Brookfield

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

Tel 207.755.5600
Fax 207.755.5655
www.brookfieldrenewable.com

July 12, 2019

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)
Initial Study Report, Initial Study Report Meeting, and Notice of Intent to File Draft License Application

Dear Secretary Bose:

Topsham Hydro Partners Limited Partnership (L.P.) (Topsham Hydro or Licensee), an indirect member of Brookfield Renewable (Brookfield), is the current Licensee of the Pejepscot Hydroelectric Project (Project) (FERC No. 4784), located on the Androscoggin River in the village of Pejepscot and the Town of Topsham, Maine (ME).

On August 31, 2017, Topsham Hydro filed its Notice of Intent (NOI) with the Federal Energy Regulatory Commission (FERC or Commission) to pursue a new license for the continued operation of the Project. Consistent with the Commission's Integrated Licensing Process (ILP) and 18 CFR §5.15(c), Topsham Hydro is filing the enclosed Initial Study Report (ISR) with the Commission.

Topsham Hydro initiated several studies at the Project as outlined in the study plans and schedules approved by the Commission on July 3, 2018. The enclosed ISR describes the study methods, data collected, and results of the following FERC-approved study plans implemented and completed in the 2018 field season:

- Water Quality Assessment
- Tailwater Benthic Macroinvertebrate Study
- Stranding Evaluation
- Wildlife Resources Survey
- Botanical Resources Survey
- Historic Architectural Survey

Please note that information pertaining to the Historic Architectural Survey is being filed separately as Privileged (non-public information).

In addition, pursuant to 18 CFR §5.15(c)(2), Topsham Hydro will hold the ISR Meeting with licensing participants and the Commission within 15 days of filing the enclosed ISR. Topsham Hydro has scheduled the ISR Meeting for July 23, 2019 via conference call – Call-in Number: 1-866-214-0726, Call-in Code: 632013. The call is scheduled to start at 09:00 am and be concluded by 12:00 pm. A meeting summary will be filed by Topsham Hydro no later than August 11, 2019.

If there are any questions or comments regarding the ISR, or any information provided by Topsham Hydro in this document, please contact me at (207) 755-6505 or via email at Randy.Dorman@BrookfieldRenewable.com.

Sincerely,

Randy Dorman
Licensing Specialist
Brookfield Renewable

Attachment: Initial Study Report for the Pejepscot Hydroelectric Project

cc: Distribution List

DISTRIBUTION LIST
Pejepscot Hydroelectric Project (FERC No. 4784)
Initial Study Report

I, Randy Dorman, Licensing Specialist, Brookfield Renewable, hereby certify that copies of the foregoing document have been transmitted to the following parties on July 12, 2019.

Randy Dorman
Licensing Specialist

July 12, 2019

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	Mr. Harold Peterson Bureau of Indian Affairs Eastern Regional Office 545 Marriot Drive, Suite 700 Nashville, TN 37214

Mr. Sean McDermott National Marine Fisheries Service 55 Great Republic Drive Gloucester, MA 01930	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. Matt Buhyoff National Marine Fisheries Service Atlantic Salmon Recovery Coordinator 17 Godfrey Drive Orono, ME 04473	Mr. John T. Eddins Office of Project Review Advisory Council on Historic Preservation 401 F Street NW, Suite 308 Washington, DC 20001-2637
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. Kevin Mendik Hydro Program Manager Northeast Region National Park Service 15 State Street, 10th Floor Boston, MA 02109-3572
Mr. Bryan Rice Director Bureau of Indian Affairs U.S. Department of the Interior MS 4606 MIB 1849 C Street NW Washington, DC 20240	
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

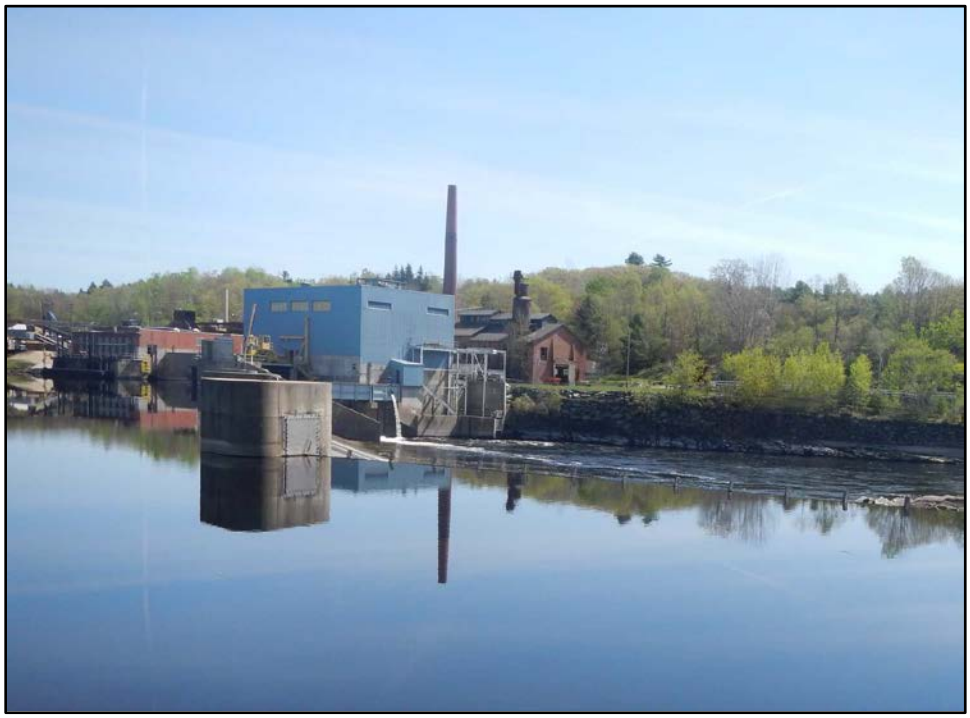
Cumberland County Government 142 Federal Street Portland, ME 04101	Sagadahoc County Government 752 High Street Bath, ME 04530
Androscoggin County Government 2 Turner Street Auburn, ME 04210	
Non-Government Organizations	
Mr. Brian Graber Director American Rivers Northeast Field Office 516 West Hampton 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 and 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. Randy Dorman Licensing Specialist Brookfield Renewable 150 Main Street Lewiston, ME 04240	Mr. Steven Murphy Director, Licensing Brookfield Renewable 33 West 1st Street South Fulton, NY 13069
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	

This page intentionally left blank.

INITIAL STUDY REPORT

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

July 2019

Brookfield

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Brookfield	Brookfield Renewable
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission
El.	Elevation (NGVD 29, feet)
FERC	Federal Energy Regulatory Commission
ft.	Feet / foot
ILP	Integrated Licensing Process
ISR	Initial Study Report
kV	Kilovolt
Licensee	Topsham Hydro Partners, L.P.
ME	Maine
MDEP	Maine Department of Environmental Protection
MDIFW	Maine Department of Inland Fisheries and Wildlife
MDMR	Maine Department of Marine Resources
MHPC	Maine Historic Preservation Commission
msl	Mean Sea Level (NGVD 29)
MW	Megawatt
NGVD 29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
PAD	Pre-Application Document
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PSP	Proposed Study Plan
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2

SPD	Study Plan Determination
Topsham Hydro	Topsham Hydro Partners, L.P.
USFWS	U.S. Fish and Wildlife Service
USR	Updated Study Report

This page intentionally left blank.

1 OVERVIEW

Topsham Hydro Partners Limited Partnership (L.P.) (Topsham Hydro or Licensee), an indirect member of Brookfield Renewable (Brookfield), herby files this Initial Study Report (ISR) with the Federal Energy Regulatory Commission (FERC or Commission) in support of licensing the Pejepscot Hydroelectric Project (Project), FERC Project No. 4784. The Project is located on the Androscoggin River in the village of Pejepscot and the Town of Topsham, Maine to the east, the Town of Lisbon, Maine to the north, and the Towns of Durham and Brunswick, Maine 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 proposing the continued operation of the Project under a new FERC license.

Topsham Hydro is using FERC's Integrated Licensing Process (ILP), as defined in 18 CFR Part 5 of the Commission's regulations to obtain a new license. Consistent with 18 CFR § 5.5 and 5.6, Topsham Hydro initiated the process of licensing the Project by filing the Pre-Application Document (PAD) and Notice of Intent (NOI) on August 31, 2017. FERC subsequently issued a Scoping Document 1 (SD1) on October 30, 2017. A Scoping Meeting and Site Visit were held on November 28 and 29, 2017. 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.[1] On February 5, 2018, FERC issued its Scoping Document 2 (SD2).

Topsham Hydro filed the Proposed Study Plan (PSP) on February 12, 2018 and held its study plan meeting on March 22, 2018, as required by the ILP. Comments on the PSP were received from MDEP, MHPC, NMFS, and the USFWS. The Revised Study Plan (RSP) addressed these comments and was filed with FERC on June 12, 2018. Comments on the RSP were filed by MDEP. FERC issued its Study Plan Determination (SPD) on July 3, 2018, which identified fifteen (15)[2] studies to be performed in support of licensing. Topsham Hydro began the approved studies in the summer of 2018 and consulted with interested stakeholders during the 2018 field season in support of performing the studies.

This ISR is being submitted in accordance with 18 CFR § 5.15(c) and includes: a description of Topsham Hydro's overall process of implementing the study plans; an explanation of variances, if any, from the SPD; and results of the natural resource studies completed in 2018 (first-year studies). Consistent with FERC regulations, results of the Cultural Resources Surveys are being filed with FERC, MHPC, and applicable Native American Tribes under separate cover as "Privileged" to protect sensitive archaeological data and other culturally important information.

[1] Comments were received from MDEP on December 27, MDMR and NMFS on December 28, and MDIFW on December 29, 2017. USFWS provided their comments on January 3, 2018.

[2] FERC's July 3, 2018 Study Plan Determination noted that the proposed *Largemouth and Smallmouth Bass Spawning Habitat Survey* was not required. Although not required by FERC, the Licensee has elected to proceed with conducting the survey nonetheless. Including this study, the Licensee has conducted, or will conduct, a total of 16 studies.

Information related to protecting sensitive archaeological data and other culturally important information is also restricted under Section 106 of the National Historic Preservation Act (NHPA).

1.1 Project Location and Area

The Project is located on the Androscoggin River in the village of Pejepscot and the Town of Topsham, ME about 4 miles upstream of the city of Brunswick, ME (Figure 1.1-1). The Project straddles the border between Cumberland and Sagadahoc Counties, and includes a portion of Androscoggin County. From the Pejepscot Project, the Androscoggin River flows approximately 14 miles to its mouth at Merrymeeting Bay (the head-of-tide is located at the Brunswick Dam downstream of the Project at about river mile 9.3). The drainage area at the Project is 3,420 square miles while the average annual inflow to the Project is approximately 7,000 cfs.

The Project boundary follows the contour level of 75.0 ft. above mean sea level (msl), except in the vicinity of the dam and powerhouse and at the upstream limit of the impoundment. The Project boundary extends approximately 3 miles upstream from the Pejepscot Dam to the previous location of the old Route 125 bridge, which was 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 feet downstream of the Pejepscot Dam. In total, the Project boundary encompasses approximately 229 acres.

1.2 Project Description

The Project consists of the following existing facilities: (1) a 560-foot-long, 47.5-foot-high, rock- and gravel-filled, timber-crib dam, with the cribs topped with a 5-foot thick reinforced concrete slab with a crest elevation of 67.5 ft. msl and a 480-foot long reinforced concrete spillway; (2) a 225-acre impoundment with a gross storage capacity of 3,278 acre-feet at the normal pool elevation of 67.5 ft. msl; (3) an original powerhouse that was constructed in 1898, and a newer powerhouse that was constructed from 1985 to 1987, consisting of four generating units that have a combined FERC-authorized capacity of 13.88-MW; (4) two separate intake structures, the old powerhouse intake and the new powerhouse intake; (5) main and secondary substations with a 900-foot-long, 15-kV transmission lines to the substations; (6) upstream and downstream fish passage facilities; and (7) recreational amenities including a canoe portage and fishing access. The Project's facilities are depicted in Figure 1.2-1.

Fish passage facilities are operated for both the upstream and downstream passage of fish at the Project. The upstream fish passage facility is a vertical lift (elevator) that lifts migratory fish in a hopper about 30 feet vertically from near the powerhouse tailrace to the impoundment level behind the dam. The lift hopper is about 20 feet long and 7 feet wide with a sloping bottom that assists in removal of the fish from the hopper. The downstream fish passage facilities consist of two entry weirs, one on either side of the Unit 1 turbine intake. From each weir, an outlet pipe transports the fish in water down to the tailwater. The weir gates are four feet 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.

1.3 Process and Schedule

Consistent with the process plan and schedule included in the Commission's SD2, Topsham Hydro is filing this ISR on July 12, 2019. In addition, as defined by 18 CFR §5.15(c)(2), Topsham Hydro will hold an ISR meeting via conference call with the licensing parties and Commission staff on July 23, 2019. Per the regulations, the purpose of the meeting will be to discuss the study results as well as licensing participant's proposals, if any, to modify the study plans.

Following the ISR Meeting, and in accordance with CFR §5.15(c)(3), Topsham Hydro will file a meeting summary on or before August 11, 2019. On or before September 10, 2019, Licensing participants may then file any disagreement(s) concerning the ISR Meeting Summary and Topsham Hydro's study proposals as well as any recommendations for modifications to ongoing studies or requests for new studies. Recommendations for modified or new studies must be accompanied by justification in accordance with 18 CFR §5.15(c)(4) and meet the applicable criteria as defined by 18 CFR §5.15(d) and §5.15(e). Topsham Hydro will then have 30 days (on or before October 10, 2019) to file any responses to comments, disagreements, or requests. After which time FERC will have an additional 30 days (on or before November 9, 2019) to issue a determination regarding any disagreements and/or modifications to the approved study plans.

Following the completion of second year studies, an Updated Study Report (USR) must be filed with FERC no later than July 12, 2020. The USR will provide study results for second-year studies. Within 15 days following the filing of the USR (or by July 27, 2020) Topsham Hydro will meet the licensing participants and FERC staff to discuss the 2019 study results. Topsham Hydro will then file a meeting summary with FERC within 15 days of the USR Meeting.

1.4 Study Plan Implementation

Topsham Hydro successfully completed six of the sixteen studies in 2018, including the Water Quality Assessment, Tailwater Benthic Macroinvertebrate Survey, Stranding Evaluation, Wildlife Resources Survey, Botanical Resources Survey, and Historic Architectural Survey. In addition, the first phases of the Historic Archaeological Phase I Survey and Precontact Period Archaeological Survey were completed in 2018. Final study reports for the Water Quality Study, Tailwater Benthic Macroinvertebrate Study, and Stranding Evaluation can be found in Appendix A, B, and C, respectively. The Wildlife Resources Survey and Botanical Resources Survey study reports were consolidated into one joint report, which can be found in Appendix D. As previously noted, information pertaining to the Historic Architectural Survey is being filed under separate cover as 'Privileged.'

The remaining eight studies, as well as the second phase of the archaeological studies, will be completed in 2019. Table 1.4-1 provides a summary of the status of each study.

Table 1.4-1: List of Studies Initiated and Status

Study	Status
Studies completed in 2018	
Water Quality Assessment	The water quality monitoring work was completed during the 2018 field season (June through October). The analysis and report have been completed (Appendix A).
Tailwater Benthic Macroinvertebrate Survey	The macroinvertebrate survey work was completed during the 2018 field season (July through September). The analysis and report have been completed (Appendix B).
Stranding Evaluation	The Stranding Evaluation study was completed during the 2018 field season. The analysis and report have been completed (Appendix C).
Wildlife Resources Survey	Biological surveys were conducted in August 2018. The analysis and report have been completed. The Wildlife and Botanical Resources Surveys are being submitted as a single report (Appendix D).
Botanical Resources Survey	Surveys of plant communities and botanical resources were conducted in August 2018. The analysis and report have been completed. The Wildlife and Botanical Resources Surveys are being submitted as a single report (Appendix D).
Historic Architectural Survey	The Historic Architectural Survey was conducted in August 2018. Any additional cultural/historic surveys are to be completed in 2019.
Studies started in 2018 and continued in 2019	
Historic Archaeological Phase I Survey	The first phase of this survey was conducted in August 2018. The Historic Archaeological Phase I Survey is to be completed in 2019.
Precontact Period Archaeological Survey	The first phase of this survey was conducted in August 2018. The Precontact Period Archaeological Survey is to be completed in 2019.
Studies to be completed in 2019	
Eel Monitoring Survey	The eel monitoring survey work started in June 2019 and is estimated to be completed in August 2019.

Evaluation of Spring Migration Season Fish Passage Effectiveness	The spring migration season fish passage effectiveness monitoring began in May 2019 and is expected to be completed in July 2019.
Evaluation of Fall Migration Season Fish Passage Effectiveness	The fall migration season fish passage effectiveness monitoring is scheduled to be conducted from October through November 2019.
Fish Entrainment and Turbine Survival Assessment	The Fish Entrainment and Turbine Survival Assessment is scheduled to be conducted from August through November 2019 and will incorporate results of both the Spring and Fall Migration Season Fish Passage Effectiveness studies.
Recreation Facilities Inventory and Use Assessment	The Recreation Facilities Inventory and Use Assessment is scheduled to be conducted during the 2019 open water recreation season (May through October).
Sediment Storage and Mobility	The Sediment Storage and Mobility study will be completed in 2019.
Large Woody Debris	The Large Woody Debris study will be completed in 2019.
Largemouth and Smallmouth Bass Spawning Habitat Survey	The Largemouth and Smallmouth Bass Spawning Habitat Survey will be completed in 2019.

1.5 Continuation of Studies

As described in Section 1.4, ten studies described in this ISR will continue into 2019, including:

- 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
- Recreation Facilities Inventory and Use Assessment
- Historic Archaeological Phase I Survey
- Precontact Period Archaeological Survey
- Sediment Storage and Mobility
- Large Woody Debris
- Largemouth and Smallmouth Bass Spawning Habitat Survey

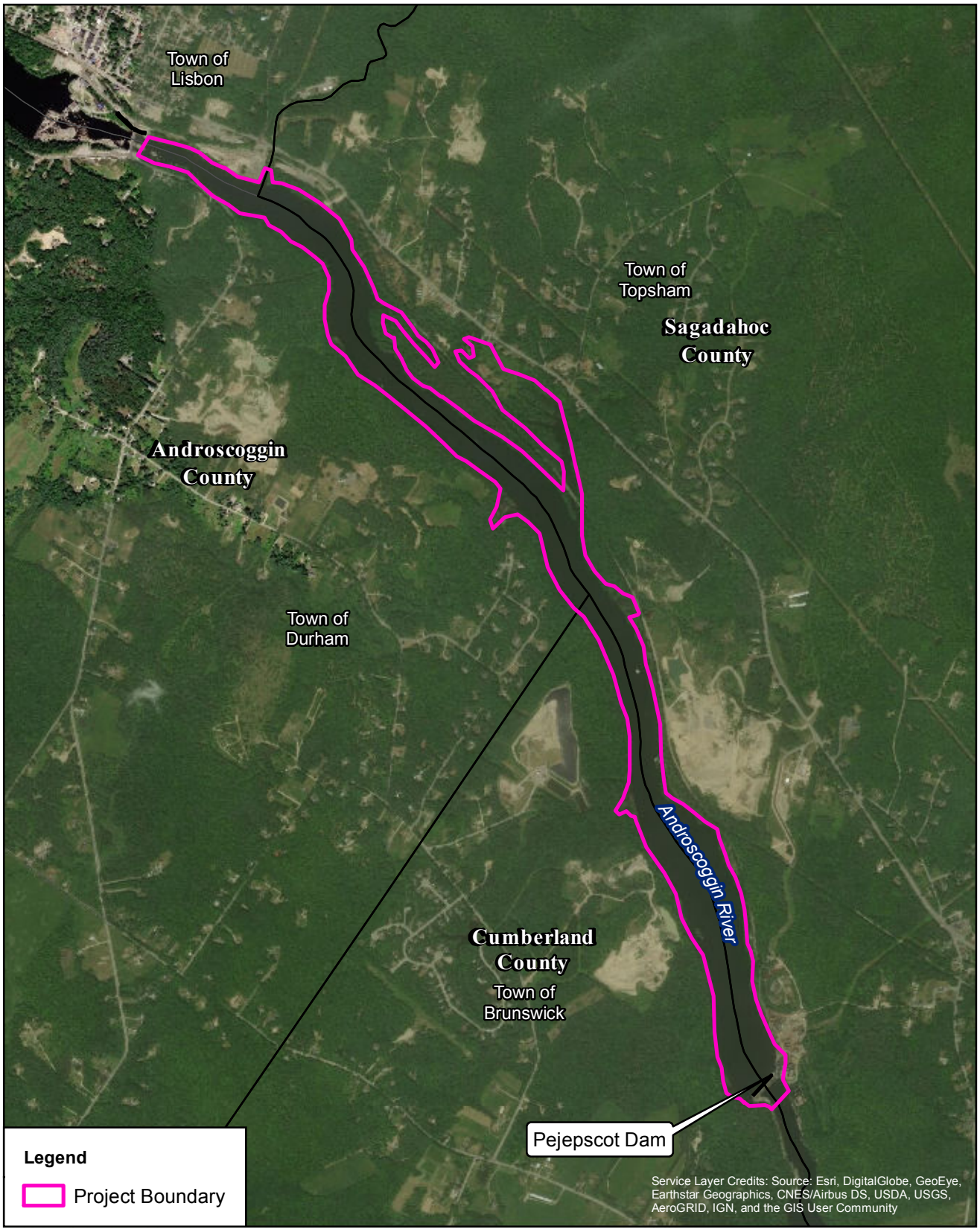
Reports for these studies will be provided in the USR, which must be filed with FERC no later than July 12, 2020.

1.6 Initial Study Report Meeting

Topsham Hydro has scheduled the Initial Study Report Meeting with the licensing parties and Commission staff for July 23, 2019. The meeting will be held via conference call – Call-in Number: 1-866-214-0726, Call-in Code: 632013. The call is scheduled to start at 09:00 am and be concluded by 12:00 pm. Following the meeting, the Licensee will file the ISR Meeting Summary no later than August 11, 2019.

1.7 Draft License Application

In accordance with 18 CFR §5.16(c), Topsham Hydro plans to file a Draft License Application (DLA) with the Commission and distribute the DLA to the licensing stakeholders on or before April 3, 2020.



Brookfield

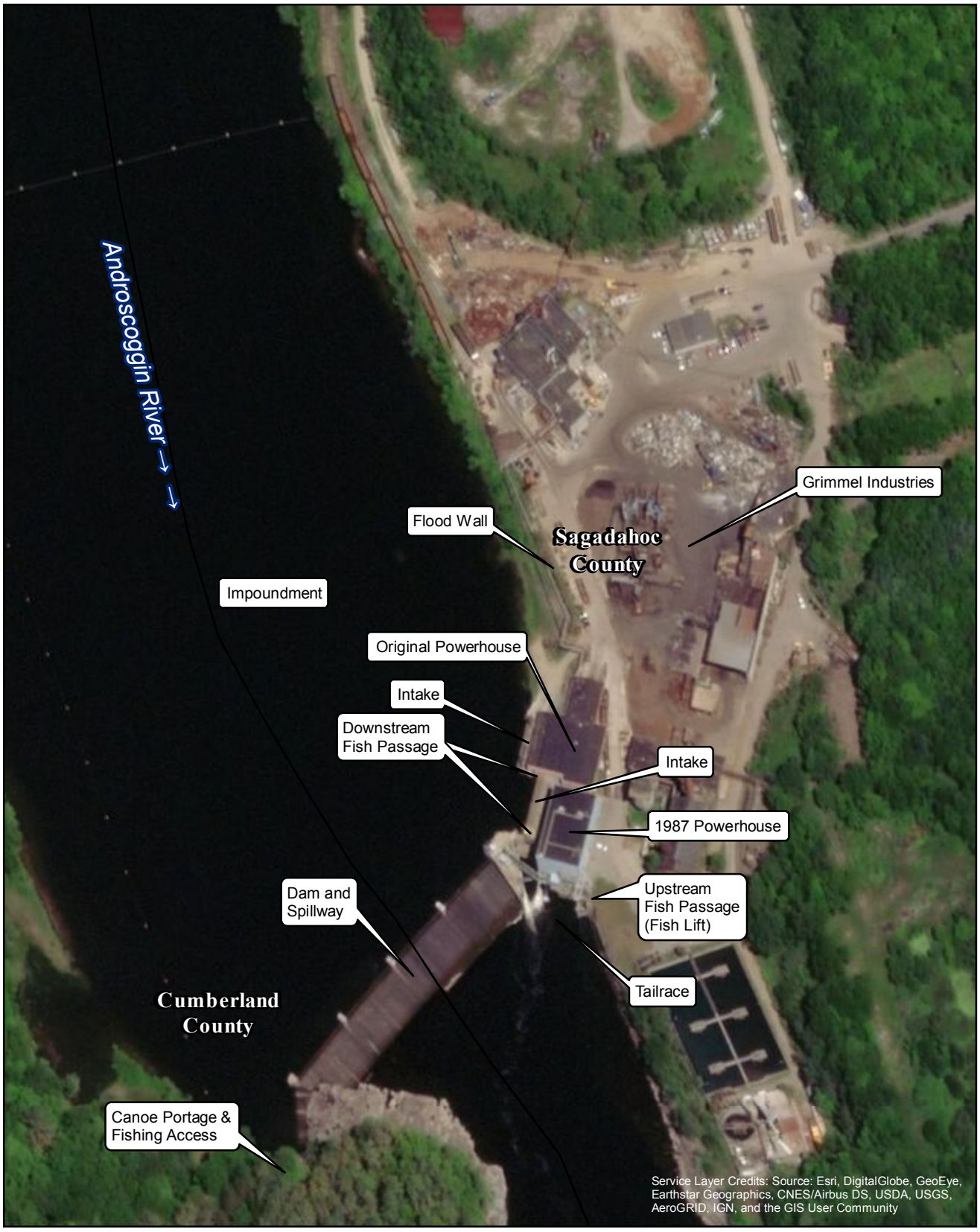
Initial Study Report
Pejepscot Hydroelectric
Project (FERC No. 4784)

N

0 1,000 2,000 4,000 Feet

Figure 1.1-1:
Project Location

Path: P:\1925\maps\ISR\figure_1_1-1_project_location.mxd



Brookfield

Initial Study Report
Pejepscot Hydroelectric
Project (FERC No. 4784)

N

0 100 200 400
Feet

Figure 1.2-1:
Project Facilities

Path: P:\1925\maps\ISR\figure_1_2-1_facilities.mxd

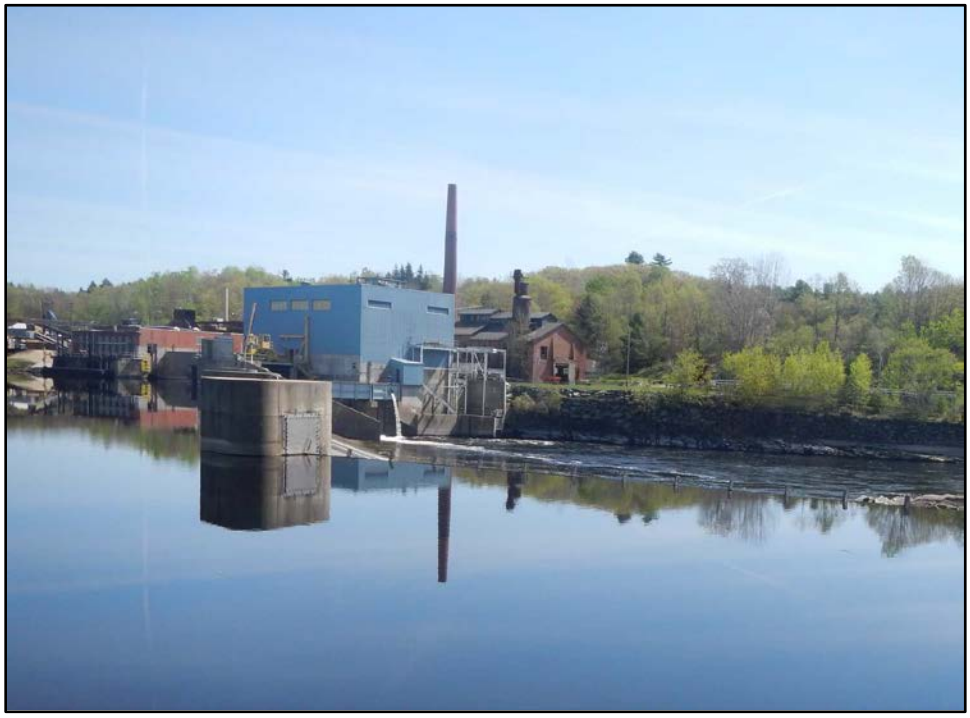
APPENDIX A: WATER QUALITY ASSESSMENT

This page intentionally left blank.

INITIAL STUDY REPORT

WATER QUALITY STUDY

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

July 2019

Brookfield

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND DEFINITIONS

℃	Degrees Celsius
Brookfield	Brookfield Renewable
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission
DO	Dissolved Oxygen
FERC	Federal Energy Regulatory Commission
HETL	Maine Health and Environmental Testing Laboratory
ILP	Integrated Licensing Process
Licensee	Topsham Hydro Limited Partnership, L.P.
m	meter
MDEP	Maine Department of Environmental Protection
ME	Maine
mg/l	Milligrams per liter
MRSA	Maine Revised Statutes Annotated
MW	Megawatt
NH	New Hampshire
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
PAD	Pre-Application Document
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PSP	Proposed Study Plan
PCU	Platinum Cobalt Units
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SPD	Study Plan Determination
Topsham Hydro	Topsham Hydro Limited Partnership, L.P.
TSI	Trophic State Index
µS/cm	microSiemens/centimeter
ug/l	Micrograms per liter
USGS	United States Geological Survey
VLMP	Volunteer Lake Monitoring Program

1.0 INTRODUCTION

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 to the north, and the Town of Durham 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 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. The Revised Study Plan (RSP) was filed in accordance with the ILP schedule on June 12, 2018. FERC issued a Study Plan Determination (SPD) on July 3, 2018.

In the RSP, Topsham Hydro proposed to conduct the following water quality assessments: 1) trophic state study of the Project impoundment, and 2) riverine water quality sampling of the Project tailwater.

2.0 GOALS AND OBJECTIVES

The goal of the water quality assessment is to update baseline information and document water quality conditions upstream and downstream of the Project dam. The study objectives are to: 1) collect periodic water quality data in the Project impoundment, and 2) collect continuous water temperature and dissolved oxygen data in the Androscoggin River downstream of the Project dam during low flow, warm water temperature conditions.

3.0 STATE WATER QUALITY STANDARDS

The Androscoggin River is classified by MDEP as Class C from its confluence with the Atlantic Ocean at Merrymeeting Bay, upstream, through Project waters, until its confluence with the Ellis River at Rumford Point in Maine about 75 miles upstream of the Project. Class C waters must be

of such quality that they are suitable for the designated uses of drinking water supply after treatment, fishing, agriculture, recreation in and on the water, industrial process and cooling water supply, hydroelectric power generation (except as prohibited under Title 12, section 403), navigation, and as a habitat for fish and other aquatic life.

The dissolved oxygen content of Class C water may be no less than 5 mg/l or 60% of saturation, whichever is higher, except in identified salmonid spawning areas where water quality is sufficient to ensure spawning, egg incubation, and survival of early life stages. Water quality in these areas must be sufficient for these purposes to be maintained.

Per the state standards, discharges to Class C waters may cause some changes to aquatic life, provided 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.

4.0 METHODS

4.1 Impoundment Trophic Sampling

Trophic sampling was conducted in accordance with the Lake Trophic State Sampling Protocol for Hydropower Studies (MDEP, 2017), and was consistent with Maine Department of Environmental Protection (MDEP) protocols. Sampling personnel received MDEP certification to collect water quality data prior to performing the sampling activities.

4.1.1 Vertical Profiles

Vertical profiles were collected twice per month from June[1] through October 2018 at the deepest location of the impoundment (see AR-01[2], Figure 4.1-1). Topsham Hydro installed a temporary buoy to mark the sampling station for the open water sampling season.

Water temperature and dissolved oxygen profile data were collected at 1-meter intervals from the water surface to the bottom using a YSI ProDSS Multiparameter Water Quality Meter. The instrument was checked prior to each use and calibrated according to manufacturer specifications. One replicate profile measurement was made for every profile collected. Replicates were obtained outside of the metalimnion (if applicable) to avoid remeasuring parameters when they are in a transitional state. A profile was remeasured if replicate values were not within 0.3 mg/l and 0.3 °C, as stated in the Volunteer Lake Monitoring Program (VLMP) instructions or within water quality meter instrumentation error value.

4.1.2 Water Clarity

Water clarity was measured at the impoundment sampling location during each field visit using a Secchi disk and Aquascope. The depth at which the Secchi disk was no longer visible through

[1] The study was not initiated until late June, therefore; Topsham Hydro was only able to conduct one trophic sampling event during the month of June, rather than two.
[2] The buoy was initially installed on June 27, 2018; however, before the July 13, 2018 sampling event the location of the buoy was moved slightly south to an area of slightly deeper water (~1 meter).

the Aquascope was recorded. At least two Secchi disk measurements were made during each field visit and the results were averaged.

4.1.3 Water Quality Sample Parameters

The water quality profile data and Secchi disk readings were used to determine the depth of the epilimnion and the associated core sampling depth. Water samples were collected each visit from the epilimnion using an integrated core sampler at a depth between the surface and two times the Secchi disk depth, or within 1 meter of the bottom, whichever was less, if the impoundment was unstratified.

Per MDEP protocols, all water samples were stored on ice and delivered within 24 hours to the state of Maine's Health and Environmental Testing Laboratory (HETL) in Augusta, ME for analysis of total alkalinity, color, pH, chlorophyll-a, and total phosphorus.

On August 23, 2018, Topsham Hydro collected and submitted additional water samples to HETL for analysis of nitrate and dissolved organic carbon. In addition, samples for chloride, sulfate, specific conductance, total calcium, total iron, total magnesium, total potassium, total silica[3], total sodium, and total dissolved aluminum were submitted to Eastern Analytical, Inc. in Concord, NH for analysis. The water column was not stratified during the August 23 sampling; thus, per MDEP protocols, an integrated epilimnetic core sample was collected at a depth between the surface and two times the Secchi disk depth, or within 1 meter of the bottom, whichever was less. The MDEP detection limits for all analytes are shown in Table 4.1-1.

4.2 Downstream Water Temperature and Dissolved Oxygen Monitoring

Topsham Hydro monitored water temperature and dissolved oxygen downstream of the Project dam in accordance with the MDEP Sampling Protocol for Hydropower Studies (MDEP, 2017). A location within the Project tailwater (see AR-02 in Figure 4.1-1) was monitored continuously from August 2 to October 2, 2018.

During deployment, dissolved oxygen measurements, using a YSI Handheld Optical Dissolved Oxygen Meter were initially made at AR-02 along a transect across the stream, at the first, second and third quarter points, to determine if there were significant differences (defined by MDEP as ±0.2 mg/l) in dissolved oxygen concentration (Table 4.2-1). There were no violations of dissolved oxygen criteria and no significant differences in concentrations among the quarter points, therefore, the water quality meter was deployed in the location of the main river flow, per MDEP protocols.

The water quality meter (HOBO U26 with temperature and optical dissolved oxygen sensor) was set to record temperature and dissolved oxygen in 15-minute increments continuously throughout the study period. The meter was deployed at approximately mid-depth within the water column.

[3] In an email received on June 30th, 2018, MDEP informed Topsham Hydro that it was making an adjustment to the MDEP Sampling Protocol for Hydropower Studies. Specifically, MDEP was no longer requiring a late summer sample for silica; as this parameter was being removed from the protocol. Since this particular study was already initiated, Topsham Hydro completed the sampling and testing of the silica parameter anyway.

The meter was cleaned, maintained, and offloaded per manufacturer recommendations regularly throughout the study period.

The dissolved oxygen percent saturation was calculated from measured dissolved oxygen concentration, barometric pressure, and measured water temperature using the U.S. Geological Survey (USGS) DOTABLES program. Barometric pressure was obtained from the Portland Jetport, ME National Oceanic and Atmospheric Administration (NOAA) climate station (NOAA, 2018).

4.3 Equipment Specifications

Vertical profile measurements, periodic spot checks, and discrete measurements were collected with a portable hand held multiparameter meter. The meter used for this study for dissolved oxygen and temperature was the YSI ProDSS multiparameter meter. The equipment performance specifications are shown in Table 4.3-1.

Continuous water temperature and dissolved oxygen measurements were collected with Onset HOBO Dissolved Oxygen Loggers (Model U26-001). The equipment performance specifications are shown in Table 4.3-2.

Table 4.1-1: Water Quality Parameter Detection Limits

Parameter	Detection Limit
Field Parameters	
Secchi disk transparency	0.1 m
Temperature	0.1℃
Dissolved Oxygen	0.1 mg/l
Twice Monthly Lab Analytes	
Total phosphorus	0.001 mg/l
Chlorophyll a	0.001 mg/l
Color	1.0 SPU
pH	0.1 SU
Total alkalinity	1.0 mg/l
One-Time Late Summer Sample Analytes	
Total phosphorus	0.001 mg/l
Chlorophyll a (uncorrected*)	0.002 mg/l
Color	1.0 SPU
pH	0.1 SU
Total alkalinity	1.0 mg/l
Nitrate	0.01 mg/l
Dissolved Organic Carbon	0.25 mg/l
Total iron	0.005 mg/l
Total and dissolved aluminum	0.010 mg/l
Total calcium	1.0 mg/l
Total magnesium	0.1 mg/l
Total sodium	0.05 mg/l
Total potassium	0.05 mg/l
Total silica	0.05 mg/l
Specific conductance	1 µS/cm
Chloride	1.0 mg/l
Sulfate	0.5 mg/l

* Chlorophyll a is not needed in stratification samples below the epilimnion. Uncorrected chlorophyll a will be tested via trichromatic determination

Source: MDEP, 2017

Table 4.2-1: Initial Water Temperature and Dissolved Oxygen Measurements made at Deployment, August 2, 2018, Downstream of Pejepscot Dam.

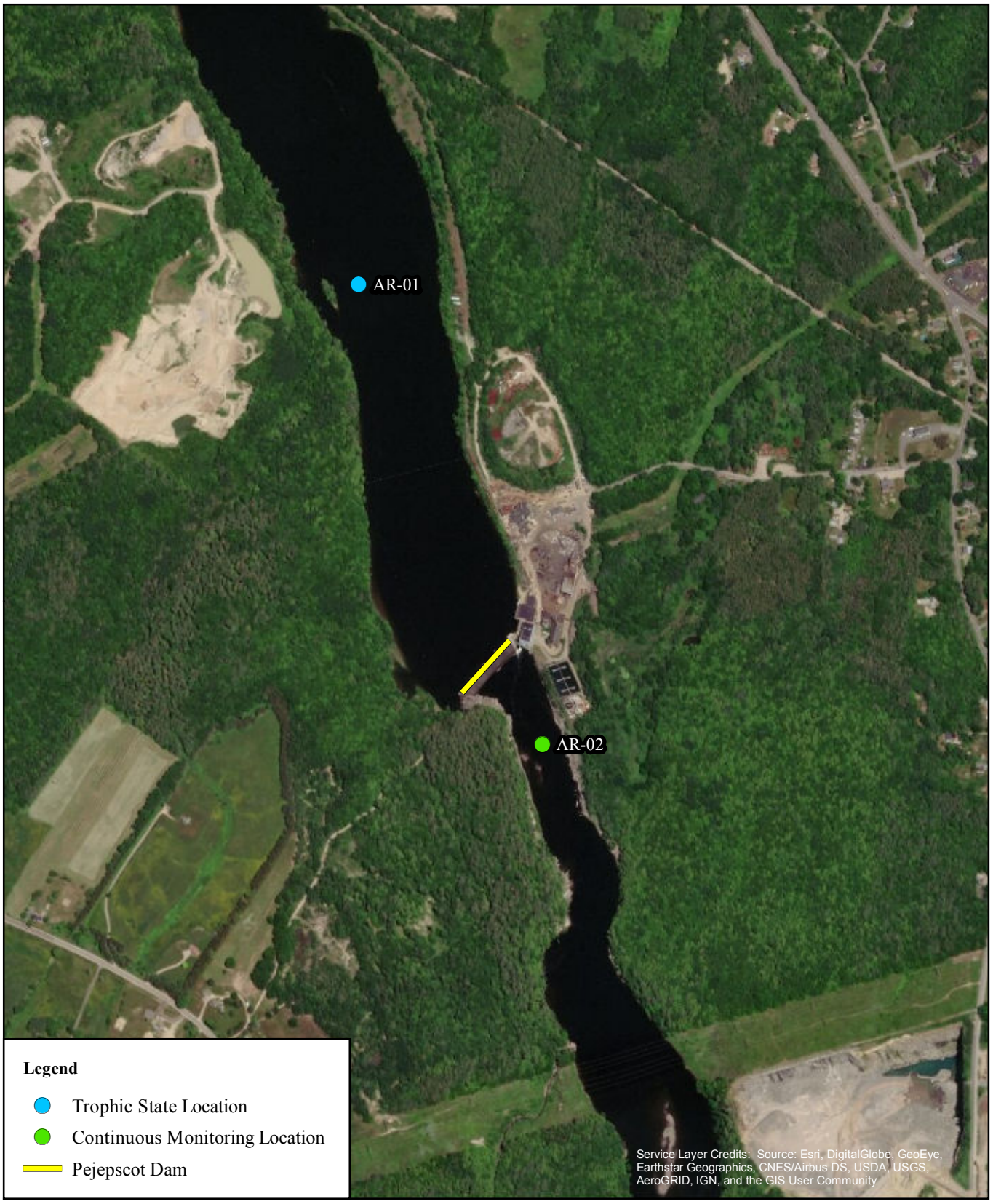
Point	Water Temperature (°C)	Dissolved Oxygen (mg/l)	Dissolved Oxygen Percent Saturation
River Right (25%)	26.1	8.23	101.6
Center (50%)	26.0	8.37	103.2
River Left (75%)	25.9	8.23	101.3

Table 4.3-1: YSI Hand Held Meter Specifications

Parameter	Range	Accuracy	Resolution
Dissolved Oxygen (YSI)	0 to 50 mg/l	0-20 mg/l: ± 0.1 mg/L 20-50 mg/l: ± 8% of the reading	0.01 mg/l
Temperature (YSI)	-5 to +70°C	±0.2°C	0.1°C

Table 4.3-2: HOBO U26-001 Dissolved Oxygen Logger Specifications

Parameter	Range	Accuracy	Resolution
Dissolved Oxygen	0 to 30 mg/l	0.2 mg/l up to 8 mg/l; 0.5 mg/l from 8 to 20 mg/l	0.02 mg/l
Temperature	-5 to +40°C	±0.2°C	0.02°C



Brookfield

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)
WATER QUALITY STUDY

N

0 400 800 1,600 Feet

Figure 4.1-1:
Water Quality Locations

Path: P:\1925\maps\Study Plans\water_quality_study\figure_4_1-1_wq_sites.mxd

5.0 RESULTS

5.1 Environmental Conditions

River flow ranged from a low of 1,876 cubic feet per second (cfs) on June 23, 2018 to a high of 6,718 cfs on August 6, 2018 during the study period (Figure 5.1-1). Throughout the majority of the study period, river flow was below the long-term median daily value (Figure 5.1-1).

Monthly air temperatures for the 2018 study period as recorded at the Durham, ME monitoring station are presented in Table 5.1-1 (NOAA, 2018). Monthly mean air temperatures during the study period were warmer than the historic period of 1994 to 2018 for the months of July, August, and September, whereas air temperatures in the months of June and October were cooler. Based on these circumstances, sampling conditions were suitable for monitoring in accordance with MDEP protocols (e.g., low flow, high temperature conditions).

5.2 Impoundment Sampling

5.2.1 Total Phosphorus

Phosphorus is one of the major nutrients needed for plant growth. Since it's natural occurrence in lakes is very low, phosphorus limits the growth of algae in lake ecosystems. Small increases in phosphorus in lake water can cause substantial increases in algal growth (MDEP, 2014). In the Project impoundment, total phosphorus ranged from 13 to 23 ug/l with an average 19 ug/l (Table 5.2-1). Total phosphorus levels were below the proposed state standard upper limit of 33 ug/l for Class C waters (MDEP, 2012).

5.2.2 Color

The amount of color in a lake refers to the concentration of natural dissolved organic acids such as tannins and lignins, which give the water a tea color. Water with a color value greater than 25 platinum cobalt units (PCU) is considered to be colored and may have a reduced Secchi disk transparency (MDEP, 2014). In the Project impoundment, color ranged from 28 to 46 PCU with an average of 35 PCU (Table 5.2-1) suggesting that the impoundment was slightly colored.

5.2.3 Chlorophyll-a

Chlorophyll-a is a measurement of the green pigment found in all plants including microscopic plants such as algae. It is used as an estimate of algal biomass, the higher the Chlorophyll-a number the higher the amount of algae in the lake. Large concentrations of chlorophyll-a can be an indication of eutrophication that can adversely affect lacustrine or riverine processes or dissolved oxygen concentrations (MDEP, 2014). Throughout the 2018 sampling, chlorophyll-a ranged from 0.001 mg/l to 0.004 mg/l with an average of 0.003 mg/l (Table 5.2-1). Chlorophyll-a was below the proposed state standard upper limit of 0.008 mg/l (MDEP, 2012).

5.2.4 Alkalinity

Alkalinity is a measure of the capacity of water to neutralize acids and is also known as the buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate, and hydroxide ions, with bicarbonate being the major form. Water bodies with alkalinity values less than 10 mg/l are considered poorly buffered (MDEP, 2014). Total alkalinity in the Project impoundment ranged from 14 mg/l to 22 mg/l with an average of 18 mg/l (Table 5.2-1).

5.2.5 pH

pH is a measure of the acidity of water and regulates the biological processes that may occur in a water body. pH ranged from 6.9 to 7.2 with an average of 7.1 (Table 5.2-1). All pH values were within the recommended range of 6.0 to 8.5 for Class C waters.

5.2.6 Secchi Disk

Secchi disk transparency is a measure of the water clarity, or transparency, of a waterbody. Factors which reduce clarity are algae, zooplankton, water color and silt. Since algae are generally the most abundant, measuring transparency indirectly measures the algal productivity (MDEP, 2014). In the Project impoundment, the Secchi disk transparency ranged from 2.42 to 4.66 meters with an average of 3.98 meters (Table 5.2-1). The Secchi disk transparency was above the proposed standard of 2.0 m throughout the sampling period (MDEP, 2012).

5.2.7 Trophic State

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 (MDEP, 2014b). An oligotrophic lake is characterized as having low productivity, a mesotrophic lake has medium productivity, and a eutrophic lake is highly productive. Table 5.2-2 lists the criteria used to classify the trophic state of lakes in Maine (MDEP, 2014).

The Maine Trophic State Index (TSI) for lakes can be calculated as (MDEP, 1996):

$$TSI = 70*\log (\text{mean chlorophyll-a} + 0.7)$$

Using the average chlorophyll-a concentration for the entire sampling period (0.003 mg/l) (Table 5.2-1), the TSI for the Project impoundment is 36, which is categorized as mesotrophic. In addition, the range of chlorophyll-a and total phosphorus values measured in the Project impoundment are within the ranges for mesotrophic waters (Table 5.2-2).

5.3 Late Summer Sampling

5.3.1 Specific Conductance

Specific conductance is a measure of the ability of water to carry an electrical current and is directly related to the dissolved ions (charged particles) present in water. Specific conductance

will increase if there is an increase of pollutants entering the lake or pond (MDEP, 2014). Specific conductance was measured for the August 21, 2018 lake trophic core sample. The value was 83 µS/cm.

5.3.2 Dissolved Metals and Nutrients

Table 5.3.2-1 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.

5.4 Impoundment Water Temperature and Dissolved Oxygen Profiles

The water temperature at the lake trophic sample site ranged from 21.6ºC to 23.1ºC during the first profile (June 27) and then increased steadily until August 7, when the highest water temperatures occurred (26.6ºC to 26.9ºC) (Figure 5.4-1). The maximum water temperature during the study (26.9ºC) was measured on August 7 just below the surface; the next highest temperature (25.9ºC) was measured on July 13 just below the surface (Figure 5.4-1). The water temperature steadily decreased throughout late August, September, and October and ranged from 12.0 ºC to 12.2ºC during the last profile (collected on October 18) (Figure 5.4-1). The average water temperature throughout the water column at the lake trophic station ranged from 12.2 ºC on October 18th to 26.7 ºC on August 7.

Throughout the monitoring period, the dissolved oxygen concentration at the lake trophic station ranged from 7.0 mg/l to 9.9 mg/l (Figure 5.4-2). The minimum dissolved oxygen concentration was 7.0 mg/l at a depth of 7 meters on July 24 (Figure 5.4-2). The highest dissolved oxygen concentrations at the lake trophic station ranged from 9.7 mg/l to 9.9 mg/l on October 18. The average dissolved oxygen concentration throughout the water column ranged from 7.2 mg/l on July 24 to 9.8 mg/l on October 18. The dissolved oxygen concentration exceeded the established state standard of 5 mg/l for Class C waters.

The dissolved oxygen percent saturation ranged from 82.2 percent to 103.6 percent throughout the monitoring period (Figure 5.4-3). The highest dissolved oxygen percent saturation value was measured on June 27 (103.6 percent) at the surface (Figure 5.4-3). The average dissolved oxygen percent saturation throughout the water column ranged from 85.1 percent on July 27 to 101.6 percent on September 4. The dissolved oxygen percent saturation exceeded the established state standard of 60 percent saturation for Class C waters.

5.5 Riverine Sampling

5.5.1 Water Temperature

The water temperature in the Project tailwater ranged from 16.8ºC to 27.3ºC with an average of 23.5ºC throughout the sampling period (August 2 – October 2) (Figure 5.5.1-1). The minimum temperature in the Project tailwater was recorded on October 2 at 2:15 pm, and the highest temperature was observed on August 7 at 5:00pm.

5.5.2 Dissolved Oxygen

Hourly dissolved oxygen concentrations in the Project tailwater ranged from 7.8 to 9.7 mg/l with an average of 8.5 mg/l over the monitoring period (Figure 5.5.2-1). Dissolved oxygen percent saturation ranged from 94.3 to 106.2 percent with an average of 99.6 percent (Figure 5.5.2-2).

Table 5.1-1: 2018 and Historic Mean Monthly Air Temperature Recorded at the Durham, ME Monitoring Station

Temperature (°C)	June	July	August	September	October
2018	15.9	20.7	21.1	16.2	7.4
Mean (1994-2018)	17.0	20.1	19.3	15.2	8.7
Difference	-1.1	0.6	1.8	1.0	-1.3

Table 5.2-1: 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 5.2-2: Criteria for Classifying the Trophic State of Lakes in Maine

Trophic State	Chlorophyll-a (mg/l)	Total Phosphorus (mg\l)	Secchi disk (m)
Oligotrophic	<0.0015	<0.0045	>8
Mesotrophic	0.0015-0.007	0.0045-0.02	4-8
Eutrophic	>0.007	>0.02	<4

Table 5.3.2-1: 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

Table 5.4.1: Temperature and Dissolved Oxygen Profiles at Project Impoundment - Results

Depth (m)	6/27/2018		7/13/2018[4]		7/24/2018		8/7/2018		8/21/2018	
	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)
0	23.1	8.9	25.9	8.0	24.2	7.4	26.9	7.6	24.4	7.8
1	22.3	8.8	25.9	8.0	24.1	7.4	26.7	7.7	24.3	7.7
2	22.0	8.6	25.8	7.9	24.1	7.3	26.7	7.7	24.2	7.7
3	21.8	8.6	25.7	7.9	24.0	7.3	26.7	7.6	24.2	7.7
4	21.7	8.5	25.5	7.8	24.0	7.2	26.6	7.6	24.2	7.7
5	21.7	8.4	25.4	7.7	24.0	7.2	26.6	7.6	24.2	7.6
6	21.6	8.3	25.3	7.6	23.9	7.1	26.6	7.6	24.2	7.6
7			25.3	7.5	23.9	7.0	26.6	7.6	24.2	7.5
8			25.3	7.5						

Depth (m)	9/4/2018		9/17/2018		10/2/2018		10/18/2018	
	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)
0	25.1	8.6	22.8	8.5	16.7	8.7	12.0	9.9
1	24.9	8.6	22.8	8.4	16.8	8.7	12.2	9.9
2	24.8	8.5	22.8	8.4	16.8	8.6	12.2	9.9
3	24.8	8.5	22.7	8.4	16.8	8.6	12.2	9.8
4	24.7	8.5	22.7	8.4	16.9	8.6	12.2	9.8
5	24.7	8.5	22.7	8.4	16.9	8.6	12.2	9.8
6	24.7	8.4	22.7	8.3	16.9	8.5	12.2	9.7
7	24.7	8.4	22.7	8.2	16.9	8.5	12.2	9.7

[4] The buoy was initially installed on June 27, 2018; however, before the July 13, 2018 sampling event the location of the buoy was moved slightly south to an area of slightly deeper water (~1 meter).

Figure 5.1-1: River Flow at USGS Gage No. 1059000 Androscoggin River near Auburn, ME prorated to the Project

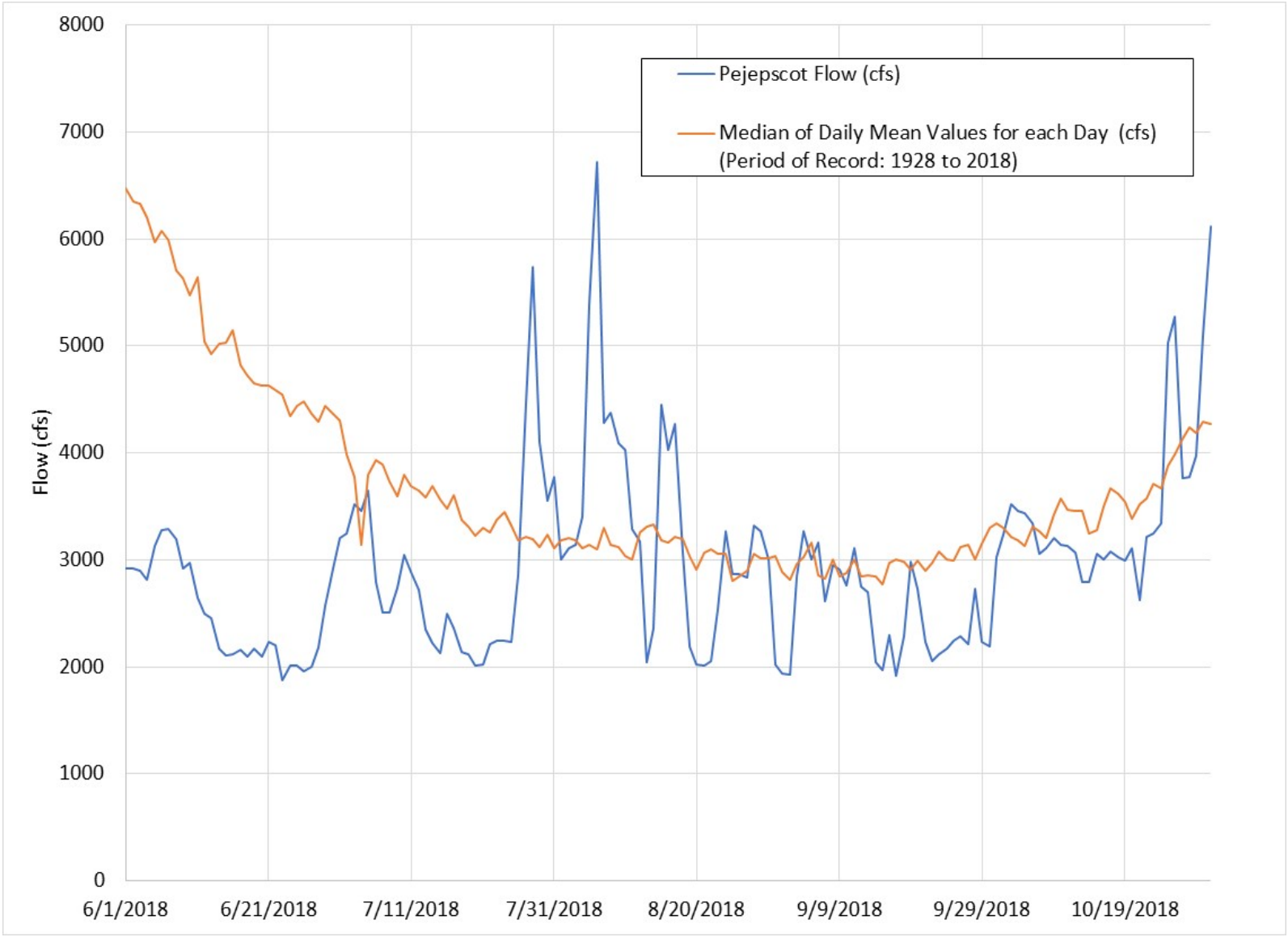


Figure 5.4-1: Water Temperature Profiles at the Project Impoundment, 2018

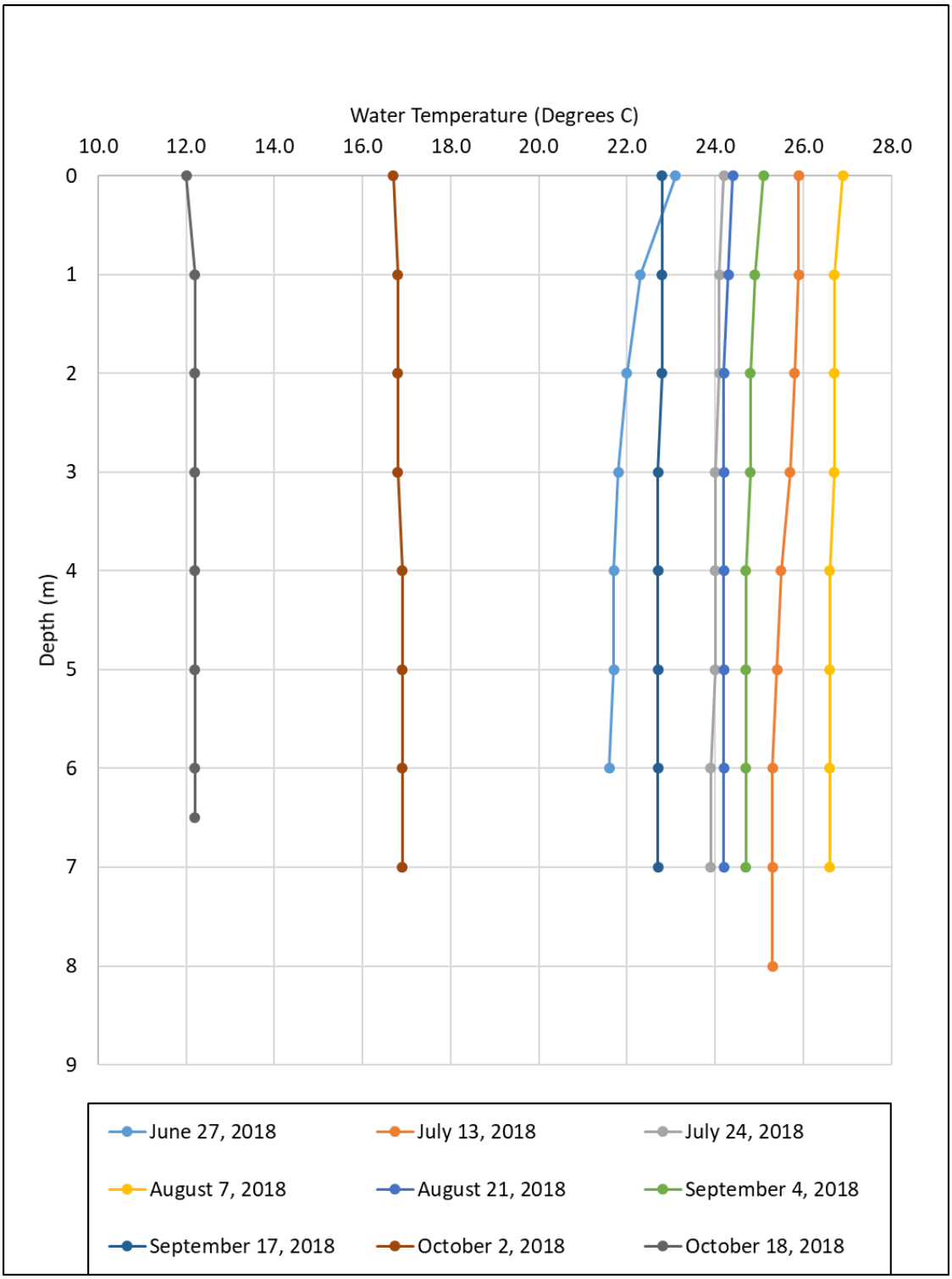


Figure 5.4-2: Dissolved Oxygen Profiles at the Project Impoundment, 2018

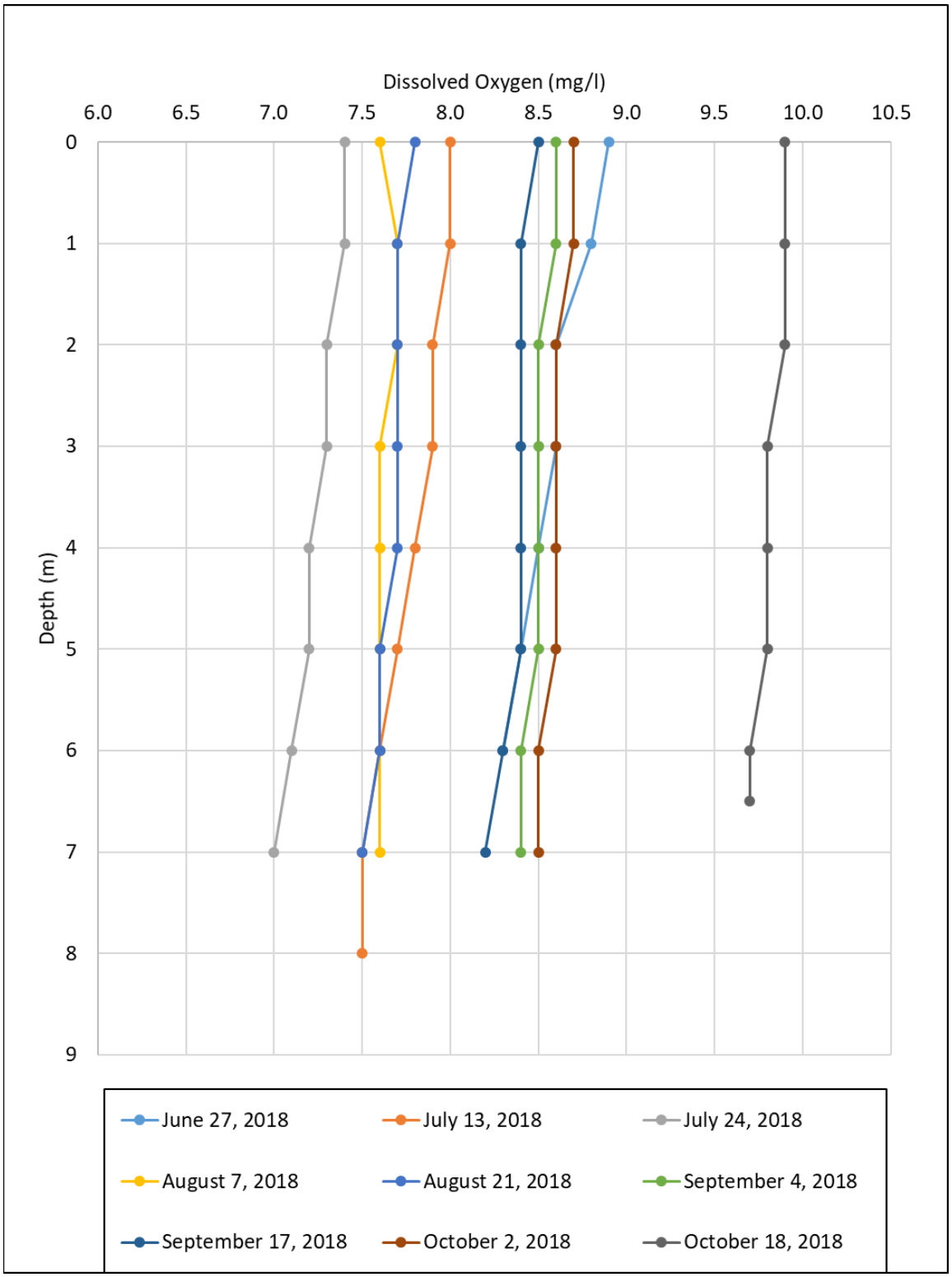


Figure 5.4-3: Dissolved Oxygen Percent Saturation Profiles at the Project Impoundment, 2018

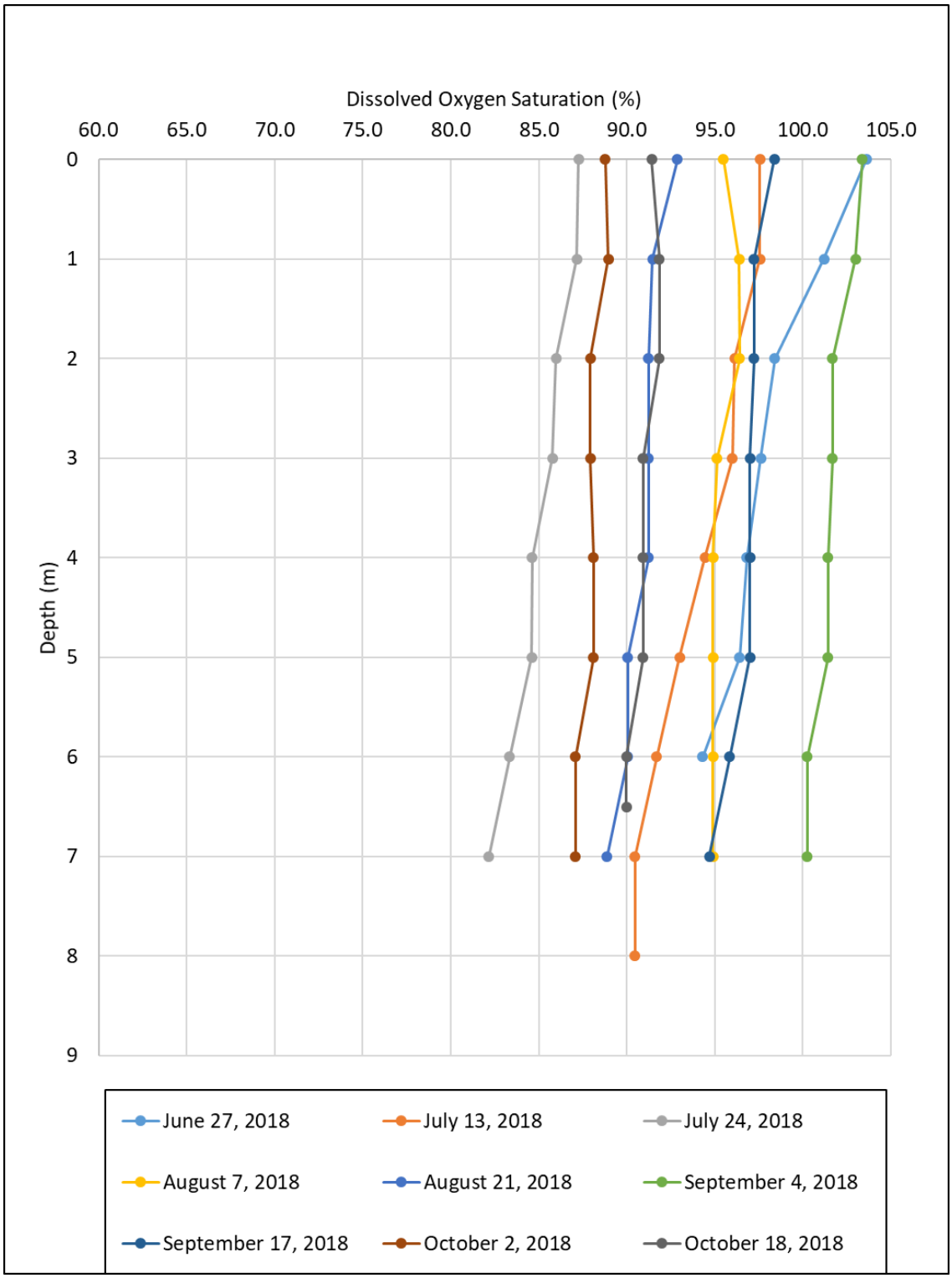


Figure 5.5.1-1: Continuous Water Temperature in the Project Tailwater, August 2 – October 2, 2018

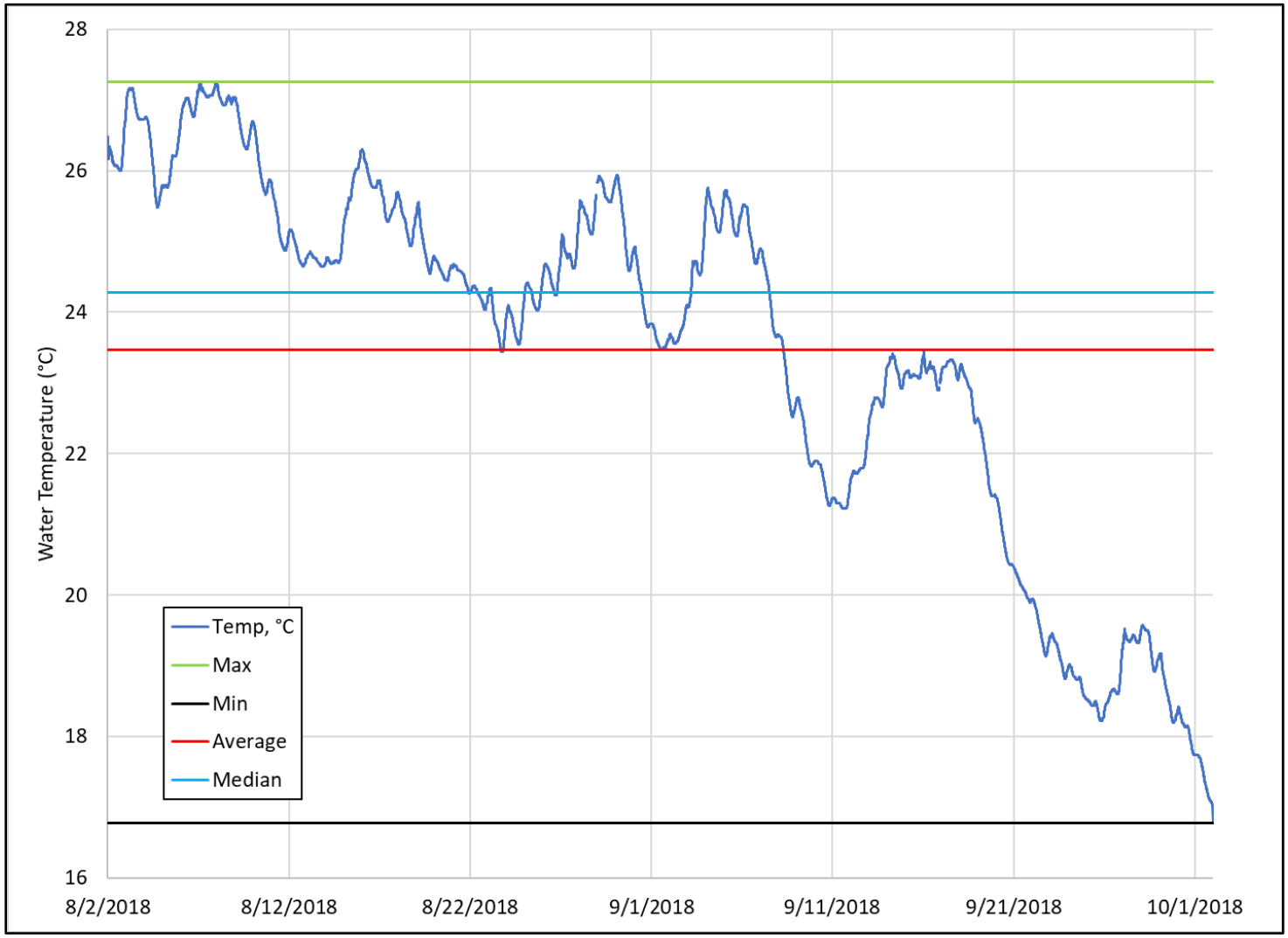
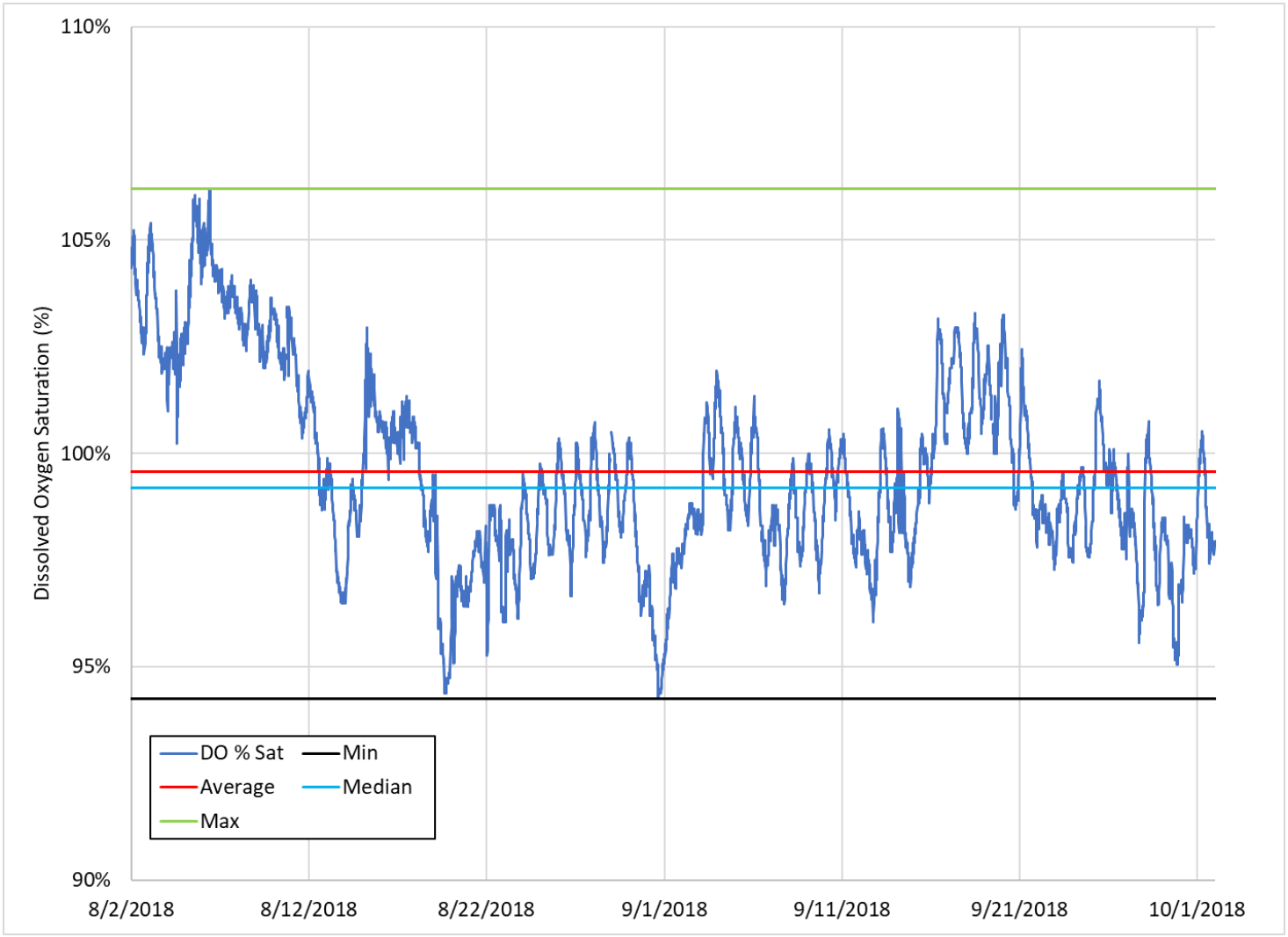


Figure 5.5.2-1: Continuous Dissolved Oxygen in the Project Tailwater, August 2 – October 2, 2018

Figure 5.5.2-2: Continuous Dissolved Oxygen Percent Saturation in the Project Tailwater, August 2 – October 2, 2018



6.0 SUMMARY

The study results indicate that water quality at the Project was within the MDEP's state water quality standards. Water temperatures and dissolved oxygen were relatively uniform throughout the water column within the Project impoundment, which resulted in no summer stratification. Over the study period, water temperature within the Project impoundment ranged from 12.0 ºC (October) to 26.9 ºC (August). Dissolved oxygen 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 dissolved oxygen percent saturation in the Project impoundment ranged from 82.2 percent (July) to 103.6 (September) percent throughout the monitoring period. The dissolved oxygen percent saturation in the Project impoundment exceeded the established state standard of 60 percent saturation for Class C waters.

The water temperature in the Project tailwater ranged from 16.8 ºC (October) to 27.3 ºC (August) with an average of 23.5 ºC. Dissolved oxygen 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). Dissolved oxygen 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.

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.

7.0 VARIANCES FROM THE FERC APPROVED STUDY PLAN

The study was not initiated until late June. Therefore, Topsham Hydro was only able to conduct one trophic sampling event during the month of June, rather than two. In addition, Unit 1 was offline for the duration of the study while undergoing maintenance. Inflow was passed over the spillway during this time.

8.0 REFERENCES

Maine Department of Environmental Protection (MDEP). 1996. 06-096 Chapter 581 Regulations Relating to Water Quality Evaluations. May 4, 1996 http://www.maine.gov/dep/water/wd/general.html.

Maine Department of Environmental Protection (MDEP). 2012. Draft Chapter 583 Nutrient Criteria for Surface Waters. June 12, 2012. https://www.maine.gov/dep/water/nutrient-criteria/chapter583-6-12-2012.pdf

Maine Department of Environmental Protection (MDEP). 2014. Maine Volunteer Lake Monitoring Program (VLMP) Maine Lakes Report 2013. http://www.mainevlmp.org/maine-lake-report/

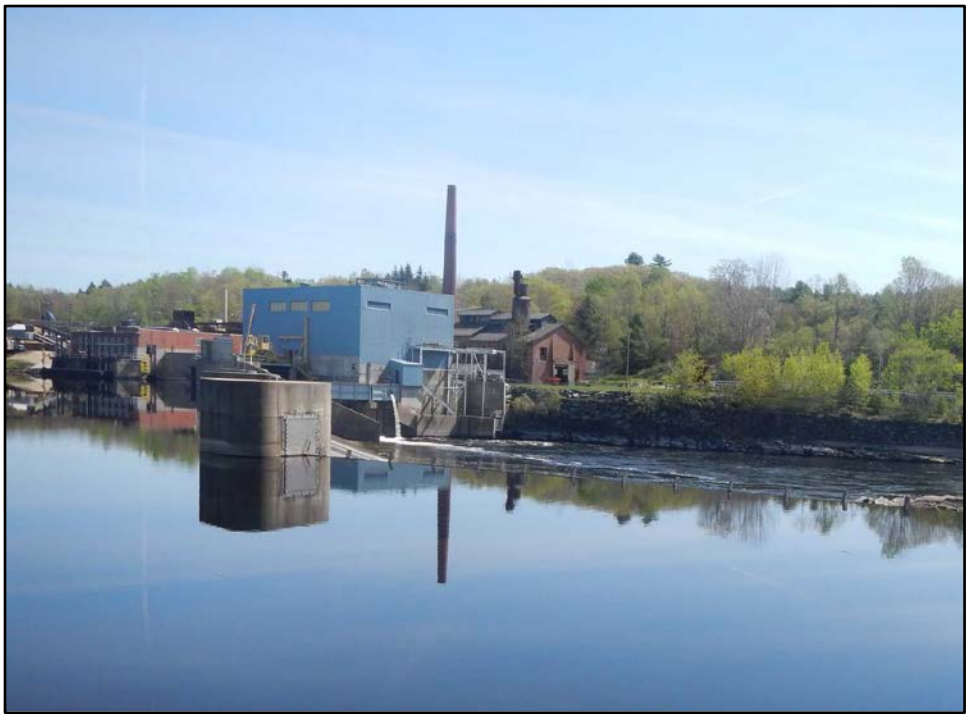
Maine Department of Environmental Protection (MDEP). 2017. DEP Sampling Protocol for Hydropower Studies. December 2017.

National Oceanic and Atmospheric Administration (NOAA) 2018. [Online] URL: (https://w2.weather.gov/climate/xmacis.php?wfo=gyx). Accessed November 2018.

APPENDIX B: TAILWATER BENTHIC MACROINVERTEBRATE SURVEY

This page intentionally left blank.

INITIAL STUDY REPORT
TAILWATER BENTHIC MACROINVERTEBRATE SURVEY
PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)



Submitted by:

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

Prepared by:

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

July 2019

Brookfield

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND DEFINITIONS

Brookfield	Brookfield Renewable
CFR	Code of Federal Regulations
cfs	Cubic feet per second
Commission	Federal Energy Regulatory Commission
DO	Dissolved Oxygen
FERC	Federal Energy Regulatory Commission
HETL	Maine Health and Environmental Testing Laboratory
ILP	Integrated Licensing Process
MDEP	Maine Department of Environmental Protection
ME	Maine
mg/l	Milligrams per liter
MW	Megawatt
NH	New Hampshire
NOI	Notice of Intent
PAD	Pre-Application Document
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PSP	Proposed Study Plan
PCU	Platinum Cobalt Units
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SPD	Study Plan Determination
TSI	Trophic State Index
us/cm	microSiemens/centimeter
ug/l	Micrograms per liter
USGS	United States Geological Survey
VLMP	Volunteer Lake Monitoring Program

1.0 INTRODUCTION

A survey of benthic macroinvertebrates was conducted in support of the relicensing of the Pejepscot Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) No. 4784, as identified in the Revised Study Plan (RSP) submitted by Topsham Hydro Partners Limited Partnership (Topsham) on June 12, 2018 and approved by the FERC in its Study Plan Determination letter dated July 3, 2018. This is a report for the 2018 study efforts of the Tailwater Benthic Macroinvertebrate Survey. The majority of work for this study was conducted by Normandeau Associates, Inc. (Normandeau). The Maine Department of Environmental Protection (MDEP) was provided with a listing of observed taxonomic classifications and abundance (data listing provided in Appendix A) in order to aid them in their determination of water classification standards for the Project tailrace.

2.0 OBJECTIVES

The goal of this 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 study objective was to determine the composition of the benthic macroinvertebrate community within the tailrace reach of the dam in accordance with the most recent MDEP protocol for macroinvertebrate sampling.

3.0 STUDY AREA

The study area included the section of the Androscoggin River located approximately 600-700 feet downstream of the Project. As specified in the RSP, a single sampling station was established within representative habitat downstream of the Project facilities (Figure 3-1).

Brookfield

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)
MACROINVERTEBRATE STUDY

N

0 200 400 800 Feet

Figure 3-1:
Location of Benthic Macroinvertebrate Sampling Station Downstream of Pejepscot
August, 2018

Path: P:\1925\maps\Study Plans\Macroinvertebrates_Study\Figure_3-1.mxd

4.0 METHODS

Benthic macroinvertebrate community sampling downstream of the Project was conducted following the MDEP's Methods for Biological Sampling and Analysis of Maine's Rivers and Streams (Davies and Tsomides 2014) which presents the standard practices and procedures that have been adopted by MDEP to acquire benthic macroinvertebrate data for purposes of aquatic life classification attainment evaluation. As described in the RSP, a set of three rock baskets were deployed at a sampling location downstream of the power station and within representative benthic macroinvertebrate habitat. Samplers were filled with 7.25 ± 0.5 kg of clean, washed cobble graded to a uniform diameter range of 3.8-7.6 cm. Pejepscot samplers were deployed during the late summer low-flow period from July 1 to September 30 specified in the MDEP protocol and remained in the river for the required 28 days (± 4 days). At the time of deployment, baskets were oriented parallel to stream flow and were placed at locations where there was a high degree of certainty that they would remain watered for the duration of the study period and were outside of any potential bank effects.

At the completion of the exposure period, samplers were approached from the downstream side and collected by carefully lifting them into an aquatic sampling net. Following collection, samplers were washed through a 600 micron sieve bucket. Each rock was visually inspected, and the surface was rinsed through the bucket. Contents of the sieve bucket were placed in double-labeled jars and preserved with a 70% solution of ethyl alcohol. Habitat and water quality measurements were collected at the time of deployment and retrieval at both sampling locations. Habitat parameters evaluated were those shown on the physical habitat data sheet included in the MDEP protocol. These included substrate composition, canopy coverage, land use, and terrain characteristics. Water quality measurements included velocity, temperature, specific conductance, dissolved oxygen, pH, and total dissolved solids. Also noted were the dates of exposure.

The benthos samples were sent to Normandeau's benthic taxonomy laboratory located in Stowe, Pennsylvania. Taxonomists there sorted, identified and enumerated the full contents of the three rock basket samplers. Samples were analyzed using stereo-zoom and compound microscopes. Organisms were identified and enumerated to the lowest practical taxon, generally genus and species, dependent on their age and condition using published taxonomic keys. Chironomidae (midges) larvae were slide mounted after being prepared in a clearing solution and identified using a compound microscope. Worms were also slide mounted and identified using a compound microscope.

The following metrics were evaluated for the macroinvertebrate samples collected downstream of Pejepscot:

- **Total Number of Taxa**: The number of genera identified.

- **Number of EPT Taxa**: Number of genera in the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), collectively referred to as the "EPT" taxa. These three groups of benthic insects are considered particularly sensitive to pollution.

- **Number of Ephemeroptera Taxa**: The number genera classified as mayflies.
- **Number of Plecoptera Taxa**: The number genera classified as stoneflies.
- **Number of Trichoptera Taxa**: The number genera classified as caddisflies.
- **Percent EPT**: The percentage of the total number of specimens in a sample representing individuals classified as mayflies, stoneflies or caddisflies.
- **Percent Ephemeroptera**: The percentage of the total number of specimens that are mayfly nymphs.
- **Number of Intolerant Taxa**: The number of genera considered to be sensitive to environmental perturbation (tolerance values = 0 – 3).
- **Percent Tolerant Organisms**: The percent of macroinvertebrate specimens considered tolerant to environmental perturbations (tolerance values = 7 – 10).
- **Percent Dominant Taxon**: The percent abundance of the single most abundant taxon.
- **Hilsenhoff Biotic Index (HBI)**: A weighted average of the tolerance values of all taxa present. Organisms are assigned a tolerance value from 0 to 10 indicating their sensitivity to organic pollutants (0 being most sensitive, 10 being most tolerant). HBI is calculated as:
    - HBI= ($\Sigma n_i \times a_i)/N$
        - Where:
            - n = number of specimens in taxa i
            - a = tolerance value of taxa i
            - N = total number of specimens in sample
- **Shannon Diversity Index (base e)**: This metric compares the distribution of individuals among all taxa present in a sample. Shannon Diversity (H') is calculated as $H' = \Sigma$ pi ln pi, where pi is the proportion of the total number of individuals occurring in taxon i. Maximum diversity is obtained when the numbers of individuals are equally distributed among taxa. A value near zero indicates community dominance by a small number of taxa. Higher values indicate that the numbers of individuals are evenly distributed.

5.0 RESULTS

5.1 Habitat and Macroinvertebrate Collections

Macroinvertebrate samplers were installed at the sampling location downstream of Pejepscot on August 2, 2018 and were retrieved 27 days later on August 29, 2018. Recorded physical habitat parameters at the time of deployment and retrieval are summarized in Table 5-1. In general, aquatic habitat in the area approximately 660 feet 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 5-2). 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 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 rating provides an estimate of the overall tolerance of the community in the sample area. For the sampling location downstream of Pejepscot this value were 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" (Hilsenhoff 1987).

5.2 Water Quality Classification Standards

A full listing of taxonomic classifications and abundance values for each of the three replicates from the downstream sampling location as well as all the physical data collected during deployment and retrieval of the samplers were provided to MDEP for their determination as to whether or not the macroinvertebrate community sampled downstream of Pejepscot meets the aquatic life criteria for that section of the Androscoggin River. The statutory class of the Androscoggin River downstream of Pejepscot is Class C. MDEP characterizes Class C waters as being of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life. The dissolved oxygen content of Class C water may be not less than 5 parts per million or 60% of saturation, whichever is higher.

Normandeau provided taxonomic and habitat information to the MDEP on November 28, 2018 and MDEP returned a Classification Attainment Report on November 30, 2018 (see full report in Appendix B). The final determination indicated that the macroinvertebrate community sampled downstream of Pejepscot during August 2018 met Class A standards.

Table 5–1. Summary of Macroinvertebrate Sampling Location Habitat and Conditions Downstream of Pejepscot, August 2018

Parameter	Sample Location	
	Deployment	Retrieval
Date-Time	8/2/18-13:10	8/29/18-10:56
No. Samplers	3	3
Coordinates	N43.95536 W70.02387	
Land Use (500 m radius US)	upland conifer, upland hardwood	
Terrain (500 m radius US)	Flat, rolling	
Canopy Cover (upstream view)	Open (0-25% shaded)	
Physical Bottom Characteristics	Boulders (<10") - 50% Rubble (3"-10") - 40% Sand (<1/8") - 10%	
Channel Width (m)	~80 m	
Site Depth (cm)	97	97
Flow (cm/s)	37.9	45.4
Dissolved O_2 (mg/L)	8.21	7.97
Temperature (^oC)	25.9	25.2
pH	7.09	6.95
SPC (µS/cm)	106	93
Observations		
Fish	juvenile YOY smallmouth bass observed	
Algae/Macrophytes	Present in mats on bottom substrate	
Habitat Quality	Good in appearance	
Dams/Impoundments	Pejepscot - US ~660 ft	
Discharges	Powerhouse	
Nonpoint stressors	None observed	

Table 5–2. 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**

6.0 SUMMARY

The macroinvertebrate community was sampled approximately 660 feet downstream of Pejepscot following approved MDEP field and laboratory methods during August 2018. Macroinvertebrate samples collected at the downstream location yielded adequate numbers of sensitive taxa indicating that under the current operational regime there are no detrimental impacts to the macroinvertebrate community.

7.0 VARIANCES FROM FERC-APPROVED STUDY PLAN

There was no variance from the methodologies and schedule as described in the FERC-approved study plan.

8.0 REFERENCES

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

Hilsenhoff, W.L. 1987. An improved biotic index of stream pollution. The Great Lakes Entomologist 20: 31-36.

APPENDIX A. TAXONOMIC LISTING FOR MACROINVERTEBRATE SAMPLES COLLECTED DOWNSTREAM OF PEJEPSCOT DURING AUGUST 2018.

MDEP Taxonomic Code	Taxon Name	No. Identified		
		Rep 1	Rep 2	Rep 3
09020401008	*Acentrella*		1	1
09020401007011	*Acerpenna pygmaea*	44	17	11
09020209042	*Acroneuria*	4	3	1
10010104013	*Amnicola*	5	3	8
09020309048	*Argia*			1
09020401001	*Baetis*	31	11	31
09020301004012	*Boyeria vinosa*		2	
09020618072	*Ceraclea*	8	7	2
09020604015	*Cheumatopsyche*	36	15	21
09020601003	*Chimarra*	16	7	49
09021011037	*Cricotopus*	16	3	15
09021011024	*Diamesa*	1		
09021011085	*Dicrotendipes*			1
03010102	*Dugesiidae*	11	1	13
09020401005	*Heterocloeon*	9	3	3
09010203006011	*Hyalella azteca*	1		
09030101	*Hydrachnidia*			1
09020604016030	*Hydropsyche morosa*	6		9
09020604016047	*Hydropsyche phalerata*	172	45	290
09020604016	*Hydropsyche*	5	3	5
09020607026	*Hydroptila*	9	1	3
09020404018	*Isonychia*	16	1	18
09020402011	*Leucrocuta*			1
09020402015046	*Maccaffertium exiguum*	4		1
09020402015	*Maccaffertium*	34	25	32
09020604018	*Macrostemum*	17	4	49
09020618074	*Nectopsyche*	1	1	
05	*Nematoda*	1		
09021011012	*Nilotanypus*			5
09020603009	*Nyctiophylax*		1	1
09020618078	*Oecetis*	3	3	1
09020209049151	*Paragnetina media*		1	8
09020401012	*Plauditus*			1
09020603010	*Polycentropus*	8	13	8
09021011102182	*Polypedilum flavum*	1	1	8
09021011102185	*Polypedilum illinoense group*	2	3	
09021011026045	*Potthastia gaedii*			2
09021011072127	*Rheotanytarsus exiguus group*	4	2	3

MDEP Taxonomic Code	Taxon Name	No. Identified		
		Rep 1	Rep 2	Rep 3
09021011072128	*Rheotanytarsus pellucidus*	5		3
09021012047	*Simulium*	89	11	241
09021113070055	*Stenelmis crenata*	1		
08020202014001	*Stylaria fossularis*	1		
09021011076	*Tanytarsus*			1
09021011062	*Thienemanniella*	10	1	82
09021011020041	*Thienemannimyia group*			1
09020411038	*Tricorythodes*		1	
09021011065113	*Tvetenia vitracies*	5	1	9

This page intentionally left blank.

APPENDIX B. MDEP CLASSIFICATION ATTAINMENT REPORT FOR SAMPLE LOCATION DOWNSTREAM OF PEJEPSCOT DURING AUGUST 2016.

This page intentionally left blank.

Maine Department of Environmental Protection
Biological Monitoring Program
Aquatic Life Classification Attainment Report

Station Information

Station Number: S-954
Waterbody: Androscoggin River - Station 954
Town: Brunswick
Directions: BELOW PEJEPSCOT DAM; UP RIVER RD FROM BRUNSWICK TO PUBLIC FISHING PARK ACCESS AND CANOE PORTAGE

River Basin: Androscoggin
HUC8 Name: Lower Androscoggin
Latitude: 43 57 19.82 N
Longitude: 70 1 26.95 W
Stream Order: 5

Sample Information

Log Number: 2716 Type of Sample: ROCK BASKET Date Deployed: 8/2/2018
Subsample Factor: X1 Replicates: 3 Date Retrieved: 8/29/2018

Classification Attainment

Statutory Class: C **Final Determination: A** Date: 11/30/2018
Model Result with P≥0.6: A **Reason for Determination: Model**
Date Last Calculated: 11/29/2018 Comments:

Model Probabilities

First Stage Model			
Class A	0.49	Class C	0.02
Class B	0.48	NA	0.00

C or Better Model	
Class A, B, or C	1.00
Non-Attainment	0.00

B or Better Model	
Class A or B	1.00
Class C or Non-Attainment	0.00

A Model	
Class A	0.75
Class B or C or Non-Attainment	0.25

Model Variables

01 Total Mean Abundance	569.00
02 Generic Richness	42.00
03 Plecoptera Mean Abundance	5.67
04 Ephemeroptera Mean Abundance	98.67
05 Shannon-Wiener Generic Diversity	3.53
06 Hilsenhoff Biotic Index	4.15
07 Relative Abundance - Chironomidae	0.11
08 Relative Generic Richness Diptera	0.29
09 *Hydropsyche* Abundance	178.33
11 *Cheumatopsyche* Abundance	24.00
12 EPT Generic Richness/ Diptera Generic Richness	1.75
13 Relative Abundance - Oligochaeta	0.00
15 Perlidae Mean Abundance (Family Functional Group)	5.67
16 Tanypodinae Mean Abundance (Family Functional Group)	2.00
17 Chironomini Abundance (Family Functional Group)	5.33
18 Relative Abundance Ephemeroptera	0.17
19 EPT Generic Richness	21.00
21 Sum of Abundances: *Dicrotendipes, Micropsectra, Parachironomus, Helobdella*	0.33
23 Relative Generic Richness- Plecoptera	0.05
25 Sum of Abundances: *Cheumatopsyche, Cricotopus, Tanytarsus, Ablabesmyia*	35.67
26 Sum of Abundances: *Acroneuria, Maccaffertium, Stenonema*	34.67
28 EP Generic Richness/14	0.79
30 Presence of Class A Indicator Taxa/7	0.29

Five Most Dominant Taxa

Rank	Taxon Name	Percent
1	*Hydropsyche*	31.34
2	*Simulium*	19.98
3	*Maccaffertium*	5.62
4	*Thienemanniella*	5.45
5	*Baetis*	4.28

Maine Department of Environmental Protection
Biological Monitoring Program
Aquatic Life Classification Attainment Report

Station Number: **S-954** Town: Brunswick Date Deployed: 8/2/2018

Log Number: **2716** Waterbody: Androscoggin River - Station 954 Date Retrieved: 8/29/2018

Sample Collection and Processing Information

Sampling Organization: NORMANDEAU ASSOCIATES

Taxonomist: NORMANDEAU ASSOCIATES

Waterbody Information - Deployment			Waterbody Information - Retrieval		
Temperature:	25.9	deg C	Temperature:	25.2	deg C
Dissolved Oxygen:	8.21	mg/l	Dissolved Oxygen:	7.97	mg/l
Dissolved Oxygen Saturation:	101.3	%	Dissolved Oxygen Saturation:	96.9	%
Specific Conductance:	106	uS/cm	Specific Conductance:	93	uS/cm
Velocity:	37.9	cm/s	Velocity:	45.4	cm/s
pH:	7.09		pH:	6.95	
Wetted Width:	81.1	m	Wetted Width:	80.8	m
Bankfull Width:	90.5	m	Bankfull Width:	88.4	m
Depth:	97	cm	Depth:	97	cm

Water Chemistry

Summary of Habitat Characteristics

Landuse Name	Canopy Cover	Terrain	
Upland Conifer	Open	Flat	
Upland Hardwood			
Potential Stressor	**Location**	**Substrate**	
Regulated Flows	Below Dam	Boulder	50 %
	Main Stem	Rubble/Cobble	40 %
		Sand	10 %

Landcover Summary - 2004 Data

Sample Comments

Maine Department of Environmental Protection
Biological Monitoring Program
Aquatic Life Taxonomic Inventory Report

Station Number: S-954 Waterbody: Androscoggin River - Station 954 Town: Brunswick

Log Number: 2716 Subsample Factor: X1 Replicates: 3 Calculated: 11/29/2018

Taxon	Maine Taxonomic Code	Count (Mean of Samplers)		Hilsenhoff Biotic Index	Functional Feeding Group	Relative Abundance %	
		Actual	Adjusted			Actual	Adjusted
Dugesiidae	03010102	8.33	8.33		--	1.5	1.5
Nematoda	05	0.33	0.33		--	0.1	0.1
Stylaria	08020202014		0.33		CG		0.1
Stylaria fossularis	08020202014001	0.33			--	0.1	
Hyalella	09010203006		0.33	8	CG		0.1
Hyalella azteca	09010203006011	0.33			--	0.1	
Acroneuria	09020209042	2.67	2.67	0	PR	0.5	0.5
Paragnetina	09020209049		3.00	1	PR		0.5
Paragnetina media	09020209049151	3.00			--	0.5	
Boyeria	09020301004		0.67	2	PR		0.1
Boyeria vinosa	09020301004012	0.67			--	0.1	
Argia	09020309048	0.33	0.33	7	PR	0.1	0.1
Baetis	09020401001	24.33	24.33	4	CG	4.3	4.3
Heterocloeon	09020401005	5.00	5.00	2	SC	0.9	0.9
Acerpenna	09020401007		24.00	5	CG		4.2
Acerpenna pygmaea	09020401007011	24.00			--	4.2	
Acentrella	09020401008	0.67	0.67	3	CG	0.1	0.1
Plauditus	09020401012	0.33	0.33		CG	0.1	0.1
Leucrocuta	09020402011	0.33	0.33	1	SC	0.1	0.1
Maccaffertium	09020402015	30.33	32.00	4	SC	5.3	5.6
Maccaffertium exiguum	09020402015046	1.67			--	0.3	
Isonychia	09020404018	11.67	11.67	2	CF	2.1	2.1
Tricorythodes	09020411038	0.33	0.33	4	CG	0.1	0.1
Chimarra	09020601003	24.00	24.00	2	CF	4.2	4.2
Nyctiophylax	09020603009	0.67	0.67	5	PR	0.1	0.1
Polycentropus	09020603010	9.67	9.67	6	PR	1.7	1.7
Cheumatopsyche	09020604015	24.00	24.00	5	CF	4.2	4.2
Hydropsyche	09020604016	4.33	178.33	4	CF	0.8	31.3
Hydropsyche morosa	09020604016030	5.00			--	0.9	
Hydropsyche phalerata	09020604016047	169.00			--	29.7	
Macrostemum	09020604018	23.33	23.33	3	CF	4.1	4.1
Hydroptila	09020607026	4.33	4.33	6	P	0.8	0.8
Ceraclea	09020618072	5.67	5.67	3	CG	1.0	1.0
Nectopsyche	09020618074	0.67	0.67	3	SH	0.1	0.1
Oecetis	09020618078	2.33	2.33	8	PR	0.4	0.4
Nilotanypus	09021011012	1.67	1.67	6	PR	0.3	0.3
Thienemannimyia	09021011020		0.33	3	PR		0.1

Maine Department of Environmental Protection
Biological Monitoring Program
Aquatic Life Taxonomic Inventory Report

Station Number: S-954 Waterbody: Androscoggin River - Station 954 Town: Brunswick

Log Number: 2716 Subsample Factor: X1 Replicates: 3 Calculated: 11/29/2018

Taxon	Maine Taxonomic Code	Count (Mean of Samplers)		Hilsenhoff Biotic Index	Functional Feeding Group	Relative Abundance %	
		Actual	Adjusted			Actual	Adjusted
Thienemannimyia group	09021011020041	0.33			--	0.1	
Diamesa	09021011024	0.33	0.33	5	CG	0.1	0.1
Potthastia	09021011026		0.67	2	CG		0.1
Potthastia gaedii	09021011026045	0.67			--	0.1	
Cricotopus	09021011037	11.33	11.33	7	SH	2.0	2.0
Thienemanniella	09021011062	31.00	31.00	6	CG	5.4	5.4
Tvetenia	09021011065		5.00	5	CG		0.9
Tvetenia vitracies	09021011065113	5.00			--	0.9	
Rheotanytarsus	09021011072		5.67	6	CF		1.0
Rheotanytarsus exiguus group	09021011072127	3.00			CF	0.5	
Rheotanytarsus pellucidus	09021011072128	2.67			CF	0.5	
Tanytarsus	09021011076	0.33	0.33	6	CF	0.1	0.1
Dicrotendipes	09021011085	0.33	0.33	8	CG	0.1	0.1
Polypedilum	09021011102		5.00	6	SH		0.9
Polypedilum flavum	09021011102182	3.33			--	0.6	
Polypedilum illinoense group	09021011102185	1.67			--	0.3	
Simulium	09021012047	113.67	113.67	4	CF	20.0	20.0
Stenelmis	09021113070		0.33	5	SC		0.1
Stenelmis crenata	09021113070055	0.33			--	0.1	
Hydrachnidia	09030101	0.33	0.33		--	0.1	0.1
Amnicola	10010104013	5.33	5.33		SC	0.9	0.9

APPENDIX C: STRANDING EVALUATION

This page intentionally left blank.

INITIAL STUDY REPORT

STRANDING EVALUATION

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

July 2019

Brookfield

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS AND DEFINITIONS

Brookfield	Brookfield Renewable
CFR	Code of Federal Regulations
cfs	Cubic feet per second
Commission	Federal Energy Regulatory Commission
FERC	Federal Energy Regulatory Commission
ILP	Integrated Licensing Process
Licensee	Topsham Hydro Partners Limited Partnership
MDEP	Maine Department of Environmental Protection
MDMR	Maine Department of Marine Resources
ME	Maine
MW	Megawatt
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
PAD	Pre-Application Document
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PSP	Proposed Study Plan
RSP	Revised Study Plan
Topsham Hydro	Topsham Hydro Partners Limited Partnership
SD1	Scoping Document 1
SD2	Scoping Document 2
SPD	Study Plan Determination
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1.0 INTRODUCTION

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 to the north, and the Town of Durham 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 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. The Revised Study Plan (RSP) was filed in accordance with the ILP schedule on June 12, 2018. FERC issued a Study Plan Determination (SPD) on July 3, 2018.

In the RSP, Topsham Hydro proposed to conduct a stranding evaluation to provide information regarding the potential for fish stranding below the Project spillway.

2.0 GOALS AND OBJECTIVES

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.

3.0 BACKGROUND AND EXISTING INFORMATION

As noted in the RSP, prior to conducting this evaluation there was no existing information regarding stranding-prone areas or operational scenarios for the Project. This study was needed to quantify Project effects on a potential source of fish mortality and injury.

On September 12, 2018, the reconnaissance-level field survey portion of the study was conducted jointly with representatives from Topsham Hydro, Gomez and Sullivan Engineers,

D.P.C., Normandeau Associates, Inc., the National Marine Fisheries Service (NMFS), the United States Fish and Wildlife Service (USFWS), and the Maine Department of Marine Resources (MDMR) participating. Streamflow, as recorded at the Androscoggin River at Auburn, ME United States Geological Survey (USGS) gage, was approximately 2,230 cfs. Before the survey began, all streamflow at the Project was passed through bascule gate No. 1, as the Project turbines were out-of-service (Figure 3.0-1).

Figure 3.0-1: Flow Conditions before Stranding Evaluation Survey

4.0 METHODS

4.1 Operational Data Review

Prior to conducting the field investigation, a desktop literature review was performed to gather information on the typical sequencing of bascule gate operations, as well as the frequency of annual spill operations at the Project. This information was used to determine the inflow and operational conditions under which the ledges might experience variable flows.

4.2 Field Survey

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. The field survey consisted of lowering bascule gate No. 5, and simultaneously raising bascule gate No. 1. The objective of this operation was to convey all streamflow through bascule gate No. 5, onto the exposed bedrock area. After completion of this operation and bascule gate No. 5 was fully lowered and bascule gate No. 1 was fully raised, the operation would be reversed. Once the reverse operation was complete, and all streamflow was again passed through bascule gate No. 1, the exposed bedrock area on river right would be investigated for the occurrence of potential stranding pools. The field survey was photo-documented and videotaped.

5.0 RESULTS

The survey participants convened on river left, near the Project powerhouse, to view the bascule gate operations. Lowering of bascule gate No. 5 and the raising of bascule gate No. 1 began at 9:19 am (Figure 5.0-1)[1]. The total elapsed time to complete this operation was approximately 18 minutes (Figure 5.0-2). The operation of the gates was then reversed, and bascule gate No. 5 was returned to the fully raised position and bascule gate No. 1 was returned to its previously lowered position (total elapsed time approximately 16 minutes). Figure 5.0-3 shows a view from river left of the exposed bedrock area shortly after bascule gate No. 5 was fully raised.

The survey participants then traveled to river right to more closely view the exposed bedrock area. Due to safety precautions, the exposed bedrock area was not traversed. However, the survey participants did view the study area from the streambank top, where a several potential stranding pools were noted in the bedrock outcrop (Figure 5.0-4).

The survey participants discussed potential mitigation options to alleviate the stranding potential of the pools within the bedrock area. Options discussed included the following:

[1] Videotape documentation of the bascule gate operations was collected, and is available using the following links:

Crest Gate Lowering =>https://www.youtube.com/watch?v=UM0Sy04KUgk&t=21s
Crest Gate Raising=>https://www.youtube.com/watch?v=-2JvSlDQC20&t=13s

1. After a typical lowering and raising operation of bascule gate No. 5, Project operations staff could survey the pools in the bedrock area for any stranded fish, and steps could be taken to return fish to the river, if necessary;

2. The potential stranding pools could be filled with concrete/grout to prevent their occurrence, and remove the fish stranding hazard; and

3. Excavation of channels in the bedrock could be performed to allow for draining of the pools and egress of any fish within the pools.

Figure 5.0-1: Initiation of Bascule Gate Operation (9:19 am)

Figure 5.0-2: Bascule Gate No. 5 in Fully Lowered Position (9:37 am)

Figure 5.0-3: Exposed Bedrock Area Below Bascule Gate No. 5 (9:54 am)

** As viewed from river left shortly after Bascule Gate No. 5 was returned to the fully raised position*

Figure 5.0-4: Exposed Bedrock Area Below Bascule Gate No. 5 (10:31 am)

** As viewed from river right shortly after Bascule Gate No. 5 was returned to the fully raised position*

6.0 SUMMARY

Several potential stranding pools were noted in the bedrock outcrop on the right side of the Project dam, below bascule gate No. 5. The survey participants discussed several potential mitigation options to alleviate the stranding potential in this area, including: 1) conducting surveys of the pools following spill operations to locate any stranded fish and return them to the river, if necessary; 2) filling the potential stranding pools with concrete/grout to prevent future fish stranding; or 3) excavation of channels in the bedrock to allow for draining of the pools and egress of any fish with the pools.

7.0 VARIANCES FROM THE FERC APPROVED STUDY PLAN

The methodology proposed in the RSP called for on-ground surveys to traverse any pools, visually document fish present, and look for fish trapped under rocks. Due to safety concerns, field crews were not permitted to traverse the pools where potential stranding could occur. Instead, field crews observed the potential stranding areas from an elevated position along the adjacent bank.

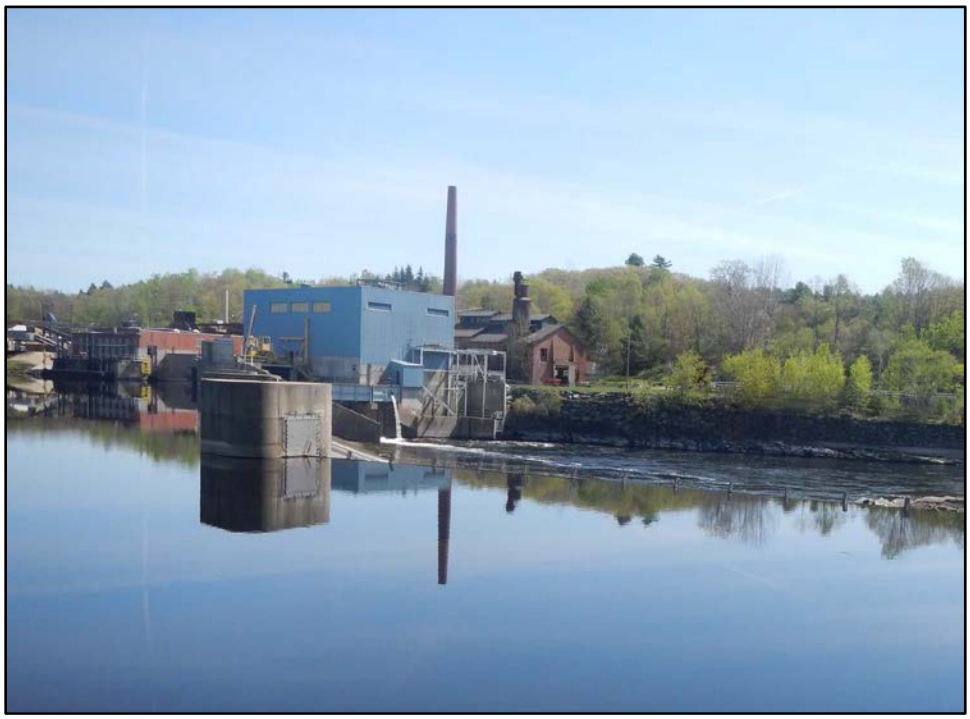
APPENDIX D: BOTANICAL AND WILDLIFE RESOURCES STUDY

This page intentionally left blank.

INITIAL STUDY REPORT

BOTANICAL AND WILDLIFE RESOURCES SURVEYS

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

July 2019

Brookfield

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND DEFINITIONS

Brookfield	Brookfield Renewable
CFR	Code of Federal Regulations
Commission	Federal Energy Regulatory Commission
FERC	Federal Energy Regulatory Commission
GPS	Global Positioning System
ILP	Integrated Licensing Process
Licensee	Topsham Hydro Partners, L.P.
ME	Maine
MDIFW	Maine Department of Inland Fisheries and Wildlife
MNAP	Maine Natural Areas Program
MW	Megawatt
NOI	Notice of Intent
PAD	Pre-Application Document
Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PSP	Proposed Study Plan
QA/QC	Quality Assurance / Quality Control
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SPD	Study Plan Determination
TE	Threatened and Endangered
Topsham Hydro	Topsham Hydro Partners, L.P.
USFWS	U.S. Fish and Wildlife Service

This page intentionally left blank.

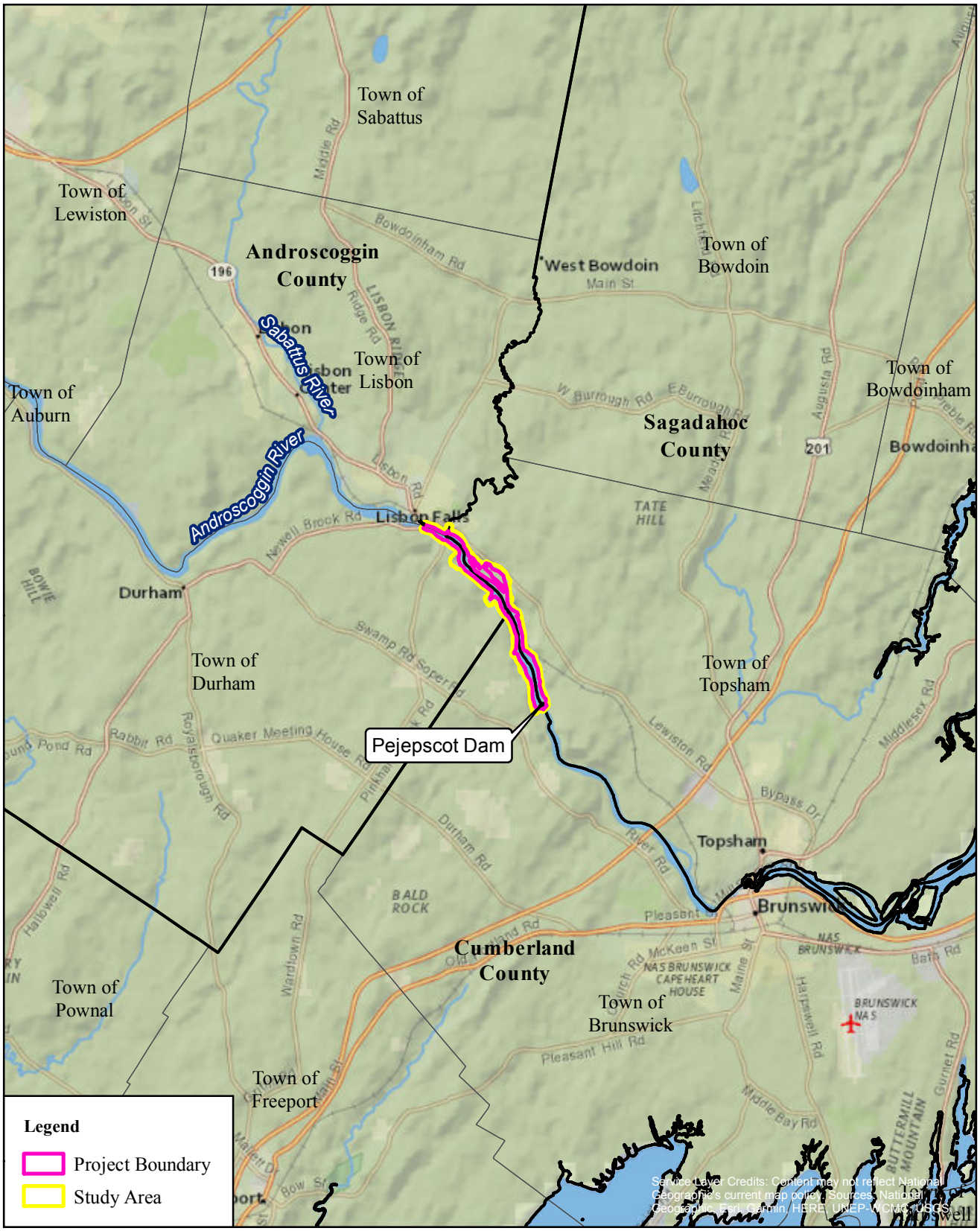
1.0 INTRODUCTION

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 to the north, and the Town of Durham and the Town of Brunswick to the west. The Project straddles the border between Cumberland and Sagadahoc Counties and extends into Androscoggin County (Figure 1.0-1). 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. The Revised Study Plan (RSP) was filed in accordance with the ILP schedule on June 12, 2018. FERC issued a Study Plan Determination (SPD) on July 3, 2018.

In the RSP, Topsham Hydro proposed to conduct reconnaissance level habitat surveys to document the wildlife and botanical resources in the Project Area, to document any threatened and endangered (TE) species, and to provide information pertinent to potential Project effects on wildlife and botanical resources. This report summarizes the findings of both habitat surveys, which were conducted in August 2018.



PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)
BOTANICAL AND WILDLIFE
RESOURCES SURVEYS

Brookfield

N

0 1 2 4
Miles

Figure 1.0-1:
Pejepscot Hydroelectric Project
General Location

Path: P:\1925\maps\Study Plans\botanical_resources_study\figure_1_0-1_location.mxd

2.0 GOALS AND OBJECTIVES

2.1 Botanical Resources

The reconnaissance level survey is designed to provide information pertinent to:

- the nature and extent of riparian and wetland botanical resources; and
- the presence or absence of TE plant species or associated habitats within the Project area.

2.2 Wildlife Resources

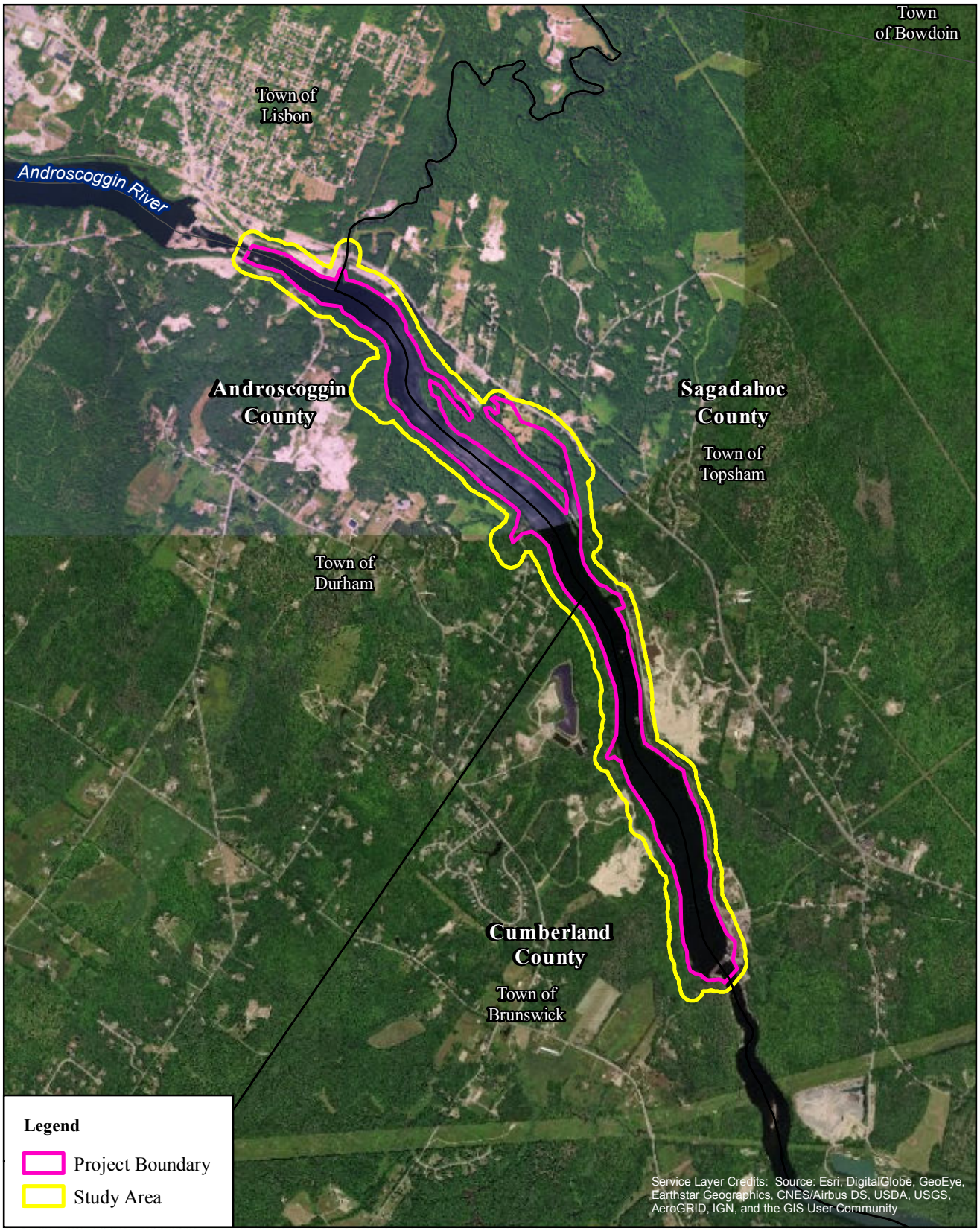
The reconnaissance level survey is designed to provide information pertinent to:

- existing wildlife (bird and mammal) habitats in riparian, wetland, and upland areas of the Project impoundment and tailwater shoreline;
- the presence of wildlife species at the Project; and
- the presence of TE species or associated habitats.

3.0 STUDY AREA DESCRIPTION

The Project is 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 described as a transitional zone. 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).

The Project boundary approximately follows the contour level of 75 feet 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 approximately 200 feet downstream of the existing Route 125 bridge, which is located approximately 0.25 miles downstream of the Worumbo Dam and 0.3 miles upstream of the confluence of the Androscoggin and Little Rivers. The Project boundary terminates approximately 260 feet downstream of the Pejepscot Dam. The Project boundary encompasses a total of approximately 229 acres. The study area included areas enclosed in the Project boundary as well as adjacent areas within 200 feet of the 75-foot contour level, approximately 514 acres. Figure 3.1-1 depicts the Project boundary and study area.



Brookfield

PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)
BOTANICAL AND WILDLIFE
RESOURCES SURVEYS

N

0 0.25 0.5 1 Miles

Figure 3.1-1:
Pejepscot Hydroelectric Project Boundary and Study Area

Path: P:\1925\maps\Study Plans\botanical_resources_study\figure_3_1-1_project_boundary.mxd

4.0 METHODS

4.1 Botanical Resource Survey Methods

4.1.1 Study Design

The reconnaissance level survey was designed to provide information pertinent to the nature and extent of riparian and wetland botanical resources, and the presence or absence of TE botanical species or associated habitats within the study area. The vegetation survey involved three phases of work: desktop analysis, field verification, and the production of a cover type map. The field data collection was performed according to the RSP (Brookfield, 2018) and was conducted in conjunction with the Wildlife Resources Survey (Section 5.0).

4.1.2 Field Data Collection

Prior to fieldwork, background data were gathered, including digital imagery, ecological information about Androscoggin River shoreline communities as well as historical information about land use at the Project site. The general vegetation cover types were identified through photo interpretation and referencing the National Land Cover Database (USGS, 2011). A base map was developed showing draft depictions of plant communities. The base map was refined using data gathered during the field survey.

Biologists surveyed plant communities and botanical resources from August 21, 2018 through August 23, 2018. The study area was systematically traversed on foot or by small motorboat. Field mapping was electronically recorded on a Global Positioning System (GPS) equipped field computer running ArcGIS software. The wireless field computer was loaded with the land cover data from the desktop analysis. Field biologists updated the polygon boundaries, delineated new features as needed, and assigned attributes to all unique land cover types found during the surveys. Polygons were drawn to delimit the boundaries of each distinct cover category area and the boundaries of each plant community. Each polygon was given a unique number for identification and the following data were collected:

- plant species composition, including the dominant and more prominent associated species in each vegetation layer (tree, shrub and herbaceous layers);
- predominant land use(s) associated with each cover type;
- rare, unique, and particularly high-quality habitat;
- occurrence of any TE plant species; and
- occurrence of exotic invasive plant species

The natural plant communities were defined using Maine's Natural Heritage Classification Keys (MDACF, 2018d) and descriptions were recorded for the disturbed or developed areas.

Newcomb's Wildflower Guide (1977) and Gleason and Cronquist's Flora of Eastern North America and Adjacent Canada (1991) were the primary sources for plant species identification.

4.1.3 Data Processing and GIS Mapping

Data collected on the GPS equipped field computers was imported into an ArcGIS database for further analysis and quality assurance. Land features that were not mapped in the field, such as roads and railroads, were digitized as a desktop exercise. The data were then checked for spatial inaccuracies such as gaps in coverage or overlaps between different land cover types using ArcGIS topology tools. ArcGIS topology tools are a collection of rules that allow geodatabases to more accurately model data. After the topology checks were performed, analysts performed statistical analysis on the seamless data.

4.2 Wildlife Resources Survey Methods

4.2.1 Study Design

The reconnaissance level survey was designed to provide information on the type and quantity of habitat and wildlife resources that have become established under existing Project operation as well as the presence of TE species or associated habitats. The observation survey was performed according to the RSP (Brookfield, 2018) and was conducted in conjunction with the Botanical Resources Survey (Section 4.1).

4.2.2 Field Data Collection

Records from the Maine Natural Areas Program (MNAP), Maine Department of Inland Fisheries and Wildlife (MDIFW), and United States Fish and Wildlife Service (USFWS) were reviewed prior to the survey to gather a list of potential state or federal TE wildlife species. Biologists accessed the study area on foot, by car, or in a small motorboat. The survey was conducted from August 21, 2018 through August 23, 2018 using binoculars and/or a spotting scope to minimize disturbance to wildlife. Observations made by the biologists were documented on the field datasheets. The Sibley's Guide to Birds (2003) was the primary source for species identification and nomenclature. The identification of the non-bird species was confirmed using the MDIFW website (MDIFW, 2018a).

5.0 RESULTS

5.1 Botanical Resources

The study area encompasses approximately 514 acres. Within this area, twenty different cover types were mapped (Figure 5.1-1). Table 5.1-1 summarizes acreages of each cover type as well as percentages of the total 514-acre study area. Plant species identified during the study are listed in Table 5.1-2 and are discussed further below. Field photos taken during the survey are shown in Appendix A.

Cover Type

In 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, 2018d). 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*).

Emergent wetland plant communities occupied 25.6 acres (5%) and were primarily pickerelweed macrophyte aquatic beds (MDACF, 2018d). 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.

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

Upland Vegetation

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 sometimes considered non-native. Most mature forested areas had well-developed understories with intact shrub and herbaceous layers.

Invasive Species

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

Threatened and Endangered Species

Several state-listed plant species were identified in the PAD as potentially occurring in or near the Project area (Table 5.1-3); however, no TE species were observed during the botanical surveys. 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, 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 study area do not occur over peaty substrates nor are they particularly tannic. Habitat for this species does not exist within the study 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 field survey, and there are no bogs, fens or wet gravel deposits within the study area.

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 study 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 study area in the open wetlands.

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 study 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 study area.

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 study area, but habitat for each of them does exist within the mesic woods mapped.

Table 5.1-1: Summary of Cover Type Polygons Mapped During Botanical Resources Survey

Cover Type	Total Acres	Percent of Study Area	Associated Land Uses[1]	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
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

[1] USGS, 2014

Cover Type	Total Acres	Percent of Study Area	Associated Land Uses[1]	Habitat Type
Conifer Plantation	0.6	0.1%	Evergreen Forest	Upland
Boat launch	0.2	<0.1%	Developed, Open Space	Other
TOTAL	**513.9**	**100%**		

Table 5.1-2: Plant Species Observed in Pejepscot Study Area

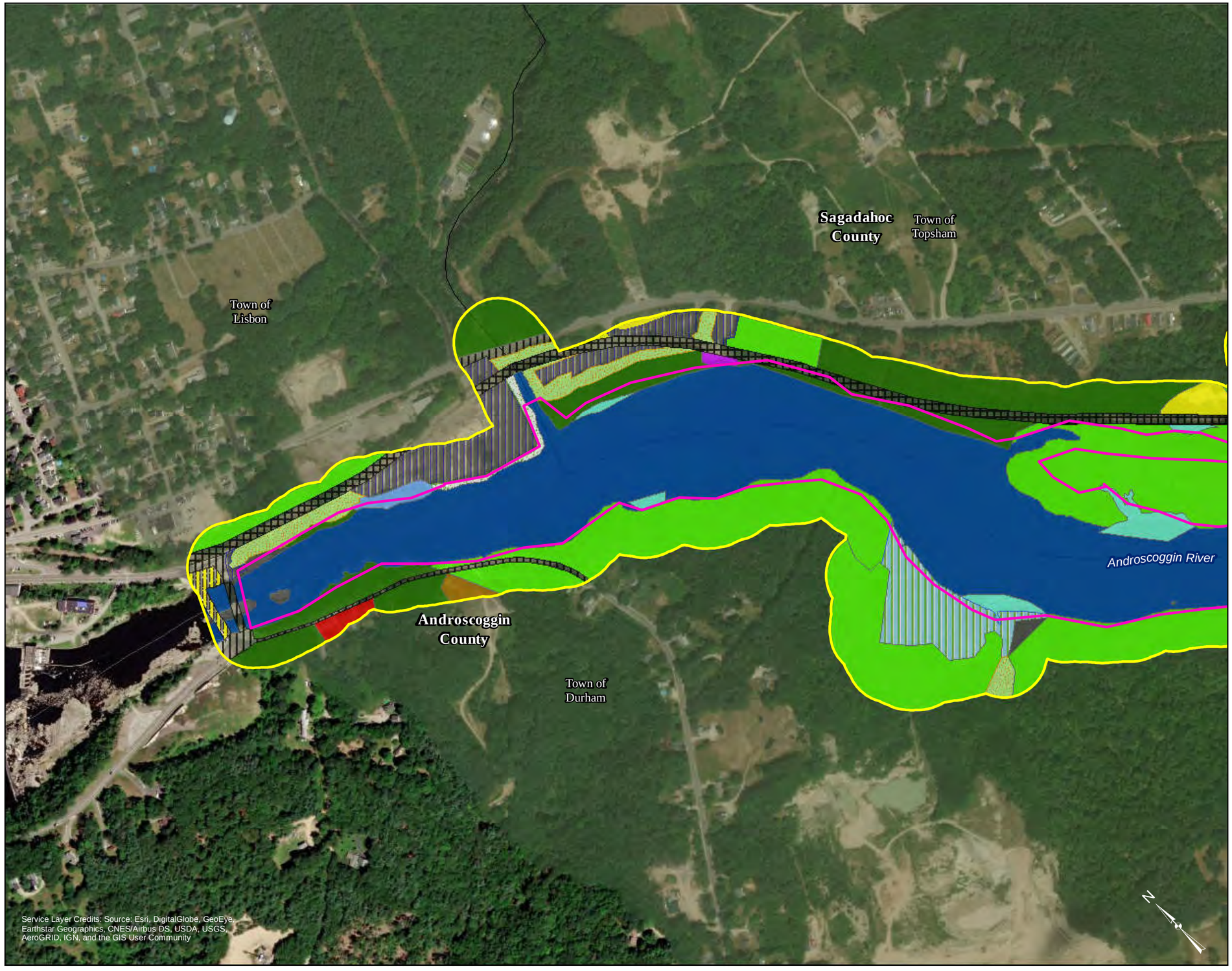
Common Name	Scientific Name	Status[2]
Red maple	*Acer rubrum*	Native
Silver maple	*Acer saccharinum*	Native
Sugar maple	*Acer saccharin*	Native
Mountain maple	*Acer spicatum*	Native
Alder	*Alnus sp.*	Native
Sweet birch	*Betula lenta*	Native
Paper birch	*Betula papyrifera*	Native
Flowering rush	*Butomus 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
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*	Native
Norway spruce	*Picea abies*	Introduced
White spruce	*Picea alba*	Native

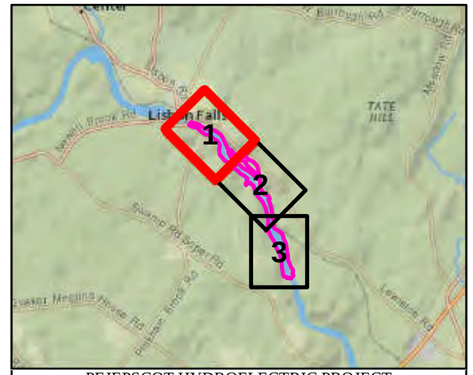
[2] Sources: (MDACF, 2018 a,b,c and USDA, 2018)

Common Name	Scientific Name	Status[2]
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
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

Table 5.1-3: State-listed Plants Listed in the PAD

Common Name	Species Name	Status	Found in Study Area?	Habitat in Study 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





PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)
BOTANICAL AND WILDLIFE
RESOURCES SURVEYS

Figure 5.1-1: Botanical Cover Types
Page 1 of 3

Legend

- Project Boundary
- Study Area

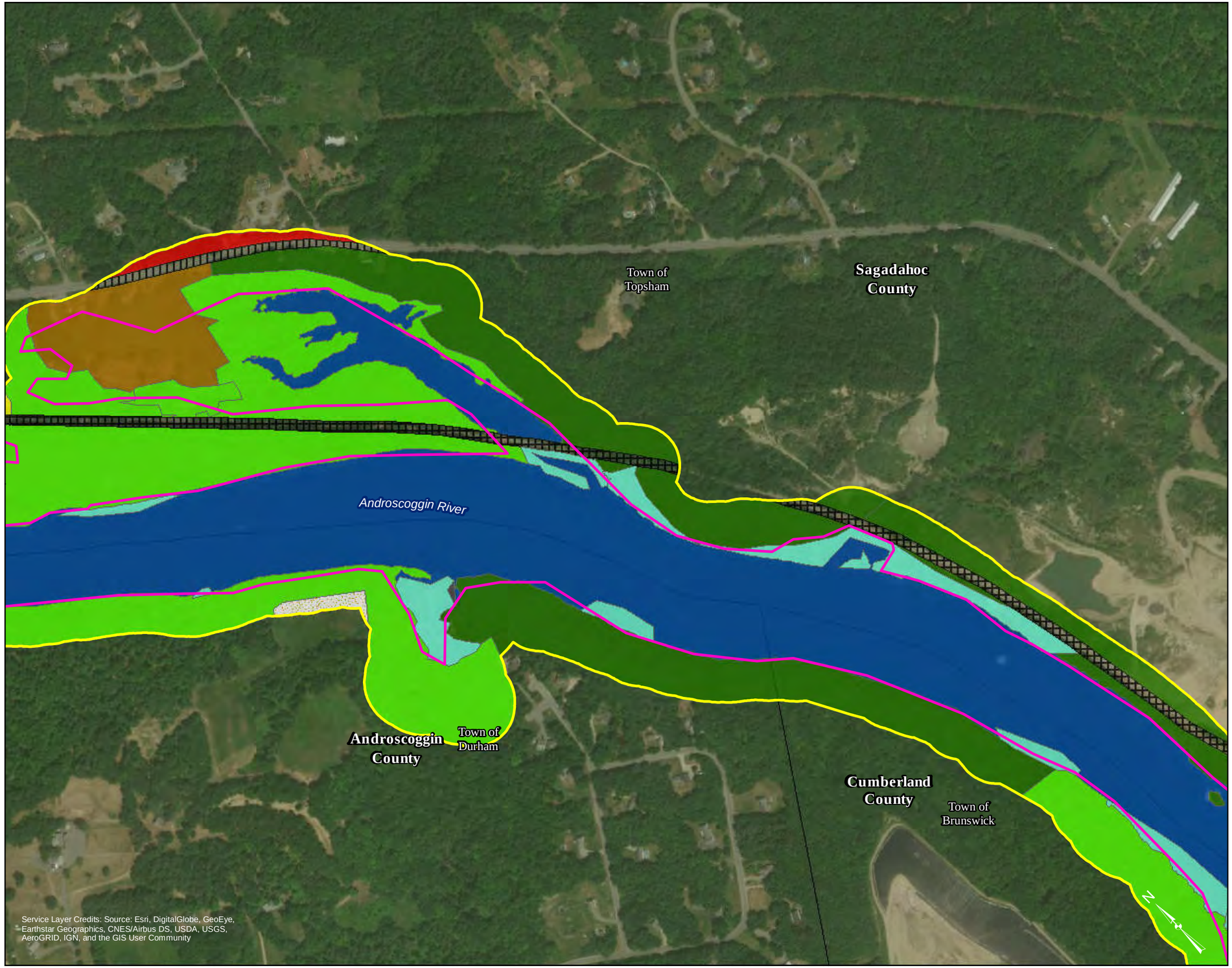
Cover Type

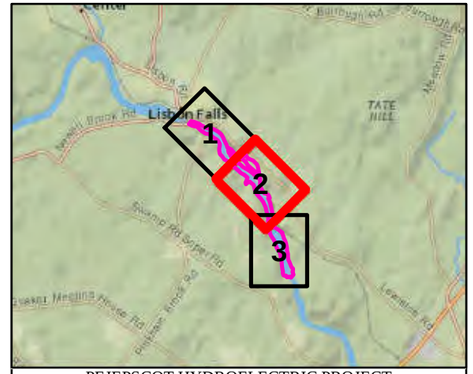
- Old field
- Shrub
- Deciduous forest
- Mixed forest
- Sand
- Residential
- Boat launch
- Rock
- Parking
- Paved/road
- Railroad
- Dam and related facilities
- Young woods
- Wetland
- Forested wetland
- Water structure
- Open water

0 250 500 1,000 Feet

Brookfield

Path: P:\1925\maps\Study Plans\botanical_resources_study\figure_5_1-1_cover_type.mxd





PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)
BOTANICAL AND WILDLIFE
RESOURCES SURVEYS

Figure 5.1-1: Botanical Cover Types
Page 2 of 3

Legend

- Project Boundary
- Study Area

Cover Type

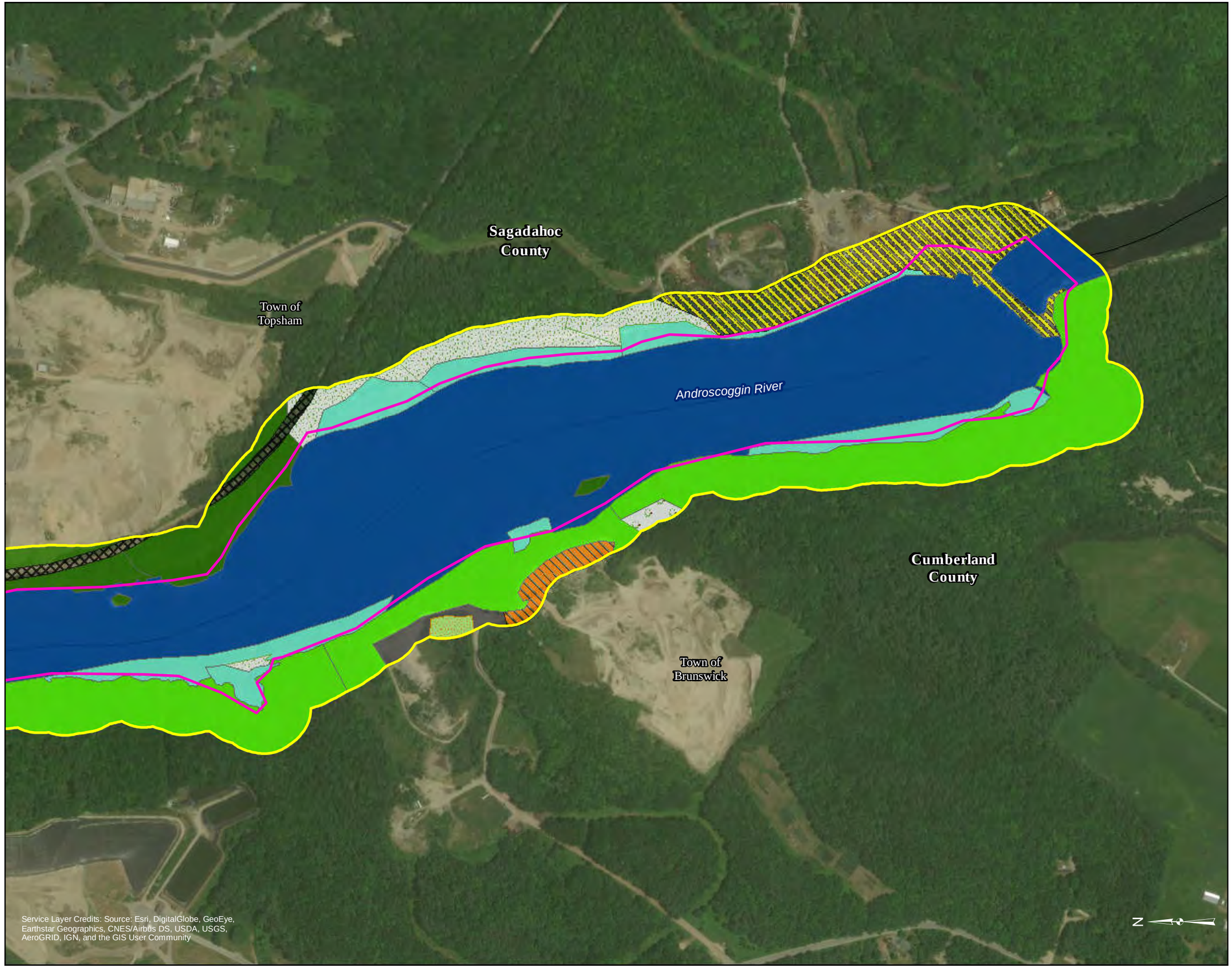
- Agriculture
- Old field
- Deciduous forest
- Mixed forest
- Sand
- Residential
- Rock
- Paved/road
- Railroad
- Wetland
- Open water

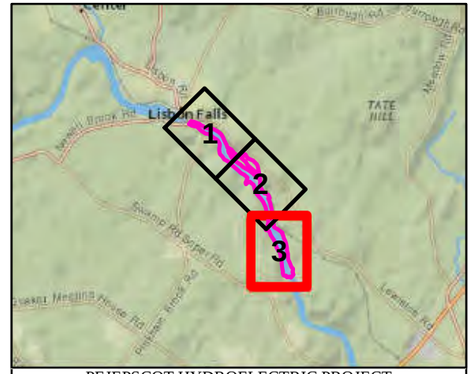
0 250 500 1,000 Feet

N

Brookfield

Path: P:\1925\maps\Study Plans\botanical_resources_study\figure_5_1-1_cover_type.mxd





PEJEPSCOT HYDROELECTRIC PROJECT
(FERC No. 4784)
BOTANICAL AND WILDLIFE
RESOURCES SURVEYS

Figure 5.1-1: Botanical 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

0 250 500 1,000 Feet

Brookfield

Path: P:\1925\maps\Study Plans\botanical_resources_study\figure_5_1-1_cover_type.mxd

5.2 Wildlife Resources

The study area provides habitat for numerous species of song birds, wading birds, gulls and waterfowl. A total of 26 bird species were observed during the field survey, including three species of Special Concern[3] (Table 5.2-1). The Special Concern species observed 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 TE bird species were observed during survey.

Eastern gray and red squirrels (*Sciurus carolinensis* and *S. vulgaris*) and an eastern milk snake (*Lampropeltis triangulum triangulum*) were also observed during the survey. Insects that were seen included monarch butterflies (*Danaus plexippus*), bumble bees (*Bombus* sp.), and yellow jackets (*Vespinae* sp.). Biologists were unable to determine if any of the observed bumble bees were on the TE or Special Concern list from MDIFW (MDIFW, 2015). Small fish, two turtles, and tadpoles were also observed in or near the Androscoggin River waters during the field survey. These were spotted as glimpses and could not be identified. The only reptile to be identified was an eastern milk snake (*Lampropeltis triangulum triangulum*), which was observed on the railroad tracks along the eastern shoreline. This species currently has no state status. All the non-bird species identified during the survey are listed in Table 5.2-2.

Several bat species are listed in the PAD (Brookfield, 2017) as having 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 habitats for several bat species do exist in the study area. The New England cottontail is also known to exist near the Project area. New England cottontail habitat includes dense stands of deciduous trees, which are present in the Project area. No TE mammal species were observed in the Project area during the field survey, nor were any non-native animal species.

[3] A species of special concern is any species of fish or wildlife that does not meet the criteria of an endangered or threatened species but is particularly vulnerable, and could easily become, an endangered, threatened, or extirpated species due to restricted distribution, low or declining numbers, specialized habitat needs or limits, or other factors. Special concern species are established by policy, not by regulation, and are used for planning and informational purposes; they do not have the legal weight of endangered and threatened species (MDIFW, 2015).

Table 5.2-1: Bird Species Observed in the Pejepscot Project Area

Common Name	Scientific Name	Observation Type		Maine Status[4]
		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[5]
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
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

[4] Source: MDIFW, 2015
[5] Removed from MDIFW, 2015

Table 5.2-2: Non-bird Animal Species Observed in the Pejepscot Project Area

Common Name	Scientific Name	Observation Type		Status[6]
		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 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

[6] Source: MDIFW, 2015

6.0 SUMMARY

A total of 20 cover types were mapped within the study area. The dominant cover type was open water (43%). The dominant vegetated cover types included mixed forest (25%) and deciduous forest (13%). Non-vegetated/developed cover types encompassed (11%) of study area. The least dominant cover types were wetlands (5%) followed by other vegetated areas (3%) and forested wetlands (<1%). The forested and wetland cover types represent native plant communities in Maine. Natural forested communities included hemlock forest, oak-pine woodland and birch-oak talus woodlands. The most common natural wetland community was the pickerelweed-macrophyte aquatic bed.

The natural plant communities appeared to be healthy and vigorous. Forested areas had intact canopy, shrub and herbaceous layers, were generally mature and showed a mix of tree ages. Most wetlands were a mix of open water and vegetated areas and appeared to be stable. Shrub-dominated areas were mostly successional stands.

Invasive species were present but not overly abundant. No state or federally listed TE plant species were observed in the study area during the field survey, though there is potential habitat for several of the listed species shown in the PAD.

The plant communities in the study area provide habitat for a variety of wildlife species. Wading birds and ducks were observed on and around the impoundment. Mammals that are commonly found in woodlands, wetlands and urban areas were noted during the study. No observations of mammalian predators (coyotes, foxes, etc.) were noted, but these are often elusive and may be present in the area. Several bat species were listed in the PAD as being potentially present in the study area. No bats were observed during the field studies, which occurred during daylight hours. The species listed in the PAD are often found in forested areas, particularly those near a water source over which insects may be abundant. Forested habitats surround large portions of the impoundment, therefore appropriate roosting and foraging habitat for these bat species does exist in the study area. Reptiles and amphibians were observed, but the only herptile identified was the eastern milk snake. Most of the wildlife observed were birds. Biologists saw 26 different bird species, including three species of Special Concern. No TE wildlife species were observed in the study area.

7.0 VARIANCES FROM THE FERC APPROVED STUDY PLAN

There were no variances from the methodologies and schedule as described in the FERC-approved study plan.

8.0 REFERENCES

Bailey, Robert G. (1995). Ecoregions of the United States. United States Department of Agriculture: Forest Service. Rocky Mountain Research Station. Retrieved from https://www.fs.fed.us/land/ecosysmgmt/colorimagemap/images/212.html

Brookfield Renewable. (2017). Pre-Application Document. Prepared by Topsham Hydro Partners Limited Partnership. Lewiston, ME: Author. Filed with FERC August 31, 2017.

Brookfield Renewable. (2018). Revised Study Plan for the Pejepscot Hydroelectric Project. Prepared by Topsham Hydro Partners Limited Partnership. Lewiston, ME: Author. Filed with FERC June 2018.

Gleason, H.A. and Cronquist, A. Flora of Eastern North America (1991). Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Bronx, NY, New York Botanical Garden. 9th printing (2006).

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). Native Shrubs. Retrieved from https://www.maine.gov/dacf/php/pesticides/yardscaping/plants/n_shrubs.htm

Maine Department of Agriculture, Conservation and Forestry (MDACF) (2018c). Native Trees. Retrieved from https://www.maine.gov/dacf/php/pesticides/yardscaping/plants/n_trees.htm

Maine Department of Agriculture, Conservation and Forestry (MDACF) (2018d). Natural Community Classification Key. Retrieved from https://www.maine.gov/dacf/mnap/features/communitykey.htm

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 and Wildlife. (2018a). Fish & Wildlife – Living with Wildlife. Retrieved from https://www.maine.gov/ifw/fish-wildlife/wildlife/wildlife-human-issues/living-with-wildlife/index.html

Maine Department of Inland Fisheries and Wildlife. (2018b). State List of Endangered & Threatened Species. Retrieved from http://www.maine.gov/ifw/fish-wildlife/wildlife/endangered-threatened-species/listed-species.html

Newcomb, L. (1977). Newcomb's Wildflower Guide. New York, NY: Little, Brown and Company.

Sibley, D. (2003). The Sibley Field Guide to Birds of Western North America. 1st edition.

United States Geological Survey (USGS). 2014. National Land Cover Database. 2011 Edition.

United States Department of Agriculture. (2018). National Resources Conservation Service Plants Database. Retrieved from https://plants.usda.gov/adv_search.html

This page intentionally left blank.

APPENDIX A: PHOTOGRAPHS FROM BOTANICAL AND WILDLIFE RESOURCES SURVEYS

This page intentionally left blank.

Wetland on western shoreline of the impoundment

Mixed forest on western shoreline of the impoundment

Mixed forest on western shoreline of the impoundment

Wetland and mixed forest on western shoreline of the impoundment

Wetland and mixed forest on western shoreline of the impoundment

Wetland cover on western shoreline of the impoundment

Wetland cover on western shoreline of the impoundment

Ecosystems gradient (wetland, brush cover and deciduous forest) on eastern shoreline of the impoundment

Deciduous forest on eastern shoreline of the impoundment

Ecosystems gradient (wetland, brush cover and mixed forest) on eastern shoreline of the impoundment

Eastern shoreline of the impoundment

Wetland on eastern shoreline of the impoundment

Dam related facilities southern end of Pejepscot Project, looking downstream

Wetland on western shoreline of the impoundment

Wetland along western shoreline of the impoundment

Wetland along western shoreline of the impoundment

Wetland along western shoreline of the impoundment

Wetland along eastern shoreline of the impoundment

Wetland along eastern shoreline of the impoundment

Wetland on western shoreline of the impoundment

Wetland on western shoreline of the impoundment

Railroad adjacent to eastern shoreline of the impoundment

Boat launch at the impoundment

Canal St bridge at northern end of the impoundment

Hardened shoreline/developed areas on north-eastern end of the impoundment

Wetland cove area along eastern shoreline of the impoundment

Wetland cove area along eastern shoreline of the impoundment

Wetland cove area along eastern shoreline of the impoundment

Bald Eagles (*Haliaeetus leucocephalus*) seen at the impoundment area

Common Egret (*Ardea alba*) at the impoundment area

Great Blue Heron (*Ardea Herodias*) at the impoundment area

This page intentionally left blank.

APPENDIX E: HISTORIC ARCHITECTURAL SURVEY

Filed under separate cover as ‘Privileged’