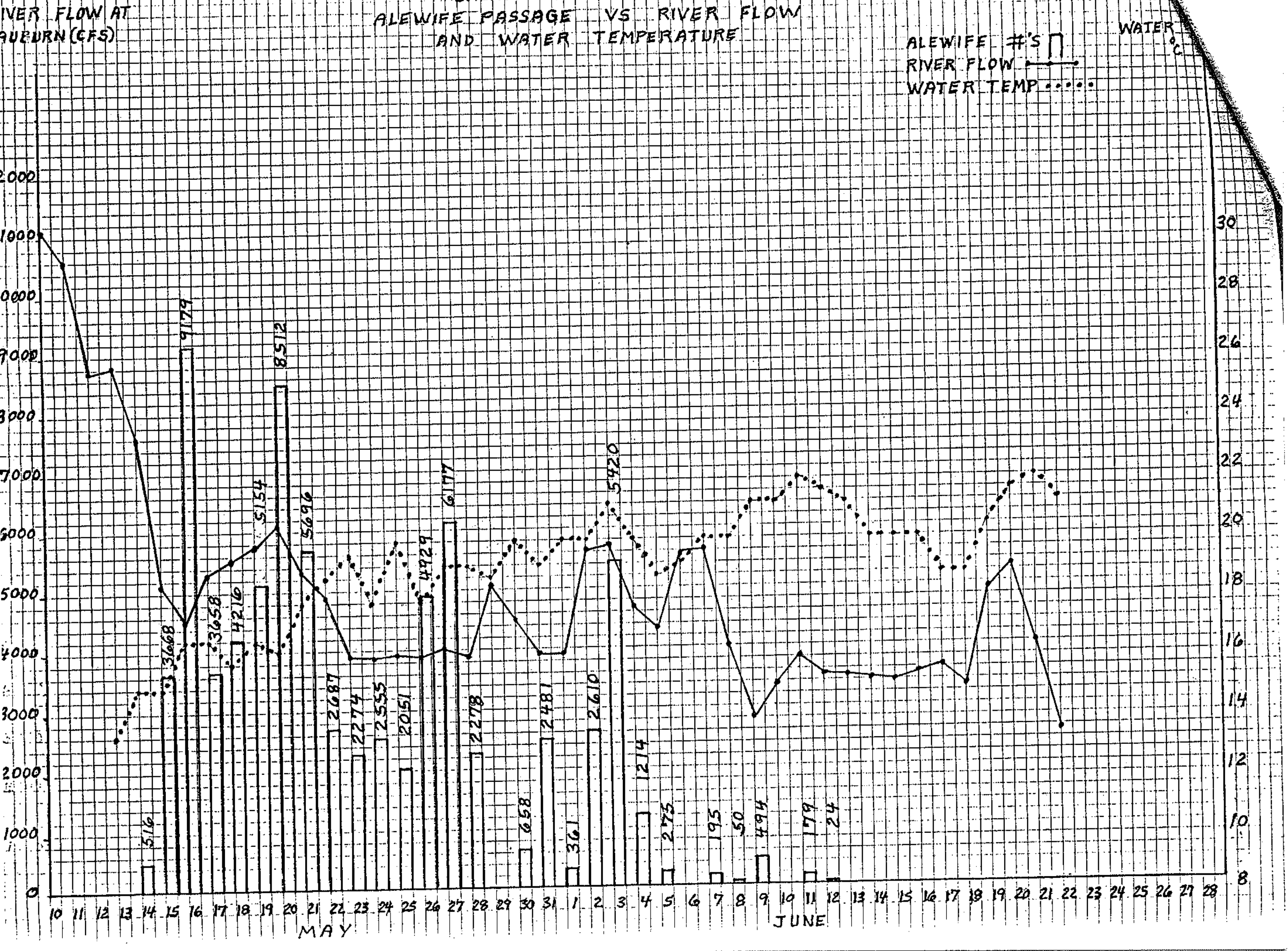
BRUNSWICK FISHWAY- 1992 ALEWIFE PASSAGE AND RIVER FLOW (CFS)



GRAPH 1

BRUNSWICK FISHWAY - 1991

ALEWIFE PASSAGE VS RIVER FLOW AND WATER TEMPERATURE



John R. McKernan, Jr.
Governor

William J. Brennan
Commissioner

DEPARTMENT OF MARINE RESOURCES

Telephone (207) 624-6550
[redacted]

February 9, 1993

CHARLES RITZI ASSOCIATES
RR#1 Box 360
Readfield, ME 04355

Re: Pejepscot Hydro, FERC #4784-ME
Upstream & Downstream Passage Studies

Dear Mr. Ritzi:

We have reviewed the 1992 study results of upstream fish passage and the progress report for evaluation of downstream fish passage at the Pejepscot Project and offer the following comments:

<u>1992 Upstream Passage Studies</u>: **Page 5, third paragraph, second sentence** should be corrected to read: "A background board with a <u>4</u>-inch [instead of <u>6</u>-inch] grid pattern." **Page 6, first paragraph, second sentence** should read: "A totol of 45,050 alewives were counted by DMR and <u>7,988</u> of these...." **Page 7, second paragaph, first sentence**, the number should be <u>7,588</u> instead of 7,988 and the percentage at the end of the sentence is <u>73.3%</u>, instead of 70%.

Study results indicate that passage efficiency for the two cohorts in 1992 were similar to study results in 1991, excluding the 1992 blue-tagged cohort group. Overall passage efficiency at Pejepscot, based on tagged fish, is about 87% which is close to our goal of 90% upstream passage efficiency. Unfortunately, river flows were not high enough in 1991 or 1992 to test passage efficiency with spillage conditions at Pejepscot. We recommend that one cohort be tagged in 1993, or as soon as flow conditions allow, to evaluate fish passage at Pejepscot under spill conditions.

<u>Downstream Fish Passage Report</u>: We have reviewed the progress report on downstream passage evlauation and feel that the Licensee is making good progress on this activity. We concur with the planned activities and look forward to working with the Licensee in carrying out this phase of the evaluation.

It should be noted on **Page 5, last paragraph**, that the years 1992 and 1991 should be substituted for 1993 and 1992, respectively.

Considering the need to study passage under a spill condition, we would support a two-year extension of the FERC filing schedule for the upstream passage effectiveness studies.

Thank you for the opportunity to review these reports.

Sincerely,

Lewis N. Flagg

LEWIS N. FLAGG, DIRECTOR
ANADROMOUS FISH DIVISION

LNF/jcw
cc Gordon Russell, USFWS
Ed Baum, ASRSC
Tom Bigford, NMFS
Steve Timpano, IFW
Dana Murch, DEP

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Offices
400 Ralph Pill Marketplace
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4901

REF: FERC #4784 February 26, 1993

Charles Ritzi
Charles Ritzi Associates
RR 1 Box 360
Readfield, ME 04355

Dear Mr. Ritzi:

We have reviewed the results of your monitoring of upstream and downstream passage of anadromous fish at the Pejepscot Hydroelectric Project, located on the Androscoggin River. We regret not being able to attend the meeting on February 8, 1993, in which the studies were discussed with the other fishery agencies.

Upstream Passage

Overall efficiency of the upstream passage facility at Pejepscot during the last two years appears to be close to the agency goal of 90 percent. However, it will be necessary to continue the upstream passage studies in order to monitor their performance during spill conditions, something that has not occurred so far during the study period. Therefore, we concur with your recommendation for a two-year extension of the completion date so that monitoring can take place during spillage at the dam.

Downstream Passage

You appear to be making good progress toward initiation of the downstream passage studies at Pejepscot. We recognize that this has involved construction of collection and holding facilities at the site, as well as developing marking techniques that will be effective for juvenile clupeids. We request that you keep us informed of your activities this year, including an opportunity to observe your debugging runs.

Thank you for the opportunity to review the results of the fish passage studies at the Pejepscot Project. If you have any questions, please contact Gordon Russell at 207-827-5938.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor
New England Field Offices

Topsham - Androscoggin River Diadromous Species Passage and Atlantic Salmon Informal Section 7 Consultation Meeting 3

Review of existing Downstream Passage Performance/discussion of potential Proposed Measures

Meeting Date/Time/Location: May 12, 2020; 3:00 pm; Via Conference Call

Meeting Attendees:

A.) National Marine Fisheries Service: Matt Buhyoff, Don Dow, Dan Tierney
B.) US Fish and Wildlife Service: Ken Hogan, Anna Harris, Bryan Sojkowski
C.) Maine Department of Marine Resources: Gail Wippelhauser, Casey Clark
D.) Maine Department of Environmental Protection: Chris Sferra, Kathy Howatt
E.) Brookfield Renewable: Randy Dorman, Kelly Maloney, Matt LeBlanc
F.) Environmental Consultants: Gomez and Sullivan, Kirk Smith and Tim Sullivan, and Normandeau, Drew Trested

Discussion Schedule Strategy: To hold topic specific monthly meetings (n=6).

1) Discussed development of proposed action for the Final License Application
2) Discussed studies conducted to date for downstream passage:
   a. Downstream Adult Alewife and Shad – 2019 spring upstream adult shad and adult river herring study (passage route)
      i. Adult Alewife Study - Alewife taken from Brunswick; 99 river herring tagged; released into the Pejepscot impoundment; plus 16 fish that had passed the Pejepscot fish lift and passed back downstream (115 total adult herring). 80% passed downstream within 24 hrs of arrival; 86 within 48 hours of arrival. Approximately half went through Unit 1; a third on spill and 11% used bypass. Majority of passage happened from time of release (May 23) to June 4 in the late afternoon/early evening hours. Project survival for total passage at dam estimated at a minimum of 81%. Of those, specific passage routes had 100% using downstream bypass (10 of 10 fish), 85% on spill (22 of 26 fish) and 88% passing through Unit 1 (42 of 48 fish). Had 8% that showed up that didn't pass, were detected at 200 m marker but didn't pass or moved upstream and failed to return, similar to other Projects tested such as those on the Penobscot.
      ii. Shad Study – 42 tagged and released taken from Cataract; somewhat late in the season; released into the impoundment and moved downstream in July; median residence time of about 5 days; about 1/3 didn't pass at all moved back upstream and didn't re-approach; 25% on spill; 10% use downstream bypass; about 1/3 through Unit 1. Project survival is about 51% but driven heavily by those that just didn't pass. By passage route 33% through downstream bypass (1 of 3 fish); 89% on spill (8 of 9 fish); and 82% using Unit 1 (9 of 11 fish).
   b. Juvenile Alosine Study - Juveniles taken from Sabattus; 98 river herring tagged; 97% released into the Pejepscot impoundment approached the 200 m; residence time was

short – median time = 0.5 hours; longest was 18 hours. 1/3 used the bypass entrances (split roughly equally between the 2), remainder used Unit 1. No spill conditions at Project during period of time tagged fish were resident. Did not estimate survival using the tagged fish due to uncertainty with retaining the externally attached tags during passage events. Instead survival was estimated as part of a desktop assessment of impingement and entrainment and turbine survival using the USFWS TBSA model. Mid to high 90% for survival of 2, 4, and 6 inch fish estimated through Unit 1.

c. Downstream Silver Eel Passage – 50 obtained from commercial harvester on St. Croix River; all moved downstream and approached the Project. Median residence time of 2 hours. 65% passed within 24 hours of arrival. All but 1 eel used Unit 1; no spill to little spill during eel passage study. All passed between the 3 and 23 of October, during late evening and early night-time hours. Total project survival estimated at 90%; 92% survival through Unit 1.

d. Smolt Downstream Passage – 2013 – 2015, 2018 smolt studies. 2013-2015 studies conducted under ISPP – HDR performed the 2013 and 2014 assessments, Normandeau performed 2015. The 2015 study estimated downstream passage survival at 86%, median residence time was 0.3 hrs. Majority of passage (70%) was through Unit 1 and 17% through downstream bypass. Additional study year in 2018, Project was operated with night-time spill flow in May to pass 500 cfs. Median residence time was similar 0.5 hrs. 41% on spill, 30% on Unit 1 and 15% using downstream bypass. Adjusted 2018 project survival, corrected for unimpounded reach mortality = 95.3%.

3) Discussed study results

a. Gail asked how survival was estimated for eel. Drew clarified that it was based on downstream detections at Brunswick.

b. Gail compared the passage time to estimated swimming speed, it would take about 2 hours to get to Station F8 and an additional 1.3 hours to get to Station F9. The eel who took longer to these stations may have been injured. Drew did indicate that there was no drift component to the study. Gail could not estimate from the data tables how many eels achieved this; Drew indicated that he could investigate this.

c. Gail asked about downstream shad study and her calculations are that only 16 went through passage routes. Drew clarified that there were 3 through downstream bypass, 9 spill, 11 via Unit 1.

4) Possible improvements to downstream fish passage that agencies might suggest

a. Donnie has always been concerned about the old powerhouse but the units are not prioritized and they are not good for fish. Seems as though large adult fish have a hard time with the downstream bypass.

b. Matt B indicated that there is a lot of entrainment through turbines, which tends to be bad for larger fish. Measures to prevent entrainment would be good. Not a lot of information regarding entrainment through the old units. The old units are brought online about 1/3 of the time. Matt L clarified that the draw to the old powerhouse is significantly less powerful than Unit 1.

c. Donnie clarified that there is no downstream passage at the old powerhouse. Fish have to move past the old powerhouse to get to the downstream fish passage.
d. Drew clarified that during the smolt studies, the old powerhouse was on and a very small proportion of the fish went through the old powerhouse. The velocities are about 1/5 of what Unit 1 is.
e. Donnie asked for clarification of survival of adult alewives; Drew said that the survival through the old powerhouse 2 – 36%
f. Kelly clarified that the outcome of passage through the old powerhouse is poor but the risk of entrainment is low since there is low velocities in front of the racks. Drew clarified 0.6 fps is the velocity in front the old powerhouse rack (three units 350 cfs max for each Francis unit). Unit 1 velocities are 3.25 fps (7,550 cfs).
g. Gail reviewed the flow duration curve – in May, Unit 1 is exceeded 55% of the time and in June, Unit 1 is exceeded 20% of the time
h. Matt B May 36%, June 21%, September 43% October 44% - average time operation of Francis units between 2015 and 2019.
i. Donnie suggested new rack structure, closer rack spacing, fishboom, etc. could be implemented. Kelly stated that fish boom configuration
j. Gail asked about rack spacing – Unit 1 (1.5 spacing at top and 2.5 spacing at the bottom below El. 55); Old Powerhouse (1.5 bar spacing). Dan T. asked if we could clarify whether its clear spacing or bar spacing.
k. Bryan is concerned about the velocities in front of Unit 1 and tighter rack spacing would not address that. Donnie indicated that through velocity would increase if rack spacing was tighter. Bryan indicated increasing the cross-sectional area of the rack would bring the velocities down.
l. Donnie indicated about adult shad using the existing downstream passage facility. Drew clarified that alewives using the bypass were 100% survival. Only 1 out of 3 shad survived the downstream bypass; could be hitting the viewing box. Could be the pipe itself. Bryan indicated that the sample size is so low, it’s hard to determine what the issue might be. Donnie and Bryan suggested upgrading the pipe.
m. Bryan asked about the survival over the spillway and asked about where fish passed on the spillway. Matt L indicated that the gates run in sequence from the powerhouse to the left. First gate section would be most favorable to survival; there was high flow during the study so possibly all gates were open.
n. Kelly asked whether study would show which gate was issue if all gates were open. Drew said no but if only one gate where open that would be telling. Drew will research gate operations.
o. Casey indicated that the original powerhouse rack extends 2.2 ft above the pond but the new powerhouse is 6 ft below normal pond (seems to imply that the entrance top elevations are likely different). Not positioned the same and could be affecting the choice of route of passage.

p. Drew indicated that the bypass are likely surface structures to capitalize on the surface flows above the 6 ft top elevation of the Unit 1 intake. Matt L and Drew indicated that the surface entrance is about 2 ft deep.
q. Ken indicated that USFWS would like to see a modification that addresses approach velocities and guidance (eel, alosine and salmonids) to a downstream bypass improved to provide higher survival.
r. Donnie indicated that approach velocities can also be addressed by turning down units. Get rid of skimmer wall and make the whole thing a rack structure but the skimmer wall probably prevents vortices. Worthington boom isn't necessarily off the table but eel need to be addressed.
s. Donnie suggested that an Alden weir could be installed at the new/improved bypass. Uniform acceleration is preferred at the entrance to the downstream fishway. Donnie indicated that keeping fish out of units of old powerhouse is important.
t. Donnie indicated that adult alewives passing on spill was pretty high (15%).
u. Bryan indicated that spill had us go from 70% entrainment to 30% so the goal would be to reduce the approach velocity, minimize rack spacing, angled in a way that would guide fish to a downstream bypass that would pass more flow (minimum of 5% of station capacity).
v. Drew indicated that route specific mortality rates need to be considered in terms of sample size. Alewife was 15% and shad was 11% but that equated to 4 fish and 1 fish.
w. Dan indicated that a lot of information is from high flow years. The project may not always been spilling. 2015 survival for smolt was 86%; only study that has been conducted in a low flow year. In 2018, was a high flow year and we were spilling anyway.

5) Discussed next steps:
    a. Kelly would like to have an additional meeting to regroup on upstream and downstream issues and improvements
    b. Matt will provide a list of information needs for upstream passage ahead of next meeting; Kelly will follow up on items for downstream passage identified during the meeting
6) Schedule/Deadlines
    a. Meetings (n=5; March – August)
    b. Draft of the Licensee Proposed Action (mid-July, 2020)
    c. Comments (mid-August, 2020)
        i. Optional meeting to discuss (early August, 2020)?
    d. Final Licensee Proposed Action (August 31, 2020)
7) Anticipated next meetings:
    a. Meeting 4: Upstream and Downstream Issues and Improvements Recap (May 27 @ 10 am)
    b. Meeting 5: Performance Standards and Timing Goals; Final Proposed Actions (June)
    c. Draft Licensee Proposed Action/BA (for ESA species) to Agencies for review – mid-July, 2020

d. Meeting 6, if necessary or requested: Discussion of draft Licensee Proposed Action/BA – early August, 2020
e. File Final Licensee Proposed Action/BA with Topsham FLA – August 31, 2020

Topsham - Androscoggin River Diadromous Species Passage and Atlantic Salmon Informal Section 7 Consultation Meeting 4

Review of Agency Information Request Responses

Meeting Date/Time/Location: July 2, 2020; 10:00 pm; Via Teams Meeting

Meeting Attendees:

A.) National Marine Fisheries Service: Matt Buhyoff, Don Dow
B.) US Fish and Wildlife Service: Ken Hogan, Bryan Sojkowski, Antonio Bentivoligio
C.) Maine Department of Marine Resources: Gail Wippelhauser
D.) Maine Department of Environmental Protection: Chris Sferra
E.) Brookfield Renewable: Randy Dorman, Kelly Maloney, Matt LeBlanc
F.) Environmental Consultants: Gomez and Sullivan, Kirk Smith and Tim Sullivan, and Normandeau, Drew Trested

Discussion Summary – Information Requests:

1) Comparison of eel downstream passage time
    a. Drew reviewed the analysis; assumed constant rate swim speed; examine transit time of eels between all detection stations; eels in green shade indicate that the swim speeds are greater than constant straight-line speed; while a lot are in excess, there's no clear indication that the eels that passed past the project took longer.
    b. Gail asked about diurnal vs nocturnal movements; Drew indicated that there was no daylight correction; Gail will follow up with questions if she has any.
2) Unit operations
    a. Kirk discussed that in the entrainment report, there was discussion of the old powerhouse operations and the report did not factor the major outage of Unit 1. This is atypical and the run times of the old powerhouse needed to be recalculated to not be skewed by the Unit 1 outage.
    b. Handout provides revised Table 4-1 and 4-2 for the entrainment report; revisions are a better reflection of actual conditions.
3) Approach velocities and trashracks
    a. Kelly reviewed the table and clarified clear spacing and actual discharge/intake velocity
    b. Gail asked whether the intake velocities were the same regardless of the clear spacing; Bryan clarified that the through velocity would be higher but the intake velocity is the same regardless of the clear spacing; Don clarified that the velocity is a calculated average and Bryan clarified that there may be hot spots.
4) Gate Operations during downstream adult river herring study
    a. Drew responded to the fate of the 4 fish that experienced mortality and a correlation to spill; Drew knew the time of passage of these fish and noted that Gate 1 was open during 2 of the 4 mortality events; the other 2 events, there were no gates open but

there was spill over the gate crests, we do not have information regarding where they passed.

b. Chris asked about "release" column; Drew clarified that all the alewife were released from the same location and the release corresponds to the date of the release (and direction – upstream study vs downstream study).

5) Upstream fish passage operations

a. Matt reviewed the operations protocol and discussed the conditions under which the lifts are conducted; Matt indicated that the station operator did adhere to the O&M Plan; Matt indicated that the daily lift schedule per the O&M plan called for less than 400 fish per day, 2 lifts; 400 to 800 fish per day, 4 lifts; over 1,200 fish per day, 2 lifts per hour or more as needed. During the 2019 fish passage season, during the peak of the run the lift schedule did not exceed one lift per hour as required within the O&M plan. Early tagging efforts were conducted during the beginning of the fish run during high water and thus smaller numbers of fish captured each day required fewer lifts per day.

b. Bryan indicated that validation of analysis that when all 4 pumps were on, you can get the entrance gate set correctly; but the photo taken during their site visit did not indicate that the lift entrance hydraulics.

c. Matt indicated that there are not specific numbers in the presentation for the entrance gate setting; the station runs consistently throughout the day; so at a max capacity condition, all 4 pumps would be on and the gate would be set pursuant to the O&M Plan; changes are made daily; at 7,300 cfs then, all four pumps would be on and the entrance gate would be at 4 ft

d. Matt reviewed the slide; emphasized that even at high flows, nice flow along the wall

e. Bryan asked about the presence of shad during the study; Drew clarified that Matt's presentation was for 2020 dates; Bryan indicated that it is critical to understand the flow and operations data on the dates of the shad study

f. Bryan indicated that getting the gate down to a minimum of 3 ft and the more depth the better; when analyzing the 2019 study, can't check the box regarding the gate being where it should be.

g. Matt indicated that we could use the river flows to correlate to gate depth.

h. Don indicated that the gate depth is important but so is the headloss across the gate; if you have a large headloss you will probably deter shad passage.

i. Matt asked about 5 fps entrance velocity and would this not going along with a drop; is it more important to have the drop over 10 ft or 3 ft; Don indicated it's more important to have it over a longer distance for shad; function of the velocity but also the elevation inside the entrance and the tailrace; velocity is directly related to headloss which is directly related to elevations.

j. Kelly reviewed the facility data needs and indicated that the head loss is still being determined.

k. Ken asked about daily gate elevation adjustments and whether they have been documented; Matt indicated that they have not been done in the past but they are in

2020; Matt clarified that because the O&M Plan is followed, the gate setting could be determined.

l. Ken indicated that USFWS is curious about how the fishway was operated last year because trying to understand the results of the study; if there was a failure of operations, that's one thing. But if the O&M Plan was followed and fish still did not pass, that's another thing.
m. Bryan asked that when we are gathering info on assumed gate elevation; we should specifically also get May 19, 2019 because that's the day Don and Bryan were on site and observed entrance issues; Matt clarified that debris was a concern that day; Bryan indicated that the lip of the gate seemed high that day.

6) 2004/2005 Study
   a. Drew reviewed the late May/early June study; spaghetti tagged 200 fish from Brunswick released upstream with another 270 untagged fish and watched the window; low passage numbers overall at Brunswick so questions regarding fish behavior, whether enough untagged fish were included; question was raised about spill flow and conditions in the riverine reach between Pejepscot and Brunswick; drought years in 01-02 so expected low returns; delayed the study until consistent runs over 100k at Brunswick.
   b. Bryan indicated note regarding Ben Rizzo suggested plates be installed to address attraction water issue; flow was going in the wrong direction; Bryan asked whether those plates are currently installed or was anything done.
   c. Matt indicated we will have to explore that; Matt doesn't quite understand what the plates are or what they are for but will look into that.
   d. Bryan noted that the passage efficiency is similar to 2019 and Ben noted attraction flow issues so maybe there is a correlation.
   e. Group discussed and reviewed the 2004, 2005 and 2006 annual reports to determine that "a new stainless steel pump" and modification of the "V trap entrance" was done in 2005.
7) Downstream Passage Studies 1991 – 1996
   a. Drew reviewed that there was a lot of variation in methodology; ended up with a marking study; marked 8 study groups in the 1996 study; tagged approximately 3,400 fish; 21% effectiveness for the downstream bypass; also presented some scaled estimates of the efficiency numbers (would hold live fish in river and adjust account for handling/tagging loss); raw rate is probably more representative; DTA played around with lighting and sound deterrence, was nothing overly conclusive which is consistent with other locations.
8) Passage Facility Sound Study
   a. Randy clarified that we will be conducting the sound study.
   b. Kelly indicated that the sound study will not be completed ahead of the FLA.
   c. Drew clarified that it would be done this year but report will not be done by August 31, which is when the FLA will be filed.
9) CFD Modelling

a. Working on getting the authorization.

10) Upstream Eel Survey
    a. Matt coordinated with Gail on a logical location for the eelway; seasonal studies were extremely difficult to do a decent job, need LOTO and very huge complicated effort; if you have done enough eel studies, you can likely predict where the eel will pass; will install in a location that will not get blown out and looks like the best suitable and monitor.
    b. Gail indicated that she concurred with the approach; Ken indicated concurrence as well.
    c. Ken asked about whether we would include USFWS and whether this would be done post-licensing; Kelly clarified yes to both.

11) Radio – telemetry study
    a. Kelly indicated that any follow up study would occur once improvements are made to the fishway; would serve as an effectiveness study.
    b. Matt indicated that given the data the agencies have, hard to determine what upstream improvements might be; Matt would like another study done to inform what improvements need to be made.
    c. Matt indicated that correlation of operating conditions and flow conditions (though can't plan for that); would help the agencies narrow down the Section 18 prescriptions; if agencies were having to go forward with a prescription now, passage is poor and there is a lot of attraction to the other side of the river for American shad that does not have an upstream fishway; would behoove Brookfield to conduct additional studies that would obviate the need for the agencies to prescribe a second fishway.
    d. Ken indicated that there is not good information on the operational conditions of the passage during the studies; the agencies were on-site and witnessed poor passage conditions; if the position is that the facility was operated as it was supposed to be operated, then that implies a need for the facility to be upgraded; but the agencies are more curious to understand was it operated the way it was supposed to be; the only way that the agencies can determine that the facility was operated correctly or erroneously is by redoing the study and recording the conditions.
    e. Don indicated that, given the fact that the results were so poor prior, it is in the best interest of Brookfield to do the study again to show improvement.
    f. Matt indicated that the agencies would hope Brookfield, in response to the USR that we include the sound, CFD and radio-telemetry study.

12) Discussed next steps:
    a. DLA Comments Due – July 2; USR – July 12; USR Meeting – July 22; Kirk clarified that there is an opportunity for Brookfield to proposed modifying the study plan when the USR meeting summary is submitted-August 11.
    b. Schedule our next meeting to coincide with USR meeting – 2 pm on July 22.

13) Schedule/Deadlines
    a. Meetings (n=7; March – August)
    b. Draft of the Licensee Proposed Action (late-July, 2020)
    c. Comments (mid-August, 2020)

        i. Optional meeting to discuss (early August, 2020)?

    d. Final Licensee Proposed Action (August 31, 2020)

14) Anticipated next meetings:
    a. Meeting 5: Upstream and Downstream Issues and Improvements Recap (late July)
    b. Meeting 6: Performance Standards and Timing Goals; Final Proposed Actions (early August)
    c. Draft Licensee Proposed Action/BA (for ESA species) to Agencies for review – mid-August, 2020
    d. Meeting 7, if necessary or requested: Discussion of draft Licensee Proposed Action/BA – mid-August, 2020
    e. File Final Licensee Proposed Action/BA with Topsham FLA – August 31, 2020

Pejepscot Hydroelectric Project
Androscoggin River Diadromous Species Passage and Atlantic Salmon Informal Section 7 Consultation

Meeting No. 4

Brookfield Response to Information Requests

1. Information Request 1-Comparison of American Eel downstream passage time between stations to estimated swimming speed to determine potential for injury.
2. Information Request 2-Unit operations for May, June, September, and October.
3. Information Request 3-Approach velocities at old and new powerhouses.
4. Information Request 4-Trashrack spacing, trashrack size and location (top and invert elevations).
5. Information Request 5- Gate operations during adult river herring downstream passage study.
6. Information Request 6- Facility data needs.
7. Information Request 7-2004 and 2005 Pejepscot fish passage operations reports.
8. Information Request 8-1991 thru 1996 downstream passage efficiency studies
9. Information Request 9-Flow and entrance conditions at the fish lift

Information Request 1-Comparison of American Eel downstream passage time between stations to estimated swimming speed to determine potential for injury

The minimum duration of time for eels to travel between fixed telemetry receiver locations in the vicinity of Pejepscot during fall 2019 were calculated for an 825 mm eel moving at an assumed constant rate of 0.5 body lengths/second. The 825 mm body length is near to the median length for eels radio-tagged as part of the 2019 passage assessment. Minimum travel times were calculated and are presented below for the 2.6 mile reach from the Pejepscot boat launch in the impoundment (i.e., release location) and Station F1 (i.e., the upstream approach receiver), the 1.8 mile reach from the Pejepscot tailrace to Station F8, the 2.25 mile reach between Stations F8 and F9, the 0.5 mile reach between Stations F9 and F10. These minimum travel times assume that eels are moving downstream at a constant speed.

Green shaded boxes in the tables below represent transit times in excess of the calculated value for a particular study reach. Of the fifty test eels, five were lost during downstream passage at the Project based upon a lack of detection at any of the three downstream monitoring stations. When the upper two reaches (Pejepscot to Station F8 and Station F8 to Station F9) are considered, 27 of the 43 eels with known transit durations moved through one or both of the reaches within the calculated transit time for an actively swimming 825 mm eel. Two individuals went undetected at F9 and as a result were not considered. Of those 27 individuals, 44% (12 of 27) passed through both stretches in less than the estimated transit time, 37% (10 of 27) exceeded 2.0 hours to pass from Pejepscot to F8 but did pass from F8 to F9 in less than 2.4 hours, and 19% (5 of 27) exceeded 2.4 hours to pass from F8 to F9 but did pass from Pejepscot to F8 in less than 2.0 hours.

Passage data at Station F1 was available for 37 radio-tagged eels and permitted an evaluation of the time needed for an eel to move from the release site to the upstream face of the dam. Of those 37 individuals, only 4 eels (11%) covered the distance in less than the calculated minimum duration of 2.8 hours. All tagged eels were held for 24 hours after tagging to allow them time to recover following anesthesia and surgery.

Calculated value for each study reach, estimated for an 825 mm eel moving at 0.5 body lengths/second.

Reach	Hours for: 825 mm @ 0.5 BL/s
Release to Station F1	2.8
Passage - Station F8	2.0
Station F8-F9	2.4
Station F9-F10	0.5
Passage - Station F10	4.9

Radio-tagged eel transit times downstream of Pejepscot

Tag ID	Total Length (mm)	Release Date	Reported Passage Fate	Transit Time (Hours)			
				Pejepscot to Station F8 (1.8 miles)	Station F8 to F9 (2.25 miles)	Station F9 to F10 (0.5 miles)	PJ to Station F10 (4.55 miles)
50	744	10/3/2019	Alive	0.8	1.6	0.3	2.7
51	783	10/3/2019	Alive	0.8	1.2	0.5	2.5
52	822	10/3/2019	Alive	4.1	1.2	0.4	5.7
53	740	10/3/2019	Alive	5.1	2.7	311.5	319.3
54	815	10/3/2019	Alive	21.8	-	-	23.5
55	885	10/3/2019	Alive	281.6	31.9	0.7	314.2
56	981	10/3/2019	Alive	1.2	9.1	13.3	23.5
57	755	10/3/2019	Alive	1.5	-	-	295.9
58	901	10/3/2019	Alive	2.1	-	-	3.8
59	849	10/3/2019	Alive	5.6	17.7	198.0	221.3
60	802	10/3/2019	Alive	1.3	139.3	0.7	141.4
61	926	10/3/2019	Alive	318.0	1.3	0.4	319.7
62	922	10/3/2019	Alive	71.0	-	-	72.2
63	838	10/3/2019	Alive	1.1	1.2	0.2	2.5
64	820	10/3/2019	Alive	1.7	101.3	-	-
65	924	10/3/2019	Alive	355.0	-	-	-
66	938	10/3/2019	Alive	210.1	1.3	0.2	211.6
67	839	10/3/2019	Dead	-	-	-	-
68	886	10/3/2019	Alive	4.9	88.0	196.8	289.7
69	847	10/3/2019	Alive	212.0	3.6	16.2	231.8
70	930	10/3/2019	Alive	0.9	1.6	6.0	8.5
71	826	10/3/2019	Alive	292.7	3.6	0.8	297.0
72	805	10/3/2019	Alive	23.6	94.7	201.7	320.0
73	780	10/3/2019	Alive	2.3	5.3	14.2	21.8
74	848	10/3/2019	Alive	461.0	1.5	8.9	471.4
75	854	10/8/2019	Alive	1.0	34.7	121.1	156.8
76	845	10/8/2019	Alive	1.0	1.4	0.3	2.7
77	768	10/8/2019	Alive	1.4	1.3	0.2	2.9
78	874	10/8/2019	Alive	1.1	-	-	24.4
79	764	10/8/2019	Alive	14.8	4.1	1.4	20.2
80	851	10/8/2019	Alive	188.9	21.8	0.6	211.3
81	890	10/8/2019	Alive	45.9	1.3	0.2	47.4
82	772	10/8/2019	Alive	1.6	1.1	0.4	3.2
83	875	10/8/2019	Alive	1.4	1.3	14.2	16.9
84	750	10/8/2019	Alive	1.0	1.7	196.2	198.9
85	802	10/8/2019	Alive	1.0	-	-	2.7
86	786	10/8/2019	Alive	298.4	1.6	0.3	300.2
87	917	10/8/2019	Dead	-	-	-	-
88	890	10/8/2019	Dead	-	-	-	-
89	682	10/8/2019	Alive	250.2	1.3	0.4	251.9
91	842	10/8/2019	Alive	161.1	1.3	0.4	162.7
92	793	10/8/2019	Dead	-	-	-	-
93	950	10/8/2019	Alive	95.7	1.2	0.3	97.2
94	776	10/8/2019	Alive	1.4	1.7	0.2	3.3
95	831	10/8/2019	Alive	129.2	49.1	4.5	182.9
96	998	10/8/2019	Dead	-	-	-	-
97	731	10/8/2019	Alive	1.0	-	-	3.2

Tag ID	Total Length (mm)	Release Date	Reported Passage Fate	Transit Time (Hours)			
				Pejepscot to Station F8 (1.8 miles)	Station F8 to F9 (2.25 miles)	Station F9 to F10 (0.5 miles)	PJ to Station F10 (4.55 miles)
98	658	10/8/2019	Alive	5.5	14.4	0.2	20.1
99	821	10/8/2019	Alive	0.9	112.9	92.3	206.1
100	687	10/8/2019	Alive	173.4	1.7	0.3	175.4

Radio-tagged eel transit times upstream of Pejepscot

Tag ID	Total Length (mm)	Release Date	Reported Passage Fate	Transit Time (hrs) for Release to Station F1 (2.6 miles)
50	744	10/3/2019	Alive	5.2
51	783	10/3/2019	Alive	3.3
52	822	10/3/2019	Alive	9.0
53	740	10/3/2019	Alive	3.7
54	815	10/3/2019	Alive	-
55	885	10/3/2019	Alive	11.3
56	981	10/3/2019	Alive	2.0
57	755	10/3/2019	Alive	26.0
58	901	10/3/2019	Alive	3.8
59	849	10/3/2019	Alive	13.4
60	802	10/3/2019	Alive	323.5
61	926	10/3/2019	Alive	102.2
62	922	10/3/2019	Alive	-
63	838	10/3/2019	Alive	60.8
64	820	10/3/2019	Alive	3.9
65	924	10/3/2019	Alive	-
66	938	10/3/2019	Alive	-
67	839	10/3/2019	Dead	27.4
68	886	10/3/2019	Alive	7.1
69	847	10/3/2019	Alive	25.7
70	930	10/3/2019	Alive	1.8
71	826	10/3/2019	Alive	27.6
72	805	10/3/2019	Alive	-
73	780	10/3/2019	Alive	4.8
74	848	10/3/2019	Alive	3.0
75	854	10/8/2019	Alive	-
76	845	10/8/2019	Alive	2.6
77	768	10/8/2019	Alive	-
78	874	10/8/2019	Alive	33.2
79	764	10/8/2019	Alive	176.0
80	851	10/8/2019	Alive	29.7
81	890	10/8/2019	Alive	-
82	772	10/8/2019	Alive	34.9
83	875	10/8/2019	Alive	8.3
84	750	10/8/2019	Alive	2.0
85	802	10/8/2019	Alive	5.3
86	786	10/8/2019	Alive	50.1
87	917	10/8/2019	Dead	52.5
88	890	10/8/2019	Dead	26.7
89	682	10/8/2019	Alive	-
91	842	10/8/2019	Alive	-
92	793	10/8/2019	Dead	-
93	950	10/8/2019	Alive	33.5
94	776	10/8/2019	Alive	76.8
95	831	10/8/2019	Alive	-
96	998	10/8/2019	Dead	6.7
97	731	10/8/2019	Alive	24.7
98	658	10/8/2019	Alive	195.6
99	821	10/8/2019	Alive	-
100	687	10/8/2019	Alive	25.3

Information Request 2-Unit operations for May, June, September, and October

Page 17 of the *Desktop Entrainment and Turbine Survival Assessment* study states “Operation of the Francis Units has averaged 36%, 21%, 43%, and 44% during the peak outmigration months of May, June, September, and October for the period 2015-2019 (Table 4-1).

Note there was a major outage (i.e., generator rewind) of Unit 1 from July 2018 to April 2019 (see yellow highlighting). This skewed the average operation of the Francis Units for the 2015-2019 timeframe, as they would not have typically operated as much during the recent Unit 1 outage period.

Removing this period from the calculation of the average for the 2015-19 timeframe, the above statement would now read, “Operation of the Francis Units has averaged 36%, 21%, 29%, and 30% during the peak outmigration months of May, June, September, and October for the period 2015-2019 (Table 4-1). This revision would reflect more typical of operations. Similar revisions were made to Table 4-2 from the report, which reflects the percentage of time of operation of Unit 1.

Revised Table 4-1: Monthly Percentage of Time Pejepscot Francis Units 21, 22, or 23 Operated for Years 2015-2019 (Yellow highlighting shows Unit 1 outage period)

Month	Operation Year					Previous Average	New Average (Not Including 2018-19 Unit 1 Outage)
	2015	2016	2017	2018	2019	2015-19	2015-19
January	49%	21%	0%	35%	98%	41%	26%
February	0%	39%	10%	0%	100%	30%	12%
March	0%	85%	7%	30%	100%	44%	31%
April	66%	72%	51%	87%	76%	70%	69%
May	**27%**	**10%**	**100%**	**43%**	**0%**	**36%**	**36%**
June	**52%**	**6%**	**14%**	**35%**	**0%**	**21%**	**21%**
July	14%	0%	0%	100%	0%	23%	4%
August	0%	7%	0%	100%	0%	21%	2%
September	**40%**	**39%**	**19%**	**99%**	**19%**	**43%**	**29%**
October	**15%**	**40%**	**52%**	**99%**	**14%**	**44%**	**30%**
November	18%	0%	49%	99%	18%	37%	21%
December	30%	11%	0%	98%	0%	28%	10%

Revised Table 4-2: Monthly Percentage of Time Pejepscot Kaplan Unit 1 Operated for Years 2015-2019 (Yellow highlighting shows Unit 1 outage period)

Month	Operation Year					Previous Average	New Average (Not Including 2018-19 Unit 1 Outage)
	2015	2016	2017	2018	2019	2015-19	2015-19
January	59%	99%	100%	100%	0%	72%	90%
February	100%	100%	100%	96%	0%	79%	99%
March	100%	99%	93%	100%	0%	78%	98%
April	99%	100%	99%	100%	0%	80%	100%
May	**94%**	**100%**	**100%**	**100%**	**66%**	**92%**	**92%**
June	**100%**	**94%**	**100%**	**64%**	**98%**	**91%**	**91%**
July	100%	100%	100%	0%	99%	80%	100%
August	100%	93%	100%	0%	87%	76%	95%
September	**62%**	**61%**	**81%**	**0%**	**79%**	**57%**	**71%**
October	**100%**	**60%**	**58%**	**0%**	**97%**	**63%**	**79%**
November	100%	100%	92%	0%	100%	78%	98%
December	100%	99%	100%	0%	100%	80%	100%

Information Request 3-Approach velocities at old and new powerhouses

Information Request 4-Track spacing (clear), trashrack size and location (top and invert elevations)

Table 3-1: Pejepscot Project Impoundment and Intake Characteristics (from Fish Entrainment and Turbine Survival Assessment Report)

<table>
<tr><th>Site Characteristic</th><th colspan="5">Pejepscot Project</th></tr>
<tr><td>Normal Full Pond Elevation (ft)</td><td colspan="5">67.5</td></tr>
<tr><td>Operating Mode</td><td colspan="5">Run-of-River</td></tr>
<tr><td>Surface Area at Normal Full Pond (acres)</td><td colspan="5">225</td></tr>
<tr><td>Total Storage Volume (acre-feet)</td><td colspan="5">3,278</td></tr>
<tr><td>Impoundment Length (miles)</td><td colspan="5">~ 3</td></tr>
<tr><td>Total Hydraulic Capacity (cfs)</td><td colspan="5">8,600</td></tr>
<tr><th></th><th colspan="2">Unit 1</th><th>Unit 21</th><th>Unit 22</th><th>Unit 23</th></tr>
<tr><td>Top Rack Elevation (ft)</td><td colspan="2">61.35</td><td colspan="3">69.7</td></tr>
<tr><td>Bottom Rack Elevation (ft)</td><td colspan="2">36</td><td colspan="3">43.3</td></tr>
<tr><td rowspan="2">Trash Rack Spacing (in)</td><td>El. 61.35-55.1 section</td><td>1.5 clear</td><td colspan="3" rowspan="2">1.5 clear</td></tr>
<tr><td>El. 55.1-36.0 section</td><td>2.5 clear</td></tr>
<tr><td>Trash Rack Length (ft)</td><td colspan="2">25.35</td><td>26.4</td><td>26.4</td><td>26.4</td></tr>
<tr><td>Trash Rack Width (ft)</td><td colspan="2">91.6</td><td>23.8</td><td>23.8</td><td>23.8</td></tr>
<tr><td rowspan="2">Trash Rack Surface Area (sq. ft)</td><td>1.5-inch section</td><td>572.5</td><td rowspan="2">576</td><td rowspan="2">576</td><td rowspan="2">576</td></tr>
<tr><td>2.5-inch section</td><td>1,750</td></tr>
<tr><td>Maximum Turbine Discharge (cfs)</td><td colspan="2">7,550 (rated)
7,100 (actual)</td><td>350</td><td>350</td><td>350</td></tr>
<tr><td>Intake velocity (fps)</td><td colspan="2">3.25 (rated)
3.06 (actual)</td><td>0.60</td><td>0.60</td><td>0.60</td></tr>
</table>

Table 3-2: Pejepscot Project Turbine Characteristics (from Fish Entrainment and Turbine Survival Assessment Report)

Characteristic	Pejepscot Project			
	Units 1	Unit 21	Unit 22	Unit 23
Turbine Type	Vertical Kaplan	Horizontal Francis		
Number blades	4	--	14	14
Max turbine discharge (cfs)	7,550	350	350	350
Turbine efficiency [1]	0.9	0.85	0.85	0.85
Min turbine discharge (cfs)	1,170	350	350	350
Efficiency at peak discharge [1]	90.0%	90.0%	90.0%	90.0%
Runner diameter (ft)	18	3	3	3
RPM	81.8	180	180	180
Design head (ft)	24	13.5	13.5	13.5

1 = assumed estimates based on default values in TBSA model for Kaplan/Francis unit.
Blank cell indicates information not available.

Information Request 5-Gate operations during adult river herring downstream passage study

Below are passage times and associated hourly operational records for all adult river herring that passed downstream on spill. Of the 26 adult river herring that were identified as utilizing spill, four were determined to have died during passage. This is based on 26 individuals, so the loss of 4 fish has a big impact to overall percent, and estimates of passage survival include background mortality (i.e., natural mortality) for each species in the reach from the approach receiver to the first downstream receiver, along with any tagging-related mortalities or tag regurgitations. It is not outside of the realm of possibility that a minor percentage of fish may regurgitate tags during passage.

Operations data provides hourly records of total spill discharge and the settings for gates 1-5 (1 closest to powerhouse). A closed gate has a reported value in the 3.0-3.3 range. With regard to adult river herring spill mortality, Gate 1 was open for 2 (Fish ID 162 and 33) of the 4 events. One (Fish ID 31) passed during spill of approximately 3,500 cfs but it does not appear gates were open; however there was 1.4 feet of spill over all of the gate crests during this time. One fish passed (Fish ID 28) during lower flows (505 cfs), when the crest gates were closed but there was some spill due to the headpond being higher than the gate crest. In both these instances, since the crest gates were closed, but the headpond elevation was higher than the crest, it was difficult to discern which gate(s) was used by both of these fish at the time of passage.

Release Date	Release	Frequency	ID	Pass_Date	Pass_Time	PJ_Route	FATE	Spill_cfs	U1_cfs	U21_cfs	U22_cfs	U23_cfs	HP_Ele	TW_Ele	Gate1	Gate2	Gate3	Gate4	Gate5
5/24/2019	DS3	440	162	5/30/2019	21:17:16	Spill	Dead	5309	6960	0	0	0	68.9	45.1	1.0	3.1	2.9	3.0	3.3
5/23/2019	DS2	360	33	5/29/2019	17:11:14	Spill	Dead	4606	7061	0	0	0	68.9	44.7	1.8	3.0	2.9	3.0	3.3
5/23/2019	DS2	360	31	5/28/2019	17:17:24	Spill	Dead	3582	7213	0	0	0	68.9	44.6	3.0	3.1	3.0	3.0	3.3
5/23/2019	DS2	360	28	6/2/2019	20:00:10	Spill	Dead	505	7255	0	0	0	67.6	43.3	3.0	3.1	3.0	3.0	3.3

Information Request 6-Facility data needs

1. Elevation of Entrance Gate – this is the elevation (same datum as displayed on the 1986 design set) of the lip of the gate. This value is typically obtained via a gage on the screw stems or actuator.

   Entrance Gate is set at 4 different elevations depending on flows from pumps; gage set at entrance gate and manually adjusted to 3 ft below that; based off of water level sensor in the center of the dam; set first thing in the morning and left for the day given that generation generally does not change during the day; tick marks on the gate stem that denote the different settings for the 3 ft depth; Entrance gate settings are specified in the O&M; pumps are turned on depending on unit outflow.

2. Drop Head Loss at Entrance – this is the measured drop in water surface from within the entrance channel to the tailwater. Typically this value is between 0.5 – 1.0 feet for alosines. This value should not be instantaneous but rather measured over 10 to 20 feet in length. It is recommended that the head loss be measured by either a staff gage or water pressure transducer placed approximately 10 feet upstream of the entrance gate and a staff gage or water pressure transducer placed approximately 10 feet downstream of the entrance gate. The difference in elevation readings between the two is the head loss.

   Brookfield is investigating whether desktop hydraulic calculations can be completed to estimate head loss at the entrance for several fish lift attraction flow and tailwater elevation combinations.

3. Depth Elevation of Water in Entrance Channel – this value can be back calculated from the drop, or this depth can be measured via staff gage located within the entrance channel and used to calculate the drop. If the drop from entrance to tailwater is not determined by elevation, all other data should either be referenced from the tailwater elevation or the gate elevation. In other words, all data should be able to be related to one another.

   Gate elevations are adjusted daily per O&M Plan.

4. Total Attraction Water – number of pumps running and estimated attraction water. This assumes that the pumps are not variable speed and provide a set amount of flow of 40 cfs each. If pumps are down then the entrance gate needs to be adjusted.

   Flow is not variable; pumps are on or off; 30 cfs coming from upper flume; calculate attraction flow based on numbers of pumps on; gates are adjusted depending on flow as specified in the O&M Plan.

Excerpt from O&M Plan attached for discussion.

Appendix D: US FISH PASSAGE OPERATIONS PROTOCOL

Number of Pumps Operating	Depth Below Tailwater Level (ft)
1	1
2	2
3	3
4	4

River Flow (cfs)	Kaplan Turbine Gate Setting	No. of Pumps	Total Attraction Flow (cfs)
0 - 1700	0 - 1/4 gate	One pump	70
1700 - 3500	1/4 to 1/2 gate	Two pumps	110
3500 - 5200	1/2 to 3/4 gate	Three pumps	150
Over 5200	More than 3/4 gate	Four pumps	190

	No. of Fish Passing Per Day	Lift Frequencies
Non-Peak	0 - 400	2 Lifts per day
	400 - 800	4 Lifts per day
	800 - 1200	6 Lifts per day
Peak	1200 - 1600	2 Lift per hour
	1600 - 2000	2 Lifts per hour
	2000 - 2400	4 Lifts per hour
	2400 - 2800	6 Lifts per hour
	Over 2800	As Required

Information Request 7-2004 and 2005 Pejepscot fish passage operations reports

ORIGINAL

Devine Tarbell & Associates, Inc.
Consulting Engineers, Scientists, & Regulatory Specialists

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OFFICE OF THE
SECRETARY

2004 APR 19 P 4: 04

FEDERAL ENERGY
REGULATORY COMMISSION

Principals:
John J. Devine, P.E., President
John C. Tarbell, P.E.
James M. Lynch
Edwin C. Luttrell, P.E.

April 12, 2004

File 6617.05

Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

SUBJECT: Pejepscot Hydro Project, FERC No. 4784-ME
Summary of Annual Agency Consultation

Dear Secretary:

In accordance with the FERC Order Approving Modifications to the Downstream Fish Passage Facility and Operation Plan, issued August 19, 1997, the licensee's representatives held the annual meeting on March 19, 2004 to discuss the status of anadromous fish runs in the Androscoggin River and operation of the fish passage facilities at the Pejepscot Hydro Project.

Minutes of the meeting were prepared by Michael Brown of the Maine Department of Marine Resources and are enclosed with this letter.

Based on discussions at the meeting, there are no changes proposed to the operation of the fish passage facilities at the Pejepscot Hydro Project. The upstream fish passage study was discussed at the meeting and if high water does occur this year the licensee and agencies are in agreement on the study plan.

This should complete the annual consultation requirements. If you have any questions please call me.

Sincerely,

Devine Tarbell & Associates, Inc

Edwin E. Hudson
Senior Engineer

EEH/ma

cc: Tom Squiers - MDMR
Gordon Russell - USF&WS
Sharon Burdett – IHD
John Demchak - Topsham

PEJEPSCOT HYDRO PROJECT MEETING

Department of Marine Resources - Stock Enhancement Division
Hallowell, ME March 19, 2004

Meeting attendees were Edwin Hudson, John Demchak (Independent Hydro Developers); Michael Brown, (MDMR), Paul Christman (ASC). The purpose of the meeting was to discuss the status of fishway operations at the Pejepscot Hydro Project (FERC #4784), progress of fish restoration on the Androscoggin River, and outstanding fish passage study requirements at the project.

2003 Fish Passage Operations: Pejepscot staff presented water flow data and a summary of the upstream and downstream fish passage operations (Attachment 1) for the 2003 calendar year. The downstream fish passage facility was opened on June 17, 2003. The downstream facility was closed for the season November 21, 2003. The downstream weirs were closed for a three-day period during high water from November 3 through November 5.

The upstream fish lift was started May 22 at MDMR's request. All attraction water pumps were functional in 2003, providing good attraction flow. The fish lift operates on an automated schedule at 0800, 1000, 1200, and 1400 hours daily during the fish migration period. The lift was not operated from July 10, 2003 at MDMR's request and was closed for the season on the same date. The attraction pumps and the upper fishway channel were dewatered on October 31, 2003

Flow Modifications at the Fish Lift Entrance

During a site visit to the fishlift on May 28, 2003. USFW engineer Ben Rizzo observed attraction flow problems at the entrance to the fishlift. The flow field in the lift area was flowing toward the trap and Mr. Rizzo felt this might cause attraction problems for fish attempting to find the upstream passage. The USFW Service has suggested that the plates above the pumps be modified to deflect flow away from the upstream entrance to enhance attraction. The USFW Service will work with Pejepscot to correct this problem.

Anadromous Fish Restoration Progress: MDMR staff summarized anadromous fish runs, stocking efforts, and observations at the Brunswick Fishway, located 4.7 river miles downstream of Pejepscot. The Brunswick Fishway was opened on May 6, 2003. The 2003 river herring run occurred from May 12 through June 12 at water temperatures ranging from 10.3° to 17.9°C. Of the total of 53,732 river herring that ascended the Brunswick Fishway, 20,392 were truck stocked into 1,846 surface hectares of lake habitat in Androscoggin tributaries above Brunswick and 29,420 were passed into the Brunswick headpond. One-hundred-fifty-two alewives were sacrificed for biological data and 9 were mortalities at the Brunswick Fishway.

Seven American shad were captured in the Brunswick Fishway from June 9 through August 8. A summary of shad returns and a stocking history are provided in following attachments.

Fish Passage Studies: Pejepscot presented a proposal to conduct an upstream passage efficiency study under spill conditions as discussed in previous meetings. Under the proposal the licensee's agent will coordinate with MDMR in monitoring the alewife run and river flows. If appropriate spill conditions exist during the alewife run the licensee's agent will tag a study cohort(s) of fish that will be released from the Brunswick Fishway. Study fish will be tagged with a Floy or T-Bar Anchor Tag. It will be the MDMR's responsibility to initiate the study by contacting Ed Hudson or appointed agent if flows appear to be suitable for the study. ***(see attached proposal study)***. This study was not implemented in 2003 due to the lack of high water. The study plan will remain in affect during the 2004 study period.

2004 Restoration Plans/Fish Passage Operations: The decision was made to continue operations of the upstream and downstream passage facilities according to the same schedule and conditions as those of 2003. Based upon previous seasons, the upstream passage facility should be operational by May 15. The actual operation date is contingent upon when the first fish are passed at the downstream Brunswick Fishway. The downstream passage is scheduled to be operational by June 15. As in previous years, MDMR will notify Pejepscot when to shut down upstream fish passage at any time during the summer and the end of the season. Upstream passage in 2004 may be kept open later into November at the first three facilities to provide passage for late-running fish such as Atlantic salmon. MDMR plans to continue counting, releasing, and stocking fish from the Brunswick facility. Adult shad activity in/around the fishway entrance will be monitored and attempts will be made to capture them either for transport to the hatchery to produce fry for the river and/or transport above Brunswick for release into upstream spawning grounds. There was discussion of MDMR recruiting volunteers to help monitor the alewife run at Pejepscot and Worumbo. Random fish counts would be made at these two stations by trained volunteers under the direction of MDMR staff. Ed Hudson and John Demchak indicated that Pejepscot would cooperate as long the volunteers were trained; the gates would have to be closed and opened in order to provide effective passage of fish. MDMR plans to stock a minimum of 600 adult shad from the Merrimack River and up to 500,000 shad fry, if available, into the Androscoggin River below Lewiston Falls (17.3 river miles above the Pejepscot). In the future MDMR would like to record American shad behavior in and around the fishlift V-Gates at the entrance to the fishlift. These observations will probably not occur 2004 if the number of shad passed above Brunswick remains low. Pejepscot was notified that there is a remote chance of a radio tagged American shad being passed into the Brunswick headpond. If this occurs then DMR personnel may visit the fishlift daily to record fish behavior/movements.

Topsham Hydro Project
Summary of Fish Passage Operation
2003 Year

Downstream Fish Passage

- June 17 — Opened downstream fishway with lights and inside weir.
- November 3 — Closed Weirs due to high flows and trash
- November 5 — Opened Weirs after cleaning trash when flow dropped
- November 21 — Shutdown for the winter after high flow and trash problems.

Upstream Fish Passage

- May 22 — Started upstream fishway operation per DM&R request.
- May 28 — Found hopper slide gate stuck open and repaired gate
- July 10 — Stopped upstream fishway operation per DM&R communication

USGS STATION NUMBER 01059000 ANDROSCOGGIN RIVER NEAR AUBURN, ME
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1	2,660	2,280	2,590	2,560	1,960	1,920	17,100	8,510	5,920	2,300	2,310	1,830	1
2	1,910	1,700	3,100	2,610	2,030	1,940	13,300	7,970	4,680	2,290	2,030	1,800	2
3	1,890	1,700	2,580	2,450	2,050	1,950	11,400	9,990	3,140	2,300	1,900	2,650	3
4	2,270	2,410	2,700	2,260	2,380	2,370	9,790	14,700	2,510	2,590	2,410	2,440	4
5	1,880	2,400	2,690	2,440	2,320	1,950	9,110	12,000	3,550	2,610	2,450	3,350	5
6	1,620	2,630	2,460	2,700	2,120	2,130	7,850	9,240	2,720	2,110	3,750	2,720	6
7	1,670	2,970	1,750	2,490	2,090	1,950	7,100	7,710	3,230	2,180	6,060	2,690	7
8	1,860	2,880	1,800	2,480	2,100	1,940	6,979	6,690	4,120	2,250	5,510	2,810	8
9	1,690	2,330	2,170	2,450	2,060	1,950	6,430	6,450	4,480	2,240	4,520	2,440	9
10	1,760	2,240	2,190	2,240	2,050	2,360	6,340	6,550	4,100	2,200	4,550	2,340	10
11	1,930	2,120	2,170	2,260	2,060	1,930	5,770	6,460	3,580	1,830	8,450	2,210	11
12	1,870	3,340	1,980	2,210	2,240	1,940	3,970	6,550	4,020	1,850	9,050	2,190	12
13	1,810	5,180	1,830	2,420	2,460	1,940	6,300	6,550	3,930	2,110	6,570	1,729	13
14	2,280	4,800	1,930	2,230	2,470	2,000	8,750	5,649	3,390	2,410	5,100	1,760	14
15	1,850	1,920	2,640	2,030	2,180	1,970	8,810	6,460	7,670	2,570	5,000	2,230	15
16	2,050	3,550	3,410	2,010	2,150	1,970	10,800	7,050	9,870	2,270	4,010	1,770	16
17	2,700	3,180	3,310	1,910	1,880	2,260	13,300	6,370	8,169	2,030	3,810	2,670	17
18	3,439	3,950	2,940	1,870	1,930	3,010	10,300	5,860	6,969	2,130	1,950	3,570	18
19	3,380	2,540	2,590	1,860	1,900	3,469	8,040	5,669	5,709	1,850	2,610	3,720	19
20	2,760	2,039	3,100	1,910	1,920	3,880	6,820	5,350	4,100	1,810	2,240	2,410	20
21	2,400	2,039	2,880	1,890	1,920	4,300	6,510	4,400	1,800	2,230	2,660	3,010	21
22	2,859	2,340	2,740	1,880	1,930	5,230	6,780	4,460	1,770	1,780	4,020	4,230	22
23	2,180	2,500	3,280	1,920	1,950	6,830	6,630	4,350	3,560	1,870	1,840	3,750	23
24	1,830	4,130	4,510	1,850	1,940	7,190	9,010	3,600	2,290	2,440	1,850	5,639	24
25	1,870	5,830	2,330	1,900	1,930	8,129	9,830	3,540	2,190	2,670	1,840	7,280	25
26	1,640	4,890	2,580	1,840	1,940	9,280	10,100	2,950	2,100	2,340	1,860	5,669	26
27	1,719	4,520	2,600	1,900	1,900	10,200	10,100	4,660	2,270	2,300	1,840	5,550	27
28	1,729	3,250	2,090	1,920	1,900	14,399	10,500	4,940	2,340	1,870	1,870	4,630	28
29	1,760	2,210	2,710	1,940		14,700	10,700	4,890	2,470	2,380	2,230	3,950	29
30	2,829	2,300	2,340	1,890		19,600	10,100	5,840	2,960	2,150	1,830	3,080	30
31	2,720		2,620	1,930		26,500		5,930		2,280	1,840		31
AVERAGE	2,155	3,006	2,600	2,137	2,063	5,522	8,951	6,495	3,987	2,201	3,483	3,204	
MAXIMUM	3,439	5,830	4,510	2,700	2,470	26,500	17,100	14,700	9,870	2,670	9,050	7,280	
MINIMUM	1,620	1,700	1,750	1,840	1,880	1,920	3,970	2,950	1,770	1,780	1,830	1,729	

USGS STATION NUMBER 01059000 ANDROSCOGGIN RIVER NEAR AUBURN, ME
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1	3,400	21,400	14,900	12,900									1
2	3,920	14,599	11,800	11,100									2
3	3,860	12,100	9,450	9,980									3
4	3,930	11,000	6,939	9,560									4
5	4,210	10,900	6,150	9,590									5
6	3,489	10,400	6,020	8,900									6
7	4,450	8,220	6,000	7,720									7
8	3,920	7,270	6,130	7,580									8
9	3,820	7,570	4,840	8,090									9
10	3,780	6,450	4,610	6,690									10
11	3,530	6,100	7,220	6,420									11
12	3,380	6,060	13,200	6,540									12
13	3,690	6,310	24,200	4,990									13
14	3,910	9,080	17,400	6,530									14
15	6,520	10,300	13,300	6,470									15
16	14,599	7,980	12,400	6,020									16
17	13,200	7,420	13,200	5,550									17
18	8,440	7,480	29,600	5,090									18
19	6,540	6,720	46,300	5,470									19
20	5,649	9,350	36,700	6,210									20
21	6,090	24,200	26,500	4,270									21
22	12,000	20,800	22,400	5,010									22
23	13,600	14,700	21,300	5,590									23
24	9,910	12,200	20,000	5,590									24
25	7,500	11,000	22,300	5,580									25
26	7,570	9,190	32,300	5,480									26
27	8,640	9,170	28,399	4,920									27
28	15,600	9,200	23,400	4,460									28
29	28,999	12,600	18,800	4,470									29
30	36,200	18,900	16,700	4,370									30
31	31,500		14,800	4,230									31
AVERAGE	9,221	10,956	17,331	6,625	0	0	0	0	0	0	0	0	
MAXIMUM	36,200	24,200	46,300	12,900	0	0	0	0	0	0	0	0	
MINIMUM	3,380	6,060	4,610	4,230	0	0	0	0	0	0	0	0	

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Devine Tarbell & Associates, Inc.
Consulting Engineers, Scientists, & Regulatory Specialists

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2005 MAY 16 P 4:24

FEDERAL ENERGY
REGULATORY COMMISSION

Principals:
John J. Devine, P.E., President
John C. Tarbell, P.E.
James M. Lynch
Edwin C. Luttrell, P.E.

May 10, 2005

File 6617.05

Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

SUBJECT: Pejepscot Hydro Project, FERC No. 4784-ME
Summary of Annual Agency Consultation

Dear Secretary:

In accordance with the FERC Order Approving Modifications to the Downstream Fish Passage Facility and Operation Plan, issued August 19, 1997, the licensee's representatives held the annual meeting on March 18, 2005 to discuss the status of anadromous fish runs in the Androscoggin River and operation of the fish passage facilities at the Pejepscot Hydro Project.

Minutes of the meeting were prepared by Michael Brown of the Maine Department of Marine Resources and are enclosed with this letter.

Based on discussions at the meeting, there are no changes proposed to the operation of the fish passage facilities at the Pejepscot Hydro Project. The upstream fish passage study under spill conditions was attempted in May and June 2005 and the results discussed at the meeting. Due many factors including limited spill and few fish available during the study period the results were poor. "It was decided that the study should be conducted again when suitable flows exist, after cohorts of the drought years of 2001 and 2002, and after we consistently observe runs over 100,000 alewives at Brunswick."

Fish lift modifications as proposed by Ben Rizzo of USFWS were discussed and Topsham agreed to make the modifications recommended before the lift was put into operation for 2005.

This should complete the annual consultation requirements. If you have any questions please call me.

Sincerely,

DEVINE TARBELL & ASSOCIATES, INC.

Edwin E. Hudson
Senior Engineer

EEH/ct

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cc: Anton Sidoti - FERC NYRO
Tom Squiers - MDMR
Gordon Russell - USF&WS
Sharon Burdett – IHD
John Demchak - Topsham

PEJEPSCOT HYDRO PROJECT MEETING

Department of Marine Resources - Stock Enhancement Division
Hallowell, ME March 18, 2005

Meeting attendees were Edwin Hudson (Devine Tarbell), Mary McCann (Devine Tarbell), John Demcheck (Independent Hydro Developers); Michael Brown (MDMR), Jason Valliere (MDMR), Paul Christman (ASC), Ben Rizzo (USFWS), and Larry Miller (USFWS). The purpose of the meeting was to discuss the status of fishway operations at the Pejepscot Hydro Project (FERC #4784), progress of fish restoration on the Androscoggin River, and outstanding fish passage study requirements at the project.

2004 Fish Passage Operations:
Pejepscot staff presented a summary of the upstream and downstream fish passage (DSP) operations for the 2004 calendar year. The DSP opened on June 2nd with lights and inside weir and was shut down for the season on November 29th after experiencing high flow and trash problems.

The upstream fish lift was started on May 13th at MDMR's request. All attraction water pumps were functional in 2004, providing attraction flow. The fish lift operates on an automated schedule at 0900, 1100, 1300, 1500 and 1700 hours daily during the fish migration period. The lift was not operated from August 2nd, 2004 through October 7th per MASC protocol as water temperatures exceeded the 22C upper limit. The upstream fish lift was restarted October 7th at MDMR's request. On October 11th upstream passage was shutdown due to large numbers of juvenile fish in the hopper when dumping and a number of fish were falling through the grating and getting trapped under the hopper. MDMR granted permission on October 12th, 2004 for Pejepscot Hydro to secure the fish lift for the season.

Flow Modifications at the Fish Lift Entrance:
In response to USFWS engineer Ben Rizzo's May 28th, 2003 visit when he identified and notified Pejepscot hydro of attraction flow problems, modifications were discussed and Pejepscot Hydro agreed to make necessary modifications to correct the flow field in the lift area by installing grating and plywood to baffle the flow caused by attraction pumps 3 and 4 preventing it from back flowing into the trap area. Modifications should improve passage efficiency of all fish species including those of most concern by reducing confusion in the trap area.

Anadromous Fish Restoration Progress:
MDMR staff summarized anadromous fish runs, stocking efforts, and observations at the Brunswick Fishway, located 4.7 river miles downstream of Pejepscot. The Brunswick Fishway was opened on May 7th, 2004. The 2004 river herring run occurred from May 9th through June 16th at water temperatures ranging from 9.1° to 19.2°C. Of the total of 113,686 river herring that ascended the Brunswick Fishway, 20,668 were truck stocked into 1,846 surface hectares of lake habitat in Androscoggin tributaries above Brunswick and 86,354 were passed into the Brunswick headpond. One-hundred-seventy-four alewives were sacrificed for biological data and 243 were Brunswick Fishway and or transport mortalities. Six-thousand-two-hundred-forty-seven were transported and stocked out of the Androscoggin River Basin. Twelve American shad were captured in the Brunswick Fishway from June 13th through July 23rd.

Fish Passage Studies:
Mary McCann (Devine Tarbell) summarized the results of the upstream fish passage study under spill conditions that was conducted from May 28th to June 17th, 2004. Two Hundred alewives were tagged at the Brunswick fishway with yellow spaghetti tags and released upstream with 270 additional untagged alewives to maintain schooling behavior. The Pejepscot fishway was monitored for the following 20 days to document the number of tagged fish passing up through the fishway. Only 23 of the 200 fish were observed moving above Pejepscot for a passage efficiency of 11.5%. This is much lower than the 87% average passage efficiency observed in earlier studies conducted under normal conditions. The study raised many questions and concerns. Concerns included the length of time spill occurred, 3 days and the low numbers of alewives passing at Brunswick during the study reducing the number of alewives available to induce typical schooling behavior. Questions raised included where did the other 177 tagged fish go? Did flow inhibit upstream movement? Why there was a gap observed in the run? It was decided that the study should be conducted again when suitable flows exist, after the cohorts of the drought years of 2001 and 2002, and after we consistently observe runs over 100,000 alewives at Brunswick.

2005 Restoration Plans/Fish Passage Operations:
The decision was made to continue operations of the upstream and downstream passage facilities according to the same schedule and conditions as those of 2004. Based upon previous seasons, the upstream passage facility should be operational by May 15. The actual operation date is contingent upon when the first fish are passed at the downstream Brunswick Fishway. The downstream passage is scheduled to be operational by June 15. As in previous years, MDMR will notify Pejepscot when to shut down upstream fish passage at any time during the summer and the end of the season. Upstream passage in 2005 may be kept open later into November at the first three facilities to provide passage for late-running fish such as Atlantic salmon. MDMR plans to continue counting, releasing, and stocking fish from the Brunswick facility. Adult shad activity in/around the fishway entrance will be monitored and attempts will be made to capture them either for transport to the hatchery to produce fry for the river and/or transport above Brunswick for release into upstream spawning grounds. MDMR plans to stock a 1,000 adult shad from the Merrimack River and up to 500,000 shad fry, if available, into the Androscoggin River below Lewiston Falls (17.3 river miles above the Pejepscot). Pejepscot was notified that there is a remote chance of a radio tagged American shad being passed into the Brunswick headpond. If this occurs then DMR personnel may visit the fishlift daily to record fish behavior/movements. Edwin Hudson of Pejepscot Hydro offered to purchase 10 radio telemetry tags to support MDMR with their adult American shad behavior study located at the Brunswick Fishway.

Information Request 8-1991 thru 1996 downstream passage efficiency studies

INDEPENDENT HYDRO DEVELOPERS, INC.

473 THIRD STREET
SUITE 301
NIAGARA FALLS, NEW YORK 14301
TELEPHONE: 716-282-6155
TELEFAX: 716-282-0525

ORIGINAL

April 24, 1997

TOP6617.00
TOP 6620.00

The Secretary
FEDERAL ENERGY REGULATORY COMMISSION
825 N. Capitol Street, NE
Washington, DC 20426

ATTN: J. Mark Robinson, Director
Division of Project Compliance and Administration

054

RE: **PEJEPSCOT HYDRO PROJECT – FERC NO. 4784-ME**
EVALUATION OF DOWNSTREAM FISH PASSAGE FACILITY
FOR JUVENILE CLUPEIDS 1991-1996
FINAL REPORT

Dear Mr. Robinson:

In compliance with Commissions Order 4784-030 issued April 30, 1991 and order 4784-052 and 053 granting an extension of time, Topsham Hydro Partners, Inc., Chrysler Capital Corporation and Utilco Group, Inc. (Licensees) herewith, file the original and seven (7) copies of the final report on Evaluation of Downstream Fish Passage Facility for passage of Juvenile Clupeids 1991 through 1996.

The report was made available to the U.S. Fish and Wildlife Service, the Maine Department of Marine Resources, the Maine Department of Inland Fisheries and Wildlife and the Maine Atlantic Sea-Run Salmon Commission. Comment letters from the U.S. Fish and Wildlife Service and from the Maine Department of Marine Resources are included in the report.

Based upon the Agency recommendations, the licensees propose the following modifications to the downstream fish passage facility and operating plan commencing in June 1997:

- The fishway monitoring system used for the effectiveness and efficiency studies will be bypassed and the fishways will be run at design flow.
- The fishway entrance weirs will be backlighted.
- Attraction lights will be provided in front of the fishway entrance weirs.
- The sound deterrent system will be operated with one unit at the center of the trashrack.
- The large turbine will be operated in a first-on/last-off mode. The small units will not be operated unless the large turbine is at capacity or during an emergency/maintenance outage of the large unit.

- Records will be maintained to document fishway flows and maintenance of the downstream passage facilities.

- Annual agency consultation meetings will be held to discuss the status of anadromous fish runs in the Androscoggin River, and to evaluate the need for developing additional study plans. The licensee will file with the Federal Energy Regulatory Commission and with the Maine Department of Environmental Protection, a summary report of each annual meeting.

Sincerely,

Olaf M. Erickson, P.E.
Vice President, Operations

OME/kpq

Enclosures

cc: A. Sidoti (FERC-NY)
L. Flagg (DMR)
S. Timpano (IF&W)
G. Russell (USF&W)
E. Baum (ASRSC)
D. Murch (DEP)
C. Ritzi (Ritzi & Assoc.)
J. Truebe (Lakeside Eng.)
I. Hermann (THP)
J. Demchak (THP)

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PEJEPSCOT HYDROELECTRIC PROJECT
FERC PROJECT NO. 4784-ME

EVALUATION OF DOWNSTREAM FISH PASSAGE FACILITY FOR JUVENILE CLUPEIDS 1991 THROUGH 1996 FINAL REPORT

Prepared for:

TOPSHAM HYDRO PARTNERS
(Limited Partnership)
CHRYSLER CAPITAL CORPORATION
UTILCO GROUP, INC. (Licensees)

Prepared by:

NORTHROP, DEVINE & TARBELL, INC.
and
CHARLES RITZI ASSOCIATES
and
LAKESIDE ENGINEERING, INC.
and
AQUA-BIO TECH

April 1997

PEJEPSCOT HYDROELECTRIC PROJECT
FERC PROJECT NO. 4784-ME
EVALUATION OF DOWNSTREAM FISH PASSAGE FACILITY FOR JUVENILE CLUPEIDS 1991 THROUGH 1996
FINAL REPORT
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Section 1

Introduction

1.1 Description of Project Facilities and Operation

1.1.1 Project Facilities and Operation

The Pejepscot Hydroelectric Project, located on the Androscoggin River in Southern Maine, consists of a 560 foot long overflow dam with five-3-foot-high crest gates, two powerhouses, one (powerhouse A) with a 12,500 KW vertical shaft Kaplan turbine (Unit 1) and adjacent to it, Powerhouse B consisting of three small horizontal shaft Francis turbines (one 500 KW and two 600 KW) and upstream and downstream fish passage facilities (See Figure 1 in Appendix 4 and Photo 1 in Appendix 5).

The gross head at the plant of 25 feet. The Kaplan turbine in Powerhouse A has a flow capacity of about 7,100 cfs and the three small units in Powerhouse B have a combined capacity of about 1,000 cfs. With all units operating the total turbine flow is about 8,100 cfs.

Because of its large flow capacity, the Kaplan turbine operates almost continuously. It is occasionally shut down for planned and unplanned maintenance. While its minimum flow capacity is about 1,200 cfs, the prescribed minimum flow release at Gulf Island upstream from Pejepscot is 1,700 cfs, so that the Kaplan turbine operates continuously even during the summer low flow period.

The three small turbines in Powerhouse B normally operate only during the spring run-off period when river flow exceeds the Kaplan turbine flow capacity of 7,100 cfs.

When river flow exceeds the hydraulic capacity of all four turbines (about 8,100 cfs), the 3-foot-high crest gates on the dam open, and all excess river flow is discharged over the dam.

1.1.2 Downstream Fish Passage Facilities and Operation

The downstream fish bypass facilities at Pejepscot consist of two 4-foot-wide weir entrances, one on the north side, and the other on the south side of the trashrack upstream from the Kaplan turbine (Unit 1). A 30- inch-diameter steel pipe carries fishway flow from the north weir entrance to the plant tailrace and a 24-inch diameter pipe conveys fishway flow from the south weir entrance to the tailrace (see Figure 1 in Appendix 4 and Photo 1 in Appendix 5).

At the weir entrances, a 4-foot-wide by 24-inch high weir gate controls flow to each fishway pipe. When fully lowered, the tops of the weir gates are at elevation 65.5 feet which is 24 inches below normal headpond elevation 67.5 ft and about 5.5 feet above the invert of the 24 inch and 30 inch fishway pipes (invert elevation 60.0 ft.). The maximum discharge at each entrance is estimated to be about 40 cfs. The weir gates are adjustable to allow fishway discharge of about 1 percent of the turbine flow (see Figure 3 in Appendix 4).

The downstream fish passage facility is operated continuously from about June 1 to November 30. It is opened and closed on notification by the Maine Department of Marine Resources.

To facilitate the fishway effectiveness studies, described in Section 1.3 of this report, modifications were made to the 24-inch and 30-inch fishway pipes to allow diversion of pipe flow to the fishway monitoring system (i.e. dewatering screens and fish holding tanks). A riser box and temporary gate were installed in each pipe to divert fishway flow to the dewatering screen (see Figure 2 in Appendix 4, Photos 2 through 4 in Appendix 5, and additional photos in Progress Report No. 3).

Once the fishway effectiveness studies are complete, the pipe diversion gates will be left in an open position allowing free flow of fish and water to the tailrace.

1.2 Background

The Federal Energy Regulatory Commission (FERC) Order No. 4784-012 approving the functional design drawings for the Pejepscot fish passage facilities required the Licensees to file a plan for monitoring the effectiveness of the fish passage facilities. The Licensees' plans for studies of alewife passage were filed with the FERC in March, 1991. Effectiveness studies for other species of anadromous fish (American shad and Atlantic salmon) are not required at this time due to the small populations of these species in the Androscoggin River. The FERC issued, on April 30, 1991, Order No. 4784-030 approving the fish passage study plans. A copy of the order is included in Appendix 1.

The Licensees' approved downstream facility study plan consists of three phases:

Phase 1: A feasibility study to assess the site-specific practicability of various study methods (year 1; 1991).

Phase 2: Method effectiveness studies (years 2 and 3; 1992 and 1993).

Phase 3: Fish passage efficiency studies (years 4 and 5; 1994 and 1995).

Phase 3 Extension: Fish passage efficiency study (year 6, 1996).

This study program was originally scheduled to be undertaken over a 5-year period which began in June, 1991. Progress reports were to be submitted annually (see FERC order of April 30, 1991 in Appendix 1) and a final report (including recommendations for any necessary changes to the downstream fish passage facilities) was to be submitted at the completion of the 5-year study period.

Progress Report No. 1, which described the results of the Phase 1 feasibility study conducted in 1991, was filed with the FERC in February 1992. The Phase 1 study was conducted by Lakeside Engineering, Inc. (LE) and Charles Ritzi Associates (CRA). Progress Reports Nos. 2 and 3, which described the results of the 1992 and 1993 Phase 2 effectiveness studies, were filed with FERC in March, 1993 and February 1994, respectively. The construction and facilities operation for these studies were accomplished by Topsham Hydro Partners personnel, with input and review by LE and CRA.

The 1994 study plan that initiated the scheduled two year Phase 3 efficiency studies was approved by FERC Order No. 8787-047 issued on May 2, 1994 (see Appendix 1) and Progress Report No. 4. describing the results of the 1994 study was filed with the FERC on April 10, 1995. The FERC approved the 1995 study plan (the second year of the Phase 3 efficiency studies) by Order No. 4784-050 issued on April 14, 1995 (see Appendix 1) and Progress Report No. 5 describing the results of the 1995 study was filed with the FERC on March 20, 1996. For the 1994 and 1995 studies fish staining and tagging were done by Northrop, Devine & Tarbell, Inc. (ND&T) personnel with the fishway monitoring conducted by Topsham Hydro Partners personnel. LE and CRA) continued to provide technical advice and review.

While 1995 was scheduled as the final year of the fishway efficiency studies, abnormal drought conditions in 1995 resulted in a paucity of study fish and no studies were completed. Accordingly, with review agency fishery concurrence (see correspondence in Appendix 2) the FERC issued Orders No. 4784-052 & 053 on April 19, 1996 approving a one year Phase 3 extension until May 1, 1997, including acceptance of a plan for essentially a repeat in 1996 of the studies initially planned for 1995 (see Appendix 1).

The following is Progress Report No. 6 which describes the results of the 1996 study. Study personnel were the same as in 1995 with the central exception that Richard Arsenault of Aqua-Bio Tech was retained by Topsham Hydro Partners to mark fish and conduct the fishway monitoring and other on-site studies. Mr. Arsenault recently retired from the Maine Department of Inland Fisheries and Wildlife following a 25-year career as a fisheries biologist.

1.3 Summary of Previous Studies

1.3.1 Phase 1, Feasibility Studies (1991)

In 1991, project structures and configuration were surveyed to determine the most practical method for capture, sampling, and counting fish discharged from the project's downstream fishways. Based on these studies and experience on the Sebasticook River, where similar fish passage studies were underway, it was decided that a mark/recapture method would be the most feasible at the Pejepscot project. Cohorts of study fish marked by immersion staining would be released into the protect impoundment with recapture in the downstream fishways.

This method necessitated development of a monitoring/capture system on the fishways, including sorting/counting facilities for identifying and counting both marked and unmarked alewife. Refinement of marking, holding and release equipment and techniques resulting in viable study fish cohorts were also necessary.

1.3.2 Phase 2, Effectiveness Studies (1992-1993)

During 1992, the first year of the scheduled 2-year Phase 2 effectiveness studies, work continued on finalizing study equipment. A prototype monitoring and capture system was installed at the south downstream fishway. This facility included a monitoring platform, a riser box to redirect fishway discharge, an inclined screen dewatering system, and a holding tank.

During 1993, the final year of the Phase 2 effectiveness studies, the final elements of the monitoring and capture system were installed/fabricated and tested, including a riser box, inclined dewatering screen and holding tank on the north fishway pipe; a jib crane; two, 100-gallon staining/transport hoppers; live cars; a live car mooring dock; and mating of the hopper and small fork lift tractor for transport between the monitoring facilities and the live car mooring dock. All this equipment was tested and worked well. In addition, a debugging fishway efficiency test was conducted with the conclusion that the planned study methods were practical. Therefore, except for moving the release point for study fish closer to the dam/fishway, the equipment and methods employed in 1993 were considered appropriate and were used for the Phase 3 efficiency studies begun in 1994. The fishway monitoring and capture system in place since 1994 is shown in Figure 2 in Appendix 4 and the photos in Appendix 5.

1.3.3 Phase 3, Efficiency Studies (1994-1995)

The 1994 mark and recapture efficiency studies using stained juvenile clupeids resulted in efficiencies of 1.0, 2.4, and 2.8 percent, with serious bias towards low efficiency due to poor stain retention. Consequently, other methods of marking were investigated, with two tests conducted using streamer tags; the results of those tests were fishway efficiencies of 10.4 and 19.5 percent. The search for a reliable marking method included an elastomer injection system, which was clearly superior to any other method considered and the obvious method of choice for further studies.

After agency consultation on 1994 study results, it was concluded that the mark and recapture efficiency studies would be continued in 1995 using an elastomer injection marking system. The Licensee would also maximize fishway entrance weir backlighting effectiveness, determine the most appropriate entrance weir depth setting, and investigate the use of a sound generator as a behavioral deterrent to improve fishway attraction.

Unfortunately, 1995 was an unusual water year in the Northeast with severe drought conditions from April through late October, followed by extremely high river flows. Therefore, there were few juvenile alewife moving downstream during the normal migration period, and the migration occurred on extremely high flows when there was almost continuous spillage at the dam. Consequently, few juvenile alewife were captured and no definitive fishway efficiency studies were possible. The Licensee was able to perfect the use of elastomer injection as a long-term mark and an ultraviolet viewing system (ultraviolet light and shade from sunlight) was developed for the monitoring holding boxes. Also, the sharp-crested fishway entrance weirs were changed to broad-crested to create a more gradual velocity transition zone, and the 500 watt quartz overhead floodlights used in 1994 for backlighting of the fishway entrance weirs were replaced with 50 watt metal halide lights for a better ambient light match.

In addition, in 1995 a sound deterrent system (SDS) was mounted on the intake trashrack, and a hydro acoustics system was installed to monitor fish behavior resulting from the use of the SDS. However, because of very limited downstream movement of juvenile alewife it was not possible to acquire any robust data on fish passage related to the SDS.

Section 2

Pejepscot 1996 Facility Efficiency Study

2.1 Study Goal and Scope

The goal of the 1996 downstream fishway efficiency study was to determine how many of the juvenile clupeids approaching the Pejepscot Dam pass the dam via the fishway. In consultation with the agencies, the following goals were set for the 1996 studies:

- Release six study cohorts (300-500 juveniles each) marked by elastomer injection into the impoundment and count recaptures in the fishway monitoring system. If available, also study post-spawned adult alewife passage. Complete study releases before early October when debris makes monitoring extremely difficult and unpredictable.

- Review fishway weir depth and backlighting for maximum efficiency conditions.

- Investigate use of a sound generator to deter fish from trashrack/turbine passage (with the goal of maximizing fishway efficiency). Use hydro acoustics to investigate the degree to which the sound generator affects alewife behavior.

2.2 Study Methods

2.2.1 Study Chronology and General Study Conditions

Table 1 (see Appendix 3) is a log of significant events for the 1996 fishway efficiency study. The fishway monitoring system was operational on August 12, 1996. The first efficiency test was begun on August 14, and the fishway monitoring system was operational until October 11. A total of eight efficiency tests was conducted, with the last study lot released on October 7.

Both fishway entrance weirs were operated to a depth of 13.5 inches through September 3, then with a depth of 16.0 inches. Both entrances were backlighted with a 50W metal halide floodlight in the gatewell just above water level throughout the study. In addition, on September 23 a 500W quartz floodlight was installed in front of each fishway entrance weir to increase attraction. During the August 12 through October 11 study period, only the main hydro unit (Unit No. 1) operated as there was insufficient flow to operate Units No. 21, 22, or 23. Average daily Androscoggin River flows were between approximately 1,300 and 4,400 cfs during the study period (see Table 2 in Appendix 3). There was no recorded spillage (other than from wave action) over the dam during the study period. River temperatures at Pejepscot were in the range of 53.9°F to 76.7°F as shown in Table 3 in Appendix 3.

2.2.2 Fishway Monitoring System Captures

All fish using the downstream fishway were captured in the two monitoring holding boxes for identification, counting, and observation of elastomer marks. The number of juvenile clupeids captured was usually estimated (because of the large number of fish), and the catch was scanned for the presence of juvenile shad.

From August 12 through October 11 the monitoring boxes were checked almost daily, and usually five or more times each day. Monitoring normally was conducted from 7:00 a.m. through late afternoon. Table 4 in Appendix 3 is a summary of captures of clupeids using the north and south fishway weirs and the total number using both weirs. Capture of species other than clupeids was also recorded.

2.2.3 Juvenile Clupeid Fishway Passage Tests

Marking Techniques/Protocol

All juvenile alewife marking was with the Visible Implant Fluorescent Elastomer Tagging System (Northwest Marine Technology, Inc.). With this method, a biocompatible, two part, elastomer material containing fluorescent coloring is injected into fish tissue using a hypodermic needle and air pressure. Within hours, this material cures into a pliable solid and a permanent well-defined mark. A low-light intensity situation with an ultraviolet light are used for best mark identification. We injected juveniles under the membranes on the gill covers (cheeks) behind both eyes. While time consuming to apply, this mark could be observed readily using an ultraviolet light. Four elastomer colors were used, (red, orange, green, and yellow (chartreuse); all colors were easily observed in the monitoring box, but yellow was used only once since it was more difficult to distinguish its pattern during injection.

Marking techniques/protocol varied among the eight study lots, with all changes in protocol intended to increase survival during marking and subsequent handling and holding prior to release. Study Lots 1 and 2 were handled as in 1995, i.e., fish were marked over a 2 day period, held in a livecar for 1 or 2 nights, and released on the third day. The logic was that this process would "cull out" the weakest fish and allow the remaining fish to recover from marking before release into the river. All marked fish were held in an aerated hopper until the end of marking each day and then transported (via tractor) to the livecar at the livecar mooring dock, approximately 200 feet above the intake structure.

Since recaptures of Lot 1 and (especially) Lot 2 marked fish were relatively low, it was decided to modify marking protocol to minimize handling and holding losses. Accordingly, Study Lots 3 through 7 were handled differently after the marking phase of the operation. For all lots, candidate fish were taken from the monitoring holding boxes, dip netted into a 100 gallon aerated hopper, and transported to the marking area. Approximately 25 fish were then dip-netted into a half-filled 5-gallon pre-marking bucket, and 5 to 10 of these fish were then placed in the marking tub (with MS-222 anesthetic) at a rate matched to marking speed to minimize the period of anesthetization. But while Lots 1 and 2 marked fish were stored in a recovery/transport hopper, Study Lots 3 through 7 fish were placed in a 5 gallon recovery bucket (25 fish per bucket) of fresh river water after marking and then immediately hand-carried to the livecar.

To further reduce handling and holding for Study Lot 8 each recovery bucket of fish was released from the livecar mooring dock after being hand-carried from the marking area and allowed to recover on the dock, i.e., these fish were released into the river within approximately 20 minutes of marking.

Juvenile Tests Conducted

Eight juvenile alewife tests were conducted, with 345 to 598 marked fish released for each study lot. All study lots were released from the livecar mooring dock (see Figure 1 in Appendix 4). Study Lots 1 through 7 were released as groups from a livecar, while Study Lot 8 was released by 25-fish bucketfuls soon after marking. Control fish for each study lot were held in a livecar for up to 22 days following study lot releases.

2.2.4 Survival of Study Lot Control Fish Held in a Livecar

Control fish from each of the eight study lot releases were held in a livecar to assess pre- and post-release survival of the marked fish. Control groups ranged from 24 to 50 fish, and they were monitored for 15 to 29 days.

Control groups were initially held separately but were intermingled as space was required for subsequent tests. These fish were not monitored daily late in the study period, but all groups except Lot 8 were monitored virtually daily through at least Day 12 following release of their matching study lots. For Study Lots 1 and 2 (which were marked over a 2 day period and held in a livecar for 1 or 2 nights before release) there were mortalities prior to release of the study lots. For Study Lots 3 through 8, the initial monitoring of control mortalities was at the same time as release of the study lot fish. Table 5 in Appendix 3 is a summary of survival of control fish.

2.2.5 Survival of Juvenile Alewife Subjected to Various Marking Treatments and Held in a Livecar

To attempt to gain insight into mortality of study juvenile alewife induced by various handling/marking techniques, separate groups of fish were subjected to different marking treatments and held in a livecar to monitor subsequent survival. Four separate treatments were assessed:

- No marking. No anesthetic (MS-222).
- Upper lobe candal fin clipped. Anesthetized with MS-222.
- Upper lobe candal fin clipped. Elastomer injection one cheek (side). Anesthetized with MS-222.
- Elastomer injection both cheeks (sides). Anesthetized with MS-222.
- No marking. No anesthetic. Held 5 hours in transport hopper and large number (approximately 800) held in one livecar to assess survival at higher livecar density.

These groups were monitored from 6 to 30 days. The groups were intermingled with some control fish which resulted in a small degree of miscounting, apparently due to loss of elastomer because of the delicate cheek membranes of smaller fish. Table 6 in Appendix 3 is a summary of the results of this testing.

2.2.6 Observation of Behavior of Juvenile Clupeids at Fishway Entrance Weirs

As time allowed and juvenile clupeids were migrating, their behavior was observed on several occasions at the fishway entrance weirs. Most observations were of the south weir because of more favorable visibility conditions. These were qualitative assessments; there was no attempt to record numbers of fish demonstrating specific behaviors.

2.2.7 Sound Deterrent System Trials and Monitoring

In discussing trials and monitoring of the sound deterrent system (SDS), it must be noted that this was not a major study goal, and that no statistically designed assessment was conducted. In fact, the combination of site variables and the short time span and inherent sporadic nature of juvenile alewife migration makes any statistically valid assessment a major study unto itself, and certainly far beyond the scope of this fishway efficiency study.

The SDS was installed to attempt to maximize fishway efficiency, and because other researchers have shown that sound can be an effective influence on behavior of alewife. Therefore, assessment of the performance of the SDS has been on a time available basis, with monitoring of fishway captures and marking fish having priority. Nevertheless, several trials were conducted and many short observations were made.

- On two occasions (overnight) the SDS was moved from its normal central location on the intake trashrack to as near as possible to the south fishway entrance weir (within about 12 feet) and captures in the north weir and south weir boxes compared.

- On one occasion (lasting 3 days) the SDS was moved as near as possible (about 12 feet) to the north fishway entrance weir and captures in the north weir and south weir monitoring boxes compared.

- All three SDS units were operated after release of Study Lots 1, 2, 3, and 5; the SDS was turned off after the release of Study Lot 4; and only the middle unit of the SDS was operated after the release of Study Lots 6, 7, and 8.

The strength of the SDS field intensity was measured on two occasions, August 8, 1995 and August 9, 1996. Table 7 in Appendix 3 is a summary of these measurements, and the locations of the measurements are shown in Figure 5 in Appendix 4.

2.2.8 Temperature and Dissolved Oxygen Measurements During Juvenile Alewife Marking Operation

On September 3, to document ambient temperature and dissolved oxygen (DO) conditions, a series of measurements was taken during various stages of the fish marking operations and in both the holding livecars. A summary of these measurements is in Table 8 in Appendix 3.

These measurements were taken during the marking of Study Lot 3, which was marked and released on September 3. Fish were collected from the monitoring holding box and transported to the marking area in the aerated hopper used in previous studies. Up to approximately 36 fish were dip-netted from the hopper and into a half-filled 5-gallon pre-marking bucket, and then fish were transferred to the marking tub (containing MS-222 anesthetic) in small groups (5 to 10), as determined by the rate of marking, to ensure the shortest necessary period of anesthetization. After marking, fish were placed in a 5-gallon recovery bucket (25 fish per bucket) of fresh river water and hand quickly carried to a livecar immediately after marking. Reject fish (not marked) were removed from the pre-marking bucket and held in a second aerated hopper until the completion of that day's marking operation, then released below the dam.

2.2.9 Size Sampling of Juvenile Alewife

A size sample was taken for each marked study lot; actually recaptures of each lot were measured for a sample. These data are in Table 2 in Appendix 3. In addition, numerous size samples were taken from the monitoring holding boxes throughout the study period. These data are in Table 9 in Appendix 3.

2.3 Study Results

2.3.1 Fishway Monitoring System Captures

Estimated captures of juvenile alewife in the fishway monitoring system holding boxes during the August 12 through October 11 study period totaled approximately 534,000 fish, with approximately 275,000 taken in the North weir box and approximately 259,000 in the South weir box (see Table 4 in Appendix 3). For the 50 days of monitoring counts, the highest daily North weir box count was approximately 67,000 fish, the highest South weir box count was approximately 84,000 fish, and the highest combined count was approximately 93,000 fish (North box approximately 9,000; South box approximately 84,000). Comparing daily North and South weir box counts, the North box count was higher on 28 days, the South box count on 19 days, and the counts were essentially the same on 3 days.

Seasonally, there were several peaks of emigration: August 12 and 13 (approximately 15,800 fish); August 15 through 21 (approximately 97,400 fish); September 3 through 6 (approximately 25,878 fish); September 11 (approximately 6,150 fish); September 20 through 24 (approximately 41,883 fish); and an extensive period from September 26 through October 9 (approximately 339,397 fish). On a daily basis, most captures were during strong daylight, specifically 3 hours after sunrise to 3 hours before sunset. There were few captures during hours of darkness. During daylight there were two peaks of use of the fishway, prior to noon and late afternoon. Figure 4 in Appendix 4 shows the ambient environmental and study conditions prevailing throughout the study, the number of juvenile clupeids passing the fishways, and the seasonality of the releases of marked study fish.

With the intensive monitoring effort in 1996 the weir boxes were kept reasonably free of debris and overflowing and potential loss of fish occurred for a short period on only one day (October 6). Only two post-spawning (adult) alewife and one adult shad were captured. Only 43 juvenile shad were observed, all between October 4 and 11. Although it is possible more shad may have been mixed with larger captured groups and not observed, none were noted during the marking operations, and it is not likely that there was a significant juvenile shad emigration in 1996.

The following non-clupeid species were also captured:

Species	Number	Size (inches)
Smallmouth bass	2	3-11
Largemouth bass	26	2.5-12
White perch	20	9-12
Chain pickerel	1	9
Common sucker	1	16
Golden shiner	12	3-4
Banded killifish	3	3
Rainbow smelt	1	3
Fallfish, Common Shiner	60±	1.3-4

Further regarding the presence of various large predator species in the vicinity of the fishways, Richard Arsenault conducted sampling by angling in the area of the intake trashracks and below the dam under the fishway monitoring system platform. Adult largemouth and smallmouth bass, white perch, and eel were easily caught, and these fish were large enough to be effective predators on numbers of juvenile alewife. Two largemouth bass (9 and 11 inches) taken in the fishway monitoring system contained recently eaten juvenile alewife.

2.3.2 Juvenile Alewife Fishway Passage Tests

Table 10 in Appendix 3 is a summary of the results of the eight tests of fishway passage of marked juvenile alewife. The conditions/variables prevailing for each of the eight study lots are shown in Table 2 in Appendix 3.

The size of the study lots was 345 to 598 fish and the fishway passage efficiencies ranged from 13.0 percent to 40.9 percent with the following distribution:

Study Lot	Fishway Efficiency %
1	19.0
2	14.9
3	18.1
4	23.9
5	19.0
6	40.9
7	13.0
8	31.0

Overall, for the eight study lots (totaling 3,356 marked fish released) there were 732 recaptures and an unweighted average efficiency of 21.8 percent.

Marked fish captures were monitored from 5 to 59 days after release, with seven of the eight study lots monitored for 11 days or longer; for Lot 8, which was monitored only 5 days, there were no recaptures after day 3. The distribution of recaptures was as follows:

Study Lot	Recapture Distribution
1	All by Day 6
2	All by Day 5, except 1 on Day 41
3	Through Day 15, only 1 after Day 9
4	Through Day 18
5	Through Day 13
6	All by Day 8
7	All by Day 5
8	All by Day 3, but monitoring only through Day 5

With notable exceptions, there was a general pattern to the distribution of recaptures. For all study lots except Lot 8 the most recaptures were on Day 2; for Lot 8 the most recaptures were on Day 1. For all lots except Lot 5, recaptures were predominantly on Days 1 through 3; for Lot 5 there were smaller but nearly equal recapture numbers on Days 2, 4, 7, 8, and 10. Lots 4 and 5 showed continuing recaptures through Days 18 and 13, respectively.

For the lots released at 7:40 a.m. (Lot 1) and 11:00 a.m. (Lot 2) there were only 1 and 3 recaptures, respectively, on Day 1. However, for Lot 8, which was released in small groups from 8:56 a.m. through 4:00 p.m., there were 69 recaptures on Day 1. There were virtually no recaptures on Day 1 for Lots 3 through 7 which were released between 4:15 p.m. and 6:30 p.m., but there was also virtually no checking of the monitoring system until 7:00 a.m. on Day 2.

2.3.3 Survival of Juvenile Alewife Control Fish Held in a Livecar

For each study lot, a control group of 24 to 50 fish was held in a livecar for a period of 15 to 29 days to check on marking/handling survival. The results of the survival monitoring are shown in Table 5 in Appendix 3.

With the exception of Lot 8, virtually all controls died during the period of monitoring; for Lot 8 monitoring was terminated on Day 15 with approximately 25 percent of the controls still alive. There were some minor discrepancies between the number of controls used and total control mortalities (i.e., small undercounts and overcounts) due to intermingling of the groups and a low level of elastomer loss from the most fragile-membraned smaller fish.

The distribution of mortalities varied among the control groups, with Lots 1, 2, and 3 having the most mortalities within 5 days. Lots 4 and 5 had initial lower mortality and total mortalities distributed over a long period. Lots 6, 7, and 8 had virtually no mortalities until Day 4 with total mortalities then low until after approximately Days 13 and 15. A paired comparison of 50 marked and 50 unmarked fish of Lot 7 showed a very similar mortality pattern.

Variables potentially influencing differing survival rates and timing as the study progressed were:

- Refining of marking technique and more rapid marking.
- Different/improved marking and holding protocols.
- Lower water temperature.
- Larger study fish.
- Availability of food organisms in the livecar.

2.3.4 Survival of Juvenile Alewife Subjected to Various Marking Treatments and Held in a Livecar

To check on survival related to various marking/holding scenarios, five tests were conducted using several treatments and these groups were held in livecars for 5 (one group) to 30 (four groups) days. Table 6 in Appendix 3 is a summary of the results of this testing.

The treatments assessed were:

- T1 - unmarked, no anesthetization
- T2 - Upper lobe of caudal fin clipped, anesthetized with MS-222
- T3 - Upper lobe of caudal fin clipped, elastomer injection under membrane of one cheek, anesthetized with MS-222
- T4 - Elastomer injection under membrane of both cheeks, anesthetized with MS-222.
- T5 - To check on livecar density, approximately 800 fish were subjected to only holding 5 hours in an aerated transportation hopper before placement in a livecar.

There were no striking differences in the degree or pattern of mortalities among tests, except that, contrary to intuition, T1 and T2 fish had higher initial mortality than either T3 or T4, and T4 had later and lower mortalities than T3. For T5, based on percentage, mortalities were higher than the other test groups for the 6 days held, but the estimate of an 800 fish group may well have been low, with a corresponding lower percentage mortality.

2.3.5 Observation of Behavior of Juvenile Clupeids at Fishway Entrance Weirs

On a time-available basis, a number of observations were made of juvenile clupeid behavior at the north and south fishway weirs, especially the south weir. Visibility was much better at the south weir, especially when the metal flow guide was in place. Typically, south weir fish would orient with the current, head upstream, and slowly drop back over the weir. However, significant numbers of fish would swim back upstream and back into the impoundment in front of the weir. On one occasion (August 19) it was possible to observe fish moving in an out of the weir while fish were being collected in the fishway monitoring system.

Juvenile clupeids were observed feeding approximately 15 feet in front of the small turbine trashracks in strong current. These fish would rise from deeper water (2 to 3 feet) to feed on the smallest flying ants drifting on the surface. Feeding movements were very fast.

Similarly, in late afternoon near dusk, juvenile clupeids were observed feeding heavily on insects in front of the large turbine trashracks. These fish actually leapt from the water to take small insects in flight several inches above the water surface.

2.3.6 Sound Deterrent System Trials and Monitoring

The strength of the SDS was measured twice, on August 8, 1995 and August 9, 1996. The results of these measurements are shown in Table 7 in Appendix 3 and the locations of the measurements are shown in Figure 3 in Appendix 4. In general, the field was uniform with the highest intensity close to the center of the trashrack and at a depth of 5 feet. The intensity near the fishway entrance weirs was low and highest at a depth of 5 feet. This was the pattern of influence intended when the SDS was installed, but the weaker intensities at the fishway entrance weirs could still be a deterrent, which could be counterproductive to moving the fish to the weirs.

To attempt to assess the effectiveness of the SDS to improve fish passage efficiency, the SDS was moved nearer both the North and South fishway entrance weirs, and the SDS was turned off after the release of Study Lot 4 and restricted to the central unit only after the release of Study Lots 6, 7, and 8. On August 20 at 2:40 p.m. the SDS was moved to within approximately 12 feet of the South entrance weir; the following morning there were 3,000 juvenile alewives in the North weir box of the monitoring system, and only 800 in the South box. This test was repeated on August 22 at 9:30 a.m.; on the next morning there were 150 alewives in the north weir box and 100 in the south box. Similarly, on August 23 at 1:30 p.m. the SDS was moved to within 12 feet of the North entrance weir and remained there until 2:25 p.m. on August 26. On August 24 there were 100 alewife in the North box and 300 in the South box, and on August 26 there were 50 alewife in the North box and 500 in the South box. Consistently, captures in each monitoring holding box were higher when the SDS was positioned nearer the opposite fishway entrance weir.

Regarding study lot recaptures, the following fishway efficiency results were achieved for the three SDS scenarios:

SDS Scenarios

3 Units on	No SDS	Middle Unit Only
Lot 1 - 19%	Lot 4 - 23.9%	Lot 6 - 40.9%
Lot 2 - 14.9%		Lot 7 - 13.0%
Lot 3 - 18.1%		Lot 8 - 31.0%
Lot 5 - 19.0%		

2.3.7 Temperature and Dissolved Oxygen Measurements During Juvenile Alewife Marking Operation

On September 3, during the marking of Study Lot 3, temperature and DO measurements were taken at various stages of the operation, and in the holding livecars. The results are in Table 8 in Appendix 3. The ambient river temperature was 72.5°F to 73.1°F on this day, the temperature range in the various stages of the marking operation was 70.0°F to 73.5°F, and the temperatures in the two livecars were approximately 73°F. The lower marking operation temperature can be explained by the fact that the marking was done in a building where the shade created cooler ambient conditions, i.e., the marking water actually cooled somewhat with time.

For DO, the livecar level was 8.2 mg/L and 94 percent saturation. In the marking process, DO ranged from 4.88 mg/L to 8.21 mg/L and 55 to 94 percent saturation, with the lowest concentrations in the pre-marking bucket. This bucket contained approximately 2.5 gallons of water and up to 36 fish at a time for periods of 15 to 25 minutes. However, the pre-marking bucket water was changed after marking of each batch of 25 fish.

2.3.8 Size Sampling of Juvenile Alewife

The size of juvenile alewife generally increased gradually as the study progressed. Table 2 in Appendix 3 shows the size of the study lot fish, and Table 9 in Appendix 3 shows sample sizes taken between August 21 and October 2. Study lot fish ranged from an average length of 84.0 mm and a range of 78.0 to 91.0 mm for Lot 1 to an average of 99.7 mm and a range of 85.0 to 109.0 mm for Lot 8. The seasonal samples ranged from an average of 75.3 mm and a range of 60.0 to 99.0 mm on August 21, to an average of 100.5 mm and a range of 82.0 to 114.0 mm on September 28. Fish up to 135.0 mm and averaging 128.0 mm were observed on September 27 but these were intentionally selected as the largest fish captured on that day.

Section 3

Discussion and Agency Consultation

The primary goal of the 1996 studies was to determine Pejepscot downstream fishway efficiency for juvenile clupeids. Efforts would also be made to review fishway weir depth and backlighting for maximum efficiency conditions, to investigate the use of a sound generator to maximize fishway efficiency, and to investigate the degree to which the sound generator affects alewife behavior. It is also necessary to comply with the FERC requirement regarding determination of the need for any changes in project structures or operations, or for any further studies. This section discusses these goals.

3.1 Fishway Efficiency

The eight study lot releases resulted in "raw" fishway efficiencies in the range of 13.0 to 40.9 percent, with an overall average of 21.8 percent. These are minimal efficiencies because they do not take survival of the study lots into consideration. The control fish held in livecars for each study lot were intended to provide survival data to adjust the raw efficiencies to more accurate estimates.

Tables 11 through 18 (see Appendix 3) summarize the data collected for the eight study lots and a method of incorporating control fish survival to determine a reasonable adjustment of the raw efficiency data. The adjustment method groups all fishway recaptures and control survival for the entire period during which there were fishway recaptures. This method has been used for studies on the Merrimack River. The following text table summarizes the results of these efficiency adjustments:

Study Lot	Raw Efficiency	Grouped Data Efficiency
1	19%	95%
2	14.9%	66%
3	18.1%	87%
4	23.9%	149%
5	19%	53%
6	40.9%	64%
7	13%	14%
8	31%	31%

The 149 percent adjusted efficiency for Lot 4 is obviously an outlier, and if we discard this lot and the poorest return (Lot 7), the range of adjusted efficiencies for the remaining six lots was 31 to 95 percent, with an average of 66 percent.

3.2 Other Study Goals and Findings

The major goal of the 1996 studies was to determine the efficiency of the downstream fishway. There were secondary goals related to the effects of weir depth and backlighting, the SDS, and weir attraction lighting on fishway efficiency, but efforts towards these goals were governed by available time and unfavorable study conditions, and the primary study goal. Only a limited number of lots of study fish could be released and monitored for fishway passage during the field season, and decisions on controllable variables were made with the overriding goal of providing what appeared to be study conditions most likely to produce the highest fishway efficiency rather than exploring all potential variable combinations.

3.2.1 Weir Depth

Only two weir depths were used in 1996, 13.5 and 16.0 inches. The full flow capacity of the fishway weirs could not be tested due to a backwater associated with the monitoring system. To minimize injury to fish the dewatering system relies on an upwelling flow box to absorb energy. The water then goes over a weir to provide a uniform flow down the dewatering screen. The test system was installed as a retrofit with the working platform braced off the existing walls. Minimizing the platform size while providing a safe working area required making the pipe penetrations on the upper end of the slope. Thus the physical head to provide a full flow was not available.

1996 study results did not indicate any difference in fishway efficiency related to the two weir depths. When the monitoring system is removed for normal fishway operation the full weir capacity can be passed.

3.2.2 Weir Backlighting

Since fish passage literature indicates that ambient level backlighting is desirable, there was no attempt to study this variable in the field.

3.2.3 The Sound Deterrent System

Some testing of the SDS was accomplished by operating with all three sound units on and in the center of the trashrack for four efficiency tests (range of 14.9 to 19.0 percent; average 17.8 percent), with all sound units off for one test (23.9 percent), and with only on unit on and in the central position for three tests (range of 13.0 to 40.9 percent; average 28.3 percent). These results do not document that the SDS increased fishway efficiency.

To test sound location, all three units were moved from the usual central location to approximately 12 feet from the North and South weirs, respectively, for three short periods. During these periods, captures in the monitoring system North and South weir holding boxes were consistently higher when the SDS was nearest the opposite fishway weir. These results indicate that the SDS "moves" juvenile clupeids away from the sound source.

Due to the presence of numbers of other species in the area of the trashrack, and the inability to accurately detect instantaneous reaction of fish when the SDS was turned on, no definitive data were acquired using the sound monitoring system.

3.2.4 Attraction Lighting

The attraction lighting in front of the fishway weirs was not installed until the release of study Lot 6, and was in place when efficiencies of 40.9, 13.0, and 31.0 percent were achieved. Therefore, it is possible that this lighting improved fishway efficiency.

3.3 Project Fish Passage Efficiency

In addition to the capture of marked fish it is estimated that a total of over 0.5 million downstream migrating juvenile clupeids used the fishway in 1997. Marked and unmarked fish were captured August 12 through October 11, and it is known that there was additional fish migration before and after the monitoring period.

As the spillway gates were closed during the entire study period, it is assumed that the juvenile clupeids not using the downstream fishway facilities migrated past the project via the powerhouse. Based upon the estimated efficiency of the Pejepscot fishway facility, about 34 percent of the total population of downstream migrating fish passed through the turbine, as has been the case in all prior years.

A telltale sign of fish kill by a hydro turbine is the intensity of bird feeding downstream from the plant. Since inception of the downstream migration studies in 1991, particular attention has been paid to the behavior of bird feeding activity downstream from the project. At no time has there been any significant bird feeding activity at Pejepscot. The plant operators and fishway attendants characterize bird activity downstream from the plant as occasional indicating there is no fish kill at Pejepscot.

To substantiate the conclusion that the Pejepscot turbine will safely pass juvenile clupeids, text Table 19 summarizes the Pejepscot turbine characteristics and those of similar turbines at which turbine survival studies have been made. It is seen from Table 19 that the Pejepscot summarizes the Pejepscot turbine characteristics and those of similar turbines at which turbine survival studies have been made. It is seen from Table 19 that the Pejepscot turbine has 4 blades as compared to 5 to 7 blades of the studied turbines. The rated head and the turbine speed (RPM) is also significantly lower (more favorable) than the turbines tested.

Another factor not listed in Table 19 but considered favorable for fish passage through a turbine is the runner setting. At Pejepscot, the runner centerline is submerged below tailwater by more than 6 feet.

The measured efficiency of the tested turbines is summarized below in text Table 20. It is seen from Table 20 that survival varied from 92.9 percent to 100 percent excluding one test of the Safe Harbor turbine which was affected by an unusual event unrelated to safe turbine passage; additionally, the Safe Harbor turbine is not a Kaplan turbine.

It is the licensee's belief, based on tests of similar turbines and observation of bird feeding activity in the Pejepscot tailrace, that the Pejepscot turbine has a very high passage survival rate estimated to be in excess of 90 percent.

TABLE 19

Comparison of hydraulic and physical characteristics of Pejepscot Project Kaplan turbine with other similar low-head hydroelectric dams equipped with Kaplan type turbines where turbine passage survival studies on juvenile clupeids were conducted using the HI-Z Turb'N Tag recapture technique.

	SAFE HARBOR, PA		**HADLEY FALLS, MA**		**CRESCENT, NY**	**CONOWIDO, MD**	**PEJEPSCOT, ME ***
Turbine type	Kaplan	Mixed Flow	Kaplan	Fixed Propeller	Kaplan	Mixed Flow	Kaplan
Manufacturer	I.P. Morris S.M. Smith	Allis Chalmers	N/A	N/A	Voith Hydro	Voith Hydro	Allis Chalmers/ Voith Hydro
Number of blades or buckets	5	7	5	5	5	6	4
Rated head (ft)	55	55	50	50	27	90	24
Approx. flow @ rated output (cfs)	8,300	9,200	1,550	2,500	1,500	10,000	7,000
RPM	109	77	128	150	144	120	82
Runner diameter maximum (in)	220	240	169	169	108	225	217
Water passage diameter at runner (in)	220	241	169	169	108	225.5	217
Blade tip speed (fps)	105	80	N/A	N/A	68	118	77
Number of wicket gates	20	20	N/A	N/A	16	24	24
Space between wicket gates (in)	30	25	N/A	N/A	27	23	25.5
Percent wicket gate opening at most efficient setting	86	90	N/A	N/A	83	N/A	20

* Centerline of runner 6.5 ft. below normal tailwater.

Source: Adapted January 1994 report prepared for Central Maine Power Company Cataract Project (FERC No. 2528-Saco River) by RMC Environmental Services, Inc.

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TABLE 20

Comparison of survival rates of juvenile clupeids in passage through low-head hydroelectric dams equipped with Kaplan type turbines. Studies utilized the HI-Z Turb'N Tag recapture technique to estimate turbine passage survival.

Location	Turbine Type or Operation Mode Tested[b]	Discharge/ Unit (cfs)	Species	Size (mm)	Number Tested[a]	Physically Recovered(%)		Survival (%) Short-term (1 h)	Survival (%) Long-Term (48 h)
						Test	Control		
Safe Harbor, PA	Mixed flow/efficient gate Normal	9200	American shad	95-140	100	91	92	98	100
	Mixed flow/efficient gate Vented	9200	American shad	95-140	99	94	98	99	67[d]
	Kaplan/efficient gate	8300	American shad	95-140	100	99	99	98	98
Hadley Falls, MA	Kaplan/100% gate	4200	American shad	55-110	100	76	76	97	[c]
	Kaplan/35% gate	1550	American shad	55-110	100	81	78	100	
	Fixed Propeller/100% gate	4200	American shad	55-110	120	74	83	89	
Crescent, NY	Kaplan/efficient gate	1520	Blueback herring	77-105	125	84	86	96	96
Conowingo, MD	Mixed flow/55-57% gate (inefficient)	8000	American shad	100-149	108	88	93	94.9	92.9

a Test specimens; normally equal number of control specimens also released.
b Station characteristics presented in Table 19
c Not determined because of high control mortality and vandalism.
d High control mortality associated with sudden increase in turbidity and lower water temperature.

Source: Adapted from January 1994 report prepared for Central Maine Power Company Cataract Project (FERC No. 2528-Saco River) by RMC Environmental Services, Inc.

3.4 Agency Consultation

The draft of this report was discussed at an agency consultation meeting on February 18, 1997 (see report of this meeting in Appendix 2). DMR (March 14, 1997) and USFWS (April 11, 1997) have provided comments on the draft report and the consensus reached at the consultation meeting (see correspondence in Appendix 2).

In summary, while USFWS does not concur that the fishway efficiency and turbine passage conclusions presented in this report are completely supported by the study results, the agencies concur that no further studies of downstream fishway effectiveness are indicated at this time. Both agencies reserve the option of further studies sometime in the future, with any such studies deferred until other target species and life stages (i.e. adult river herring and American shad and Atlantic salmon) are more abundant, or until information collected at other comparable hydroelectric projects indicates that additional modifications should be evaluated at Pejepscot. USFWS recommends: (1)Annual agency consultation to discuss the status of anadromous fish runs in the Androscoggin River and to evaluate the need for developing additional study plans, and (2) That the licensee file a summary of each annual meeting with FERC and MDEP.
Regarding project and downstream fishway facilities and operation, the agencies recommend the following measures:

- Operate the downstream fishways at design flow.
- Backlight the fishway entrance weirs.
- Maintain records to document fishway flows and maintenance of the downstream passage facilities.
- Provide attraction lights in front of the fishway entrance weirs.
- Operate the sound deterrent system at the center of the trashrack during the downstream passage migration period.
- Operate the large turbine in a first-on/last-off mode during the downstream migration period. The small units should not be operated unless the large turbine is at capacity or during an emergency/maintenance outage of the large unit.

Section 4
Conclusions and Recommendations

Based on the results of the 1991 through 1996 feasibility, fishway effectiveness and fishway efficiency studies, and the DMR and USFWS recommendations regarding study results and the need for future studies, the licensee understands that the agencies have concluded that no continued study of downstream fish passage facilities is indicated. However, the agencies do have definite recommendations regarding downstream passage facilities modifications and operation and project operation.

Therefore, based on current agency recommendations, the licensee proposes the following facilities and operational scenarios for future operation of the Pejepscot Hydroelectric Project:

- The fishway monitoring system used for the effectiveness and efficiency studies will be bypassed and the fishways will be run at design flow.
- The fishway entrance weirs will be backlighted.
- Attraction lights will be provided in front of the fishway entrance weirs.
- The sound deterrent system will be operated with one unit at the center of the trashrack.
- The large turbine will be operated in a first-on/last-off mode. The small units will not be operated unless the large turbine is at capacity or during an emergency/maintenance outage of the large unit.
- Records will be maintained to document fishway flows and maintenance of the downstream passage facilities.
- Annual agency consultation meetings will be held to discuss the status of anadromous fish runs in the Androscoggin River, and to evaluate the need for developing additional study plans. The licensee will also file a summary of each annual meeting with FERC and MDEP by April 1 of each year.

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April 21, 1997

APPENDICES

APPENDIX 1

FERC ORDER APPROVING STUDY PLANS AND SCHEDULE

FERC ORDER APPROVING 1994 FISHWAY EFFICIENCY STUDY PLAN

FERC ORDER APPROVING 1995 FISHWAY EFFICIENCY STUDY PLAN

FERC ORDER APPROVING EXTENSION OF TIME AND 1996 FISHWAY EFFICIENCY STUDY PLAN

UNITED STATES OF AMERICA 55 FERC 62,092
FEDERAL ENERGY REGULATORY COMMISSION

Topsham Hydro Partners
Chrysler Capitol Corporation
Utilco Group, Inc.

Project No. 4784-030
Maine

ORDER APPROVING FISH PASSAGE STUDY PLAN
(Issued April 30, 1991)

On March 26, 1991, Topsham Hydro Partners, Chrysler Capitol Corporation, and Utilco Group, Inc. (licensees) filed a fish passage study plan for the Pejepscot Project as required by Commission order dated June 28, 1990. The order required the licensees to consult with federal and state fish resource agencies and develop a plan and schedule for evaluating the efficiency of the upstream and downstream fish passage facilities at the project. The order also required that the licensees develop a plan and schedule for effectuating changes in project structures or operations if the results of the studies indicate that such are needed to provide adequate fish passage.

The licensees' proposed upstream fish passage study would consist of tagging adult alewives at the downstream Brunswick fishway, releasing these fish into the Brunswick impoundment, and counting the fish that pass through the Pejepscot fishway. Fishway efficiency would be determined by comparing total Brunswick and Pejepscot fishway counts and from results of tagged fish counting. All Atlantic salmon, brown trout, other resident salmonids, and smallmouth bass would also be counted. The study would be conducted during May through June of 1991 and 1992. The progress report for the 1991 season and the 1992 study plan would be available in March 1992. In September 1992, a draft report of 1991-1992 studies would be given to the fishery agencies for review. The final report of the upstream fish passage efficiency study would be filed with the agencies and the Commission in March 1993.

The licensees' proposed downstream fish passage study would be more complex due to the small size and fragility of juvenile alewives, the difficulty of sampling in the project's two tailraces, and the need for development of a site specific plan. Thus, the downstream study plan would consist of three phases: (1) a feasibility study to assess site specific practicability of various study methods; (2) method effectiveness studies; and (3) finally, passage efficiency studies. Observations of bird activity in the vicinity of the tailrace would also be recorded. Study methods would be based on studies being conducted at hydropower projects on the Sebasticook River, which to date have investigated video camera monitoring of entrance weirs and floating net pens to capture fish at the fishway discharge. Phase 1 would be conducted during June through November 1991. In February 1992, the licensee would meet with the fishery agencies to review the feasibility of various study methods. Phase 2 effectiveness studies would take place during May through November 1992 and June through November 1993. The licensees would then meet with the fishery agencies to review a draft of the 1992 study results. A final progress report and 1993 study plan would be submitted to the agencies in February 1993. During 1994, similar meetings and report filing would occur after the phase 2 study is completed. Phase 3 efficiency studies would commence in May 1994 and continue through November 1994. A progress report and final 1995 study plan would be available to the fishery agencies in March 1995. The second year of the efficiency study would be conducted during June through November 1995. The final report on downstream passage study would be filed with the agencies in March 1996.

On February 28, 1991, the licensees, the U.S. Fish and Wildlife Service (FWS), and the Maine Department of Marine Resources (DMR) met to review the draft of the study plan. The Maine Atlantic Sea Run Salmon Commission (ASRSC) commented by letter dated February 22, 1991. DMR and FWS provided comments on the February 28th meeting in letters dated March 11, 1991. The licensees' consultant also extracted comments from the Maine Department of Inland Fisheries and Game and the ASRSC via telephone on March 14 and March 11, 1991, respectively. Review of the meeting minutes and agency correspondence on licensees' filing indicates general agreement with the study proposal.

The licensees' upstream fish passage study proposal is reasonable, includes agency requests, and should be approved with additions. The progress report for the first year of study should be filed with the Commission and, for Commission approval, any changes deemed necessary for the second study year. Further, as the agencies have indicated, sufficient numbers of American shad and Atlantic salmon native to the Androscoggin River are not available at this time to assess passage of these species at the project. Thus, the requirement to study fish passage efficiency must be flexible to permit continuation of the study if desired when American shad and Atlantic salmon are available in sufficient numbers. Also, the licensees' schedules do not indicate whether the final report would include plans and schedules for making changes in project structures or operations, if necessary to provide adequate upstream fish passage. The final report for the study should include such plans and schedules as appropriate.

The licensees' downstream fish passage study, on the other hand, is less definitive in delineating the study methods to be used. After each year of each phase of the study, the licensee proposes to meet with the fishery agencies to review the previous year's results and then proffer a plan for the ensuing year of the study. Annual progress reports and explicit plans for each ensuing year of the downstream fish passage study should be filed with the Commission for approval. For phase three of the study, the elected study plan filed for approval should include agency comments on the elected study method. Further, the additions noted above for the upstream passage study should also apply to the downstream passage study.

The Director orders:

(A) The fish passage study plan and schedule filed on March 26, 1991, is approved, except as modified by paragraphs B through C. The licensee shall complete the study and file final reports on the upstream and downstream tasks of the study and, for Commission approval, any recommendations for changes in project structures or operations if needed to provide adequate fish passage, by May 1, 1993 and May 1, 1996, respectively. Plans and schedules for any changes shall be developed after consultation with the U.S. Fish and Wildlife Service, the Maine Department of Marine Resources, the Maine Atlantic Sea Run Salmon Commission, and the Maine Department of Inland Fisheries and Game. If the study results indicate that further studies are needed for alewife, of when Atlantic salmon or American shad are present in sufficient numbers, the reports shall also contain plans and schedules for such, also developed after consultation with the aforementioned agencies. The Commission reserves the right to require changes to the plans and schedules to be provided above.

(B) At least 60 days prior to initiation of the second season of the upstream fish passage study or by March 1, 1992, the licensee shall file the first year's study results, and for Commission approval, any changes deemed necessary for the ensuing study year. The Commission reserves the right to require changes to the plans.

(C) Exclusive of the initial year of phase one of the downstream fish passage study, the licensee shall file an annual progress report of the preceding study year and, for Commission approval, the study plan for the ensuing year by: March 1, 1992; April 1, 1993; March 1, 1994; and April 1, 1995. The Commission reserves the right to require changes to the plans and schedules to be provided above.

(D) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. 385.713.

J. Mark Robinson
Director, Division of Project
Compliance and Administration

UNITED STATES OF AMERICA 67 FERC 62, 085
FEDERAL ENERGY REGULATORY COMMISSION

Topsham Hydro Partners,
Chrysler Capitol Corporation,
and Utilco Group, Inc.

Project No. 4784-047
Maine

ORDER APPROVING FISHWAY EFFICIENCY STUDY PLAN
(ISSUED MAY 2, 1994)

On February 25, 1994, Topsham Hydro Partners, Chrysler Capitol Corporation, and Utilco Group, Inc. (licensees) filed progress report no. 3 on the results of downstream fish passage studies conducted during 1993 at the Pejepscot Project, pursuant to the Order Approving Fish Passage Study Plan, issued on April 30, 1991.1 That order requires, in part, the filing of annual progress reports on the evaluation of the downstream fish passage facility at the project and, for Commission approval, the study plan for each ensuing year. A final report on downstream fish passage with recommendations for changes in project structures or operations, if found necessary through the study, is due May 1, 1996.

The Pejepscot Project is located on the Androscoggin River and has a total of four turbine/generator units that discharge into the project's two tailraces. A relatively new 12.5 megawatt (MW) turbine (Unit 1) discharges into the project's "Tailrace A," while three older 0.5 MW units (Units 22, 23, and 24) discharge into the project's "Tailrace B."

The downstream fish passage facility at the project consists of two surface weirs, one on either side of the intake to the project's large turbine. These weirs regulate flow into two transport pipes (24-inch and 36-inch diameter), that discharge into Tailrace B.

The downstream fish passage evaluation for 1993 comprised the second and final year of phase 2 of the approved five-year study to assess the effectiveness of the downstream fish passage facility at the project. During 1993, the final elements of the monitoring and capture system were installed/fabricated and tested. The licensees report that the equipment worked well.

For 1994, the equipment and methods developed and employed during phase 2 will be used for the phase 3 efficiency studies. Up to six efficiency tests will be conducted using at least 500 alewives for each test. Experiments with immersion staining will continue, as will monitoring for the presence of American shad

1 55 FERC 62,092 (1991).

and observation of gull and cormorant behavior in the tailrace areas. During the study, marked fish will be released approximately 100 feet upstream of the dam/fishway.

The licensees report that the state and federal fishery agencies are in agreement with the study facilities and proposed methods of study. The licensees report, however, that the U.S. Fish and Wildlife Service requested that the study, at some point, address the effectiveness for collecting downstream migrants that are released farther than 100 feet upstream, i.e., at 1000 feet distance.

The licensees' proposed fish release point is adequate for this first year of the efficiency phase of the study. Depending on the outcome, more distant release points may be appropriate for the ensuing years' study.

The proposed activities assessing the efficiency of the downstream fish passage facilities at the project are appropriate and should be approved.

The Director orders:

(A) The licensees' plan for the 1994 evaluation of the effectiveness of the downstream fish passage facilities at the Pejepscot Project, filed on February 25, 1994, is approved.

(B) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. 385.713.

J. Mark Robinson
Director, Division of Project
Compliance and Administration

ATTACHMENT A

UNITED STATES OF AMERICA 71 FERC 62, 028
FEDERAL ENERGY REGULATORY COMMISSION

Topsham Hydro Partners,
Chrysler Capitol Corporation,
and Utilco Group, Inc.

Project No. 4784-050
Maine

ORDER APPROVING FISHWAY EFFICIENCY STUDY PLAN
APRIL 14, 1995

On April 6, 1995, Topsham Hydro Partners, Chrysler Capitol Corporation, and Utilco Group, Inc. (licensees) filed progress report no. 4 on the results of downstream fish passage studies conducted during 1994 at the Pejepscot Project. The filing was made under the Order Approving Fish Passage Study Plan, issued on April 30, 1991.1

Background

The Pejepscot Project is located on the Androscoggin River and has a total of four turbine/generator units that discharge into the project's two tailraces. A relatively new 12.5 megawatt (MW) turbine (Unit 1) discharges into the project's "Tailrace A," while three older 0.5 MW units (Units 22, 23, and 24) discharge into the project's "Tailrace B."

The downstream fish passage facility at the project consists of two surface weirs, one on either side of the intake to the project's large turbine. These weirs regulate flow into two transport pipes (24-inch and 36-inch diameter), that discharge into Tailrace B.

The Commission's April 30, 1991 order requires, in part, the filing of annual progress reports on the evaluation of the downstream fish passage facility at the project and the study plan for each ensuing year through 1995. The order also reserves the right to the Commission to require changes to the plans and schedules for the next year's study. A final report with recommendations, for Commission approval, for any changes in project structures or operations, found necessary from the study, is due to be filed with the Commission on May 1, 1996.

Study results and recommendations

The downstream fish passage evaluation for 1994 comprised phase 3 of the approved five-year study to assess the downstream fish passage facility at the project. Equipment and methods developed and employed during 1993 were used for the phase 3

1 55 FERC 62,092 (1991).

efficiency studies. During 1994, the first of two scheduled years of mark and recapture efficiency studies was completed.

The goal of the 1994 study was to determine how many of the emigrating juvenile alewives approaching the project dam pass via the downstream fishways. For the tests, the fishway entrance weirs were operated at depths of one foot and, for two of the five tests, both entrances were backlighted with quartz floodlights in the gatewells.

Five efficiency tests were conducted using from 221 to 484 alewives for each test. The first three tests using stained juvenile clupeids realized efficiencies of 1.0, 2.4, and 2.8 percent. The low efficiencies were attributed, in part, to poor stain retention making identification difficult. The fourth and fifth tests, employing floy-tagged juveniles, showed efficiencies of 10.4 and 19.5 percent. There was no reported problem with identification during these tests.

Experiments with marking juvenile alewives continued after poor results in 1994 with stained fish. It was concluded that an elastomer injection system, although time consuming to apply, would be the best method for ease of observation.

For 1995, the fifth year of the required five-year study, the licensees propose to continue the mark and recapture efficiency studies using the elastomer injection system. Again, the goal will be to conduct at least 6 tests using from 300 to 500 juvenile alewives for each test. Fishway entrance weir depth and backlighting will be reviewed for best efficiency and the use of sound to deter fish from the trashracks will be investigated. Hydroacoustics will be used to study how sound affects the alewives. The licensees also will study upstream fishway efficiency under spill conditions if such conditions exist during 1995.

Agency comments

By letters dated March 10 and 13, 1995, the U.S. Fish and Wildlife Service and the Maine Department of Marine Resources, respectively, concur with the licensees' proposed studies for 1995. Both agencies noted the poor fishway efficiency results for the 1994 tests.

Discussion and conclusions

The tests proposed for assessing the efficiency of the downstream fish passage facilities at the Pejepscot Project for 1995 are appropriate and should be approved. The marking procedure should remedy some of the problems encountered during the 1994 studies.

The tests to be performed in 1995 are the last required by the Order Approving Fish Passage Study Plan, issued on April 30, 1991, with a final report due by May 1, 1996. That report is required to contain any recommendations, for Commission approval, for changes to project structures or operation found necessary from the five year downstream passage study. However, the results of the downstream passage monitoring during 1994 were less than consistent, show poor efficiencies, and provide little direction towards defining solutions to downstream passage problems at the project. Depending on the results of the tests to be conducted in 1995, changes to the facility and further testing will likely be required. The Commission's April 30, 1991 order provides for further study if the study results indicate the need for such.

The Director orders:

(A) The licensees' plan for the 1995 evaluation of the effectiveness of the downstream fish passage facilities at the Pejepscot Project, filed on April 6, 1995, is approved.

(B) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. 385.713.

J. Mark Robinson
Director, Division of Project
Compliance and Administration

(1) O. Erickson
(2) File

UNITED STATES OF AMERICA75 FERC ¶62,046
FEDERAL ENERGY REGULATORY COMMISSION

Topsham Hydro Partners,)
Chrysler Capitol Corporation,)
and Utilco Group, Inc.)

Project No. 4784-052
& 053

ORDER APPROVING EXTENSION OF TIME AND
FISHWAY EFFICIENCY STUDY PLAN
Issued April 19, 1996

On March 25, 1996, Topsham Hydro Partners, Chrysler Capitol Corporation, and Utilco Group, Inc. (licensees) filed progress report no. 5 on the results of downstream fish passage study conducted during 1995 at the Pejepscot Project and, for Commission approval, the 1996 study plan. The licensees also filed a request for a one-year extension of time to May 1, 1997, to file a final report on downstream fish passage study, including any measures for necessary modifications to project structures. The filings were made under the Order Approving Fish Passage Study Plan, issued on April 30, 1991. 1/ The project is located on the Androscoggin River in Cumberland and Androscoggin counties, Maine.

BACKGROUND

The Pejepscot Project and has a total of four turbine/generator units that discharge into the project's two tailraces. A relatively new 12.5 megawatt (MW) turbine (Unit 1) discharges into the project's "Tailrace A," while three older 0.5 MW units (Units 22, 23, and 24) discharge into the project's "Tailrace B."

The downstream fish passage facility at the project consists of two surface weirs, one on either side of the intake to the project's large turbine. These weirs regulate flow into two transport pipes (24-inch and 36-inch diameter) that discharge into Tailrace B.

The Commission's April 30, 1991 order requires, in part, the filing of annual progress reports on the evaluation of the downstream fish passage facility at the project and the study plan for each ensuing year through 1995. The order also reserves the right of the Commission to require changes to the plans and schedules for the next year's study. A final report with recommendations, for Commission approval, for any changes in project structures or operations, found necessary from the study, is due to be filed with the Commission on May 1, 1996.

1/ 55 FERC ¶ 62,092

STUDY RESULTS AND RECOMMENDATIONS

The downstream fish passage evaluation for 1995, as proposed by the licensees and approved by Commission order issued April 14, 1995, 2/ required the licensees to continue the mark and recapture efficiency studies using the elastomer injection system. The goal was to conduct at least 6 tests using from 300 to 500 marked juvenile alewives for each test. Fishway entrance weir depth and backlighting were to be reviewed for best efficiency and the use of sound to deter fish from the trashracks was also to be investigated, with hydroacoustics used to study how sound affects the alewives. The licensees were also to study upstream fishway efficiency under spill conditions if such conditions were found to exist during 1995.

During 1995, the licensees assessed elastomer injection methods, modified the fishway inlet weir, replaced the 500-watt overhead floodlights used in 1994 with less intense lighting, and installed a sound deterrent system at the intake trashrack. A hydroacoustics system was also installed on the south forebay wall to monitor fish behavior resulting from the use of the sound deterrent system. Severe drought conditions extending from April through late October, however, interfered with the study.

During the downstream migration period, Androscoggin River flow was 58.0 to 43.7 percent of normal in August and September, respectively, then suddenly rose to 162.6 and 251.5 percent in October and November 1995. During the drought flow period, very few juvenile alewives moved downriver from their production lakes. During the high flow period, when most of the alewives migrated, spillage precluded accurate study of the efficiency of the downstream fish passage facility. Further, what fish were captured for study during the drought period were American shad juveniles, which experienced almost complete mortality during handling and marking.

Because of the atypical river conditions in 1995, which precluded completion of the fishway efficiency study, the licensees propose to extend the study for another year with the same study goals in 1996 as in 1995, i.e., to release and monitor passage of six lots (approximately 300 fish each) of elastomer-marked juvenile alewives (and adults if available) and to use the sound deterrent system to maximize fishway efficiency. The licensees also requested an extension of time to May 1, 1997, to file the final report on the downstream passage study.

2/ 71 FERC ¶ 62,028

AGENCY COMMENTS

By letters dated February 21 and 22, 1996, the Maine Department of Marine Resources and the U.S. Fish and Wildlife Service, respectively, concurred with the licensees' need to extend the downstream fish passage study for at least another year. Both agencies noted the atypical flow conditions prevented completion of the study.

DISCUSSION AND CONCLUSIONS

Androscoggin River flow conditions precluded the licensees from completing the fish passage efficiency study in 1995 and from being able to file the final report on the study by May 1, 1996, as required by our April 30, 1991 order. Therefore, it is appropriate that their request to continue the study during 1996 using the same goals and methods previously approved for 1995 and to file a final report on results of the study, including any measures for necessary modifications to project structures, by May 1, 1997, be approved.

The Director orders:

(A) The licensees' plan for the 1996 evaluation of the effectiveness of the downstream fish passage facilities at the Pejepscot Project, filed on March 25, 1996, is approved.

(B) The licensees' March 25, 1996 request for a one-year extension of time to May 1, 1997, to file a final report on downstream fish passage studies, including any measures for necessary modifications to project structures, is approved.

(C) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. § 385.713.

J. Mark Robinson
Director, Division of Project
Compliance and Administration

APPENDIX 2

AGENCY CONSULTATION

DMR COMMENT LETTER OF FEBRUARY 21, 1996

USFWS COMMENT LETTER OF FEBRUARY 22, 1996

REPORT OF FEBRUARY 18, 1997 AGENCY CONSULTATION MEETING

DMR COMMENT LETTER OF MARCH 14, 1997

USFWS COMMENT LETTER OF APRIL 11, 1997

Angus S. King, Jr.
Governor

Robin Alden
Commissioner

DEPARTMENT OF MARINE RESOURCES

Telephone (207) 624-6550
FAX (207) 624-6024

February 21, 1996

Charles F. Ritzi
NORTHROP, DEVINE & TARBELL INC.
500 Washington Avenue
Portland, ME 04103

RE: Pejepscot Project, FERC #4784
Downstream Facility Efficiency Studies

Dear Mr. Ritzi:

This letter is a followup to the agency consultation meeting of February 14, 1996 to review the ***1995 Downstream Passage Efficiency Study*** results.

- Fishway Efficiency Study - No study was conducted due to lack of juvenile alewives caused by drought conditions (few alewives were able to leave nursery areas because of decreased flows)
- Fishway Entrance Weir Modification - No assessment could be made due to absence of fish
- Sound Deterrent & Hydroacoustic Monitoring of Fish Behavior at the Intake - Both systems appear to function properly but larger numbers of fish are needed to make final assessment

Due to lack of information obtained in 1995, we feel that the studies should be extended for another year with the goals being the same as those of 1995.

Sincerely,

MALCOLM E. SMITH
STOCK ENHANCEMENT DIVISION

MES/jcw
cc Lewis N. Flagg, Division Director
Gordon Russell, USFWS
Olaf Erickson, Independent Hydro

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4986

REF: FERC #4784

February 22, 1996

Mr. Charles F. Ritzi
Northrup, Devine & Tarbell, Inc.
500 Washington Avenue
Portland, Maine 04103

Dear Mr. Ritzi:

We have reviewed the results of your 1995 downstream fish passage studies at the Pejepscot Hydroelectric Project, located on the Androscoggin River. We concur with your conclusion that abnormal runoff conditions during the downstream migration period in 1995 precluded collection of meaningful data, and with your recommendation that the studies be repeated in 1996. We understand that this will require getting a one-year extension from the Federal Energy Regulatory Commission on the deadline for completing the downstream passage investigations.

We ask that you notify us when the studies are to begin this year so that we can arrange for a site visit. If you have any questions, please contact Gordon Russell at (207) 827-5938.

Sincerely yours,

Michael J. Bartlett
Supervisor
New England Field Office

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NORTHROP, DEVINE & TARBELL, INC.
ENGINEERING AND ENVIRONMENTAL SCIENCE

February 20, 1997

PEJEPSCOT PROJECT (FERC NO. 4784)
REPORT OF AGENCY CONSULTATION MEETING

ATTENDEES:	Lewis Flagg - Department of Marine Resources Malcolm Smith - Department of Marine Resources Gordon Russell - U.S. Fish & Wildlife Service Olaf Erickson - Independent Hydro Developers Jon Truebe - Lakeside Engineering Richard Arsenault - Aqua-Bio Tech Charles Ritzi - Northrop, Devine & Tarbell, Inc.
DATE OF MEETING:	February 18, 1997
LOCATION:	Department of Marine Resources, Augusta, Maine
PURPOSE:	**To review 1996 downstream fishway study results and draft of final report to FERC**

The Atlantic Salmon Authority (ASA), Department of Inland Fisheries and Wildlife (DIFW), and Department of Environmental Protection (DEP) were notified of the meeting but did not attend.

The 1996 draft final report was reviewed with agreement on the following items:

1. The 1996 mark/recapture studies documented effective downstream passage of juvenile clupeids and no further studies are recommended at this time.
2. No evidence of turbine passage mortality (e.g., bird feeding activity) has been observed at Pejepscot, as opposed to observations at other projects.
3. Based on the studies at Pejepscot and the general literature/experience available on downstream passage, the Pejepscot downstream facilities should be operated in the following mode:
   - the study backlighting should be maintained;
   - the study attraction lighting should be maintained;
   - the study sound deterrent system should be maintained, but with only one sound unit located at the center of the trashracks; and
   - the fishway entrance weirs should be operated with the deeper study setting, i.e., 16 inches.

NDT

4. The graph showing the relationship of site/study variables to the total number of juvenile clupeids using the fishway should be included in the final report, with addition of study lot release dates and flows/temperatures during the two-week period preceding fishway monitoring.
5. The final report should describe in detail the downstream passage facilities configuration and operating procedures, e.g., weir flow, period of operation, lighting.
6. Relevant information on downstream passage facilities determined at other sites may be used to fine-tune future facilities operation at Pejepscot, e.g., use of backlighting and attraction lights.
7. Determination of effectiveness for shad and Atlantic salmon may be indicated sometime in the future, depending on the status of these restorations.
8. DMR and USFWS will provide comments for inclusion in the final report. USFWS comments will be issued after review by Ben Rizzo, Fish Passage Consultant.

Prepared by Charles F. Ritzi on February 20, 1997. If there should be corrections or revisions to this report, please contact Charles F. Ritzi as soon as possible.

CFR/bp

cc: Attendees
E. Baum (ASA)
J. Boland (DIFW)
S. Timpano (DIFW)
D. Murch (DEP)
File

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Angus S. King, Jr.
Governor

Robin Alden
Commissioner

DEPARTMENT OF MARINE RESOURCES

Telephone (207) 624-6550
FAX (207) 624-6024

RECEIVED
MAR 27 1997
INDEPENDENT HYDRO DEVELOPERS, N.F.

14March97

Olaf Erickson
INDEPENDENT HYDRO DEVELOPERS, INC.
473 Third Street, Suite 301
Niagara Falls, NY 14301

RE: 1996 Downstream Passage Studies
Pejepscot Hydro - FERC #4784

Dear Mr. Erickson:

We have reviewed the ***1996 Downstream Fish Passage Studies*** at the Pejepscot Project subsequent to our staff's 18Feb97 meeting with you and offer the following comments and recommendations:

The Licensee has expended an extensive amount of time and effort to evaluate the efficiency of downstream passage facilities at the Pejepscot Project. Based on mark/recapture test results of eight study lots of fish, the unadjusted average efficiency was 21.8%, ranging from 13.0 to 40.9%. Although unadjusted study results fall short of our goal of ≧ 90% downstream passage efficiency, we recognize that study results represent the minimum percentage of safe passage of juvenile alewives past the project. We do not recommend any further downstream passage efficiency studies at this site. Based on the 1996 study, we recommend that the downstream passage facilities be operated in accordance with conditions and weir settings that produced the best test passage results (Test Lots 4, 6 and 8) as follows:

1. Set the downstream passage weir depth at a minimum of 16"
2. Backlight the weir entrances
3. Provide attraction lights in front of the weir entrances
4. Operate the sound deterrent system at the center of the trash rack during the downstream passage migration period

These operational conditions should be maintained unless future study results at other comparable sites indicate that fine tuning future operations at Pejepscot could enhance downstream passage efficiency.

Thank you for the opportunity to review and comment on these study results. If you have any questions, please contact our staff scientist, Lewis Flagg, at (207) 624-6341.

Sincerely,

ROBIN ALDEN
COMMISSIONER

RA/jcw
cc Charles Ritzi, NDT
Steve Timpano, IF&W
Ed Baum, ASA
Dana Murch, DEP
Gordon Russell, USF&WS
Lewis Flagg, DMR
Jon Kurland, NMFS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4986

April 11, 1997

REF: FERC #4784

Mr. Olaf Erickson
Independent Hydro Developers, Inc.
473 Third Street, Suite 301
Niagara Falls, New York 14301

Dear Mr. Erickson:

We have reviewed the final report on the evaluation of downstream fish passage facilities at the Pejepscot Hydroelectric Project, located on the Androscoggin River in Maine. We offer the following comments:

General

The final report is the culmination of a 6-year study (1991-96), which was designed to evaluate juvenile clupeid (river herring) passage at the existing downstream migrant facilities at the Pejepscot Project. The evaluation was done by marking, releasing and recapturing test fish in an experimental facility that was designed specifically for the study. The work included an evaluation of various settings of the two, 4-ft. wide bypass weirs to determine the effectiveness of various attraction flows. This was supplemented with experiments using flow guides (weir shaping devices) and behavioral measures (lights and sound).

In general the results of the studies indicate relatively low efficiency of the downstream passage facilities at the Pejepscot Project. The unadjusted average for eight study lots was roughly 22 percent, which is far below the fishery agencies' goal of 90 percent bypass efficiency. We believe that the effectiveness would have increased if the full bypass flow (40 cfs per weir) had been used and evaluated. Unfortunately, the study design and experimental equipment limited bypass flows to less than half of what they were designed to use.

We are also concerned about the excessive mortality (up to 80 percent) of juvenile clupeids that were used as controls in the study. As discussed in the report, the rate of mortality observed for the controls was used to adjust the raw bypass efficiency results for the study lots, which increased the average efficiency from 22 to 66 percent. Such high rate of mortality among control fish is uncharacteristic, based on the results of other downstream passage studies. Accordingly, while some adjustment of the raw data may be in order, we question whether the average should be raised to as much as 66 percent. Moreover, the reported turbine flow was much lower than the capacity for the project during the 1996 study period. A higher generating flow would probably have increased the reported entrainment of fish at the project.

The report also discusses the potential survival of fish that are entrained into the turbine flow, with the speculation that mortality is probably low due to the absence of significant feeding activity by gulls and other birds immediately below the project during the downstream migration period. While it is true that modern, large generating units, such as the one at Pejepscot, are likely to inflict less injury and mortality than older, smaller turbines, additional studies would have to be conducted to quantify survival of turbine-passed fish. Thus we cannot yet agree that overall downstream passage of juvenile clupeids at the project is meeting agency objectives.

Specific Comments

Pg 5 - Section 2.2.1--Study Chronology and General Study Conditions

The reported turbine flow (large unit only) during the August 13 to October 11 study period ranged from 1,050 to 4,146 cfs with a median value of approximately 1,890 cfs. This is only 27 percent of the rated 7,000 cfs turbine flow of the large unit and 23 percent of the rated total project turbine flow (4 units: total 8,100 cfs). The normal mean flow in the Androscoggin River at the Auburn gaging station during the August, September and October migration period is approximately 3,097, 3,191 and 4,095 cfs, respectively. Thus, the flows were below normal during the study period, which probably resulted in lower turbine entrainment than would otherwise be expected.

Pg 14 - Section 2.3.2--Fishway Passage Tests

The low bypass efficiency of 22 percent (unadjusted average for the eight test runs) is likely due to the magnitude of the bypass flows that were evaluated in the study (only 15 to 19 cfs, as opposed to the design flow of 40 cfs). It is unclear why monitoring of each test ran beyond three days after release of the fish, when a shorter period of time would probably have been sufficient for any "active migrants" released within 200 ft. of the project forebay to pass the facility.

Pg 15 - Section 2.3.3 -- Survival of Control Fish

It is unfortunate that the control fish experienced such high rates of mortality, as this makes any adjustment of the raw bypass efficiency data problematic. As indicated in the report, the later study lots (6 - 8) suffered less mortality (especially during the first several days of observation). If any adjustment of raw data is to be done, it should be based on the higher rates of survival exhibited by the later study lots.

Pg 17 - Section 2.3.5 -- Observations at Fishway Weirs

In addition to observing the behavior of juvenile clupeids at the fishway entrance weirs, an attempt should have been made to describe and document the surface flow field at each bypass. This includes the zone of influence, flow vectors, changes in bypass flow field under various turbine discharges, eddy formation in the forebay, etc.

Pg 21 - Section 3.1 -- Fishway Efficiency

Due to the high rates of mortality of the control fish in lots 1 - 5, any adjustment of raw bypass efficiency should be based only on the survival of control lots 6 - 8. If this approach were taken, the adjusted bypass efficiency would be approximately 36 percent. (The adjusted efficiency for study lot No. 4, which was calculated to be 149 percent, indicates that the mortality of the control fish in the early study lots should not be used to modify the raw data.)

Pg 22 - Section 3.2.1 -- Weir Depth

It is unfortunate that physical limitations of the monitoring/recapture equipment prevented an evaluation of the 40 cfs design flow for the bypass weirs. Although the study did not find any difference in efficiency using bypass flows in the range of 15 - 19 cfs, we would expect the use of the downstream passage system to increase with the full design flow.

Pg 23 -24 - Section 3.3 - Fish Passage Efficiency

The estimate of the numbers of fish passing through the turbine (34 percent) is based on the calculated adjusted bypass efficiency (66 percent). As discussed above, the adjusted efficiency is probably no more than 36 percent, and would be less using only the raw data. This means that passage of fish through the turbines is probably at least 64 percent, and may be even higher, especially considering the fact that the project was operating well below rated capacity during the study.

Determining the survival of fish that become entrained in the turbine flow at Pejepscot was not an objective of this study. Additional investigation would be needed to test the licensee's belief that the large turbine at Pejepscot has a fish survival rating in excess of 90 percent.

Pg 27 - Section 3.4 - Conclusions

Due to the high mortality of the control fish, we disagree with the conclusion that the mean adjusted bypass efficiency is approximately 66 percent. Using survival data for the later control lots, a more realistic adjusted bypass efficiency is about 36 percent for the median turbine flow (1,890 cfs) that occurred during the study. The bypass efficiency would probably be even less for higher turbine flows. Since the full design flow of 40 cfs per weir was not evaluated in this study, it remains to be seen whether downstream passage at Pejepscot is meeting agency goals.

Recommendations

Based on the results of the downstream passage studies conducted to date at the Pejepscot Project, we have the following recommendations:

1. Operate the current downstream passage facilities at Pejepscot at the design flow of 40 cfs per bypass weir with surface backlighting to enhance emigration of all target species. Maintain records to document bypass flows and maintenance of the downstream passage facilities.

2. Operate the large turbine at Pejepscot so that it is the first on, and last off line during the downstream migration period. The small units at the project should not be operated unless the large turbine is at capacity or during an emergency/maintenance outage of the large unit.

3. Plan to conduct additional effectiveness studies at Pejepscot at some future date, when so advised by state and federal fishery agencies. The current downstream passage studies focused only on juvenile clupeids. It will likely be necessary to evaluate the effectiveness of the downstream fishway for adult clupeids (river herring and American shad) and Atlantic salmon. However, the size of the clupeid and salmon runs in the Androscoggin River is still relatively small. We recommend that future downstream passage studies be deferred until other target species and life stages are more abundant, or until information collected at other comparable hydroelectric projects indicates that additional modifications should be evaluated at Pejepscot. (We suspect that such additional studies would not have to be conducted for at least five years.) However, in order to not lose touch with downstream passage issues at the project, we recommend that the licensee convene an annual meeting with the fishery agencies to discuss the status of anadromous fish runs in the Androscoggin River and to evaluate the need for developing additional study plans. The licensee should also keep the Federal Energy Regulatory Commission and the Maine Department of Environmental Protection advised on issues related to downstream passage at the project, by filing a summary of the annual meeting with the fishery agencies.

We appreciate the opportunity to provide comments on the results of the downstream passage studies at the Pejepscot Project. If you have any questions, please contact Gordon Russell at (207) 827-5938 or Ben Rizzo at (617) 244-1368.

Sincerely yours,

Michael J. Bartlett
Supervisor
New England Field Office

cc: NMFS, Gloucester (C. Mantzaris)
RO/EN (Ben Rizzo)
ME DEP, Augusta (Dana Murch)
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APPENDIX 3

TABLE 1 - LOG OF SIGNIFICANT EVENTS FOR 1996 PEJEPSCOT FISHWAY STUDY

TABLE 2 - SUMMARY OF CONDITIONS DURING 1996 PEJEPSCOT FISHWAY STUDY

TABLE 3 - 1996 ANDROSCOGGIN RIVER WATER TEMPERATURES (°F) TAKEN THREE FEET IN FRONT OF THE CENTER OF THE PEJEPSCOT PROJECT TRASHRACK, AT A DEPTH OF THREE FEET, USING AN APELCO DEPTH FINDER

TABLE 4 - ESTIMATED CAPTURES OF JUVENILE ALEWIFE IN FISHWAY MONITORING SYSTEM DURING 1996 PEJEPSCOT FISHWAY STUDY

TABLE 5 - SURVIVAL OF 1996 PEJEPSCOT PROJECT FISHWAY STUDY JUVENILE ALEWIFE CONTROL FISH KEPT IN A LIVECAR AFTER RELEASE OF MARKED STUDY LOTS

TABLE 6 - SUMMARY OF TESTS OF MORTALITY OF JUVENILE ALEWIFE HELD IN A LIVECAR AFTER VARIOUS MARKING TREATMENTS

TABLE 7 - RESULTS OF PEJEPSCOT PROJECT DETERRENT SOUND SYSTEM FIELD INTENSITY MONITORING, AUGUST 8, 1995 AND AUGUST 9, 1996

TABLE 8 - TEMPERATURE AND DISSOLVED OXYGEN MEASUREMENTS DURING PEJEPSCOT PROJECT JUVENILE ALEWIFE ELASTOMER MARKING ON SEPTEMBER 3, 1996

TABLE 9 - JUVENILE ALEWIFE SIZE SAMPLES FROM 1996 PEJEPSCOT PROJECT FISHWAY MONITORING SYSTEM RECAPTURES

TABLE 10 -SUMMARY OF RECAPTURES OF MARKED JUVENILE ALEWIFE 1996 PEJEPSCOT FISHWAY STUDY

TABLE 11 THROUGH 18 - SUMMARIES OF INDIVIDUAL STUDY LOT DATA AND ADJUSTMENTS FOR CONTROL FISH SURVIVAL

TABLE 1
LOG OF SIGNIFICANT EVENTS FOR 1996
PEJEPSCOT FISHWAY STUDY

DATE	EVENT
8/12/96	Began operation of fishway monitoring system; entrance weir depths 13.5 inches, both weir lights on and trash boom in place. Began marking juvenile alewife study Lot 1.
8/13/96	Finished marking study Lot 1. Sound deterrent system turned on, (all three units) at 9:00 a.m..
8/14/96	Released study Lot 1 at 7:40 a.m.; 384 elastomer marked fish released and 26 kept for controls.
8/15/96	Began marking study Lot 2.
8/16/96	Finished marking study Lot 2.
8/17/96	Released study Lot 2 at 11:00 a.m.; 598 fish released and 34 kept for controls.
8/19/96	Began observations of juvenile alewife behavior in entrance weirs.
8/20/96	Began testing of survival in livecars using several different marking treatments.
8/26 - 28/96	Impoundment drawn down 0.5 foot during work day for welding/painting on dam. Entrance weirs opened to 16.5 inches deep to compensate and maintain flow.
9/3/96	Marked study Lot 3. Released 393 fish at 4:20 p.m. Kept 24 fish for controls. Opened both entrance weirs to 16.0 inches deep.
9/6/96	Trash boom breaks, removed and not replaced. Lots of debris in south weir and south monitoring box; box overflowed, possible loss of some marked study fish. Removed metal flow guides from entrance weirs.
9/10/96	Marked study Lot 4. Released 440 fish at 4:15 p.m. Kept 25 fish for controls.
9/17/96	Marked study Lot 5. Released 420 fish at 5:40 p.m. Kept 25 fish for controls.
9/23/96	Marked study Lot 6. Released 345 fish at 6:30 p.m. Kept 50 fish for controls. Installed attraction lights above both entrance weirs. Sound deterent system reduced to middle unit only.
9/30/96	Marked study lot 7. Released 376 fish at 6:20 p.m. Kept 50 marked and 50 unmarked fish for controls.
10/7/96	Marked study Lot 8. Released 400 fish, in 25 fish lots, from 8:56 a.m. through 4:08 p.m. Kept 50 fish for controls.
10/11/96	Terminated fishway monitoring. No recaptures or downstream movement of unmarked fish since October 9. Adverse monitoring conditions. Continued monitoring of control fish until October 21.

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SUMMARY OF CONDITIONS DURI

STUDY LOT AND PERCENT RECAPTURES	LENGTH OF RECAPS (MM)	WATER TEMP (°F) WHEN MARKED	MARKING TREATMENT	RELEASE DATE AND TIME	TRASH BOOM	
Lot 1 (ORANGE) 19.0%	X=84.O RANGE 78-91 (N=23)	~°73	Marked two days, one or two nights, in livecar, recovery in hopper throughout marking period. Transport to livecar via hopper and tractor, after all of the fish were marked.	Aug. 14 7:40 a.m.	Yes	Y
Lot 2 (YELLOW) 14.9%	X=84.8 RANGE 75-93 (N=63)	~°73-°74	Same as Lot 1	Aug. 17 11:00 a.m.	Yes	Y w o 3 6
Lot 3 (GREEN) 18.1%	X=87.8 RANGE 72-110 (N=59)	~°72-°73	Marked and released same day. Recovery in small groups in bucket and hand-carried to livecar soon after marking. Released after all fish were marked.	Sept. 3 4:20 p.m.	Yes, but only until Sept. 6	Y w o 3 6

* Flows are daily averages

BLE 2
NG 1996 PEJEPSCOT FISHWAY STUDY

WEIR LIGHTS	WEIR DEPTH (INCHES)	WEIR FLOW GUIDES	SOUND SYSTEM	ATTRACT LIGHTS	CONDITIONS AFTER RELEASE			
					DATE	FLOW IN CFS *		WEATHER FIRST TWO DAYS
						RIVER	TURBINE	
es	13.5	Yes	On 3 Units	No	8/13 8/14 8/15 8/16	3644 4117 4125 4093	3374 3847 3855 3823	First day sunny Second day Overcast
es, but N eir light f Aug. to Sept.	13.5	Yes	On 3 Units	No	8/17 8/18 8/19 8/20 8/21 8/22 8/23 8/24 8/25 8/26 8/27	2539 2710 2384 2696 2753 2561 2760 2387 2060 1790 2433	2369 2440 2114 2426 2483 2291 2490 2117 1790 0 2163	Both Days Sunny
es, but N eir light f Aug. to Sept.	16.0 on Sept. 3	Yes, but removed Sept. 6	On 3 Units	No	9/3 9/4 9/5 9/6 9/7 9/8 9/9	2128 1966 1320 1666 1541 1684 2047	1858 1696 1050 1396 1271 1414 1777	

STUDY LOT AND PERCENT RECAPTURES	LENGTH OF RECAPS (MM)	WATER TEMP (°F) WHEN MARKED	MARKING TREATMENT	RELEASE DATE AND TIME	TRASH BOOM
Lot 4 (RED) 23.9%	X=96.7 RANGE 82-110 (N=55)	~°69-°71	Same as Lot 3	Sept. 10 4:15 p.m.	No
Lot 5 (ORANGE) 19.0%	X=86.2 RANGE 73-97 (N=56)	~°66	Same as Lots 3 and 4	Sept. 17 5:40 p.m.	No
Lot 6 (GREEN) 40.9%	X=97.9 RANGE 77-113 (N=71)	~°64	Same as Lots 3 through 5	Sept. 23 6:30 p.m.	No
Lot 7 (RED) 13.0%	X=100.1 RANGE 83-121 (N=54)	~°62	Same as Lots 3 through 6	Sept. 30 6:20 p.m.	No
Lot 8 (ORANGE) 31.0%	X=99.7 RANGE 85-109 (N=156)	~°54-56	Same as Lots 3 through 7, Except each bucket of fish released at livecar dock within 20 to 40 minutes of marking	October 7 all day 8:56 a.m. thru 4:08 p.m.	No

* Flows are daily averages.

WEIR LIGHTS	WEIR DEPTH (INCHES)	WEIR FLOW GUIDES	SOUND SYSTEM	ATTRACT LIGHTS	CONDITIONS AFTER RELEASE			
					DATE	FLOW IN CFS *		WEATHER FIRST TWO DAYS
						RIVER	TURBINE	
Yes	16.0	No	Off	No	9/10 9/11 9/12 9/13 9/14 9/15 9/16	2128 2115 2047 3928 2433 3920 4164	1858 1845 1777 3658 2163 3650 3894	Overcast Day 1, sunny Days 2 and 3.
Yes	16.0	No	On 3 units	No	9/17 9/18 9/19 9/20 9/21 9/22	4290 4416 4322 4180 2006 1639	4020 4146 4052 3910 1736 1369	Both days overcast, wind, and rain
Yes	16.0	No	On, but middle unit only	Yes	9/23 9/24 9/25 9/26 9/27 9/28 9/29	1657 1824 2033 1698 1824 1702 1715	1387 1554 1763 1428 1554 1432 1445	Both days sunny
Yes	16.0	No	On, but middle unit only	Yes	9/30 10/1 10/2 10/3 10/4 10/5 10/6	1748 3578 2597 2040 2230 1844 1582	1478 3308 2327 1770 1960 1574 1312	Both days clear
Yes	16.0	No	On, but middle unit only	Yes	10/7 10/8 10/9 10/10 10/11	1666 1530 2504 2189 3570	1396 1260 2234 1919 3300	First day sunny, second and third days rain.

Table2.D10 048100.00/8.0 CR/bp(#1) December 12, 1996

TABLE 3

1996 ANDROSCOGGIN RIVER WATER TEMPERATURES (°F) TAKEN THREE FEET IN FRONT OF THE CENTER OF THE PEJEPSCOT PROJECT TRASHRACK, AT A DEPTH OF THREE FEET, USING AN APELCO DEPTH FINDER

AUGUST			AUGUST			SEPTEMBER			SEPTEMBER			SEPTEMBER		
DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F
12	7:00 A.M.	73.0°	24	9:50 A.M.	75.3°	3	6:56 A.M.	72.5°	10	3:57 P.M.	70.9°	20	10:50 A.M.	64.3°
13	7:00 A.M.	73.0°	26	6:53 A.M.	73.4°		4:31 P.M.	73.1°	11	8:30 A.M.	68.9°		2:35 P.M.	65.6°
15	7:00 A.M.	73.0°		11:42 A.M.	74.2°	4	6:59 A.M.	71.2°		12:25 P.M.	70.3°	21	7:15 A.M.	65.4°
19	1:45 P.M	74.5°		1:30 P.M.	75.0°		10:40 A.M.	72.5°		2:55 P.M.	70.9°		9:50 A.M.	65.9°
20	7:00 A.M.	74.0°		2:25 P.M.	75.6°		12:37 A.M.	72.9°	12	6:58 A.M.	70.0°	23	7:49 A.M.	64.2°
	10:55 A.M.	74.1°	27	6:55 A.M.	74.5°	5	6:54 A.M.	72.6°		12:28 P.M.	70.8°		5:31 P.M.	64.5°
	12:20 P.M.	74.7°		9:25 A.M.	74.7°		8:30 A.M.	72.7°		2:31 P.M.	70.7°	24	6:56 A.M.	62.0°
21	6:50 A.M.	74.4°		10:54 A.M.	74.9°		10:10 A.M.	72.9°	13	7:00 A.M.	68.6°		2:25 P.M.	64.8°
	1:00 P.M.	75.0°		12:25 P.M.	75.4°		12:25 P.M.	75.1°		9:35 A.M.	68.5°		4:50 P.M.	62.9°
	2:10 P.M.	75.3°		2:41 P.M.	76.1°		1:43 P.M.	75.8°	14	8:33 A.M.	66.9°		5:06 P.M.	62.7°
22	6:45 A.M.	73.4°	28	6:55 A.M.	74.0°		2:33 P.M.	76.7°		10:05 A.M.	66.9°		5:30 P.M.	62.6°
	9:30 A.M.	74.2°		9:46 A.M.	74.1°	6	6:57 A.M.	73.7°	16	7:20 A.M.	66.1°	25	5:38 A.M.	61.0°
	11:03 A.M.	74.3°		10:42 A.M.	73.5°		8:58 A.M.	74.0°	17	7:10 A.M.	66.1°		9:31 A.M.	61.3°
	12:18 P.M.	75.6°		12:09 P.M.	74.5°		9:43 A.M.	74.1°		12:06 P.M.	66.1°		12:40 P.M.	61.3°
	2:28 P.M.	76.4°		1:40 P.M.	75.1°		1:08 P.M.	74.9°		5:30 P.M.	66.4°	26	6:25 A.M.	60.0°
23	6:57 A.M.	74.5°	29	6:54 A.M.	73.5°		2:33 P.M.	75.8°	18	7:02 A.M.	65.7°		3:30 P.M.	61.2°
	9:03 A.M.	75.5°		8:40 A.M.	73.6°	7	9:00 A.M.	74.1°		9:45 A.M.	65.5°	27	6:45 A.M.	59.4°
	10:40 A.M.	75.8°	30	6:56 A.M.	73.4°		9:50 A.M.	74.1°		2:50 P.M.	65.4°		9:31 A.M.	59.6°
	12:15 P.M.	76.1°		8:10 A.M.	73.7°	9	7:03 A.M.	71.3°	19	7:02 A.M.	63.4°		2:06 P.M.	60.6°
	1:35 P.M.	76.5°		9:53 A.M.	73.0°		8:50 A.M.	71.1°		12:31 P.M.	64.1°	28	12:30 P.M.	60.8°
	2:40 P.M.	76.7°	31	8:45 A.M.	73.1°	10	7:00 A.M.	69.2°		2:20 P.M.	64.3°	29	2:23 P.M.	63.0°
24	8:45 A.M.	74.6°		10:20 A.M.	73.3°		11:30 A.M.	69.5°	20	7:03 A.M.	64.0°	30	12:55 P.M.	62.2°

TABLE 3

1996 ANDROSCOGGIN RIVER WATER TEMPERATURES (°F) TAKEN THREE FEET IN FRONT OF THE CENTER OF THE PEJEPSCOT PROJECT TRASHRACK, AT A DEPTH OF THREE FEET, USING AN APELCO DEPTH FINDER

AUGUST			AUGUST			SEPTEMBER			SEPTEMBER			SEPTEMBER		
DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F
12	7:00 A.M.	73.0°	24	9:50 A.M.	75.3°	3	6:56 A.M.	72.5°	10	3:57 P.M.	70.9°	20	10:50 A.M.	64.3°
13	7:00 A.M.	73.0°	26	6:53 A.M.	73.4°		4:31 P.M.	73.1°	11	8:30 A.M.	68.9°		2:35 P.M.	65.6°
15	7:00 A.M.	73.0°		11:42 A.M.	74.2°	4	6:59 A.M.	71.2°		12:25 P.M.	70.3°	21	7:15 A.M.	65.4°
19	1:45 P.M	74.5°		1:30 P.M.	75.0°		10:40 A.M.	72.5°		2:55 P.M.	70.9°		9:50 A.M.	65.9°
20	7:00 A.M.	74.0°		2:25 P.M.	75.6°		12:37 A.M.	72.9°	12	6:58 A.M.	70.0°	23	7:49 A.M.	64.2°
	10:55 A.M.	74.1°	27	6:55 A.M.	74.5°	5	6:54 A.M.	72.6°		12:28 P.M.	70.8°		5:31 P.M.	64.5°
	12:20 P.M.	74.7°		9:25 A.M.	74.7°		8:30 A.M.	72.7°		2:31 P.M.	70.7°	24	6:56 A.M.	62.0°
21	6:50 A.M.	74.4°		10:54 A.M.	74.9°		10:10 A.M.	72.9°	13	7:00 A.M.	68.6°		2:25 P.M.	64.8°
	1:00 P.M.	75.0°		12:25 P.M.	75.4°		12:25 P.M.	75.1°		9:35 A.M.	68.5°		4:50 P.M.	62.9°
	2:10 P.M.	75.3°		2:41 P.M.	76.1°		1:43 P.M.	75.8°	14	8:33 A.M.	66.9°		5:06 P.M.	62.7°
22	6:45 A.M.	73.4°	28	6:55 A.M.	74.0°		2:33 P.M.	76.7°		10:05 A.M.	66.9°		5:30 P.M.	62.6°
	9:30 A.M.	74.2°		9:46 A.M.	74.1°	6	6:57 A.M.	73.7°	16	7:20 A.M.	66.1°	25	5:38 A.M.	61.0°
	11:03 A.M.	74.3°		10:42 A.M.	73.5°		8:58 A.M.	74.0°	17	7:10 A.M.	66.1°		9:31 A.M.	61.3°
	12:18 P.M.	75.6°		12:09 P.M.	74.5°		9:43 A.M.	74.1°		12:06 P.M.	66.1°		12:40 P.M.	61.3°
	2:28 P.M.	76.4°		1:40 P.M.	75.1°		1:08 P.M.	74.9°		5:30 P.M.	66.4°	26	6:25 A.M.	60.0°
23	6:57 A.M.	74.5°	29	6:54 A.M.	73.5°		2:33 P.M.	75.8°	18	7:02 A.M.	65.7°		3:30 P.M.	61.2°
	9:03 A.M.	75.5°		8:40 A.M.	73.6°	7	9:00 A.M.	74.1°		9:45 A.M.	65.5°	27	6:45 A.M.	59.4°
	10:40 A.M.	75.8°	30	6:56 A.M.	73.4°		9:50 A.M.	74.1°		2:50 P.M.	65.4°		9:31 A.M.	59.6°
	12:15 P.M.	76.1°		8:10 A.M.	73.7°	9	7:03 A.M.	71.3°	19	7:02 A.M.	63.4°		2:06 P.M.	60.6°
	1:35 P.M.	76.5°		9:53 A.M.	73.0°		8:50 A.M.	71.1°		12:31 P.M.	64.1°	28	12:30 P.M.	60.8°
	2:40 P.M.	76.7°	31	8:45 A.M.	73.1°	10	7:00 A.M.	69.2°		2:20 P.M.	64.3°	29	2:23 P.M.	63.0°
24	8:45 A.M.	74.6°		10:20 A.M.	73.3°		11:30 A.M.	69.5°	20	7:03 A.M.	64.0°	30	12:55 P.M.	62.2°

TABLE 3 (continued)

OCTOBER			OCTOBER											
DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F	DATE	TIME	°F
1	7:08 A.M.	60.8°	7	7:21 A.M.	54.4°									
	10:59 A.M.	61.1°		11:07 A.M.	55.6°									
	12:47 P.M.	61.4°		1:50 P.M.	56.2°									
	5:50 P.M.	60.7°		3:39 P.M.	56.7°									
2	10:00 A.M.	60.2°		5:26 P.M.	56.3°									
	1:15 P.M.	60.8°	8	8:56 A.M.	55.7°									
	3:18 P.M.	60.9°		3:08 P.M.	56.4°									
3	10:00 A.M.	60.2°		4:45 P.M.	56.7°									
	3:46 P.M.	60.9°	9	8:58 A.M.	56.1°									
	5:00 P.M.	60.5°		3:08 P.M.	56.5°									
4	10:00 A.M.	58.2°	10	10:34 A.M.	55.4°									
	1:50 P.M.	58.4°	11	8:59 A.M.	53.9°									
	4:54 P.M.	58.3°		11:40 A.M.	54.2°									
	5:29 P.M.	57.8°		12:30 P.M.	54.4°									
5	9:53 A.M.	55.8°		3:32 P.M.	55.0°									
	12:14 P.M.	56.2°												
	2:15 P.M.	57.8°												
	5:25 P.M.	57.0°												
6	2:00 P.M.	55.8°												

TABLE 4
ESTIMATED CAPTURES OF JUVENILE ALEWIFE IN FISHWAY MONITORING SYSTEM DURING 1996 PEJEPSCOT FISHWAY STUDY

DATE	NORTH WEIR BOX		SOUTH WEIR BOX		TOTAL CAPTURES	REMARKS
August 12						
	Closed until Noon		11:30	4,000	13,000	N = 3,000
	2:30	3,000		6,000		S = 10,000
	Total	3,000		10,000		
13	7:30	2,000		800	2,801	N = 2,000
	8:45	0		1		S = 801
	Total	2,000		801		
14	7:00	400		500	904	N = 404
	11:50	0		0		S = 500
	1:00	0		0		
	2:45	4		0		
	Total	404		500		
15	7:00	700		200	5,400	N = 4,700
	2:30	4,000		500		S = 700
	Total	4,700		700		
16	7:00	3,000		7,000	19,500	N = 5,500
	12:30	2,000		2,000		S = 14,000
	2:30	500		5,000		
	Total	5,500		14,000		
17	9:00	4,000		12,000	18,050	N = 6,000
	12:00	2,000		50		S = 12,050
	Total	6,000		12,050		
18	8:00	10,000		12,000	22,000	N = 10,000
						S = 12,000
19	7:00	8,000		6,000	20,750	N = 8,250
	9:30	0		5,000		S = 12,500
	12:30	200		1,500		
	2:30	50		12,500		
	Total	8,250				

DATE	NORTH WEIR BOX		SOUTH WEIR BOX	TOTAL CAPTURES	REMARKS
August 20	7:00	5,000	300	7,910	N = 7,600
	9:30	0	0		S = 310
	10:15	0	0		
	10:48	0	0		
	12:30	0	0		
	2:00	2,500	10		
	2:55	100	0		
	Total	7,600	310		
21	7:30	3,000	800	3,800	N = 3,000
	10:45	0	0		S = 800
	11:50	0	0		
	1:00	0	0		
	2:10	0	0		
	2:50	0	0		
	Total	3,000	800		
22	7:10	200	100	300	N = 200
	8:15	0	0		S = 100
	9:23	0	0		
	10:45	0	0		
	12:20	0	0		
	1:55	0	0		
	2:45	0	0		
	Total	200	100		
23	7:30	150	100	255	N = 152
	8:00	0	0		S = 103
	9:03	2	3		
	10:45	0	0		
	12:18	0	0		
	2:00	0	0		
	Total	152	103		
24	9:15	100	300	400	N = 100
	10:25	0	0		S = 300
	Total	100	300		
26	7:05	2	100	359	N = 52
	8:45	50	200		S = 307
	11:40	0	0		
	1:30	0	7		
	2:30	0	0		
	Total	52	307		

DATE	NORTH WEIR BOX		SOUTH WEIR BOX	TOTAL CAPTURES	REMARKS
August 27	7:10	50	100	150	N = 50
	8:30	0	0		S = 100
	12:45	0	0		
	2:02	0	0		
	Total	50	100		
28	7:10	75	500	576	N = 75
	10:30	0	1		S = 501
	12:30	0	0		
	2:39	0	0		
	Total	75	501		
29	7:30	60	60	240	N = 120
	8:40	60	60		S = 120
	Total	120	120		
30	9:33	50	115	165	N = 50 S = 115
September 3	8:05	150	350	3,000	N = 650
	4:40	500	2,000		S = 2,350
	Total	650	2,350		(1 dead adult shad)
4	7:20	800	2,000	10,876	N = 5,829
	9:35	0	35		S = 5,047
	11:45	0	12		
	1:15	29	0		
	2:30	5,000	3,000		
	Total	5,829	5,047		
5	7:10	2,000	500	5,500	N = 2,000
	8:45	0	0		S = 3,500
	11:20	0	0		
	12:35	0	0		
	1:45	0	0		
	2:40	0	3,000		
	Total	2,000	3,500		
6	7:00	6,000	500	6,502	N = 6,002
	8:35	2	0		S = 500
	11:45	0	0		
	12:45	0	0		
	2:22	0	0		
	Total	6,002	500		
7	7:45	75	75	150	N = 75
	10:30	0	0		S = 75
	Total	75	75		

DATE	NORTH WEIR BOX		SOUTH WEIR BOX	TOTAL CAPTURES	REMARKS
September 9	7:10	54	10	64	N = 54
	8:55	0	0		S = 10
	Total	54	10		
10	7:05	100	800	906	N = 103
	11:33	1	2		S = 803
	3:55	2	1		
	5:00	0	0		
	Total	103	803		
11	7:10	75	75	6,150	N = 75
	8:15	0	0		S = 6,075
	9:40	0	0		
	11:55	0	0		
	12:30	0	0		
	1:30	0	6,000		
	Total	75	6,075		
12	7:05	100	75	175	N = 100
	7:30	0	0		S = 75
	10:25	0	0		
	12:30	0	0		
	1:45	0	0		
	2:55	0	0		
	Total	100	75		
13	7:05	200	100	300	N = 200
	8:40	0	0		S = 100
	9:38	0	0		
	Total	200	100		
14	8:40	250	110	363	N = 252
	10:15	2	1		S = 111
	Total	252	111		
16	(Total 250 - left in boxes)				
17	7:15	800	400	1,201	N = 801
	12:10	1	0		S = 400
	5:20	0	0		
	Total	801	400		
18	7:10	100	400	500	N = 100
	9:55	0	0		S = 400
	11:00	0	0		
	12:30	0	0		
	1:45	0	0		
	2:50	0	0		
	Total	100	400		

DATE	NORTH WEIR BOX		SOUTH WEIR BOX	TOTAL CAPTURES	REMARKS
September 19	7:10	150	200	360	N = 155
	8:30	0	1		S = 205
	9:45	0	2		
	11:00	0	1		
	12:35	5	1		
	1:30	0	0		
	2:35	0	0		
	Total	155	205		
20	7:05	4,000	200	4,200	N = 4,000
	9:50	0	0		S = 200
	11:05	0	0		
	12:40	0	0		Debris in S weir
	1:40	0	0		
	2:30	0	0		
	Total	4,000	200		
21	7:20	400	250	650	N = 400
	9:50	0	0		S = 250
	Total	400	250		Debris in S weir
23	8:00	2,000	400	18,901	N = 12,001
	1:30	1	500		S = 6,900
	5:35	10,000	6,000		
	Total	12,001	6,900		
24	7:00	75	50	18,132	N = 13,075
	10:00	0	0		S = 5,057
	1:00	0	5,000		
	2:20	10,000	0		
	3:50	3,000	7		
	5:20	0	0		
	Total	13,075	5,057		
25	5:00	50	25	77	N = 50
	7:00	0	2		S = 27
	8:30	0	0		
	9:40	0	0		
	11:00	0	0		
	12:40	0	0		
	1:20	0	0		
	Total	50	27		

DATE	NORTH WEIR BOX		SOUTH WEIR BOX	TOTAL CAPTURES	REMARKS
September 26	6:30	2,000	800	34,396	N = 2,090
	8:00	0	4		S = 32,306
	10:40	0	25,000		
	1:45	1	6,000		
	2:45	14	500		
	3:50	50	1		
	5:30	25	1		
	Total	2,090	32,306		
27	7:20	100	50	27,250	N = 23,200
	9:35	0	0		S = 4,050
	11:00	100	0		
	11:35	20,000	3,000		(1 smelt S box)
	2:10	3,000	1,000		
	Total	23,200	4,050		
28	1:15	7,000	3,000	73,000	N = 67,000
	3:20	60,000	3,000		S = 6,000
	Total	67,000	6,000		
29	2:30	36,000	4,000	48,200	N = 37,000
	4:50	-	7,000		S = 11,200
	5:30	1,000	200		
	Total	37,000	11,200		
30	7:45	2,000	75	93,278	N = 9,203
	12:00	6,000	80,000		S = 84,075
	1:00	0	1,000		
	1:50	2	3,000		
	2:45	1,000	0		
	3:00	200	0		
	6:15	1	0		
	Total	9,203	84,075		
October 1	7:10	200	25	15,384	N = 9,778
	9:50	1	0		S = 5,606
	10:20	75	50		
	11:25	3,500	1,500		
	12:50	3,000	3,000		
	2:15	200	200		
	2:55	2,000	500		
	4:10	200	20		
	4:40	100	300		
	5:15	500	10		
	5:40	2	1		
	Total	9,778	5,606		

DATE	NORTH WEIR BOX		SOUTH WEIR BOX	TOTAL CAPTURES	REMARKS
October 2	7:00	(Total 200)	(Total 200)	5,745	N = 3,737 S = 1,808
	10:20	1	0		
	11:15	0	0		
	12:30	1,000	800		
	1:25	0	0		
	2:00	5	2		
	3:10	200	200		
	4:00	2,500	800		
	4:40	12	2		
	5:30	19	4		
	Total	3,737	1,808		
3	7:00	50	50	9,761	N = 5,959 S = 3,802
	10:20	100	1,500		
	12:30	3	1,000		
	1:10	0	100		
	1:30	0	100		
	2:00	25	1,000		
	2:12	200	3		
	2:20	500	3		
	3:00	500	0		
	3:05	4,000	6		
	3:50	75	25		
	4:30	500	14		
	5:10	3	0		
	5:40	3	1		
	Total	5,959	3,802		
4	10:00	1	1	3,879	1 Shad in N Box N = 3,272 S = 607
	11:40	2,500	50		
	1:00	9	500		
	2:00	200	50		
	3:15	500	0		
	4:40	50	2		
	5:40	12	4		
	Total	3,272	607		
5	10:30	50	20	7,248	50% Shad
	11:20	0	800		No Shad
	12:15	200	2,000		
	1:35	0	4,000		No Shad
	3:15	75	2		N = 425
	4:20	100	0		S = 6,823
	5:35	0	1		
	Total	425	6,823		

DATE	NORTH WEIR BOX		SOUTH WEIR BOX	TOTAL CAPTURES	REMARKS
October 6	2:30	(not counted)	6	2,506	N = 2,500
	4:03	2,500	0		S = 6
	4:35	0	0		
	Total	2,500	6		
7	7:28	10	0	10,196	N = 7,313
	9:20	100	0		S = 2,883
	11:15	3	75		
	12:15	0	2,000		
	1:55	1,200	600		
	3:40	6,000	200		
	5:35	0	8		
	Total	7,313	2,883		
8	7:00	50	50	5,607	N = 5,557
	9:15	1,500	0		S = 50
	10:20	2,000	0		
	11:25	1,000	0		
	12:30	7	0		
	1:45	1,000	0		
	3:15	0	0		
	4:45	0	0		
	Total	5,557	50		
9	7:00	10	10	2,947	Both boxes overflowing
	11:40	0	1		N = 386
	12:20	1	50		S = 2,562
	1:00	200	1		unknown = 10
	1:15	100	0		
	1:50	0	2,500		
	Total	75	0		
		386	2,562		
10	9:40	7	0	7	6 Shad in N box
	10:55	0	0		N = 7
	11:50	0	0		S = 0
	1:00	0	0		
	2:00	0	0		
	3:00	0	0		
	4:40	0	0		
	Total	7	0		

DATE	NORTH WEIR BOX		SOUTH WEIR BOX	TOTAL CAPTURES	REMARKS
October 11	7:00	36	Total both	37	1 Shad N Box
	9:30	1	boxes		N = 1
	9:50	0	0		S = 0
	10:45	0	0		unknown = 36
	11:45	0	0		
	12:25	0	0		
	1:15	0	0		
	2:00	0	0		
	3:15	0	0		
	4:30	0	0		
	Total	1	0		
			0		
GRAND TOTALS		274,603	259,170	533,772**	

*** Does not include 36 fish not assigned to specific monitoring boxes.**

Table4.D10
048100.00/8.0
CR/bp(#1)
December 10, 1996

SURVIVAL OF 1996 PEJEPSCOT PROJECT FI
KEPT IN A LIVECAR AFTER

STUDY LOT	RELEASE DATE	NUMBER OF CONTROL FISH	MORT												
			* 0	** 1	2	3	4	5	6	7	8	9	10	11	12
1	8/14	26	1	8	6	1	2	0	3	0	0	0	0	0	0
2	8/17	34	7	3	-	14	0	4	0	0	0	0	1	2	1
3	9/3	24	-	0	6	3	2	2	-	2	1	0	1	1	1
4	9/10	25	-	0	3	1	6	2	-	2	0	0	0	0	0
5	9/17	25	-	0	2	1	2	1	3	1	0	1	2	0	1
6	9/23	50	-	0	0	1	6	4	4	2	1	3	4	3	1
7	9/30	50 Marked	-	0	1	0	0	3	3	5	1	1	2	3	2
		50 Unmarked	-	0	1	0	1	0	4	5	3	1	6	2	3
8	10/7	50	-	0	0	0	0	1	-	-	-	14	-	-	13

* Fish marked on two days, held two nights in livecar before release; day 0 denotes mortalities prior to relea

**Day 1 denotes day of release of marked fish

ABLE 5

WAY STUDY JUVENILE ALEWIFE CONTROL FISH
ELEASE OF MARKED STUDY LOTS

ITIES IN LIVECAR AT DAY:

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	TOTAL CONTROL MORTALITIES	REMARKS
2	1	0	0	0	0	0	0	-	-	-	-	-	-	2	-	-	26	Last mortality on day 27
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	Not segregated after day 12
0	0	0	3	-	-	-	-	-	-	-	-	-	-	-	-	-	22	Not segregated after day 16
4	0	2	1	0	0	-	-	-	-	1	1	-	-	-	-	-	23	
2	-	-	-	-	2	2	1	-	-	-	1	-	-	-	-	1	23	
3	4	1	-	1	4	1	-	-	-	5	-	-	1	-	-	2	51	
-	-	-	9	-	-	14	-	-	3	-	-	-	-	-	-	-	47	Monitoring terminated on day 22
-	-	-	6	-	-	14	-	-	5	-	-	-	-	-	-	-	51	
[illegible]	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	Monitoring terminated on day 15

TA

SUMMARY OF TESTS OF MORTA
IN A LIVECAR AFTER VAR

MARKING TREATMENT	DATE	NUMBER OF FISH	MORTALIT												
			1*	2	3	4	5	6	7	8	9	10	11	12	13
Unmarked No MS222	8/20	50	0	0	14	2	-	3	3	1	1	3	0	-	-
Upper Caudal Clip, with MS222	8/20	50	1	1	2	2	-	4	1	2	0	1	1	-	-
Upper Caudal Clip. Elastomer one side, with MS222	8/21	32	0	0	2	-	6	1	1	1	3	0	-	-	7
Elastomer both sides with MS222	8/21	30	0	0	0	-	2	1	3	1	0	3	-	-	5
Unmarked No MS222. Held 5 hrs. in transport hopper	8/28	Approx. 800	9	43	135	-	-	238	-	-	-	-	-	-	-

* Day 1 denotes day following placement in livecar.

BLE 6

LITY OF JUVENILE ALEWIFE HELD
OUS MARKING TREATMENTS

IN LIVE CAR AT DAY:																		
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total Mortalities	Remarks
6	3	0	0	2	-	5	3	2	0	0	2	-	2	0	1	1	54	Mortalities greater due to mixing of treatments in liveca and some loss of elastomer from smallest test fish.
3	3	3	1	1	-	8	6	1	1	4	1	-	3	0	1	1	52	
0	1	0	0	-	2	0	0	2	0	0	-	0	0	0	0	-	26	
2	1	1	1	-	3	4	1	1	0	0	-	0	1	0	0	-	30	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	425	Test terminated on Day 6. Livecar needed to store controls for marke study lot.

TABLE 7
RESULTS OF PEJEPSCOT PROJECT DETERRENT SOUND SYSTEM FIELD INTENSITY MEASUREMENTS, AUGUST 8, 1995 AND AUGUST 9, 1996. (SEE FIGURE 5 IN APPENDIX 4 FOR MONITORING LOCATIONS)

Measurement Location	Date	Depth (feet)	Percent of Maximum * Signal Strength
A	8/8/95	5	3
	8/9/96	1	6
		5	6
B	8/8/95	5	11
	8/9/96	1	17
		5	28
C	8/8/95	5	100
	8/9/96	1	11
		5	100
D	8/8/95	5	11
	8/9/96	1	11
		5	28
E	8/8/95	5	3
	8/6/96	1	8
		5	9
CU	8/8/95	5	6
	8/9/96	1	12
		5	25

* Transducers set on Wide (49°) beam setting.

CR/bp (#1)
048100.00/2.0
Table7.D10
December 12, 1996

TABLE 8
TEMPERATURE AND DISSOLVED OXYGEN MEASUREMENTS DURING PEJEPSCOT PROJECT JUVENILE ALEWIFE ELASTOMER MARKING ON SEPTEMBER 3, 1996

Monitoring Location	Time	Temperature* (°C)	Dissolved Oxygen * (M_g/L)	%Saturation
Fishway Monitoring System Transport Hopper	9:45 a.m.	22.2	7.21	82
Pre-Marking Bucket	9:45 a.m.	21.1	4.88	55
Marking Tub (with MS-222)	9:45 a.m.	21.3	5.73	65
Recovery Bucket	9:45 a.m.	22.1	7.37	84
Reject Holding Hopper	9:45 a.m.	23.1	8.21	94
Fishway Monitoring System Transport Hopper	1:00 p.m.	22.4	7.80	89
Pre-Marking Bucket	1:00 p.m.	22.3	5.88	67
Marking Tub (with MS-222)	1:00 p.m.	22.0	5.95	68
Recovery Bucket	1:00 p.m.	22.1	7.15	81
Reject Holding Hopper	1:00 p.m.	23.1	7.82	90
Livecar 1	1:15 p.m.	22.9	8.21	94
Livecar 2	1:15 p.m.	22.7	8.17	94

* Measurements with YSI Model 85 hand held oxygen/temperature/conductivity/salinity meter calibrated on-site to elevation 100 feet.

TABLE 9
JUVENILE ALEWIFE SIZE SAMPLES FROM 1996 PEJEPSCOT PROJECT FISHWAY MONITORING SYSTEM RECAPTURES

SAMPLE NUMBER	DATE	SAMPLE SIZE	AVERAGE LENGTH (MM)	LENGTH RANGE (MM)	REMARKS
1	8/21	51	75.3	60-99	
2	8/22	43	79.1	66-99	
3	8/23	73	79.1	63-98	
4	8/24	86	86.4	62-103	
5	8/26	69	84.1	57-100	
6	9/4	40	89.2	70-117	
7	9/6	69	99.5	86-113	Largest fish - all but three 90 mm or larger
8	9/14	110	92.9	75-125	
9	9/19	98	91.7	74-113	
10	9/20	90	102.4	84-130	
11	9/21	117	96.2	73-120	
12	9/23	60	101.4	80-126	
13	9/27	24	128.0	117-135	Only largest fish
14	9/28	71	100.5	82-114	
15	10/1	74	98.0	80-117	
16	10/2	90	101.1	86-123	

TA

SUMMARY OF RECAPTURES OF MARKED JUVE

STUDY LOT	MARKING DATE(S)	RELEASE DATE AND TIME	NUMBER RELEASED	1* N**S	2 N S	3 N S	4 N S	5 N S	6 N S	7 N S
Lot 1 Orange	8/12 8/13	8/14 7:40 a.m.	384	0 1 1	15 13 44	11 12 23	0 1 1	1 1 2	0 2 2	0
Lot 2 Yellow	8/15 8/16	8/17 11:00 a.m.	598	1 2 3	53	24	5 2 7	0 1 1	0	0
Lot 3 Green	9/3	9/3 4:20 p.m.	393	0	21 36 57	5 3 8	0	1 1 2	0	0
Lot 4 Red	9/10	9/10 4:15 p.m.	440	0	3 56 59	8 1 9	6 1 7	2 2 4	0	0
Lot 5 Orange	9/17	9/17 5:40 p.m.	420	0	4 11 15	2 2 4	13 2 15	1 1 2	0	6 1
Lot 6 Green	9/23	9/23 6:30 p.m.	345	0	57 12 69	0	5 51 56	6 4 10	1 0 1	2 2
Lot 7 Red	9/30	9/30 6:20 p.m.	376	1 0 1	27 13 40	2 0 2	1 1 2	3 1 4	0	(
Lot 8 Orange	10/7	10/7 8:56 a.m. through 4:08 p.m.	400	68 1 69	45 3 48	1 6 7	0	0	-	
		TOTAL RELEASE	3,356							

* Day 1 is day marked fish were released.
** N is North fishway entrance weir monitoring box.
S is South fishway entrance weir monitoring box.
Individual monitoring box data not available or incomplete for some days.

.E 10

ILE ALEWIFE 1996 PEJEPSCOT FISHWAY STUDY

CAPTURES AT DAY:

8 N S	9 N S	10 N S	11 N S	12 N S	13 N S	14 N S	15 N S	16 N S	17 N S	18 N S	RECAPTURES TOTAL	%	REMARKS
0	0	0	0	0	0	0	0	0	0	0	73	19.0	Monitoring Terminated Day 59
0	0	0	0	0	0	0	0	0	0	0	89	14.9	Also, 1 Recap on 9/26 on day 41. Monitoring terminated day 56
0 1 1	0 2 2	0	0	0	0	0	1	0	0	0	71	18.1	Monitoring Terminated Day 39
4 8 12	3	0	2	0	0	1 1 2	2 1 3	0	2	2	105	23.9	Monitoring Terminated Day 32
11 1 12	0	11	1 0 1	3 0 3	1 0 1	0	0	0	0	0	80	19.0	Monitoring Terminated Day 25
2 1 3	0	0	0	0	0	0	0	0	0	0	141	40.9	Monitoring Terminated Day 19
0	0	0	0	-	-	-	-	-	-	-	49	13.0	Monitoring Terminated Day 11
-	-	-	-	-	-	-	-	-	-	- 0	124	31.0	Monitoring Terminated Day 5
										TOTAL RECAPS AND X%	**732**	**21.8**	

		Table 11		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #1				
Lot #1	Monitored for 59 days			
Raw Data Gives Fishway Efficiency of 19%				
Released	384	on 8/14/96 at 7:40 a.m.		
Controls	26	-1 = 25 Actual at Start		
		Cumulative		Cumulative
Study *	Fishway	Fishway	Mortalities	Mortalities
Day	Recaptures	Recaptures	in Live Car	in Live Car
1	1	1	8	8
2	44	45	6	14
3	23	68	1	15
4	1	69	2	17
5	2	71	0	17
6	2	73	3	20
7	0	73	0	20
8	0	73	0	20
9	0	73	0	20
10	0	73	0	20
11	0	73	0	20
12	0	73	0	20
13	0	73	2	22
14	0	73	1	23
15	0	73	0	23
16	0	73	0	23
17	0	73	0	23
18	0	73	0	23
19	0	73	0	23
20	0	73	0	23
21	0	73	0	23
22	0	73	0	23
23	0	73	0	23
24	0	73	0	23
25	0	73	0	23
26	0	73	0	23
27	0	73	2	25
* Last test day based on final day of fishway recapture. (Day 6)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (73/384)(1/0.20)				
Fishway Efficiency (%) =		95		

		Table 12		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #2				
Lot #2	Monitored for 56 days			
Raw Data Gives Fishway Efficiency of 14.9%				
Released	598	on 8/17/96 at 11:00 a.m.		
Controls	34	-7 = 27 Actual at Start		
		Cumulative		Cumulative
Study *	Fishway	Fishway	Mortalities	Mortalities
Day	Recaptures	Recaptures	in Live Car	in Live Car
1	3	3	3	3
2	53	56	0	3
3	24	80	14	17
4	7	87	0	17
5	1	88	4	21
6	0	88	0	21
7	0	88	0	21
8	0	88	0	21
9	0	88	0	21
10	0	88	1	22
11	0	88	2	24
12	0	88	1	25
* Last test day based on final day of fishway recapture. (Day 5)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (88/598)(1/0.22)				
Fishway Efficiency (%) =		66		

		Table 13		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #3				
Lot #3	Monitored for 39 days			
Raw Data Gives Fishway Efficiency of 18.1%				
Released	393	on 9/3/96 at 4:20 p.m.		
Controls	24			
		Cumulative		Cumulative
Study *	Fishway	Fishway	Mortalities	Mortalities
Day	Recaptures	Recaptures	in Live Car	in Live Car
1	0	0	0	0
2	57	57	6	6
3	8	65	3	9
4	0	65	2	11
5	2	67	2	13
6	0	67	0	13
7	0	67	2	15
8	1	68	1	16
9	2	70	0	16
10	0	70	1	17
11	0	70	1	18
12	0	70	1	19
13	0	70	0	19
14	0	70	0	19
15	1	71	0	19
16	0	71	3	22
* Last test day based on final day of fishway recapture. (Day 15)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (71/393)(1/0.21)				
Fishway Efficiency (%) =		87		

		Table 14		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #4				
Lot #4	Monitored for 32 days			
Raw Data Gives Fishway Efficiency of 23.9%				
Released	440	on 9/10/96 at 4:15 p.m.		
Controls	25			
Study * Day	Fishway Recaptures	Cumulative Fishway Recaptures	Mortalities in Live Car	Cumulative Mortalities in Live Car
1	0	0	0	0
2	59	59	3	3
3	9	68	1	4
4	7	75	6	10
5	4	79	2	12
6	0	79	0	12
7	0	79	2	14
8	12	91	0	14
9	3	94	0	14
10	0	94	0	14
11	2	96	0	14
12	0	96	0	14
13	0	96	4	18
14	2	98	0	18
15	3	101	2	20
16	0	101	1	21
17	2	103	0	21
18	2	105	0	21
19	0	105	0	21
20	0	105	0	21
21	0	105	0	21
22	0	105	0	21
23	0	105	1	22
24	0	105	1	23
* Last test day based on final day of fishway recapture. (Day 18)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (105/440)(1/0.16)				
Fishway Efficiency (%) =		149		

		Table 15		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #5				
Lot #5	Monitored for 25 days			
Raw Data Gives Fishway Efficiency of 19%				
Released	420	on 9/17/96 at 5:40 p.m.		
Controls	25			
		Cumulative		Cumulative
Study *	Fishway	Fishway	Mortalities	Mortalities
Day	Recaptures	Recaptures	in Live Car	in Live Car
1	0	0	0	0
2	15	15	2	2
3	4	19	1	3
4	15	34	2	5
5	2	36	1	6
6	0	36	3	9
7	16	52	1	10
8	12	64	0	10
9	0	64	1	11
10	11	75	2	13
11	1	76	0	13
12	3	79	1	14
13	1	80	2	16
14	0	80	0	16
15	0	80	0	16
16	0	80	0	16
17	0	80	0	16
18	0	80	2	18
19	0	80	2	20
20	0	80	1	21
21	0	80	0	21
22	0	80	0	21
23	0	80	0	21
24	0	80	1	22
25	0	80	0	22
26	0	80	0	22
27	0	80	0	22
28	0	80	0	22
29	0	80	1	23
* Last test day based on final day of fishway recapture. (Day 13)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (80/420)(1/0.36)				
Fishway Efficiency (%) =		53		

		Table 16		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #6				
Lot #6	Monitored for 19 days			
Raw Data Gives Fishway Efficiency of 40.9%				
Released	345	on 9/23/96at 6:30 p.m.		
Controls	50			
Study * Day	Fishway Recaptures	Cumulative Fishway Recaptures	Mortalities in Live Car	Cumulative Mortalities in Live Car
1	0	0	0	0
2	69	69	0	0
3	0	69	1	1
4	56	125	6	7
5	10	135	4	11
6	1	136	4	15
7	2	138	2	17
8	3	141	1	18
9	0	141	3	21
10	0	141	4	25
11	0	141	3	28
12	0	141	1	29
13	0	141	3	32
14	0	141	4	36
15	0	141	1	37
16	0	141	0	37
17	0	141	1	38
18	0	141	4	42
19	0	141	1	43
20	0	141	0	43
21	0	141	0	43
22	0	141	0	43
23	0	141	5	48
24	0	141	0	48
25	0	141	0	48
26	0	141	1	49
27	0	141	0	49
28	0	141	0	49
29	0	141	2	51
* Last test day based on final day of fishway recapture. (Day 8)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (141/345)(1/0.64)				
Fishway Efficiency (%) =		64		

		Table 17		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #7				
Lot #7	Monitored for 11 days			
Raw Data Gives Fishway Efficiency of 13%				
Released	376	on 9/30/96 at 6:20 p.m.		
Controls	50			
		Cumulative		Cumulative
Study *	Fishway	Fishway	Mortalities	Mortalities
Day	Recaptures	Recaptures	in Live Car	in Live Car
1	1	1	0	0
2	40	41	1	1
3	2	43	0	1
4	2	45	0	1
5	4	49	3	4
6	0	49	3	7
7	0	49	5	12
8	0	49	1	13
9	0	49	1	14
10	0	49	2	16
11	0	49	3	19
12	0	49	2	21
13	0	49	0	21
14	0	49	0	21
15	0	49	0	21
16	0	49	9	30
17	0	49	0	30
18	0	49	0	30
19	0	49	14	44
20	0	49	0	44
21	0	49	0	44
22	0	49	3	47
* Last test day based on final day of fishway recapture. (Day 5)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (49/376)(1/0.94)				
Fishway Efficiency (%) =		14		

		Table 18		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #8				
Lot #8	Monitored for 5 days			
Raw Data Gives Fishway Efficiency of 31%				
Released	400	on 10/7/96 between 8:56 a.m. and 4:08 p.m.		
Controls	50			
Study * Day	Fishway Recaptures	Cumulative Fishway Recaptures	Mortalities in Live Car	Cumulative Mortalities in Live Car
1	69	69	0	0
2	48	117	0	0
3	7	124	0	0
4	0	124	0	0
5	0	124	1	1
6	0	124	0	1
7	0	124	0	1
8	0	124	0	1
9	0	124	14	15
10	0	124	0	15
11	0	124	0	15
12	0	124	13	28
13	0	124	0	28
14	0	124	0	28
15	0	124	10	38
* Last test day based on final day of fishway recapture. (Day 3)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (124/400)(1/1.0)				
Fishway Efficiency (%) =		31		

APPENDIX 4

FIGURE 1 - DOWNSTREAM FISH PASSAGE FACILITIES PRIOR TO STUDY SYSTEM INSTALLATION

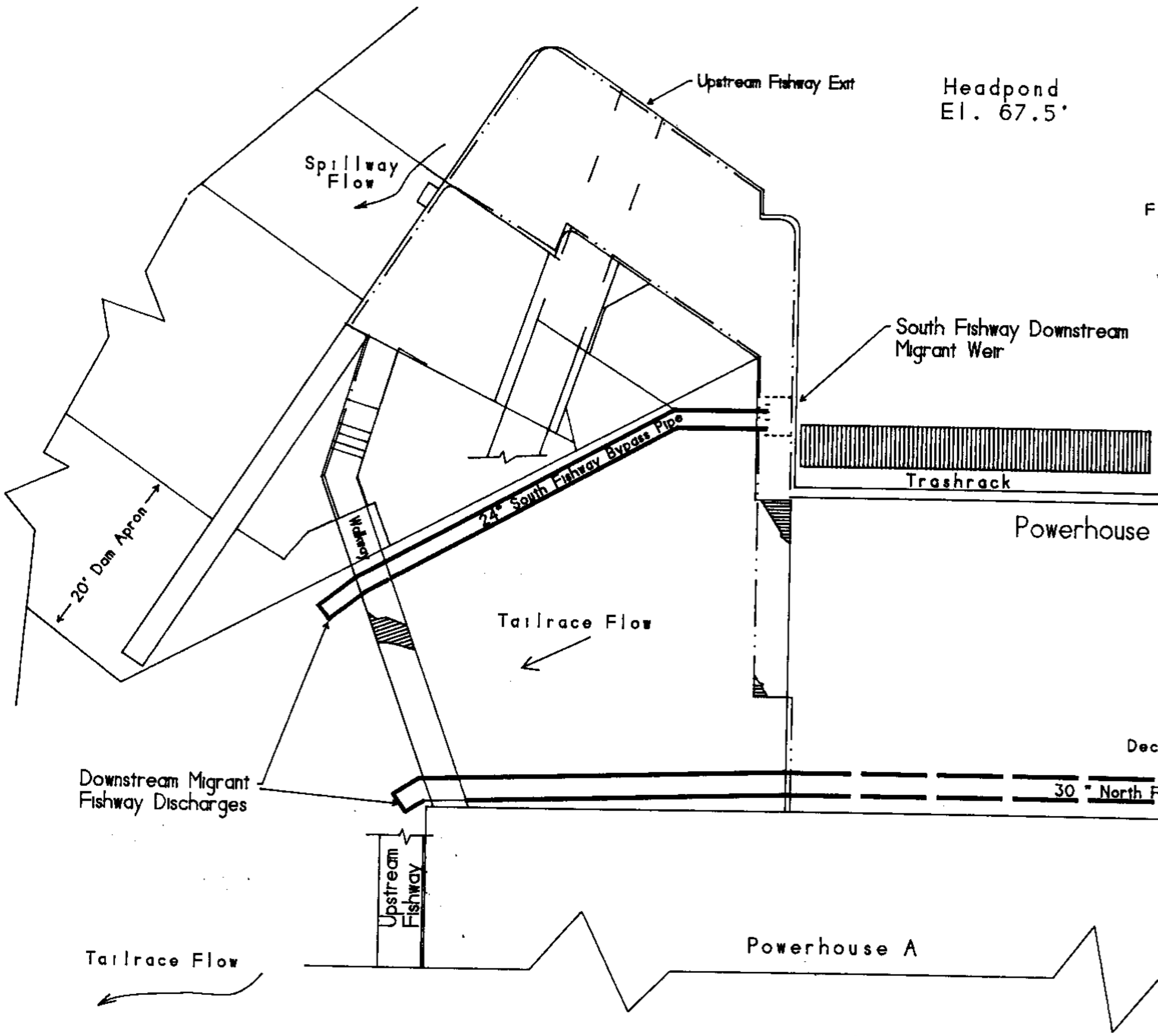
FIGURE 2 - DOWNSTREAM FISH PASSAGE FACILITY WITH STUDY SYSTEM INSTALLED

FIGURE 3 - ACOUSTIC DETERRENT AND LIGHTING SYSTEMS USED FOR DOWNSTREAM PASSAGE STUDIES

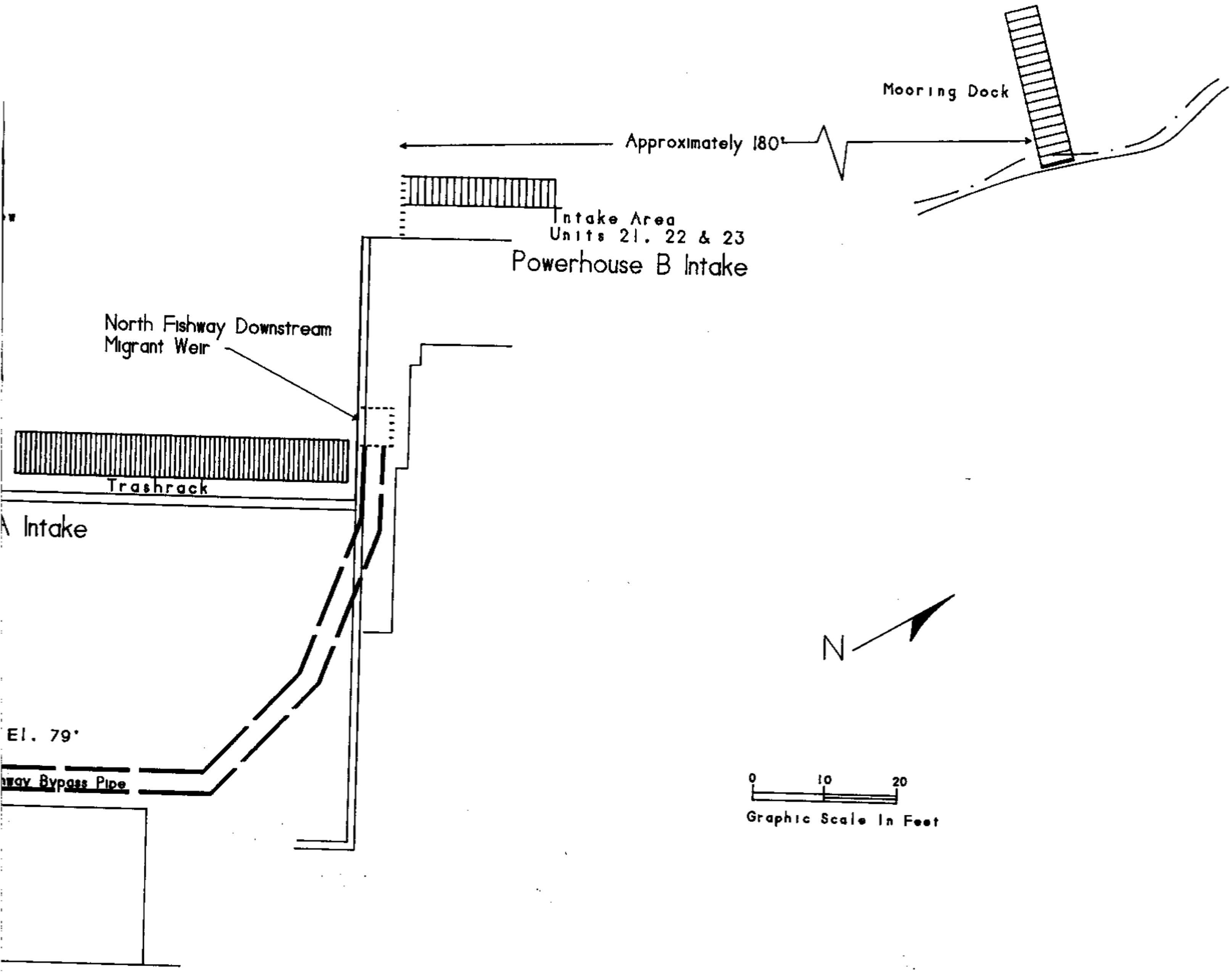
FIGURE 4 - AMBIENT ENVIRONMENTAL AND STUDY CONDITIONS, NUMBER OF JUVENILE CLUPEIDS PASSING THE FISHWAYS, AND SEASONALITY OF RELEASES OF MARKED STUDY FISH DURING THE 1996 PEJEPSCOT PROJECT DOWNSTREAM FISH PASSAGE FACILITIES STUDY

FIGURE 5 - SOUND DETERRENT SYSTEM FIELD INTENSITY MEASUREMENT LOCATIONS

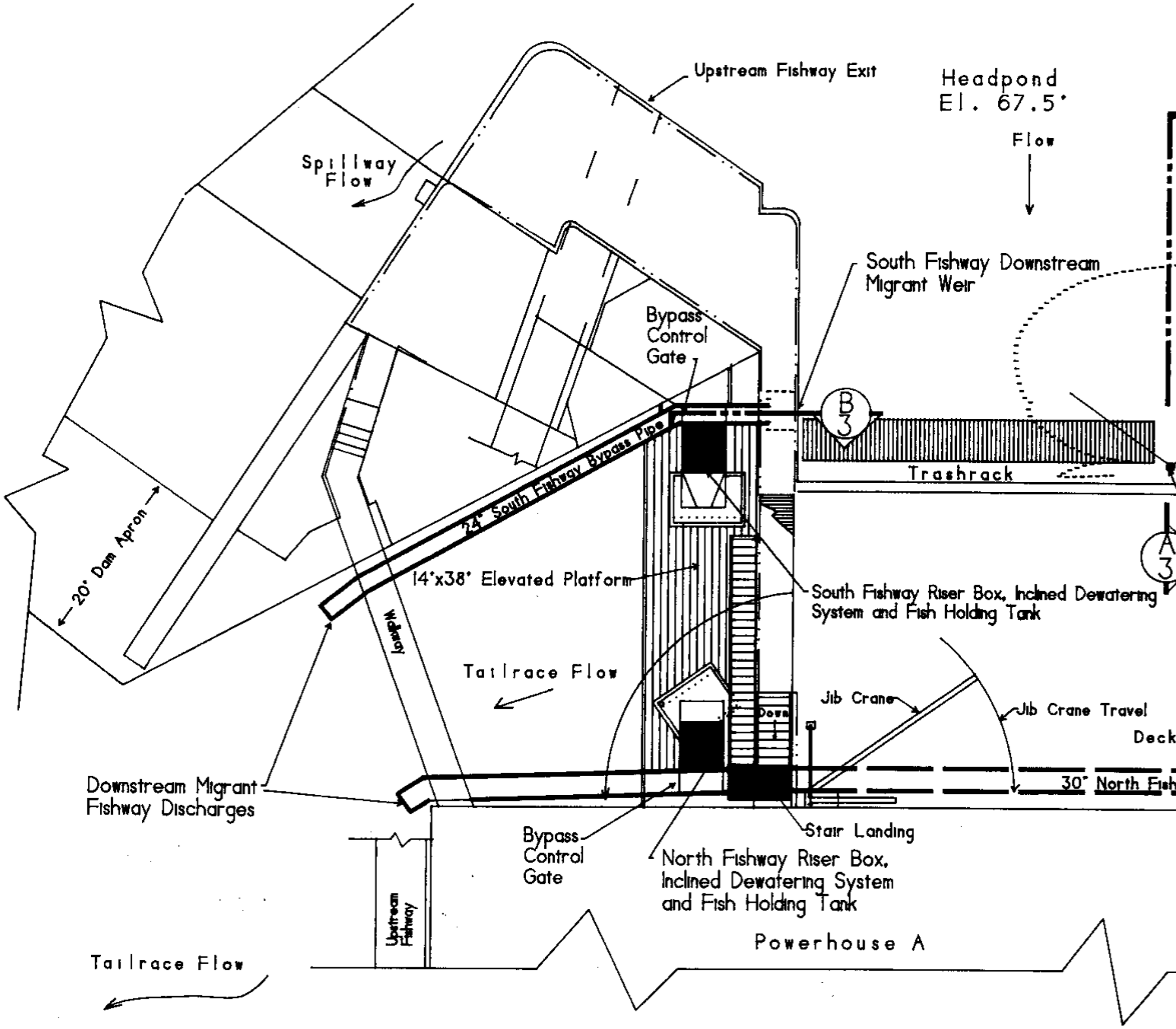
		Table 18		
1996 Pejepscot Fishway Efficiency Study Data Summary				
and Adjustment of Raw Efficiency Results Lot #8				
Lot #8	Monitored for 5 days			
Raw Data Gives Fishway Efficiency of 31%				
Released	400	on 10/7/96 between 8:56 a.m. and 4:08 p.m.		
Controls	50			
		Cumulative		Cumulative
Study *	Fishway	Fishway	Mortalities	Mortalities
Day	Recaptures	Recaptures	in Live Car	in Live Car
1	69	69	0	0
2	48	117	0	0
3	7	124	0	0
4	0	124	0	0
5	0	124	1	1
6	0	124	0	1
7	0	124	0	1
8	0	124	0	1
9	0	124	14	15
10	0	124	0	15
11	0	124	0	15
12	0	124	13	28
13	0	124	0	28
14	0	124	0	28
15	0	124	10	38
* Last test day based on final day of fishway recapture. (Day 3)				
Fishway Efficiency = (a/b)(1/c) =				
where :	a = number of marked fish caught in fishway			
	b = total number marked fish released in impoundment			
	c = percent survival of marked control fish			
Computation of Adjusted Fishway Efficiency				
Fishway Efficiency = (124/400)(1/1.0)				
Fishway Efficiency (%) =		31		


Upstream Fishway Exit
Headpond
El. 67.5'
F
Spillway
Flow
South Fishway Downstream
Migrant Weir
24" South Fishway Bypass Pipe
Trashrack
Powerhouse
Walkway
20' Dam Apron
Tailrace Flow
Dec
Downstream Migrant
Fishway Discharges
30 " North F
Upstream
Fishway
Powerhouse A
Tailrace Flow

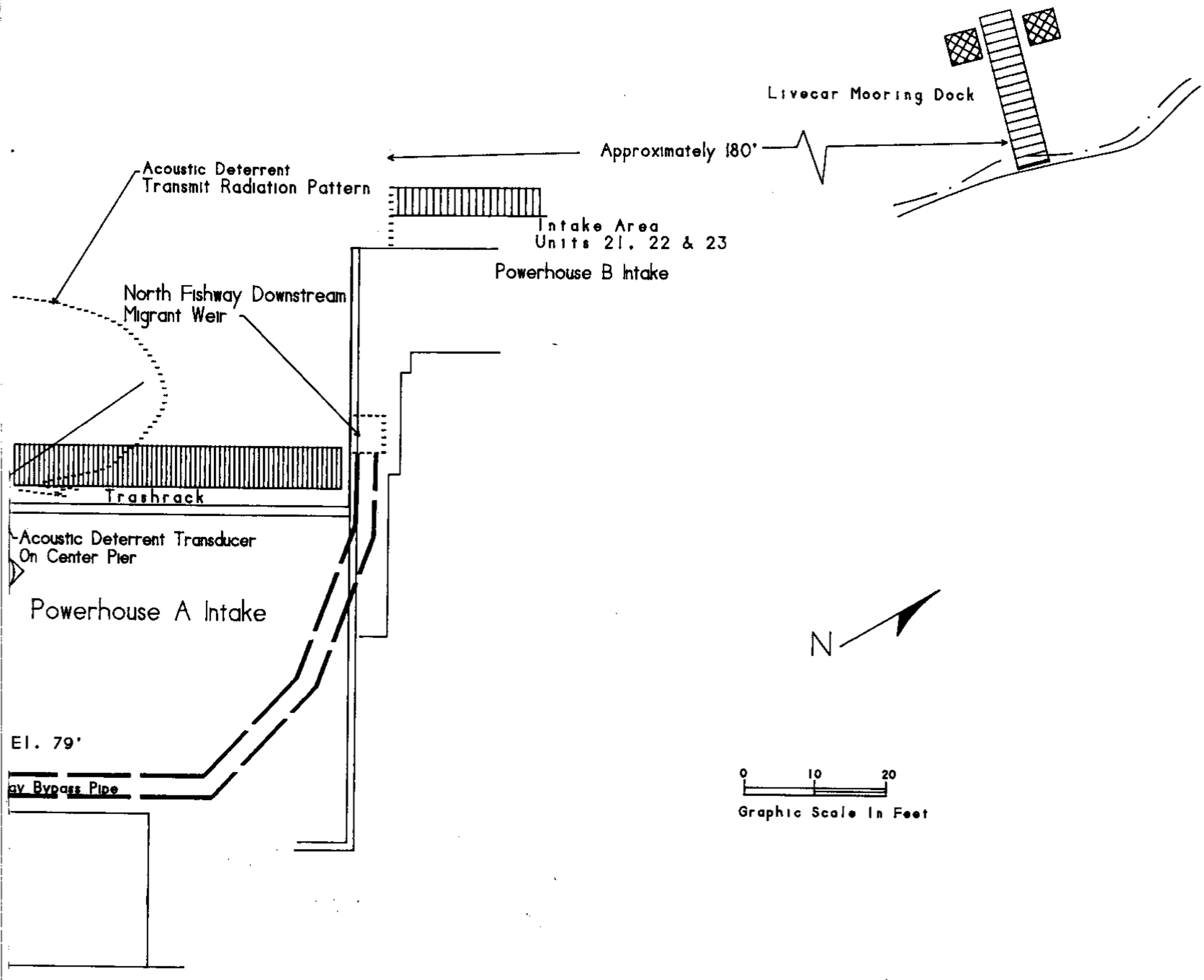
Plan View



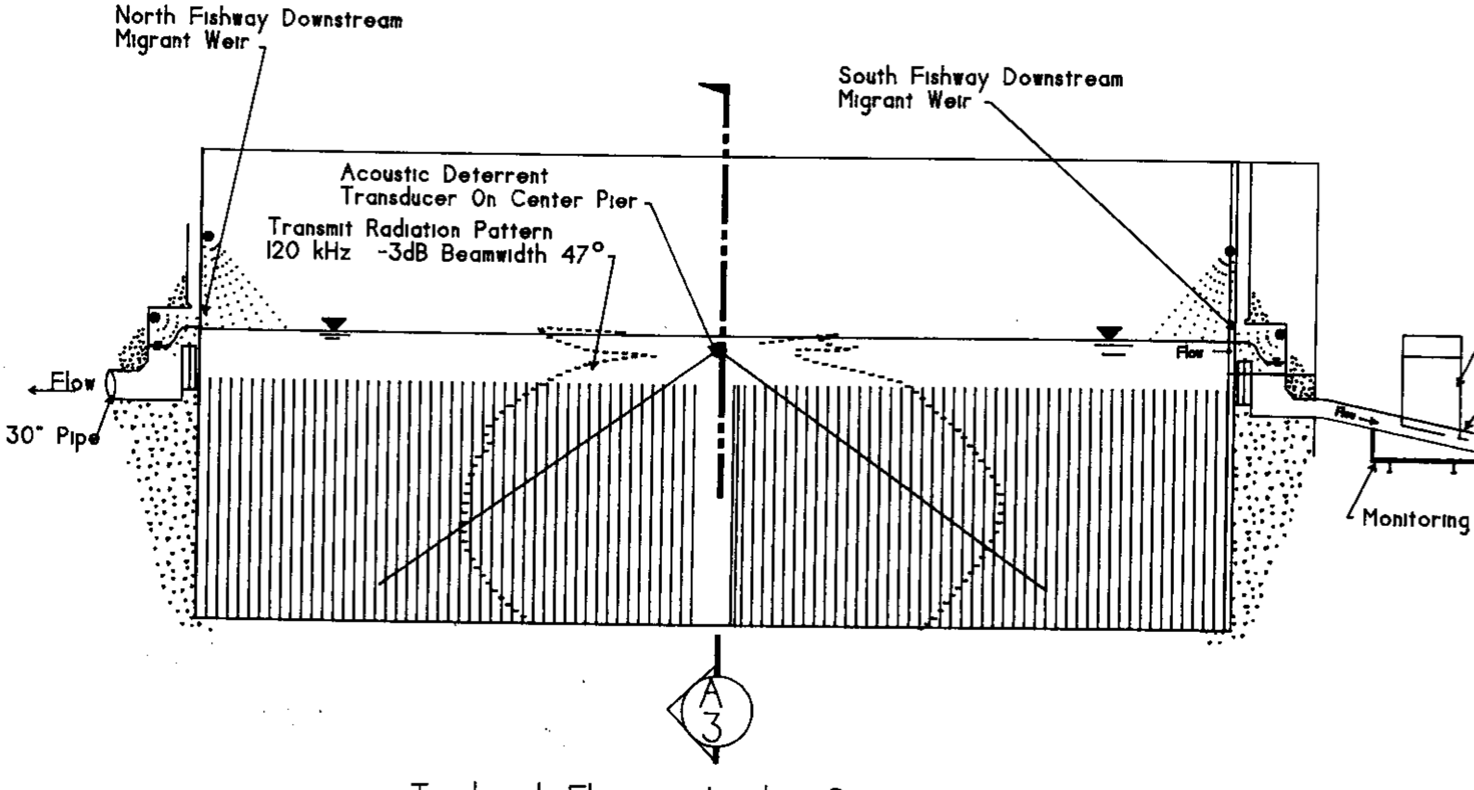
Downstream Fish Passage Facilities
Prior To Study System Installation
Pejepscot Hydroelectric Project
Topsham Hydro Partners
Figure 1


Upstream Fishway Exit
Headpond
El. 67.5'
Flow
Spillway Flow
South Fishway Downstream Migrant Weir
Bypass Control Gate
B
3
Trashrack
24" South Fishway Bypass Pipe
20' Dam Apron
14'x38' Elevated Platform
South Fishway Riser Box, Inclined Dewatering System and Fish Holding Tank
A
3
Walkway
Tailrace Flow
Jib Crane
Jib Crane Travel
Deck
Down
Downstream Migrant Fishway Discharges
30" North Fish
Bypass Control Gate
Stair Landing
North Fishway Riser Box, Inclined Dewatering System and Fish Holding Tank
Upstream Fishway
Powerhouse A
Tailrace Flow

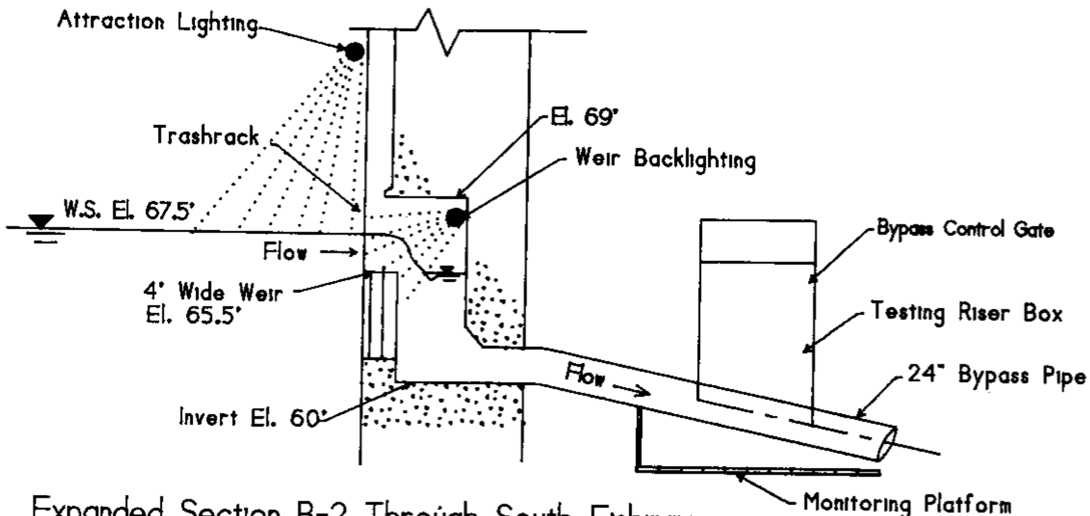
Plan View



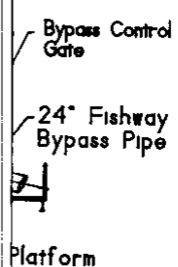
Downstream Fish Passage Facility With
Study System Installed
Pejepscot Hydroelectric Project
Topsham Hydro Partners
Figure 2

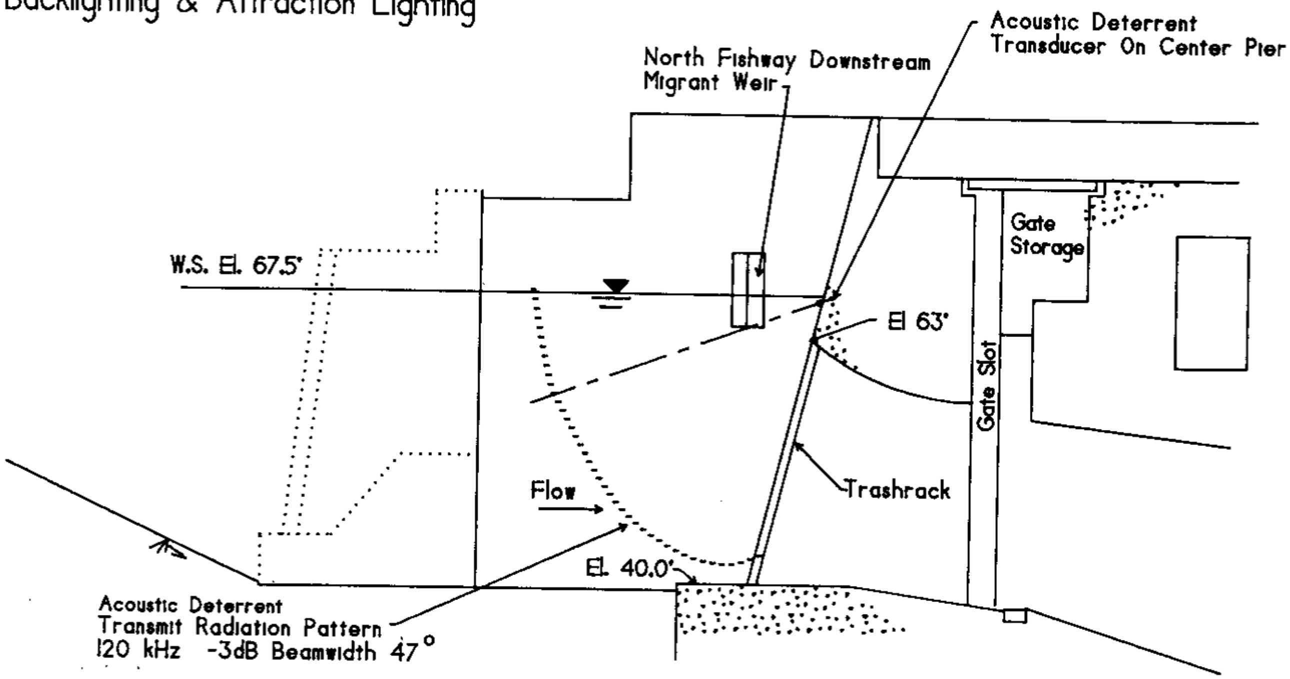


Trashrack Elevation Looking Downstream
120 kHz Transducer Deployment On Pier



Expanded Section B-2 Through South Fishway
Locating Weir Backlighting & Attraction Lighting

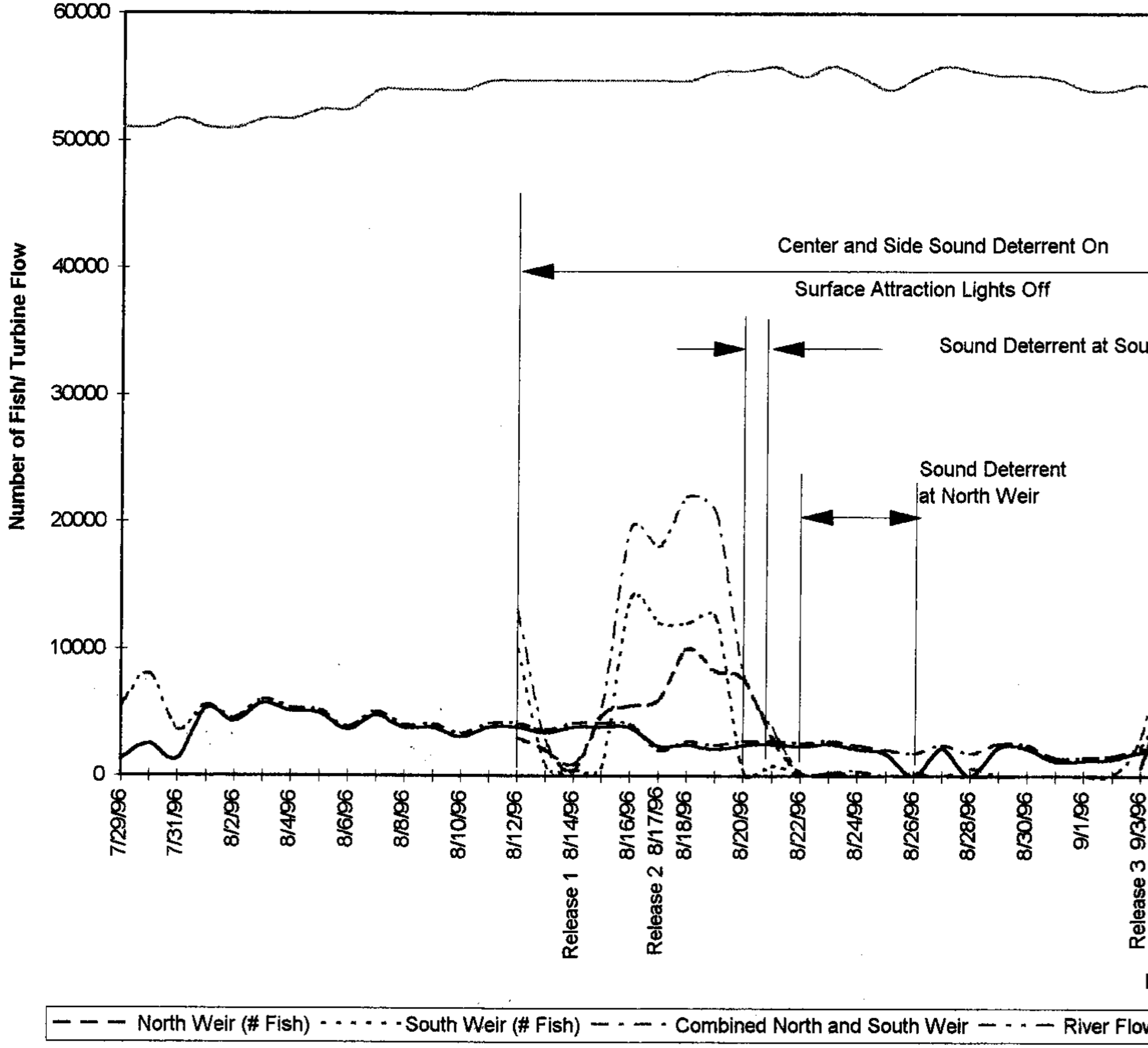




Section A-2 Through Turbine Intake
Single Transducer Deployment On Center Pier

Acoustic Deterrent & Lighting
Systems Used For
Downstream Fish Passage Studies
Pejepscot Hydroelectric Project
Topsham Hydro Partners
Figure 3

Ambient Environmental And Study Conditions, Number Of Juvenile Clupeids Pa
The 1996 Pejepscot Project Downst



ɪing The Fishways, And Seasonality of Releases Of Marked Study Fish During
am Fish Passage Facilities Study

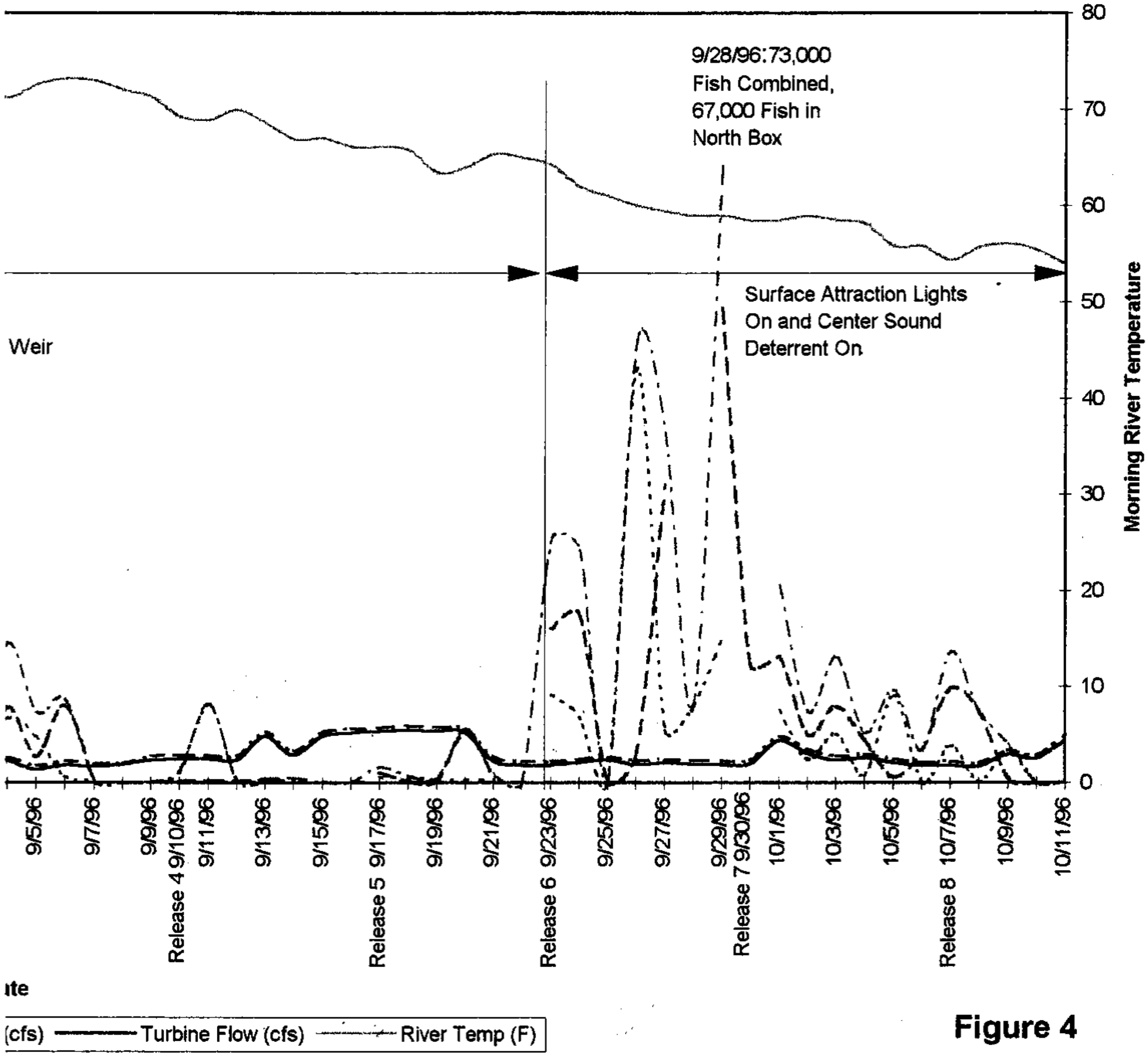
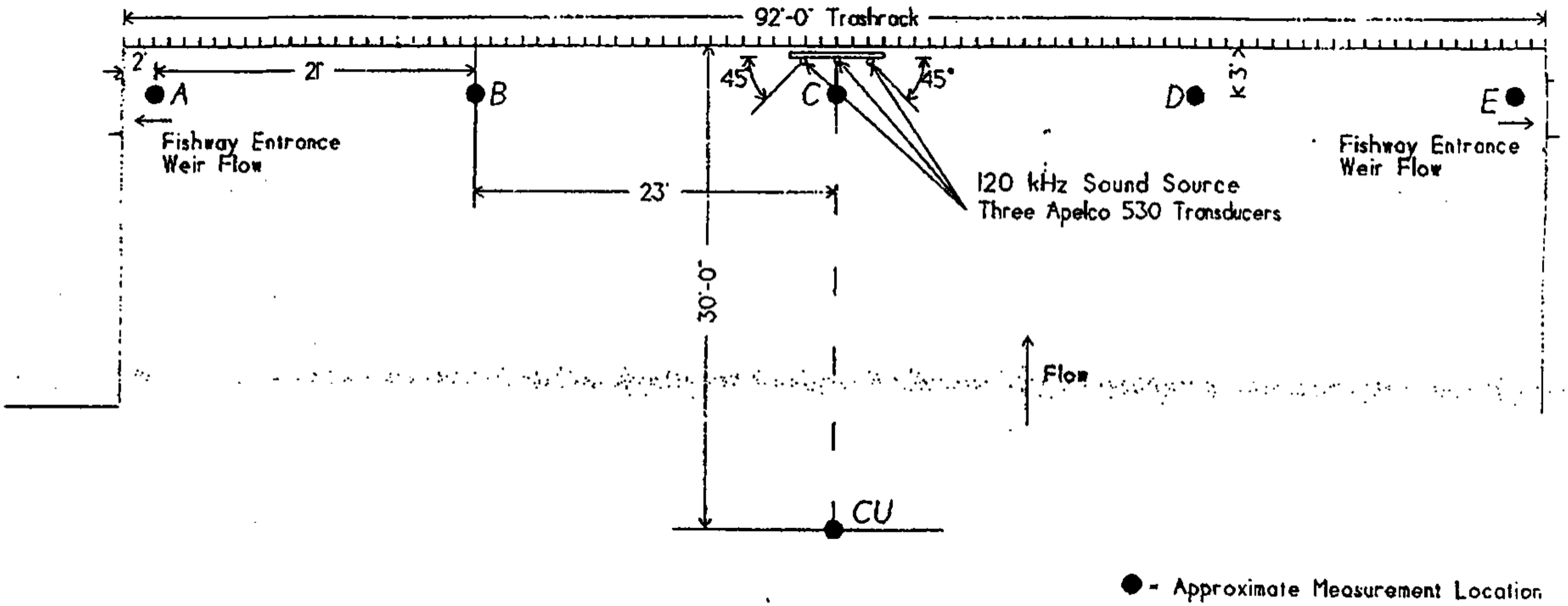


Figure 4

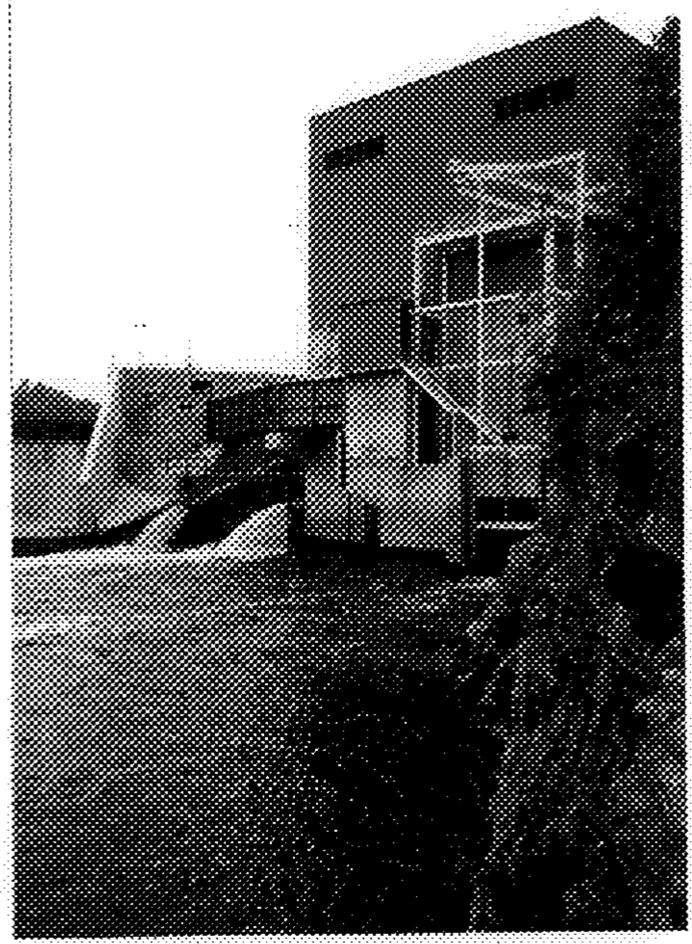


Pejepscot Intake Plan View

Figure 5
Pejepscot Hydroelectric Project
Sound Deterrent System Field Intensity Measurement Locations

APPENDIX 5

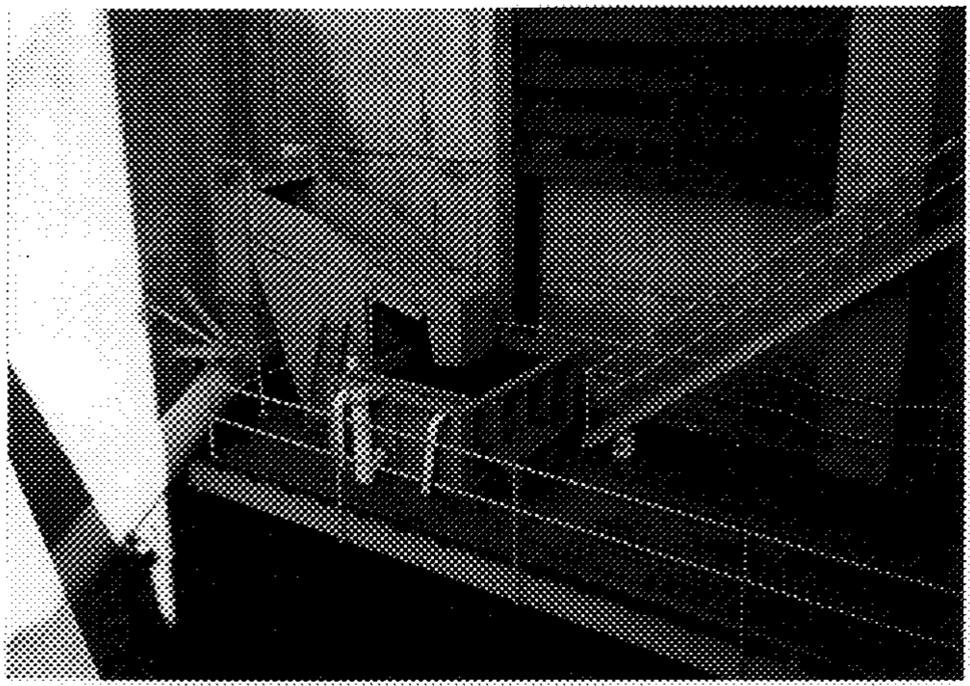
PHOTOS



PEJEPSCOT HYDRO STATION

View of Downstream and
Upstream Fish Passage Facilities

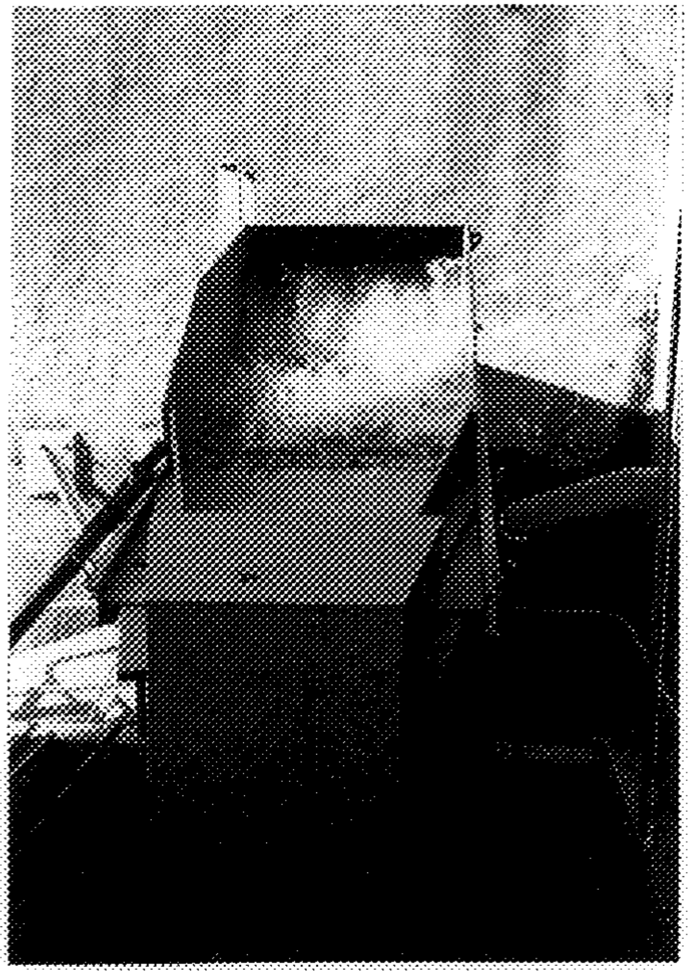
PHOTOGRAPH 1



PEJEPSCOT HYDRO STATION
SOUTH DOWNSTREAM FISHWAY

View of pipe riser and gate,
inclined dewatering screen
and holding tank.

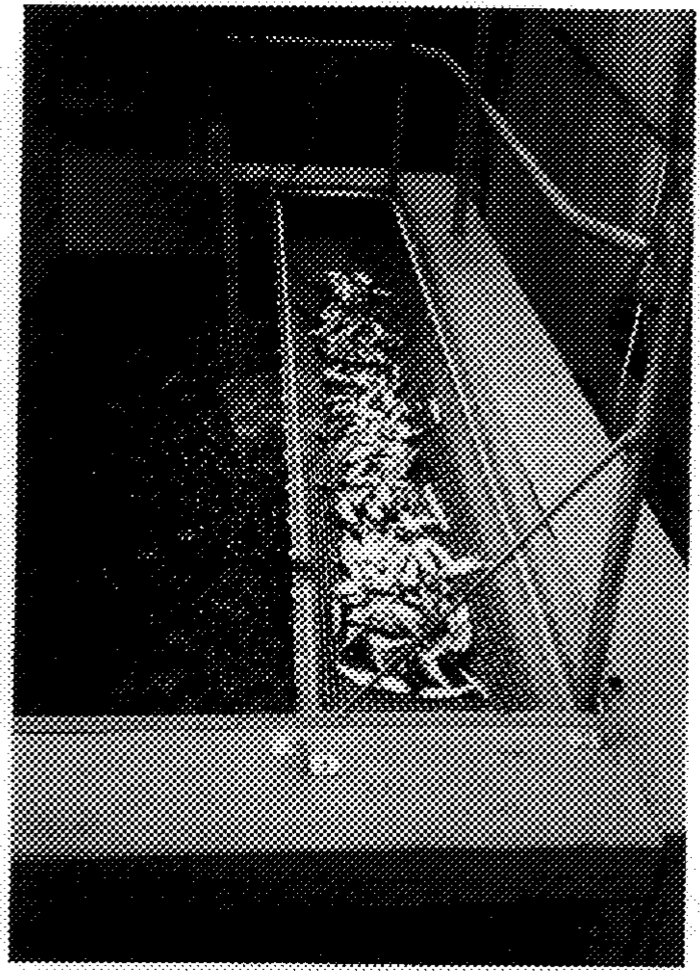
PHOTOGRAPH 2



PEJEPSCOT HYDRO STATION
SOUTH DOWNSTREAM FISHWAY

Water drains through screens
fish slide into holding tank.

PHOTOGRAPH 3



PEJEPSCOT HYDRO STATION
SOUTH DOWNSTREAM FISHWAY

Catch of downstream migrating juvenile alewife.

PHOTOGRAPH 4

Information Request 9-Flow and entrance conditions at the fish lift

Prejepscot Project flow data

May 14,2020

Head pond	68.62						
Tailwater	44.57						
Units	21. 100%	22. 100%	23. Down	24. 100%			
Spill	All spilling						
Total station flow		7,300					
Temp.	10.5 c						
Pumps	100%	190cfs					
Down stream bypasses closed for cleaning, opened back up at 2:00 pm							

May 18,2020

Head pond	69.57			
Tailwater	45.3			
Units	21. 100%	22. 100%	23. Down	24. 0%
Spill	All spilling			
Total station flow		12,330		
Temp.	11.6 c			
Pumps	100%	190cfs		
Down stream bypasses open				

May 21,2020

Head pond	68.86			
Tailwater	45.03			
Units	21. 100%	22. 100%	23. Down	24. 0%
Spill	All spilling			
Total station flow		10,669		
Temp.	12.0 c			
Pumps	100%	190cfs		
Down stream bypasses open				

May 26,2020

Head pond	67.23			
Tailwater	43.12			
Units	21. 100%	22. 0%	23. Down	24. 0%
Spill	0%			
Total station flow		6,599		
Temp.	11.8 c			
Down stream bypasses open				

May 29,2020

Head pond	67.24				
Tailwater	42.85				
Units	21. 92%	22. 0%	23. Down	24. 0%	
Spill	0%				
Total station flow		6,400			
Temp.	14.5 c				
Down stream bypasses open					

June 1,2020

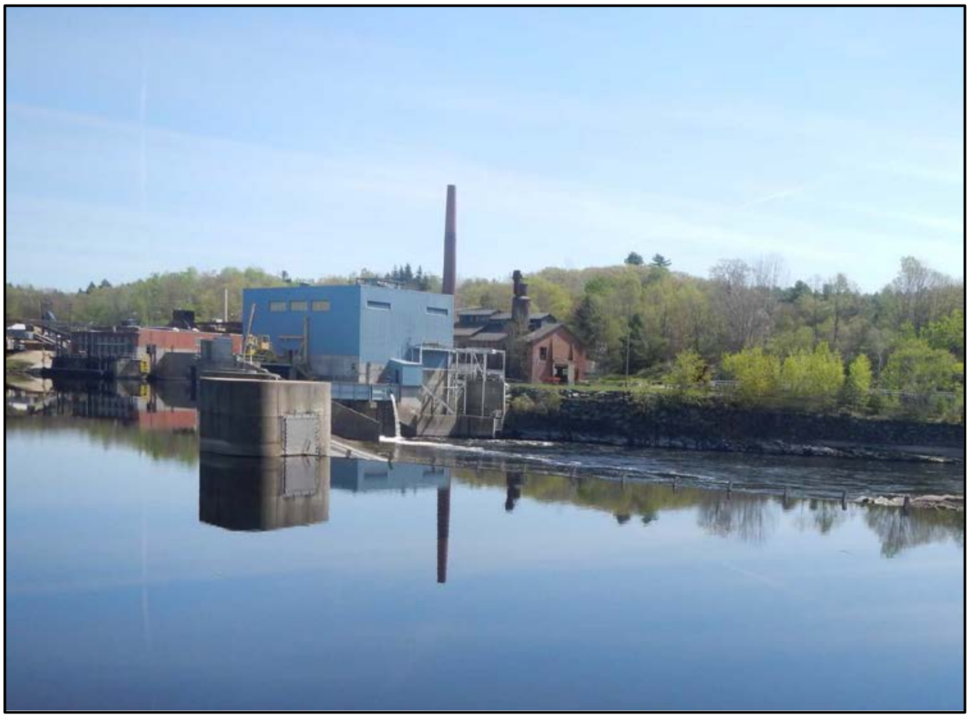
Head pond	67.27			
Tailwater	41.91			
Units	21. 72%	22. 0%	23. Down	24. 0%
Spill	0%			
Total station flow		4,700		
Temp.	19.4 c			
Down stream bypasses open, fishway Is running.				

APPENDIX E-3: HISTORIC PROPERTIES MANAGEMENT PLAN

{The Historic Properties Management Plan is being filed separately as Privileged (non-public information) in Volume III to protect the location of resources listed on or eligible for the NRHP}

APPENDIX E-4: OPERATIONS MONITORING PLAN

OPERATIONS MONITORING PLAN
PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)



Submitted by:

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GOMEZ AND SULLIVAN ENGINEERS

August 2020

Brookfield

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LIST OF ABBREVIATIONS AND DEFINITIONS

cfs	cubic feet per second
FERC	Federal Energy Regulatory Commission
ft	feet
MDEP	Maine Department of Environmental Protection
MDIFW	Maine Department of Inland Fisheries and Wildlife
MDMR	Maine Department of Marine Resources
ME	Maine
mi^2	square miles
MGD	million gallons per day
MW	megawatt
NASCC	North American System Control Center
NMFS	National Marine Fisheries Service
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
RM	river mile
SCADA	Supervisory Control and Data Acquisition
Topsham Hydro	Topsham Hydro Partners Limited Partnership
USFWS	U.S. Fish and Wildlife Service

1.0 BACKGROUND

Topsham Hydro Partners Limited Partnership (L.P.) (Topsham Hydro) owns and operates the Pejepscot Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC or the Commission) Project No. 4784. The 13.88-megawatt (MW) Project is located on the Androscoggin River in the village of Pejepscot and the Town of Topsham, Maine (ME) to the east, the Town of Lisbon, ME to the north, and the Town of Durham, ME and the Town of Brunswick, ME to the west. The Project straddles the border between Cumberland and Sagadahoc counties and extends into Androscoggin County.

The purpose of this plan is to document how Topsham Hydro will monitor, record compliance with, and report deviations from the requisite minimum flow and impoundment level requirements described below.

2.0 PROJECT DESCRIPTION

The Project is the second dam on the Androscoggin River located at approximately river mile (RM) 14. The Project dam is approximately 4 miles upstream of the Brunswick Hydroelectric Project and 3.25 miles downstream of the Worumbo Hydroelectric Project. In total, the Project is the second of 22 hydroelectric projects on the mainstem Androscoggin River. The Androscoggin River basin above the dam has a drainage area of approximately 3,420 square miles (mi^2). The Project boundary extends approximately 3 miles upstream from the Pejepscot Dam.

2.1 Project Works

Existing Project structures generally consist of a dam, spillway, fish passage facilities, two powerhouses, a sheet-pile floodwall, an interconnection with the local utility’s transmission system, and ancillary equipment.

The Pejepscot Dam is a 560-foot-long, 47.5-foot-high, rock- and gravel-filled, timber-crib, overflow structure with a sheet-pile cutoff to bedrock along the upstream side. The cribs are topped with a 5-foot-thick reinforced concrete slab to protect the dam from erosion during periods of high river flow. Spillway capacity is provided by operating the gates on the crest of the dam. The crest is equipped with five, 96-foot-long by 3-foot-high, hydraulically operated, bascule gates separated by concrete piers. The bascule gates are constructed of steel, and can be operated automatically or manually. The Project has a spillway discharge capacity of 95,000 cubic feet per second (cfs).

The powerhouses at the Project include an original powerhouse that was constructed in 1898, and a newer powerhouse that was constructed from 1985 to 1987. The original (northerly) powerhouse contains three rehabilitated horizontal Francis units (identified as Nos. 21, 22, and 23) with a combined output capacity of about 1.58-MW. These units are typically operated at either 100% gate or completely off. The three units pass approximately 350 cfs each (1,050 cfs total) at 100% gate. The newer powerhouse contains a vertical-shaft, low speed, adjustable-blade, propeller type (Kaplan) turbine-generator unit (identified as Unit No. 1) rated at 12.3-MW. The minimum and maximum rated flow through the turbine is 1,170 and 7,550 cfs, respectively.

The upstream fish passage facility is a vertical lift (elevator) that lifts migratory fish in a hopper about 30 feet (ft) vertically from near the powerhouse tailrace to the impoundment level behind the dam. The fish lift is designed to pass 85,000 American shad and 1,000,000 river herring annually. The upstream fish passage is operated annually from April 15 to November 15. The four attraction pumps are operated by station technicians; the number of pumps operating is determined based on the flow coming through the turbine and out the tailrace. When river flows are less than 1,700 cfs, one pump is operated (total attraction flow 70 cfs). When river flows are between 1,700 and 3,500 cfs, two pumps are operated (total attraction flow 110 cfs). When river flows are between 3,500 and 5,200 cfs, three pumps are operated (total attraction flow 150 cfs). Finally, when river flows are greater than 5,200 cfs, four pumps are operated (total attraction flow 190 cfs). The total of 190 cfs (attraction flow from four pumps (160 cfs) plus an additional 30 cfs provided from the impoundment via the exit trough).

The downstream fish passage facilities consist of two entry weirs, one on either side of the Unit 1 turbine intake. Each entry weir has an invert elevation of 65.5 ft. From each weir, an outlet pipe conveys downstream migrating fish in water down to the tailwater. The weir gates are four ft wide and are part of an inlet box with the outlet pipe located on the side opposite the weir. The right-side weir has a 30-inch diameter transport pipe and the left-side weir has a 24-inch diameter transport pipe. Both pipes have a free discharge to the water below the dam. Each downstream bypass can pass approximately 13 cfs, 29 cfs, and 87 cfs at headpond elevations of 66.5 ft. (low), 67.2 ft. (normal), and 69.0 ft. (high), respectively. This assumes that the entrance gate at each downstream bypass is in the fully opened position. The downstream fishway is currently operated from April 1 to December 31, as river conditions allow.

2.2 Impoundment

The Pejepscot Project impoundment encompasses approximately 225 acres at a full pond elevation of 67.5 ft. The reservoir has an estimated gross volume of 3,278 acre-ft. The Project impoundment has no significant usable storage capacity due to the Project's run-of-river operational mode.

2.3 License Requirements

Based on the Final License Application and consultation to date, Topsham Hydro anticipates that the new license articles pertaining to minimum flow requirements, impoundment elevation fluctuations, and the operation of the existing fish passage structures will be as follows.

- Maintain year-round minimum flow of 1,710 cfs or inflow, whichever is less[1].
- Operate in a run-of-river mode maintaining a normal pond elevation of 67.2 ft or 0.3 ft below the top of the spill gates[2].
- Operate the upstream passage facilities from April 15 to November 15.

[1] Minimum flow requirements under the current license are described as "continuous," but Brookfield proposes that the requirement in the new license be instead based on the hourly average. This change would capture the intent of the minimum flow measure, but would avoid unnecessary reporting of very short term excursions due to unplanned events such as extreme weather, equipment failure, and so on. A similar change was adopted in 2011 for the Gulf Island-Deer Rips Hydropower Project (FERC No. 2283).

[2] Brookfield also proposes that, for compliance purposes, the pond level elevation also be based upon hourly average, for similar logic as the minimum flow requirement.

- Operate the downstream fish passage facilities from April 1 to December 31.

In addition to the existing license requirements listed above, Topsham Hydro anticipates additional operational requirements associated with the proposed measures below.

- Seasonal installation and maintenance (June 1 through September 15) of a permanent American eel upstream passage ramp.
- Reduce the operational setting for Unit 1 (unit turndown) to approximately 3,480 cfs (resulting in intake approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually to enhance downstream eel passage.

3.0 OPERATIONS MANAGEMENT

3.1 River Basin Operations

The Androscoggin River flow regime is set by the Upper Androscoggin River Storage System, which consists of a series of headwater storage reservoirs located in Maine and New Hampshire. Outflow from the storage reservoirs is set in accordance with various legal agreements. The upper portion of the Androscoggin River contains 16 run-of-river hydroelectric projects until reaching the Gulf Island Hydroelectric Project. The Gulf Island Project then re-regulates downstream flow for the lower Androscoggin River. The lower portion of the Androscoggin River contains 5 run-of-river hydroelectric projects, including the Pejepscot Project which is the second dam upstream of the Androscoggin River's confluence with Merrymeeting Bay.

3.2 Typical Operations

The Project is operated as a run-of-river facility. The main turbine generator unit (Unit 1) is operated on pond level control. Unit 1 controls the turbine wicket gates to maintain a preset pond level which is normally at about elevation 67.2 ft or 0.3 ft below the top of the spill gates. When Unit 1 nears its maximum flow capacity of 7,550 cfs, one or more of the three small units (Units 21, 22 and 23) is manually started. The small units are mainly operated during high spring runoff and after large storm events that increase river flow.

The Project is required to release a continuous minimum flow of 1,710 cfs, as measured immediately downstream from the Project powerhouse, or inflow to the impoundment, whichever is less, minus process water (approximately 5 million gallons per day (MGD) or 9.3 cfs) and 100 cfs for pond level control.

3.3 High Water Operations

Under higher river flow conditions, water in excess of the hydraulic capacity (8,600 cfs) of the generating units is spilled at the dam. It is estimated that the Project is operated in this manner approximately 25 percent of the year. High flows in the Androscoggin River Basin occur annually during the spring and fall run-off periods. The magnitude of spring flows may vary considerably depending on the water content of the melting snow cover, the occurrence of coincidental heavy spring rainfall, and warm temperatures.

Under flood conditions, in addition to spillage and maximum unit operation, the spill gates on the dam spillway are lowered to help control upstream water levels. When the pond level reaches elevation 69.0 (1.5 ft above the spill gates), the gates begin to lower starting with Gate 1, closest to the powerhouse. The gates operate on pond level control and as flow increases, they maintain the pond level of elevation 69.0 until all five gates are open. When the flow starts decreasing and the pond level drops to elevation 68.0 the gates start to close to maintain a level above elevation 68.0. When all five gates are closed, the pond is again on turbine pond level control until the pond level exceeds elevation 69.0. Appendix A contains the rating curve for the spillway gates.

3.4 Low Water Operations

With the existing regulation of the upstream storage facilities, the reduction in river flows due to adverse water conditions is generally minimal and infrequent. During low inflow conditions, Topsham Hydro operates the Project to maintain the impoundment level near 67.2 ft and to provide the required minimum downstream releases and flows necessary for operation of the fish passage structures. The minimum downstream releases are provided through turbine operations and fish passages when in operation. During the rare occasions when inflows to the impoundment are less than the minimum hydraulic capacity of the Project's turbines, the minimum downstream flow release is provided over the spillway and through the fish passages when in operation.

3.5 Routine Maintenance and Operation

The Project is remotely operated using a Supervisory Control and Data Acquisition (SCADA) link from Topsham Hydro's North American System Control Center (NASCC) in Marlborough, Massachusetts. At the control center, dispatchers are on duty 24 hours a day, seven days a week. The Project is normally visited by operations and maintenance personnel each workday. A local operating crew is also available during weekdays and weekends as necessary to perform routine maintenance and operations at the facility. Daily logs of impoundment level, Project outflow, and outages are maintained electronically for the Project.

3.6 Scheduled Maintenance

3.6.1 Minimum Flows

Periodic turbine shutdowns will occur as necessary to perform maintenance activities. Under these circumstances, Topsham Hydro will maintain a minimum continuous downstream flow of 1,710 cfs or inflow, whichever is less, through the turbine units, fish passages, and/or over the spillway as available or appropriate.

During planned maintenance activities or other conditions where temporary changes to the required minimum flows are necessary, Topsham Hydro will consult with the Maine Department of Environmental Protection (MDEP), Maine Department of Inland Fisheries and Wildlife (MDIFW), Maine Department of Marine Resources (MDMR), National Marine Fisheries Service (NMFS), and U.S. Fish and Wildlife Service (USFWS).

3.6.2 Impoundment Water Levels

Drawdowns of the impoundment may be required from time to time to perform major maintenance on Project structures or to accommodate requests or orders from Federal or state agencies and entities concerned with public safety, construction/maintenance of downstream public works projects, and other similar activities. The impoundment level may be drawn down as low as 64.5 ft for Project maintenance. However, agency consultation will be initiated before the impoundment level is be drawn down below 66.5 ft for more than 1 hour. During planned drawdowns exceeding this level, Topsham Hydro will consult with the MDEP, MDIFW, MDMR, NMFS, and USFWS on impoundment water levels and minimum flows during refill.

3.6.3 Fish Passage Operations

The Project fishways will be operated and maintained, and records maintained, in accordance with the Fish Passage Operations and Maintenance Plan as approved. Any new fishways installed as a result of the new license will be operated in accordance with an updated Fish Passage Operations and Maintenance Plan.

Fishway maintenance is typically addressed prior to spring start-up, but may also be addressed during the operational season (as needed) through brief fishway dewaterings following agency consultation. The upstream fishway and its attraction water source are checked periodically to make sure that they are operating properly, and any debris inhibiting fish passage is removed. Maintenance of the downstream fish passage facilities typically consists of periodic inspections of the entrance weirs and their associated trashracks for lodged debris. In addition, repairs are made as needed to broken or malfunctioning components of the system.

3.7 Unscheduled Operations

3.7.1 Minimum Flows

The minimum flow can be maintained by either the large vertical Kaplan unit (Unit 1) running at 3.1 MW (1,710 cfs), or having Unit 1 run at 2.5 MW (1,450 cfs), along with one of the smaller units (either Unit 21, 22, or 23), both passing together approximately 1,830 cfs. The generating unit(s) may occasionally trip unexpectedly (i.e. line fault, equipment failure, etc.). Under these circumstances, Topsham Hydro will maintain the minimum downstream flow of 1,710 cfs or inflow (whichever is less) through the remaining unit(s) or through the spillway gates.

In the event that one of the smaller units (either Unit 21, 22, or 23) is on line and trips, the NASCC will remotely increase generation at Unit 1, as needed, to meet the minimum flow. If Unit 1 is on line and trips, gates operate automatically based on the headpond level. The siren sounds prior to the gates lowering.

If the hourly average flow drops below the minimum, Topsham Hydro will notify MDEP, MDIFW, MDMR, NMFS, and USFWS of the minimum flow excursion within 24 hours (see Section 5.0, Reporting).

3.7.2 Impoundment Water Levels

There may be occasions where Topsham Hydro will need to initiate an unplanned drawdown to respond to emergencies beyond its control, such as dam safety, public safety, or impending electrical system blackout emergencies. Should the hourly average headpond drop below the minimum, Topsham Hydro will notify the MDEP, MDIFW, MDMR, NMFS, and USFWS within 24 hours of such emergencies and include the date, time, and the reason for the emergency drawdown (see Section 5.0, Reporting).

4.0 OPERATIONS MONITORING

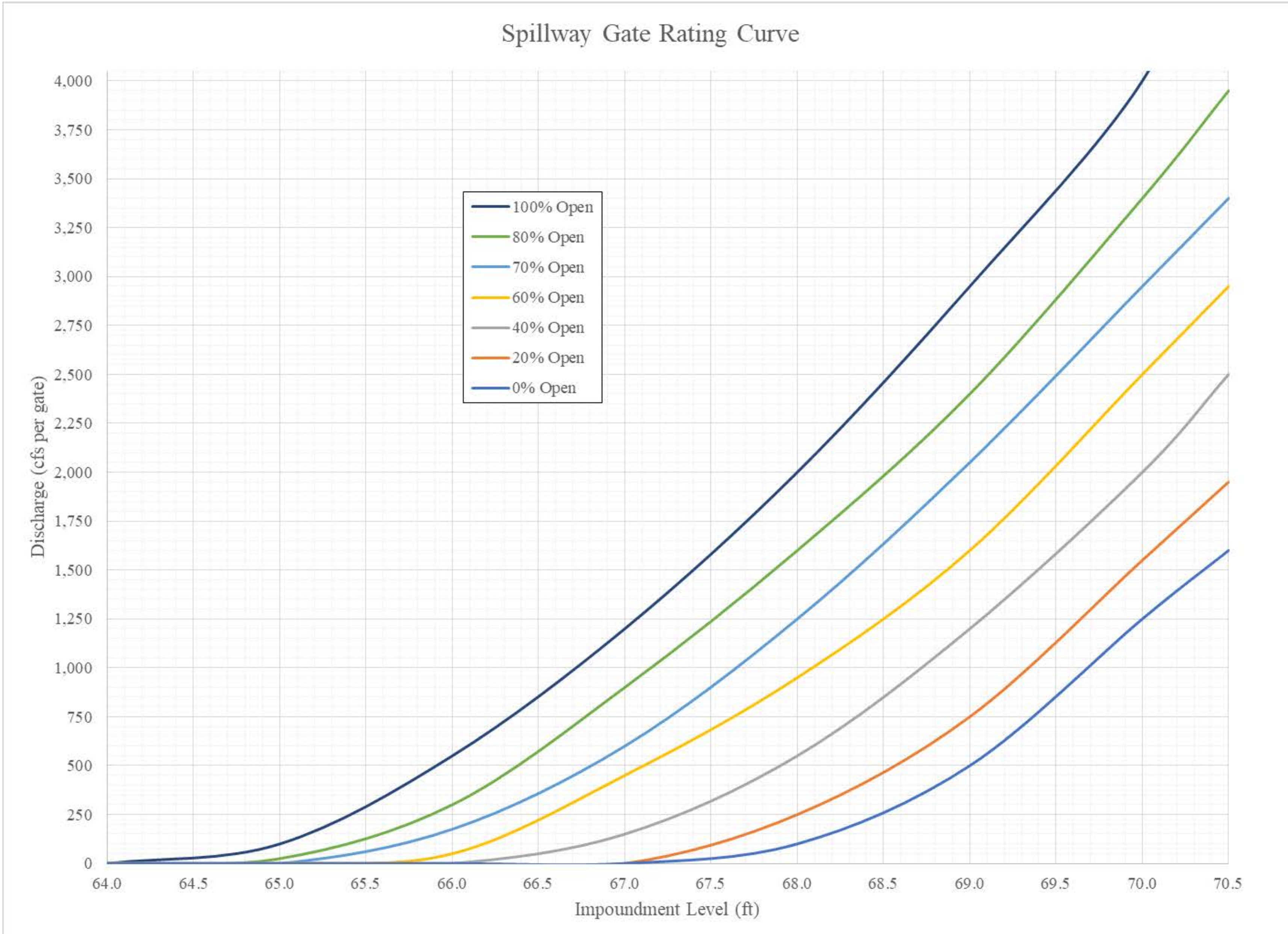
Topsham Hydro will monitor generation at the Project continuously via SCADA. Unit 1 outflow is calculated automatically from the generation readings using a conversion factor based on kW/cfs passed through the unit (Appendix B). Flow through the other Project components including the fish passages, and over the spillway will be determined by reading and recording gate settings and pond level and calculating flow based on the engineering curves for each component (Appendices A and C). A pressure-sensitive headwater sensor (transducer) is in place at the dam and provides real-time impoundment levels. Project outflow and impoundment level will be recorded electronically by the SCADA system at least every 15 minutes and archived for Topsham Hydro's record of compliance with the requirements of the FERC license. Topsham Hydro will provide copies of monitoring data (i.e., flow and impoundment level conditions) to the FERC, MDEP, MDIFW, MDMR, NMFS, and USFWS upon written request.

5.0 REPORTING

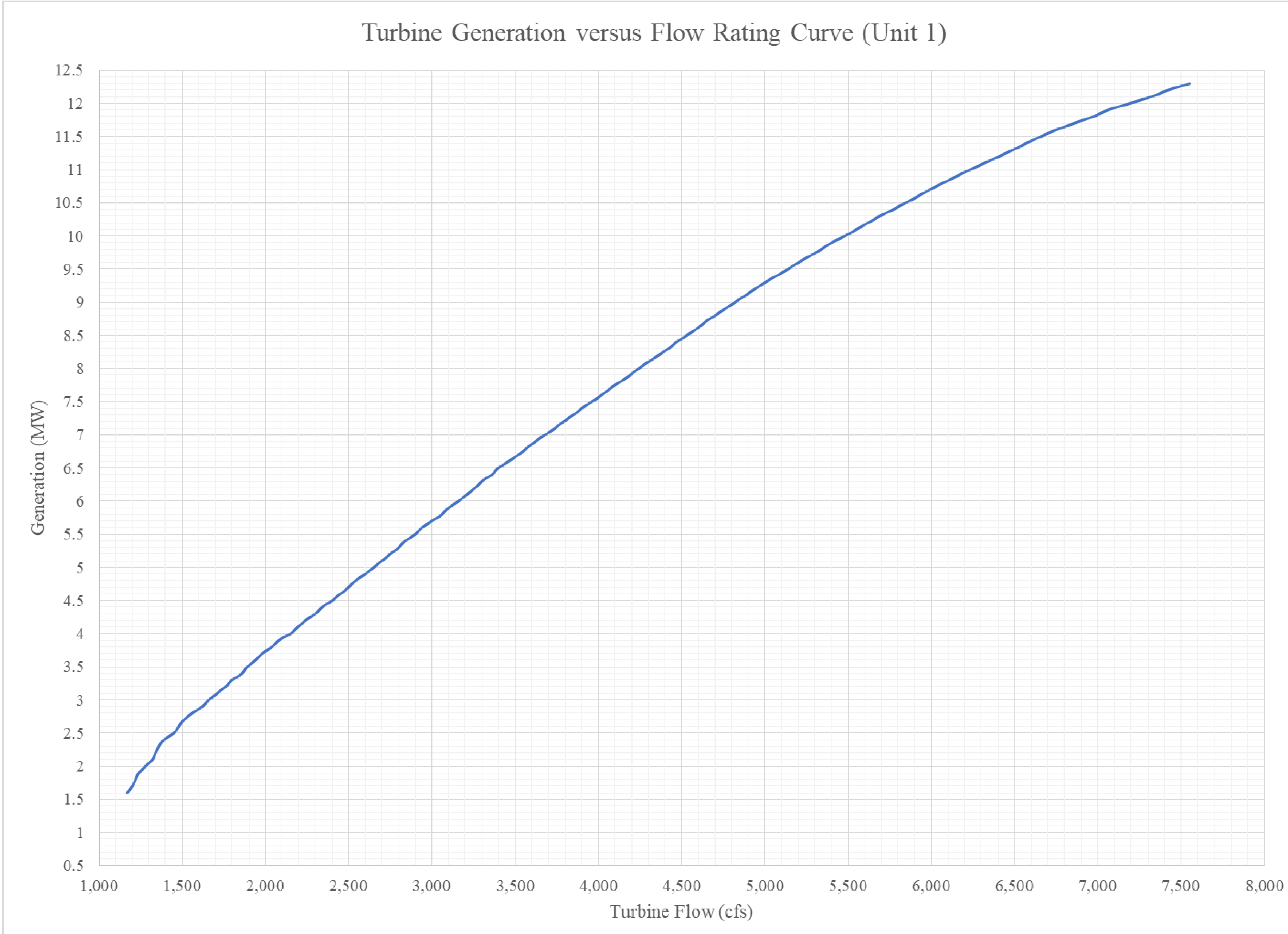
Topsham Hydro will notify the MDEP, MDIFW, MDMR, NMFS, and USFWS within 24 hours of a deviation, as specified herein, from minimum flow or impoundment elevation requirements. The agency notification will include a brief summary of the deviation and observed environmental or public safety effects, if any, resulting from the deviation. The required minimum flow and/or impoundment elevations may also be interrupted for short periods of time upon agreement with MDEP, MDIFW, MDMR, NMFS, and the USFWS.

Topsham Hydro will notify FERC within 10 days of any such deviations from minimum flow or impoundment elevation requirements. The notification will contain, to the extent possible, the cause, severity, and duration of the deviation, and any observed or reported environmental effects resulting from the incident. The report will also provide pertinent Project data, a description of corrective measures, if any, and documentation of consultation with the agencies. A copy of the report will be provided to the resource agencies.

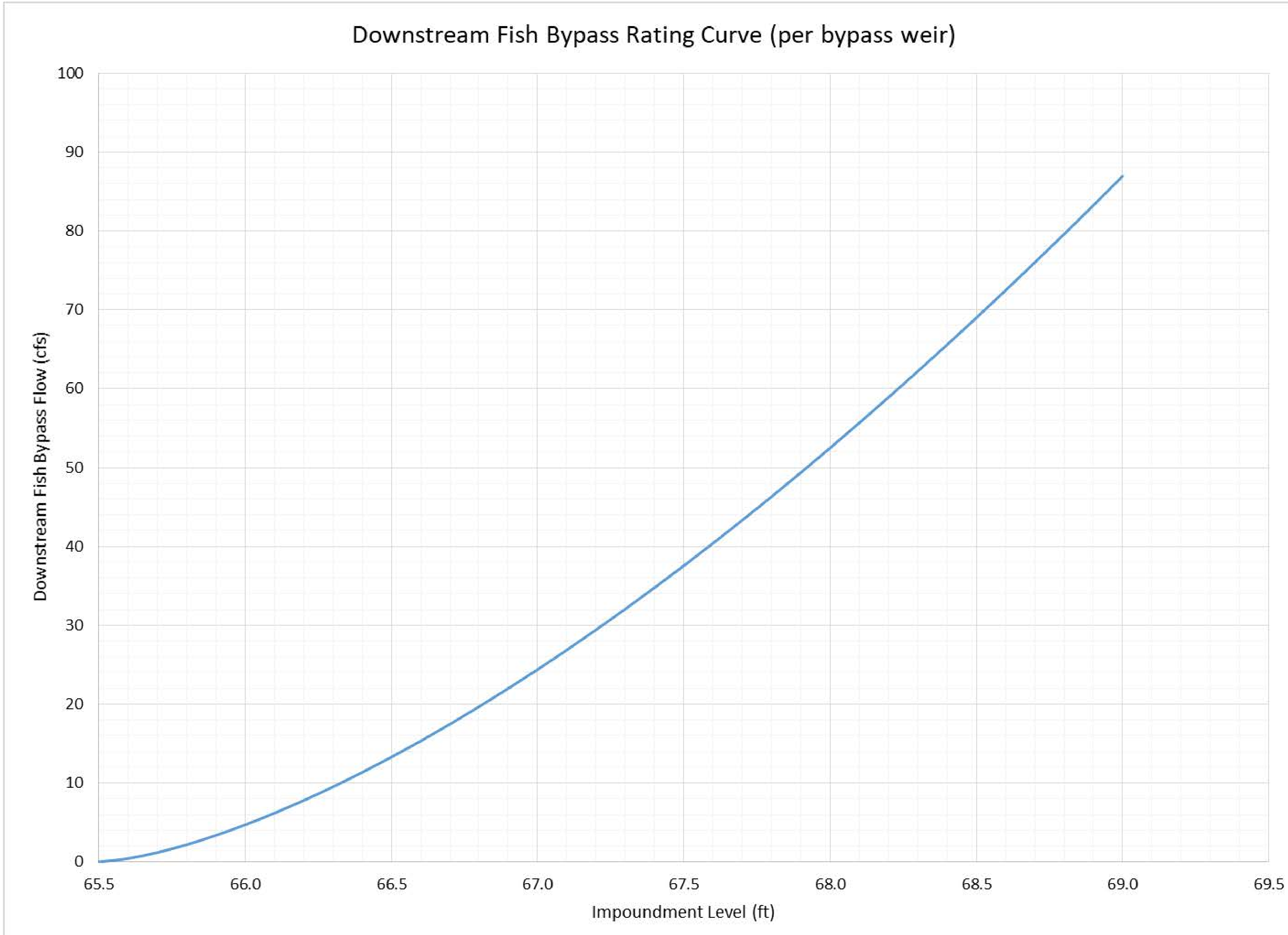
APPENDIX A: SPILLWAY GATE RATING CURVE


Spillway Gate Rating Curve
100% Open
80% Open
70% Open
60% Open
40% Open
20% Open
0% Open
Discharge (cfs per gate)
4,000
3,750
3,500
3,250
3,000
2,750
2,500
2,250
2,000
1,750
1,500
1,250
1,000
750
500
250
0
64.0
64.5
65.0
65.5
66.0
66.5
67.0
67.5
68.0
68.5
69.0
69.5
70.0
70.5
Impoundment Level (ft)

APPENDIX B: TURBINE GENERATION VERSUS FLOW RATING CURVE

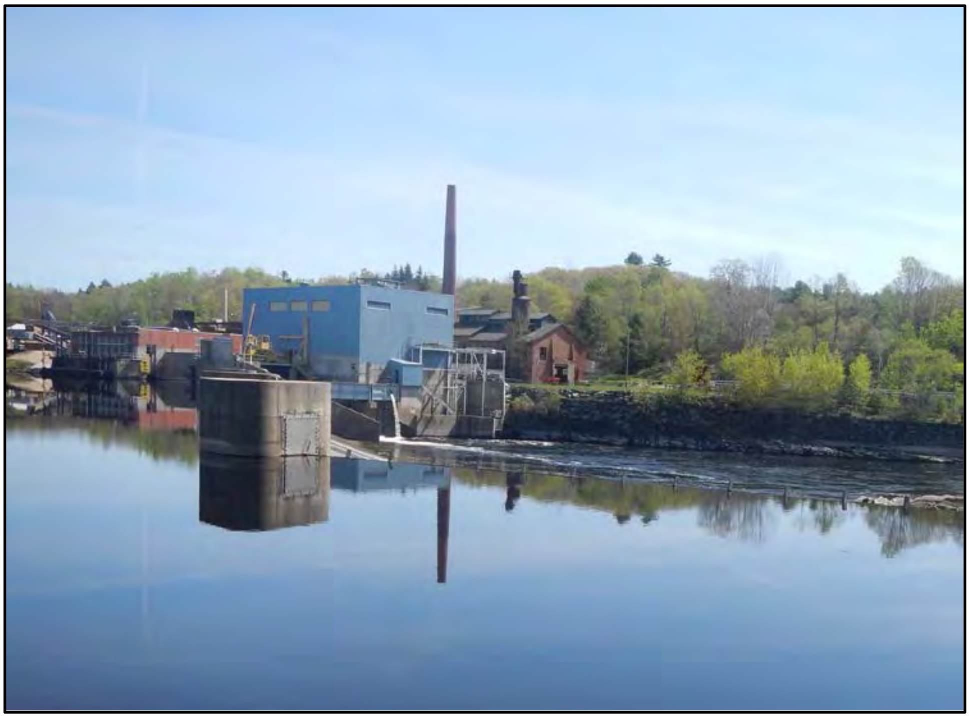

Turbine Generation versus Flow Rating Curve (Unit 1)
Generation (MW)
12.5
12
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
6,500
7,000
7,500
8,000
Turbine Flow (cfs)

APPENDIX C: DOWNSTREAM FISH PASSAGE FLOW RATING CURVE


Downstream Fish Bypass Rating Curve (per bypass weir)
Downstream Fish Bypass Flow (cfs)
0
10
20
30
40
50
60
70
80
90
100
65.5
66.0
66.5
67.0
67.5
68.0
68.5
69.0
69.5
Impoundment Level (ft)

APPENDIX E-5: FISHWAY OPERATIONS AND MAINTENANCE PLAN

FISH PASSAGE OPERATIONS MAINTENANCE PLAN
PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)



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August 2020

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LIST OF ABBREVIATIONS AND DEFINITIONS

cfs	cubic feet per second
FERC	Federal Energy Regulatory Commission
FOMP	Fishway Operations and Maintenance Plan
ft	feet
HP	horsepower
Hz	Hertz
MGD	million gallons per day
MW	megawatt
NMFS	National Marine Fisheries Service
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
Topsham Hydro	Topsham Hydro Partners Limited Partnership

1.0 INTRODUCTION

This Fish Passage Operations and Maintenance Plan (FOMP) is intended to define how Topsham Hydro Partners Limited Partnership (L.P.) (Topsham Hydro), owner and Licensee of the Pejepscot Hydroelectric Project (FERC No. 4784) (Project) will operate and maintain the Project fish passage facilities.

The FOMP describes the fish passage facilities that currently exist at the Pejepscot Project, the period in which the facilities are 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 FOMP includes the necessary supporting information such as contact information, daily inspection forms, drawings, and spare parts on-site.

2.0 BACKGROUND

The Pejepscot Project straddles the border between Cumberland and Sagadahoc Counties in Topsham and Brunswick, Maine. Existing Project structures generally consist of a dam, spillway, fish passage facilities, two powerhouses, a sheet-pile floodwall, an interconnection with the local utility's transmission system, and ancillary equipment.

The Pejepscot Dam is a 560-foot-long, 47.5-foot-high, rock- and gravel-filled, timber-crib, overflow structure with a sheet-pile cutoff to bedrock along the upstream side. The cribs are topped with a 5-foot-thick reinforced concrete slab to protect the dam from erosion during periods of high river flow. At the right (west) end of the dam where the abutment rock level is high, there is no cribwork, and the dam consists of a low, mass-concrete section. The dam is abutted on the right by a high bedrock outcrop and on the left (east) by a mass-concrete and stone-masonry pier.

Spillway capacity is provided by operating the gates on the crest of the dam. The crest is equipped with five, 96-foot-long by 3-foot-high, hydraulically operated, steel bascule gates separated by concrete piers. The gates can be operated automatically or manually. The hydraulic pump units that operate the gates are contained in the mass-concrete pier forming the left abutment of the dam. The crest gate seals are heated to permit operation of the gates during cold weather, including movement when subjected to heavy ice pressure. The Project has a spillway discharge capacity of 95,000 cubic feet per second (cfs). Overtopping of the dam does not occur until the headwater reaches elevation 81 feet (ft.)[1], at which point the spillway discharge is approximately 110,000 cfs.

The powerhouses at the Project include an old (original) powerhouse that was constructed in 1898, and a new powerhouse that was constructed from 1985 to 1987. The combined installed capacity of the four generating units is 13.88 megawatts (MW). The Project has two separate intake structures, the old powerhouse intake and the new powerhouse intake, both of which are integral with the powerhouses.

The old powerhouse intake has 1.5-inch bar spacing on the trashrack. The bar racks have a top elevation of 69.7 ft. and extend down to an elevation of 43.3 ft. The racks are approximately 71.4

[1] Unless otherwise noted, all elevations refer to the National Geodetic Vertical Datum of 1929, U.S. Survey ft – also known as "mean sea level" or MSL.

ft. wide. The new powerhouse has 1.5-inch bar spacing at the top of the trashrack and 2.5-inch bar spacing at the bottom. The bar racks have a top elevation of 61.15 ft. and extend down to an elevation of 36.0 ft. The racks are approximately 91.6 ft. wide. The 1.5-inch bar spacing extends from elevation 61.35 ft. to elevation 55.1 ft. (total of 6.25 ft.). The remaining portion of the bar rack from elevation 55.1 ft. down to elevation 36.0 ft. (total of 19.1 ft.) has a clear-bar spacing of 2.5-inches.

The older (northerly) powerhouse contains three rehabilitated horizontal Francis units (identified as Nos. 21, 22, and 23) with a combined output capacity of about 1.58-MW. Each unit has four Francis runners attached to a single turbine shaft, each with a rotational speed of 180 revolutions per minute (rpm). These units do not have the ability to selectively operate with fewer than four turbine runners. However, one of the Francis units was damaged several years ago and the turbine shaft was cut so that only two runners on that particular unit are now in operation. Wicket gates are used to adjust the flow settings of the units.

The newer (southerly) powerhouse contains a vertical-shaft, low speed, adjustable-blade, propeller type (Kaplan) turbine-generator unit (identified as Unit No. 1) rated at 12.3-MW, with one runner containing four blades and 18 ft in diameter; it rotates at 81.8 rpm. The minimum and maximum flow through the turbine is 1,170 and 7,550 cfs, respectively. The rated head of the unit is 24 ft. Wicket gates are used to adjust the flow settings of the unit. The combined maximum capacity of all four units is 8,600 cfs.

3.0 DESCRIPTION OF FISH PASSAGE FACILITIES

3.1 Upstream Fish Passage

The upstream fish passage facility is a vertical lift (elevator) that lifts migratory fish in a hopper about 30 ft vertically from near the powerhouse tailrace to the impoundment level behind the dam (Appendix A). The fish lift is designed to pass 85,000 American shad and 1,000,000 river herring annually. The lift hopper is about 20 ft long and 7 ft wide with a sloping bottom that assists in removal of the fish from the hopper. The hopper has a capacity of approximately 1,000 gallons. The inlet to the hopper is a V-trap about 8 inches wide by 8 ft high. In front of the entry gate there are four attraction pumps under a grating that create an additional flow up to 160 cfs through the entry channel to attract the fish to the lift. These pumps can be sequenced to change the volume of water passing through the entry channel, depending on the flow out of the powerhouse tailrace. The lift basket discharges the fish into a metal channel about 6 ft wide and 8 ft high. The channel is approximately 110 ft long from the lift hopper to the gate at the dam. Along the channel is a viewing window to observe the fish along with a crowding panel that moves the fish closer to the window for viewing. There is a continuous flow of about 30 cfs from the impoundment to the lift basket to attract the fish to the impoundment.

The upstream fish passage is operated annually from April 15 to November 15[2]. The lift is currently operated automatically to lift the fish hopper every two hours beginning at 8 a.m. for a total of five lifts per day. Topsham Hydro is proposing to change the lift cycle to the following schedule.

[2] At flows above 15,000 cfs, the fish lift is temporarily shut down until flows subside.

- April 15 to May 15 and following passage of the first fish at the downstream Brunswick Project, the lift will be operated once every two hours beginning at 8 a.m. for a total of five lifts per day.
- May 16 through June 15, the lift will be operated once every hour beginning at 8 a.m. for a total of ten lifts per day.
- June 16 through July 1, the lift will be operated once every two hours beginning at 8 a.m. for a total of five lifts per day.
- July 2 through November 15, the lift will be operated once a day following passage of salmon at Brunswick if not already identified passing though Pejepscot.

The four attraction pumps are operated by station technicians; the number of pumps operating is determined based on the flow coming through the turbine and out the tailrace. When river flows are less than 1,700 cfs, one pump is operated (total attraction flow 70 cfs). When river flows are between 1,700 and 3,500 cfs, two pumps are operated (total attraction flow 110 cfs). When river flows are between 3,500 and 5,200 cfs, three pumps are operated (total attraction flow 150 cfs). Finally, when river flows are greater than 5,200 cfs, four pumps are operated (total attraction flow 190 cfs). The total of 190 cfs (attraction flow from four pumps (160 cfs) plus an additional 30 cfs provided from the impoundment via the exit trough) represents approximately 2.2% of the Project maximum turbine discharge capacity (8,600 cfs).

A preset weir in the channel provides an attraction flow through the channel and hopper. The channel from the hopper to the impoundment is opened when the seasonal operation is started for passage of diadromous fish. The gates in the channel that allow fish to be counted through the observation window are left open unless they are being used for counting. Fish within the lift are not actively counted and, historically, the counting facilities have only been used for efficiency tests of the lift.

Topsham Hydro proposes to investigate factors associated with the existing fish lift (i.e., internal and external attraction flow hydraulics and acoustics) that may be affecting upstream passage effectiveness, and develop a plan and schedule, in consultation with resource agencies, containing potential physical and/or operational modifications to be constructed/implemented no later than Year 3 of the new license[3], to address issues that may be impacting upstream passage of migratory fish species.

Topsham Hydro is proposing a study to install and operate an interim trap structure to further investigate upstream migrating American Eel passage at the Project. A temporary, portable eel trap will be installed at one location downstream of Project Dam during the first full passage season (June 1 through September 15) after the effective date of the new license. Interim eel trap sampling will be continued for a total of three full passage seasons. The results of the upstream juvenile American Eel passage study will be used to identify a suitable location for a permanent upstream American Eel trap to be installed when upstream eel passage facilities are constructed at the downstream Brunswick Hydroelectric Project. Figure 4.6.2-1 within Exhibit E provides a conceptual design drawing of the proposed interim upstream American Eel passage facility.

3.2 Downstream Fish Passage

[3] During 2020 and 2001 Topsham Hydro will investigate factors associated with the existing fish lift (i.e., internal and external attraction flow hydraulics and acoustics) that may be affecting upstream passage effectiveness.

The downstream fish passage facilities consist of two entry weirs, one on either side of the Unit 1 turbine intake (Appendix B). Each entry weir has an invert elevation of 65.5 ft. From each weir, an outlet pipe conveys downstream migrating fish in water down to the tailwater. The weir gates are 4 ft wide and are part of an inlet box with the outlet pipe located on the side opposite the weir. The right-side weir has a 30-inch diameter transport pipe and the left-side weir has a 24-inch diameter transport pipe. Both pipes have a free discharge to the water below the dam. Each downstream bypass can pass approximately 13 cfs, 29 cfs, and 87 cfs at headpond elevations of 66.5 ft. (low), 67.2 ft. (normal), and 69.0 ft. (high), respectively. This assumes that the entrance gate at each downstream bypass is in the fully opened position. The clear spacing of the grizzly racks at the entrance to the downstream bypasses is approximately 7 inches. There is one horizontal steel member on the grizzly racks at an approximately elevation of 67.3 ft. The downstream fishway is currently operated from April 1 to December 31, as river conditions allow.

To enhance downstream passage at the Project, Topsham Hydro is proposing to install and operate a fish guidance system/boom and trash boom to direct downstream migrants to a new bypass within bascule gate no. 1, which will then convey migrants to the Project tailwater. Figure 4.6.2-2 within Exhibit E provides a conceptual design drawing of the proposed downstream passage facility.

Topsham Hydro is proposing to discontinue the north (left bank) downstream fish bypass beginning in the second full passage season after the effective date of the new license; continue operation of south (right bank) downstream fish bypass.

To enhance downstream passage for American Eel, Topsham Hydro is proposing to reduce the operational setting for Unit 1 (unit turndown) to approximately 3,480 cfs (resulting in intake approach velocities of less than 1.5 fps) for eight hours during the night (8:00 pm to 4:00 am) between September 1 and October 31 annually.

4.0 OPERATION AND MAINTENANCE OF FISH PASSAGE FACILITIES

4.1 Upstream Fish Passage Operations and Maintenance

Operational Period

- Fish Lift: April 15 to November 15, seven days a week as river conditions allow.

Opening Methods

At least two to three weeks prior to fish lift start-up if river conditions allow:

- If necessary, de-water fish lift lower flume and clear all debris;
- Inspect for any damaged components and repair as necessary;
- Install the 4 Flygt attraction water pumps;
- Test all fishway components and repair as necessary;
- Water up fish lift by fully opening upper flume exit gate and adjust entrance gate for approximately one foot differential between fish lift and tailrace;
- Open valve that provides attraction water behind hopper; and
- Grease fish lift entrance operator stem and exit flume operator stems.

Spare Parts

- 1 hopper wheel;

- 6 hopper wheel bushings;
- 2 drive bushings for entrance gate operator;
- 2 drive bushings for exit gate operator;
- 1 attraction water pump Flygt 20 HP with 60 Hz motor;
- 1 air hose and reel spring for hopper vee gate;
- 1 hopper hoist brake; and
- 1 solenoid for hopper hoist brake.

Workforce Planning

- Staffing Requirements:
  - Start Up - Crew of 3;
  - Routine Operations – Crew of 1;
  - Routine Maintenance - Crew of 2 for standard maintenance, crew of 3 for fish lift entry for cleaning; and
  - Shut Down - Crew of 3.
- Daily basis:
  - The fish lift is inspected for debris accumulation and if debris is found, staff will remove debris from fish lift. If debris is not manageable by hand, operations crew will de-water fish lift and remove debris.
  - The 4 attraction water pumps are inspected for proper operation and proper settings based on unit flows, see Appendix E.
  - The entrance gate is adjusted for proper outflow based on the number of attraction pumps operating, see Appendix E.
  - The fish lift frequency time is set as follows:
    - April 15 to May 15 and following passage of the first fish at the downstream Brunswick Project, the lift will be operated once every two hours
    - May 16 through June 15, the lift will be operated once every hour
    - June 16 through July 1, the lift will be operated every 2 hours.
    - July 2 through November 15, the lift will be operated once a day following passage of salmon at Brunswick if not already identified passing though Pejepscot.
  - The fishway log sheets are completed consistent with Appendices C and D.
- Weekly basis:
  - Facility's lead fishway technician to provide via email a completed Fishway Operations Report consistent with Appendix D to Maine Department of Marine Resources (MDMR) and National Marine Fisheries Service (NMFS) by Monday at 0800 hours.
- Cleaning process:
  - If necessary, de-water fish lift and inspect for stranded fish.
  - Set up fall arrest/fall retrieval device, perform pre-use fall arrest equipment inspection.
  - Prep chainsaw for operation, inspect all chainsaw PPE.
  - Inspect access ladder for damage.

  - Inspect rigging for large debris removal.
- Preventative Maintenance process:
  - Monthly
    - Grease the entrance gate and exit gate operator stems.
    - Inspect and repair as necessary hopper mechanical (cotter pins, turn buckles, cables, limit switches, etc.).
  - Yearly
    - Inspect the fish lift hopper hoist.
    - Change the oil in each attraction pump.
    - Inspect the entrance gate, and exit gate operators.

Winterizing Methods

- Close the exit gate and remove debris from the upper flume.
- Remove the 4 attraction water pumps.
- Lift hopper.

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[4].
- Notify NMFS of any changes in Project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)[5]
- The first Topsham Hydro 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

- The downstream facilities will be operated between April 1 and December 31, as river conditions allow.

Opening Methods

- Inspect the surface sluice gates and remove debris.
- Grease surface sluice gate operator stems.
- Open the surface sluice gates to 100%.
- Install cleaning platforms.

Spare Parts

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

[5] 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.

- Due to the design of the downstream fishway, it has been determined that spare parts are not necessary at this time.

Workforce Planning

- Staffing Requirements:
  - Start Up – Crew of 1.
  - Routine Operations – Crew of 1.
  - Routine Maintenance – Crew of 2 for standard maintenance.
  - Shut Down – Crew of 1.
- Daily basis:
  - Inspect the fishway sluice 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 and dewater fishway if necessary.
  - The fishway log sheets are completed consistent with Appendices C and D.
- Weekly basis:
  - Facility's lead fishway technician to provide via email a completed Fishway Operations Report consistent with Appendix D to Oliver Cox of MDMR and Jeff Murphy of NMFS by Monday at 0800.
- Cleaning process:
  - Set up fall arrest/fall retrieval device, perform pre-use fall arrest equipment inspection.
  - Prep chainsaw for operation, inspect all chainsaw PPE.
  - Work off of cleaning platforms to remove debris from surface sluice gate trash racks.
- Preventative Maintenance process:
  - Yearly:
    - Grease surface sluice gate operator stems.

Downstream Fish Passage De-watering Method

- Close surface sluice gates.

Winterization Methods

- Close surface sluice gate.
- Remove cleaning platforms.

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[6].
- Notify NMFS of any changes in Project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)[7].
- The first Topsham Hydro point of contact for all fishway related issues is the local Supervisor of Operations.
- Refer to Section 6.0 for contact information.

5.0 SAFETY

5.1 Safety Rules and Procedures

Pursuant to Topsham Hydro's Safety Procedure SP9, Job Safety and Environmental Plans are completed prior to, and ideally, well in advance of any work at the fishways. 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 Topsham Hydro Contacts

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Steve.Michaud@brookfieldrenewable.com

Matt Leblanc, Compliance Specialist, Brookfield
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matthew.leblanc@brookfieldrenewable.com

6.2 Agency Contacts

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

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

[7] 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.

Sean Ledwin, Director, MDMR
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Gail Wippelhauser, MDMR
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Dan Tierney, Fishery Biologist, NMFS
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Nels Kramer, Fishery Biologist,
Maine Department of Inland Fisheries and Wildlife
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Kathy Howatt, Hydropower Coordinator
Maine Department of Environmental Protection
(w) 207-446-2642
Kathy.Howatt@maine.gov

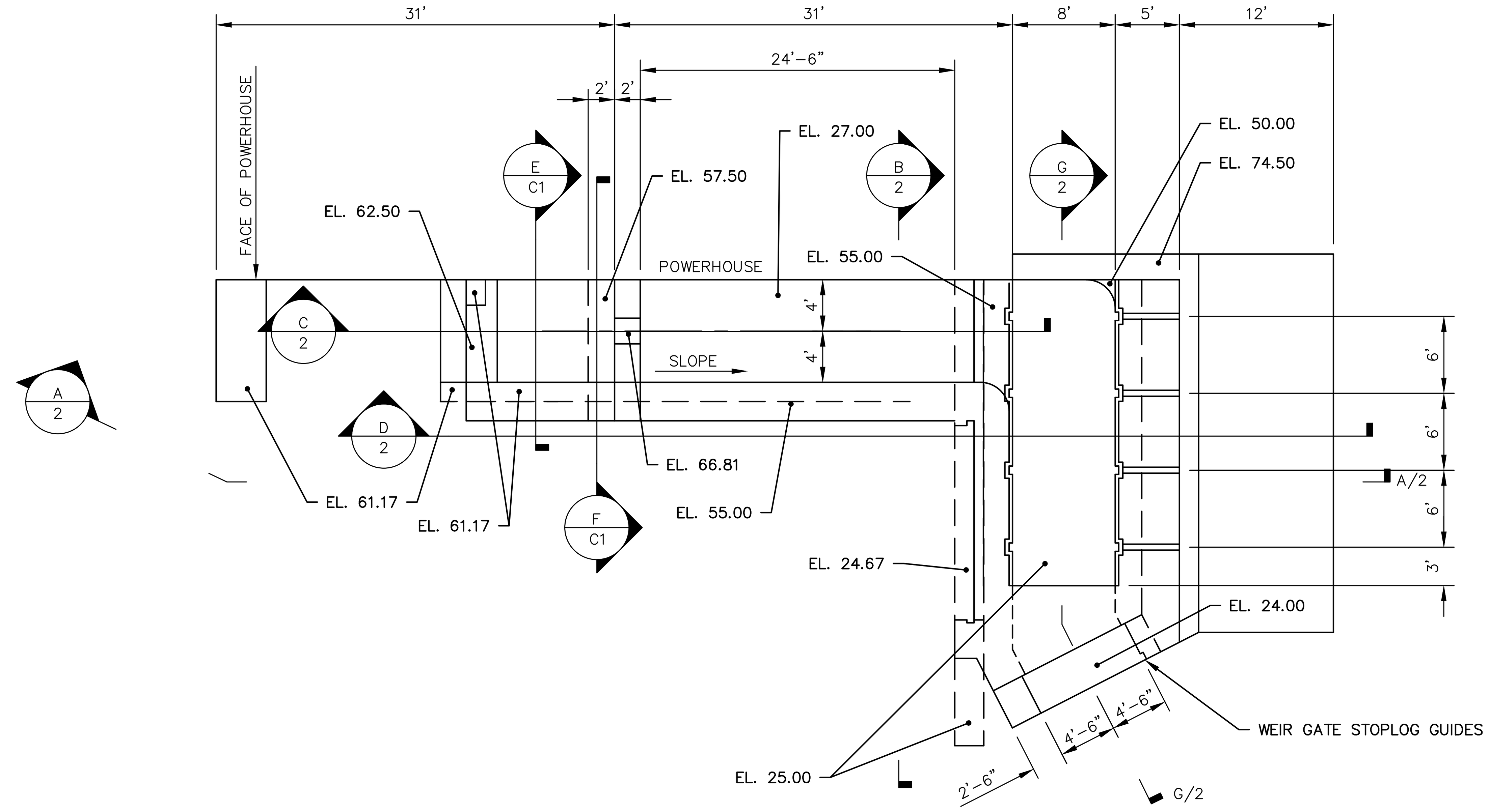
Notice:

- 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[8].
- Notify NMFS of any changes in Project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)[9].
- The first Topsham Hydro point of contact for all fishway related issues is the local Supervisor of Operations
- Refer to Section 6.0 for contact information

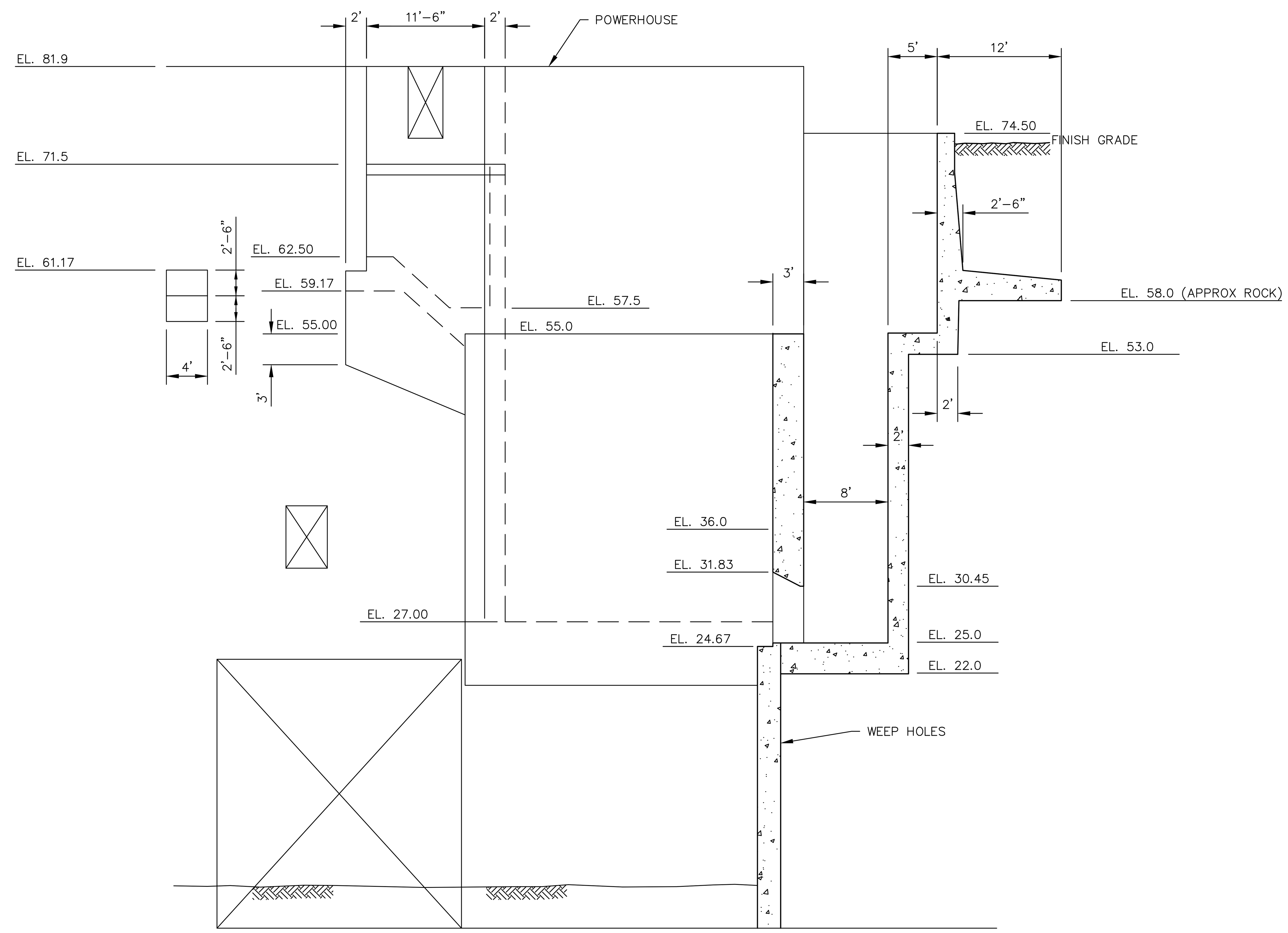
[8] This would typically include date collected, species, measurements, photographs, etc.

[9] 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.

APPENDIX A: FISH LIFT DESIGN DRAWINGS



1 PLAN
SCALE: 1" = 8'



A SECTION A-A
SCALE: 1" = 8'

Topsham Hydro Partners Limited Partnership

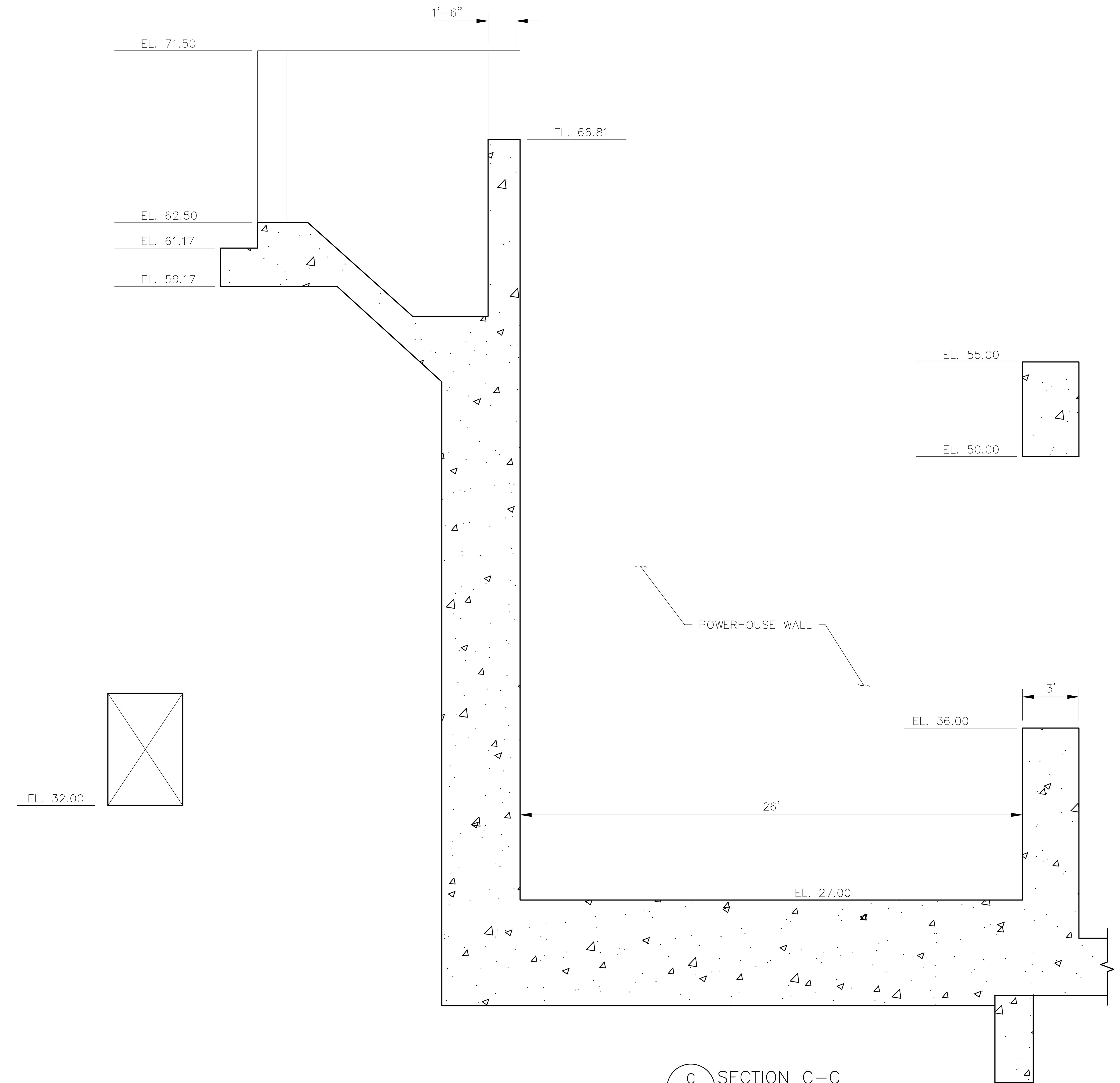
PEJEPSCOT HYDROELECTRIC PROJECT

FERC NO. 4784

FISH LIFT PLAN AND SECTION A

8' 0 8' 16'
SCALE:1"=8'

B
2
SECTION B–B
SCALE: 1" = 4'

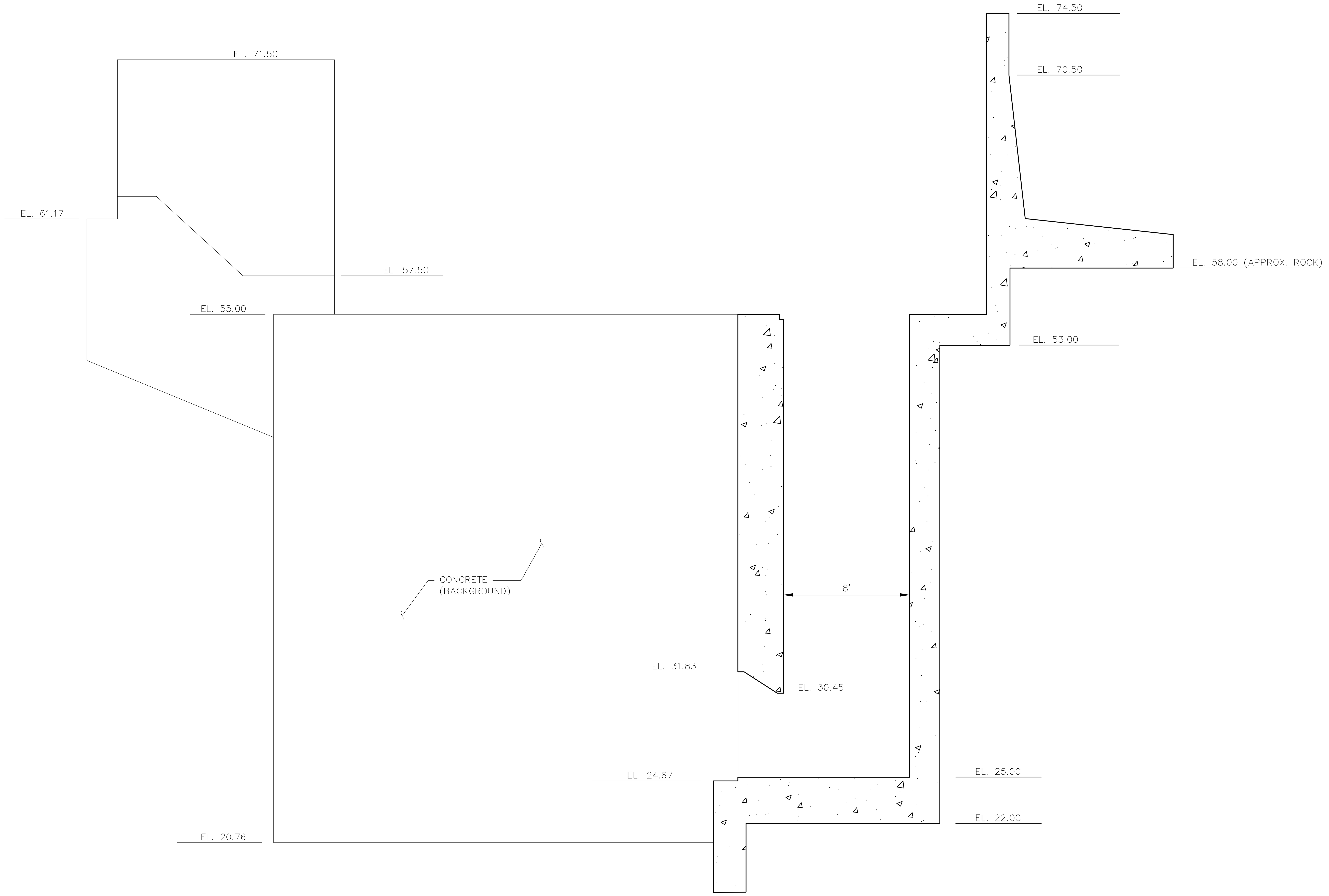


C
2
SECTION C–C
SCALE: 1" = 4'

Topsham Hydro Partners Limited Partnership
PEJEPSCOT HYDROELECTRIC PROJECT
FERC NO. 4784

FISH LIFT SECTIONS B AND C

4' 0 4' 8'
SCALE:1"=4'

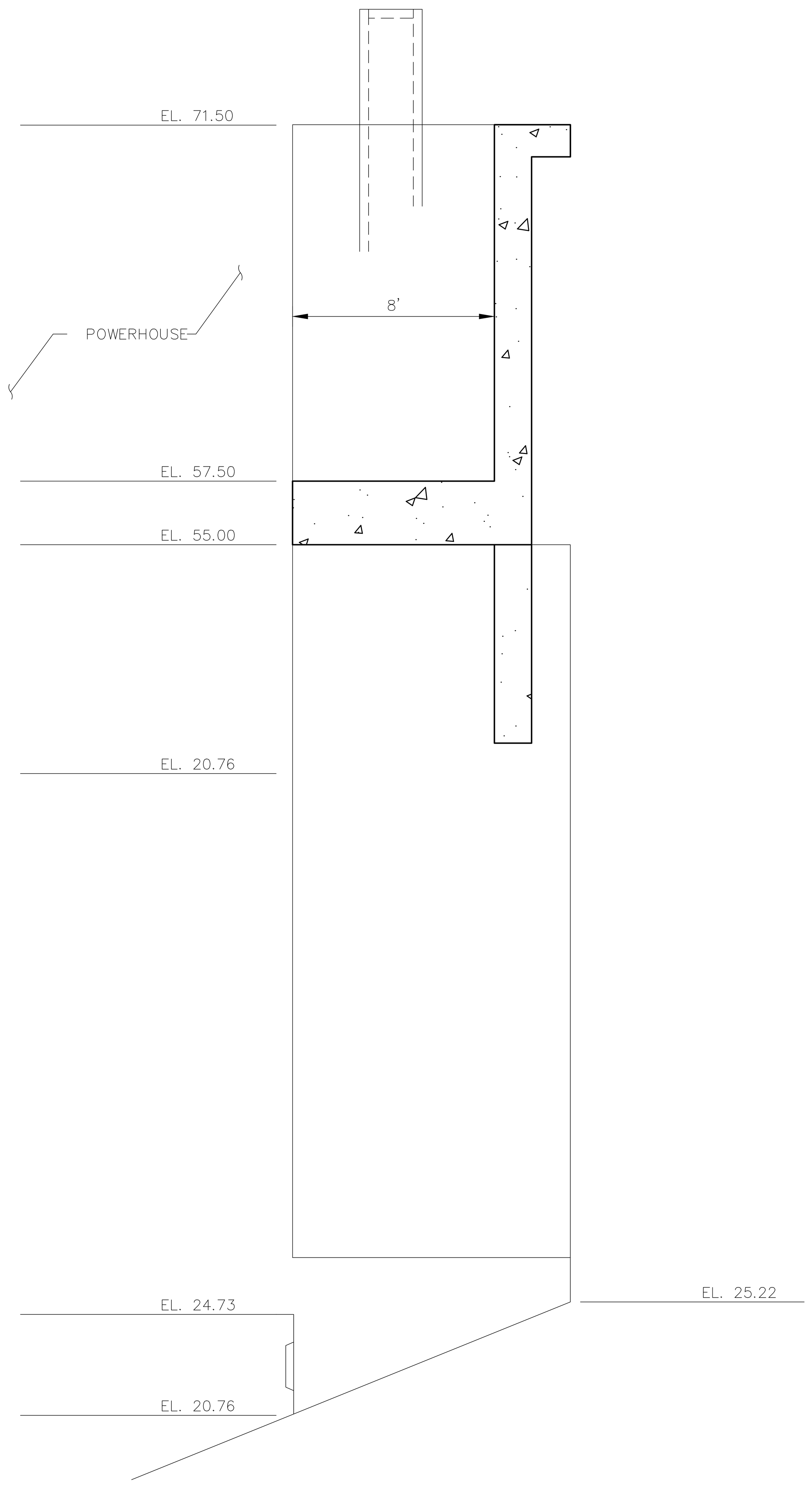


D
1
SECTION D–D
SCALE: 1" = 4'

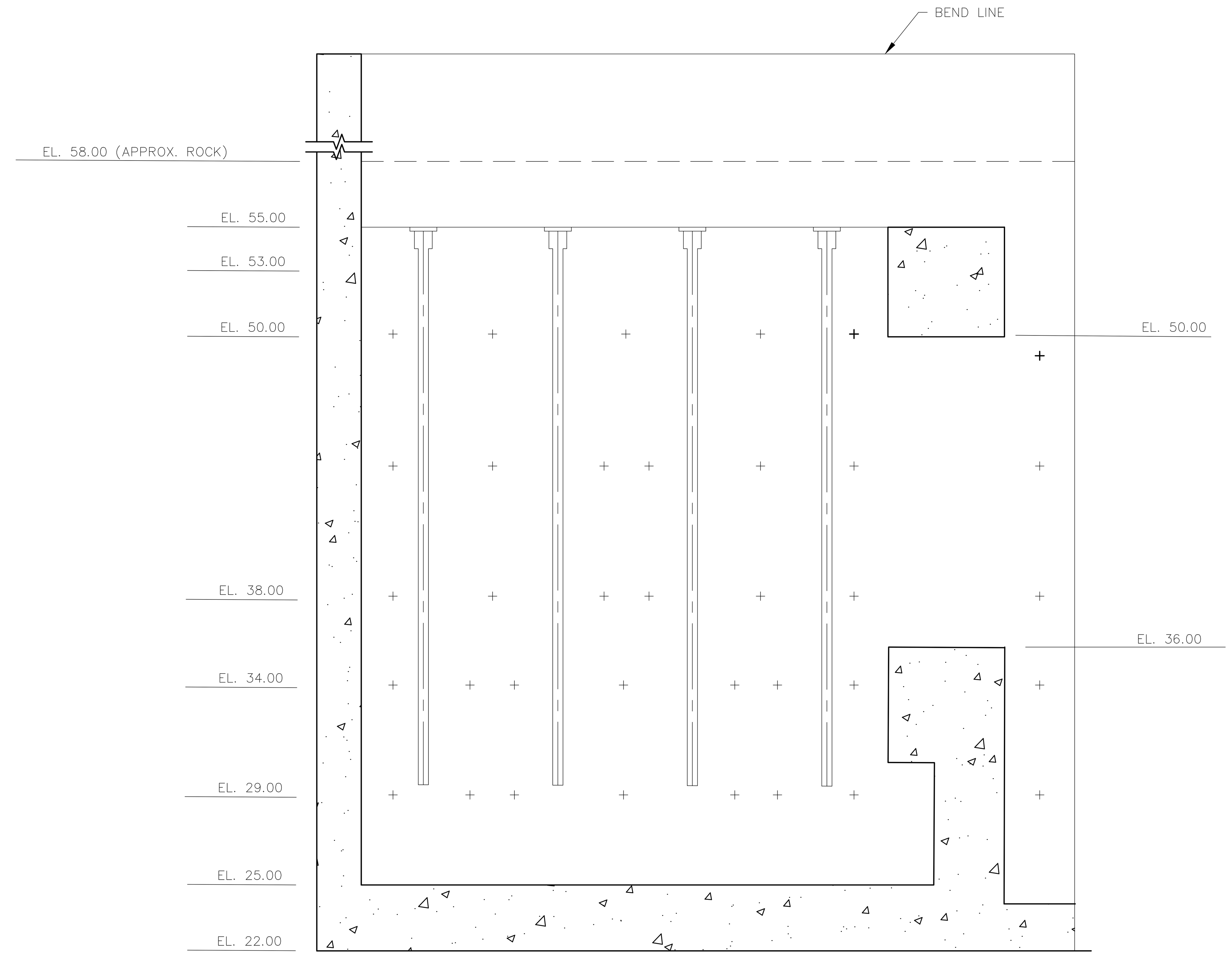
Topsham Hydro Partners Limited Partnership
PEJEPSCOT HYDROELECTRIC PROJECT
FERC NO. 4784

FISH LIFT SECTION D

4' 0 4' 8'
SCALE:1"=4'



F 4 SECTION F–F
SCALE: 1" = 4'



G 4 SECTION G–G
SCALE: 1" = 4'

Topsham Hydro Partners Limited Partnership
PEJEPSCOT HYDROELECTRIC PROJECT
FERC NO. 4784

FISH LIFT SECTIONS F AND G

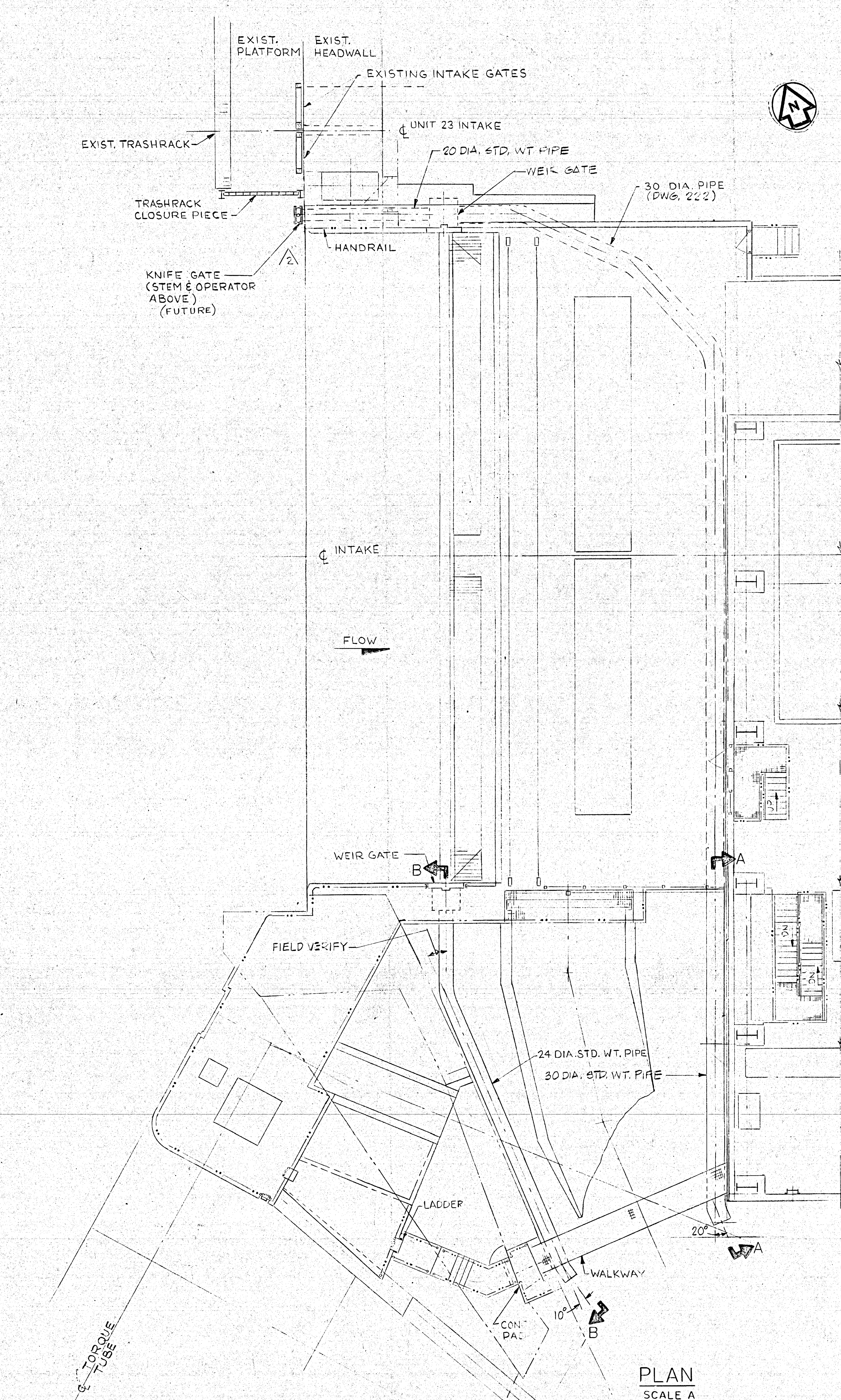
4' 0 4' 8'
SCALE:1"=4'

APPENDIX B: DOWNSTREAM FISH BYPASS DRAWINGS

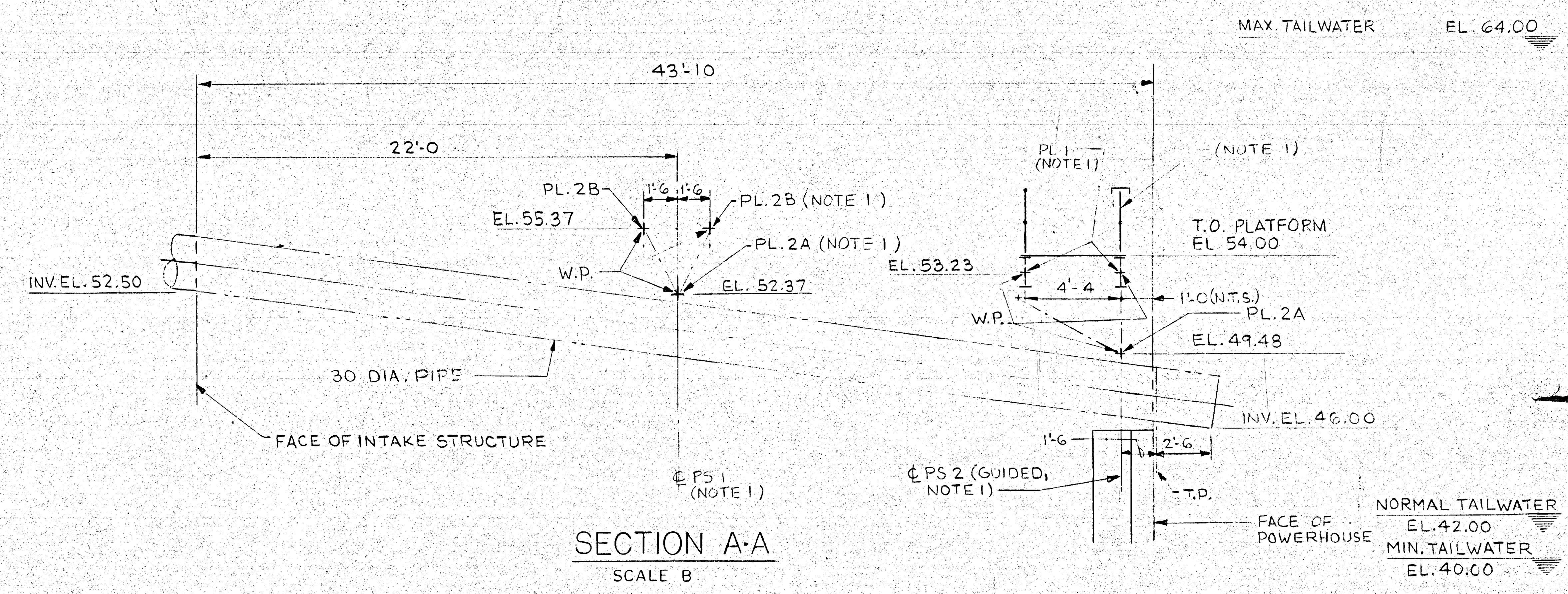
DRAWING NO. 7182C2-157 | SHT. 1 | REV. 3 | ACRES PROJ NO. P718202

NOTES

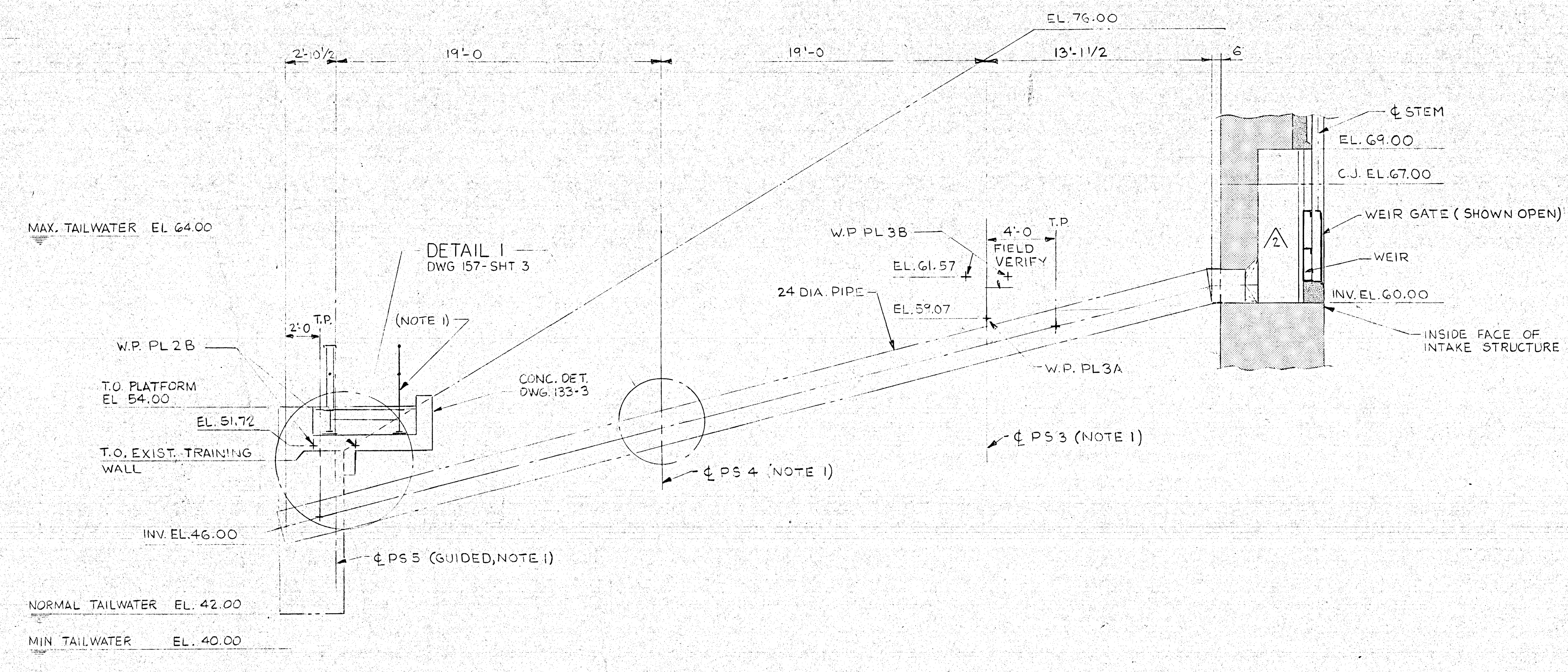
1. FOR WALKWAY, PL & PIPE SUPPORT DETAILS REFER TO SHT. 3
2. (3) THE EXISTING TRAINING WALL IS UNLIKELY TO BE PLUMB. SURVEY MEASUREMENTS USED TO VERIFY FIELD DIMENSIONS SHOULD THEREFORE BE TAKEN AT THE ACTUAL EMBEDDED PLATE LOCATIONS, AND NOT AT THE TOP OF THE WALL.
3. FINISH FISH PIPES & PIPE SUPPORTS WITH COATING S-G AS SPECIFIED.



PLAN
SCALE A



SECTION A-A
SCALE B



(3) SECTION B-B (NOTE 2)
SCALE B

SCALE C 0 1 2 FEET
SCALE B 0 4 8 FEET
SCALE A 0 8 16 FEET

THIS DRAWING SHALL BE READ WITH SPEC. NO. 7182-2

ACRES — TOPSHAM HYDRO PARTNERS LIMITED PARTNERSHIP
PEJEPSCOT HYDROELECTRIC PROJECT

DOWNSTREAM FISH PASSAGE
STRUCTURAL STEEL
PLAN & SECTIONS

DEPARTMENT HEAD 6/28/86 — PROJECT ENGINEER 6/27/86 — PROJECT MANAGER 6/27/86

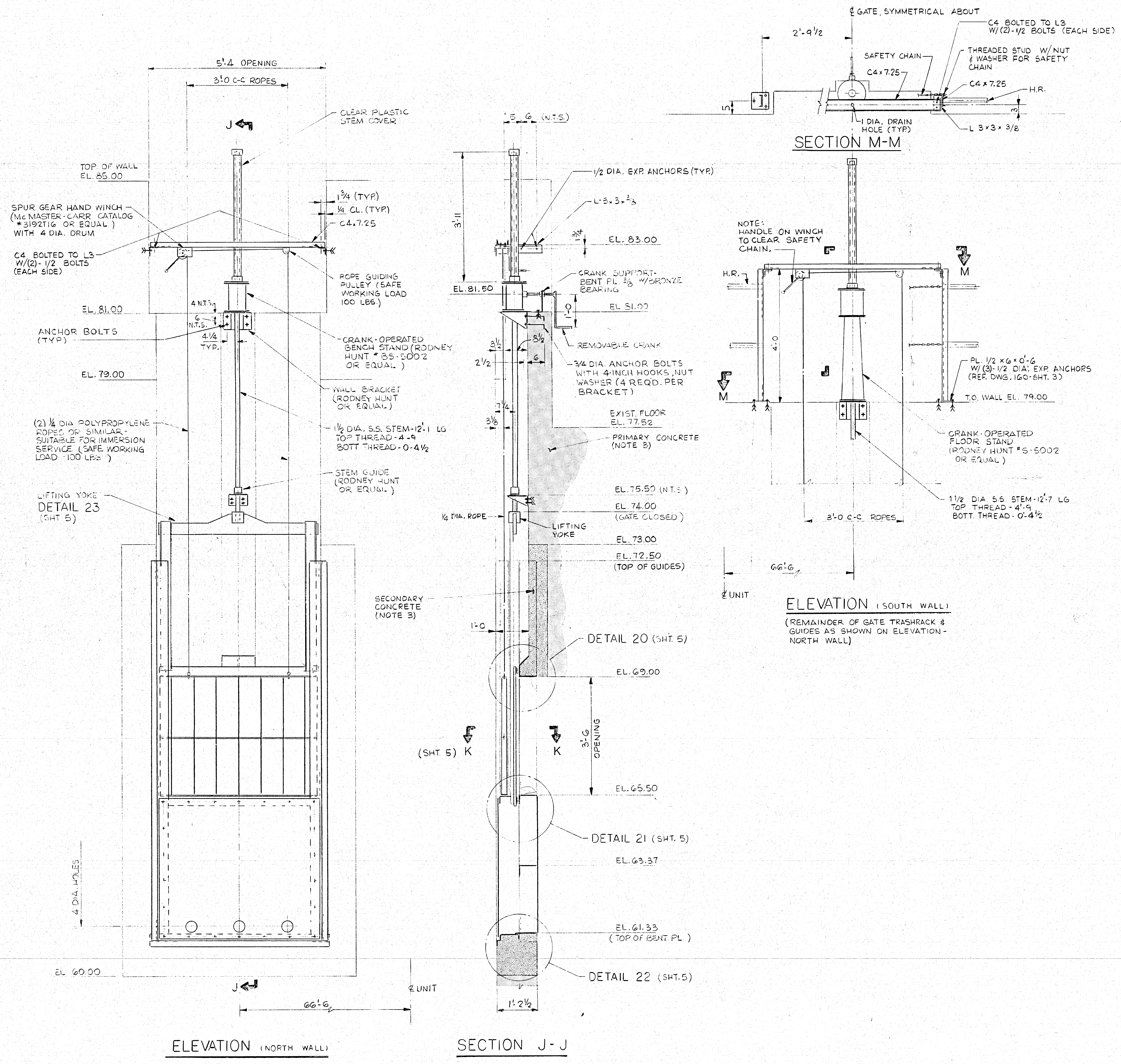
ACRES PROJECT NO. P718202 — DRAWING NUMBER 7182C2-157 — SHEET 1 OF 5 — REV 3

ACRES INTERNATIONAL CORPORATION

DATE	REV NO	DESCRIPTION OF REVISIONS	SQUAD LEADER	PRIME COORD	PROJ ENGR
10-7-86	2	REV. PLAN (E7) & SECT. B-B (C2)	JB	RCP	
9-12-86	1	GENERAL REVISION	JB	RCP	
6/27/86	0	ISSUED FOR CONSTRUCTION. PIPE SUPPORTS-MOUNTING PLATES	JB	RCP	
2/10/88	3	AS BUILT. REVISED AS PER CONTRACTOR MARK-UPS (B-4).	JM		

DRAFTING REVIEW		PRIME DEPARTMENT DESIGN REVIEW				DEPARTMENT DESIGN REVIEW			
DRAWN BY	CHECKED BY	DEPT NAME	DESIGNED BY	COORDINATOR	DWG CHECK	ARCHITECTURAL	CIVIL	ELECTRICAL	MECHANICAL
T.E.D. 6/27/86	JMB 6-27-86	CIVIL	RCP	RCP 6/27/86	RCP 6/27/86		6/25/86		6/27/86

DRAWING NO. 7182C2-157 | SHT. 4 | REV. 1 | ACRES PROJ NO. P718202



NOTES:

1) FOR CONCRETE & REINFORCING AT GATES, REFER TO DWG. 130-SHT. 12.
2) ALL WELDED CONSTRUCTION, UNLESS OTHERWISE NOTED. CONTINUOUS WELDS, WELD SIZE TO BE MINIMUM PERMITTED BY AISC.
3) PAINT SYSTEM S-5 AS SPECIFIED.

SCALE 0 2 4 FEET

THIS DRAWING SHALL BE READ WITH SPEC. NO. 7182-2

ACRES

TOPSHAM HYDRO PARTNERS LIMITED PARTNERSHIP

PEJEPSCOT HYDROELECTRIC PROJECT

DOWNSTREAM FISH PASSAGE
WEIR GATES & TRASHRACKS
STRUCTURAL & EMBEDDED STEEL
ELEVATIONS & SECTIONS

DATE	REV NO	DESCRIPTION OF REVISIONS		
1-29-88	1	AS BUILT - NO EXCEPTIONS TAKEN	JM	
9/9/86	0	ISSUED FOR CONSTRUCTION	JB	

DEPARTMENT HEAD 9-9-86; PROJECT ENGINEER 9-9-86; PROJECT MANAGER 9/9/86

ACRES INTERNATIONAL CORPORATION

ACRES PROJECT NO. P718202 | DRAWING NUMBER 7182C2-157 | SHEET 4 of 5 | REV 1

DRAFTING REVIEW		PRIME DEPARTMENT DESIGN REVIEW				DEPARTMENT DESIGN REVIEW			
DRAWN BY	CHECKED BY	DEPT NAME	DESIGNED BY	COORDINATOR	DWG CHECK	ARCHITECTURAL	CIVIL	ELECTRICAL	MECHANICAL
JM	JMBoyer	CIVIL	CWM	RCP	CWM		JM		
DATE 3-13-86	DATE 9-8-86			DATE 9/4/86	DATE 9/9/86	DATE	DATE 9/9/86	DATE	DATE 9-9-86

APPENDIX C: DAILY INSPECTION FORM

Pejepscot Daily Fishway Inspection Form

Date: ____________________ Time: ____________________ Inspector ____________________

Upstream Fishway

Flow adequate ____________________

Fish way debris ok ____________________

Attraction water on ____________________

Comments

Downstream Fishway

Flow adequate ____________________

Entrances not blocked by debris ____________________

Comments

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

Requirement:

APPENDIX D: FISHWAY OPERATION WEEKLY REPORT

Fishway Operation 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 Operation Status:

Note: Weekly Fishway Operations report to be provided to NMFS and MDMR personnel each Monday by 0800 hours.

APPENDIX E: UPSTREAM FISH PASSAGE OPERATIONS PROTOCOL

UPSTREAM FISH PASSAGE OPERATIONS PROTOCOL

Number of Pumps Operating	Depth Below Tailwater Level (ft)
1	1
2	2
3	3
4	4

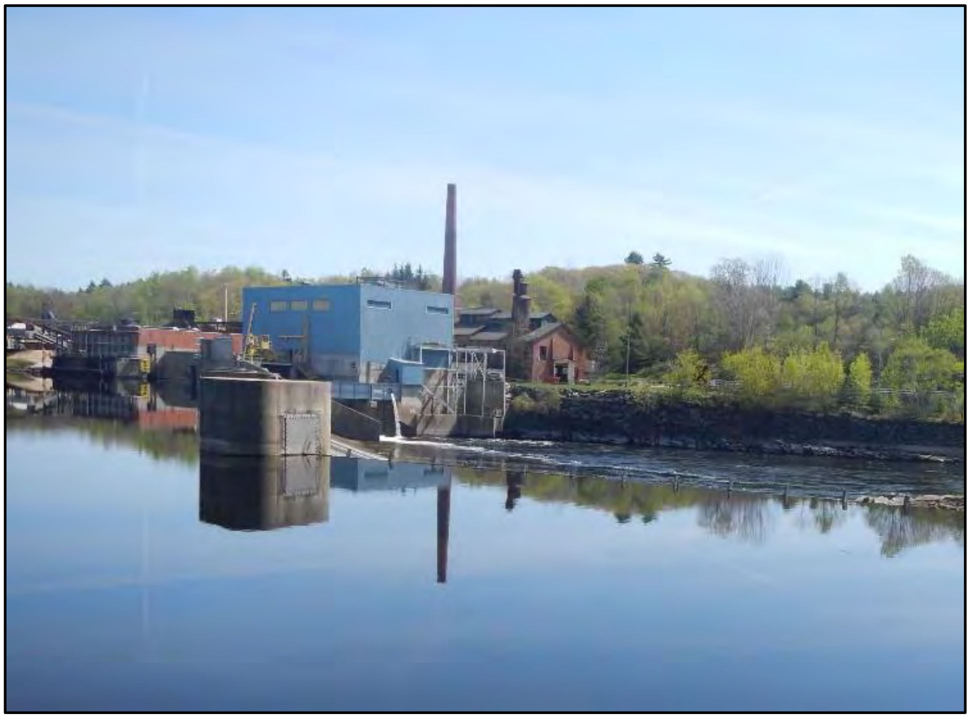
River Flow (cfs)	**Kaplan Turbine Gate Setting**	**Number of Pumps Operating**	**Total Attraction Flow (cfs)**
0 - 1700	0 - 1/4 gate	1	70
1700 - 3500	1/4 to 1/2 gate	2	110
3500 - 5200	1/2 to 3/4 gate	3	150
Over 5200	More than 3/4 gate	4	190

The fish lift frequency time is set as follows:

- April 15 to May 15 and following passage of the first fish at the downstream Brunswick Project, the lift will be operated once every two hours.
- May 16 through June 15, the lift will be operated once every hour.
- June 16 through July 1, the lift will be operated every 2 hours.
- July 2 through November 15, the lift will be operated once a day following passage of salmon at Brunswick if not already identified passing though Pejepscot.

APPENDIX E-6: RECREATION MANAGEMENT PLAN

RECREATION MANAGEMENT PLAN
PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)



Submitted by:
Brookfield Renewable
Topsham Hydro Partners Limited Partnership
150 Main Street
Lewiston, ME 04240

Prepared by:
Gomez and Sullivan Engineers

August 2020

Brookfield

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND DEFINITIONS

Brookfield	Brookfield Renewable
CFR	Code of Federal Regulations
Commission	Federal Energy Regulatory Commission
FERC	Federal Energy Regulatory Commission
ILP	Integrated Licensing Process
Licensee	Topsham Hydro Partners Limited Partnership
ME	Maine
MW	Megawatt
NOI	Notice of Intent
PAD	Pre-Application Document
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PSP	Proposed Study Plan
Recreation Study	Recreation Facilities Inventory and Public Recreation Use Assessment
RSP	Revised Study Plan
Topsham Hydro	Topsham Hydro Partners Limited Partnership
SD1	Scoping Document 1
SD2	Scoping Document 2
SPD	Study Plan Determination

1.0 INTRODUCTION

1.1 Background

Topsham Hydro Partners Limited Partnership (L.P.) (Topsham Hydro or Licensee), an indirect member of Brookfield Renewable (Brookfield), is in the process of relicensing the 13.88-megawatt (MW) Pejepscot Hydroelectric Project (Project) (FERC No. 4784) with the Federal Energy Regulatory Commission (FERC or Commission). The Project is located on the Androscoggin River in the village of Pejepscot and the Town of Topsham, Maine (ME) to the east, the Town of Lisbon, ME to the north, and the Towns of Durham and Brunswick, ME to the west. The Project straddles the border between Cumberland and Sagadahoc counties and extends into Androscoggin County. The original license was issued on September 16, 1982 and expires on August 31, 2022.

Topsham Hydro is using FERC's Integrated Licensing Process (ILP) as established in regulations issued by FERC July 23, 2003 (Final Rule, Order No. 2002) and found at Title 18 Code of Federal Regulations (CFR), Part 5. Topsham Hydro filed a Pre-Application Document (PAD) and Notice of Intent (NOI) to seek a new license for the Project on August 31, 2017.

Topsham Hydro distributed the PAD and NOI simultaneously to Federal and state resource agencies, local governments, Native American tribes, members of the public, and others thought to be interested in the relicensing proceeding. Following the filing of the PAD, FERC prepared and issued Scoping Document 1 (SD1) on October 30, 2017. FERC also held agency and public scoping meetings on November 28, 2017 and a site visit on November 29, 2017. The FERC Process Plan and Schedule provided agencies and interested parties an opportunity to file comments on the PAD and SD1 and request studies by December 29, 2017. FERC subsequently issued Scoping Document 2 (SD2) on February 5, 2018. Topsham Hydro filed a Proposed Study Plan (PSP) on February 12, 2018 and held a Study Plan Meeting on March 22, 2018. In the PSP, Topsham Hydro proposed to conduct a recreation facilities inventory and public recreation use assessment to provide information regarding recreational use and opportunities in the Project vicinity. The Revised Study Plan (RSP) containing the same proposed recreation assessment was filed in accordance with the ILP schedule on June 12, 2018. FERC issued a Study Plan Determination (SPD) on July 3, 2018 approving the Recreation Facilities Inventory and Public Recreation Use Assessment (Recreation Study) without modification. The study was conducted from May to October 2019. The results of the study provide a comprehensive picture of recreational use at the Project, which informed the development of this Recreation Management Plan (RMP). The goal of this RMP is to ensure that adequate and safe public recreational access to Project lands and waters is provided over the term of the new FERC license.

1.2 Project Description

The 13.88-MW Pejepscot Project is located on the Androscoggin River in southern Maine at river mile 14. The Project is located in the village of Pejepscot and the Town of Topsham, ME to the east, the Town of Lisbon, ME to the north, and the Towns of Durham and Brunswick, ME to the west. The Project straddles the border between Cumberland and Sagadahoc counties and extends into Androscoggin County. The Androscoggin River basin above the Pejepscot Dam has a drainage area of approximately 3,420 mi^2. The Project is the second of 28 dams on the main stem of the Androscoggin River and its headwaters.

2.0 EXISTING RECREATION FACILITIES

Topsham Hydro currently operates the following three FERC-approved Project recreation facilities at the Project:

- Pejepscot Boat Ramp: located in Topsham off Route 196 on the eastern shore of the Androscoggin River just downstream from Lisbon Falls. The site provides Project impoundment access for trailered and hand-carry boats via a concrete ramp with an asphalt approach.
- Pejepscot Fishing Park: located off River Road in Brunswick, on the western shore of the Androscoggin River. The site provides access to the river above and below the dam, as well as a boat landing, trail, and metal staircase for portaging around the dam.
- Lisbon Falls Fishing Park: located adjacent to the Route 125 Bridge approximately 600 feet downstream of Worumbo Dam. The Fishing Park includes a parking area on the north side of Route 125 as well as a footpath and a staircase leading to the Androscoggin River.

Figure 2.0-1 depicts existing Project recreation facilities in relation to the Project boundary. Table 2.0-1 provides an overview of each site and associated amenities. The following subsections describe each site in greater detail. Photographic documentation of each site and associated amenities is included as Appendix A.

2.1 Pejepscot Boat Ramp

The Pejepscot Boat Ramp is operated by Topsham Hydro and is located approximately 2.5 miles upstream of the dam directly off Lisbon Street/Route 196 in the Town of Topsham. The facility provides boat launching opportunities for trailered and cartop boats and angler access to the Project impoundment. The site consists of a large gravel parking area, a gated gravel access lane that crosses a railroad track, a gravel turnaround area, and a boat ramp providing access to the Project impoundment. Figure 2.1-1 presents an overview of the facility. The site is comprised of two parcels divided by the railroad right of way: one parcel holds the parking area and the other holds the boat ramp and gravel turnaround area. Topsham Hydro holds easements on the parking and boat ramp parcels and a private railroad crossing permit to connect them.

Access to the site consists of an approximately 25 foot wide gravel driveway off Lisbon Street/Route 196. The gravel parking area is approximately 115 feet long and 40 feet wide, with space for approximately 12 vehicles with trailers. The access road leading from the parking area to the turnaround area and boat launch is gated; the gate is closed during high flow conditions or as needed for safety considerations based on the discretion of Project operating and safety staff. The access road leads to a gravel turnaround area, large enough to allow for vehicles with trailers to pivot in order to back down the boat ramp. The approach to the boat ramp is a nearly 15 foot wide asphalt road. The ramp itself is composed of two sets of concrete planks each 7.5 feet wide. The total ramp length, including the asphalt approach, is approximately 45 feet.

A large sign near the site entrance, visible from traffic passing in both directions on Lisbon Street/Route 196, identifies the site as the Pejepscot Boat Ramp. A smaller attached sign indicates that the park is open for public use from one hour before sunrise to one hour after sunset. A large sign between the parking area and the gated access lane identifies Topsham Hydro as the site owner, provides a map of recreation sites in the Pejepscot Recreation Area, provides contact information and the FERC project number, includes hours of operations, and prohibits overnight camping. Nearby signage contains safe boating guidelines and a Maine Department of Inland Fisheries and Wildlife informational sign.

2.2 Pejepscot Fishing Park

The Pejepscot Fishing Park, also known as the Pejepscot Dam Recreation Area, is located off River Road in the Towns of Topsham and Brunswick. The site provides recreational access to the river above and below Pejepscot Dam, views of the dam and appurtenant facilities, boat take-out and put-in opportunities above and below the dam, and a trail for portaging around the dam. The site is accessed via a long gravel access road and consists of a small parking area, angler access above and below the dam, and a portage facility. Figure 2.2-1 presents an overview of the facility. The site is situated on three parcels; Topsham Hydro owns one of the parcels and holds easements on the remaining two.

A large wooden sign at the top of the access road off River Road identifies the site as the Pejepscot Fishing Park. Attached signage indicates that the park is open for public use from one hour before sunrise to one hour after sunset and that the use of tobacco is prohibited on the property. The approximately 2,000 foot long gravel access road leads to a small gravel parking area with room for approximately three vehicles; vehicular access beyond the parking area is blocked by a cable strung between two posts. A trash receptacle is provided near the parking area.

Beyond the parking area and adjacent to the portage trail is a flat, open area overlooking the Project dam. Access to and views of the Project are restricted by fencing. A large sign posted on the fencing identifies Topsham Hydro as the site owner, provides a map of recreation sites in the Pejepscot Recreation Area, provides contact information and the FERC project number, includes hours of operations, and prohibits overnight camping.

The portage facility consists of an unimproved boat landing area above the dam, a 600-foot-long trail leading around the dam, and a put-in below the dam. The take-out landing is located just above the dam along a steep boulder wall. An informal footpath was observed leading roughly 100 feet upstream to an area with a shallower grade; it was assumed that this area is informally used as a take-out landing.

To access the take-out, boaters pass around the western edge of the upstream boat barrier (installed from May 15 through October 15) and follow the inner canoe barrier along the shore. From the take-out, boaters follow the edge of the fence along an unimproved dirt path indicated by a canoe portage sign. The trail continues up the hill to the dam overlook area and continues along the edge of the fence downhill to a set of steel stairs descending a steep exposed ledge face. Along the stairs is a ramp upon which canoes and kayaks can be slid down. At the bottom of the stairs is a flat rock landing with handrails guiding users down a steep section of ledge to a lower shelf. The lower shelf runs for approximately 55 feet to an area where the slope to water's edge is more gradual. The put-in is located in a gentle backwater with a gradual rocky slope into the water.

Anglers access the shoreline above and below the dam using the portage trail. In addition, there is an informal footpath leading from the parking area to the shoreline approximately 1,300 feet downstream from the dam.

2.3 Lisbon Falls Fishing Park

The Lisbon Falls Fishing Park, operated by Topsham Hydro, is located in the Town of Lisbon off Canal Street/Route 125. The site provides angler access to the Androscoggin River approximately 3.2 miles upstream of the Project and immediately downstream from the Worumbo Project (FERC No. 3428). The site consists of a parking area, a gravel access path leading to the shoreline, and informal access along the shoreline. Canal Street/Route 125 separates the parking area from the recreation area, which is fenced and gated. Figure 2.3-1 presents an overview of the facility. Topsham Hydro holds easements on the parcels comprising the site, which are owned by Eagle Creek; these leases expire with the termination of the current license.

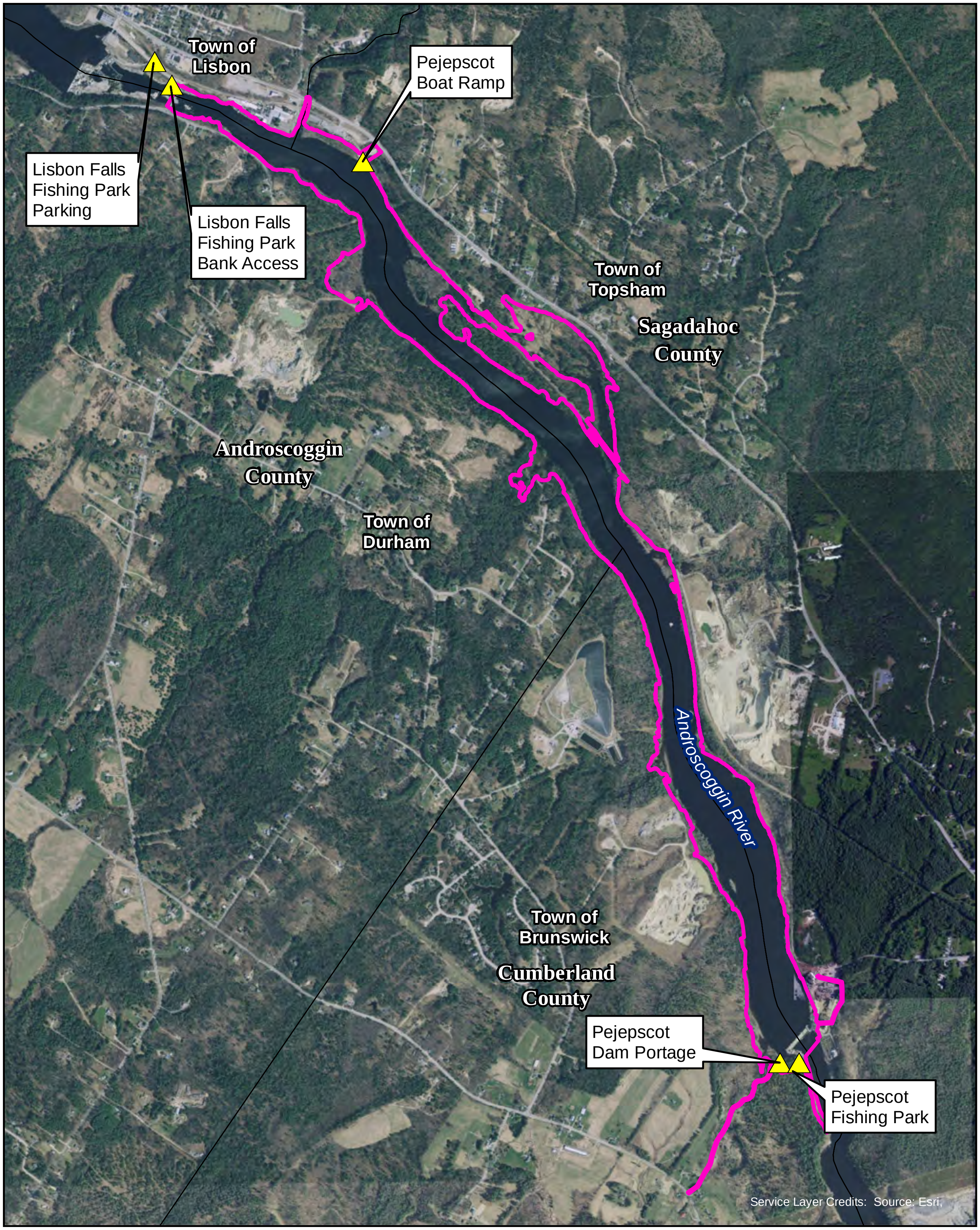
Vehicular access to the site is directly off Canal Street/Route 125. The gravel parking area measures approximately 95 by 23 feet, providing space for 10 vehicles without trailers, and is bordered by a large boulder wall approximately 20 feet high. A large sign at the east end of the parking area identifies the site as the Lisbon Falls Fishing Park. A smaller attached sign indicates that the park is open for public use from one hour before sunrise to one hour after sunset.

A crosswalk leads from the parking area to the gated path entrance. The site is also accessible by pedestrians using the sidewalk on the south side of Canal Street/Route 125. A large sign affixed to the fencing identifies Topsham Hydro as the site owner, provides a map of recreation sites in the Pejepscot Recreation Area, provides contact information and the FERC project number, includes hours of operations, and prohibits overnight camping. The approximately 10 foot wide access path runs on top of the bank along the shoreline downstream to the Route 125 Bridge. The access path ends near the upstream bridge abutment, but informal footpaths continue to the top of the rocks downstream from the bridge.

Approximately 70 feet along the access path from the gated entrance, a set of wooden stairs leads down to a narrower trail extending to the shoreline. Several informal footpaths lead along the river to provide angler access to approximately 300 feet of shoreline.

Table 2.0-1: Project Recreation Sites and Associated Amenities

Recreation Site	Facilities/ Amenities	Description
Pejepscot Boat Ramp	Parking Area	Gravel, space for 12 vehicles with trailers
	Boat Ramp	Asphalt approach, ramp consisting of two sets of concrete planks each 7.5 feet wide
	Signage	Entrance sign, Part 8 sign
Pejepscot Fishing Park	Parking Area	Gravel, space for 3 vehicles
	Portage Take-out	Unimproved landing, canoe restraining barrier along right bank, canoe portage sign
	Portage Trail	Dirt, roughly 600 feet long, directional signs
	Portage Put-in	Steel stairs with canoe slide, footpath from stairs to shoreline
	Bank Fishing Access	Shoreline access above and below the dam via portage trail, additional informal footpath
	Signage	Entrance sign, Part 8 sign, portage signs
Lisbon Falls Fishing Park	Parking Area	Gravel, space for 10 vehicles
	Bank Fishing Access	Gravel access path, wooden stairs, informal shoreline footpaths
	Signage	Entrance sign, Part 8 sign



Brookfield

N

0 500 1,000 2,000 Feet

Pejepscot Hydroelectric Project
(FERC No. 4784)
Recreation Management Plan

Figure 2.0-1:
Project Recreation Facilities

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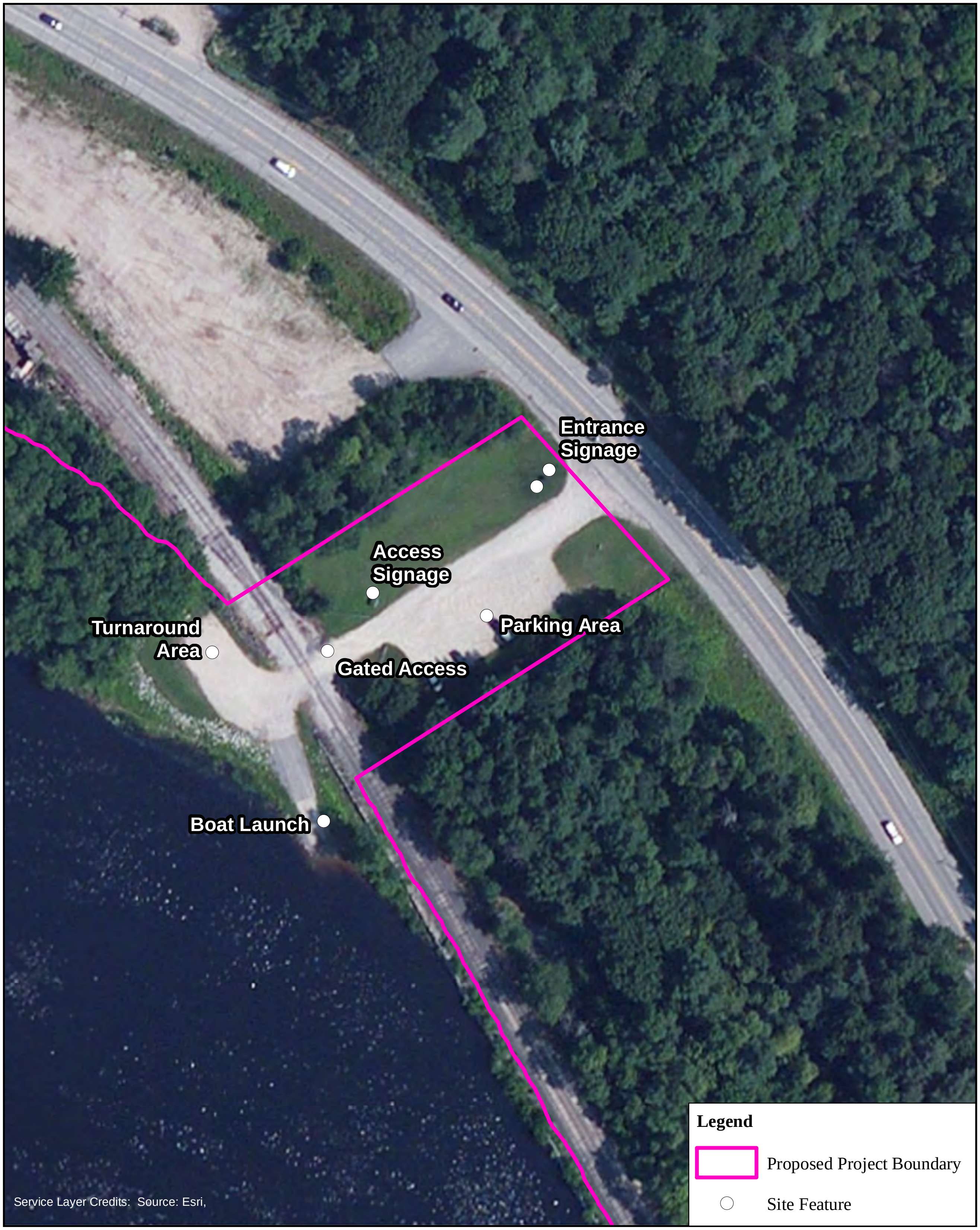

Brookfield

N

0 25 50 100 Feet

Pejepscot Hydroelectric Project
(FERC No. 4784)
Recreation Management Plan

Figure 2.1-1:
Pejepscot Boat Ramp
Facility Overview

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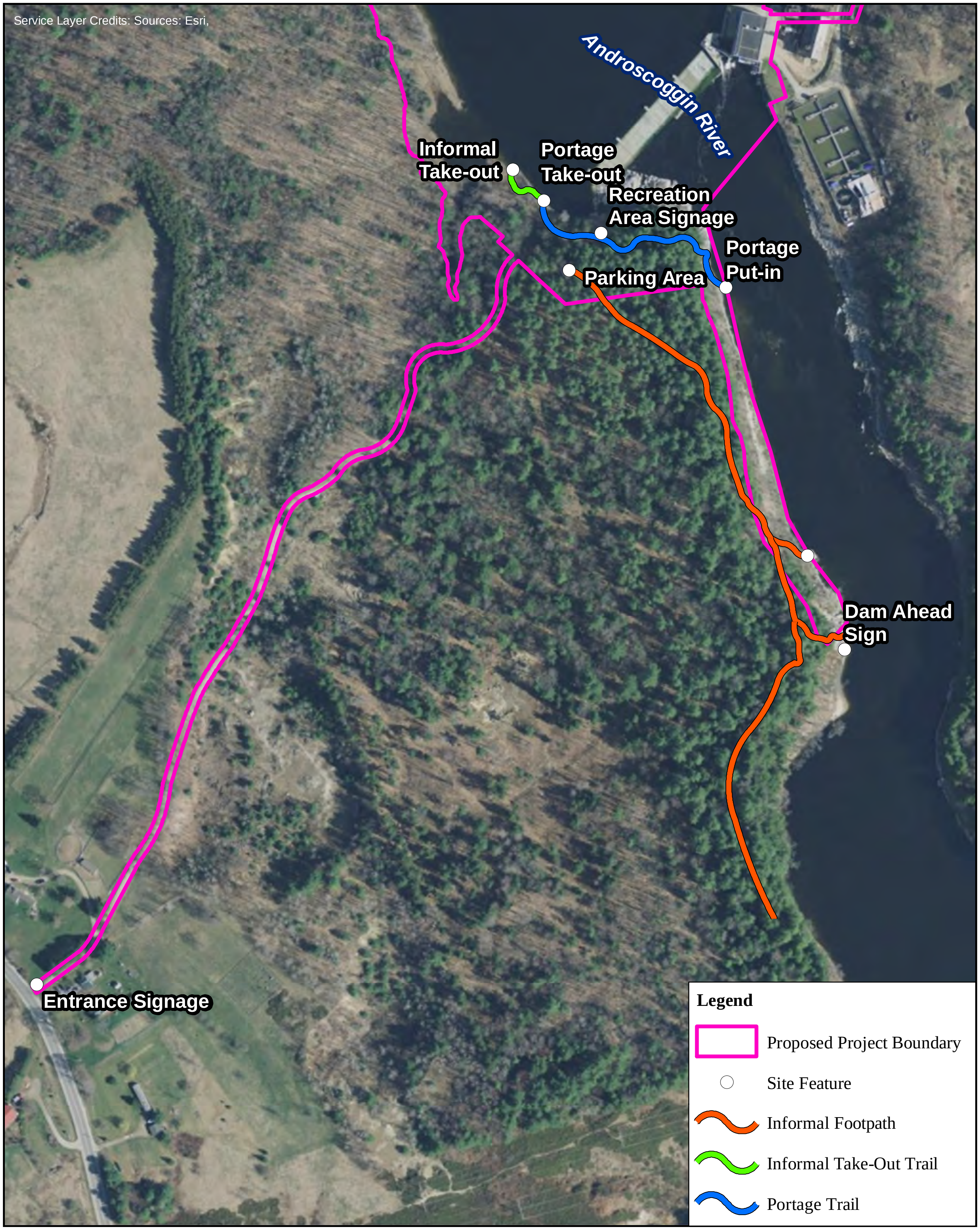

Brookfield

Pejepscot Hydroelectric Project
(FERC No. 4784)
Recreation Management Plan

Figure 2.2-1:
Pejepscot Fishing Park
Facility Overview

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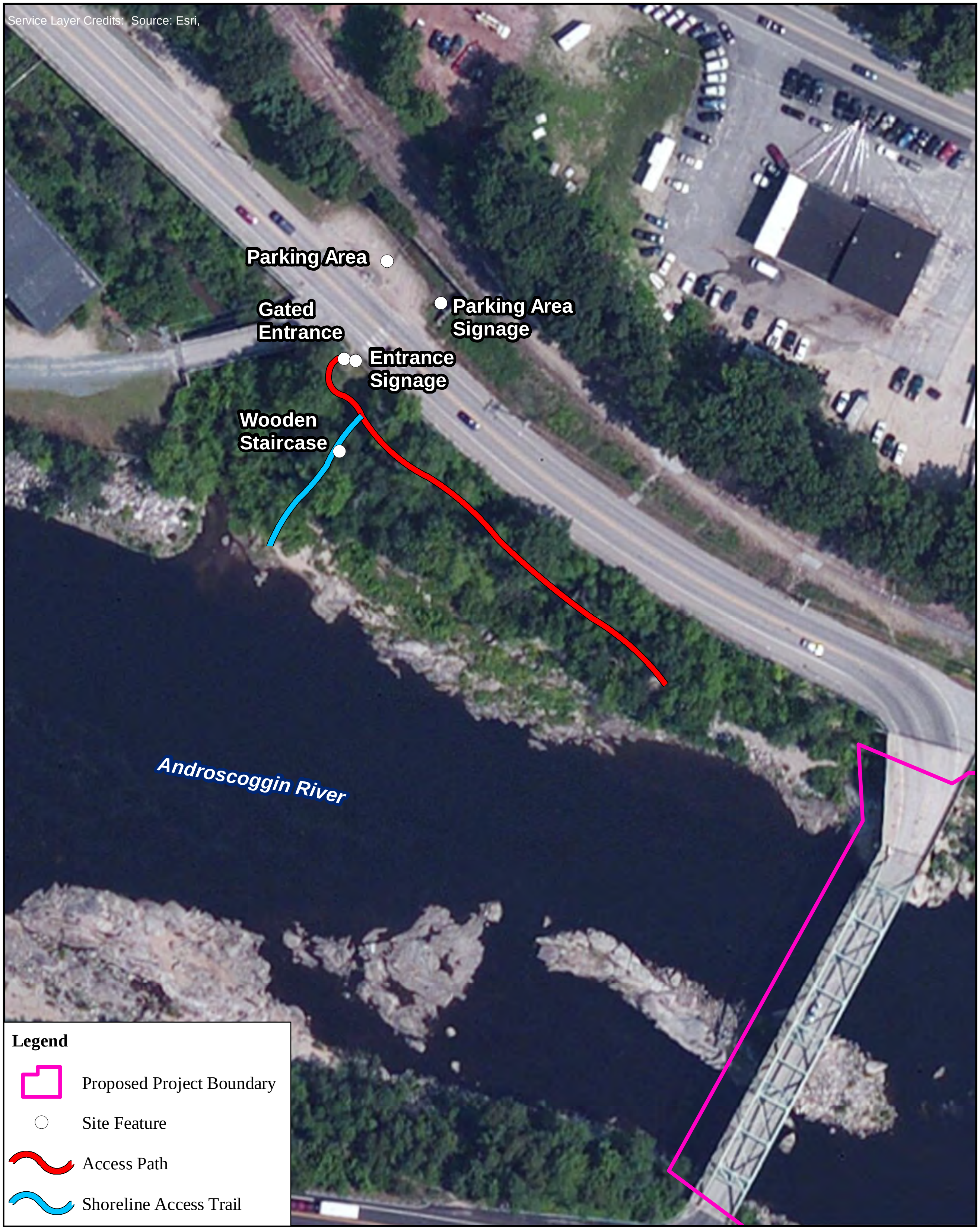

Brookfield

Pejepscot Hydroelectric Project
(FERC No. 4784)
Recreation Management Plan

Figure 2.3-1:
Lisbon Falls Fishing Park
Facility Overview

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3.0 PROPOSED RECREATION FACILITY IMPROVEMENTS

The results of the Recreation Study provide a comprehensive picture of the recreational opportunities available within the study area, the level of usage at each recreation site, the types of activities engaged in, the condition of the facilities, and the facilities' ability to meet the recreational demand. The FERC-approved recreation facilities in the study area provide an array of recreational opportunities, including access to the Androscoggin River both above and below the dam for fishing, boating, hiking, and sightseeing. The results of the study demonstrate that there is ample access and capacity for recreational demand in the Project area: all Project recreation facilities were used at 33 percent or less of capacity on average non-peak weekends. The recreation facilities were found to be in fair condition, although maintenance issues were identified at each site. Aside from maintenance considerations, the facilities appear to serve the recreational demand in the Project vicinity.

The following subsections identify measures proposed to address maintenance issues and/or enhance recreation at Project recreation facilities.

3.1 Proposed Measures

3.1.1 Pejepscot Boat Ramp

The Pejepscot Boat Ramp site was found to be in overall fair condition during the Recreation Study site condition assessment. The parking and turnaround areas were in serviceable condition, but general erosion and wear were noted in both areas. At the driveway entrance, a rut approximately three inches deep had formed along the edge of the pavement. The boat ramp was found to be in generally good condition, although encroaching vegetation and sediment have narrowed the effective ramp width. Signage at the site was in overall good condition with the exception of the sign at the entrance, which is cracked and peeling.

Topsham Hydro proposes to implement the following measures at the Pejepscot Boat Ramp:

- Re-grade the driveway and parking area, including placing and compacting gravel fill to level driveway and provide a safe turnout onto Lewiston Road.
- Clear sediment and vegetation from the surface of the boat ramp in order to restore the full width for use. Proposed grades adjacent to the ramp will tie into existing concrete planks and any exposed sediment will be seeded.
- Replace the entrance sign with a similarly sized sign identifying the site.

3.1.2 Pejepscot Fishing Park

With the exception of the steel portage staircase, the Pejepscot Fishing Park is generally maintained in primitive condition. At the time the site condition assessment was conducted, the access road was in serviceable condition. The parking area showed signs of rutting but was generally in fair condition. The unimproved portage trail was flat and of constant grade, although in places roots and boulders projected up from the path and in other portions loose gravel was noted on the path's surface. Downed trees and branches were found across the informal footpaths.

The boat slide adjacent to the steel stairs is constructed of wood and appeared to have originally been topped with a carpet material, which has since worn away. The stairs appeared stable and sturdy; however, at the top right (looking downslope) a support was missing. The bottom of the steps was anchored by rocks placed to provide flat footing, and the railing around this platform had several loose nuts. The transition from the bottom of the stairs to the ledge did not provide stable footing. Downed trees were found across both informal footpaths at the site. Existing signage at the site was in good condition; however, there does not appear to be signage upstream of the portage take-out identifying the facility.

Topsham Hydro proposes to implement the following measures at the Pejepscot Fishing Park.

- Re-grade the 0.5 mile access road, including placing and compacting gravel fill to repair areas with significant erosion.
- Consult with the Town of Brunswick to secure an easement to utilize the existing informal footpath beginning at the back of the facility's parking area (see Figure 3.1.2-1). Should negotiations with Town officials be successful, Topsham Hydro will:
    - Reroute the portage trail to this less steep put-in area;
    - Remove the steel staircase and extend the existing chain link fence to discourage access to the steep section of ledge;
    - Clear the downed trees and other debris from the section of informal trail between the parking area and the shoreline access downstream of the dam; and
    - Add directional signage leading boaters along the rerouted portage trail.
- Erect an upstream sign indicating the location of the portage take-out.

3.1.3 Lisbon Falls Fishing Park

The Lisbon Falls Fishing Park site was in overall fair condition at the time the site condition assessment was conducted. The gravel parking lot was generally flat and appeared to drain toward the roadway. A few recent gravel fill deposits were observed as well as minor depressions. The gravel path was of firm and constant grade. Generally, vegetation had started to encroach on all gravel surfaces. The wooden stairs were in serviceable condition, although minor graffiti and settlement or warping of the landing platform was observed. The trail below the stairs was in primitive condition, as were the informal footpaths along the shoreline. Signage at the site was in good condition, aside from the entrance signage identifying the park, which has minor graffiti.

The parcels comprising the Fishing Park are leased to Topsham Hydro from Eagle Creek under an agreement that terminates with the end of the current FERC license for the Pejepscot Project. In addition, the upstream end of the Pejepscot Project boundary overlaps the project boundary for the Worumbo Project (No. 3428), which is owned by Eagle Creek. Topsham Hydro and Eagle Creek have agreed to seek Commission approval to revise the boundaries of both projects to eliminate the overlap. The Lisbon Falls Fishing Park is located within this area of overlap. As described above, Topsham Hydro currently operates and maintains the facility; however, the lands are leased from Eagle Creek. This facility is proposed to be removed from the Pejepscot Project boundary, but would continue to be encompassed with the Worumbo Project boundary with the exception of the parking area for this facility. To alleviate this discrepancy, Eagle Creek proposes to modify the Worumbo Project boundary to include the parking area. With the modifications of the boundary for each Project, Eagle Creek would assume responsibility for the continued operation and maintenance of the Lisbon Falls Fishing Park.

3.2 Cost and Schedule

Proposed recreation improvements will be implemented within two years of license issuance. Estimated costs for proposed improvements are provided in Table 3.2-1.

Table 3.2-1: Estimated Cost of Proposed Recreation Improvements

Recreation Facility	Proposed Improvements	Estimated Cost ($)[1]
Pejepscot Boat Ramp	Re-grade driveway and parking area	18,200
	Parking area fill	8,300
	Clear sediment and vegetation from boat ramp	5,700
	Replace entrance sign	800
	Subtotal	**33,000**
Pejepscot Fishing Park	Re-grade access road	29,600
	Access road fill (8" layer, select portions of road, approx. 600' long)	22,000
	Remove steel staircase and extend chain link fencing at top of ledge	12,100
	Clear informal trail (new rerouted portage trail) between parking area and shoreline access	1,800
	Add directional signage along rerouted trail segment	300
	Add signage upstream of portage	2,400
	Subtotal	**68,200**
	TOTAL	**101,200**

[1]Estimate assumes engineering and permitting are not necessary. Costs include an additional 10% for mobilization/demobilization and 40% for contingency.

[2] Engineer's estimate is based on generally available databases (e.g. Means) and in-house pricing information for the local market. Competitive bidding environments, unknown field conditions, and other local market factors may contribute to variances in costs.

Brookfield

Pejepscot Hydroelectric Project
(FERC No. 4784)
Recreation Management Plan

Figure 3.1.2-1:
Proposed Portage
Trail Relocation, Tentative Route

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4.0 RECREATION FACILITY MAINTENANCE

4.1 Proposed Maintenance

Topsham Hydro proposes to continue to operate and maintain the existing formal recreation sites and their associated facilities and amenities, including Pejepscot Fishing Park and the portage trail, Lisbon Falls Fishing Park, and the Pejepscot Boat Ramp. Topsham Hydro will ensure that the sites and amenities remain usable over the term of the new license.

4.2 Cost and Schedule

Maintenance, improvements, and/or repairs will be conducted on an observed, as-needed basis. Estimated annual operation and maintenance costs are provided in Table 4.2-1.

Table 4.2-1: Estimated Operations and Maintenance Costs

Recreation Facility	Operation and Maintenance Tasks	Estimated Annual Cost ($)
Pejepscot Boat Ramp	Parking lot clean up (weekly trash removal and general upkeep)	6,600
	Parking lot maintenance	2,800
	Boat ramp maintenance/minor trimming/clearing	3,300
	Subtotal	**12,700**
Pejepscot Fishing Park	Parking lot clean up (weekly trash removal and general upkeep)	6,600
	Access road maintenance	3,200
	Portage maintenance/minor trimming/clearing	1,100
	Subtotal	**10,900**
	TOTAL	**23,600**

5.0 RECREATION FACILITY MONITORING

As discussed in Section 3.0, Project recreation facilities are currently used at a third or less of capacity. The Project has ample capacity to meet recreational demand; therefore, no formal use monitoring is proposed. As discussed in Section 4.0, Topsham Hydro is committed to ensuring that Project recreation facilities remain usable over the term of the new license, and maintenance, improvements, and repairs will be conducted on an observed, as-needed basis. If observed changes in facility condition or capacity necessitate modification of the RMP, Topsham Hydro will submit proposed modifications to the appropriate agencies for review and comment prior to submittal to FERC. All plans will be submitted to FERC for approval prior to construction.

APPENDIX A – SITE PHOTOGRAPHS

LIST OF PHOTOS

Pejepscot Boat Ramp

Photo 1: Pejepscot Boat Ramp, Entrance Signage

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/15/2019)

Photo 2: Pejepscot Boat Ramp, Parking Area

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/15/2019)

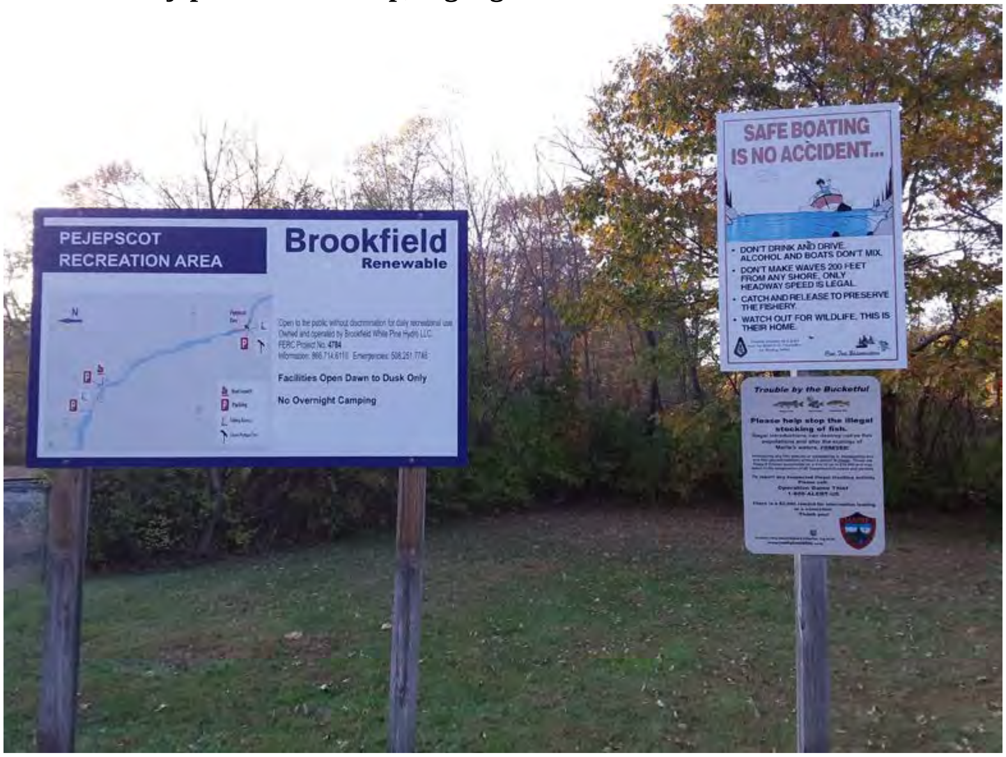
Photo 3: Pejepscot Boat Ramp, Infrared Counter

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/15/2019)

Photo 4: Pejepscot Boat Ramp, Gated Access Road, Signage

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/15/2019)

Photo 5: Pejepscot Boat Ramp, Signage



(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/15/2019)

Photo 6: Pejepscot Boat Ramp, Turnaround Area

(Photo taken by J. Commerford, Gomez and Sullivan Engineers, 10/16/2019)

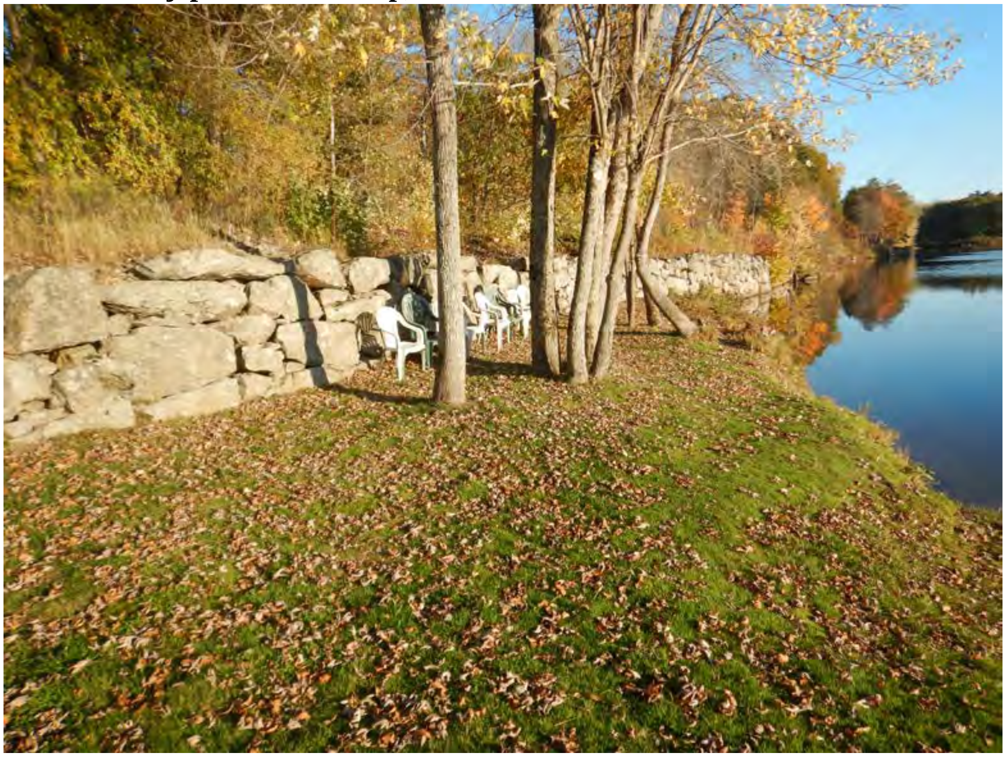
Photo 7: Pejepscot Boat Ramp, Launch Approach

(Photo taken by J. Commerford, Gomez and Sullivan Engineers, 10/16/2019)

Photo 8: Pejepscot Boat Ramp, Launch

(Photo taken by J. Commerford, Gomez and Sullivan Engineers, 10/16/2019)

Photo 9: Pejepscot Boat Ramp, Bank Downstream from Launch



(Photo taken by J. Commerford, Gomez and Sullivan Engineers, 10/16/2019)

Pejepscot Fishing Park

Photo 10: Pejepscot Fishing Park, Entrance Signage

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 11: Pejepscot Fishing Park, Access Road, Vehicle Counter

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 12: Pejepscot Fishing Park, Vehicle Counter

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 13: Pejepscot Fishing Park, Parking Area

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 14: Pejepscot Fishing Park, Cabled Entrance to Recreation Area

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

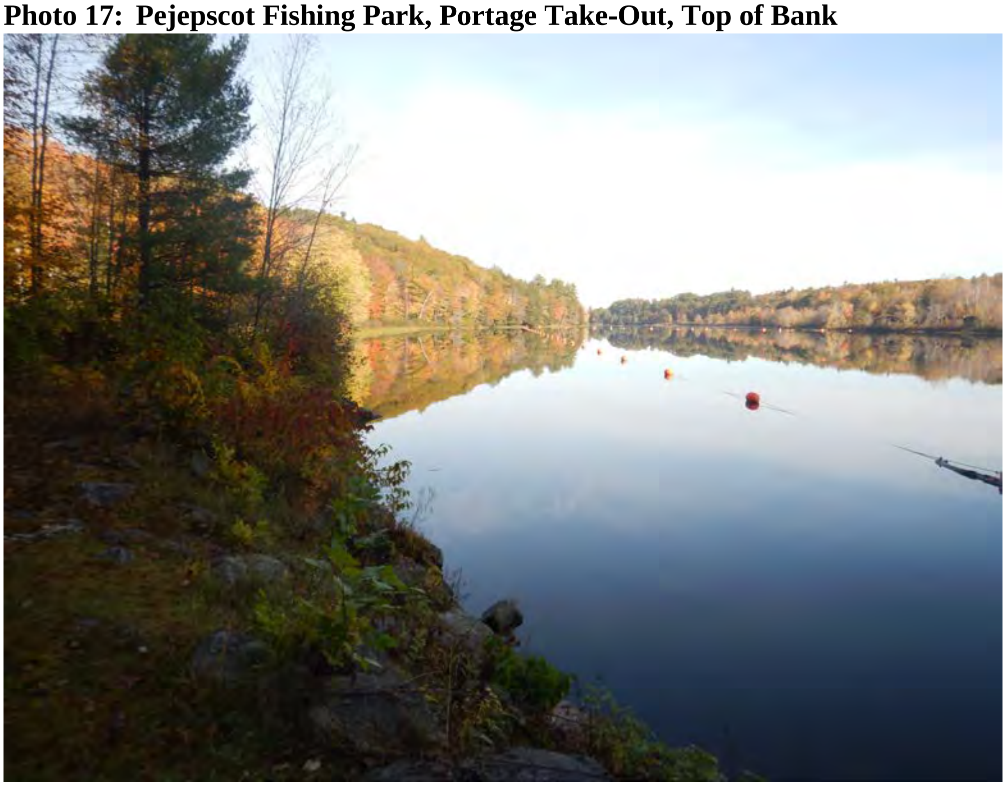
Photo 15: Pejepscot Fishing Park, Dam Overlook Area

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 16: Pejepscot Fishing Park, Dam Overlook Area Signage

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 17: Pejepscot Fishing Park, Portage Take-Out, Top of Bank



(Photo taken by J. Commerford, Gomez and Sullivan Engineers, 10/16/2019)

Photo 18: Pejepscot Fishing Park, Portage Take-Out, Bottom of Bank

(Photo taken by J. Commerford, Gomez and Sullivan Engineers, 10/16/2019)

Photo 19: Pejepscot Fishing Park, Canoe Portage Directional Sign

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 20: Pejepscot Fishing Park, Alternate Portage Take-Out

(Photo taken by J. Commerford, Gomez and Sullivan Engineers, 10/16/2019)

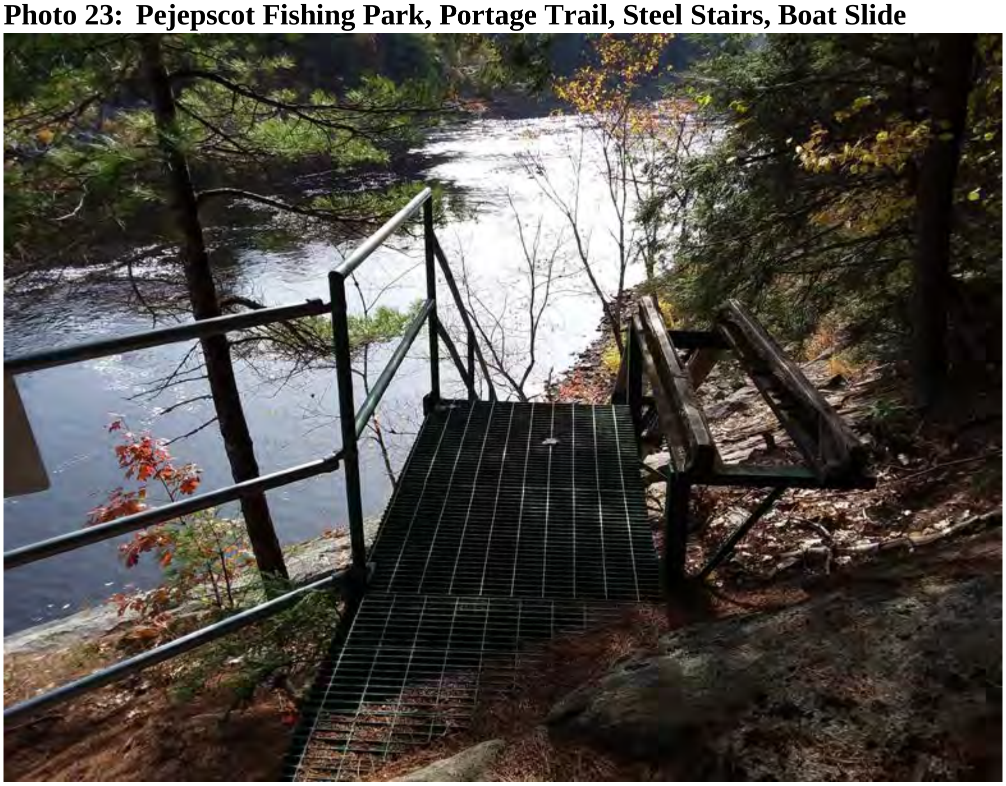
Photo 21: Pejepscot Fishing Park, Alternate Portage Take-Out, Informal Footpath

(Photo taken by J. Commerford, Gomez and Sullivan Engineers, 10/16/2019)

Photo 22: Pejepscot Fishing Park, Portage Trail

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 23: Pejepscot Fishing Park, Portage Trail, Steel Stairs, Boat Slide



(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 24: Pejepscot Fishing Park, Portage Trail, Steel Stairs, Rock Ledge

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 25: Pejepscot Fishing Park, Portage Put-In

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 26: Pejepscot Fishing Park, Informal Angler Access Footpath

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Lisbon Falls Fishing Park

Photo 27: Lisbon Falls Fishing Park, Parking Area Signage

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 28: Lisbon Falls Fishing Park, Parking Area

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 29: Lisbon Falls Fishing Park, Crosswalk to Gated Entrance

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 30: Lisbon Falls Fishing Park, Entrance Signage

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 31: Lisbon Falls Fishing Park, Access Path, Infrared Counter

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 32: Lisbon Falls Fishing Park, Infrared Counter

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 33: Lisbon Falls Fishing Park, Wooden Staircase

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 34: Lisbon Falls Fishing Park, Wooden Staircase, Shoreline Access Trail

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 35: Lisbon Falls Fishing Park, Shoreline Access, Looking Downstream

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 36: Lisbon Falls Fishing Park, Shoreline Access, Looking Upstream

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 37: Lisbon Falls Fishing Park, Access Path, Bridge Abutment

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

Photo 38: Lisbon Falls Fishing Park, Access Path, Informal Footpaths at End

(Photo taken by M. Rheaume, Gomez and Sullivan Engineers, 10/16/2019)

EXHIBIT F
GENERAL DESIGN DRAWINGS AND SUPPORTING DESIGN REPORT

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT F
GENERAL DESIGN DRAWINGS AND SUPPORTING DESIGN REPORT

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PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT F
GENERAL DESIGN DRAWINGS AND SUPPORTING DESIGN REPORT

F.1 EXHIBIT F DRAWINGS

The following design drawings showing plan, elevations, and sections of the principal Pejepscot Hydroelectric Project (Project) works are included:

Sheet No.	Title
Sheet 1	General Plan and Sections
Sheet 2	Powerhouse Site Plan
Sheet 3	Unit 1 Powerhouse Floor Plans
Sheet 4	Unit 1 Powerhouse Sections
Sheet 5	Unit 1 Sections
Sheet 6	Unit 21, 22, and 23 Plans and Sections

F.2 SUPPORTING DESIGN REPORT

18 C.F.R. §4.41(g)(3) requires that an applicant for a new license file with the Commission a Supporting Design Report when the applicant files a license application. The purpose of the Supporting Design Report is to demonstrate that the existing structures are safe and adequate to fulfill their stated functions. Given that as a high hazard facility, the Project falls under the jurisdiction of Commission's Part 12, Subpart D - Inspection by Independent Consultant. Part 12-D Safety Inspection Reports have been filed with the Commission every five years over the term of the current license. The filing date for the most recent inspection report (Fifth) is November 30, 2015. The Applicant believes that this most recent Part 12 report, along with the Supplemental Technical Information Document, the Potential Failure Modes Analysis report and other associated dam safety documentation, fulfills the requirements and intent of 18 CFR §4.41(g)(3) for the Project. All of the Project's Independent Safety Inspection Reports and associated dam safety documents are on file with the Commission.

F.3 CRITICAL ENERGY INFRASTRUCTURE INFORMATION

In accordance with Federal Energy Regulatory Commission (FERC or the Commission) regulations, certain sensitive information related to this relicensing proceeding is being filed under separate cover with the Commission only. Special handling of this material is required to protect the security of critical energy infrastructure.

In order to protect critical energy infrastructure, the Commission has enacted regulations to govern public access to certain information. The Exhibit F drawings referenced herein contain sensitive and detailed engineering information that, if used improperly, may compromise the safety of the Project and those responsible for its operation. Therefore, the Exhibit F drawings have been labeled “Contains Critical Energy Infrastructure Information – Do Not Release.” The drawings have been submitted to FERC under separate cover. Agencies may file a CEII request under 18 C.F.R. § 388.113 or a Freedom of Information Act (FOIA) request under 18 C.F.R. § 388.108 to obtain the Exhibit F drawings.

EXHIBIT G
PROJECT MAPS

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT G
PROJECT MAPS

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PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT G
PROJECT MAPS

G.1 PROJECT MAPS

The following maps define the location of the Pejepscot Hydroelectric Project (Project), principal features, and Project boundary:

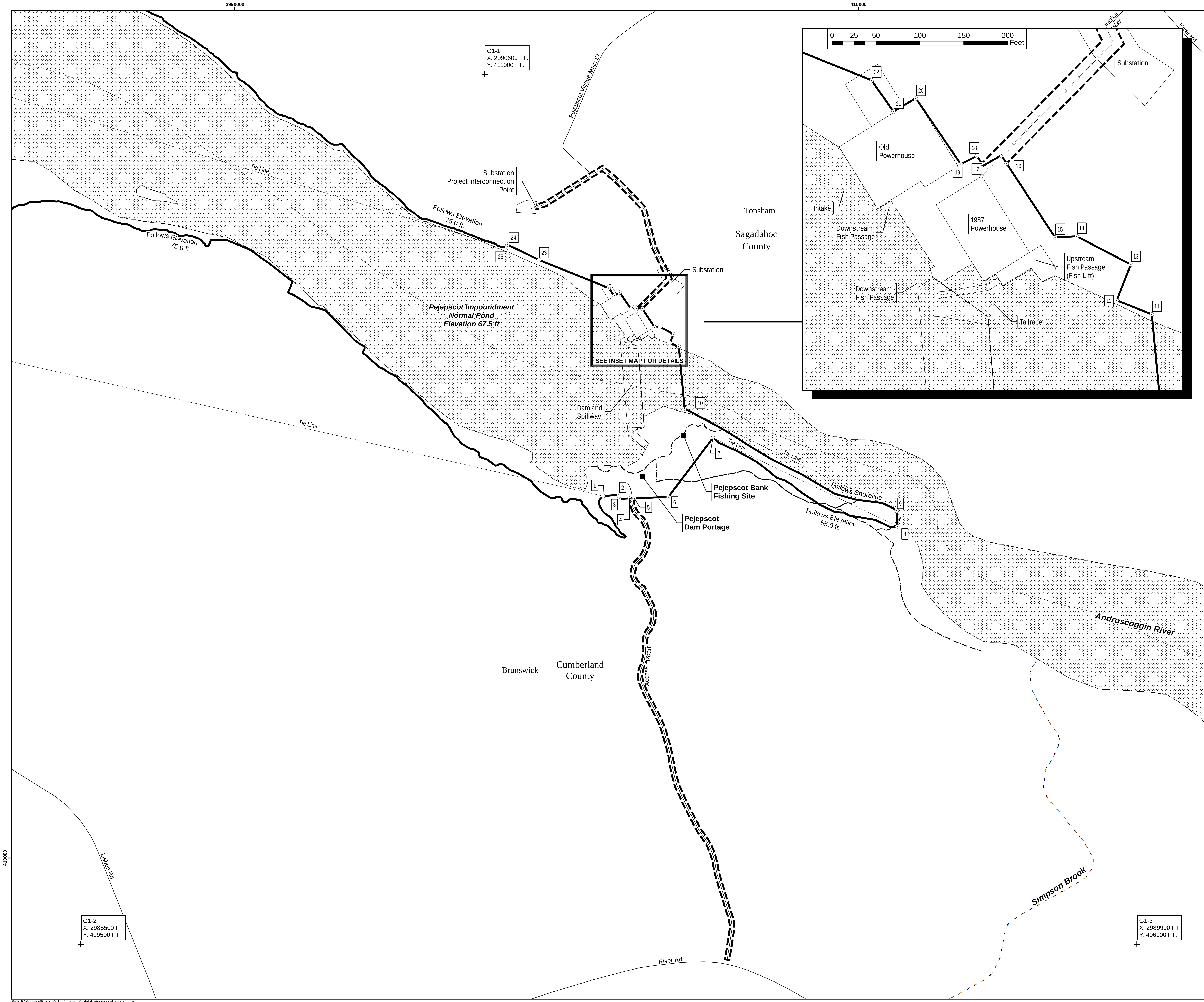
Sheet No.	Title
G-1	Project Boundary Detail Map
G-2	Project Boundary Detail Map
G-3	Project Boundary Detail Map
G-4	Project Boundary Detail Map

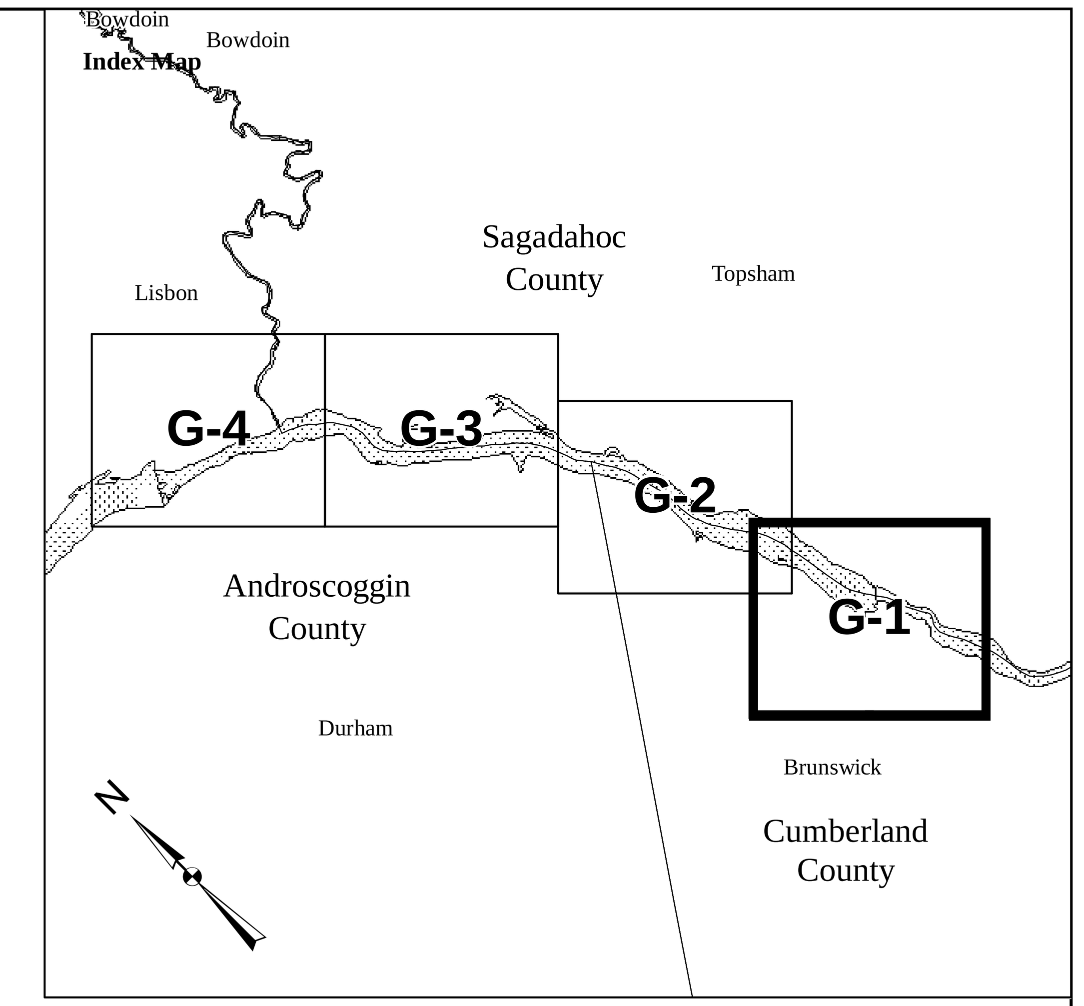
The Project boundary maps have been prepared in accordance with the requirements of 18 Code of Federal Regulations (CFR) §§ 4.39 and 4.41(h) and applicable Federal Energy Regulatory Commission (FERC) guidance. The preparation of these boundary maps in support of obtaining a new license for the Project has provided Topsham Hydro the opportunity to make the corrections and modifications listed below.

- The Project boundary has been adjusted to fully enclose the Project transmission lines.
- The Project boundary has been adjusted to include the access road to the Pejepscot Fishing Park recreation area located on the western shore of the Androscoggin River.
- The Project boundary generally follows elevation 75 feet, NGVD 1929, along the shoreline of the impoundment. More recent LIDAR data has been used to delineate the 75-foot contour shown for the proposed Project boundary. As such, the location of the contour may differ slightly in some areas, compared to the contour shown for the current Exhibit G drawings on file with the Commission, which were presumably developed with older less accurate mapping technology.
- At the upstream end of the Pejepscot Project impoundment is an area of approximately 0.95 acres where the Project boundary overlaps the project boundary for the Worumbo Project (No. 3428), which is owned by Eagle Creek Renewable Energy (Eagle Creek). The area of overlapping Project boundaries is depicted on Project Map G-4. Topsham Hydro and Eagle Creek have agreed to clarify licensee responsibility for the overlapping area by seeking Commission approval to revise the boundaries of both projects to eliminate the overlap. The decision to revise the project boundaries for both Pejepscot and Worumbo reflects both licensees' belief that eliminating the overlap will make administration of the licenses easier, and will simplify the relicensing process for the Pejepscot Project, as well as the Worumbo Project, whose Notification of Intent to seek a

new license and Preliminary Application Document are due to be filed with the Commission no later than November 30, 2020. The proposed boundary change in this area will have no impact on power generation, fish and wildlife, water quality, recreation, or cultural resources. All of the area that currently is within either the boundary for Pejepscot or Worumbo will remain within the boundary of one or the other project and be subject to the requirements of the applicable license. The Lisbon Falls Fishing Park, which is currently connected to the Pejepscot Project license, is located on this land. Topsham Hydro currently operates and maintains the facility; however, the lands are leased from Eagle Creek. The term of the lease ends at the expiration of the current Pejepscot license. This facility is proposed to be removed from the Pejepscot Project boundary, but would continue to be encompassed with the Worumbo Project boundary with the exception of the parking area for this facility. To alleviate this discrepancy, Eagle Creek proposes to modify the Worumbo Project boundary to include the parking area. With the modifications of the boundary for each Project, Eagle Creek would assume responsibility for the continued operation and maintenance of the Lisbon Falls Fishing Park.

Topsham Hydro possesses the property and/or easement rights associated with all corrections and modifications, as well as all areas associated with the defined proposed Project boundary.





Legend

- Reference Point
- Current Project Boundary
- Proposed Project Boundary
- Project Boundary Points (see table in Exhibit G text for description)
- Tie Line
- Recreation Site
- Recreation Trail
- Transmission Line
- Town Boundary
- Waterbody
- River/Creek

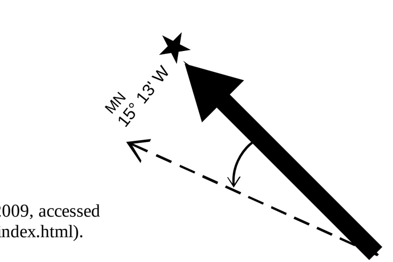
GENERAL NOTES:

1. Coordinates shown in NAD83 State Plane Maine West Zone (feet).

2. Vertical datum for all elevations shown is NGVD29.

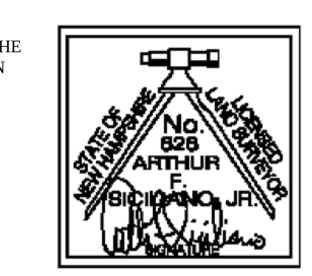
3. Elevation derived from LiDAR flown November 17 - December 2, 2009, accessed from Maine Geolibrary (https://www.maine.gov/geolib/programs/lidar/index.html).

4. The licensee has acquired rights in fee or easement to all lands necessary for construction, maintenance, and operation of the project.



Declination changing by
0° 6' E per year

I HEREBY STATE THAT THE PROJECT BOUNDARY DELINEATION FOR THE PEJEPSCOT HYDROELECTRIC PROJECT (FERC NO. 4784) AS SHOWN ON THIS EXHIBIT "G" DRAWING IS DEVELOPED WITHIN REASONABLE ACCURACIES AS REQUIRED IN 18CFR4.41 TO THE GEOGRAPHIC LOCATION BASED ON A GRAPHICAL POSITIONING IN REFERENCE TO USGS QUADRANGLE MAPPING WITHIN +/-40 FEET. THE PEJEPSCOT HYDROELECTRIC PROJECT DOCUMENTED PROJECT BOUNDARY LINE WAS ADJUSTED AND OR ROTATED TO BEST FIT WITH THE USGS QUADRANGLE MAP FEATURES GRAPHICALLY AND WAS NOT FIELD SURVEYED.



Topsham Hydro Partners Limited Partnership
Pejepscot Hydroelectric Project
FERC No. 4784

SHEET 1 of 4

0 100 200 400 600 800 Feet

EXHIBIT G-1

1 inch = 200 feet

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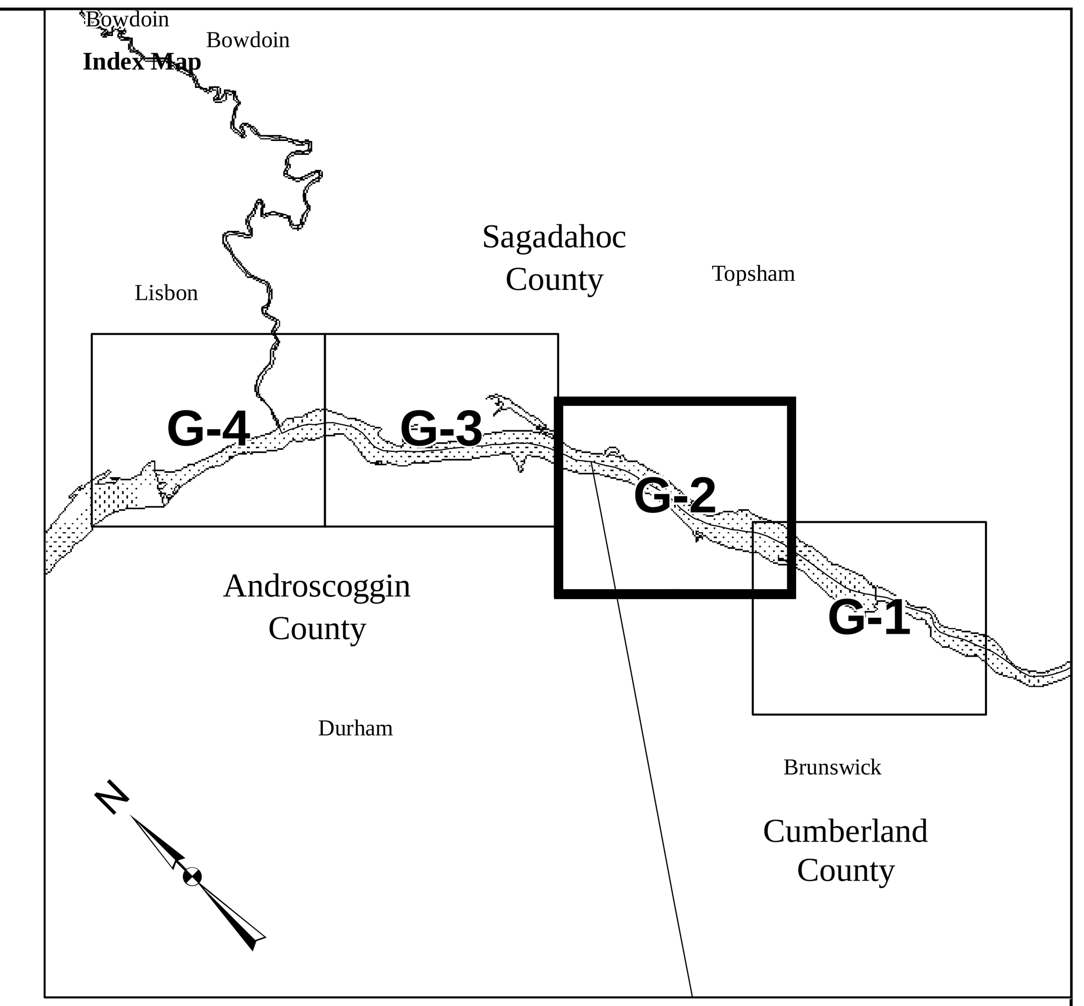

Legend

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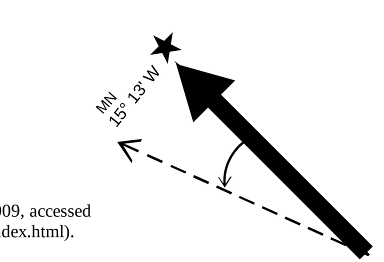

Declination changing by
0° 6' E per year

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STATE OF NEW HAMPSHIRE LICENSED LAND SURVEYOR No. 828 ARTHUR F. SICILIANO, JR. SIGNATURE

Topsham Hydro Partners Limited Partnership
Pejepscot Hydroelectric Project
FERC No. 4784

SHEET 2 of 4

0 100 200 400 600 800 Feet

EXHIBIT G-2

1 inch = 200 feet

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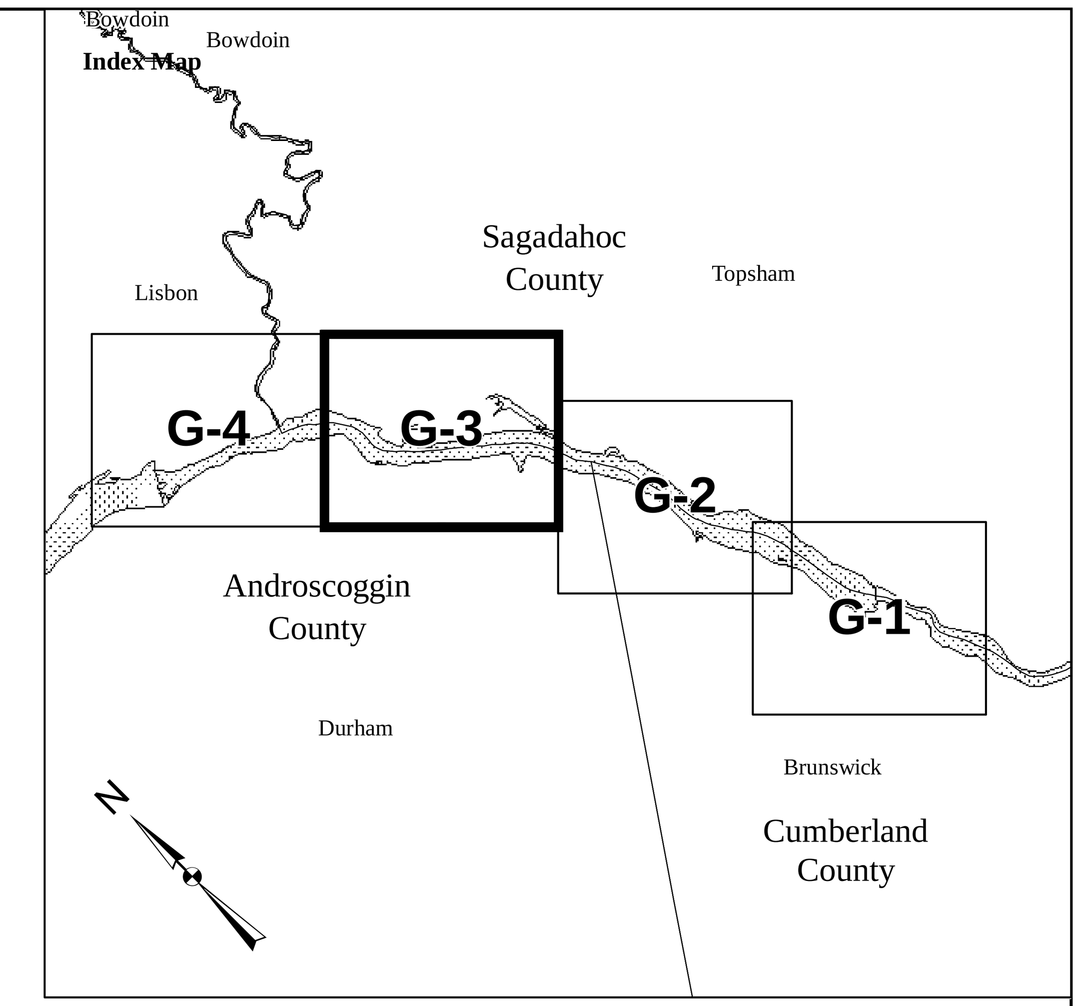

Legend

- Reference Point
- Current Project Boundary
- Proposed Project Boundary
- Project Boundary Points (see table in Exhibit G text for description)
- Tie Line
- Recreation Site
- Recreation Trail
- Transmission Line
- Town Boundary
- Waterbody
- River/Creek

GENERAL NOTES:

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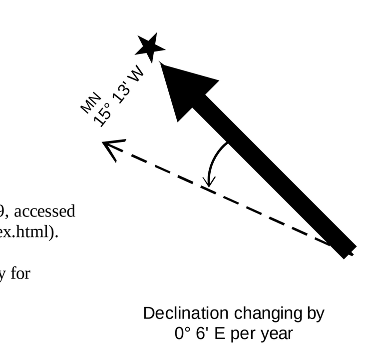
3. Elevation derived from LiDAR flown November 17 - December 2, 2009, accessed from Maine Geolibrary (https://www.maine.gov/geolib/programs/lidar/index.html).

4. The licensee has acquired rights in fee or easement to all lands necessary for construction, maintenance, and operation of the project.



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STATE OF NEW HAMPSHIRE LICENSED LAND SURVEYOR No. 828 ARTHUR F. SICILIANO, JR. SIGNATURE

Topsham Hydro Partners Limited Partnership
Pejepscot Hydroelectric Project
FERC No. 4784

SHEET 3 of 4

0 100 200 400 600 800 Feet

EXHIBIT G-3

1 inch = 200 feet

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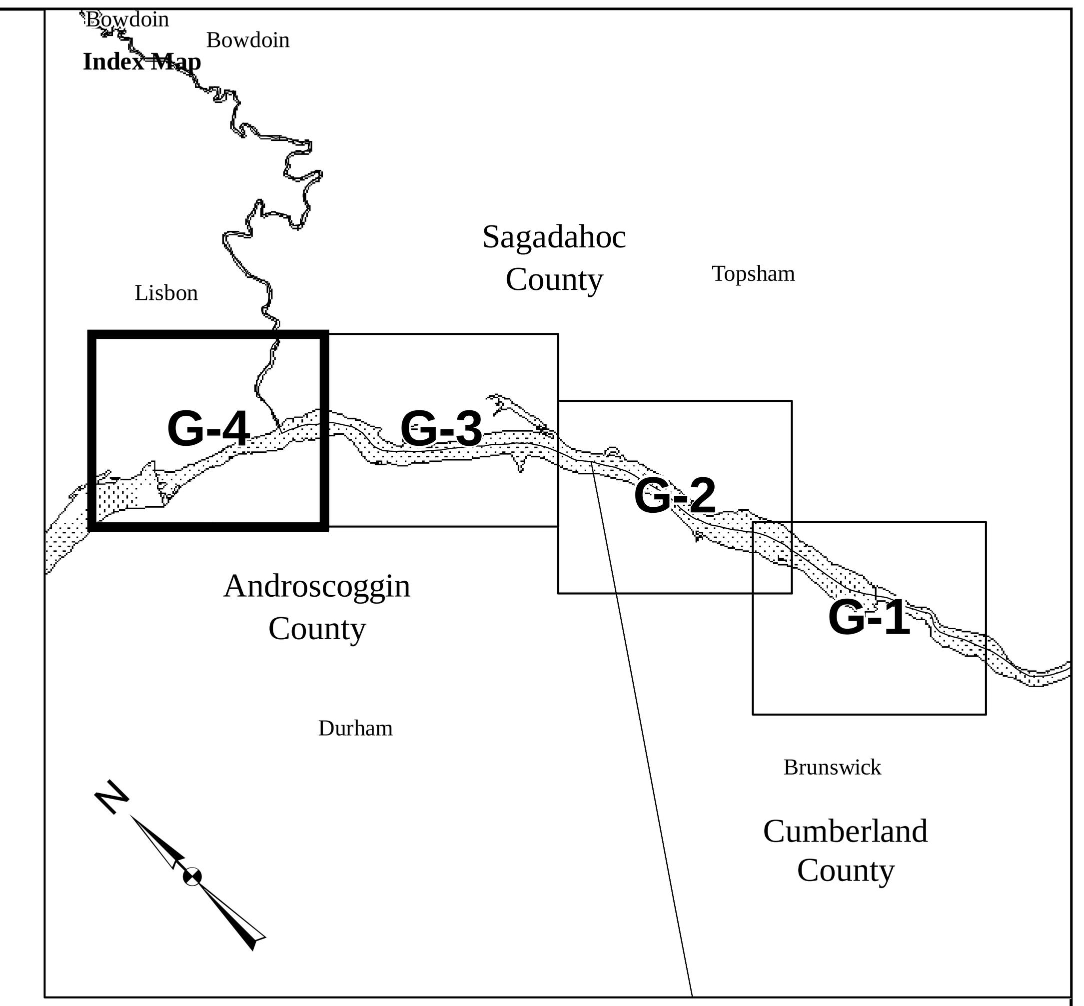

Legend

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- Transmission Line
- Town Boundary
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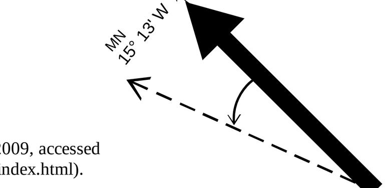

Declination changing by
0° 6' E per year

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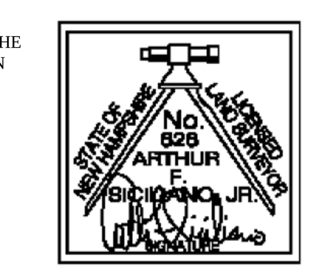

Topsham Hydro Partners Limited Partnership
Pejepscot Hydroelectric Project
FERC No. 4784

SHEET 4 of 4

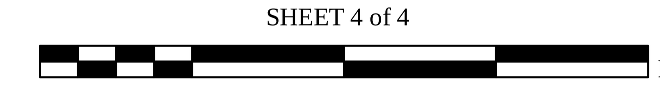

EXHIBIT G-4

1 inch = 200 feet

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Project Boundary Description

	NAD83 State Plane Maine West				
Point ID	Northing	Easting	Direction	Distance (ft)	Description
1	409260.44	2989623.82	S 49-16-7 E	71.96	Point of Beginning
2	409213.48	2989678.35	S 41-52-31 W	17.93	
3	409200.14	2989666.38	S 47-5-30 E	48.49	
4	409167.13	2989701.90	S 47-5-29 E	20.04	Follows 10' buffer of access road centerline
5	409153.48	2989716.57	S 47-5-29 E	156.01	
6	409047.27	2989830.84	N 82-1-12 E	337.34	
7	409094.10	2990164.90	S 19-19-56 E	931.52	Follows elevation 55'
8	408215.11	2990473.28	N 42-0-20 E	71.55	
9	408268.27	2990521.16	N 19-14-36 W	1071.49	Follows shoreline
10	409279.89	2990168.01	N 39-36-10 E	283.18	
11	409498.08	2990348.53	N 23-15-22 W	43.18	
12	409537.76	2990331.48	N 66-37-59 E	43.81	
13	409555.14	2990371.70	N 17-27-36 W	69.52	
14	409621.45	2990350.84	N 47-51-19 W	24.66	
15	409638.00	2990332.55	N 11-45-13 E	100.63	
16	409736.52	2990353.05	N 44-59-53 W	28.04	Follows 10' buffer of transmission line to project interconnection
17	409756.35	2990333.23	N 10-41-13 E	10.10	
18	409766.28	2990335.10	N 71-16-24 W	20.48	
19	409772.85	2990315.71	N 10-29-59 E	90.26	
20	409861.60	2990332.16	N 75-3-14 W	29.39	
21	409869.18	2990303.76	N 9-51-35 E	43.71	
22	409912.24	2990311.25	N 23-4-35 W	341.70	
23	410226.60	2990177.32	N 19-10-27 W	160.04	
24	410377.75	2990124.75	S 64-19-35 W	16.32	
25	410370.68	2990110.05	N 28-3-32 W	12943.57	Follows elevation 75'
26	421792.91	2984021.64	N 57-32-44 E	258.68	

	NAD83 State Plane Maine West				
Point ID	**Northing**	**Easting**	**Direction**	**Distance (ft)**	**Description**
27	421931.72	2984239.92	N 42-4-18 W	153.19	
28	422045.44	2984137.27	S 57-34-52 W	244.94	
29	421914.13	2983930.51	N 69-21-50 W	2665.75	Follows elevation 75'
30	422881.05	2981370.33	S 3-14-23 E	53.73	
31	422827.41	2981373.37	S 28-57-3 W	279.75	
32	422582.62	2981237.95	S 32-5-46 E	15676.23	Follows elevation 75' to point of beginning

EXHIBIT H
DESCRIPTION OF PROJECT MANAGEMENT AND NEED FOR PROJECT POWER

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT H
DESCRIPTION OF PROJECT MANAGEMENT AND NEED FOR PROJECT POWER

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LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND DEFINITIONS

ASMFC	Atlantic States Marine Fisheries Commission
cfs	Cubic feet per second
Commission	Federal Energy Regulatory Commission
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
Licensee	Topsham Hydro Partners Limited Partnership
MDEP	Maine Department of Environmental Protection
MDIFW	Maine Department of Inland Fisheries and Wildlife
MDOC	Maine Department of Conservation
ME	Maine
MOER	Maine Office of Energy Resources
MSPO	Maine State Planning Office
MWDCA	Maine Waterway Development and Conservation Act
NEPOOL	New England Power Pool
NPS	National Parks Service
NRI	National Rivers Inventory
NWSRS	National Wild and Scenic Rivers System (NWSRS)
Pejepscot Project	Pejepscot Hydroelectric Project (FERC No. 4784)
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
RPS	Renewable Portfolio Standards
SCORP	Maine Statewide Comprehensive Outdoor Recreation Plan
Topsham Hydro	Topsham Hydro Partners Limited Partnership

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC NO. 4784)

APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT H
DESCRIPTION OF PROJECT MANAGEMENT AND NEED FOR PROJECT POWER

H.1 INTRODUCTION

The Pejepscot Hydroelectric Project (Project) is an existing hydroelectric project owned by, and licensed to, Topsham Hydro Partners Limited Partnership (Topsham Hydro or Licensee). Topsham Hydro is an independent power producer and, as such, does not provide electric service to any particular group or class of customers. The Project generates renewable power that is currently sold into the New England wholesale market administered by the non-project Independent System Operator for New England (ISO New England). ISO New England administers all significant aspects of the New England Power Pool (NEPOOL) power market including: (i) the NEPOOL Open Access Transmission Tariff; (ii) the dispatch, billing and settlement system for interchange power in NEPOOL; (iii) NEPOOL energy and automatic generation control markets; and (iv) the NEPOOL installed capability market.

H.2 INFORMATION TO BE SUPPLIED BY ALL APPLICANTS

H.2.1 Plans and Ability of Owners of Pejepscot Dam to Operate and Maintain the Project

H.2.1.1 Plans to Increase Capacity or Generation

Topsham Hydro has no current plans to increase the capacity or generation of the Project.

H.2.1.2 Plans to Coordinate the Operation of the Project with Other Water Resource Projects

The current Federal Energy Regulatory Commission (FERC or the Commission) license requires that the Project be operated in a run-of-river mode. Seasonal flows and daily inflow to the Project impoundment vary almost exclusively upon the operation of upstream storage and hydroelectric projects (see Figure 2.1.2-1) and, to some small degree, inflow from impoundment tributaries. Under typical operations, inflow to the Pejepscot impoundment is relatively steady throughout each day.

Topsham Hydro is proposing to operate the Project in the same manner as it has been operated over the course of its current license. As a result, there will be no change to the Project impoundment or to downstream flows.

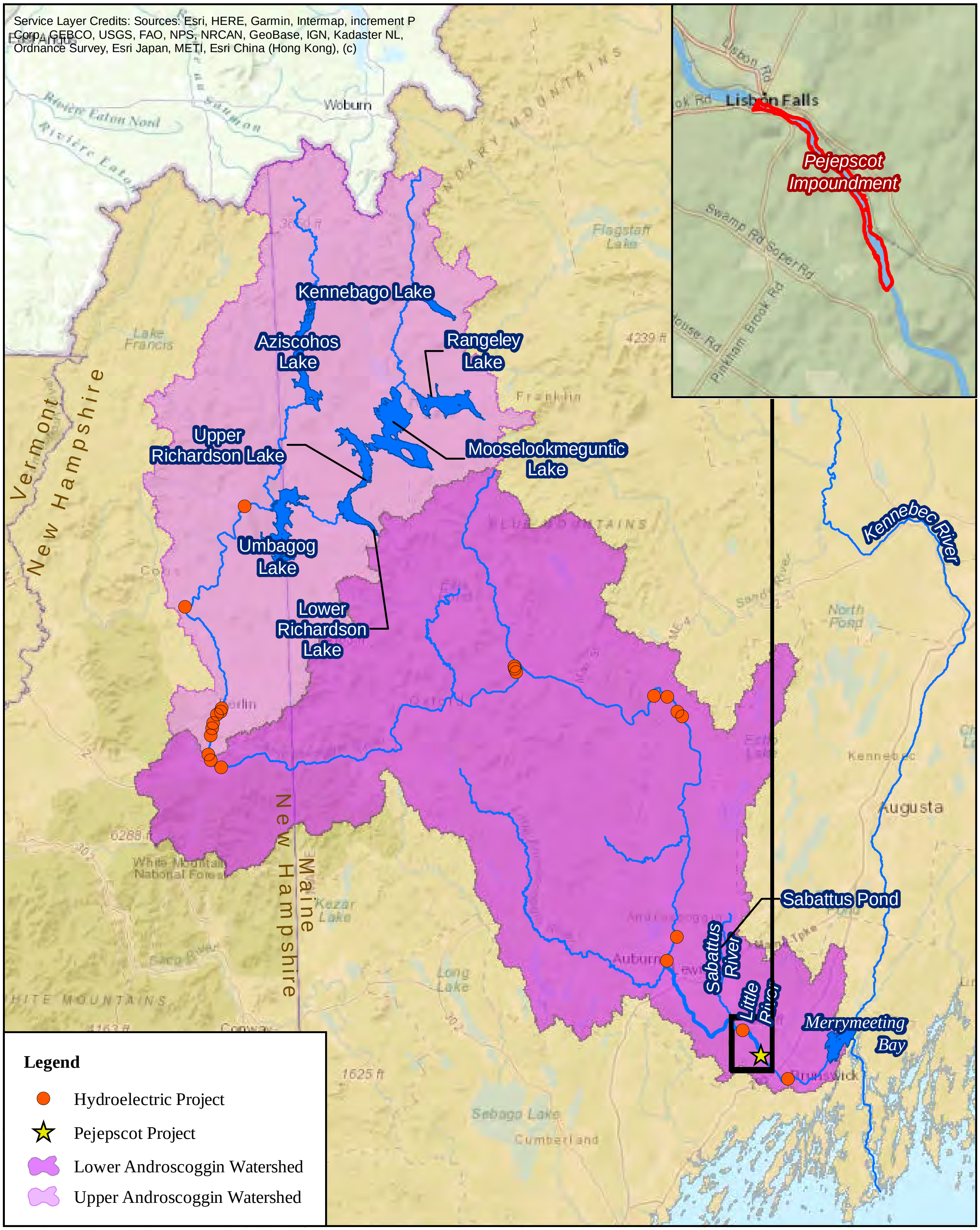
The Pejepscot Project provides 13.88-megawatts of clean renewable power. Average annual generation for the period 2009-2019 was approximately 68,516 megawatt hours per year.

H.2.1.3 Plans to Coordinate the Operation of the Project with Other Electrical Systems

Topsham Hydro is an independent power producer and member of NEPOOL that currently sells power from the Project wholesale to ISO New England. NEPOOL is a voluntary association whose members include not only traditional vertically integrated electric utilities, but independent power producers such as Topsham Hydro that are participating in the competitive wholesale electricity marketplace. ISO New England serves as the independent system operator to operate the regional bulk power system and to administer the wholesale marketplace. ISO New England's primary responsibilities are to coordinate, monitor, and direct the operations of the major generating and transmission facilities in the region. The objective of ISO New England is to promote a competitive wholesale electricity marketplace while maintaining the electrical system's integrity and reliability. ISO New England seeks to assure both maximum reliability and economy of the bulk power supply for New England.

To this end, the electric facilities of NEPOOL member companies are operated as if they comprised a single power system. ISO New England accomplishes this by central dispatching of available power resources and using the lowest cost generation and transmission equipment available at any given time consistent with meeting reliability requirements. As a result of this economic dispatch, utilities and their customers realize significant savings annually. NEPOOL participants also have strengthened the reliability of the bulk power system through shared operating reserves and coordinated maintenance scheduling.

The ISO New England staff constantly monitors and directs the operation of more than 300 generators and more than 7,600 miles of transmission lines in New England. ISO New England also is responsible for forecasting various levels of daily electricity demand that will occur throughout the region and scheduling resources to meet the demand.



Brookfield

N

Pejepscot Hydroelectric Project
(FERC No. 4784)
Final License Application

0 3.75 7.5 15 Miles

Figure 2.1.2-1.
Androscoggin River Basin

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H.2.2 Need for Electricity Generated by the Project

H.2.2.1 The Reasonable Costs and Availability of Alternative Sources of Power

The Project generates renewable power. The electrical output from the Project is sold wholesale into the ISO New England administered market.

The replacement of energy and capacity provided by the Project would be met through other sources, likely to be fossil-fired generating units, whose fuel and other viable costs would be significantly higher than those of the Project. As the lowest variable cost resource among power supply alternatives, hydroelectric assets such as the Project can bid energy into the ISO New England market at lower prices than alternative resources. Thus, loss of a low-variable cost resource such as the Project would result in upward pressure on the clearing prices in the NEPOOL market and ultimately paid by electric consumers in New England.

The Project provides renewable power, without the emissions of air pollutants or greenhouse gases that the marginal fossil fuel plants produce. This is an increasingly important fact in New England where all six New England states have enacted legislation to reduce the dependence on fossil fired generation through the introduction of Renewable Portfolio Standards (RPS), or similar legislation, that encourages and requires the use of renewable power sources. Legislation that has been enacted is designed to increase the amount of renewable power supply in the region's mix of generation resources or, alternatively, reduce the amount of fossil fired generation as a percentage of the total resource output.

As these statutes and rules are implemented or adopted in New England, "clean" hydroelectric generation becomes an even more important and valuable part of the fuel mix for electric suppliers in the region.

H.2.2.2 Increase in Costs if the Licensee is not Granted a License

If Topsham Hydro is not granted a license, this Project would cease to provide affordable and clean electricity to NEPOOL from its generation. An unquantified increase in costs would likely occur to the New England electric consumer if a license for continued operation of the Project was not granted.

H.2.2.3 Effects of Alternative Sources of Power

H2.2.3.1 Effects on Licensee's Customers

This section is not applicable since Topsham Hydro is a wholesale supplier.

H2.2.3.2 Effect on Licensee's Operating and Load Characteristics

Topsham Hydro is an independent power producer and, as such, does not maintain a separate transmission system which could be affected by replacement or alternative power sources.

H2.2.3.3 Effect on Communities Served by the Project

See the discussion above in Sections H.2.2.1 and H.2.2.2 regarding the loss of the Project's generation. Because Topsham Hydro cannot predict with any certainty the actual type or location of a potential alternative facility providing replacement power, they cannot specifically discuss potential effects of any particular community.

However, if ISO New England must replace the power benefits generated at the Project, the cost would be significantly more than the projected cost of operating the Project under the new license.

H.2.3 Need, Reasonable Cost, and Availability of Alternative Sources of Power

Topsham Hydro is an independent power producer and, as such, does not have an obligation or need to prepare load and capability forecasts in reference to any particular group or class of customers. For the region, those obligations and tasks remain within the scope of services provided by ISO New England and NEPOOL.

H.2.4 Effect of Power on Licensee's Industrial Facility

This section is not applicable to Topsham Hydro, which does not own industrial facilities.

H.2.5 Need of Indian Tribe Licensee for Electricity Generated by the Project

This section is not applicable to Topsham Hydro.

H.2.6 Impacts on the Operations and Planning of Licensee's Transmission System

Because Topsham Hydro is an independent power producer and does not own the local transmission system, this section is not applicable. Topsham Hydro maintains a single-line diagram (Appendix H-1) for the Project.

H.2.7 Statement of Need for Modifications

Topsham Hydro is not proposing any changes to the Project facilities or operation. Relicensing and the continued operation of the Project will continue to be compatible with the comprehensive development and utilization of the waterway and conform to the various comprehensive natural resource plans developed by resource management agencies, as discussed below.

H.2.8 Consistency with Comprehensive Plans

Section 10(a)(2) of the Federal Power Act (FPA) requires the Commission to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, and conserving waterways affected by the Project. In accordance with Section 10(a)(1) of the FPA, the list of Commission approved federal and state comprehensive plans was reviewed to determine applicability to the Project. The federal resources agencies, as well as the State of Maine, have prepared a number of comprehensive plans, which provide a general assessment of a variety of environmental conditions in Maine. These plans address water quality, water pollution control, wetlands, recreation, and land management issues. In addition, the State of Maine's plans include policies related to ensuring that the State's energy needs are met and supporting hydropower, a renewable and indigenous source, as a valuable portion of the energy mix. The Project's consistency with pertinent state and federal comprehensive plans is discussed below.

H.2.8.1 FERC-Approved State of Maine Comprehensive Plans

Note: Unless otherwise noted, these plans have not been updated or updates have not been submitted to FERC for approval since their development dates noted below.

Maine State Planning Office. 1987. Maine Comprehensive Rivers Management Plan. Augusta, Maine. May 1987

In 1982, the Maine State Planning Office (MSPO) submitted to FERC the Maine Comprehensive Rivers Management Plan, which was comprised of two volumes and approved by FERC in October 1982. In 1987, MSPO (eliminated in July 2012) submitted to FERC a three-volume update to the plan. Volumes 1 and 2 of the plan included the Comprehensive Hydropower Plan and Executive Department Orders and other river-related plans. Volume 3 of the Plan, included in the updated submittal in 1987, contained hydro-related core laws, Executive Orders, and other plans. In 1992 and 1993, the State of Maine produced Volumes 4 and 5 of the Comprehensive Rivers Management Plan, respectively. These volumes have also been approved by FERC. Each volume and its respective components are described in greater detail below.

State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 1

Volume 1 contains the Comprehensive Hydropower Plan issued by the Maine Office of Energy Resources (MOER) in October 1982[42]. The Comprehensive Hydropower Plan consists of three parts: Maine Rivers Policy, The Projected Contribution of Hydroelectric Generation to Meeting Maine's Electricity Needs in 1990 and 2000, and the Statewide Fisheries Plan, Summary.

"Maine Rivers Policy," Executive Order No. 1, FY82/83

On July 6, 1982, then Governor Joseph E. Brennan issued the Maine Rivers Policy which designates certain river stretches as meriting special protection. The Order stated that no new dams shall be constructed on these stretches and that additional development or redevelopment of existing dams on these stretches be designated and executed in a manner that either enhances significant resources values or does not diminish them. This policy was adopted legislatively as part of the Maine Rivers Act.

The section of the Androscoggin River on which the Project is located is not one of the listed river segments meriting special protection. Therefore, the Project conforms to this portion of the Plan.

[42] The Office of Energy Resources has since been disbanded. The State Planning Office was responsible for oversight and development of Maine's comprehensive plans until it was disbanded in July 2012, although the Department of Agriculture, Conservation, and Forestry does provide municipal level assistance in municipal level comprehensive planning.

The Projected Contribution of Hydroelectric Generation to Meeting Maine's Electricity Needs in 1990 and 2000 (MOER, October 1982)

Executive Order No. 1, FY82/83 directed MOER to prepare an estimate of the contribution that hydropower could make to meet the State's electricity needs in the years 1990 and 2000. The report was prepared in 1982; therefore, a majority of the information in the MOER report is outdated. However, the report does stress that Maine's energy policy "call for increased reliance on indigenous and renewable resources, such as hydro, in preference to imported and nonrenewable resources, such as oil." This projection does not appear to have been revised or updated since publication.

The Project currently conforms to this portion of the Plan in that it contributes hydroelectric generation (an indigenous and renewable resource) in meeting Maine's electricity needs. The new license for the Project is projected to be issued in 2022. Assuming that the Project will continue to generate electricity, it conforms to this portion of the Plan.

Statewide Fisheries Plan, Summary (Maine Department of Inland Fisheries and Wildlife (MDIFW), June 1982)

The Statewide Fisheries Plan evaluates, by river basin, whether new or improved fish passage facilities may be needed at hydroelectric projects and specifies the fishery agencies management goals, as they existed in 1982. This Plan represents the policies of the three author agencies (MDIFW, Maine Department of Marine Resources, and the Atlantic Sea-Run Salmon Commission (ASC)) regarding conservation, management, and enhancement of river fishery resources in Maine. The Plan also identifies and evaluates significant river fisheries based upon several criteria.

A discussion of existing fishery resources in the Project study area is contained in Exhibit E, Section 4.6.

<u>State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 2</u>

Volume 2 of the State of Maine Comprehensive Rivers Management Plan consists of the 1982 Maine Rivers Study. The Maine Rivers Study, generated by the Maine Department of Conservation (MDOC) and the National Park Service (NPS), defines a list of unique and natural recreation rivers and classifies them as A, B, C, or D. The mainstem of the Androscoggin River is a Class C waterbody from its confluence with the Atlantic Ocean at Merrymeeting Bay, through Project waters, upstream until its confluence with the Ellis River about 100 miles upstream of the Project at Rumford Point in Maine. Details regarding the unique or significant resources that are located in the Project area can be found in Exhibit E.

<u>State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 3, Part I</u>

Volume 3 of the State of Maine Comprehensive Rivers Management Plan contains two parts. Part I is a compilation of laws which affect the construction, operation, maintenance, and licensing of hydro projects in Maine, including: The Maine Rivers Act 12 M.R.S.A. §401 et. seq.; Maine Waterway Development and Conservation Act (MWDCA) 38 M.R.S.A. §630 et.

seq.; An Act Concerning Fishways in Dams and Other Artificial Obstructions in Inland Waterways 12 M.R.S.A. §7701-A; An Act Concerning Fishways in Dams and Other Artificial Obstruction in Coastal Waterways 12 M.R.S.A. §6121; An Act to Amend the Classification System for Maine Waters and Change the Classification of Certain Waters 38 M.R.S.A. §464 et. seq.; Alteration of Rivers, Streams, and Brooks 38 M.R.S.A. §425 et. seq.; Mandatory Shoreland Zoning and Subdivision Control 38 M.R.S.A. §435 et. seq.; Land Subdivision 30-A M.R.S.A. §4401-4407; and Land Use Regulations 12 M.R.S.A. §681 et. seq. The applicability of these Core Laws to the Project is discussed below.

Maine Rivers Act

In the *Maine Rivers Act* 12 M.R.S.A. §401 *et. seq.*, the Legislature expressly found:

> …the state's rivers comprise one of its most important natural resources, historically vital to the state's commerce and industry; that the value of the state's rivers and streams has increased due to the growth in demand for hydropower; that the rivers and streams afford Maine people with major opportunities for economic expansion through the development of hydropower; and that "the best interests of the state's people are served by a policy which recognizes the importance that their rivers and streams have for meeting portions of several public needs, provides guidance for striking a balance among the various uses which affords the public the maximum benefit and seeks harmony rather than conflict among these uses." 38 M.R.S.A. §402(6)

Topsham Hydro has consulted with and actively worked to resolve issues as they were raised by appropriate federal and state agencies, tribes, local governments, and non-governmental organizations during the relicensing process. This process has identified the importance of continued operation of the Project while identifying the relative importance of the river and its resources for various uses in providing public health benefits. Where Topsham Hydro has worked with the various interests to develop a proposal that balances all of the applicable needs, the Project conforms to this portion of the Plan.

Maine Waterway Development and Conservation Act (MWDCA) 38 M.R.S.A. §630 et. seq.

The MWDCA replaced several earlier laws and requires the developer to obtain one permit from the Maine Department of Environmental Protection (MDEP). The legislature emphasized the importance of hydropower to the State of Maine when it enacted the MWDCA.

The legislature found and declared that the surface waters of the State constitutes a valuable indigenous and renewable energy resource; and that hydropower development utilizing these waters is unique in its benefits and impacts to the natural environment, and makes a significant contribution to the general welfare of the citizens of the State for the following reasons:

- Hydropower is the State's only economically feasible, large-scale energy resource which does not rely on combustion of a fuel, thereby avoiding air pollution, solid waste disposal problems and hazards to human health from emissions, wastes, and by-products. Hydropower can be developed at many sites with minimal

environmental impacts, especially at sites with existing dams or where current type turbines can be used.
- Like all energy generating facilities, hydropower projects can have adverse effects; in contrast with other energy sources, they may also have positive environmental effects. For example, hydropower dams can control floods and augment downstream flow to improve fish and wildlife habitats, water quality, and recreation opportunities.
- Hydropower is presently the State's most significant indigenous resource that can be used to free our citizens from their extreme dependence on foreign oil for peaking power.

Topsham Hydro is proposing to continue to operate the Project for power generation in coordination with upstream storage facilities in the Androscoggin River system to provide a source of renewable energy available to the people of Maine and a reliable flow of water to downstream commercial and recreational users. Therefore, the continued operation of the Project is consistent with the policies expressed by the Maine legislature. By continuing to operate the Project, the energy-related benefits noted above will continue, in addition to fish and wildlife habitat, water quality, and recreation opportunities.

An Act Concerning Fishways in Dams and Other Artificial Obstructions in Inland Waterways 12 M.R.S.A. §7701-A

This Act was enacted with the intent of conserving, developing, or restoring anadromous or migratory fish resources by requiring the construction or repair of fishways. Under the Act, the decision to require a fishway at a dam must be based on the restoration of one or more fish species of anadromous or migratory fish to the area upstream of the obstruction. The decision to require a fishway may be justified by the protection or enhancement of any rare, threatened, or endangered fish species.

The Project area contains both riverine and impoundment fisheries habitats (see Exhibit E, Section 4.6). Upstream and downstream fish passage is required at the Project due to the presence of anadromous or other migratory fish runs within the Project area. Continuation of Project operation will help to maintain upstream and downstream passage of target fish species throughout the Androscoggin River.

An Act Concerning Fishways in Dams and Other Artificial Obstructions in Coastal Waters 12 M.R.S.A. §6121

This Act is not pertinent to the Project given the Project's location along an inland waterway.

The Maine Dam Inspection, Registration, and Abandonment Act 38 M.R.S.A. §815 et. seq.[43]

This law allows MDEP to establish water level regimes and minimum flow requirements for impoundments not within the jurisdiction of FERC.

[43] Legislative actions in recent years have changed the scope of this act.

Topsham Hydro currently holds a valid FERC license for Project operation and is submitting a License Application to FERC for the continued operation of the Project. Therefore, the Project is not subject to MDEP jurisdiction regarding establishment of water levels for non-FERC jurisdictional projects.

An Act to Amend the Classification System for Maine Waters and Change the Classification of Certain Waters 38 M.R.S.A. §464 et. seq.

This Act was enacted to restore and maintain the chemical, physical, and biological integrity of the State's waters and to preserve certain pristine state waters. Water quality standards for fresh surface waters established by the Act that are pertinent to the Project consist of Class C waters. The mainstem of the Androscoggin River is a Class C waterbody from its confluence with the Atlantic Ocean at Merrymeeting Bay, through Project waters, upstream until its confluence with the Ellis River about 100 miles upstream of the Project at Rumford Point in Maine.

Class C waters must be of such quality that they are suitable for the designate uses of drinking water after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation; navigation; and as habitat for fish and other aquatic life.

The operation of the Project and its consistency with these standards is discussed in Exhibit E, Section 4.5.

Alteration of Rivers, Streams, and Brooks 38 M.R.S.A. §425 et. seq.

This article prohibited the alteration of a river, stream, or brook or areas adjacent to rivers, streams, or brooks due to dredging, filling, or construction such that any dredged spoil, fill or structure may fall or be washed into these waters without first obtaining a permit from the Commissioner. This act was replaced with the Natural Resources Protection Act (NRPA), 38 M.R.S.A.§480-A *et. seq.*, which regulates similar activities along the State's waters. However, projects that are reviewed under the MWDCA are not subject to review under NRPA.

Topsham Hydro is not proposing any construction or redevelopment of the Project that would require an NRPA permit. If any construction is proposed in the future, the appropriate permits will be obtained.

Mandatory Shoreland Zoning and Subdivision Control 38 M.R.S.A. §435 et. seq.

This article requires that lands within 250 feet of the normal high water mark of certain waters or wetlands be subjected to municipal zoning and subdivision control.

The adjoining towns currently have zoning requirements for those lands located within 250 feet of the normal high water mark of the Project impoundment. Topsham Hydro will obtain any required shoreland zoning permits from the adjoining towns, prior to construction of any of the new facilities.

Land Subdivision 30-A M.R.S.A. §4401-4407

This article grants special protection from land subdivisions to particular river reaches identified in the article.

This article does not mention any Project lands. Land use and shoreline issues are discussed in Exhibit E, Section 4.10. The Project conforms to this portion of the Plan.

Land Use Regulations 12 M.R.S.A. §681 et. seq.

This article requires the sound planning, zoning, and subdivision control of the unorganized and organized townships of the State.

The Pejepscot Project is consistent with the Village of Pejepscot and towns of Topsham, Lisbon, Durham, and Brunswick's regulations and zoning. Land use and shoreline issues are discussed in Exhibit E, Section 4.10.

<u>State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 3, Part II</u>

Part II is a compilation of Executive Department Orders and other plans, including: Maine Rivers Policy Executive Order No. 1, FY82/83; Recreation Management and Resource Protection for Maine's Rivers; Designating the State Agencies Responsible for Water Quality Certification, Executive Order No. 5, FY85/86 Note: Updated Order No. 3, 96/97. (Note: A discussion of revised laws and Executive Department Orders implemented after the submittal of Volume 3 to the FERC in 1987 is contained in Volume 4 of the State of Maine Comprehensive Rivers Management Plan submitted to FERC in 1992, see discussion below.)

Maine Rivers Policy Executive Order No. 1, FY82/83

The Project's compliance with the Maine Rivers Policy has previously been discussed under Part I, Volume 3 of the State of Maine Comprehensive Rivers Management Plan.

Recreation Management and Resources Protection for Maine's Rivers

This is a 1985 summary report of the 1983 study titled "Maine Rivers Access and Easement Plan" by Joseph W. Hardy. This document summarizes a strategy developed in 1983 by the MDOC for protecting unique natural values and for maintaining recreational opportunities along Maine's rivers.

Topsham Hydro's proposal for continued operation of the Project is consistent with this document. Topsham Hydro manages the Project impoundment and tailwater areas to provide fishing, and both motorized and non-motorized boating opportunities for the general public.

Designating the State Agencies Responsible for Water Quality Certification, Executive Order No. 5, FY85/86 Note: Updated Order No. 3, 96/97

This Executive Order identifies the state agencies responsible for reviewing and authorizing water quality certifications for hydropower projects. MDEP has jurisdiction for water quality certification for the relicensing of the Project.

Topsham Hydro will apply for water quality certification from MDEP. Proof of receipt of delivery of the 401 Water Quality Certification Application to MDEP will be filed with the Commission when it is available.

State of Maine Comprehensive River Management Plan – December 1992 – Volume 4, Part I

Volume 4 of the State of Maine Comprehensive River Management Plan consists of three sections. Part I is a summary of the revised Core Hydro Laws subsequent to those contained in Volume 3, which were approved in 1987.

The revisions to the Core Hydro Laws contained in Volume 4 of the Plan are not all pertinent to the Project. The revised Core Hydro Laws that are pertinent to the Project are discussed below.

Special Protection for Outstanding Rivers

This law identifies river segments that are protected from further hydroelectric development in the State of Maine.

The Project is not located on an Outstanding River segment and is therefore compliant with this plan.

Hydropower Relicensing Standards

These standards require that existing hydropower impoundments be managed to protect habitat and aquatic life criteria commensurate with the appropriate water quality classifications. The standards are pertinent to the Project in that the Project area is subject to Class C water quality standards. Maine statutes at 38 M.R.S.A. subsection 464(10) clarifies that hydropower projects with riverine impoundments must satisfy the aquatic life criteria contained in 38 M.R.S.A. subsection 465(4)(c), which states that the receiving waters shall be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

The Project is consistent with the Hydropower Relicensing Standards in that operation of the Project impoundment supports all species of indigenous fish and maintains the structure and function of the resident biological community (see Exhibit E, Sections 4.5 and 4.6 for details).

State of Maine Comprehensive River Management Plan – December 1992 – Volume 4, Part II – Compilation of Executive Orders and Other Plans

Part II is a compilation of Executive Orders and other plans including Maine resource agency policy regarding hydropower. Part II of Volume 4, Implementing Plans and Orders, contains State resource agency plans and policies regarding hydropower. The following plans and orders are discussed:

State of Maine Statewide River Fisheries Management Plan, June 1982

This Plan is discussed previously under State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume I.

Maine Comprehensive Hydropower Plan, July 1992

This Plan assessed the then current and future demand for hydropower in the State of Maine. Hydropower is recognized as a significant resource available for use in meeting current and future energy needs.

Operation of the Project is consistent with this Plan as it will continue to produce reliable, efficient indigenous energy from hydropower to meet the State of Maine energy needs.

Maine State Agency Hydropower Policy Statements

These policy statements provide the basis for agency comments on hydro-project license applications.

These statements are not directly applicable to the Project as they set out the policy for State agencies to follow in commenting on hydro projects in general. Agency comments on the Project are addressed in the appropriate sections of Exhibit E.

Executive Order Designating the State Agencies Responsible for Water Quality Certification

This order identifies MDEP as the agency responsible for reviewing and providing water quality certification.

Topsham Hydro will apply for water quality certification from MDEP. Proof of receipt of delivery of the 401 Water Quality Certification Application to MDEP will be filed with the Commission when it is available.

Feasibility Study of Maine's Small Hydropower Potential

This study was performed for the MOER and examined the potential for development/expansion of hydropower development of Maine's low head dams.

This Plan is not applicable to the Project.

Maine Hydropower Licensing and Relicensing Status Report 1989-1991

These reports update hydropower licensing and relicensing activities in the State of Maine for 1989 through 1991.

The Project relicensing began after this report was written and is not included in this summary of licensing activities.

State of Maine Comprehensive River Management Plan – December 1992 – Volume 4, Part III – Hydropower and Relicensing Reports and Studies

This section of Volume 4 of the State of Maine Comprehensive River Management Plan described the regulations for hydropower relicensing and reported the status of Maine projects with regard to the federal relicensing process.

The studies and reports contained in Part III of the State of Maine Comprehensive River Management Plan are not pertinent to the Project.

State of Maine Comprehensive River Management Plan – February 1993 – Volume 5

Volume 5 of the State of Maine Comprehensive River Management Plan contains the MSPO[44] Natural Resources Policy Division's publication entitled Kennebec River Resource Management Plan: Balancing Hydropower Generation and Other Uses. This document provides a description of the various resources and beneficial uses contained in the Kennebec River Basin and provides recommendations on balancing the needs of these resources and uses. Given that the Project is located on the Androscoggin River, the Plan is not applicable to the Project.

Management of Atlantic Salmon in the State of Maine: A Strategic Plan – July 1984, Maine Atlantic Sea-Run Salmon Commission

This Plan lists as its objectives the maintenance of Atlantic salmon populations in rivers where they currently exist, and the restoration of Atlantic salmon populations in historical salmon rivers. The plan also identifies specific strategies to achieve the stated objectives, including fishway installation or improvement, increased hatchery capacity, and diversion of hatchery stocks once natural reproduction increases in stocked rivers.

Topsham Hydro maintains and operates both upstream and downstream fish passage facilities at the Project and is actively consulting with applicable resource agencies in accordance with the requirements of the Endangered Species Act (ESA).

Maine State Comprehensive Outdoor Recreation Plan (SCORP) 2014-2019, Maine Department of Conservation, Bureau of Parks and Lands

The 2003 - 2008 SCORP is included in the FERC Comprehensive Plan, however, it was updated in 2009 and again in 2014. This Plan serves as the State's official policy document for statewide outdoor recreation planning and for acquisition and development of public outdoor recreation areas and facilities. The plan identifies outdoor recreation issues of Statewide importance based upon, but not limited to, input from the public participation program and also provides information about the demand for and supply of outdoor recreation resources and facilities in the state. The SCORP satisfies the requirements of the Land and Water Conservation Fund (LWCF) Act (P.I. 88-578) which dictates that each state have an approved SCORP available on file with the National Park Service in order to participate in the LWCF program. The SCORP contains an implementation program that identifies the State's strategies, priorities, and actions for the obligation of its LWCF apportionment. The SCORP also includes a wetlands priority component with Section 303 of the Emergency Wetlands Resources Act of 1986. This wetland component provides information on state wetland conservation planning efforts as reflected in the Maine Wetlands Priority Conservation Plan published in 1988.

[44] The SPO was disbanded in July 2012, although the Department of Agriculture, Conservation, and Forestry does provide municipal level assistance in municipal level comprehensive planning.

The SCORP does not contain any recommendations or assessments that are specific to the Project area. Topsham Hydro has consulted with MDIFW on access and other recreation issues in the Project area throughout the relicensing process. Details on proposed recreation enhancements are provided in Exhibit E, Section 4.9.3. Topsham Hydro is in compliance with the strategies outlined in this Plan.

H.2.8.2 FERC-Approved Federal Comprehensive Plans

Atlantic Salmon Restoration in New England, Final Environmental Impact Statement 1989-2021. U.S. Fish and Wildlife Service, 1989

This document discusses the stated aim of the United States Fish and Wildlife Service relative to Atlantic Salmon (i.e., the restoration of self-sustaining populations of Atlantic salmon by the year 2021 to several rivers).

Topsham Hydro maintains and operates both upstream and downstream fish passage facilities at the Project and is actively consulting with applicable resource agencies in accordance with the requirements of the ESA.

Nationwide Rivers Inventory. National Park Service. January 1982, updated 1995

In 1981, the "Nationwide Rivers Inventory (NRI)," was completed for the New England Region. It is a survey of the nation's rivers conducted to identify segments meeting the minimum criteria for further study and/or potential inclusion into the National Wild and Scenic Rivers System (NWSRS). Once included on the NRI, a river is protected to the extent pursuant to Section f(d) of the Wild and Scenic Rivers Act, and in accordance with a Presidential Directive and guidance in the form of "Procedures for Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory," issued by the Council on Environmental Quality:

> "Each federal agency shall, as part of its normal planning and environmental review process, take care to avoid or mitigate adverse effects on Rivers identified in the Nationwide Inventory."[45]

This directive gives guidance to federal agencies on protecting the resources that cause the river to qualify for listing on the NRI.

The Project is not located on any of the river segments listed by NRI. Topsham Hydro has maintained the NPS on all distributions throughout the relicensing process.

[45] Presidential Directive, August 2, 1979.

Fishery Management Report No. 35 of the Atlantic States Marine Fisheries Commission (ASMFC): Shad and River Herring – Amendments 1 thru 3 to the Interstate Fishery Management Plan for Shad and River Herring – 1999 National Marine Fisheries Service; Technical Addendum 1 to Amendment 1 of the Interstate Fisheries Management Plan for Shad and River Herring – 2000 National Marine Fisheries Service

The goal of Amendment 1 of the plan was to protect, enhance, and restore East Coast migratory spawning stocks of American Shad, Hickory Shad, and River Herrings in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass. Objectives identified in the plan were to prevent overfishing of American Shad stocks by constraining fishing mortality; develop definitions of stock restoration; determine appropriate target morality rates and specify rebuilding schedules for American Shad populations within the management unit; maintain existing or more conservative regulations for Hickory Shad and River Herring fisheries until new stock assessments suggest changes are necessary; and promote improvements in degraded or historic alosine habitat throughout the species range.

Technical Addendum 1 addresses clarifications and corrections in Amendment 1. Many of the clarifications and corrections are minor. Amendment 1 was written to “protect, enhance, and restore East Coast migratory spawning stocks of American Shad, Hickory Shad, and River Herrings in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass.”

The goal of Amendment 2 to the plan for shad and River Herring is to protect, enhance, and restore East Coast migratory spawning stocks of American Shad, Hickory Shad, Alewife, and Blueback Herring in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass. The management unit under this plan includes all migratory American Shad, Hickory Shad, Alewife, and Blueback Herring stocks of the East Coast. This Amendment prohibited commercial and recreational river herring fisheries in state waters beginning January 1, 2012, unless a state or jurisdiction has a sustainable management plan reviewed by the Technical Committee and approved by the Management Board. The Amendment defines a sustainable fishery as “a commercial and/or recreational fishery that will not diminish the potential future stock reproduction and recruitment.” Amendment 2 required states to implement fisheries-dependent and independent monitoring programs. Maine has a sustainable fishery management plan for River Herring that has been approved by the ASMFC.

Amendment 3 to the plan for shad and River Herring was developed to address only measures for American Shad, whereas Amendment 2 addressed measures for Alewife and Blueback Herring (collectively River Herring). The goal of the Amendment is to protect, enhance, and restore Atlantic coast migratory stocks and critical habitat of American Shad in order to achieve levels of spawning stock biomass that are sustainable, can produce a harvestable surplus, and are robust enough to withstand unforeseen threats. This Amendment requires similar management and monitoring as developed in Amendment 2. Specifically, Amendment 3 prohibits shad commercial and recreational fisheries in state waters beginning January 1, 2013, unless a state or jurisdiction has a sustainable management plan reviewed by the Technical Committee and approved by the Management Board. American shad are not commercially harvested in Maine.

Topsham Hydro maintains and operates both upstream and downstream fish passage facilities at the Project and is actively consulting with applicable resource agencies regarding measures to protect and enhance American Shad and River Herring at the Project.

Interstate Fishery Management Plan for American Eel (Anguilla rostrata) (Report No. 36) – 2000 Atlantic States Marine Fisheries Commission

The Atlantic States Marine Fisheries Commission prepared a Fisheries Management Plan for the American Eel fishery in order to protect and restore the species. The Atlantic States Marine Fisheries Commission American Eel Fisheries Management Plan is a working document that describes the goals and objectives for the species, its current status, the ecological challenges affecting the species, and management options and actions needed to reach and maintain management goals. The stated goals of the Fisheries Management Plan are to: (1) protect and enhance the abundance of American Eel in inland and territorial waters of the Atlantic States and jurisdictions and contribute to the viability of the American Eel spawning population, and (2) provide for sustainable commercial and recreational fisheries preventing the over harvest of any eel life stage.

Topsham Hydro maintains and operates both upstream and downstream fish passage facilities at the Project and is actively consulting with applicable resource agencies regarding measures to protect and enhance American Eel at the Project.

Androscoggin River Watershed Comprehensive Plan for Diadromous Fishes, Greater Atlantic Region Policy Series 20-01. NOAA Fisheries Greater Atlantic Regional Fisheries Office. NOAA Fisheries. 2020.

The Androscoggin River Comprehensive Plan was developed by the National Marine Fisheries Service to support the restoration of diadromous fish within the Androscoggin River watershed. The recommended actions within the Plan take into account the historical and current condition, future potential, as well as inland fisheries, recreation and development interests. This includes the protection, mitigation, and enhancement of fish, wildlife, and habitat. The Plan builds off the existing management actions in the Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon and the Draft Androscoggin Fisheries Management Plan. The geographic scope of the Plan is the Androscoggin River watershed with a restoration focus downstream from Lewiston Falls, the Little Androscoggin River, the Sabattus River, and the Little River. These areas align with critical habitat for Atlantic salmon and represent a practical portion of the historical diadromous fish habitat in the Androscoggin River. The Plan’s primary purpose is to support development of terms and conditions in the hydropower licensing process, foster coordination among agencies and stakeholders, and support a collaborative restoration approach.

Topsham Hydro maintains and operates both upstream and downstream fish passage facilities at the Project and is actively consulting with applicable resource agencies regarding measures to protect and enhance diadromous fish at the Project.

H.2.9 Financial and Personnel Resources

Topsham Hydro is an affiliate of Brookfield Renewable, who has considerable experience operating not only the Pejepscot Project but other hydroelectric and water storage projects as well. Topsham Hydro has a complete staff of engineers, biologists, operators, mechanics, and electricians that are trained and experienced in the operation of hydroelectric projects. For example, along the Androscoggin River there are maintenance/operations personnel, the operations clerk, and the supervisor. If required, Topsham Hydro can also utilize staff from other nearby rivers and projects, or contract with contractors to undertake larger scale maintenance or upgrade projects. In addition, Topsham Hydro has available the administrative, licensing, and support personnel that are needed to maintain compliance with the terms of the license.

Information regarding the Project's expected annual costs and value are provided in Exhibit D of the License Application.

H.2.10 Notification of Affected Land Owners

Topsham Hydro does not propose to expand Project lands associated with this license application beyond property currently owned by Topsham Hydro.

H.2.11 Applicant's Electricity Consumption Efficiency Improvement Program

This section is not applicable given that Topsham Hydro is an independent power producer.

H.2.12 Identification of Indian Tribes Affected by the Project

There are no Indian tribes affected by the Project. The federally-recognized Indian tribes likely to be interested in the relicensing are included on the current distribution list for the Project.

H.3 INFORMATION TO BE PROVIDED BY AN APPLICANT WHO IS AN EXISTING LICENSEE

H.3.1 Measures Planned to Ensure Safe Management, Operation, and Maintenance of the Project

The Project is usually operated locally, though it has some ability to be remotely operated using a supervisory control and data acquisition link to Topsham Hydro's control system in Marlborough, Massachusetts. Local operators are available during weekdays and weekends as necessary to perform routine maintenance and operations of the facility. Daily logs of pond level, flow, and outages are maintained electronically for the Project.

Topsham Hydro has a sound compliance history for the Project. Additionally, Part 12 inspections are conducted by FERC's New York Regional Office on a regular basis. Topsham Hydro completes all necessary corrective actions to address comments and recommendations arising from FERC inspections in a timely manner.

The dam is inspected annually by Topsham Hydro's Engineering and Operations staff, as well as after floods in the Project vicinity. In addition, routine repairs are performed as needed. Topsham Hydro maintains an Emergency Action Plan (EAP) for the Project. Topsham Hydro maintains and annually verifies the accuracy of the EAP contact list to be used in the event of a dam failure at the Project. Topsham Hydro's staff reviews the EAP at least annually, and there is annual EAP training for Project personnel.

H.3.1.1 Existing and Planned Operation of the Project during Flood Conditions

The Project impoundment has no appreciable storage capacity and the Project is operated in run-of-river mode. The impoundment water level is maintained by Project operation. The hydraulic capacity of the generating facilities is approximately 8,600 cfs. Based on the long-term hydrology of the Androscoggin River in the vicinity of the Project, river flows exceed 8,600 cfs approximately 25% of the time. When inflows to the Project exceed this flow level, water in excess of the hydraulic capacity of the generating units is spilled at the dam. A detailed description of the existing and planned operation of the Project during normal and high flow conditions is contained in Exhibit B of this License Application.

H.3.1.2 Warning Devices Used to Ensure Downstream Public Safety

There are numerous safety devices at the Project and along the Androscoggin River advising the public of the Project and safety considerations. Public safety devices are inspected annually (at a minimum) and more frequently during normal work, especially during the fishing and boating seasons. Project safety signs include the following.

- "DANGER POWER PLANT INTAKE & SPILLWAY RESTRICTED AREA KEEP CLEAR" signs (1) upstream of the dam along the eastern and western banks of the river.
- "DANGER NO TRESPASSING" sign (2) along the western bank of the river at the dam entrance from the fishing park and canoe portage area.

- “CANOE PORTAGE” signs (3) on the western bank of the river upstream of the fishing park and dam.
- “DANGER SPILLWAY AND POWERPLANT UNSTEADY WATER LEVEL If siren activates Leave Area Immediately” sign (4) found along the western bank of the tailrace area of the river, at the end of the canoe portage trail downstream of the dam by the stairs.
- “PEJEPSCOT HYDROELECTRIC PROJECT Welcome to the Pejepscot Fishing Park and Canoe Portage: These facilities are for your use and enjoyment and are made available to all members of the public. PLEASE DO NOT LITTER so that others may also enjoy its natural beauty. The park is closed during winter months and unsafe river conditions.” signs (5) along the western bank of the river from the canoe portage to downstream of the dam.
- “DAM AHEAD DANGER” signs (6) located on the individual buoys that are part of the boat barrier.
- “SPILLWAY RESTRICTED KEEP CLEAR” signs (7) on the eastern and western banks of the river below the dam.
- “WARNING POWER CANAL Current Changes With No Warning No Swimming or Wading.
- BOATS PROHIBITED” sign (8) located powerhouse facing the tailrace.
- “PEJEPSCOT BOAT RAMP NOTICE THIS PARK IS OPEN FOR PUBLIC USE 1 hour before sunrise to 1 house after sunset After hours use is strictly prohibited” sign located upstream of the boat barrier.

Non-signage safety features and measures found at the Project area.

- Boat barrier with signs ("DAM AHEAD DANGER") are located approximately 200 yards upstream of the spillway. The barrier is installed by May 15 and removed after October 15 annually.
- A canoe restraining barrier that runs parallel to the western shore from the boat barrier to the canoe portage area.
- There is one siren at the Project site located at the dam that sounds 90 seconds prior to a spillway gate lowering. A light flashes red and white as a gate lowers as well.
- Spillway gate lowering procedures occur in order, with the first gates to open nearest to the powerhouse and the last gates to open nearest to the western shore.
- Chain link fences, with gates and locks where necessary, are installed to prevent unauthorized access to project facilities.

H.3.1.3 Proposed Changes Affecting the Existing Emergency Action Plan

Topsham Hydro does not propose any modifications to the EAP as a result of issuance of a new license for the Project.

H.3.1.4 Existing and Planned Monitoring Devices

Topsham Hydro has deployed water level sensors and staff gauges to monitor the impoundment and tailwater levels associated with the Project. Headpond elevation is monitored remotely by Brookfield Renewable's North American System Control Center on a continual basis. In addition, the aforementioned instrumentation is subject to annual visual inspections.

Additional information regarding dam safety and monitoring devices is classified as CEII and can be found in the Project's Dam Safety and Surveillance Monitoring Plan and Reports, which have been filed with the Commission's New York Regional Office.

H.3.1.5 Project's Employee and Public Safety Record

No lost-time accidents have occurred at the Project within the last 5 years. There have been no project-related deaths or serious injuries to members of the public within the Project boundary during the past 5 years. No accidents attributable to Project operations have occurred within the period of recordkeeping for the facility.

H.3.2 Current Operation of the Project

A description of the Project operation is contained in Exhibit B of this License Application.

H.3.3 Project History

A description of the Project history is contained in Exhibit C of this License Application.

H.3.4 Lost Generation Due to Unscheduled Outages

Table 3.4-1 lists the record of unscheduled outages and related lost generation during the last five years (2015-2019).

Table 3.4-1. Pejepscot Project Unscheduled Outages and Lost Generation, 2015-2019

Unit	Date / Time Unavailable	Date / Time Available	Estimated MWh lost	Reason for Unit Unavailability
Unit 1	11/25/2019 11:19	11/25/2019 11:35	2.9	Strainer cleaning
Unit 1	11/3/2019 7:29	11/3/2019 7:51	4.6	Clean cooling strainer
Unit 1	11/1/2019 14:25	11/1/2019 14:42	3.6	Clean cooling strainer
Unit 1	10/28/2019 16:07	10/28/2019 16:35	6.7	Clean cooling strainer
Unit 1	10/2/2019 14:16	10/3/2019 8:58	101.0	Shear pin broken
Unit 23	9/23/2019 13:39	9/23/2019 14:06	0.2	Station service switching
Unit 22	9/23/2019 13:29	9/23/2019 14:10	0.3	Station service switching
Unit 22	9/23/2019 8:34	9/23/2019 9:01	0.2	Station service switching
Unit 23	9/23/2019 8:34	9/23/2019 8:46	0.1	Station service switching
Unit 1	9/23/2019 7:00	9/23/2019 19:45		Replace brush holders
Unit 1	9/13/2019 12:44	9/13/2019 14:25	5.2	External power fault
Unit 23	9/13/2019 12:44	9/13/2019 14:25		External power fault
Unit 1	9/11/2019 17:11	9/12/2019 6:57	54.5	Rainwater into control box heavy storm event
Unit 1	8/26/2019 10:17	8/30/2019 12:57	444.0	Annual inspection
Unit 1	7/17/2019 23:24	7/18/2019 10:42	81.4	Exciter problem caused broken wicket shear pin
Unit 1	6/30/2019 13:50	6/30/2019 22:15	98.5	Loss of station service
Unit 1	6/19/2019 6:30	6/19/2019 7:47	8.1	Bad electrical connection to governor bypass solenoid
Unit 1	6/13/2019 15:10	6/13/2019 16:14	3.3	Upstream station trip by CMP outage caused low headpond elevation
Unit 1	5/30/2019 10:34	5/30/2019 10:42	1.8	Tripped during local adjustments
Unit 21	4/23/2019 14:47	9/26/2019 15:00	497.5	Penstock leakage
Unit 22	4/23/2019 14:47	9/9/2019 15:00	331.6	Penstock leakage
Unit 23	4/23/2019 14:47	7/10/2019 13:30	497.5	Penstock leakage
Unit 23	3/5/2019 13:14	3/5/2019 13:51	0.3	Brush inspection
Unit 21	3/4/2019 19:39	3/4/2019 20:22	0.4	Tripped offline due to hydraulic system breaker tripping
Unit 22	3/3/2019 6:39	3/5/2019 11:59	19.2	Burned collector ring and brush rig
Unit 21	1/9/2019 8:21	1/9/2019 13:56	3.0	Station service breaker tripped
Unit 23	1/9/2019 8:21	1/9/2019 13:45	2.9	Station service breaker tripped

Unit	Date / Time Unavailable	Date / Time Available	Estimated MWh lost	Reason for Unit Unavailability
Unit 23	1/7/2019 5:30	1/7/2019 14:13	4.7	Trashrack differential - ice
Unit 21	1/7/2019 5:29	1/7/2019 13:57	4.6	Trashrack differential - ice
Unit 21	12/28/2018 4:38	12/28/2018 8:35	2.1	Trashrack differential from ice
Unit 23	12/28/2018 4:38	12/28/2018 8:05	1.9	Trashrack differential from ice
Unit 21	12/27/2018 6:03	12/27/2018 12:00	3.2	Trashrack differential from ice
Unit 21	12/26/2018 7:36	12/26/2018 10:31	1.6	Trashrack differential from ice
Unit 21	12/26/2018 1:54	12/26/2018 2:06	0.1	Trashrack differential from ice
Unit 23	12/26/2018 1:54	12/27/2018 11:19	18.0	Trashrack differential from ice
Unit 21	12/26/2018 1:29	12/26/2018 1:41	0.1	Trashrack differential from ice
Unit 23	12/26/2018 1:29	12/26/2018 1:53	0.2	Trashrack differential from ice
Unit 21	12/26/2018 0:00	12/26/2018 0:44	0.4	Trashrack differential from ice
Unit 22	12/26/2018 0:00	2/19/2019 11:18	479.3	Tripped offline due to ice exciter problems
Unit 23	12/26/2018 0:00	12/26/2018 1:03	0.6	Tripped offline due to ice
Unit 22	12/26/2018 0:00	2/19/2019 11:18	479.3	Tripped offline due to ice exciter problems
Unit 21	11/23/2018 2:34	11/23/2018 16:32	7.5	Trashrack differential - icing
Unit 22	11/23/2018 2:34	11/23/2018 16:32	5.0	Trashrack differential - icing
Unit 23	11/23/2018 2:34	11/23/2018 16:32	7.5	Trashrack differential - icing
Unit 23	11/4/2018 11:51	11/4/2018 12:29	0.3	Rack cleaning
Unit 21	11/4/2018 11:46	11/4/2018 12:20	0.3	Rack cleaning
Unit 22	11/4/2018 11:46	11/4/2018 12:20	0.2	Rack cleaning
Unit 21	10/30/2018 15:44	10/30/2018 19:48	2.2	Relay testing
Unit 22	10/30/2018 15:44	10/30/2018 19:48	1.5	Relay testing
Unit 23	10/30/2018 15:44	10/30/2018 19:48	2.2	Relay testing
Unit 21	9/20/2018 9:09	9/20/2018 16:42	4.1	Relay testing
Unit 22	9/20/2018 9:09	9/20/2018 16:42	2.7	Relay testing
Unit 23	9/20/2018 9:09	9/20/2018 16:42	4.1	Relay testing
Unit 22	9/20/2018 8:53	9/20/2018 9:08		relay testing
Unit 21	9/20/2018 8:35	9/20/2018 9:08		offline for relay testing

Unit	Date / Time Unavailable	Date / Time Available	Estimated MWh lost	Reason for Unit Unavailability
Unit 21	8/28/2018 10:15	8/28/2018 13:38	1.8	Trashrack differential
Unit 23	8/28/2018 10:15	8/28/2018 13:38	1.8	Trashrack differential
Unit 22	8/9/2018 20:31	8/28/2018 13:59	202.3	Speed sensor issues
Unit 22	8/7/2018 7:59	8/7/2018 10:46	1.0	Speed sensor issues
Unit 22	8/6/2018 7:38	8/6/2018 8:42	0.4	Speed sensor issues
Unit 22	8/6/2018 6:28	8/6/2018 7:05	0.2	Speed sensor issues
Unit 21	6/21/2018 7:14	6/30/2018 7:58	117.0	Exciter belt issue
Unit 1	6/20/2018 8:01	5/10/2019 13:00	61329.2	Stator rewind
Unit 1	6/20/2018 8:01	5/10/2019 13:00	61329.2	Stator rewind
Unit 1	6/14/2018 21:44	6/14/2018 22:12	1.7	Governor potentiometer causing vibration
Unit 1	6/4/2018 6:25	6/4/2018 6:41	1.2	Governor potentiometer
Unit 1	5/31/2018 11:21	5/31/2018 12:29	4.1	Measurement / inspection of stator in preparation for rewind
Unit 1	5/17/2018 8:20	5/17/2018 8:26		Tripped due to low headpond level indicator upstream station trip
Unit 1	5/17/2018 7:37	5/17/2018 7:44		Tripped due to low headpond level indicator upstream station trip
Unit 1	4/27/2018 0:16	4/27/2018 1:31	16.9	Rack differential affecting blades
Unit 21	4/23/2018 11:36	6/6/2018 11:04	256.8	Annual inspection
Unit 23	4/19/2018 12:00	5/1/2018 13:57	156.6	Bearing temperature
Unit 1	4/11/2018 16:32	4/11/2018 16:50	4.1	Unit tripped offline due to vibration
Unit 1	3/2/2018 20:18	3/3/2018 8:00	33.7	Negative prices / DNE
Unit 1	2/20/2018 8:31	2/21/2018 14:38	298.2	Measurement / inspection of stator in preparation for rewind
Unit 1	2/15/2018 22:30	2/16/2018 6:00	18.2	Negative pricing / node DNE
Unit 1	11/21/2017 11:32	11/21/2017 11:48	3.4	Station offline for rack raking
Unit 21	11/21/2017 11:32	11/21/2017 11:48		Station offline for rack raking
Unit 22	11/21/2017 11:32	11/21/2017 11:48		Station offline for rack raking
Unit 23	11/21/2017 11:32	11/21/2017 11:48		Station offline for rack raking
Unit 1	11/14/2017 12:40	11/14/2017 13:52		Taken offline due to loss of inflow from Worumbo station
Unit 1	11/12/2017 17:53	11/12/2017 18:50	6.8	Tripped due to high rack differential
Unit 1	10/30/2017 5:32	11/3/2017 6:35	1222.8	Line bump during storm

Unit	Date / Time Unavailable	Date / Time Available	Estimated MWh lost	Reason for Unit Unavailability
Unit 21	10/30/2017 4:56	10/30/2017 5:58	0.6	Loss of external power
Unit 23	10/29/2017 10:41	11/3/2017 6:35	62.6	U23 tripped ofline due to overheated bearing
Unit 23	10/28/2017 16:33	10/29/2017 8:14	8.5	Bearing high temp
Unit 23	10/28/2017 11:24	10/28/2017 12:14	0.5	Bearing high temperature
Unit 22	10/27/2017 9:44	11/3/2017 8:48	60.1	Tripped offline due to faulty oil pressure transducer.
Unit 22	10/27/2017 7:44	10/27/2017 8:01	0.1	Faulty oil pressure transducer.
Unit 1	10/23/2017 6:55	10/23/2017 7:07	0.7	Line bump
Unit 22	10/2/2017 1:59	10/4/2017 8:58	29.7	Faulty oil flow switch
Unit 22	9/30/2017 7:56	9/30/2017 8:02	0.1	Low oil pressure
Unit 23	9/28/2017 12:45	9/28/2017 13:17	0.3	Bearing overtemperature
Unit 1	9/25/2017 9:06	10/12/2017 8:37	635.4	Annual inspection
Unit 1	9/15/2017 3:52	9/15/2017 4:22	1.8	Station trip due to lightning storm
Unit 21	9/15/2017 3:52	9/15/2017 4:22		Station trip due to lightning storm
Unit 22	9/15/2017 3:52	9/15/2017 4:22		Station trip due to lightning storm
Unit 23	9/15/2017 3:52	9/15/2017 4:22		Station trip due to lightning storm
Unit 1	9/5/2017 10:00	9/5/2017 12:10	9.8	Tripped during drawdown
Unit 1	7/6/2017 6:48	7/6/2017 6:59	2.0	Station tripped off line due to line bump
Unit 21	7/6/2017 6:48	7/6/2017 6:59		Station tripped off line due to line bump
Unit 22	7/6/2017 6:48	7/6/2017 6:59		Station tripped off line due to line bump
Unit 23	7/6/2017 6:48	7/6/2017 6:59		Station tripped off line due to line bump
Unit 1	7/3/2017 11:26	7/3/2017 13:19	23.7	Trashrack raking
Unit 21	7/3/2017 11:26	7/3/2017 13:19	1.0	Trashrack raking
Unit 22	7/3/2017 11:26	7/3/2017 13:19	0.7	Trashrack raking
Unit 23	7/3/2017 11:26	7/3/2017 13:19	1.0	Trashrack raking
Unit 22	5/30/2017 20:20	5/31/2017 7:34	4.0	Oil pressure
Unit 1	5/28/2017 11:12	5/28/2017 12:29	16.2	Tripped on vibration
Unit 22	5/21/2017 22:34	5/22/2017 8:24	3.5	Hydraulic pressure switch
Unit 22	5/20/2017 23:20	5/21/2017 8:05	3.2	Hydraulic pressure switch

Unit	Date / Time Unavailable	Date / Time Available	Estimated MWh lost	Reason for Unit Unavailability
Unit 22	5/2/2017 8:55	5/2/2017 9:32	0.2	Rack differential
Unit 23	4/28/2017 3:02	4/28/2017 7:44	2.5	Rack differential
Unit 21	4/14/2017 6:57	4/25/2017 12:30	145.6	High rack differential
Unit 22	4/14/2017 6:56	4/25/2017 14:39	97.8	High rack differential
Unit 23	4/14/2017 6:56	4/25/2017 14:40	146.7	High rack differential
Unit 22	4/12/2017 5:00	4/12/2017 5:36	0.5	Tripped off line due to rack differential. Called TO.
Unit 1	4/7/2017 9:35	4/7/2017 11:39	26.0	Rack raking
Unit 1	4/3/2017 7:44	4/3/2017 9:29	15.8	Rack raking
Unit 21	4/3/2017 7:44	4/3/2017 9:29		Rack raking
Unit 22	4/3/2017 7:44	4/3/2017 9:29		Rack raking
Unit 23	4/3/2017 7:44	4/3/2017 9:29		Rack raking
Unit 1	3/30/2017 10:04	3/30/2017 12:11	26.7	Rack raking
Unit 21	3/30/2017 10:04	3/30/2017 12:11		Rack raking
Unit 22	3/30/2017 10:04	3/30/2017 12:11		Rack raking
Unit 23	3/30/2017 10:04	3/30/2017 12:11		Rack raking
Unit 1	3/23/2017 6:32	3/23/2017 11:14	50.8	River icing
Unit 1	3/11/2017 20:30	3/12/2017 8:36	139.9	High rack differential due to icing. 86 Mechanical lockout
Unit 1	3/11/2017 5:02	3/11/2017 14:17	116.6	High rack differential. 86 mechanical lockout trip.
Unit 1	3/4/2017 19:20	3/5/2017 15:56	259.6	High rack differential
Unit 1	3/3/2017 8:52	3/3/2017 10:31	20.8	Trashrack debris / icing
Unit 21	3/3/2017 8:52	3/3/2017 10:31	1.5	Trashrack debris / icing
Unit 22	3/3/2017 8:52	3/3/2017 10:31	0.7	Trashrack debris / icing
Unit 23	3/3/2017 8:52	3/3/2017 10:31	1.5	Trashrack debris / icing
Unit 1	12/30/2016 5:59	12/30/2016 14:05	65.6	Area power outage due to snowstorm
Unit 22	12/3/2016 11:05	12/3/2016 12:57	0.8	high bearing oil temp
Unit 21	10/5/2016 7:40	10/5/2016 14:44		Transformer testing
Unit 22	10/5/2016 7:40	10/5/2016 14:47	2.6	Transformer testing
Unit 23	10/5/2016 7:40	10/5/2016 14:44	5.1	Transformer testing

Unit	Date / Time Unavailable	Date / Time Available	Estimated MWh lost	Reason for Unit Unavailability
Unit 1	9/19/2016 7:10	10/7/2016 14:27	126.4	Stator cleaning and inspection
Unit 1	8/9/2016 7:43	8/11/2016 9:15	44.6	Governor maintenance
Unit 1	8/9/2016 7:13	8/9/2016 7:43	1.4	Tripped on low flow
Unit 1	7/27/2016 3:23	7/27/2016 3:57	2.1	Governor oil pressure
Unit 1	7/26/2016 10:02	7/26/2016 10:38	2.3	NERC relay testing
Unit 21	7/26/2016 10:02	7/26/2016 10:38		NERC relay testing
Unit 23	7/26/2016 10:02	7/26/2016 10:38		NERC relay testing
Unit 1	6/13/2016 18:55	6/14/2016 8:18	77.1	Station taken off line in outage by CMP due to local fire. Station in outage PT in route to station.
Unit 21	6/13/2016 18:55	6/14/2016 8:18		Station taken off line in outage by CMP due to local fire. Station in outage PT in route to station.
Unit 23	6/13/2016 18:55	6/14/2016 8:18		Station taken off line in outage by CMP due to local fire. Station in outage PT in route to station.
Unit 1	6/8/2016 8:00	6/9/2016 11:56	301.7	Replace blade angle controller
Unit 1	6/6/2016 1:46	6/6/2016 6:11	15.9	CMP transmission feed form substation to hydro asset down. No time table of return.
Unit 1	3/11/2016 13:37	3/11/2016 13:45	1.7	Ice sheet on racks
Unit 1	3/11/2016 12:18	3/11/2016 12:35	0.2	Tripped on vibration
Unit 21	3/10/2016 8:47	3/10/2016 8:54	0.1	Unit tripped off line due to shutting unit 22 head gate
Unit 23	3/10/2016 8:47	3/10/2016 8:50	0.0	Unit tripped off line due to shutting unit 22 head gate
Unit 22	3/7/2016 7:16	8/5/2016 13:17	421.8	Broken shaft
Unit 1	3/3/2016 6:01	3/3/2016 10:04	51.0	Unit offline due to icing.
Unit 21	3/3/2016 5:16	3/7/2016 7:00		Reserve Shutdown
Unit 22	3/3/2016 5:16	3/7/2016 7:00		Reserve Shutdown
Unit 23	3/3/2016 5:16	3/7/2016 7:00		Reserve Shutdown
Unit 1	2/27/2016 7:28	2/28/2016 8:01	176.8	Topsham U1 backed down due to icing and rack D/P.
Unit 21	2/27/2016 3:25	2/28/2016 8:20	15.6	Unit off line in outage due to icing
Unit 22	2/27/2016 3:25	2/28/2016 8:13	25.9	Unit off line in outage due to icing
Unit 23	2/27/2016 3:25	2/28/2016 8:19	26.0	Unit off line in outage due to icing
Unit 1	2/18/2016 4:38	2/18/2016 5:01	5.5	Unit Tripped offline due to high vibration.

Unit	Date / Time Unavailable	Date / Time Available	Estimated MWh lost	Reason for Unit Unavailability
Unit 1	2/11/2016 10:27	2/11/2016 10:43		Unit off line in outage due to trash racks
Unit 23	4/27/2015 6:38	2/18/2016 7:32	457.9	Unit offline and OOS due to rotor/stator misalignment resulting in contact.

H.3.5 Licensee's Record of Compliance

The Project has a good record of compliance with the terms and conditions of the existing license. A review of Topsham Hydro's records indicates no violations of the terms and conditions of the license. In addition, Topsham Hydro has not received any communication from the Commission indicating possible non-compliance.

H.3.6 Actions Affecting the Public

Topsham Hydro generally allows public access to the Project impoundment and the surrounding Project lands. Topsham Hydro will, however, restrict public access to specific areas that pose a threat to public safety. Topsham Hydro provides public recreation access at several formal recreation sites that provide opportunities for bank fishing and motoring and non-motorized boating. A full description of these opportunities and associated recreational facilities provided by Topsham Hydro is contained in Exhibit E of this application.

Generation at hydropower facilities generally offsets the need for increased operation at existing baseload facilities, such as oil or coal-fueled generation plants. Fossil-fueled plants produce atmospheric pollutants that must be controlled at significant costs. The avoided cost of air pollution, therefore, is a public benefit of hydroelectric generation.

Topsham Hydro's regard for public safety is demonstrated by its active program of installing warning signs and safety devices at the Project (Section H.3.1.2), and its regular review of its internal Project safety plans.

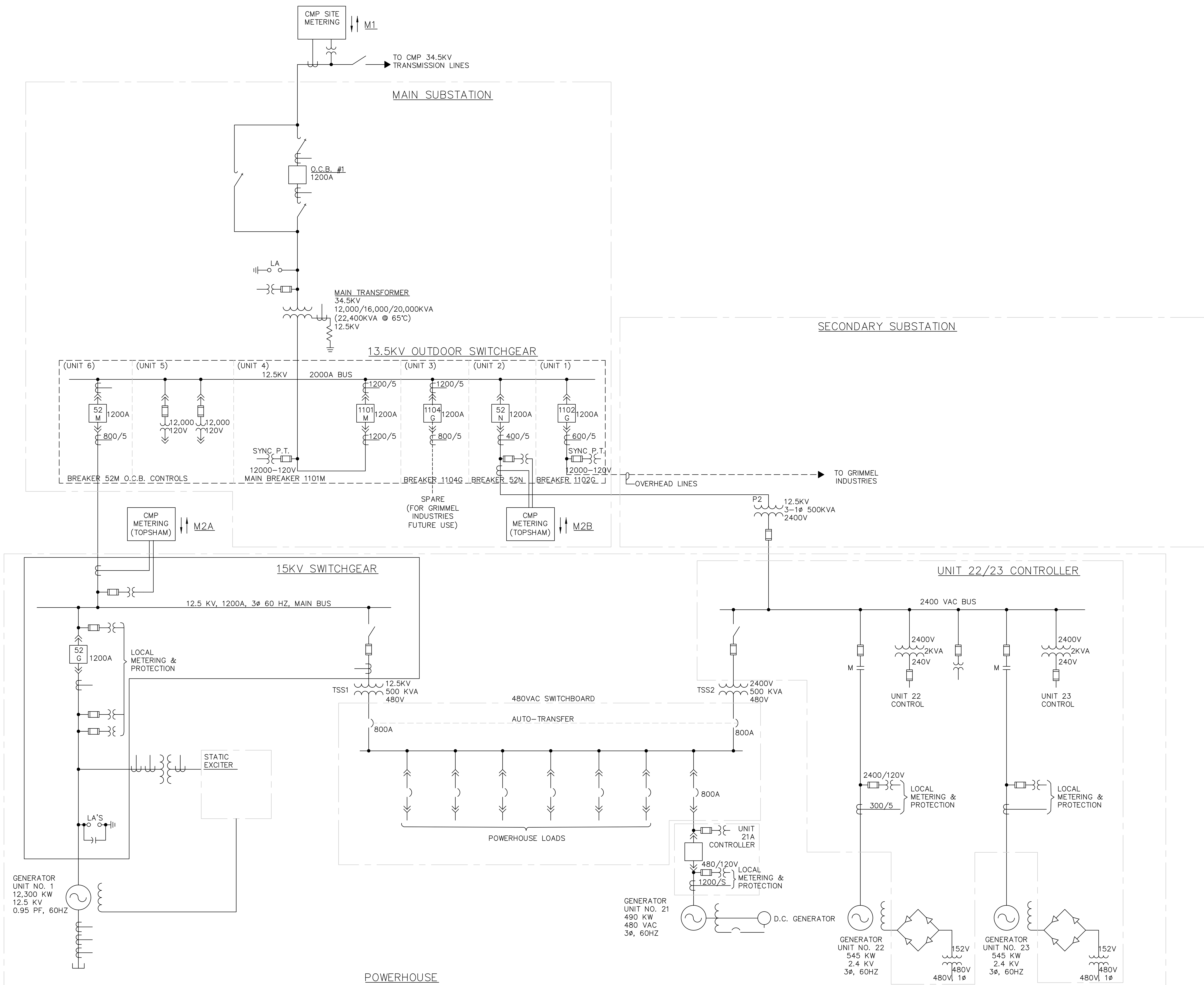
H.3.7 Ownership and Operating Expenses That Would Be Reduced if the License Were Transferred

Topsham Hydro is applying for a long-term license to continue to maintain and operate the Project. Additionally, there is no competing application to take over the Project. Because there is no proposal to transfer the Project license, this section is not applicable to the Project.

H.3.8 Annual Fees for Use of Federal or Native American Lands

This section is not applicable to the Project since no Federal or Native American Lands are present in the Project area.

APPENDIX H-1: SINGLE LINE DIAGRAM



NOTES:
1. USE OF O.C.B. #1 MAIN TRANSFORMER, BREAKER 1101M AND O.C.B. CONTROLS IS SHARED WITH GRIMMEL INDUSTRIES, INC.

Topsham Hydro Partners Limited Partnership
PEJEPSCOT HYDROELECTRIC PROJECT
FERC NO. 4784

SINGLE LINE DIAGRAM