May 7, 2021

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

Via Electronic Filing

Re: **Worumbo Hydroelectric Project (FERC No. 3428) Proposed Study Plan**

Dear Secretary Bose:

Brown Bear II Hydro, Inc. (BB2H or the Licensee), a subsidiary of Eagle Creek Renewable Energy, LLC, is relicensing the Worumbo Hydroelectric Project (FERC No. 3428) (Project) with the Federal Energy Regulatory Commission (FERC or the Commission). The FERC license for the Project expires on November 30, 2025.

In accordance with the Commission's regulations at 18 C.F.R. § 5.11, BB2H herein files the Proposed Study Plan (PSP) for the relicensing of the Project. The PSP includes responses to stakeholder comments on the Pre-Application Document (PAD) and additional information requests, individual study plans, an overview of requested studies not adopted or adopted with modification, and logistics pertaining to the study plan meeting, study reporting, and study result meetings.

BB2H will hold the PSP Meeting required by the Integrated Licensing Process (ILP) on June 7, 2021 at 9:00 am via Microsoft Teams. **If you are interested in participating in the virtual meeting, please notify Tim Sullivan (timsullivan@gomezandsullivan.com) and Matthew Nini (matthew.nini@eaglecreekre.com) via email no later than June 1, 2021.** Once notified, we will send you instructions on how to access the meeting. Comments on the PSP are due by August 5, 2021, per the Commission's regulations at 18 C.F.R. § 5.12.

If there are any questions or comments regarding the PSP, please contact Matthew Nini by email or at (973) 998-8171.

Respectfully,

David Fox
Director, Licensing and Compliance

cc: Attached Distribution List
Enclosure: Proposed Study Plan (PSP) for the Worumbo Hydroelectric Project

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CERTIFICATE OF SERVICE

I hereby certify that I caused to be served, either by U.S. First Class Mail or by electronic mail, the Proposed Study Plan upon all interested parties designated on the attached distribution list for the Worumbo Hydroelectric Project, FERC Project 3428, in accordance with Rule 2010 of the Rules of Practice and Procedure, 18 C.F.R. § 385.2010.

May 7, 2021

Brown Bear II Hydro, Inc.

David Fox
Director, Licensing and Compliance

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PROPOSED STUDY PLAN

WORUMBO HYDROELECTRIC PROJECT
FERC PROJECT NO. 3428

Submitted by:

Brown Bear II Hydro, Inc.

A subsidiary of Eagle Creek Renewable Energy

Prepared by:

GOMEZ AND SULLIVAN ENGINEERS

PAL

May 2021

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LIST OF ABBREVIATIONS AND DEFINITIONS

ºC	Degrees Celsius
3D	Three-dimensional
ABF	Aquatic base flow
AIC	Akaike's Information Criterion
APE	Area of Potential Effect
BB2H	Brown Bear II Hydro, Inc.
CARMA	Cultural & Architectural Resource Management Archive
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulations
cfs	cubic feet per second
CJS	Cormack-Jolly-Seber
cm	centimeter
Commission	Federal Energy Regulatory Commission
DMP	Dioxin Monitoring Program
DO	Dissolved oxygen
Eagle Creek	Eagle Creek Renewable Energy, LLC
El.	Elevation
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
GPS	Global Positioning System
HPMP	Historic Properties Management Plan
ILP	Integrated Licensing Process
ISR	Initial Study Report
Licensee	Brown Bear II Hydro, Inc.
m	meter
MESHPO	Maine State Historic Preservation Officer
MDEP	Maine Department of Environmental Protection
MDIFW	Maine Department of Inland Fisheries and Wildlife
MDMR	Maine Department of Marine Resources
ME	Maine
mg/L	milligrams per liter
MHPC	Maine Historic Preservation Commission

mmHg	millimeter of mercury
MW	Megawatt
National Register	National Register of Historic Places
NGVD29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NRHP	National Register of Historic Places
PA	Programmatic Agreement
PAD	Pre-Application Document
Pejepscot Project	Pejepscot Hydroelectric Project (FERC No. 4784)
PIT	Passive integrated transponder
PLC	Programmable Logic Controller
PME	Protection, mitigation, and enhancement
ppm	parts per million
Project	Worumbo Hydroelectric Project (FERC No. 3428)
PSP	Proposed Study Plan
QA/QC	Quality Assurance / Quality Control
RSP	Revised Study Plan
SD1	Scoping Document 1
SPD	Study Plan Determination
SPP	Species Protection Plan
TU	Trout Unlimited
U.S.C.	United States Code
UTM	Universal Transverse Mercator
USFWS	United States Fish and Wildlife Service
USR	Updated Study Report
VLMP	Volunteer Lake Monitoring Program
VRMP	Volunteer River Monitoring Program

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1.0 INTRODUCTION

Brown Bear II Hydro, Inc. (BB2H or Licensee), a wholly owned indirect subsidiary of Eagle Creek Renewable Energy, LLC (Eagle Creek), is licensed by the Federal Energy Regulatory Commission (FERC or the Commission) to operate the 19.4-megawatt (MW) Worumbo Hydroelectric Project (FERC No. 3428) (Project). The Project is located on the Androscoggin River in Androscoggin County, Maine (ME). On December 24, 1985, the Commission issued an Order Issuing New License for a 40-year license (effective December 1, 1985). The current license is set to expire on November 30, 2025. BB2H is in the process of relicensing the Project utilizing the Commission's Integrated Licensing Process (ILP).

In accordance with the requirements of the ILP, the Licensee filed its Notice of Intent (NOI) and Pre-Application Document with the Commission on November 23, 2020. The Licensee distributed the NOI and PAD 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 January 8, 2021. Due to the ongoing COVID-19 pandemic, FERC did not hold a site visit or public scoping meetings as is typically required under the ILP. The FERC Process Plan and Schedule included in SD1 provided agencies and interested parties an opportunity to file comments on the PAD and SD1 as well as request studies by March 23, 2021.

Comments and study requests were received from FERC, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Maine Department of Environmental Protection (MDEP), Maine Department of Inland Fisheries and Wildlife (MDIFW), Maine Historic Preservation Commission (MHPC)[1], and Trout Unlimited (TU). In accordance with the ILP requirements and SD1 Process Plan and Schedule, the Licensee is required to file a Proposed Study Plan (PSP) within 45 days following the deadline for filing comments on the PAD (i.e., by May 7, 2021). This document is the Licensee's PSP for conducting studies to inform the relicensing process.

As detailed in Section 6.0, the Licensee is proposing to conduct the following studies:

- Impoundment Trophic State Study (Section 6.1.1)
- Downstream DO and Temperature Study (Section 6.1.2)
- Benthic Macroinvertebrate Survey (Section 6.2.1)
- Downstream Aquatic Habitat Cross-section Flow Study (Section 6.2.2)
- Upstream American Eel Passage Assessment (Section 6.2.3)
- Anadromous Fish Upstream Passage Efficiency Study (Section 6.2.4)
- Downstream Passage Alternatives Study (Section 6.2.5)

[1] In preparation of the PAD, the Licensee distributed a request for information letter to applicable resource agencies and stakeholders on October 29, 2020. The MHPC comment and study request letter was received November 2, 2020 in response to the Licensee's request.

- Computational Fluid Dynamics Modeling – Downstream Passage (Section 6.2.6)
- Stranding Evaluation (Section 6.2.7)
- Debris Removal Study (Section 6.2.8)
- Historic Architectural Survey (Section 6.3.1)
- Precontact Archaeological Survey (Section 6.3.2)

Requested studies that were not adopted or that were adopted with modifications are discussed in Section 5.0.

The Licensee plans to hold the PSP Meeting required by the ILP (18 C.F.R. § 5.12) on June 7, 2021 at 9:00 am via Microsoft Teams. The purpose of the PSP Meeting will be to clarify the intent and contents of the Licensee's PSP, share any initial information or study responses, and identify any outstanding issues with respect to the PSP. **Stakeholders interested in participating in the virtual meeting should notify Matthew Nini (matthew.nini@eaglecreekre.com) and Tim Sullivan (timsullivan@gomezandsullivan.com) no later than June 1, 2021. Once notified, instructions will be provided on how to access the meeting.**

Comments on the Licensee's PSP (including any revised information or study requests) must be filed within 90 days of the PSP, or by August 5, 2021. The Licensee will then develop a Revised Study Plan (RSP) that will be filed for FERC approval no later than September 4, 2021.[2]

The enclosed PSP contains the following information:

- Study Reporting and Meetings – Section 2.0
- Response to Comments and Additional Information Requested – Section 3.0
- Comments on the Proposed Study Plan – Section 4.0
- Requested Studies Not Adopted or Adopted with Modification – Section 5.0
- Individual Study Plans – Section 6.0

[2] Note that September 4, 2021 is a Saturday. In accordance with FERC regulations, deadlines that fall on weekend days or federal holidays will default to the following Monday or business day.

2.0 STUDY REPORTING AND MEETINGS

The Licensee intends to conduct the studies outlined in Section 6.0 during the 2022 field season. The estimated start and completion dates for the field efforts associated with the proposed studies are provided in Table 2.0-1. Study progress reports will be filed with the Commission halfway through the study season (i.e., approximately late July/early August 2022).

In accordance with the Commission's regulations, the Licensee will file its Initial Study Report (ISR) no later than one year following issuance of FERC's Study Plan Determination (SPD). Based on the schedule provided in SD1, this is anticipated to be no later than October 4, 2022 with the ISR Meeting occurring October 19, 2022. The Licensee will file an Updated Study Report (USR) for those year one studies that were not completed at the time of the ISR and/or year two studies (if necessary) as detailed in FERC's Project Process Plan and Schedule published in SD1.

Table 2.0-1: Estimated Start and Completion Field Dates for Proposed Studies

Proposed Study	Estimated Start Date	Estimated Completion Date
Proposed 2022 Studies		
Impoundment Trophic State Study	June 2022	October 2022
Downstream DO and Temperature Study	June 2022	October 2022
Benthic Macroinvertebrate Survey	July 2022	September 2022
Downstream Aquatic Habitat Cross-section Flow Study	June 2022	October 2022
Upstream American Eel Passage Assessment	June 2022	August 2022
Anadromous Fish Upstream Passage Efficiency Study	April 2022	July 2022
Downstream Passage Alternatives Study	*No fieldwork*	
Computational Fluid Dynamics Modeling – Downstream Passage	June 2022	August 2022
Stranding Evaluation	June 2022	September 2022
Debris Removal Study	2022	2023
Historic Architectural Survey	June 2022	October 2022
Precontact Archaeological Survey	June 2022	October 2022
Proposed 2023 Studies		
None proposed at this time		

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3.0 RESPONSE TO COMMENTS AND ADDITIONAL INFORMATION REQUESTED

The Licensee received comments on the PAD from several groups including MDEP, MDIFW, NMFS, and USFWS. The Licensee appreciates the time and effort taken to provide such comments. Specific comments warranting a response are noted in the ensuing sections.

3.1 Project Operations & Facilities

Impoundment Water Levels (MDIFW)

MDIFW requests a summary of impoundment water level information for the past 5 years. We are particularly interested in the frequency and duration of drawdown events that exceeded 1.5 feet from the "typical" impoundment elevation. In addition, MDIFW would like the Licensee to explore the feasibility of reducing drawdowns to no more than 1 foot to minimize resource impacts, and in effort to create more operational consistency across the various hydroelectric projects in the lower Androscoggin River drainage.

Response

The requested water level information is included in Appendix A. As observed in the appendix, the Project operated in a run-of-river mode for the period examined. The impoundment water surface elevation was held stable with the exception of natural high flow events, periods when the flashboards failed, or during other brief maintenance periods. During periods when the flashboards failed, the impoundment water surface elevation was held stable at a lower elevation until the flashboards could be reset in early summer. As observed in Table 3.1-1 and Appendix A, there were six dates from 2016-2020 when the impoundment water surface elevation was more than 1.5 feet below elevation (El.) 98.5.[3] On these dates, the impoundment water surface elevation ranged from 96.97-96.60. These instances corresponded with times when failed flashboards were reset or other maintenance activities were occurring.

[3] All elevations referenced in this document refer to the National Geodetic Vertical Datum of 1929 (U.S. Feet) unless otherwise noted.

Table 3.1-1: Instances when the impoundment water surface elevation was below El. 97.0 (2016-2020)

Date	Time	Impoundment Water Surface Elevation
06/22/2017	9:00	96.67
	12:00	96.65
	15:00	96.65
06/23/2017	9:00	96.68
06/06/2018	9:00	96.61
	12:00	96.60
	15:00	96.86
06/14/2019	9:00	96.84
	12:00	96.76
	15:00	96.77
	18:00	96.92
06/14/2020	12:00	96.67
12/14/2020	12:00	96.97

Minimum Flows (MDIFW)

MDIFW requests more information regarding the basis for determining the 1,700 cfs minimum flow used in the current license and proposed for the new license. Resource agencies often use Aquatic Base Flow (ABF) when exploring minimum flow levels; however, flow data presented in Figure 4.3.1.2.4 suggests median August flow is closer to 3,000 cfs. Based on the best and most recent available data, MDIFW requests the ABF for the Project location…MDIFW requests access to more detailed flow data to examine how frequently the Project operates at the current minimum flow level or less.

Response

The current license requires that the Project provide a downstream minimum flow of 1,700 cfs or inflow, whichever is less, only if the impoundment is drawn down below El. 98.5. There is no downstream minimum flow requirement (other than the bypass minimum flow) when the impoundment is at, or above, El. 98.5. It is unclear how the 1,700 cfs was determined, however, it is likely that it is related to the 1983 Androscoggin River Headwater Benefits Agreement, which requires the upper storage system to provide a target flow of 1,550 cfs as measured at the Gorham, NH USGS gage. The Androscoggin River is a highly regulated river which relies on flow releases from the upper storage system and incremental inflow from the surrounding basin. The 1,700 cfs minimum flow requirement likely represents a combination of these hydrologic sources.

For the period examined, the Project operated in a run-of-river mode such that inflow equals outflow regardless of the impoundment water surface elevation (e.g., during periods when the flashboards have failed and the impoundment water surface elevation is below El. 98.5). Detailed flow data requested by MDIFW can be found in Appendix A. Hydrologic characteristics of the Androscoggin River in the vicinity of the Project is also discussed in Section 4.3.1 of the PAD.

Bypass Minimum Flows (MDIFW)

The Licensee is proposing to continue the bypass flows for the term of the new license with the same limitations and resource impacts that existed when the Article 31 agreement was made in the 1990's. The Licensee provided mitigation funds to address this deficiency, but it is unclear if any type of mitigation would continue. If not, the Licensee should propose new mitigations to the resource agencies that would adequately address the Article 31 findings.

Response

The comment has been noted. The Licensee will include its protection, mitigation, and enhancement (PME) proposal in its license application.

Upstream Anadromous Fish Passage (MDIFW)

It is unclear to MDIFW if fish passage is volitional or if there is some type of screening process for invasives similar to the Brunswick Hydro facility downstream – this should be clarified, as well as how staff handle invasive species when they are encountered.

Response

Generally speaking, upstream fish passage at the Project is considered volitional since the Licensee does not sort or trap and transport any fish that approach the lift. There is no screening process for invasives at the Project. During the passage season, the fish lift system is operated from 7:00 am to 5:30 pm seven days a week. The timer for daily fish lift cycle events is set for every two hours (9:00 am, 11:00 am, 1:00 pm, 3:00 pm, and 5:00 pm). BB2H staff is responsible for normal operation and maintenance, and the facility is inspected and cleaned daily. Maine Department of Marine Resources (MDMR) is responsible for overseeing normal routine fish management (as well as USFWS and MDIFW), and NMFS is responsible for activities related to Atlantic Salmon. During the Alewife run, a rotating gate system installed downstream of the fish viewing window and a wall-mounted crowder system are used to move fish in front of the viewing room window for counting. After the Alewife run is over, the rotating fish gate is removed and a video camera system that records the last 30 seconds of each hopper life cycle is used to count fish being passed upstream. There is not screening process for invasives at the Project.

Upstream Fish Passage Facilities (NMFS)

…the following information is necessary:

1. *The river flow and corresponding pond elevation at which the fishway is shut down to protect the fish lift.*

2. *The design population for American shad, alewife, blueback herring, and Atlantic salmon.*

Response

Responses to the NMFS comment are as follows:

1. The fishway is shut down to protect the fish lift when the pond level reaches approximately El. 99.5, which corresponds to roughly 15,000 cfs (though this value may depend on the number of flashboard panels that are down at a given time).

2. The Licensee is still gathering this information and will provide it once it becomes available.

Downstream Fish Passage Facilities (NMFS)

…the following information is necessary:

1. *The flow and corresponding headpond elevation that the downstream bypasses are closed.*

2. *The elevation of any horizontal steel members on the grizzly racks, if any.*

Response

Responses to the NMFS comment are as follows:

1. The downstream bypasses are not closed during periods of high flow.

2. Horizontal steel members on the grizzly racks are located at the following elevations: 51.6, 61.5, 71.4, and 82.2.

Miscellaneous Information Requests (USFWS)

The following information is needed to understand project-effects:

- *Additional photographs of the eel passage system, including photographs of the trap and any drawings of the trap;*

- *How often the Licensee monitors the upstream eel holding tanks (i.e., how often are eels counted and measured);*

- *A thorough description of how project operations are monitored and recorded; and*

- *Hourly data (water surface elevations, dam discharge, generation) for the project in spreadsheet format for the past 5 years*

Response

Responses to the USFWS comment are as follows:

- Photographs of the eel passage system are included in Appendix B.

- Eels are counted and measured an average of 3 times a week on Monday, Wednesday, and Friday. In addition, the upstream system is cleaned and maintained on these days.

- Miller Hydro submitted a Project Water Level/Flow Release Plan on October 14, 1999. This plan stated that impoundment levels are set and maintained using a programmable logic controller (PLC). For run-of-river conditions, the control system is set to maintain a pond elevation that will provide the required seasonal minimum bypass flows defined under the Project's 1998 amended license. A table of calculated flows over the west wide panels is available for various heights and configurations that can be used to determine the appropriate set point to enter into the station PLC for the headpond level control system. Impoundment levels and crest gate elevations are varied as needed to maintain the required seasonal minimum flow releases from the west side spillway. During flood conditions, the pneumatic crest gates are lowered to provide discharge capacity, with the west side crest gates set to automatically lower when the pond elevation reaches approximately 2 feet above the determined set point. After the west gate are lowered, the east side crest gates are set to lower automatically when the pond elevation again reaches approximately 2 feet above the set point. Elevations can be modified by station operators. The mechanical panels are designed to fail at approximately El. 101. During impoundment drawdown, station operators maintain the appropriate pond level set point that will progressively lower the gates in order to maintain a constant bypass flow at the required seasonal level. During impoundment refill, station generators are operated to provide a total discharge of at least 1,700 cfs.

- Impoundment water surface elevation, inflow, and outflow are presented in Appendix A. The Project does not record all of the parameters requested on an hourly basis. As such, data presented in the appendix are on a three hour timestep. A spreadsheet of the operational data is available upon request.

3.2 Water Resources

Streamflow, Gage Data, and Flow Statistics (NMFS)

The flow data should match the period of record that was provided for the generation data on page 20 Section 3.4.4. In order to more accurately represent changes to streamflow as a result of climate change, we recommend that you use most recent 10 years of data (2010 to 2020) in the development of the flow duration curves and mean daily flow curves.

Response

The flow data analyzed for the PAD represented the period 1987-2020. Using an expanded period of record in such an analysis is consistent with scientific practice in order to analyze long-term trends. That said, the flow duration curves from the PAD have been updated to also include a dashed line representing the period 2010-2020 as requested. Updated flow duration curves are found in Appendix C.

3.3 Fish & Aquatic Resources

Invasive Species (MDIFW)

Page 77 discusses several invasive species including Northern Pike, Black Crappie, and White Catfish, but does not include Carp and Rock Bass. We suggest a specific section on invasives similar to the Wildlife and Plant Sections.

Response

The comment has been noted. Changes to Fish and Aquatic Resources sub-sections, if any, will be made in the license application.

Upstream Passage Counts – Sea Lamprey (MDIFW)

Based on MDIFW experience, the sampling techniques utilized by Yoder would not likely be sufficient for documenting the presence of juvenile Sea Lamprey. It would also be valuable to reviewers if the passage of adults for this species at the two downstream facilities were reported.

Response

Yoder et al. (2006) surveyed multiple rivers using boat electrofishing methods. These methods have been shown to document the presence and relative abundance of Sea Lamprey (including juveniles and ammocetes) on other studies of Maine rivers. For example, Kiraly et al. (2015)[4] documented immature Sea Lamprey throughout the mainstem Penobscot River and within tributaries, in areas above multiple dams, using boat electrofishing. Yoder et al. (2006) documented the presence of juvenile/ammocoete lamprey in the Androscoggin River downstream of the Brunswick Dam, and on the Kennebec River, where most individuals were observed between Augusta and Waterville. The lack of Sea Lamprey juveniles/ammocoetes at any of the surveyed sites on the Androscoggin River upstream of the Brunswick Project suggests that abundance would currently be very limited, and potentially non-existent, at the Worumbo Project.

Adult Sea Lamprey counts at the Brunswick Fishway from 2000-2019 were provided in Table 4.4.4.2-1 of the PAD. No counts are available from the Pejepscot Fishway.

Upstream Passage Counts – Brook Trout (MDIFW)

It is unclear how brook trout are being handled--are they being passed or released back into the tailrace? Is there any indication whether they are of wild or stocked origin? The last column of table indicates "Other"-please provide a footnote of all other species encountered (counts not necessary).

Response

Fish counts at the Worumbo Fishway, including those for Brook Trout, would have been made at the viewing window after being lifted. They were not captured or handled, and no data were collected from those individuals. Brook Trout are stocked downstream of the Worumbo Project by MDIFW in the spring as part of a seasonal put-and-take fishery, and it is possible that some of these fish are utilizing the Project fish lift. "Other" species passed at the Worumbo Project fishway include Sunfish, Pickerel, White Perch, Yellow Perch, and Black Crappie.

It should be noted that Brown Trout are also passed at the Worumbo Project fishway. Counts for this species were unintentionally omitted from Table 4.4.4.2-2 of the PAD but will be included in the license application. This species is stocked into the Little River (along with Brook Trout), and some of these

[4] Kiraly, I.A., Coghlan, S.M., Zydlewski, and D. Hayes. 2015. An assessment of fish assemblage structure in a large river. River Research and Applications 31: 301-312.

individuals appear to be using the Project fishway. Similar to Brook Trout, these fish were not captured, and no data were collected from them. An updated Table 4.4.4.2-2 includes the following data:

Revised PAD Table 4.4.4.2-2

Year	Atlantic Salmon	River Herring	American Shad	Brown Trout	Brook Trout	Smallmouth Bass	White Sucker	Other
2000	5	2	-	2	235	8	16	0
2001	4	7,876	-	18	3	246	13	23
2002	30*	21,344	-	19	0	208	26	23
2003	1*	26,315	-	22	0	156	30	25
2004	1	42,725	7	27	7	296	56	23
2005	0	2,038	0	7	0	126	6	12
2006	2	9,826	0	2	3	100	1	9
2007	7	19,078	0	5	5	157	7	9
2008	2	46,746	0	11	4	112	17	15
2009	1	14,961	0	3	1	87	5	9
2010	5	11,952	0	0	2	114	0	30
2011	3	136	0	3	3	93	0	181
2012	1	58,654	0	3	8	400	9	85
2013	1*	28,714	0	5	6	219	11	18
2014	2*	37,113	0	3	5	327	3	12
2015	0	59,200	18	12	24	400	50	25
2016	0	12,807	45	14	15	418	12	30
2017	0	11,200	0	0	18	607	6	14
2018	0	73,073	1	45	2	636	30	8
2019	0	10,326	9	4	39	759	2	39
2020	1	24	0	2	34	424	0	48

**Denotes Atlantic Salmon identified as Landlocked.*

3.4 Recreation

Miller Park (MDIFW)

MDIFW requests that the Licensee provide information regarding any Town hours, rules, or regulations that have been imposed on [Miller Park].

Response

Miller Park and the Papermill Road Bicycle/Pedestrian Trail is open from 7 AM to sunset. Restrictions imposed by the Town of Lisbon include the following: no motorized vehicles (except emergency and maintenance vehicles, motorized wheelchairs, and snowmobiles), no alcohol, no smoking or fires, no

firearms or hunting, no littering, no camping, and all dogs must be on leash. In the Miller Park parking lot, the Town of Lisbon has imposed a combined gross vehicle weight limit (including vehicle, boat, and trailer) not to exceed 12,000 pounds.

Lisbon Falls Fishing Park (MDIFW)

…this is a relatively large water and access to both sides of the tailrace would be beneficial. Is there any access to the western side of the tailrace? If not, the Licensee should explore its feasibility as part of this relicensing process.

Response

The Licensee does not understand specifically where MDIFW is referring to when they note "the western side of the tailrace." Please provide additional clarification regarding the location noted. There is currently access to both sides of the river downstream of the dam and powerhouse.

3.5 Socio-economic

Table 4.11.5-3 (MDIFW)

Minor correction – we believe business description is reversed for Rank 9 and 10.

Response

The business descriptions noted in Tables 4.11.5-3 through 4.11.5-5 were created using third quarter 2019 data. Second quarter 2020 has since been released. The tables will be updated with the most recent information available in the license application.

4.0 COMMENTS ON THE PROPOSED STUDY PLAN

Comments on the PSP, including any revised information or study requests, must be filed within 90 days of the filing of the PSP (i.e., August 5, 2021).

In the RSP, this section will include a responsiveness matrix summarizing stakeholder PSP comments and Licensee responses. Comments will be organized by the entity which submitted them, with each comment having a unique ID.

Table 4.0-1: Matrix of PSP Comments and Responses

Comment ID	Stakeholder Comment	Licensee Response
TO BE POPULATED IN REVISED STUDY PLAN		

5.0 REQUESTED STUDIES NOT ADOPTED OR ADOPTED WITH MODIFICATION

BB2H received comment letters from six different stakeholder groups or resource agencies. Combined, these letters contained 21 study requests, several of which had significant overlap or were nearly identical. In total, BB2H is proposing to conduct 12 studies as detailed in Section 6.0. Of the 12 studies proposed, eight are being proposed as requested while the remaining four are being proposed with modifications to the requested methodology. BB2H is not proposing to conduct five of the originally requested studies; however, two of the five studies not proposed pertain to downstream fish passage. As detailed in the ensuing sections, BB2H has developed an alternative approach to examining downstream fish passage that will satisfy the concerns of the resource agencies while still gathering the information needed to develop potential PME measures.

As required by the federal regulations (18 C.F.R. § 5.11(b)(4)), if the Licensee does not adopt a requested study, an explanation of why the request was not adopted, with reference to the criteria set forth in 18 C.F.R. § 5.9(b), must be included in the PSP. Study criteria detailed in 18 C.F.R. § 5.9(b), include the following:

1. Describe the goals and objectives of each study proposal and the information to be obtained;

2. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

3. If the requestor is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;

4. Describe existing information concerning the subject of the study proposal, and the need for additional information;

5. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;

6. Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge; and

7. Describe the considerations of level of effort and cost, as applicable, and why proposed alternative studies would not be sufficient to meet the stated information needs.

Studies that were not adopted, or adopted with modifications, were generally done so because the requested study, or elements of the requested study, did not meet FERC's study criteria – in particular, criteria 4, 5, 6, or 7. Detailed explanations for why a study was proposed with modifications, or not proposed at all, are provided in the sections below.

5.1 Study Requests Adopted with Modification

The Licensee has adopted the following study requests with certain modifications to the study methodology and/or level of effort requested by the respective resource agencies.

5.1.1 Water Quality Monitoring

FERC requested that the Licensee conduct a water quality monitoring study that would provide information sufficient to enable FERC staff to understand current water quality conditions at the Project and assess any effects of Project operation on dissolved oxygen (DO) and temperature in the Project impoundment, bypassed reach, and tailrace. This study request has been consolidated with the *Impoundment Trophic State Study* and the *Downstream DO and Temperature Study*. Study plans for these studies are contained in Section 6.1.1 and 6.1.2, respectively.

5.1.2 Impoundment Aquatic Habitat Study

MDEP requested that the Licensee conduct an impoundment aquatic habitat study to determine the effect of impoundment drawdowns on the impoundment's littoral zone and the ability of the impoundment to support fish and other aquatic life. MDEP notes in their comment letter that the Project operates in run-of-river mode; therefore, normal operations should not greatly affect the littoral zone. Furthermore, MDEP notes that as an alternative to conducting the requested study, the Licensee may provide at least three years of impoundment elevation and inflow/outflow data for the Project to demonstrate that the Project operates in a run-of-river mode.

The requested data can be found in Appendix A. As observed in the appendix, the Project operates in a run-of-river mode. As a result, the originally requested impoundment aquatic habitat study is not necessary.

5.1.3 Cultural Resources Study

FERC requested that the Licensee conduct a Cultural Resources Study to evaluate the effects of Project operations, maintenance, and recreational activities on any cultural resources that may occur around the Project impoundment. This study request has been consolidated with the cultural resource studies requested by MHPC detailed in Section 6.3.

5.1.4 Three-Dimensional Computational Fluid Dynamics Modeling in the Vicinity of Fishway Entrances and Powerhouse Forebays

The USFWS requested a study titled *Three-Dimensional Computational Fluid Dynamics Modeling in the Vicinity of Fishway Entrances and Powerhouse Forebays*. The goal of the requested study was to determine the flow field conditions that exist in and around fishway entrances and the powerhouse forebay and to better understand the interaction between the hydraulics of the upstream fishway jets and the discharge from the units to identify where fish may become disoriented due to vortices and eddies.

To evaluate the effectiveness of downstream fish passage, the Licensee is proposing to conduct the *Downstream Passage Alternatives Study* (Section 6.2.5), *Computational Fluid Dynamics Modeling – Downstream Passage* (Section 6.2.6), and the *Debris Removal Study* (Section 6.2.8). The Computational Fluid Dynamics (CFD) modeling as proposed will satisfy the USFWS' goals pertaining to downstream passage.

Regarding upstream passage, the Licensee is proposing to conduct the *Anadromous Fish Upstream Passage Efficiency Study* (Section 6.2.4), which will evaluate whether the existing upstream fishway provides safe, timely, and effective passage for blueback herring, alewife, American Shad, and Atlantic Salmon. The Licensee is not proposing to conduct CFD modeling to examine upstream passage at this time as it is premature to conduct such a costly study until the results of the proposed upstream passage efficiency study

have been reviewed. In this instance, CFD modeling would best be utilized as a tool to support the final design phase of any upstream fish passage facility improvements at the Project, if such improvements are found to be necessary. Until that time, the Licensee has not adopted the upstream passage portion of this study request. This stepwise approach is consistent with other recent relicensings in Maine, including the downstream Pejepscot Hydroelectric Project (FERC No. 4784) (Pejepscot Project).

5.1.5 **Stranding**

NMFS requested that the Licensee conduct a stranding evaluation to determine if the operation and maintenance of the Project results in the stranding of various life stages of fish or other aquatic species, particularly in the bypass area. More specifically, NMFS requested that the Licensee identify which areas below the spillway and under which operational scenarios the risk for stranding occurs. To accomplish this, NMFS requested that the Licensee (1) collect three-dimensional (3D) topobathymetric data in areas identified as sensitive to flow fluctuations, (2) identify Project operations, such as flow fluctuations at particular flow levels that pose a high risk of causing stranding, and (3) evaluate the numbers of fish that become stranded in the bypass under the conditions of spill, then no spill.

As detailed in Section 6.2.7, the Licensee is proposing to conduct a one-day spill demonstration with the resource agencies to evaluate the potential for stranding below the spillway. Based on the results of the spill demonstration, potential PME measures will be identified to eliminate stranding issues, if such issues are observed. The Licensee is not proposing to conduct topobathymetric mapping as it is unnecessary to accomplish the goals and objectives of the study. The methodology proposed by the Licensee in Section 6.2.7 is consistent with the methodology previously approved by FERC, and agreed to by NMFS, at the downstream Pejepscot Project.

5.1.6 **Debris Removal Study**

NMFS notes in their study request that the Project is known to accumulate large amounts of debris, particularly in the entrances and gallery of the downstream fish bypass. NMFS states that the goal of the requested study is to quantify the effort over time to remove debris from the downstream bypass facilities, to describe the magnitude of each individual effort, and to determine the sufficiency of existing Project operations and structures in managing debris accumulations. To accomplish this, NMFS requested that the Licensee review the operator's logbooks over at least the last 20 years to enumerate the number of times a year when the downstream passages were cleaned of debris, how much debris was removed, and any specific issues removing the debris.

Based on a preliminary review of available information, it does not appear that the historic information requested by NMFS exists. The Licensee has not historically maintained debris removal records as detailed as that which were requested. Given this, the Licensee proposes to collect the requested information during the 2022 and 2023 fish passage seasons. The results of the study will be anecdotally compared to past years to determine if they were representative of long-term conditions. Section 6.2.8 details the Licensee's approach to this study.

5.1.7 **Upstream American Eel Passage Assessment**

The USFWS requested that the Licensee conduct an assessment of upstream American Eel passage at the Project to determine the impact of the Project on upstream migration of American Eels in the Androscoggin River. To accomplish this, the USFWS requested that the Licensee conduct a multi-year study that would include:

- conducting systematic surveys of eel presence/abundance at the Project to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage;

- collecting eels with temporary traps/pass devices at areas identified from surveys as potential locations of eel concentration to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures; and

- assessing movement of juvenile American Eels through the existing upstream eel passage system via passive integrated transponder (PIT) tags to quantify the number of attempts required to pass through the fishway, identify any particular areas within the passage system which may provide problematic conditions to continued upstream movement, and estimate the probability of successful upstream eel passage.

Since 2012, the Licensee has installed and operated an upstream eel passage system at the Project seasonally. The system is installed annually upon recession of high flows in the spring and is operated until August 31 each year in consultation with the MDMR. The Licensee monitors the holding tank during operation, during which eels are regularly counted and their lengths estimated before being released into the Project impoundment. Appendix B contains photographs of the upstream eel passage system. The Worumbo Project is the only project downstream of Lewison Falls that currently has a dedicated upstream eelway.

The level-of-effort requested by the USFWS is not commensurate with a Project that has an existing eelway. In lieu of conducting the study as proposed by USFWS, the Licensee is proposing to conduct one year of night-time visual surveys and observations of the existing upstream eel passage system. The proposed methodology will determine the presence/abundance of American Eel at the Project and assess potential issues, if any, with the existing upstream eel passage system. The Licensee is not proposing to conduct PIT tagging of juvenile eels due to the speculative results that would arise.[5]

The results of the study will be used to inform potential PME measures, if any additional measures are found to be necessary. The proposed methodology will still satisfy the overall goals of the upstream eel passage assessment but at the appropriate level-of-effort. The level-of-effort proposed is consistent with other relicensings in Maine, including the downstream Pejepscot Project (which does not currently have upstream eel passage).

5.2 Study Requests Not Adopted

The Licensee has not adopted the studies detailed below. Rationale for not adopting the requested studies is included in the ensuing sections.

5.2.1 Downstream Fish Passage Effectiveness and Survival: Behavior, Entrainment, and Impingement at the Intake

NMFS requested that the Licensee evaluate (1) the behavior of outmigrating juvenile and adult river herring, American Shad, and juvenile Atlantic Salmon at the Project intakes; (2) the potential level of entrainment and impingement of the species/lifestages at the Project intakes; (3) the survival of these

[5] Tagged juvenile eels may not all be equally driven to migrate upstream, and may reside in downstream habitats for undetermined periods of time post-tagging, or may pass upstream undetected via other routes at the Project.

species and lifestages that pass through the downstream fish bypass, turbines, and spillway; and (4) delays in downstream passage at the Project for these species and lifestages. NMFS requested that field studies involving both radio telemetry and direct turbine injection studies should be performed at the Project to determine routes of passage, effectiveness of existing downstream fishways, and survival through Project turbines, spillway, and other routes of passage.

As noted in NMFS' comment letter (page 15), "[t]he downstream passage is not designed to today's standards for either USFWS or NMFS and is likely insufficient to adequately pass most species and life stages of migrating fish." The NMFS letter goes on to state (page 16) that "[t]he project lacks any guidance structure to guide fish away from the turbines and physical exclusion for any lifestages for all species of diadromous fish, and adequate flows and resulting velocities to provide significant cues towards the downstream passages." Given this, the Licensee does not see the benefit in conducting extensive and costly studies on a potentially outdated system that may end up being dramatically changed as a result of this licensing proceeding. In lieu of conducting the requested study (and the *Downstream American Eel Passage Assessment* requested by USFWS – see next section), the Licensee instead proposes to conduct the following studies to evaluate downstream fish passage: *Downstream Passage Alternatives Study* (Section 6.2.5), *Computational Fluid Dynamics Modeling – Downstream Passage* (Section 6.2.6), and *Debris Removal Study* (Section 6.2.8). The results of these studies, in consultation with the resource agencies, will be used to identify the appropriate PME measures, as necessary, for improving downstream fish passage at the Project.

5.2.2 Downstream American Eel Passage Assessment

The USFWS requested that the Licensee conduct an assessment of downstream American Eel passage to determine the impact of the Project on the outmigration of silver eels in the Androscoggin River. See Section 5.2.1 for discussion pertaining to the Licensee's approach to downstream fish passage.

5.2.3 Headpond Predation

NMFS requested that the Licensee quantify the effect of predation by non-native predators on native anadromous fish in the Worumbo Project impoundment. NMFS noted that the study should include (1) sampling to obtain species assemblages/relative abundance during the spring, summer, and fall; (2) an evaluation of the risk of predation utilizing telemetry data to evaluate downstream migration speed; and (3) a method to identify and quantify predation events. Such methods could potentially include gut content analysis/development of a bioenergetics model, use of acoustic tags with predation detection technology, or use of predation even recorders.

The Licensee is not proposing to conduct this study for several reasons, including (1) there is no nexus between Project operations and effects on the predation by non-native predators on native anadromous fish in the Project impoundment, (2) the environmental baseline in FERC relicensing is the environment as it exists at the time of licensing – an impoundment has existed for over 100 years prior to the establishment of the Worumbo Project, and (3) the study would not inform the development of license conditions as required by FERC's study plan criteria.

Of particular relevance to this proceeding, NMFS requested a very similar study during the relicensing proceeding for the downstream Pejepscot Project in 2018. In their SPD, FERC found that the requested study was not required. As noted in FERC's SPD:

> *These adult* [Atlantic Salmon] *return numbers suggest that the recent number of out-migrating salmon smolts passing downstream through the project's impoundment is very small, likely not exceeding more than a few hundred smolts per year.*
>
> *Given the low number of smolts that would be passing through the impoundment in any year, it is very unlikely that Topsham Hydro would be able to obtain sufficient samples of predatory fish guts containing juvenile salmon to produce a reliable predation estimate. Additionally, even if it were to develop a reliable predation estimate, it's unclear how this data would be used to develop license requirements. The project operates in a run-of-river mode and has little to no operational flexibility that could be used to intentionally alter the existing fish community…Moreover, according to Maine DMR and Maine DIFW's 2017 draft fisheries management plan for the lower Androscoggin River, the lower river is managed to sustain production and a migration corridor for Atlantic salmon and other diadromous fish species. However, it is also managed to provide popular recreational fisheries for smallmouth and largemouth bass…Therefore, any potential license requirements directed at reducing the population sizes of these non-native predatory fish would be inconsistent with the state's management of the fishery resource of the Androscoggin River. For these reasons, we do not recommend requiring a study of non-native fish predation on juvenile Atlantic salmon in the project's impoundment.*

FERC's SPD decision was further upheld by a Study Dispute Resolution panel, which found that no change in the SPD was necessary. For the reasons noted above, combined with the existing FERC precedent, the Licensee is not proposing to conduct the requested study.

5.2.4 **Project Acoustic Effects Study**

NMFS and the USFWS requested that the Licensee evaluate Project effects on the behavior of American Shad by determining if audible and ultrasonic sounds created by the turbine generator units and/or the attraction water pumps have an effect on the passage efficiencies of American Shad through the lifting mechanism at the Project.

The Licensee is proposing to conduct the *Anadromous Fish Upstream Passage Efficiency Study* (Section 6.2.4), which will evaluate whether the existing upstream fishway provides safe, timely, and effective passage for blueback herring, alewife, American Shad, and Atlantic Salmon. The Licensee is not proposing to conduct the *Project Acoustic Effects Study* at this time as it is premature to conduct such a study until the results of the proposed efficiency study have been reviewed. This stepwise approach is consistent with other recent relicensings in Maine, including the downstream Pejepscot Project.

5.2.5 **Bass Population Study**

MDIFW requested that the Licensee conduct a bass population study to provide information regarding the status of the bass populations in the Project impoundment, particularly Smallmouth Bass. MDIFW requested that the study include the collection of biometric data to characterize bass population dynamics and relative abundance of other fish species, and an assessment of bass spawning habitat and nesting areas with differentiation by species (Largemouth and Smallmouth Bass).

The Licensee is not proposing to conduct the requested study as adequate information already exists to characterize the fish assemblage in the Project area and the requested study has no nexus to Project operations nor would it inform license conditions as required by FERC's study plan criteria. MDIFW

requested a very similar study during the relicensing proceeding for the downstream Pejepscot Project in 2018. In their SPD, FERC found that the requested study was not required. As noted in FERC's SPD:

> *Sufficient information exists to describe species composition and relative abundance of fish in the reservoir. Neither Topsham Hydro nor Maine DIFW explains how project operation affects bass spawning and nesting areas and how the data would lead to possible license conditions (section 5.9(b)(5))…Therefore, we do not recommend requiring Topsham Hydro to conduct a survey of bass spawning habitat in the project impoundment.*

For the reasons noted above, combined with the existing FERC precedent, the Licensee is not proposing to conduct the requested study.

5.3 References

Federal Energy Regulatory Commission (FERC). 2018. Study Plan Determination for the Pejepscot Hydroelectric Project. July 3, 2018.

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6.0 INDIVIDUAL STUDY PLANS

6.1 Water Quality

6.1.1 Impoundment Trophic State Study

MDEP requested that the Licensee conduct two water quality studies – the *Impoundment Trophic State Study* and the *Downstream DO and Temperature Study*. The study plan for the *Impoundment Trophic State Study* is detailed below, while the *Downstream DO and Temperature Study* is detailed in Section 6.1.2.

Goals and Objectives

The goal of the study is to determine if the Project reservoir meets Maine Water Quality Standards. The objective is to collect periodic water quality data in the Project reservoir during low flow, warm temperature conditions.

Known Resource Management Goals

MDEP notes that the resource management goal is to ensure attainment of Maine Water Quality Standards pursuant to the provisions of the Water Classification Program, 38 M.R.S. Sections 464-468 and to certify attainment of such, with any necessary conditions, under Section 401 of the Federal Water Pollution Control Action (a.k.a. Clean Water Act).

Water Quality Standards

The waters of the mainstem of the Androscoggin River in the vicinity of the Project are classified by the State of Maine as Class C waters, as is the Sabattus River between Sabattus Pond and the Androscoggin River. Class C waters must meet standards ensuring suitability for the following: drinking after treatment, agriculture, fishing, recreation in and on water, industrial processes and cooling water supply, navigation, as habitat for fish and other aquatic life, and hydroelectric power generation, except as prohibited under Title 12, section 403. DO must meet a minimum of 5 parts per million (ppm) or 60% saturation, whichever is greater. Discharges to Class C waters may cause some changes to aquatic life, except that the receiving waters must be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

Background and Existing Information

Existing water quality data was summarized in Section 4.3.2.3 of the PAD. As detailed in the PAD, the Lower Androscoggin River was monitored by several organizations near the Project as part of the following programs:

- Worumbo DO Monitoring Project 1990-1994
- MDEP 2010 Lower Androscoggin River Basin Water Quality Study Modeling Report
- Volunteer River Monitoring Program (VRMP)
- Dioxin Monitoring Program (DMP) and Fish Consumption Information

Based on review of available historic information, the Project Area meets the Class C water quality classification qualifications. MDEP notes in their study request that the existing information is not adequate to demonstrate that Project operations meet DO and other water quality standards in the impoundment.

Project Nexus

Continued operation of the Project is not expected to impact water quality negatively; however, the information gathered from this study will help confirm that the Project meets Maine's Class C water quality criteria.

Methodology

Water quality parameters for this study will be collected using MDEP's Sampling Protocol for Hydropower Studies (March 2021). Described below are the methods for data collection (Task 1), data analysis (Task 2) and reporting (Task 3).

Task 1: Methods for Impoundment Trophic State Study

All field personnel involved in sampling for this study (and the *Downstream DO and Temperature Study* in Section 6.1.2) will be certified for the protocol by MDEP's Division of Environmental Assessment, Lake Assessment Section. Arrangements for certification will be made in advance and will likely involve a qualified member of MDEP visiting the field crew on-site for training prior to or on the first day of the study.

Data collection will occur twice per month from June through October 2021, with additional water samples obtained in August, at location A81 (Figure 6.1.1-1), which is located 0.75 miles above the dam and was used in 2010 by MDEP as part of a water quality modeling study for the Lower Androscoggin River. This location will be marked with an anchored buoy and georeferenced with a GPS. Sampling will consist of collecting data for: 1) Secchi disk transparency depth, 2) vertical profiles for temperature and DO, and 3) water samples (i.e., chlorophyll a, total phosphorus, nitrate, TKN, color, DOC, pH, total alkalinity, and potentially others if the impoundment stratifies). These parameters are discussed in more detail below. Field notes will be recorded each day with weather conditions, personnel present, operations (e.g., reservoir water surface elevation) and any other pertinent observations made during the field work.

Water Clarity

Water clarity will be measured at the sampling location in the impoundment during each field visit (twice a month) using a Secchi disk and an Aquascope. The depth at which the Secchi disk is no longer visible through the Aquascope will be recorded. The Secchi depth will be measured and recorded twice, and the average of the two measurements will be considered the final measurement.

Vertical Profiles

A vertical profile will be collected at the sampling location during each field visit (twice a month). Readings will be obtained at 1-meter increments from the surface to 15 meters (m) depth, 2-meter increments from 15-25 m depth, and every 5 m in water deeper than 25 m. If there is a rapid change in temperature or DO between 15 and 25 m, readings will be taken at 1 m intervals until they stabilize. One replicate profile measurement will be taken for every profile collected. Replicates will be obtained outside of the metalimnion (if applicable) to avoid remeasuring parameters when they are in a transitional state. A profile

will be remeasured if replicate values are 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.

Water Sample Collection

Water samples will be collected each visit (twice a month) from the epilimnion using a 10-m long integrated core sampler. If thermal stratification (defined in MDEP protocol as no change in temperature greater than or equal to 1°C per m below a depth of 2 m from the water surface) does not occur, the core sample will be collected to 1 m above the bottom, or as deep as the 10-m core sampler, whichever is less. If DO is ≤ 2 ppm, the core sample will be collected to the meter above that depth, as per MDEP (2021). If thermal stratification does occur during warmer times of the year (mid to late August, possibly into September), the DO/temperature profile will be examined to determine the depth of the true seasonal epilimnion using the rule of 1°C change over 1 m of depth below a depth of 2 m (per MDEP 2021). The core sample will be taken to 1-meter below the bottom of the true epilimnion. If elevated DO is seen lower in the profile, the core will be adjusted to a deeper depth to capture the algae responsible for the oxygen spike. Water samples collected from the core samples will be sent to a lab and tested for uncorrected chlorophyll-a by the trichromatic method, total phosphorus, color, pH, and alkalinity.

Core samples collected during one of the sampling events in August (a late summer sample in mid to late August) will be analyzed for the aforementioned analytes, along with nitrate, TKN, DOC, iron, calcium, magnesium, total and dissolved aluminum, sodium, potassium, silica, specific conductance, chloride, and sulfate. If the impoundment is not stratified, no additional grab samples are needed for the late summer sample. However, if the impoundment is stratified, additional grab samples will be collected that each require the full suite of analytes, except for chlorophyll-a. If the impoundment stratifies into two layers, grab samples will be obtained with a Kemmerer or Van Dorn sampler 1 m above the bottom of the impoundment. If the impoundment stratifies into three layers, grabs will be obtained from the metalimnion (1 m below the depth to which the core sample was taken) and hypolimnion (1 m above the bottom of the impoundment).

Bottles and preservatives for all samples will be obtained from an analytical lab. Detection limits required for each parameter (as per MDEP, 2021) are listed in Table 6.1.1-1.

Task 2: Data Analysis

QA/QC

Data will be reviewed for quality assurance/quality control (QA/QC) upon completion of the field monitoring portion of the study. Field spot checks will be used to determine if data need to be adjusted (through spot-check calibration) or flagged for accuracy. Any erroneous data will be removed from the final dataset and an explanation will be provided for the reason the data were rejected.

Task 3: Report

A study report will be prepared, describing the monitoring methods and presenting the results. Quality assurance procedures will be detailed and an explanation will be provided for any deviations from the study plan, if appropriate.

Consistency with Generally Accepted Scientific Practice

The proposed methods are based on MDEP's Sampling Protocols for Hydropower Studies (March 2021), which is the standard protocol in Maine for the relicensing of hydroelectric projects.

Deliverables and Schedule

Field data collection will occur between June and October 2022, with data analysis and processing occurring during the summer/fall of 2022. Given that the study will not be completed until after the ISR, the final study report will be included with the USR. The USR will be filed no later than October 4, 2023 per FERC's Project Process Plan and Scheduled included in SD1.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. The combined cost of the *Impoundment Trophic State Study* and the *Downstream DO and Temperature Study* (Section 6.1.2) is $40,000-$60,000. The Licensee believes that the proposed level of effort is adequate to obtain information to characterize water quality in the Project area.

Table 6.1.1-1: Water Quality Parameter Detection Limits

Parameter	Detection Limit	Frequency	Sampling Method
Field Parameters			
Secchi disk transparency	0.1 m	2x/month	Disk and water scope
Temperature	0.1°C	2x/month	Electronic meter
Dissolved oxygen (DO)	0.2 mg/l	2x/month	Electronic meter
Twice Monthly Lab Analytes			
Total phosphorus	0.001 mg/L	2x/month	Core
Chlorophyll a (uncorrected*)	0.001 mb/L	2x/month	Core
Color	5.0 SPU	2x/month	Core
Nitrate	0.01 mg/L	2x/month	Core
TKN	0.01 mg/L	2x/month	Core
DOC	1.0 mg/L	2x/month	Core
pH	0.1 pH units	2x/month	Core
Total alkalinity	1.0 mg/L	2x/month	Core
Late Summer Sample Analytes (Once in August)*			
Total phosphorus	0.001 mg/L	August	Core and grab
Chlorophyll a (uncorrected*)	0.001 mg/L	August	Core**
Color	5.0 SPU	August	Core and grab
Nitrate	0.01 mg/L	August	Core and grab
TKN	0.01 mg/L	August	Core and grab
DOC	1.0 mg/L	August	Core and grab
pH	0.1 pH units	August	Core and grab
Total alkalinity	1.0 mg/L	August	Core and grab
Total iron	0.05 mg/L	August	Core and grab
Total and dissolved aluminum	0.002 mg/L	August	Core and grab
Total calcium	0.05 mg/L	August	Core and grab
Total magnesium	0.05 mg/L	August	Core and grab
Total sodium	0.05 mg/L	August	Core and grab
Total potassium	0.05 mg/L	August	Core and grab
Total silica	0.05 mg/L	August	Core and grab
Specific conductance	2 µS/cm	August	Core and grab
Chloride	0.5 mg/L	August	Core and grab
Sulfate	1.0 mg/L	August	Core and grab

**During the late summer (August) sample, no grab samples are required unless the water column is stratified.*

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

Source: MDEP, 2021

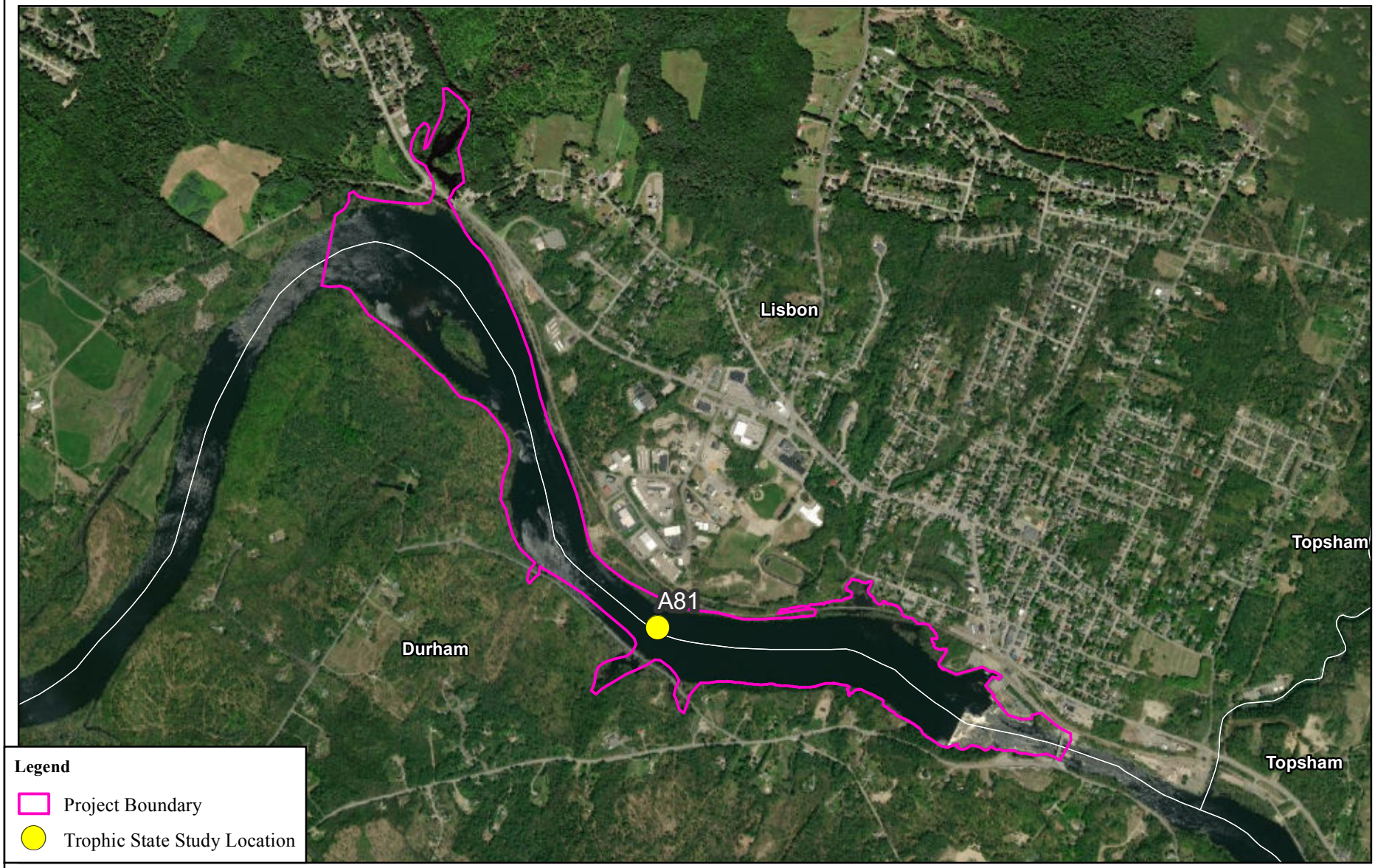

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Figure 6.1.1-1:
Proposed Site for Impoundment
Trophic State Study

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References

Maine Department of Environmental Protection (MDEP). 2021. DEP Sampling Protocol for Hydropower Studies: Lakes, Ponds and Impoundments. March 23, 2021.

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6.1.2 **Downstream DO and Temperature Study**

MDEP requested that the Licensee conduct two water quality studies – the *Impoundment Trophic State Study* and the *Downstream DO and Temperature Study*. The study plan for the *Downstream DO and Temperature Study* is detailed below, while the *Impoundment Trophic State Study* is detailed in Section 6.1.1.

Goals and Objectives

The goal of the study is to determine if the Project meets Maine Water Quality Standards in the downstream reach. The objective is to collect continuous water temperature and DO data in the Androscoggin River downstream of the Project dam and in the Project bypass during low flow, warm water temperature conditions.

Known Resource Management Goals

MDEP notes that the resource management goal is to ensure attainment of Maine Water Quality Standards pursuant to the provisions of the Water Classification Program, 38 M.R.S. Sections 464-468 and to certify attainment of such, with any necessary conditions, under Section 401 of the Federal Water Pollution Control Action (a.k.a. Clean Water Act).

Water Quality Standards

The waters of the mainstem of the Androscoggin River in the vicinity of the Project are classified by the State of Maine as Class C waters, as is the Sabattus River between Sabattus Pond and the Androscoggin River. Class C waters must meet standards ensuring suitability for the following: drinking after treatment, agriculture, fishing, recreation in and on water, industrial processes and cooling water supply, navigation, as habitat for fish and other aquatic life, and hydroelectric power generation, except as prohibited under Title 12, section 403. DO must meet a minimum of 5 ppm or 60% saturation, whichever is greater. Discharges to Class C waters may cause some changes to aquatic life, except that the receiving waters must be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

Background and Existing Information

Existing water quality data was summarized in Section 4.3.2.3 of the PAD. As detailed in the PAD, the Lower Androscoggin River was monitored by several organizations near the Project as part of the following programs:

- Worumbo DO Monitoring Project 1990-1994
- MDEP 2010 Lower Androscoggin River Basin Water Quality Study Modeling Report
- VRMP
- DMP and Fish Consumption Information

Based on review of available historic information, the Project Area meets the Class C water quality classification qualifications. MDEP notes in their study request that the existing information is not adequate to demonstrate that Project operations meet DO and other water quality standards in the impoundment.

Project Nexus

Continued operation of the Project is not expected to impact water quality negatively; however, the information gathered from this study will help confirm that the Project meets Maine's Class C water quality criteria.

Methodology

This water quality study consists of continuous DO and temperature monitoring at the confluence of the bypass and powerhouse tailrace and in the bypass reach. This section outlines the methods for data collection (Task 1), the data analysis (Task 2), and how results will be reported (Task 3). Water quality parameters will be collected based on MDEP's Sampling Protocol for Hydropower Studies (March 2021).

Task 1: Continuous DO and Temperature Monitoring

This study will be performed as per the MDEP Sampling Protocol for Hydropower Studies (MDEP, 2021). A minimum of one location at the confluence of the bypass and powerhouse tailrace that is representative of downstream flow and one location in the Zone 8 pool of the bypass reach will be monitored continuously during warm, low flow months (Figure 6.1.2-1). Daily median streamflow has been collected by the USGS, in cooperation with Brookfield Renewable, using a streamflow gaging station (No. 0105900 Androscoggin River near Auburn, ME) approximately 13 miles upstream of the Project. The estimated monthly flow values are shown below based on calculated flow at the Project using gage data from January 1987-October 2020, as presented in the PAD (Table 4.3.1.2-1). This summary indicates flow estimates to be lowest from July through September. Sampling would likely occur during a 9-week period of low flow based on the estimated data, from July 1 to August 31.[6]

	May	June	July	Aug	Sep	Oct	Nov
Median	8,981	5,068	3,420	2,876	2,664	3,752	5,887
Average	10,677	6,700	4,688	3,755	3,238	5,512	7,124

Deployment

To determine an appropriate deployment location in the tailwater, initial measurements of temperature and DO will be made using a handheld water quality meter along a transect across the stream at the bypass reach confluence (Figure 6.1.2-1, location AR-04) at the first, second, and third quarter points across the width. If there are no violations of the DO criteria and not significant (<0.4 mg/L) differences in concentrations among the quarter points, the water quality monitor will be deployed at the location shown to be representative of the main flow. Otherwise, a water quality monitor will be deployed at the location

[6] The study will be conducted during the summer when low flow is coupled with daily average water temperatures exceeding 24 ºC. The study will target a period when the water temperature and flow characteristics both meet the sampling protocol, to ensure that the sampling effort collects data representative of target conditions. Given this, the window of optimal DO monitoring may occur from July through August, or may shift to mid-July to mid-September (or even later), depending on weather, precipitation, and other factors.

with the lowest DO concentration in addition to the location of the main flow, resulting in two tailrace monitoring locations. An additional monitor will be placed in the Zone 8 pool in Section 2 of the bypass reach as requested by FERC. The monitoring locations will be geo-referenced using a GPS.

The water quality monitors (HOBO U26 with temperature and optical DO sensor) will be set to record temperature and DO in one-hour increments continuously throughout the study period. At both tailwater and bypass reach sampling locations, meters will be deployed mid-depth if the water is less than 2 m deep and in a profile of 1-m increments if water is greater than 2 m depth during low flow periods. Meters will be hung from a buoy anchored to the river bottom if depths are greater than approximately 1 m, or to a cinder block in waters less than 1 m. A barometric pressure monitor (HOBO U-20) will also be deployed to record barometric pressure concurrent to the continuous DO meters to enable DO % saturation to be processed from DO concentration measurements through the use of the manufacturer's software (HOBOware).

Approximately every two weeks, the meters will be cleaned, maintained, and offloaded per manufacturer recommendations, during which spot check measurements of DO and temperature will also be recorded using an alternate water quality meter. Continuous meters will be field calibrated as necessary if a measurement drift occurs, causing the logger to perform outside of its measurement error (Table 6.1.2-1). The barometric pressure monitoring data will be offloaded concurrently with the DO loggers. Weather, flow, and Project operations will be noted in a field log during each site visit.

Task 2: Data Analysis

QA/QC

Data will be reviewed for QA/QC upon completion of the field monitoring portion of the study. Field spot checks will be used to determine if data need to be adjusted (through spot-check calibration) or flagged for accuracy. Any erroneous data will be removed from the final dataset and an explanation will be provided for the reason the data were rejected.

Task 3: Report

A study report will be prepared, describing the monitoring methods and presenting the results. BB2H will provide operations data for the water quality monitoring period to correlate with the water quality monitoring results. Quality assurance procedures will be detailed and an explanation will be provided for any deviations from the study plan, if appropriate.

Consistency with Generally Accepted Scientific Practice

The proposed methods are based on MDEP's Sampling Protocol for Hydropower Studies (March 2021), which is the standard protocol in Maine for the relicensing of hydroelectric projects.

Deliverables and Schedule

Field data collection will occur between June and October 2022, with data analysis and processing occurring during the summer/fall of 2022. Given that the study will not be completed until after the ISR, the final study report will be included with the USR. The USR will be filed no later than October 4, 2023 per FERC's Project Process Plan and Scheduled included in SD1.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. The combined cost of the *Impoundment Trophic State Study* (Section 6.1.1) and the *Downstream DO and Temperature Study* is $40,000-$60,000. The Licensee believes that the proposed level of effort is adequate to obtain information to characterize water quality in the Project area.

Table 6.1.2-1: Water Quality Instrument Specifications

Parameter	Range	Accuracy	Resolution
Handheld Meter: YSI ProODO Meter*			
Dissolved Oxygen (% Saturation	0 to 500% air saturation	0 to 200% air saturation ± 1% of the reading or ±1% air saturation, whichever is greater; 200 to 500% air saturation ± 10% of the reading	0.1% air saturation
Dissolved Oxygen (mg/L)	0 to 50 mg/L	0 to 20 mg/L ±0.1 mg/L or ±1% of reading, whichever is greater; 20 to 50 mg/L ± 10% of reading	0.01 or 0.1 mg/L (auto-scaling)
Temperature	-5 to +70°C	± 0.2 °C	0.1°C
Barometer	375 to 825 mmHg	±1.5 mmHg from 0 to 50°C	0.1 mmHg
Continuous Meter: HOBO U-26			
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

*Subject to change based on instrument availability at time of field work to similar instrument. Any unlisted instrumentation specifications will be included in the final report.

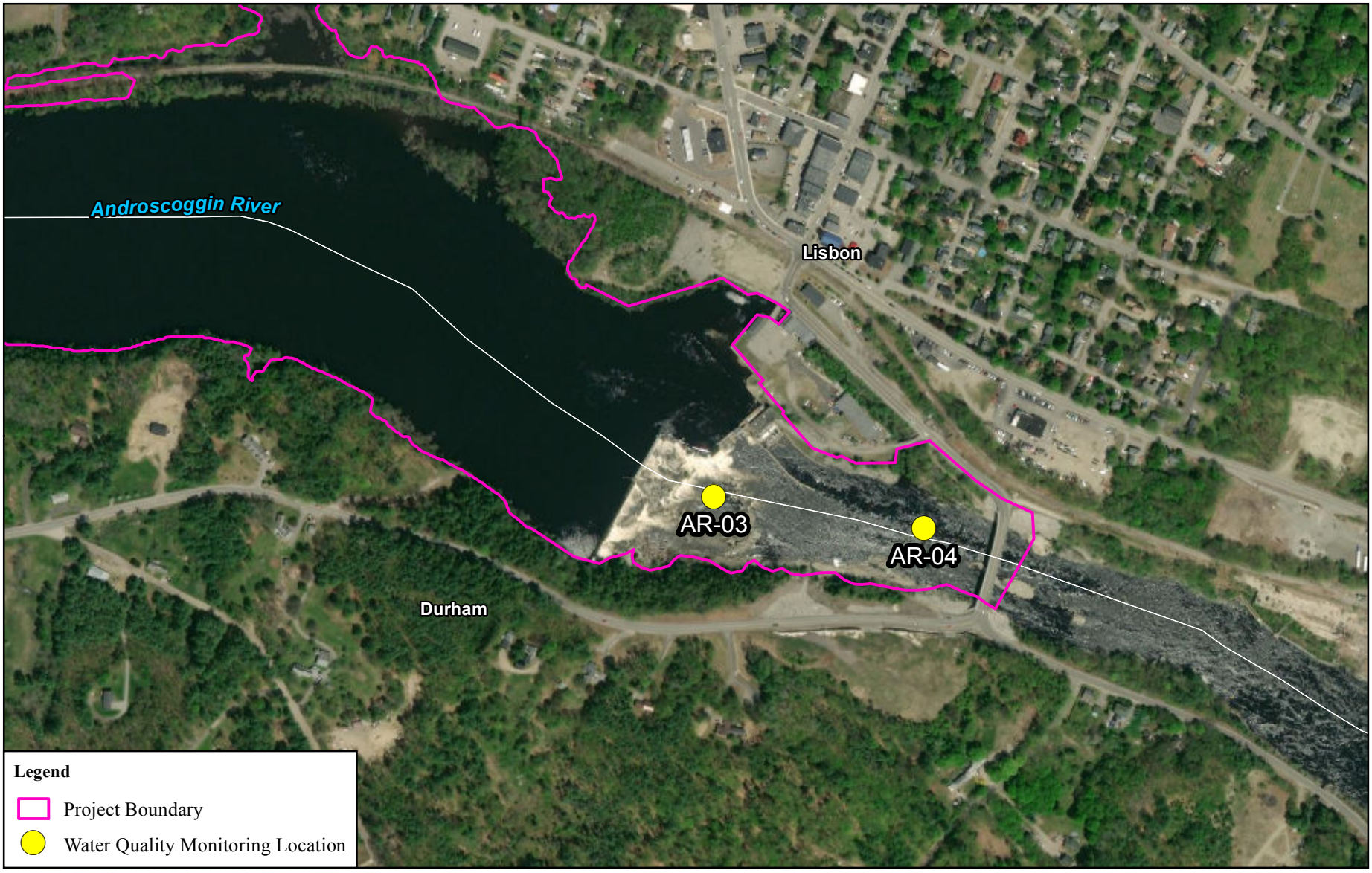

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Figure 6.1.2-1:
Proposed Locations for DO
and Temperature Sondes

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References

Maine Department of Environmental Protection (MDEP). 2021. DEP Sampling Protocol for Hydropower Studies: Rivers and Streams. March 23, 2021.

6.2 Fisheries and Aquatic Resources

6.2.1 Benthic Macroinvertebrate Survey

Goals and Objectives

The goal of the study is to determine the current macroinvertebrate community structure and to evaluate any impacts caused by Project operations. The objective of the study is to conduct a macroinvertebrate survey downstream of the Worumbo Dam following MDEP's standard protocol in *Methods for Biological Sampling and Analysis of Maine's Rivers and Streams*.

Known Resource Management Goals

MDEP notes that the resource management goal is to ensure attainment of Maine Water Quality Standards pursuant to the provisions of the Water Classification Program, 38 M.R.S. Sections 464-468 and to certify attainment of such, with any necessary conditions, under Section 401 of the Federal Water Pollution Control Action (a.k.a. Clean Water Act).

Background and Existing Information

In 2010, MDEP's biological monitoring program conducted an Aquatic Life Classification Attainment survey to evaluate the current macroinvertebrate community structure downstream of the Project in the Pejepscot Project impoundment. The data was collected in accordance with MDEP's *Methods for Biological Sampling and Analysis of Maine's Rivers and Streams* (April 2014). Review of the 2010 macroinvertebrate data indicated that the aquatic life and habitat criteria for Class C waters were attained at this location. Although the Pejepscot Project impoundment sampling indicated attainment of water quality standards, the sampling location was not in the vicinity of the Worumbo Project and, therefore, a benthic macroinvertebrate survey is necessary as part of relicensing.

Project Nexus

Continued operation of the Project is not expected to impact the benthic macroinvertebrate community negatively; however, the information gathered from this study will help confirm that the Project meets Maine's Class C water quality criteria.

Methodology

The proposed tailwater macroinvertebrate study will be designed following MDEP's Methods for Biological Sampling and Analysis of Maine's Rivers and Streams (April 2014). A sampling station will be established after the confluence with the bypass reach within representative habitat downstream of the Project facilities. Rock filled wire baskets will be deployed for macroinvertebrate collection, though mesh bags will be used if the location is determined to be too shallow and cone samplers will be used if the location is too deep for wire baskets (MDEP, 2014). Three samplers will be deployed at the site with their long axis parallel to water flow. Sampling will be conducted during the summer, low flow period (July 1-September 30) for 28 days ± 4 days. The following outlines the preparation and deployment of samplers (Task 1), the retrieval and processing of samplers (Task 2), and the reporting of results (Task 3).

Task 1: Preparation and Deployment of Rock Samplers.

Three rock basket samplers will be prepared for deployment as per MDEP (2014) and will be installed at one location downstream of the Project tailrace within representative habitat within the Project boundaries (AR-06 in Figure 6.2.1-1). If this location consists of riffle/pool habitat, a riffle/run will be chosen instead as the sample location (if possible). Prior to deployment, it will be confirmed that the chosen sample location has a high certainty of allowing the samplers to remain fully submerged. Samplers will be marked, secured, and positioned as per MDEP (2014). Bank effects will be avoided by targeting the halfway point between the wetted width if appropriate. In addition, eddies immediately upstream or downstream of large rocks/debris as well as areas of slackwater will be avoided (as per MDEP, 2014).

Rock basket samplers will be deployed for 28 days (±4 days) starting by the end of August to ensure targeted late summer, low flow conditions likely to occur between July 1 and September 30, 2022. However, if particularly low flow velocities occur at the sampling location, an extended exposure period (> 28 days) may be necessary to allow for adequate colonization of > 50 individuals in each sampler. This will be determined in consultation with MDEP, if needed.

Field Data Sheets

Concurrent with sampler deployment, a field data sheet (Attachment 1, available on the MDEP Website here) will be completed with site-specific information. This data sheet includes:

- Sample location coordinates
- Substrate composition
- Land use and terrain characteristics
- Canopy coverage
- Habitat characteristics (bank full and wetted width, depth, velocity, dissolved oxygen, temperature, specific conductivity, and pH)
- Other observations (e.g., fish, algae, macrophytes, habitat quality)

Task 2: Rock Sampler Retrieval and Processing

Rock basket samplers will be approached from downstream, and a 600-micron mesh aquatic net will be positioned downstream of the sampler before it is placed quickly inside the net. The basket sampler will be opened, and all contents will be carefully transferred into a 600-micro sieve bucket. The wire cage will be rinsed into the sieve bucket before removing, rinsing, and placing each rock back into the basket. All contents in the sieve bucket will be transferred into sample jars and preserved at approximately 70% ethyl alcohol. Samples will be labeled in the field upon collection with the date of retrieval, waterbody, and replicate (i.e., sampler) number. A slip of rite-in-the-rain paper with the same information (written in pencil) will also be placed into each sample jar. Each sample will be treated as consistently as possible. Predatory invertebrates, such as crayfish, will be placed in separate jars until ethanol is added to prevent predation.

Sample jars will be sent to a contracting laboratory for evaluation by or under the supervision of a professional freshwater macroinvertebrate taxonomist certified by the Society of Freshwater Science (MDEP, 2014).

Task 3: Report

A study report will be prepared, describing macroinvertebrate community sampling results, along with a summary of the Project operations that occurred during the rock basket deployment period. Prior to preparation of the report, numeric results of the study will be provided by MDEP for linear discriminant analysis to assess the attainment of aquatic life standards. The resulting Aquatic Life Classification Attainment Report generated by MDEP will be included as an appendix to the study report. Laboratory quality assurance procedures will be detailed if applicable and an explanation will be provided for any deviations from the study plan, if appropriate.

Consistency with Generally Accepted Scientific Practice

The proposed methods are based on MDEP's *Methods for Biological Sampling and Analysis of Maine's Rivers and Streams*, which is the standard protocol in Maine for macroinvertebrate surveys.

Deliverables and Schedule

Field deployment and retrieval will occur between July 1 and September 30, 2022, with installation occurring by the end of August to help ensure sampling occurs during low flow conditions. Given that the study will not be completed until after the ISR, the final study report will be included with the USR. The USR will be filed no later than October 4, 2023 per FERC's Project Process Plan and Scheduled included in SD1.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. Estimated costs for this study are $15,000-$25,000. The Licensee believes that the proposed level of effort is adequate to obtain information to characterize the benthic macroinvertebrate community in the Project area.

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0 875 1,750 Feet

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Figure 6.2.1-1:
Proposed location of Benthic
Macroinvertebrate Study

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Maine DEP Biological Monitoring Unit
Stream Macroinvertebrate Field Data Sheet

Location: _____

_____

Potential Stressor: _____

_____

Log Number _____
Station Number_____
Waterbody_____
River Basin_____
Town_____
Stream Order_____

Directions_____
_____
_____
Lat-Long Coordinates (WGS84, meters)
Latitude_____
Longitude_____

Type of Sampler_____
Date Deployed_____
Number Deployed_____
Date Retrieved_____
Number Retrieved_____
Agency/Collector(s) Put-In:
Take-Out:

1. Land Use (surrounding watershed)
- ☐ Urban
- ☐ Cultivated
- ☐ Pasture
- ☐ Upland hardwood
- ☐ Upland conifer
- ☐ Swamp hardwood
- ☐ Swamp conifer
- ☐ Marsh

2. Terrain (surrounding watershed)
- ☐ Flat
- ☐ Rolling
- ☐ Hilly
- ☐ Mountains

3. Canopy Cover (surrounding view)
- ☐ Dense (75-100% shaded)
- ☐ Partly open (25-75% shaded)
- ☐ Open (0-25% shaded)

(% daily direct sun) _____

4. Physical Characteristics of Bottom (estimate % of each component over 12 m stretch of site; total = 100%)

[ ] Bedrock [ ] Cobble (2.5" – 10") [ ] Sand (<1/8") [ ] Clay
[ ] Boulders (>10") [ ] Gravel (1/8" – 2.5") [ ] Silt [ ] Muck [ ] Detritus

5. Habitat Characteristics (immediate area)

Deployment	Retrieval
Time _____ AM PM	Time _____ AM PM
Wetted Width (m)_____	Wetted Width (m) _____
Bank Full Width (m) _____	Bank Full Width (m) _____
Depth (cm) _____	Depth (cm) _____
Velocity (cm/s) _____	Velocity (cm/s) _____
Diss. O_2 ___ (ppm) ___ (%)	Diss. O_2 ___ (ppm) ___ (%)
Temp (°C) _____	Temp (°C) _____
SPC (µS/cm) _____	SPC (µS/cm) _____
pH _____	pH _____
DO Meter #_____ Cal? Y / N	DO Meter #_____ Cal? Y / N
SPC Meter # _____ Cal? Y / N	SPC Meter # _____ Cal? Y / N

Flag location where measured

Temperature Probe # _____

☐ deployed ☐ retrieved

6. Observations (describe, note date)

7. Water Samples
- ☐ Standard
- ☐ Other

Lab Number:

8. Photograph #

Put-In
- Up
- Down

Take-Out
- Up
- Down

9. Landmarks of Sampler Placement (illustrate or describe landmarks to be used for relocation)

References

Maine Department of Environmental Protection (MDEP). 2014. Methods for Biological Sampling and Analysis of Maine's Rivers and Streams. Prepared by: Davies, S.P. and Tsomides, L. Originally Developed in 1987. Latest revision: April 2014.

6.2.2 **Downstream Aquatic Habitat Cross-section Flow Study**

Goals and Objectives

The goal of the study is to determine whether current instream flow releases downstream of the Worumbo Dam in the confluence of the bypass reach and the powerhouse tailrace meet Maine habitat and aquatic life criteria. The objective of the study is to measure depth, velocity, and wetted width along established transects at various discharges to determine flows where at least 75% of the stream cross-sectional area has enough water to provide sufficient habitat for fish and other aquatic organisms. The data collected as part of this study will be evaluated to determine if the downstream waters provide sufficient quantity of water to maintain riverine aquatic habitat in the bypass and tailrace reaches.

Known Resource Management Goals

MDEP notes that the resource management goal is to ensure attainment of Maine Water Quality Standards pursuant to the provisions of the Water Classification Program, 38 M.R.S. Sections 464-468 and to certify attainment of such, with any necessary conditions, under Section 401 of the Federal Water Pollution Control Action (a.k.a. Clean Water Act).

Background and Existing Information

The Project operates primarily as a run-of-river facility with the exception of power system emergencies when BB2H is called upon for maximum output or under maintenance exceptions. Inflow to the Project is primarily controlled by the operation of two upstream hydropower facilities – the Gulf Island-Deer Rips Project (FERC No. 2283, located approximately 19 miles upstream) and the Lewiston Falls Project (FERC No. 2302, located approximately 14.5 miles upstream). The Gulf Island-Deer Rips Project reregulates the river flow through a variable daily discharge schedule. The current license for the Gulf Island-Deer Rips Project requires that the normal weekly impoundment drawdown be no greater than one foot from May 1 through June 30 and four feet from July 1 through April 30. In addition, seasonal instantaneous minimum flow releases of 1,700 cfs (or inflow, if less) from May 1 through November 30 and 1,430 cfs (or inflow, if less) from December 1 through April 30 are required from the project. The Lewiston Falls Project also operates with a reservoir fluctuation of up to four feet per week with a downstream minimum flow requirement of 1,000 cfs (or inflow, if less).

The Worumbo Project provides seasonally varied minimum flows into the approximately 620-foot-long bypassed river reach between the Durham-side dam (river right, looking downstream) and the end of the tailrace training wall. BB2H is required to provide minimum flow releases as measured immediately downstream from the dam according to the following schedule:

- September 1 – October 31 200 cfs
- November 1 – December 31 50 cfs[7]
- January 1 – April 15 50 cfs
- April 16 – May 31 300 cfs

[7] Unless the downstream fishway is operational, in which case 85 cfs.

- June 1 – June 30 200 cfs
- July 1 – August 31 100 cfs

These minimum flows may be temporarily modified if required by operating emergencies or by order of any jurisdictional government agency, or as authorized in advance by MDIFW. Further, the Licensee may undershoot the state minimum flow by up to 50 percent for a period not to exceed one hour, provided that only one such under-release may be made in a 24-hour period without authorization from MDIFW. The current bypass minimum flow regime was established in coordination with resource agencies based on the results of an instream flow study conducted in the early 1990s.

Project Nexus

Data collected will be used to evaluate aquatic habitat in the Androscoggin River in the confluence of the bypass reach and the powerhouse tailrace below Worumbo Dam. Information will be used to evaluate whether the Project meets Maine habitat and aquatic life criteria and will inform the water quality certification process.

Methodology

The following describes the transect selection site visit and consultation with MDEP (Task 1), transect and water level data collection (Task 2), data analysis (Task 3), and reporting (Task 4).

Task 1: Transect Selection Site Visit and Consultation

The Licensee will coordinate a site visit with MDEP to select at least three transect locations representative of the river below the confluence of the bypass reach and powerhouse tailrace. Transects will be selected based on the professional judgement of MDEP and the Licensee, and will avoid very steep habitats (e.g., cascades, waterfalls, gorge areas). Study locations will be designated for the purpose of evaluating whether flows meet MDEP cross-sectional area requirements. The depth criteria that will be used to determine attainment at this Project will be determined in consultation between the Licensee and MDEP during the site visit.

Task 2: Transect and Water Level Data Collection

At the selected transect, a bed profile survey will be performed and the bankfull elevation will be identified. Hobo U-20 pressure sensors will be installed and surveyed at each of the transects to record water level. A separate U-20 sensor will be installed in the air to record barometric pressure. Water level sensors will be programmed to record measurements every 15 minutes and will remain in place long enough to capture a variety of flow rates.

Task 3: Data Analysis

Various water levels will be plotted on figures showing each of the river cross-sections. For each transect, a relationship between flow and wetted width will be developed. Average channel depths will also be provided. Relationships between flow, wetted width, and water level will be used to determine the flow at which 75% of the cross-section remains wetted relative to the bankfull level and contains sufficient depth.

Task 4: Report

A report will be developed that includes the results of the cross-sectional area assessment, including the figures and results of the data analysis.

Consistency with Generally Accepted Scientific Practice

Aquatic habitat cross-section flow studies are commonly performed in the State of Maine to determine whether Project minimum flows meet State criteria.

Deliverables and Schedule

Field data collection will occur during the 2022 field season. The final study report will be included with either the ISR or the USR depending on when the study is completed. Per FERC's Process Plan and Schedule included in SD1, the ISR will be filed no later than October 4, 2022 and the USR will be filed no later than October 4, 2023.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. Estimated costs for this study are $15,000-$25,000. The Licensee believes that the proposed level of effort is adequate to evaluate if Project minimum flows meet State criteria.

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6.2.3 **Upstream American Eel Passage Assessment**

The USFWS requested that the Licensee conduct a multi-year assessment to determine the impact of the Project on the upstream migration of American Eel in the Androscoggin River. Study components requested by the USFWS included: conducting systematic surveys of eel presence/abundance at the Project, collecting eels with temporary trap/pass devices at areas identified from the surveys, and assessing movement of juvenile American Eels through the existing upstream eel passage system via PIT tags.

As discussed in Section 5.1.7, the Licensee is proposing to conduct the requested study via an alternative methodology that incorporates portions of the USFWS request and is centered around night-time visual surveys and observations of the existing upstream eel passage system. The methodology detailed below reflects the appropriate level-of-effort to assess upstream eel passage at the Project.

Goals and Objectives

The goal of the study is to determine the presence/abundance of American Eel at the Project and assess potential issues, if any, with the existing upstream eel passage system. The objectives of the study are to conduct night-time visual surveys and observations of the existing eel passage system.

Known Resource Management Goals

Specific to the upstream passage of American Eel, the USFWS notes that their goals are to (1) minimize current and potential negative Project operational effects that could hinder management goals and objectives, and (2) minimize Project-related sources of upstream passage delay, injury, and stress in order to facilitate access to historical rearing habitat.

Background and Existing Information

An upstream eel passage system was completed at the Project in 2012. The system is installed annually upon recession of high flows in the spring and is operated until August 31 each year in consultation with MDMR. The Licensee monitors the holding tank during operation, during which eels are regularly counted and their lengths estimated before being released into the Project impoundment.

The eel passage system has two sections, a textured surface on the spillway face and an eel trap for collecting and holding upstream migrants. The textured spillway surface is located at the upstream terminus of the ledges near the west abutment of the spillway. The trap consists of two two-foot-wide by seven-foot-long covered ramps lined with bristles. The lower section of each ramp is mounted to the dam crest and the upper sections are connected to a collection tank, forming a “A” frame design. Water from an electric submersible pump is discharged into each ramp and a small amount of water is sprayed onto the downstream dam crest. This flowing water directs the eels into the ramps to the collection tank. Water and eels leave the collection tank by way of a four-inch pipe into a plastic holding tank mounted in the pond just upstream of the Obermeyer panel.

The number of eels approaching the Project is unknown given the lack of eel-specific passage measures at the downstream Brunswick and Pejepscot Dams along with the potential for eels to pass via other routes that would not normally be traversed by other fish species. Since 2012 between 15 and 541 eels per passage season have been counted as passing upstream of the Project through the eel passage system. The system typically passes eels between two and six inches in length.

Project Nexus

The Project is located within the historic range of American Eel. As such, the Project structures may hinder the upstream movement of American Eel.

Methodology

Task 1: Night-time Visual Surveys

Systematic surveys to detect eel presence and identify routes currently used to pass upstream at the Project will be conducted during the primary period of upstream eel migration (June 15 – August 31). Surveys will be conducted twice weekly from June 15 to July 15, once weekly from July 15 to August 15, and a final survey during the last two weeks of August.

Surveys will begin at least 30 minutes after sunset. The investigation area includes areas within the bypass reach, below the spillway gates, and below the powerhouse. Depending on operational and flow conditions, some areas may not be safely accessible during any given survey.

During each survey, a field team of at least two trained personnel will make visual observations of investigation area using headlights, flashlights, and binoculars and record the location, time and date, presence/absence of eel, estimated number and sizes of eel, eel behavior, recent weather, water temperature, and current discharge. Descriptions of leakage and other physical conditions of potential migration pathways will be recorded. The survey crew will use a red light if the water is not turbid and a white light when the water is deeper and more turbid to observe eels.

Task 2: Observations of the Eel Passage System

During the night-time visual surveys, the field crew will inspect the current eel passage system for any eels that are currently being attracted to or are climbing up the eel ladder. Climbing eels will be observed to identify potential issues with the eel passage system (e.g., difficulties entering, climbing, or abandoning upstream movement).

Task 3: Analyses

The locations and approximate numbers of eels observed below the Project will be summarized and compared with environmental conditions. Locations of eel congregations and climbing areas will be plotted on a map, or series of maps. Based on the results of the field assessment, the location and configuration of the eel passage system will be evaluated relative to other potential areas where eels were observed.

Task 4: Report

A report will be prepared describing monitoring methods and results of the field assessment, a description of areas where eels are attempting to pass at the Project, and any issues observed near to or within the current eel passage system. The report will describe if any additional study (e.g., upstream eel passage alternatives analysis) is recommended for a Year 2 portion of the study.

Consistency with Generally Accepted Scientific Practice

Direct, visual observations of eel movements below dams and within eelways are common methods for evaluating potential alternatives for upstream passage and for identifying upstream passage issues at hydroelectric projects.

Deliverables and Schedule

Field efforts associated with the study will occur between June-August 2022. The final study report will be included with the ISR, which will be filed no later than October 4, 2022 per FERC's Process Plan and Schedule included in SD1.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. Estimated costs for this study are $15,000-$30,000. The Licensee believes that the proposed level of effort is adequate to assess upstream eel passage at the Project.

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6.2.4 **Anadromous Fish Upstream Passage Efficiency Study**

NMFS requested that the Licensee conduct a study to understand upstream passage efficiency for anadromous fish (i.e., alewife, blueback herring, American Shad, Atlantic Salmon) at the Project as well as the movement and behavior of fish immediately downstream of the Project.

Goals and Objectives

The goal of the study is to evaluate whether the existing upstream fishway provides safe, timely, and effective passage for blueback herring, alewife, American Shad, and Atlantic Salmon. Additionally, this study will evaluate false attraction to the bypass area, if any, and subsequent delay that occurs as a result of that false attraction. The objectives of the study are to describe the passage effectiveness and assess the extent of delay migrating fish may experience due to fishway operations.

Known Resource Management Goals

NMFS is a federal resource agency with a mandate to protect and conserve fisheries resources and associated habitat. Resource management goals and plans are codified in their regulatory statutes.

Background and Existing Information

The existing upstream fish passage facility was constructed in 1988 and consists of a cable-operated vertical lift system with two entrances in the Project tailrace. More specifically, the upstream fish passage facility consists of: two entry way gates, a connecting gallery, four attraction flow pumps, a moving crowder/650-gallon hopper, a cable operated lift, a headwater canal, fish viewing and counting room, an electrically operated gate at the downstream end of the counting window, an attraction flow diversion pipe from the headwater canal to the crowder area, and a headpond trashrack. The hydraulic capacity of the attraction flow pumps is 40 cfs each. The hydraulic capacity of the diversion pipe is 30 to 80 cfs but is maintained at 35 cfs. The counting and viewing room also contain the air compressors and control system for the pneumatic flashboards and an air blower for de-icing the four flood gates.

The fishway is opened within 24 hours of the opening of the Brunswick upstream fishway or by May 1, whichever comes first, in accordance with the FERC Order on May 11, 2018 that accepted the terms and conditions from a Biological Opinion issued by NMFS regarding Endangered Species Act (ESA) consultation for Atlantic Salmon. The upstream fishway is operated until November 15 each year, river conditions permitting, or if an alternate date is approved by the resource agencies. During the period of upstream passage operations, the Licensee operates the upstream fishway each day from 9:00 am to 5:00 pm. Lifts are scheduled at 9:00 am, 11:00 am, 1:00 pm, 3:00 pm, and 5:00 pm. Scheduled maintenance activities during the passage season would occur between the end of July and mid-August. Any shutdowns are limited to the time needed to make necessary repairs, and the fishway is restarted as soon as repairs have been completed.

PAD sections 4.4.4.2, 4.4.5.3, and 4.4.5.4 provide information pertaining to upstream passage counts and upstream passage studies previously conducted by the Licensee. NMFS notes in their study request that the operational baseline has changed since the previous studies were conducted, thereby necessitating the need for additional study.

Project Nexus

The Project Dam is within the migration route of Atlantic Salmon, American Shad, river herring, and American Eel and, as such, may affect their upstream migration. The information collected during this study will evaluate if the Project's current upstream fish passage system is adequate for providing safe, timely, and effective passage of the target species.

Methodology

Upstream passage will be studied using radio telemetry.

Task 1: Installation, Testing, and Maintenance of Receivers and Arrays

Radio receivers (e.g., Lotek SRX or equivalent) will be installed in multiple locations (Figure 6.2.4-1). Their range and configuration will be designed to detect fish in specific areas within and around the Project such that passage effectiveness and potential issues with passage can be evaluated. The location of the detection locations include, at a minimum, the following monitoring stations[8]:

- S1: At least one mile downstream of the Project. This station would be downstream of the release location and would monitor for fallback fish and would consist of a single receiver with an aerial antenna oriented perpendicular to the river channel.

- S2: Within the Little River near Route 196, approximately 0.1 miles upstream of the mouth of this tributary. This station would document tagged fish entering the Little River that may not attempt passage at the Project and would consist of a single receiver with an aerial antenna oriented perpendicular to the stream channel.

- S3: Below the Canal Street Bridge, approximately 0.2 miles downstream of the Project fishway entrances. This station would document tagged fish entering the section of river downstream of the Project and would consist of a single receiver with an aerial antenna oriented perpendicular to the stream channel.

- S4a and S4b: Near the head of the center pier that separates the Project tailrace and spillway area. The stations would consist of a single receiver connected to two aerial antennae that are oriented in two different directions: 1) down the tailrace channel (S4a) and 2) at an angle across the downstream portion of the bypass reach (S4b).

- S5a and S5b: Near the end of the trashrack rake deck. The stations would consist of a single receiver connected to two aerial antennae that are oriented in two directions: 1) across the middle portion of the bypass and Zone 8 pool (S5a) and 2) across the upper portion of the bypass near the spillway (S5b).

- S6a and S6b: Within the fishway entrances. The stations would consist of a single receiver connected to two custom droppers meant to detect fish across a relatively small area as they pass through either of the fishway entrances.

[8] Landowner permissions will be required for installation of remote monitoring locations that are not within the Project-owned land and structures. The monitoring stations described will be evaluated in the field prior to initialization of the study and may be modified to enhance detection.

- S7: Outside of the fishway hopper. This station would consist of a single receiver connected to a custom dropper meant to detect fish as they approach the hopper.

- S8: Within the exit trough (possibly near counting window). This station would consist of a single receiver connected to a custom dropper meant to detect fish after they are lifted and exit the fishway hopper.

- S9: At the upstream end of the exit trough, where fish would enter the Project impoundment. This station would consist of a single receiver connected to a custom dropper meant to detect fish leaving the fishway and entering the impoundment.

During installation of the receivers, range testing will be performed to properly configure the receivers to maximize detection efficiencies. Levels of background noise will also be measured and recorded at each monitoring station. The receivers will be offloaded, checked, and maintained at least once per week from the initial tagging and release date until no live, tagged fish remain that could pass upstream. Additionally, beacon tags will be installed at critical and strategic locations. These beacon tags will emit a signal at specific frequencies and time intervals that will be logged by specific receivers to confirm the functionality of the receivers over the course of the study.

Task 2: Tagging and Release of Test Fish

Pending availability of fish, at least 100 adult river herring and up to 200 adult American Shad will be tagged, transported, and released as part of this study. Based on the observed run timing at Brunswick Dam, the timing of tagging efforts for river herring and American Shad will be performed from the first week of May until mid-June.

Adult river herring and adult American Shad will be collected via electrofishing or angling downstream of the Brunswick Project or by capturing within the Brunswick Project fishway (if possible).[9] Each fish will be visually evaluated for tagging suitability. Those with excessive scale loss or other signs of significant stress will not be tagged. Each fish selected for tagging will be measured to the nearest millimeter, and the sex and spawning maturity of each fish will be recorded when evident.

All fish selected for tagging will be radio-tagged gastrically and transferred to a transport tank for subsequent transport to the release location at the Pejepscot Impoundment boat launch, approximately 0.7 river miles downstream of the Project fishway. The exact procedures for transport and release will depend on the equipment and numbers of fish available but will be performed in a manner to minimize holding times and reduce stress of tagged fish.[10] Appropriate tags will be chosen based on the anticipated size of the fish and the tag models available during the study season. American Shad will be released in groups consisting of multiple fish, when possible, and river herring will be released with several un-tagged specimens to facilitate natural schooling behavior of tagged fish.

[9] The actual capture method will depend on access to these areas, the conditions encountered, and the effectiveness of the measures attempted. Efforts will be made to capture fish of a given species for tagging in a consistent manner to avoid variability in passage that could be related to capture methodologies.

[10] Handling and transport stress can be reduced in a variety of ways. Typically, limited holding times, the addition of salt to the transport water, and/or transporting groups of tagged/untagged fish as opposed to small numbers of individuals can reduce stress for schooling alosines. Though fallback will still occur, reducing stress could increase the effective sample size of the study by reducing the proportion or extent of fallback.

Task 3: Mobile Tracking

Mobile tracking will be performed along the shorelines immediately downstream of the Project and from Project structures on a weekly basis. The goal of the weekly mobile tracking will be to refine the locations of individual fish that are interacting with Project structures and flow fields.

Additionally, mobile tracking will be performed twice by boat from the Project downstream to the Pejepscot Project boater barrier. These efforts will be performed to identify/confirm dead fish and shed tags and will occur at least one week after the last tagging efforts are performed, and again at the conclusion of study field efforts.

Task 4: Data Consolidation and Processing

Detection data initially offloaded from receivers will be stored on portable memory devices and subsequently uploaded to a Project database. QA/QC of the data will be performed by examining signal strength of detections, frequencies of signals observed over time, and spatial/temporal characteristics of detections with respect to the location of other detections within the receiver array. False detections identified will be flagged in the database and will not be used in subsequent analyses.

Task 5: Radio Telemetry Analyses

Upstream passage success at the Project will be estimated using Cormack-Jolly-Seber (CJS) models, which will provide reach-specific passage success estimates between the monitoring stations at the Project. Program MARK (White and Burnham 1999) contains a suite of models that incorporates different assumptions of survival and detections between stations. Goodness of fit testing will be performed for the fully parameterized model to identify whether there are issues with model noise, and appropriate adjustments will be made as applicable within Program MARK. The various models developed within Program MARK will be ranked using Akaike's Information Criterion (AIC), which will allow for selection of the best model with the least complexity.

External efficiency will be evaluated based on models that incorporate passage between monitoring station S3 (below the Canal Street Bridge) and S6a/S6b (fishway entrances). Internal efficiency of the fishway will be evaluated based on models that incorporate passage efficiency between the fishway entrances and the upstream end of the exit trough where fish would enter the Project impoundment. Overall passage efficiency will be evaluated from S3 to S9. The reported passage efficiencies will include confidence intervals and passage rates between specific locations within each model will also be calculated/reported to identify areas where passage may be hindered.

The amount of time to pass at the Project will also be evaluated by calculating the length of time between initial detection at S3 (below the Canal Street Bridge) to the final detection at S9 (upper end of exit trough). Figures developed for individual fish showing time versus detections will aid in identifying potential areas where fish may have longer residence time and could become delayed during upstream passage. This includes the potential for false attraction to the bypass reach.

Task 6: Atlantic Salmon Desktop Assessment

Relevant literature and data regarding movements and passage of Atlantic Salmon in the Androscoggin River, along with other Maine rivers, will be gathered. Upstream passage success for Atlantic Salmon will be evaluated qualitatively based on passage studies performed at other hydropower dams and fishways

with similar characteristics. If available from the literature, the potential for injury of salmon during passage will also be evaluated.

Task 7: Report

A study report will be developed that includes the results of the radio telemetry studies for adult river herring and American Shad, along with the desktop assessment for adult Atlantic Salmon. Operations at the Project (e.g., generation, spill) and the operational settings of the lift over the study period will be reported to compare with potential patterns observed during upstream passage of tagged fish.

Consistency with Generally Accepted Scientific Practice

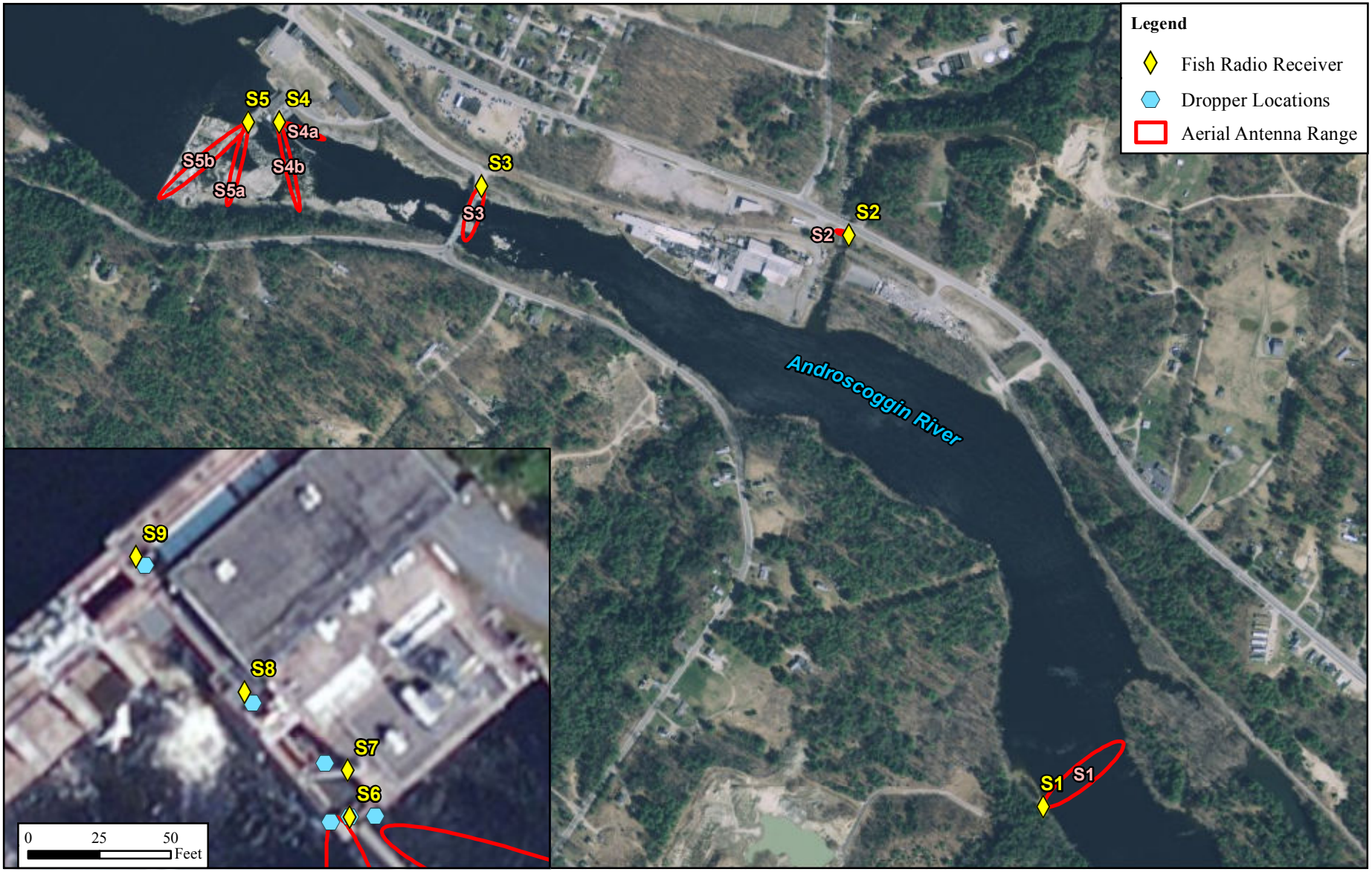
The proposed approach to evaluate upstream passage effectiveness is consistent with numerous other hydroelectric relicensings that have occurred in the State of Maine.

Deliverables and Schedule

Field efforts associated with the study will occur between April-July 2022. Data processing and report development will occur during late summer/fall of 2022. The final study report will be included with either the ISR or the USR depending on when the study is completed. Per FERC's Process Plan and Schedule included in SD1, the ISR will be filed no later than October 4, 2022 and the USR will be filed no later than October 4, 2023.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. Estimated costs for this study are $125,000-$200,000. The Licensee believes that the proposed level of effort is adequate to evaluate upstream passage effectiveness at the Project.



EAGLE CREEK
— RENEWABLE ENERGY —

N

0 350 700 1,400 Feet

Worumbo Hydroelectric Project
FERC No. 3428

Figure 6.2.4-1:
Location of Receivers and
Arrays in the Project Vicinity

Path: P:\Modeling\Projects\02214\maps\PSP\figure_6_2_4-1_receiver_locations.mxd

References

White, G.C., and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46: 120-138.

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6.2.5 **Downstream Passage Alternatives Study**

NMFS requested that the Licensee conduct a downstream passage alternatives study to evaluate potential improvements to the downstream passage system.

Goals and Objectives

The goal of this study is to determine conceptual options and expected performance for improved downstream passage that will reduce delay, increase passage efficiency, and increase survival for downstream migrating adult American Eels, blueback herring, alewives, American Shad, and Atlantic Salmon.

Known Resource Management Goals

NMFS is a federal resource agency with a mandate to protect and conserve fisheries resources and associated habitat. Resource management goals and plans are codified in their regulatory statutes.

Background and Existing Information

The Project intake structure is an integral part of the powerhouse structure. It contains two sectional vertical slide gates operated by the same gantry crane that operates the spillway gates. These gates are normally open and are closed strictly for equipment maintenance. A hydraulic trash rack located on the intake deck cleans the two approximately 40 foot high by 33-foot-wide intake racks. In addition, the intake contains three entrances for the downstream fish passage and one exit for the upstream fish passage. The trash racks are spaced 5 inches on center.

Downstream fish passage currently consists of the following components: three entry way gates with trashracks (12-inch clear spacing) extending from the headpond surface to 11.30 feet above the top of the turbine intakes, sectional gates to close individual entrances, a connecting gallery between the entrances, a 36-inch diameter downstream passage pipe, a plunge pool that measures 30-feet by 20-feet and is kept at a depth of 10-feet under normal operating conditions. Downstream fishway flows range from 119 cfs to 131 cfs under controlled pond conditions. The plunge pool is equipped with two sectional gates that may be manipulated to control the depth of water in the plunge pool. The Project gantry crane is equipped with a special boom for servicing the downstream plunge pool.

The downstream fishway consists of three inlet systems located on the upstream face of the inlet deck area starting at elevation 93.0 to 101.0 feet by 36 inches wide. Each inlet consists of the following items:

- Six inlet stop log gates:
    - Two 36 inches wide by 12 inches tall
    - Two 36 inches wide by 18 inches tall
    - Two 36 inches wide by 24 inches tall

A set of trashracks is mounted just inside the upstream opening. Each inlet area then channels the water/fish into a 36-inch diameter pipe which all three downstream inlets are connected to. This pipe then discharges the water/fish into a plunge pool area located on the river side of the station just below the fish viewing

room. The water inside the plunge pool then exits by way of a weir gate. The weir gate is adjusted to maintain the water level inside the plunge pool area above the 36-inch diameter discharge pipe opening.

The downstream passage facilities are operated in accordance with the terms of the July 2016 Final SPP accepted by FERC on May 11, 2018. In general, the downstream passage facilities are operated when many of the diadromous species would be attempting to pass downstream of the Project. More specifically, the downstream passage facilities are operated from April 1 to December 31 each year, river conditions permitting.

Section 4.4.5.2 of the PAD includes information pertaining to a downstream Atlantic Salmon smolt passage study previously conducted by the Licensee. To date, the Licensee has not conducted an analysis of potential downstream passage alternatives. The results of this study, coupled with the *Computational Fluid Dynamics Modeling – Downstream Passage* and *Debris Removal Study*, will be used to evaluate potential PME measures to provide safe, timely, and effective downstream passage for target species.

Project Nexus

The Project Dam is within the migration route of Atlantic Salmon, American Shad, river herring, and American Eel and, as such, may affect their downstream migration. The information collected during this study, combined with the *Computational Fluid Dynamics Modeling – Downstream Passage* and *Debris Removal Study*, will inform potential PME measures to enhance downstream fish passage at the Project.

Methodology

Task 1: Alternatives Analysis

Information on the current configuration of downstream passage measures implemented at the Project, along with issues identified in previous radio telemetry studies, will be summarized. The configuration of the downstream passage measures will be compared with the current recommendations for designing downstream passage for the migratory species present at hydroelectric projects. These species include Atlantic Salmon, American Shad, river herring, and American Eel.

A literature review will be performed, which will identify several downstream passage alternatives that have been utilized at other hydroelectric projects for downstream passage of the diadromous species that are found at the Project. Additionally, new technologies will also be described as part of the literature review. A preliminary report will be developed that includes the results of the alternatives analysis.

Task 2: Resource Agency Consultation

A preliminary report containing the results of the alternatives analysis will be provided to the USFWS, NMFS, and MDMR for review and comment. A consultation meeting will be held to discuss the alternatives analysis, to identify potential approaches and/or technologies that the resource agencies prefer based on the information gathered, and to identify additional information the resource agencies may have to add to the alternatives analysis.

Task 3: Feasibility Assessment

The feasibility of alternatives identified in Task 1 and 2 will be evaluated based on their potential application at the Project, as informed by the literature review, agency consultation, and the results of the CFD modeling study. This analysis will include a ranking of alternatives (e.g., feasible, potentially feasible,

not feasible), pros/cons of the alternatives, and order-of-magnitude cost estimates for installation, operation, and maintenance.

Task 4: Report

A study report will be developed that will provide the results of the alternatives analysis, resource agency consultation, and the feasibility assessment. Conceptual engineering designs of the most feasible alternatives will be provided.

Consistency with Generally Accepted Scientific Practice

Evaluations of alternatives and feasibility studies, in consultation with resource agencies, are commonly used to develop fish passage solutions at hydropower projects.

Deliverables and Schedule

The alternatives analysis (Task 1) and resource agency consultation (Task 2) will occur during the first study year. The feasibility assessment (Task 3) will be conducted during the second study year, following completion of the CFD model (Section 6.2.6). The final study report will be included with the USR, which will be filed no later than October 4, 2023 per FERC's Process Plan and Schedule included in SD1.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. Estimated costs for this study are $45,000-$90,000. The Licensee believes that the proposed level of effort is adequate to evaluate potential downstream passage alternatives at the Project.

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6.2.6 **Computational Fluid Dynamics Modeling – Downstream Passage**

USFWS and NMFS each requested that the Licensee conduct CFD modeling to evaluate hydraulic influences in the Project vicinity as related to fish passage. The USFWS requested that the Licensee conduct modeling in the vicinity of fishway entrances and the powerhouse forebay to evaluate potential hydraulic impacts to both downstream and upstream fish passage. NMFS requested that the Licensee determine the flow field conditions that exist upstream of the Project powerhouse to determine potential impacts to downstream passage.

The Licensee is proposing to conduct CFD modeling upstream of the Project powerhouse in the vicinity of the Project forebay and downstream fishway entrance. The results of this modeling effort will be coupled with the *Downstream Passage Alternatives Study* (Section 6.2.5) to evaluate potential modifications to the downstream fish passage system at the Project. As discussed in Section 5.1.4, the Licensee is not proposing to conduct CFD modeling in the vicinity of the upstream fishway entrances at this time. The Licensee believes that it is premature to propose such a study until the *Anadromous Fish Upstream Passage Efficiency Study* (Section 6.2.4) has been completed.

Goals and Objectives

The goal of this study is to determine the flow field conditions that exist upstream of the Project powerhouse. The information from this request will be coupled with the information from the *Downstream Passage Alternatives Study* (Section 6.2.5) to identify potential modifications to the downstream fish passage system. The objective of this study is to develop a series of layered drawings that show velocity magnitude at discharges that have been agreed upon by the Licensee and the resource agencies. The results of the modeling will demonstrate velocities and flow orientations in front of the powerhouse and along the racks.

Known Resource Management Goals

NMFS is a federal agency with a mandate to protect and conserve fisheries resources and associated habitat. Resource management goals and plans are codified in their regulatory statutes. USFWS states that, regarding downstream passage, it is their management goal to direct as many downstream migrating fish as possible towards the downstream bypass facility. USFWS further states that their study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and PME measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a *et seq.*).

Background and Existing Information

The Project intake structure is an integral part of the powerhouse structure. It contains two sectional vertical slide gates operated by the same gantry crane that operates the spillway gates. These gates are normally open and are closed strictly for equipment maintenance. A hydraulic trash rack located on the intake deck cleans the two approximately 40 foot high by 33 foot wide intake racks. In addition, the intake contains three entrances for the downstream fish passage and one exit for the upstream fish passage. The trash racks are spaced 5 inches on center.

Downstream fish passage currently consists of the following components: three entry way gates with trashracks (12-inch clear spacing) extending from the headpond surface to 11.30 feet above the top of the

turbine intakes, sectional gates to close individual entrances, a connecting gallery between the entrances, a 36-inch diameter downstream passage pipe, a plunge pool that measures 30-feet by 20-feet and is kept at a depth of 10-feet under normal operating conditions. Downstream fishway flows range from 119 cfs to 131 cfs under controlled pond conditions. The plunge pool is equipped with two sectional gates that may be manipulated to control the depth of water in the plunge pool. The Project gantry crane is equipped with a special boom for servicing the downstream plunge pool.

The downstream fishway consists of three inlet systems located on the upstream face of the inlet deck area starting at elevation 93.0 to 101.0 feet by 36 inches wide. Each inlet consists of the following items:

- Six inlet stop log gates:
    - Two 36 inches wide by 12 inches tall
    - Two 36 inches wide by 18 inches tall
    - Two 36 inches wide by 24 inches tall

A set of trashracks is mounted just inside the upstream opening. Each inlet area then channels the water/fish into a 36-inch diameter pipe which all three downstream inlets are connected to. This pipe then discharges the water/fish into a plunge pool area located on the river side of the station just below the fish viewing room. The water inside the plunge pool then exits by way of a weir gate. The weir gate is adjusted to maintain the water level inside the plunge pool area above the 36-inch diameter discharge pipe opening.

The downstream passage facilities are operated in accordance with the terms of the July 2016 SPP accepted by FERC on May 11, 2018. In general, the downstream passage facilities are operated when many of the diadromous species would be attempting to pass downstream of the Project. More specifically, the downstream passage facilities are operated from April 1 to December 31 each year, river conditions permitting.

Section 4.4.5.2 of the PAD includes information pertaining to a downstream Atlantic Salmon smolt passage study previously conducted by the Licensee. To date, no CFD modeled data exists in front of the powerhouse. The results of this study, coupled with the *Downstream Passage Alternatives Study*, will be used to evaluate potential PME measures to provide safe, timely, and effective downstream passage for target species.

Project Nexus

The Project Dam is within the migration route of Atlantic Salmon, American Shad, river herring, and American Eel and, as such, may affect their downstream migration. The information collected during this study, combined with the *Downstream Passage Alternatives Analysis* and *Debris Removal Study*, will inform potential PME measures to enhance downstream fish passage at the Project.

Methodology

A CFD model will be developed and various production runs will be conducted to gain a better understanding of flow field conditions that exist upstream of the Project powerhouse. In order to effectively meet the requirements of this study, five key tasks have been identified. These tasks include: 1) collect

field data; 2) compile model input datasets; 3) develop and validate three-dimensional CFD model; 4) conduct model production runs; and 5) report findings. These tasks are described in more detail below.

Task 1: Collect Field Data

Water surface elevations and water depths will be collected to create a bathymetric map of the study area. Water column velocities/profiles will also be collected for use during model validation. This data will be collected throughout the study area as needed for model development and validation, as field conditions allow. Additionally, elevations/field measurements of pertinent Project facilities will be collected to confirm/supplement information shown on Project drawings.

Task 2: Compile Model Input Datasets

Utilizing existing Geographic Information System (GIS) elevation data and the bathymetric data collected in Task 1, three-dimensional surfaces of the study area riverbed will be constructed. Project drawings and the elevations/field measurements collected in Task 1 will then be used to develop three-dimensional representations of the intake/downstream fish passage structures and other pertinent Project facilities as needed to adequately model the flow field conditions that exist upstream of the Project powerhouse.

Task 3: Develop and Validate Three-Dimensional CFD Model

The input files developed in Task 2 will be used to build a three-dimensional hydraulic model. The model domain will be approximately 120-feet by 120-ft as depicted in Figure 6.2.6-1. The model will be built to utilize a finer computational grid size near trashracks (e.g., 0.25 feet), and a coarser computational grid size further upstream of the intake structure (e.g., 4 feet). The upstream boundary will utilize a constant water level boundary condition, while mass-momentum flow sources will be used to simulate outflow at the downstream boundary. Once built, various flow scenarios will be run through the model corresponding to the conditions during the collection of field data in Task 1. Results (e.g., water surface elevations and water column velocity data) will be compared to field data to validate the model. The extents and grid sizes should be considered preliminary and may be adjusted depending on stakeholder input and feedback as well as validation results.

Task 4: Conduct Model Production Runs

Once the model has been satisfactorily validated, production runs representing a range of scenarios will be developed and executed. Model scenarios evaluated may include differing flow magnitudes, structure layouts, and/or operating conditions. The scenarios will be developed in conjunction with the *Downstream Passage Alternatives Study*, which includes stakeholder consultation. The results of these model runs will provide a better understanding of the hydraulics in front of the intake structure.

Task 5: Report Findings

A report will be developed which summarizes data collection efforts, model development and validation, and study findings. The report will address each of the objectives defined for this study and will include maps, cross sections, and other visualizations of the model results that are relevant to the study objectives.

Consistency with Generally Accepted Scientific Practice

CFD modeling has become generally accepted scientific practice when evaluating complex flow fields and hydraulic characteristics in the vicinity of hydroelectric projects.

Deliverables and Schedule

Field data collection will occur early in the 2022 field season, with model development and validation occurring thereafter. Due to its timing, it is unlikely the modeling will be completed in time for inclusion in the ISR (i.e., October 4, 2022). Therefore, the final study report will be included in the USR, which is due no later than October 4, 2023 per FERC's Process Plan and Schedule included in SD1.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. Estimated costs for this study are $90,000-$125,000. The Licensee believes that the proposed level of effort is adequate to evaluate flow field conditions in the vicinity of the Project forebay and downstream fishway entrances.

Figure 6.2.6-1: Overview of CFD Model Extents

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6.2.7 **Stranding Evaluation**

NMFS requested that the Licensee conduct an evaluation to identify areas below the spillway and under which operational scenarios the risk for stranding occurs to inform potential 10(j) recommendations and potential license conditions to minimize or prevent stranding.

Goals and Objectives

The goal of this study is to evaluate the effect of Project operations on diadromous fish. The objective of the study is to identify which areas and under which operational scenarios pose the greatest risk for the stranding of fish in the Project area, particularly the bypass.

Known Resource Management Goals

NMFS is a federal resource agency with a mandate to protect and conserve fisheries resources and associated habitat. Resource management goals and plans are codified in their regulatory statutes.

Background and Existing Information

The Project operates as a run-of-river facility with the exception of power system emergencies when BB2H is called upon for maximum output or under maintenance exceptions. During normal operations, the Licensee attempts to maintain the pond elevation in order to provide a combination of spill over the dam and the required seasonally-variable instream flows to the bypass reach. The maximum hydraulic capacity of the Project is 9,040 cfs, which is equaled or exceeded approximately 22% of the time annually. When the hydraulic capacity of the Project is exceeded, water is passed over the spillway.

Project Nexus

As high flows recede and spill over the dam ceases, the area of ledge immediately below the spillway may create disconnected pools that could strand fish.

Methodology

Task 1: Operational Data Review

Prior to conducting the field investigation, a desktop literature review will be performed to gather information on the typical sequencing of spillway gate operations as well as the frequency of annual spill operations at the Project. This information will determine the inflow and operational conditions under which stranding could occur in the areas downstream of the Project spillway.

Task 2: Field Survey

The field survey will consist of a reconnaissance level evaluation where a field crew (including agency personnel that participate) will examine potential stranding sites in the study area at an appropriate time interval after spilling operations have ceased. Any accessible pools with fish stranding potential will be identified and visited shortly after the spillage event. On-ground surveys will traverse any pools and visually document fish present as well as looking for fish trapped under rocks. Information on the number and location of fish stranded will be recorded and georeferenced. In addition, the conditions of the study area will be photo-documented.

Task 3: Report

A report will be prepared describing the results of the field assessment and the potential for stranding downstream of the Project.

Consistency with Generally Accepted Scientific Practice

The methodology proposed is consistent with similar efforts at other hydroelectric projects undergoing relicensing, including the downstream Pejepscot Project.

Deliverables and Schedule

The study will be conducted during the 2022 field season. The final study report will be included with the ISR, which will be filed no later than October 4, 2022 per FERC's Process Plan and Schedule included in SD1.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. Estimated costs for this study are $15,000-$25,000. The Licensee believes that the proposed level of effort is adequate to evaluate potential stranding in the bypass reach.

6.2.8 **Debris Removal Study**

NMFS requested that the Licensee review the Project operator's logbooks over at least the last 20 years to enumerate the number of times a year when the downstream passages were cleaned of debris, how much debris was removed, and any specific issues removing the debris. As discussed in Section 5.1.6, the information requested by NMFS is not available. As an alternative, the Licensee proposes to collect the requested information during the 2022 and 2023 fish passage seasons. The results of the study will be anecdotally compared to past years to determine if they were representative of long-term conditions.

Goals and Objectives

The goal of this study is to quantify the effort over time to remove debris from the downstream bypass facilities, to describe the magnitude of each individual effort, and to determine the sufficiency of existing Project operations and structures in managing debris accumulations. The objective of the study is to record the number of times a year when the downstream passages are cleaned of debris, how much debris was removed, and any specific issues removing debris.

Known Resource Management Goals

NMFS is a federal resource agency with a mandate to protect and conserve fisheries resources and associated habitat. Resource management goals and plans are codified in their regulations and governing statutes.

Background and Existing Information

Up until 2009, BB2H contracted with a third party to remove and dispose of the debris from the river that accumulated at the Project. Since 2009, all of the debris that has been removed from the river has been stored on site and disposed of once or twice a year, as needed. Details pertaining to the amount of debris that has been removed is not available. The table below indicates the number of times per year that the downstream fishway has been taken offline so that the intake area could be cleared of debris.

Year	Number of times secured for cleaning that year
2009	3
2010	3
2011	3
2012	5
2013	4
2014	6
2015	3
2016	3
2017	6
2018	4

2019	7
2020	6

While the downstream fishway is operating, the system racks are inspected once or twice a day and all debris is removed from the racks as needed; however, the amount of debris removed has not been historically quantified.

Project Nexus

The Project Dam is within the migration route of Atlantic Salmon, American Shad, river herring, and American Eel and, as such, may affect their downstream migration. Debris buildup and removal issues have the potential to compound problems with downstream passage. The information collected during this study, combined with the *Downstream Passage Alternatives Analysis* and the *Computational Fluid Dynamics Modeling – Downstream Passage*, will inform potential PME measures to enhance downstream fish passage at the Project.

Methodology

Plant operators will record the number of times a year when the downstream passage system is cleaned of debris, approximately how much debris was removed, and any specific issues removing debris. This information will be gathered during the 2022 and 2023 fish passage seasons and will be anecdotally compared to past years (based on operator experience) to determine if 2022 and 2023 were representative of past years. The results of this effort will be summarized in a brief report that will be filed with the USR.

Consistency with Generally Accepted Scientific Practice

The methodology proposed is consistent with similar efforts at other hydroelectric projects undergoing relicensing, including the downstream Pejepscot Project.

Deliverables and Schedule

The study will be conducted during the 2022 and 2023 fish passage seasons. The final study report will be included with the USR, which will be filed no later than October 4, 2023 per FERC's Process Plan and Schedule included in SD1.

Cost and Level of Effort

The Licensee is proposing to conduct the study during the course of one study year. Estimated costs for this study are $5,000-$10,000. The Licensee believes that the proposed level of effort is adequate to characterize debris removal at the Project.

6.3 Cultural Resources

Based on the PAD as well as the FERC and the Maine State Historic Preservation Officer (MESHPO) requested investigations to identify previously undocumented cultural resources within the Project's area of potential effects (APE), BB2H proposes to conduct historic architectural and precontact archaeological surveys as defined below. An historic archaeological survey was not requested by the reviewers and is not proposed because it is unlikely that historic archaeological properties exist within the Project APE.

Goals and Objectives

The goal of the of the cultural resources study is to identify historic properties that may be affected by the continued operation of the Project in compliance with Section 106 of the National Historic Preservation Act of 1966 (NHPA, 54 U.S.C. §§ 300101-307108), as amended, and its implementing regulation 36 C.F.R. Part 800. Historic properties are defined as any building, site, structure, object, or district that is included or potentially eligible for inclusion in the National Register of Historic Places (NRHP or National Register) (36 C.F.R § 800.16(l)(1)). The objectives of the study are to delineate a recommended APE for the Project; identify and evaluate historic properties that are within the APE; assess the potential effects of the relicensing of the Project on historic properties pursuant to 36 C.F.R. § 800.5; and resolve any potential adverse effects pursuant to 36 C.F.R. § 800.6.

Relevant Resource Management Goals and Public Interest Considerations

Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties. Section 106 seeks to accommodate the historic preservation concerns with the needs of Federal undertakings through consultation among the agency official and other consulting parties, including the State Historic Preservation Officer, Native American Tribes, local officials, the applicant for Federal assistance and other organizations and individuals who may be invited to take part in the consultation. The issuance of a license by FERC for the Project constitutes an undertaking that is reviewable under Section 106. As FERC's designee for coordinating the Section 106 consultation process, BB2H will conduct the cultural resource study and provide information about the recommended APE and the potential effects of the relicensing on historic properties. The Maine Historic Preservation Commission/State Historic Preservation Office (MHPC/MESHPO) will represent the interests of the state and its citizens in the consultation to resolve any potential adverse effects that may result from the relicensing of the Project.

Existing Information and Need for Additional Information

A review of existing information about previously recorded and expected cultural resources in the vicinity of the Project was presented in the PAD. Sources consulted consisted of the MHPC Cultural & Architectural Resource Management Archive (CARMA), town histories, and historic maps of the area.

Historic Architectural Properties

The Project is within the boundary of the former Worumbo Mill Complex (MHPC No. 53264), which was listed in the National Register in 1973, but delisted in 2017 because the district no longer retains integrity. The Worumbo Mills factory building, the key property within the district, burned in 1987. In the 1980s much of the historic dam was replaced and the non-contributing Worumbo Project was constructed. Building No. 4 (MHPC No. 53272), another important property in the former district, was demolished in 2016. All of the surviving properties of the former district are outside the Project boundary. They consist of the Worumbo Mills Powerhouse (MHPC No. 53266), Office Building (MHPC No. 53270), Bridge No.

1 (MHPC No. 53267), and Bridge No. 2 (MHPC No. 53262). Two other previously inventoried properties are adjacent to the Project boundary and consist of a portion of the Maine Central Railroad (MHPC No. 80345), which has been determined ineligible for listing in the National Register, and the Durham Bridge (MHPC No. 53224), which was demolished and replaced in 2015. A reconnaissance-level survey is needed to verify the existing condition of previously documented architectural properties in the Project boundary and identify other properties within the APE that are 50 years of age and may be eligible for inclusion in the National Register.

Archaeological Sites

There are no known or expected historic archaeological sites in the vicinity of the Project. The PAD identified one previously recorded precontact archaeological site (ME 14-152), which was identified along the east bank of the Androscoggin River in Lisbon Falls during a survey of the Lisbon Falls Bypass for the Maine Department of Transportation in 1990. The site consists of one quartz blade, one quartz core, and 49 quartz flakes, suggesting the Native American occupants were carrying out stone tool manufacturing and/or maintenance activities during an unknown precontact cultural period (Trautman and Spiess, 1990). No evaluation of the site's potential for listing in the National Register was conducted at the time of the site's discovery. A systematic precontact archaeological survey is needed to determine whether significant archaeological sites exist in areas that may be affected by Project operations or recreational developments.

Project Nexus

Activities related to the operation and maintenance of the Project over the term of the new license may affect historic properties. Potential effects include Project-related operations and development in areas sensitive to contain significant archaeological sites and developmental activities that have the potential to affect historic architectural properties. The cultural resource study will identify National Register-eligible archaeological sites and historic buildings and structures that may be directly or indirectly affected by project operations and maintenance activities.

If FERC, after consulting with the SHPO and other interested parties, determines that the relicensing of the Project has the potential to cause adverse effects on historic properties, the information from the study will form the basis for continued consultation to resolve the effects. The product of that consultation would likely be a Programmatic Agreement (PA) that stipulates actions to be taken to avoid, minimize, or mitigate the adverse effect. The development of a Historic Property Management Plan (HPMP) that specifies how historic properties will be protected and managed during the term of the license would be among the activities stipulated in the PA.

Study Area/Area of Potential Effects (APE)

The study area for the cultural resources surveys will correspond to the Project's APE, which is defined in the Section 106 regulations as being the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (36 C.F.R § 800.16(d)). FERC, as the lead federal agency for the Project, is responsible for determining the APE in consultation with the SHPO.

In its response to the PAD, the MESHPO stated that the APE for archaeological surveys of hydro-power projects in Maine consists of "…all land around the margin of the impoundment that may be affected by erosion during the term of the future license. When the Project boundary is defined as an elevation, for

example, the APE may extend above that elevation and laterally outside the Project boundary, if there is a potentially eroding landform that extends above the Project boundary elevation." For historic architectural resource surveys, the "Project APE is defined as the lands enclosed by the Project's boundary and the lands or properties outside of the Project's boundary where project construction and operation or project-related recreational development or other enhancements may cause changes in character or use of historic properties, if any historic properties exist" (Mohney 2020).

Combining these definitions, the study area for the cultural resource surveys will consist of all the lands within the Project boundary and areas beyond the boundary that are identified during initial field investigations as being impacted or threatened by Project-related operations, development, or activities. The Project boundary north of the dam extends upstream approximately 2 miles and follows the shoreline at the 100-foot contour level except in the vicinity of the dam and powerhouse. The boundary extends downstream of the dam about 0.25 miles to the Route 125 Bridge over the Androscoggin River. The Project boundary encompasses about 209 acres of land and water. If approved by FERC, in consultation with the SHPO, the study area will constitute the APE for the Project pursuant to 36 C.F.R § 800.4(a)(1).

6.3.1 **Historic Architectural Survey**

The historic architectural survey will be conducted by a qualified architectural historian who meets the Secretary of the Interior's Professional Qualification Standards (36 C.F.R. Part 61). The survey will identify and evaluate historic buildings, structures, and objects within the study area. The survey will be a reconnaissance level investigation conducted in accordance with the guidelines and procedures contained in the MHPC's *Above Ground Cultural Resource Survey, Guidelines for Identification: Architecture and Cultural Landscapes, Federal and State Regulatory Project Review Specific* (MHPC 2013). It will include background research and fieldwork to locate and identify all above ground resources within the study area that are least 50 years of age. The survey report will include recommendations about the potential National Register eligibility of each property. A preliminary assessment of the potential effects of the continued operation of the Project will be conducted for each property evaluated potentially eligible for the National Register and recommendations about the nature of the effect will be included in the report.

Methodology

The following specific tasks will be completed as part of the historic architectural survey:

Task 1: Archival Research

Background research will be conducted in state and local repositories to provide information about the general patterns of development in the study area to provide the information about the types of historic properties that may be encountered during the fieldwork. The research will be conducted in readily available secondary histories, historical maps and atlases, periodicals, and other sources that provide information about the history of the mill privilege where the Project is located and the development of Worumbo Mills and its impact on the history of the Towns of Lisbon and Durham in the nineteenth and twentieth centuries.

Task 2: Fieldwork

Fieldwork will be conducted to locate and identify all properties that appear to be at least 50 years of age in the study area. Each property's location will be recorded on a base map and the property will be photographed using a high-resolution digital camera. Notes about the property's physical appearance will be taken and a preliminary assessment will be made regarding its potential for listing in the National Register and the potential effects of the proposed project on those properties that may be eligible for the National Register.

Task 3: Report

In accordance with the MHPC's Guidelines all projects must be submitted to the MHPC for preliminary review. Information about each surveyed property will be entered into CARMA, MHPC's on-line direct data entry system to record all identified historic properties and to prepare inventory forms. This task includes inputting descriptive data, uploading digital photographs, mapping each resource in the CARMA system, and uploading a preliminary survey report that utilizes the MHPC report template. The report will include a project description, an explanation of the APE, survey boundaries, and methodology. The survey findings will be presented including the total acres surveyed, a description of the setting, the number and type of resources recorded, National Register eligibility recommendations, and a bibliography. The report will conclude with a preliminary finding of effects for properties that are listed or eligible for listing in the National Register. In accordance with MHPC guidelines, supporting materials will include a survey base map showing the location of properties surveyed and a matrix with summary information about each

property, including survey map number, address, National Register eligibility status, applicable National Register Criteria, and an evaluation of the property's historic integrity.

Consistency with Generally Accepted Scientific Practice

The historic architectural reconnaissance survey will follow applicable state and federal guidelines for historic property identification surveys, including those contained in the MHPC's *Above Ground Cultural Resource Survey, Guidelines for Identification: Architecture and Cultural Landscapes, Federal and State Regulatory Project Review Specific* (MHPC 2013) and National Register Bulletin 24: Guidelines for Local Surveys: A Basis for Preservation Planning (Derry et al. 1985).

Deliverables and Schedule

The research and reconnaissance-level field work for the historic architectural reconnaissance survey will occur in the summer and fall of 2022. The final report, including printed and electronic copies of the survey report, inventory forms, survey base map, survey matrix, and digital images index, will be completed by December 31, 2022.

Cost and Level of Effort

The cost for completion of the historic architectural survey is between $10,000-$20,000.

6.3.2 **Pre-contact Archaeological Survey**

The pre-contact archaeological survey will be conducted by a qualified archaeologist who meets the Secretary of the Interior's Professional Qualification Standards (36 C.F.R. Part 61) and has been pre-qualified as a level II prehistoric archaeologist by the Maine State Archaeologist.

Methodology

The geographic scope of the precontact archaeological survey is the study area as defined above. The survey will consist of background research and field investigations.

All methods used to conduct survey for pre-contact archaeological sites or for the NRHP-eligibility evaluation of sites will conform to MHPC guidelines. Consistent with other recent similar surveys conducted at hydropower projects in Maine, the Licensee anticipates utilizing a phased approach.

Task 1: Background Research

Archaeological site files maintained at the MHPC and previously published archaeological reports will be reviewed for updated information on known cultural resources within and/or near the Project APE. A review of local geography, geology, ecology, and soils will also be conducted to further understand the archaeological resource potential of the Project. The background research will identify areas within the APE with known and/or potential for containing pre-contact archaeological resources. A Phase 0 assessment survey will be conducted focusing on these high sensitivity areas. The MHPC's primary interest is the area of potential impacts from erosion within the impoundment area.

Task 2: Phase 0 Assessment Survey

The goals for a Phase 0 assessment survey will be to:

- Assess the study area, with particular focus on areas of active erosion, for archaeological sensitivity and identify areas with potential to contain Pre-Contact Period archaeological resources;
- Recommend refinements to the Project APE, if needed, based on the sensitivity assessment; and
- Recommend the need for Phase I reconnaissance survey in areas of active erosion assessed as archaeologically sensitive within the Project APE.

The Phase 0 assessment will include:

A visual inspection (from land or water) of the study area to document observable natural and cultural surface features indicative of Pre-Contact Period Native American occupation.

- A handheld soil auger will be used to assess ground conditions and document areas of disturbance in select areas, as needed.
- Digital photography of landforms and areas of pre-contact interest.
- A Phase 0 report summarizing the archaeological sensitivity of the study area with a focus on areas of active erosion; recommendations for refining the Project APE, if needed, and for Phase I testing

in sensitive areas determined to be within the Project APE as determined in consultation with MHPC and FERC.

Task 3: Phase I Reconnaissance Survey

The goals for a Phase 1 reconnaissance survey will be to:

- Identify and document any Pre-Contact Period cultural material and/or features within areas of active erosion that fall within the Project's APE, as defined by the Phase 0 assessment.

- Provide recommendations regarding the significance of the deposits and the need for additional work and consultation with MHPC and FERC.

The Phase I reconnaissance survey will include:

- Subsurface testing with shovel test pits, 50-x-50-centimeter (cm) in size, in areas of high probability to contain Pre-Contact Period archaeological resources that fall within the Project APE as defined from the Phase 0 assessment, and recovery of cultural material useful in identifying and dating such resources.

- Use of GPS devices to provide UTM coordinates for all sites, site features, site boundaries, and testing locations;

- Digital photography of testing locations, cultural features, and site areas;

- Laboratory processing and analyses of all recovered cultural material, including cleaning, identifying, and cataloging recovered artifacts; preliminary analysis of the spatial distribution of artifacts; and photography of diagnostic and/or representative artifact types;

- Phase I report summarizing the results of the subsurface testing, laboratory processing and analysis, and recommendations regarding the significance of the deposits and the need for additional work and consultation with MHPC and FERC.

Task 4: Phase II (Intensive-Level) Survey (if necessary)

If potentially significant pre-contact archaeological sites are identified during the Phase I reconnaissance survey in areas of active erosion or other Project impacts, in consultation with the FERC and the MHPC, then additional testing in the form of Phase II (intensive-level) survey will be conducted. Potential pre-contact archaeological sites identified during the Phase I survey in unaffected portions of the study area will be treated as significant resources for the purposes of Section 106 until additional archaeological investigations to determine their boundaries and National Register eligibility are conducted. The treatment and protection of these sites along with a phased plan to complete Phase II survey will be addressed in the Project's HPMP.

The goals for a Phase II survey will be to:

- Determine site boundaries and National Register eligibility of sites within affected portions of the study area.

- Provide recommendations for National Register eligibility, based on the field findings.

The Phase II survey will include:

- Excavation of additional 50-x-50-cm shovel test pits and larger units (combinations of 1-x-1-meter squares) for shallow (up to 100 cm below surface) cultural deposits in each identified site area to examine cultural material concentrations and/or features, and inform on the age, size, and internal complexity/configuration of the site;

- Exact placement and amount of Phase II testing will be based on the results of the Phase I testing;

- Use of GPS devices to provide UTM coordinates for all sites, site features, site boundaries, and testing locations; and

- Digital photography of all identified sites, site features, and testing locations.

- Laboratory processing and analyses of all recovered cultural material, including cleaning, identifying, and cataloging recovered artifacts; preliminary analysis of the spatial distribution of artifacts; and photography of diagnostic and/or representative artifact types.

- A Phase II report summarizing the results of the Phase II subsurface testing, laboratory processing and analysis, and recommendations for National Register eligibility, based on the field findings.

Consistency with Generally Accepted Scientific Practice

All phases of pre-contact archaeological field investigation will follow applicable Federal and Maine guidelines, including those contained in the MHPC's website (http://www.maine.gov/mhpc/) and the National Park Service in the *Recovery of Scientific, Prehistoric, Historic and Archaeological Data* (36 C.F.R. Part 66 Appendix C). In particular, MHPC-approved level II Pre-Contact Period archaeologists will be employed to undertake field surveys and site evaluations.

Deliverables and Schedule

Following completion of each phase of fieldwork, a report conforming to the MHPC standards will be completed and submitted in hard copy format to the MHPC-SHPO for review and comment. The fieldwork for the Phase 0 assessment survey and Phase 1 reconnaissance survey will occur in the summer and fall of 2022. Draft reports will be prepared for comment by the MHPC/SHPO and tribes (if applicable); the final Phase 0 report will be completed by October 2022 and the Phase I report will be completed by December 31, 2022. If necessary, Phase II investigations to evaluate the significance of archaeological sites will be conducted in the spring of 2023.

Cost and Level of Effort

The estimated cost for completion of a Phase 0 assessment survey for pre-contact archaeological resources within the study area is between $10,000-$20,000. The estimated cost for completion of Phase I reconnaissance survey for Pre-Contact period resources is approximately $15,000–$35,000. The Licensee believes that the proposed level of effort is adequate to obtain initial information on Pre-Contact Period archaeological resources within the study area.

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APPENDIX A – PROJECT OPERATIONS DATA

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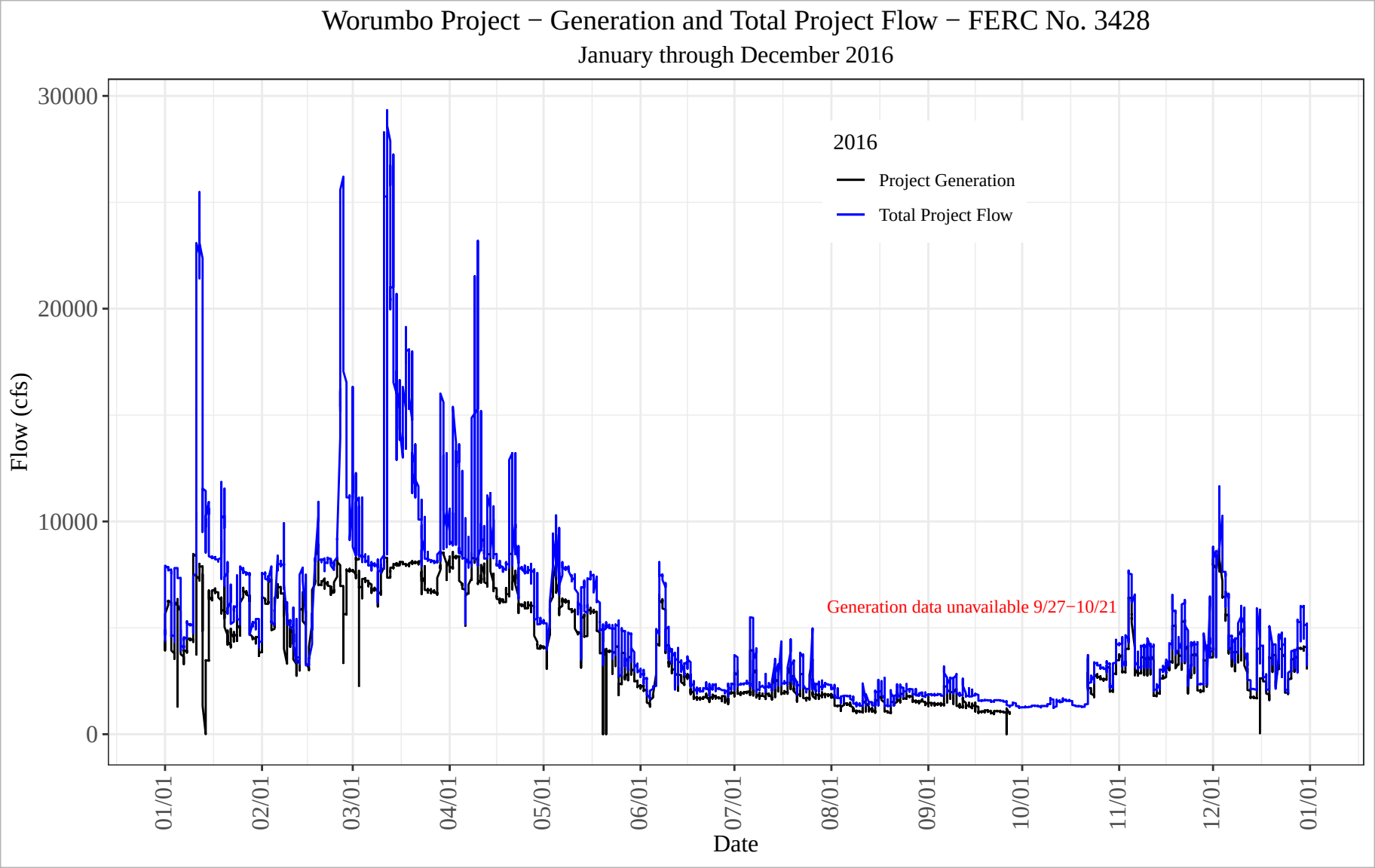
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Flow (cfs)
2016
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Total Project Flow
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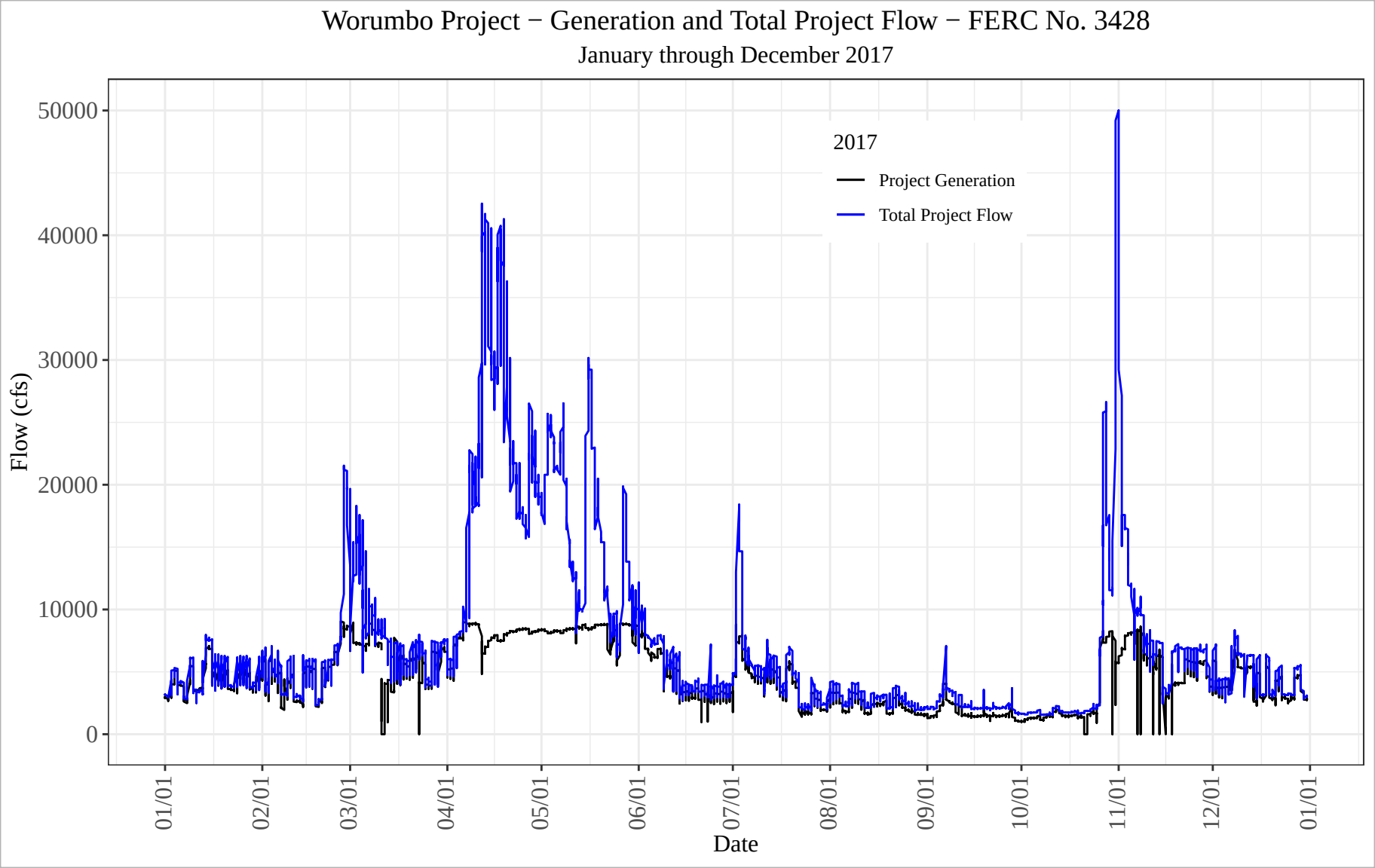
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January through December 2017
2017
Project Generation
Total Project Flow
Flow (cfs)
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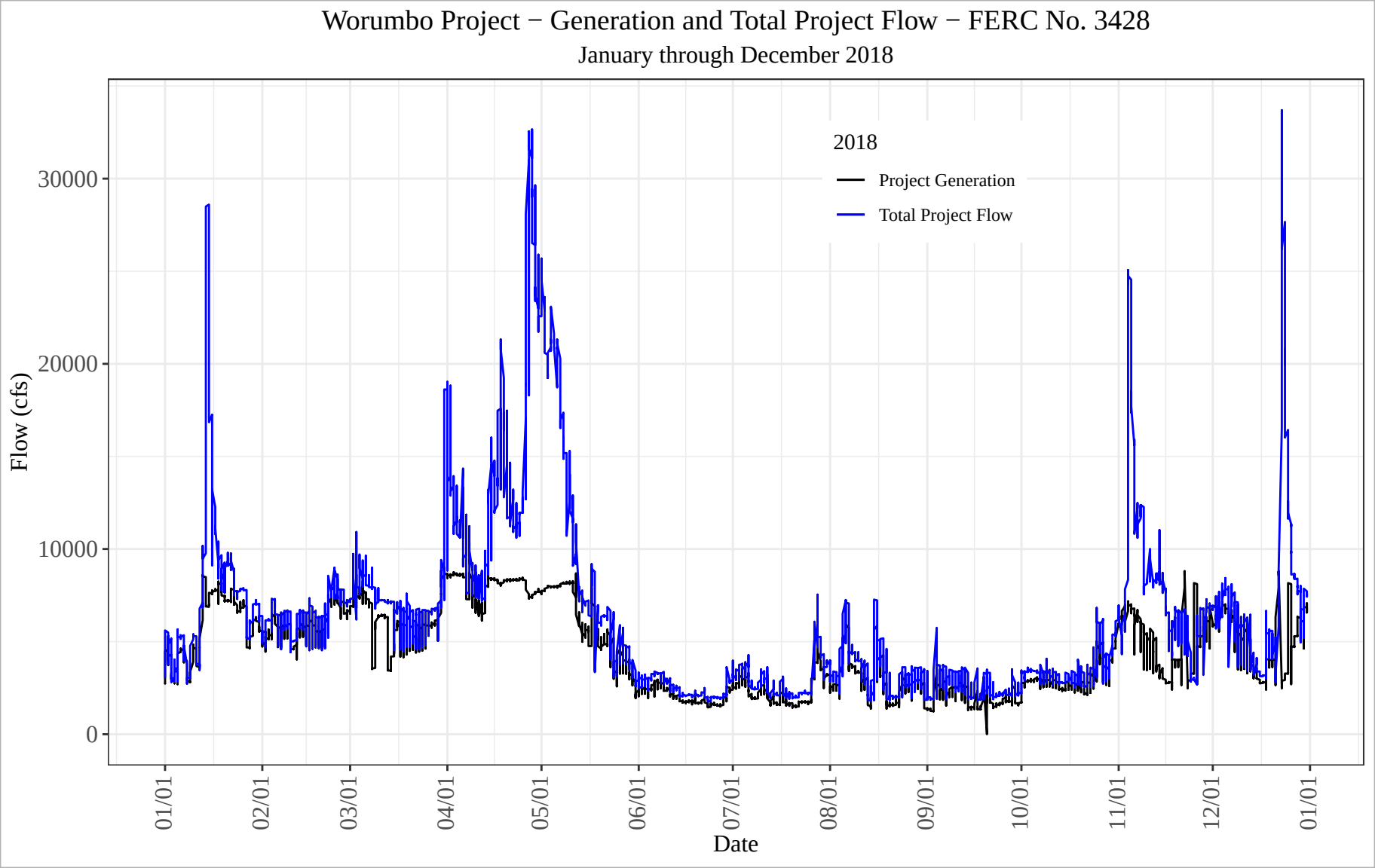
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January through December 2018
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Project Generation
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Flow (cfs)
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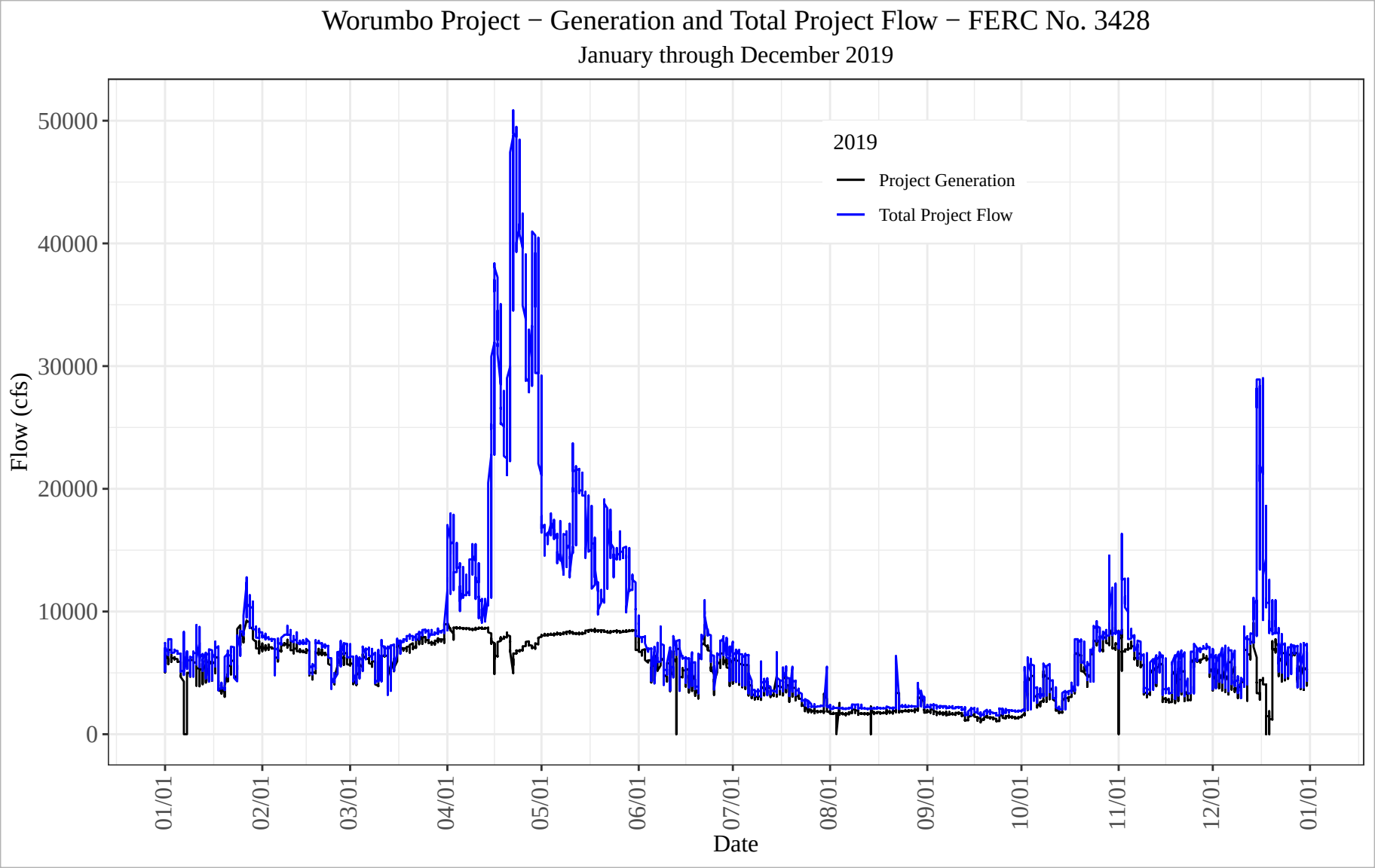
Worumbo Project − Generation and Total Project Flow − FERC No. 3428
January through December 2019
2019
Project Generation
Total Project Flow
Flow (cfs)
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30000
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02/01
03/01
04/01
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06/01
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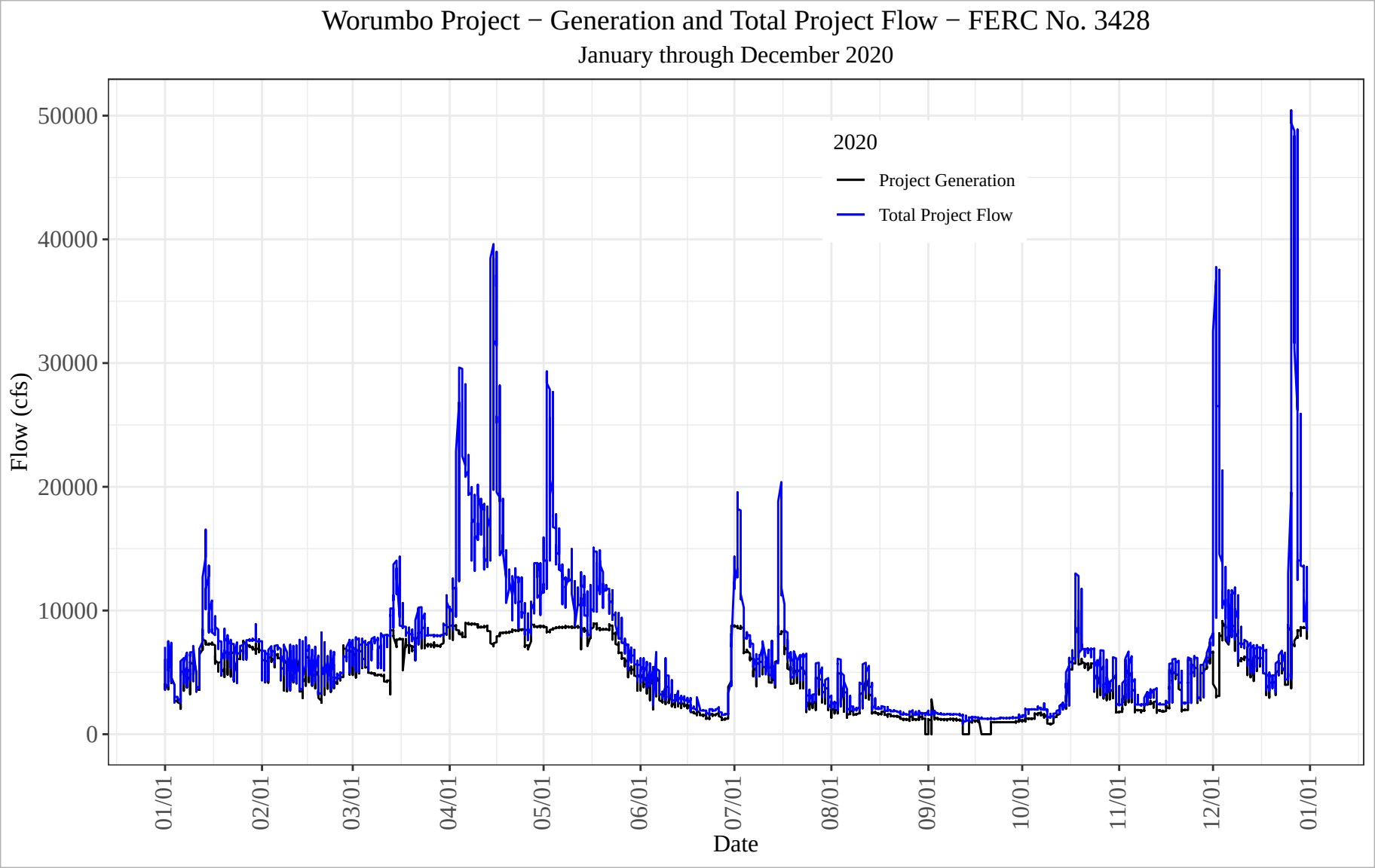
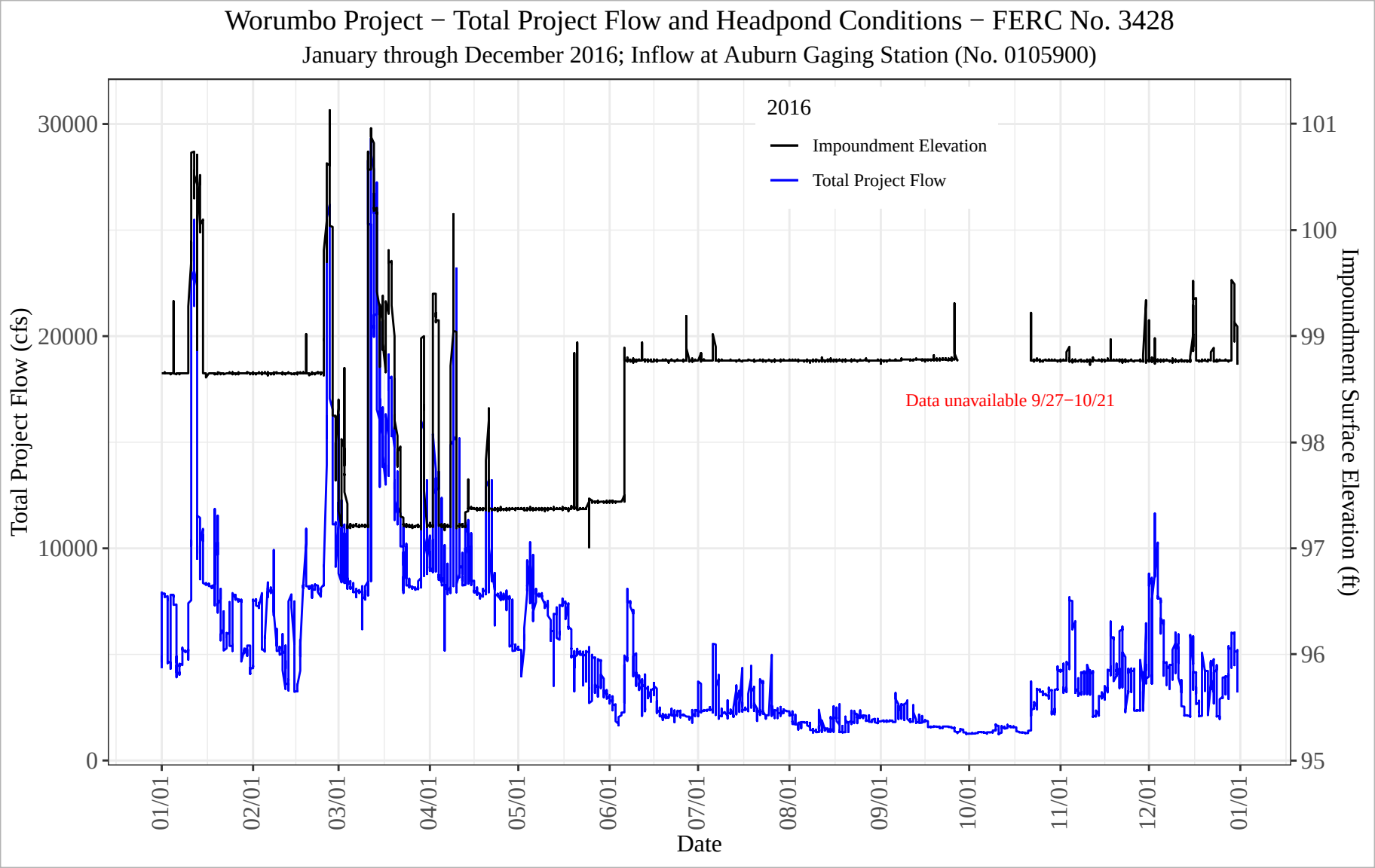
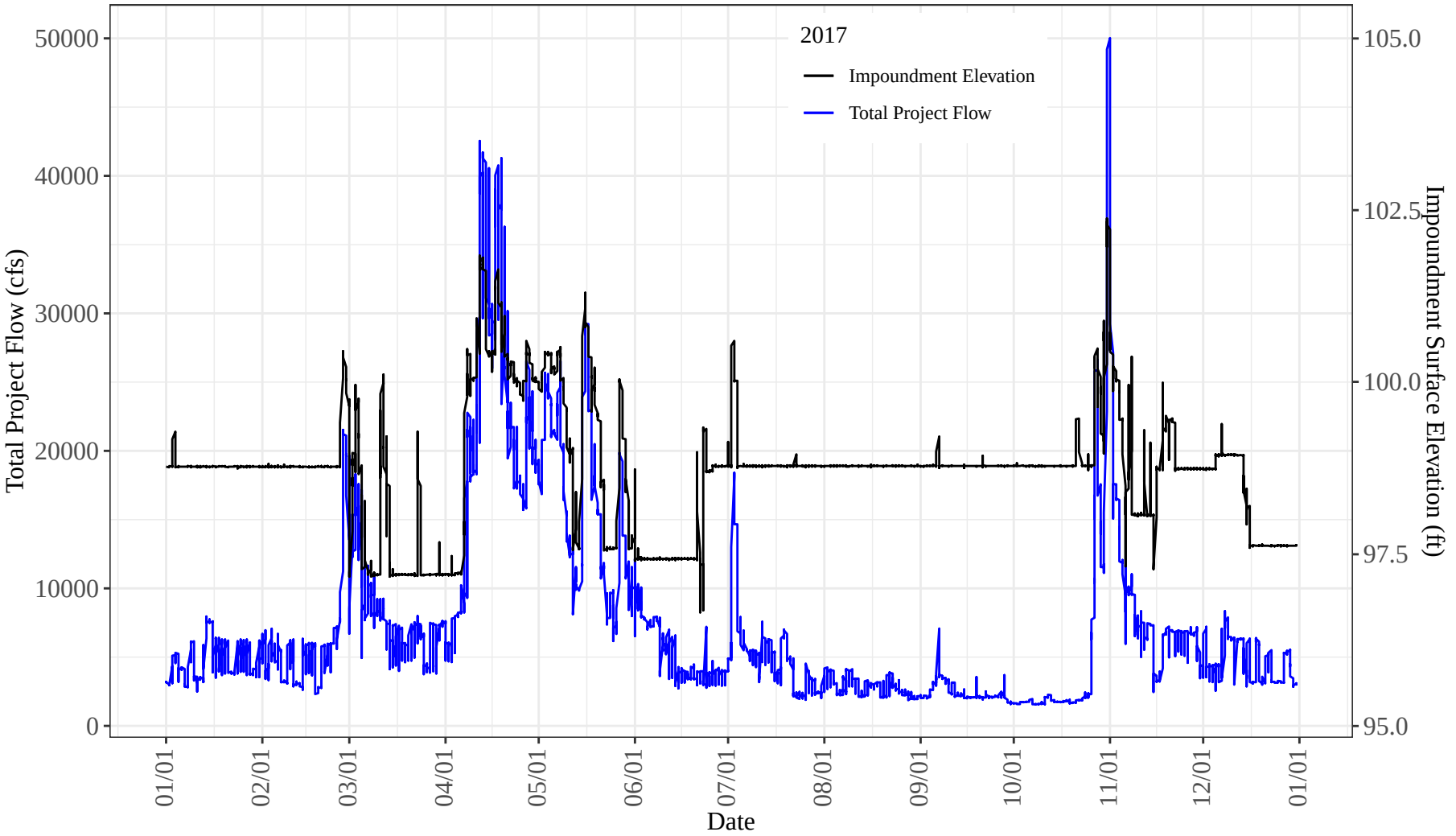
01/01
Date

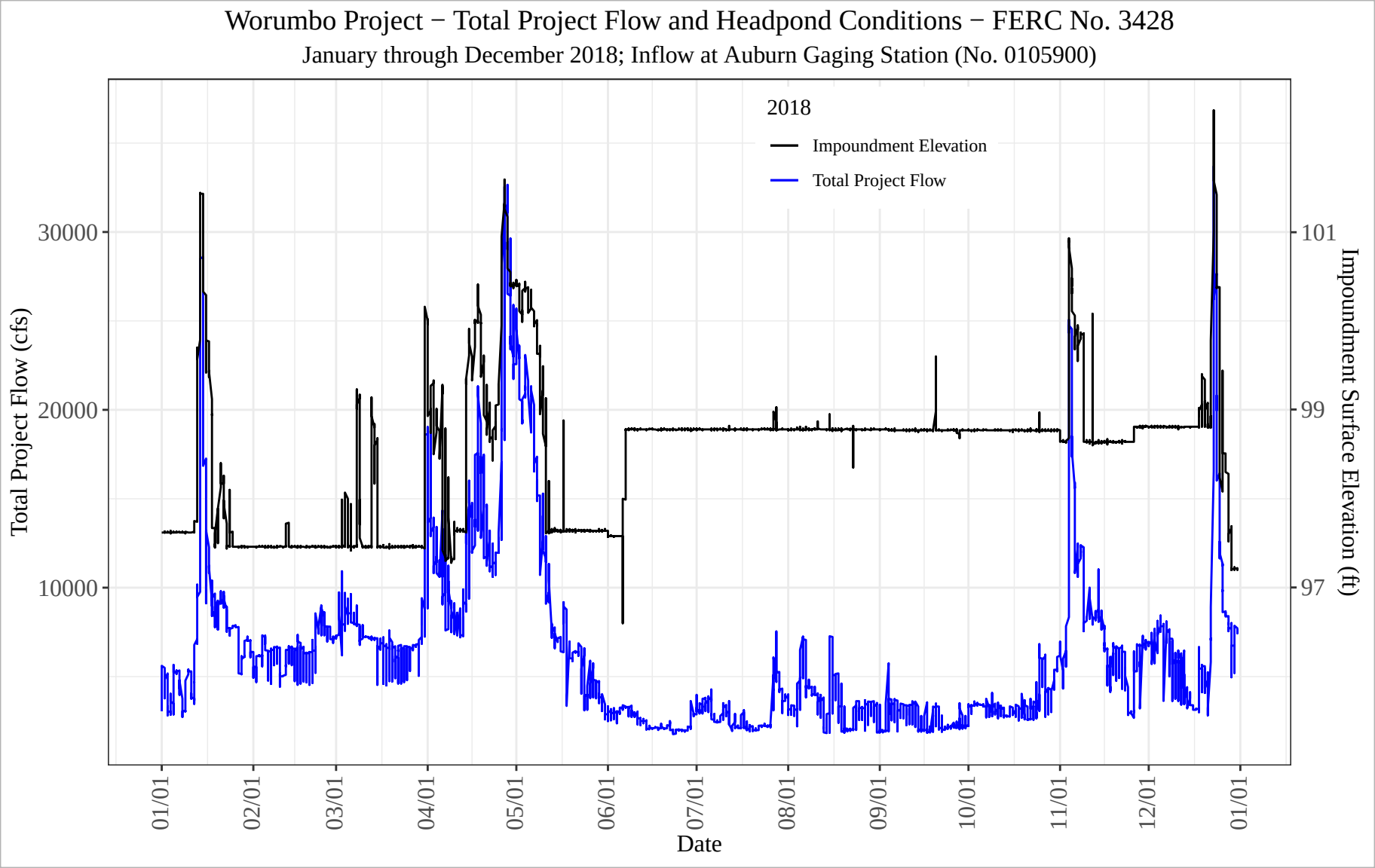

Worumbo Project − Generation and Total Project Flow − FERC No. 3428
January through December 2020
2020
Project Generation
Total Project Flow
Flow (cfs)
50000
40000
30000
20000
10000
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01
01/01
Date

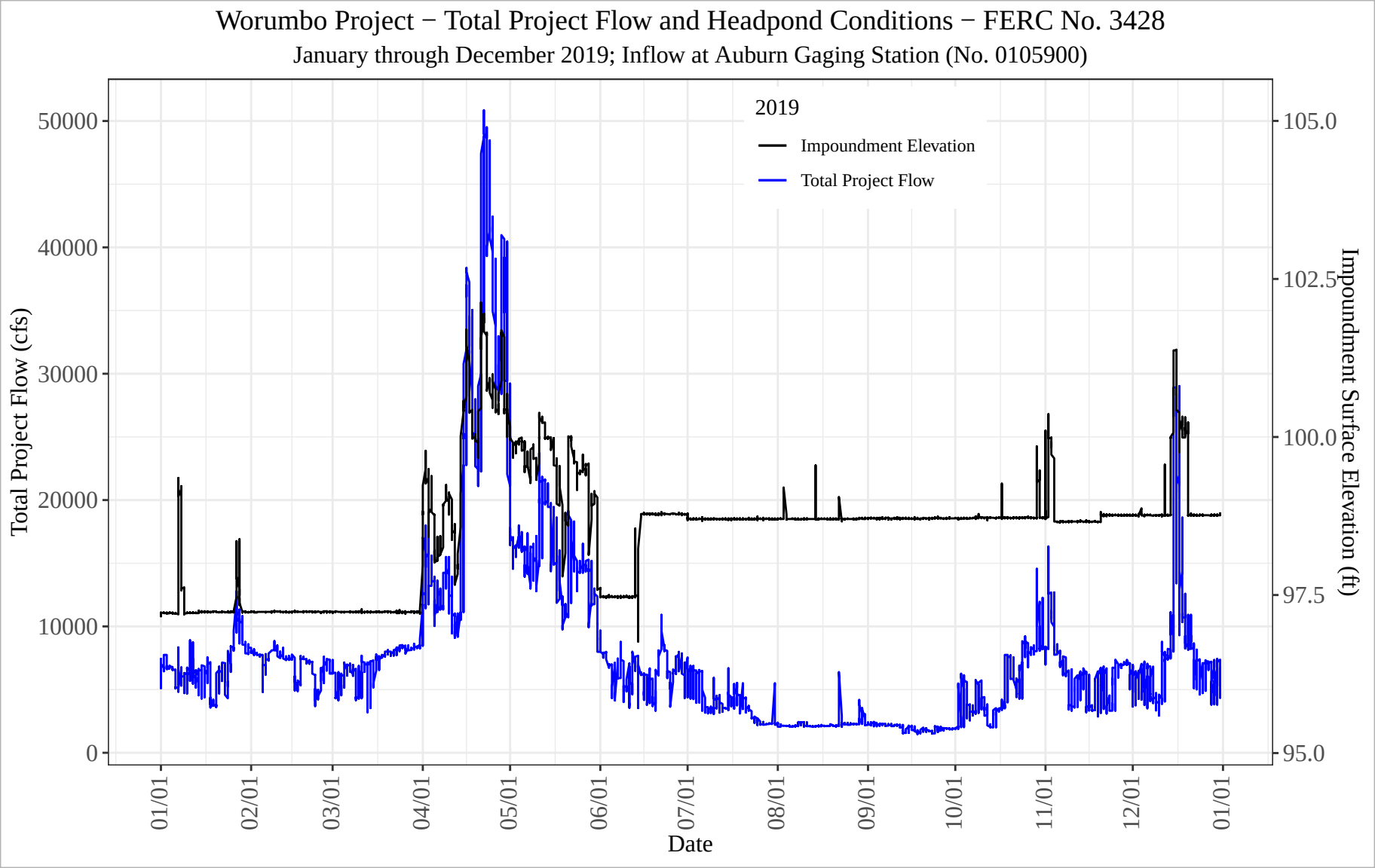

Worumbo Project − Total Project Flow and Headpond Conditions − FERC No. 3428
January through December 2016; Inflow at Auburn Gaging Station (No. 0105900)
2016
Impoundment Elevation
Total Project Flow
Data unavailable 9/27−10/21
Total Project Flow (cfs)
Impoundment Surface Elevation (ft)
Date
30000
20000
10000
0
101
100
99
98
97
96
95
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01
01/01

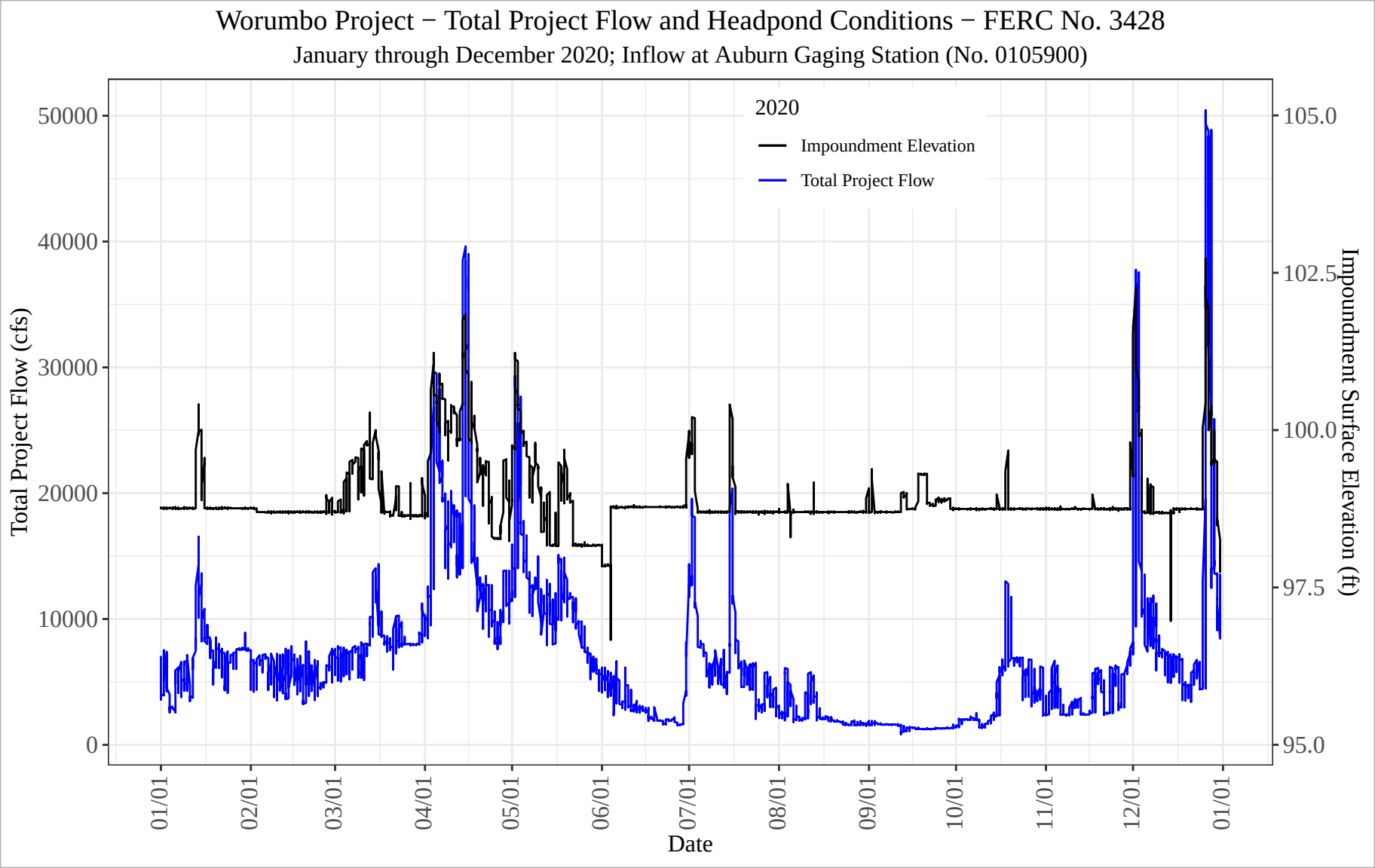
Worumbo Project − Total Project Flow and Headpond Conditions − FERC No. 3428

January through December 2017; Inflow at Auburn Gaging Station (No. 0105900)




Worumbo Project − Total Project Flow and Headpond Conditions − FERC No. 3428
January through December 2018; Inflow at Auburn Gaging Station (No. 0105900)
2018
Impoundment Elevation
Total Project Flow
Total Project Flow (cfs)
30000
20000
10000
Impoundment Surface Elevation (ft)
101
99
97
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01
01/01
Date


Worumbo Project − Total Project Flow and Headpond Conditions − FERC No. 3428
January through December 2019; Inflow at Auburn Gaging Station (No. 0105900)
2019
Impoundment Elevation
Total Project Flow
Total Project Flow (cfs)
Impoundment Surface Elevation (ft)
Date
50000
40000
30000
20000
10000
0
105.0
102.5
100.0
97.5
95.0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01
01/01


Worumbo Project − Total Project Flow and Headpond Conditions − FERC No. 3428
January through December 2020; Inflow at Auburn Gaging Station (No. 0105900)
2020
Impoundment Elevation
Total Project Flow
Total Project Flow (cfs)
Impoundment Surface Elevation (ft)
Date
50000
40000
30000
20000
10000
0
105.0
102.5
100.0
97.5
95.0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01
01/01

APPENDIX B – UPSTREAM EEL PASSAGE PHOTOGRAPHS

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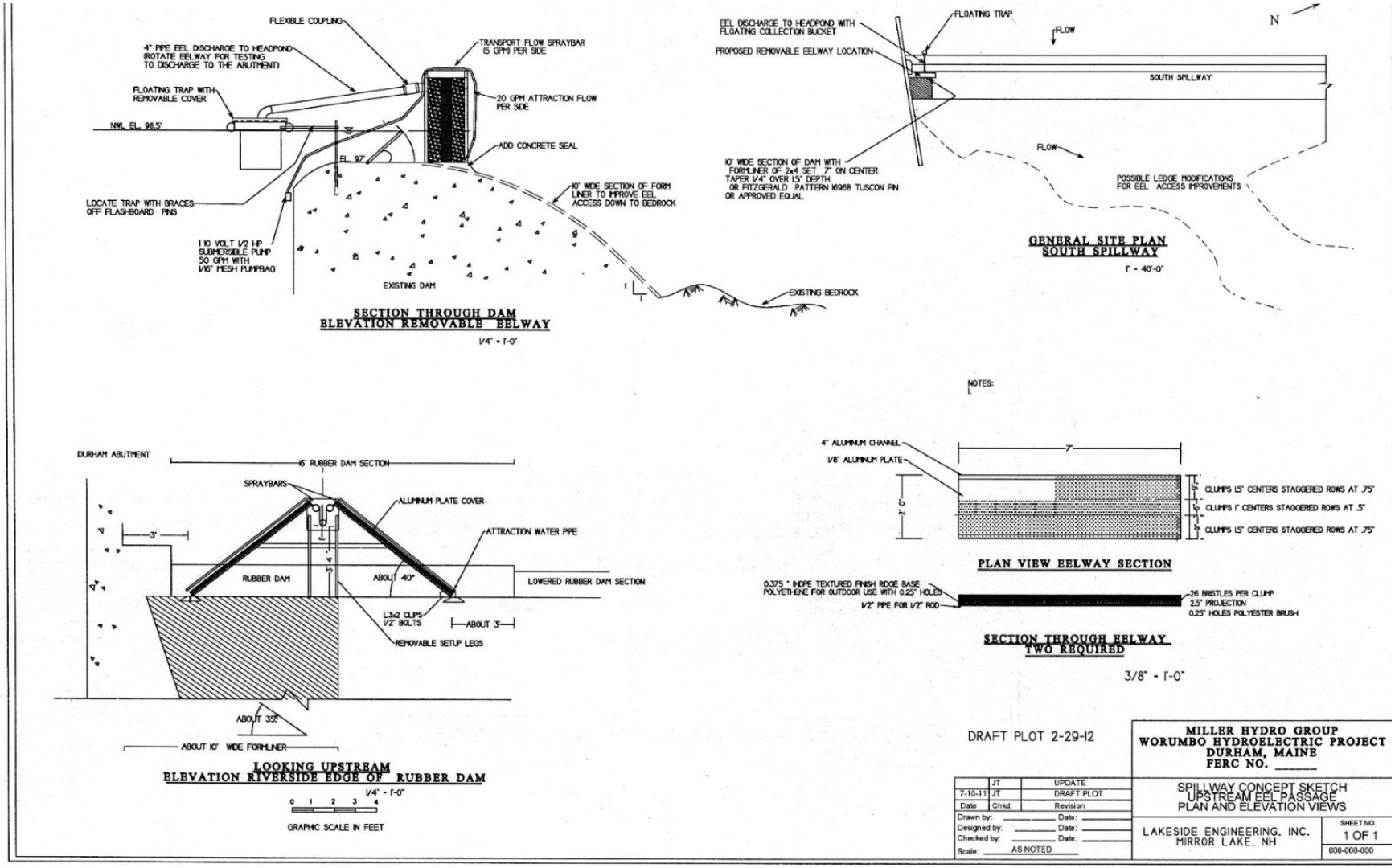
Worumbo Project - Photo of upstream eel passage system looking upstream – FERC No. 3428

Worumbo Project - Photo of upstream eel passage system looking downstream – FERC No. 3428

Worumbo Project - Drawing of upstream eel passage system – FERC No. 3428



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APPENDIX C – UPDATED FLOW DURATION CURVES

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Figure C-1: Annual Flow Duration Curves – Period of Record (1987 – 2020) Compared with 2010 - 2020

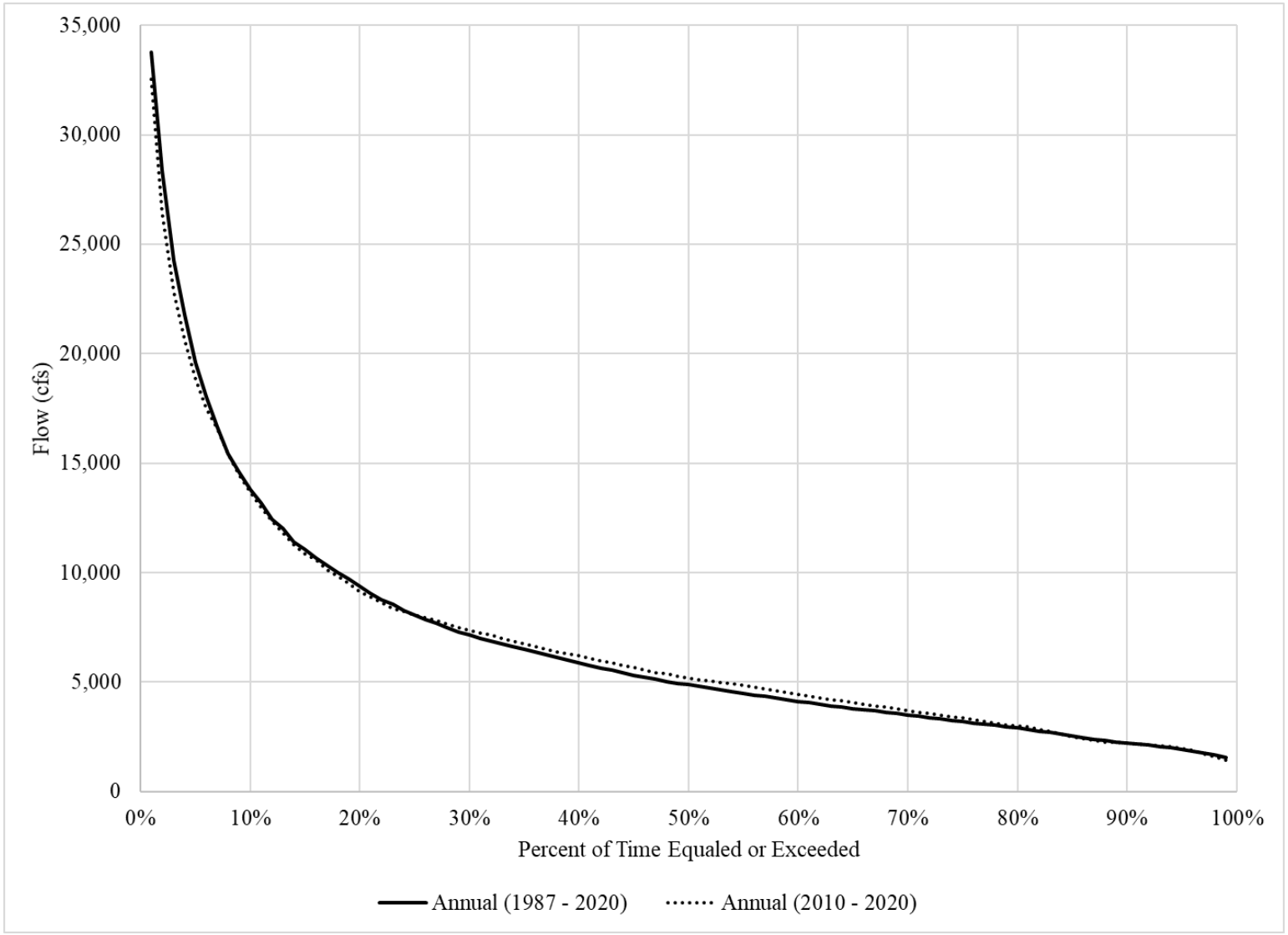

Figure C-2: January, February, and March Flow Duration Curves – Period of Record (1987 – 2020) Compared with 2010 - 2020

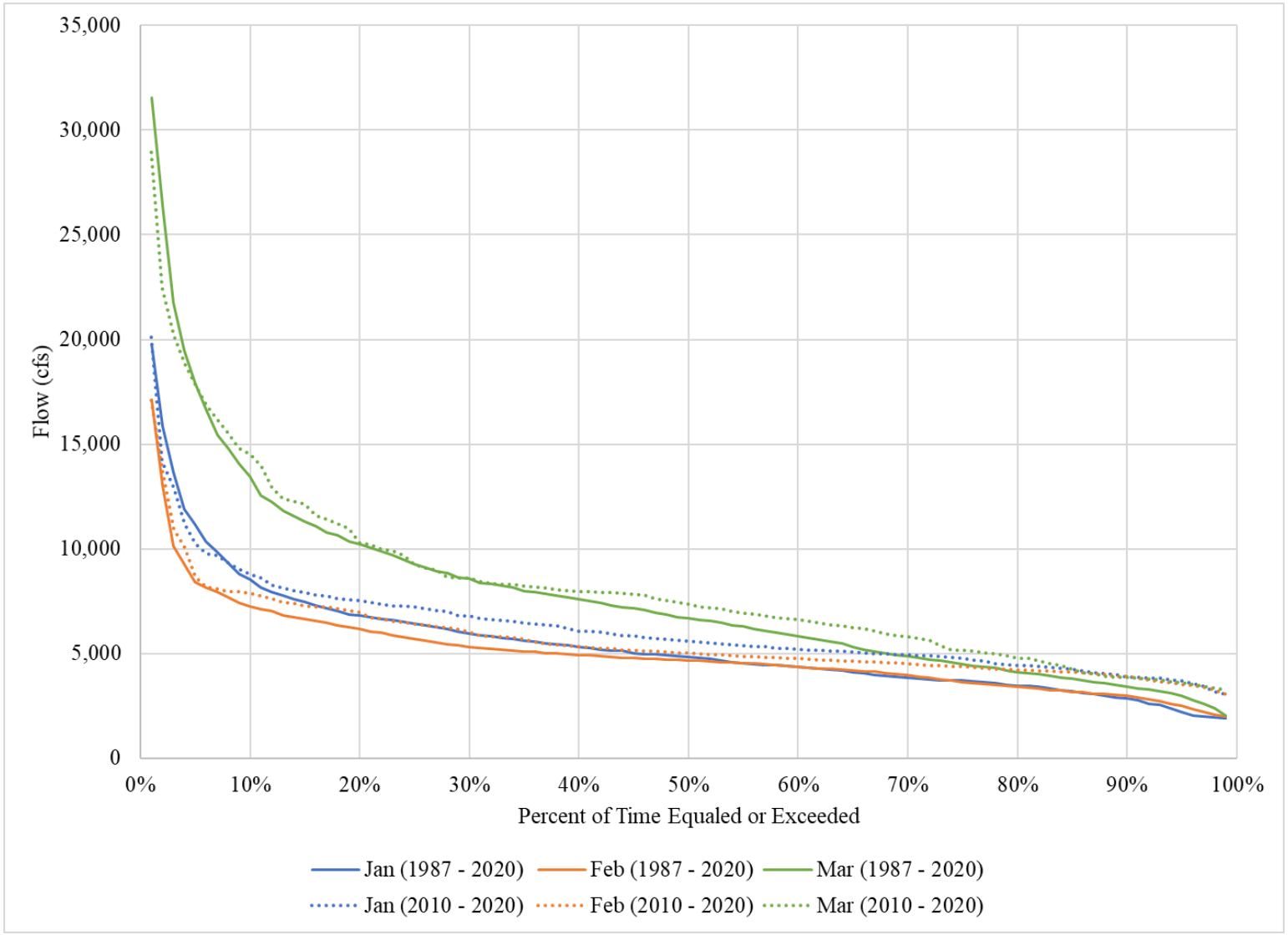

Figure C-3: April, May, and June Flow Duration Curves – Period of Record (1987 – 2020) Compared with 2010 - 2020

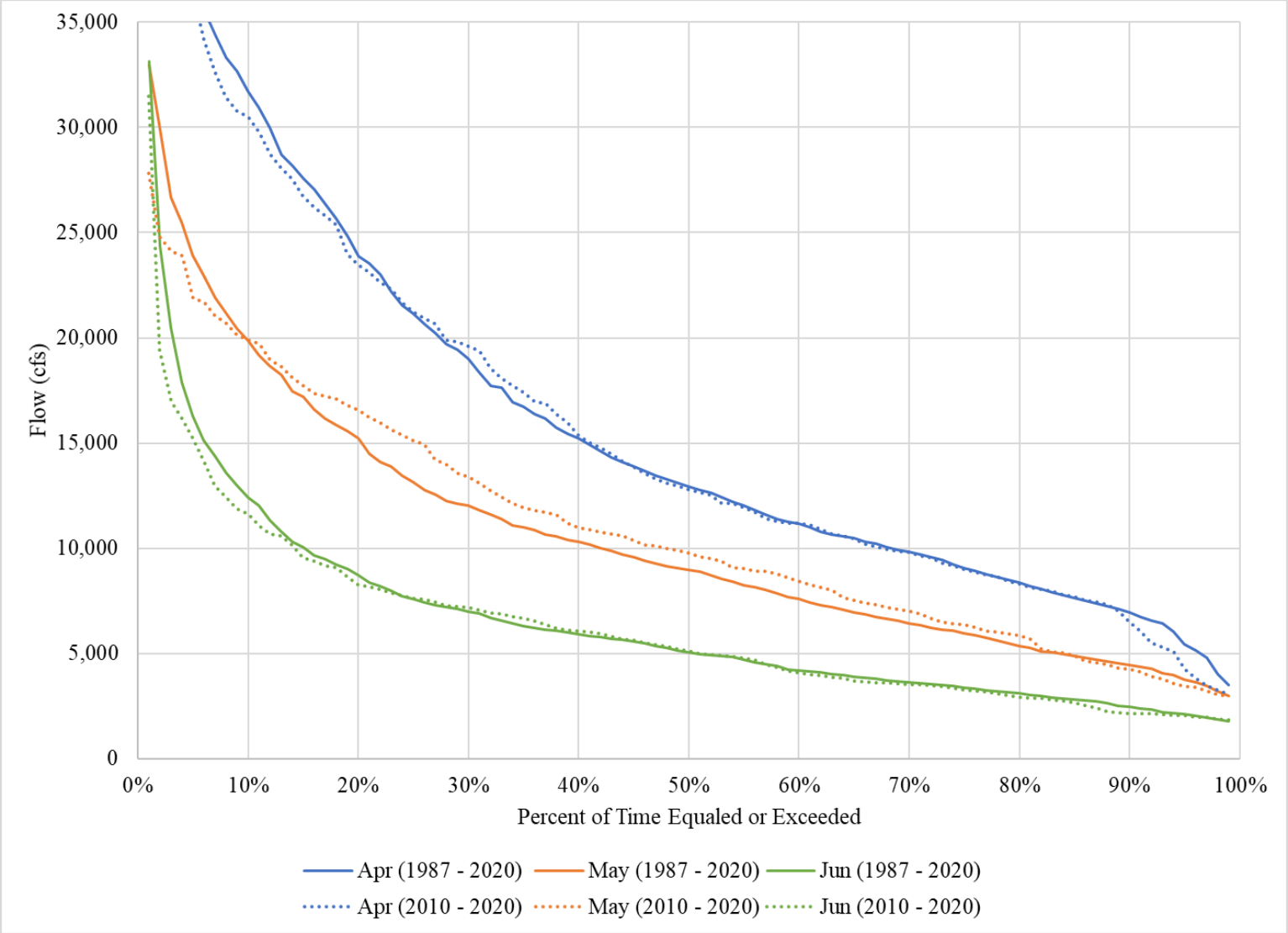

Figure C-4: July, August, and September Flow Duration Curves – Period of Record (1987 – 2020) Compared with 2010 - 2020

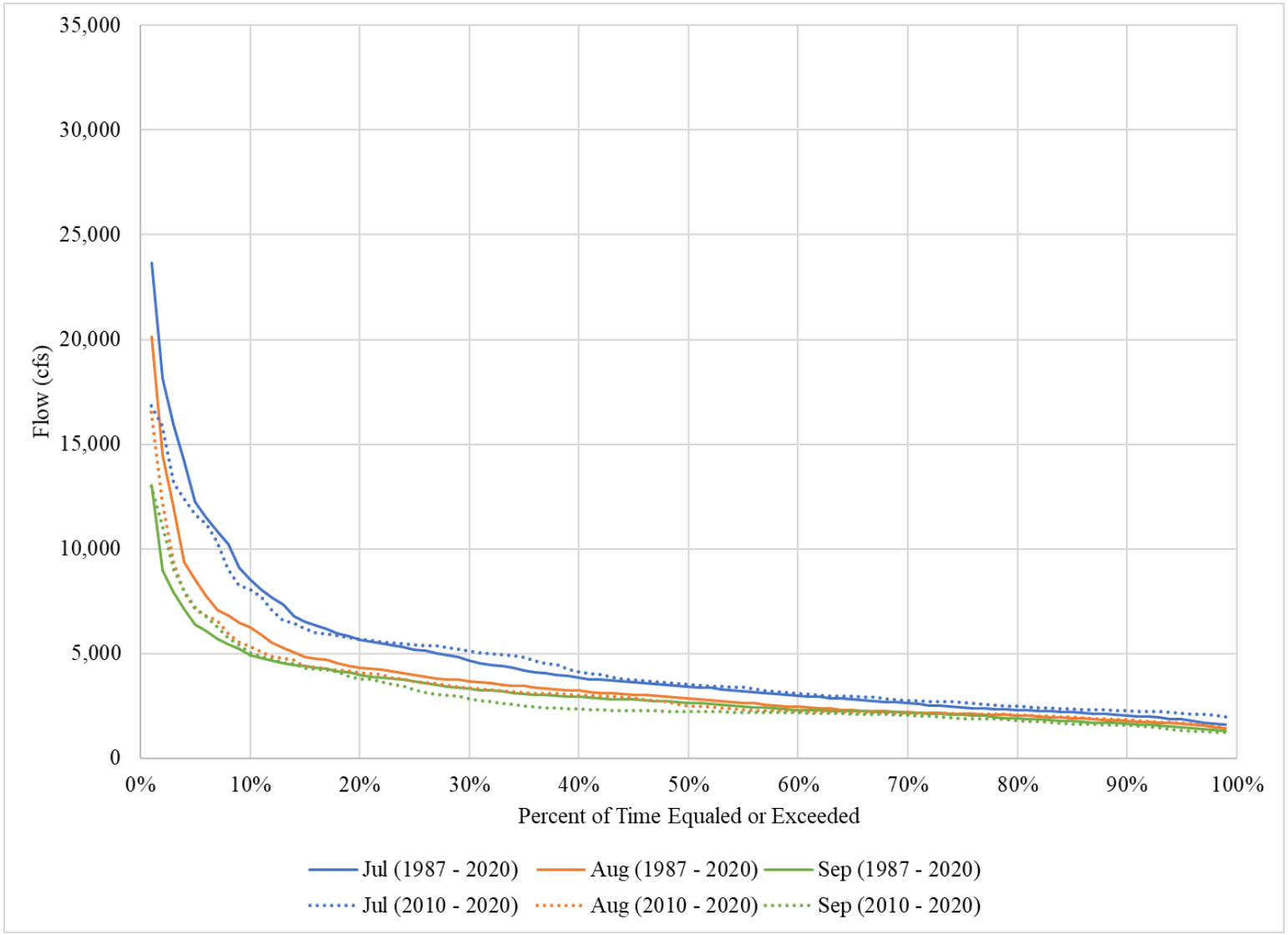

Figure C-5: October, November, and December Flow Duration Curves – Period of Record (1987 – 2020) Compared with 2010 - 2020