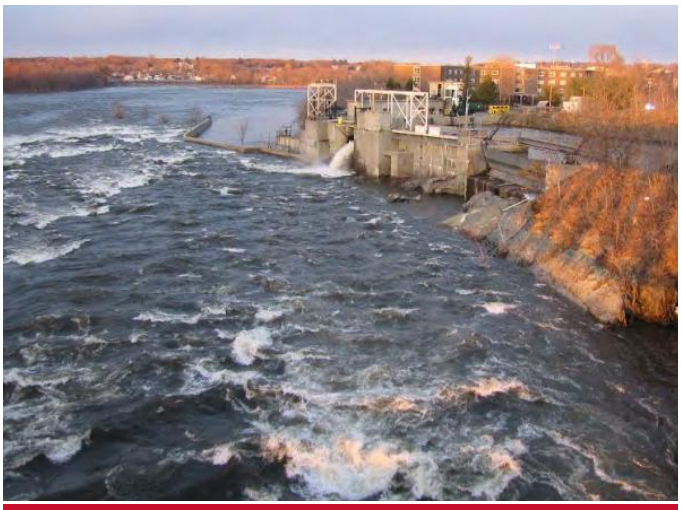

Amended Final License Application Volume I of III

Lowell Hydroelectric Project

(FERC No. 2790)

June 19, 2025

Prepared by:

Prepared for:

Boott Hydropower, LLC
Manchester, New Hampshire

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List of Acronyms

µS/cm	microsiemens per centimeter
ACHP	Advisory Council on Historic Preservation
ADA	Americans with Disabilities Act
APE	area of potential effects
ASRSC	Atlantic Sea Run Salmon Commission
AW	American Whitewater
Boott	Boott Hydropower, LLC (or Licensee, or Applicant)
CEII	Critical Energy Infrastructure Information
CFPP	Comprehensive Fish Passage Plan
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
Chapter 91	M.G.L. Chapter 91 of the Waterways Act
CMR	Codes of Massachusetts Regulations
COMP	Canal Operations and Maintenance Plan
CSO	Combined Sewer Overflow
CSPA	Comprehensive Shoreland Protection Act
CWA	Clean Water Act
DDT	Dichlorodiphenyltrichloroethane
DLA	Draft License Application
DMMSPs	Dam Safety Surveillance and Monitoring Plan
DO	dissolved oxygen
EA	Environmental Assessment
E.L. Field	Eldred L. Field
EPT	Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddis flies)
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission (or Commission)
FGMP	Final General Management Plan
FHA	Federal Highway Administration
FLA	Final License Application
FPA	Federal Power Act
GECC	General Electric Credit Corporation

GIS	Geographic Information System
GPS	Global Positioning System
HAER	Historic American Engineering Record
ILP	Integrated Licensing Process
Integrated List	Integrated List of Waters
IPaC System	Information, Planning and Consultation System
IPANE	Invasive Plant Atlas of New England
ISO	Independent System Operator
ISO-NE	Independent System Operator – New England
ISR	Initial Study Report
kV	kilovolt
LIHI	Low Impact Hydropower Institute
LMRLAC	Lower Merrimack River Local Advisory Committee
LNHP	Lowell National Historical Park
LRWU	Lowell Regional Water Utility
M	magnitude
MADCR	Massachusetts Department of Conservation and Recreation
MADEM	Massachusetts Department of Emergency Management
MADEP	Massachusetts Department of Environmental Protection
MADFW	Massachusetts Division of Fish and Wildlife
MADMF	Massachusetts Division of Marine Fisheries
MNHESP	Massachusetts Natural Heritage Endangered Species Program
MassGIS	Massachusetts Bureau of Geographic Information
MDMR	Maine Department of Marine Resources
MDPW	Massachusetts Department of Public Works
MEOEEA	Massachusetts Executive Office of Energy and Environmental Affairs
MESA	Massachusetts Endangered Species Act
M.G.L.	Massachusetts General Law
mg/L	milligrams per liter
MHC	Massachusetts Historical Commission
MIPAG	Massachusetts Invasive Plant Advisory Group
MOU	Memorandum of Understanding
MRI	Merrimack River Initiative
MRWC	Merrimack River Watershed Council
MW	megawatt
MWh	megawatt hours

NAI	Normandeau Associates, Inc.
NEFMC	New England Fishery Management Council
New Hampshire NHB	New Hampshire Natural Heritage Bureau
NGOs	non-governmental organizations
NGVD 29	National Geodetic Vertical Datum 1929
NHDES	New Hampshire Department of Environmental Services
NHDFG	New Hampshire Department of Fish and Game
NHDHR	New Hampshire Division of Historical Resources
NHDNCR	New Hampshire Department of Natural and Cultural Resources
NHFGD	New Hampshire Fish and Game Department
NHL	National Historic Landmark
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NRPC	Nashua Regional Planning Commission
NTU	Nephelometric Turbidity Unit
NWI	Nation Wetland Inventory
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
PAD	Pre-Application Document
PM&E	protection, mitigation, and enhancement measures
PPA	Power Purchase Agreement
Project	Lowell Hydroelectric Project
Proprietors	Proprietors of the Locks and Canals on the Merrimack River
PSP	Proposed Study Plan
Revised PPS	Revised Process Plan and Schedule and Determination on Requests for Study Modifications for the Lowell Hydroelectric Project
RM	river mile
RMC	RMC Environmental Services
ROR	run of river
RPS	Renewable Portfolio Standards
RSA	Revised Statutes Annotated

RSP	Revised Study Plan
RTE	rare, threatened, and endangered
SAV	submerged aquatic vegetation
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SDR	Supporting Design Report
SD1	Scoping Document 1
SD2	Scoping Document 2
Section 106	Section 106 of the NHPA
SPD	Study Plan Determination
SHPO	State Historic Preservation Officer
stakeholders	resource agencies, federally recognized Indian tribes, non-governmental organizations (NGOs), and other interested parties
SWQS	surface water quality standards
Technical Committee	Representatives from NHDFG, MADFW, USFWS, USFS, NMFS
THPO	Tribal Historic Preservation Officers
TMDL	total maximum daily loads
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VP	vegetation points
WPA	Wetlands Protection Act
WQC	Water Quality Certification
YOY	Young-of-year

Executive Summary

ES.1 Introduction

Boott Hydropower, LLC (Boott or Licensee) is the Licensee, owner, and operator of the Lowell Hydroelectric Project (Project or Lowell Project) (FERC No. 2790). The Lowell Project is located at river mile (RM) 41 on the Merrimack River in the City of Lowell in Middlesex County, Massachusetts. The approximate existing Project boundary is provided in Figure ES.1-1 and existing facilities are shown on ES.1-2.

Boott operates and maintains the Lowell Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Commission, under the authority of the Federal Power Act (FPA), 16 United States Code (USC) §791(a), et seq., may issue a license for up to 50 years for the construction, operation, and maintenance of non-federal hydroelectric developments. Boott is pursuing a new license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (C.F.R.) Part 5. The existing license was issued by FERC on April 13, 1983, and expired on April 30, 2023. On May 19, 2023, the Commission issued a Notice of Authorization for Continued Project Operation that authorized Boott to continue operation of the Lowell Project under the terms and conditions of the existing license.

In accordance with applicable regulations, 18 C.F.R. §5.17(a), Boott filed the Final License Application (FLA) with the Commission on April 30, 2021. Since the 2021 filing, FERC has issued several Additional Information Requests (AIRs) regarding Boott's previously proposed action in the FLA to decommission fifteen turbine-generator units and subsequently remove the majority of the downtown canal system from the FERC license. In the time since the filing of the FLA, Boott has reconsidered its proposal to remove the canal system and associated power stations from the license. Based on this decision, Boott has consulted with key stakeholders regarding reintroducing the downtown canal system and power stations into the new license. Exhibit E of this amended license application includes the proposed measures developed in consultation with stakeholders regarding the operation and management of the Project relative to the canal system over the term of the new FERC license.

Figure ES.1-1 Lowell Project Location Map and Existing Project Boundary

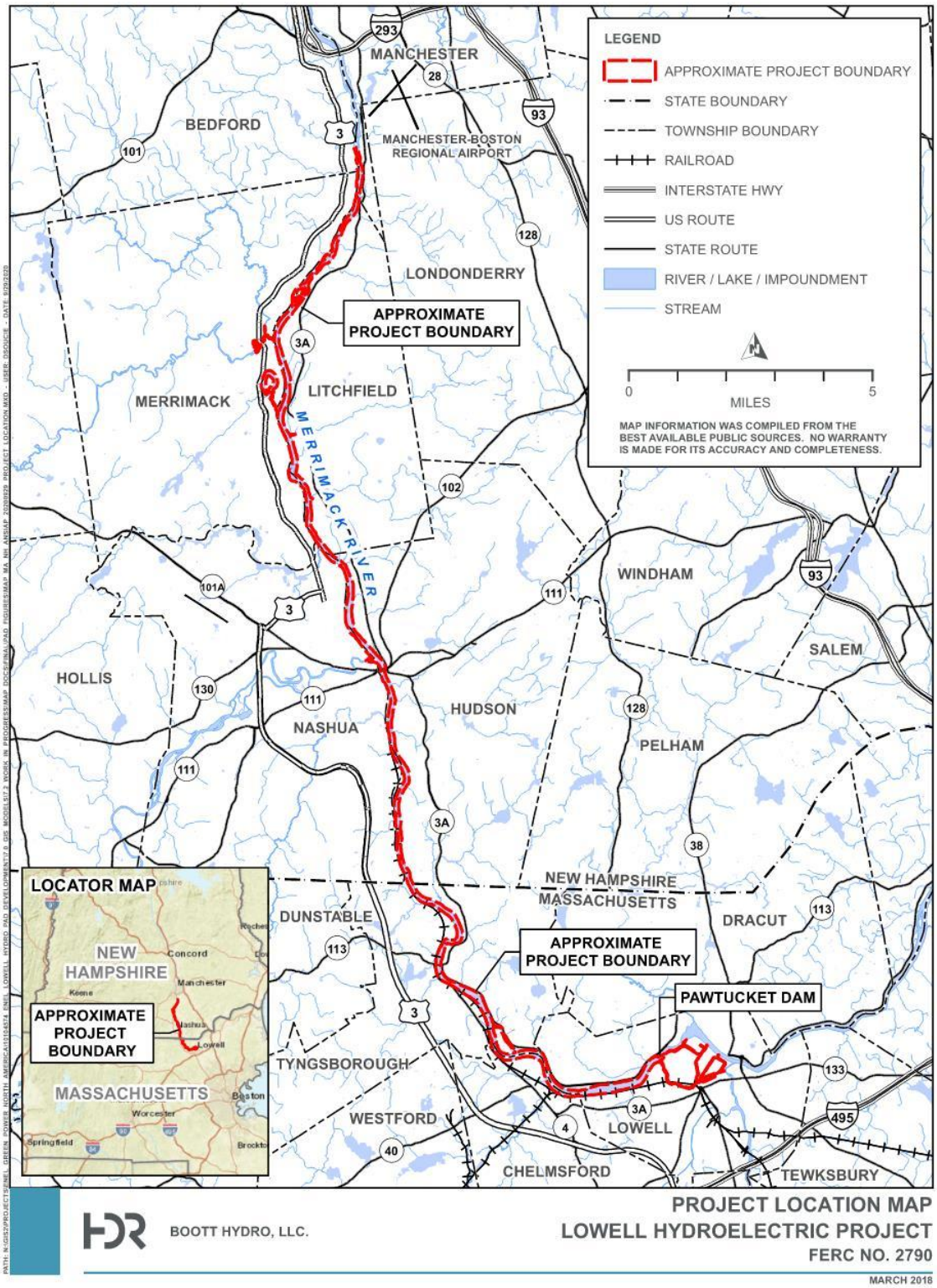
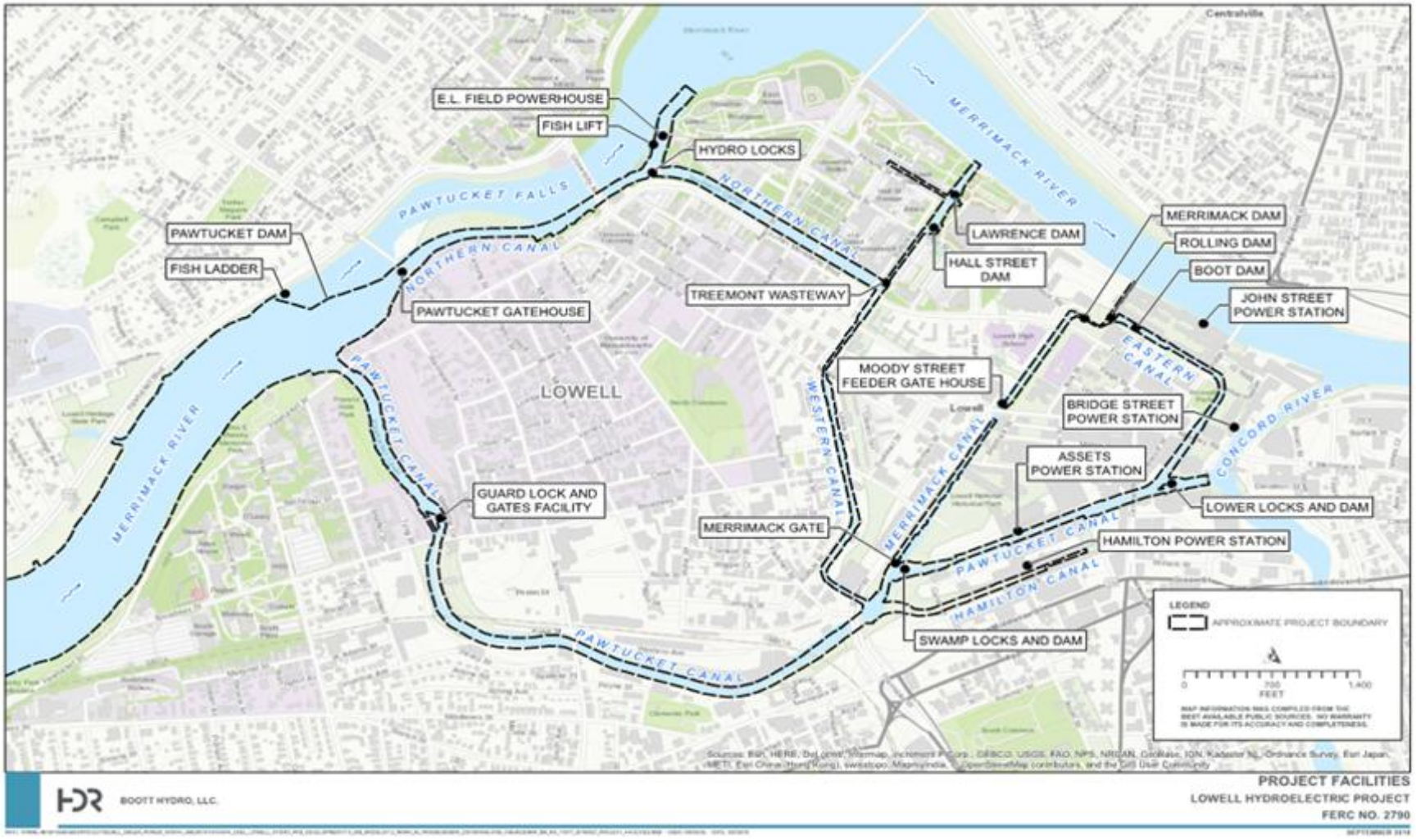


Figure ES.1-2 Existing Project Boundary and Facilities



ES.3 Summary of Relicensing Activities

On April 30, 2018, Boott, as the Licensee, filed a Pre-Application Document (PAD) and Notice of Intent (NOI) to seek a new license for the Project. The PAD provided a description of the Project and summarized existing, relevant, and reasonably available information to assist resource agencies, federally recognized Indian tribes, non-governmental organizations, and other interested parties (collectively, "stakeholders") in identifying issues, determining information needs, and preparing study requests. A preliminary list of potential studies and information needs was included in the PAD. With the NOI, Boott requested designation as the non-federal representative for informal consultation with relevant agencies under Section 7 of the Endangered Species Act (ESA)[1] and Section 106 of the National Historic Preservation Act (NHPA)[2]. FERC granted these requests on June 15, 2018. At the time of the filing of the NOI and PAD, as well as the Commission's subsequent National Environmental Policy Act (NEPA) scoping and the study scoping process that was performed through the Commission's ILP, Boott proposed to keep the canal and the associated power stations within the project boundary. Therefore, all study scoping activities were performed under the premise that the Project's canal power stations would remain operational for the term of the Project's new license.

FERC issued Scoping Document 1 (SD1) on June 14, 2018 (dated June 15, 2018). SD1 was intended to advise stakeholders as to the proposed scope FERC's NEPA analysis and to seek additional information pertinent to the Commission's analysis of the license application. As provided in 18 C.F.R. §§5.8(a) and 5.18(b), the Commission issued a notice of commencement of proceeding concomitant with SD1 and provided stakeholders with a 60-day period to request studies and provide comments on the PAD and SD1. The Commission held two public scoping meetings in Lowell, Massachusetts on July 17, 2018. A site visit at the Project, which included a tour of the Project's canal system, was held on July 18, 2018. FERC received seven comment letters on SD1, including comments from resource agencies. FERC issued Scoping Document 2 (SD2) on September 27, 2018, to reflect issues or alternatives to be considered in the NEPA based on stakeholder comments and study requests filed in response to SD1.

Pursuant to the requirements of the ILP, Boott developed a Proposed Study Plan (PSP) describing Boott's intent to conduct 13 relicensing studies to address the comments and study requests submitted by stakeholders related to terrestrial resources, aquatic resources, recreational resources, and cultural resources. Boott's PSP was filed with FERC on September 28, 2018. In accordance with 18 C.F.R. §5.11(e), a PSP Meeting was held with stakeholders on October 18 and 19, 2018 in Andover, Massachusetts. The purpose of the PSP Meeting was to clarify the intent and contents of the PSP, explain any initial information gathering needs, and address outstanding issues associated with the proposed studies.

In response to comments from stakeholders, Boott filed a Revised Study Plan (RSP) on January 28, 2019, that included 13 proposed relicensing studies. However, due to the

[1] 16 U.S.C. § 1536(a)(2)
[2] 54 U.S.C. § 306108

funding lapse at certain federal agencies between December 22, 2018, and January 25, 2019, the Commission extended the comment period on the RSP to February 27, 2019, and the issuance date for the Commission's Study Plan Determination (SPD) to March 14, 2019. FERC issued its SPD, which included studies specific to the Project's canal system, with modifications to the RSP on March 13, 2019. In the SPD, FERC approved eleven studies as proposed in the RSP and approved two studies with modifications:

1. Downstream American Eel Passage Assessment
2. Juvenile Alosine Downstream Passage Assessment
3. Upstream and Downstream Adult Alosine Passage Assessment
4. Fish Passage Survival Study
5. Three-Dimensional Computational Fluid Dynamics (CFD) Modeling
6. Instream Flow Habitat Assessment and Zone of Passage Study in the Bypassed Reach
7. Fish Assemblage Study
8. Recreation and Aesthetics Study
9. Historically Significant Waterpower Equipment Study
10. Resources, Ownership, Boundaries, and Land Rights Study
11. Water Level and Flow Effects on Historic Resources Study
12. Whitewater Boating and Access Study
13. Operation Analysis of the Lowell Canal Study

In accordance with 18 C.F.R. §5.15, Boott initiated studies as provided in the study plan and schedule approved by the Commission. On February 25, 2020, Boott filed an Initial Study Report (ISR) with the Commission and distributed the ISR to stakeholders. The ISR described the Licensee's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule. In the ISR, Boott did not propose any modifications to ongoing studies approved in the Commission's March 13, 2019 SPD or any new studies.

Boott held an in-person ISR Meeting on March 11, 2020, to discuss the overall progress in implementing the study plan, data collected to date, variances from the SPD, and an overview of results of the studies to date. Although the Commonwealth of Massachusetts declared a state of emergency on March 10th, Boott and the meeting participants were able to complete the meeting. Pursuant to the ILP, Boott filed an ISR Meeting Summary with the Commission on March 25, 2020. Stakeholders were provided a 30-day period to provide comments on the ISR Meeting Summary, recommend study modifications, or propose new studies.

By letters to the Commission, National Park Service (NPS), American Whitewater (AW), United States Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS) filed timely comments on the ISR and ISR Summary. In response, the Commission issued a Revised Process Plan and Schedule and Determination on

Requests for Study Modifications for the Lowell Hydroelectric Project (Revised PPS) on June 12, 2020. The Revised PPS required Boott file a Revised ISR for studies 1, 2, 3, 7, and 8 by September 30, 2020.

In response to the Revised PPS letter from the Commission, on September 30, 2020, Boott filed the results of the five individual study reports (studies 1, 2, 3, 7, and 8) that were not included in the February 25, 2020 ISR. Boott held a Revised ISR Meeting to discuss the results of these studies on October 15, 2020. Pursuant to the ILP, Boott filed a Revised ISR Meeting Summary with the Commission on October 30, 2020. Stakeholders were provided a 30-day period (ending on November 29, 2020) to provide comments on the Revised ISR Meeting Summary, recommend study modifications, or propose new studies.

By letters to the Commission, the City of Lowell, Massachusetts Division of Fisheries and Wildlife (MADFW), Massachusetts Division of Marine Fisheries (MADMF), NPS, and NMFS filed comments on the Revised ISR and Revised ISR Summary. Boott filed with the Commission a response to these comments on December 29, 2020, and New Hampshire Fish and Game (NHFG) filed a comment letter on January 8, 2021. On February 2, 2021, the Commission issued a Determination on Requests for Study (DRS) Modifications for the Lowell Hydroelectric Project.

In accordance with the Revised PPS and DRS letters from the Commission, on February 25, 2021, Boott filed the individual study reports (studies 4, 5, 6, 7, 9, 10, 11, 13) and updated study reports (studies 1, 2, 3, 7 and 8). Boott held a Revised ISR Meeting to discuss the results of these studies on March 11, 2021. Pursuant to the ILP, Boott filed a Revised ISR Meeting Summary with the Commission on March 26, 2021. Stakeholders were provided a 30-day period (ending on April 25, 2021) to provide comments on the Revised ISR Meeting Summary, recommend study modifications, or propose new studies. By letters to the Commission, NMFS, MADFW, NPS, and USFWS provided comments on the February 2021 Revised ISR and Revised ISR Summary.

On December 2, 2020, and in accordance with 18 C.F.R. §5.16(c), Boott filed the Draft License Application (DLA) with the Commission. FERC and stakeholders had 90 days to provide comments on the DLA (i.e., until March 2, 2021). Boott reviewed and considered all comments received, as evidenced through further development of the Licensee's measures proposed in this amended Final License Application.

In accordance with applicable regulations, 18 C.F.R. §5.17(a), Boott filed its FLA which included a previous proposal to remove the downtown canal system from the license on April 30, 2021. FERC issued a series of AIRs on May 27 and October 14, 2021; March 1 and April 19, 2022, and February 14, 2023, in regard to the FLA and Boott's previous proposal to remove the downtown canal units from the license. Boott filed responses to the AIRs on August 25 and November 15, 2021; January 18, March 31, October 4, and October 17, 2022; and May 15, 2023.

In accordance with 18 C.F.R. §5.15(f), Boott filed the Updated Study Report (USR) on November 1, 2021, and held a Study Report Meeting on November 16, 2021. Pursuant to 18 C.F.R. §5.15(c)(3), Boott filed a Study Report Meeting Summary with the Commission on December 1, 2021. Stakeholders were allowed 30 days (i.e., until December 31, 2021) to file any disagreements with the summary and/or any proposals to

modify ongoing studies with the Commission. On December 23, 2021, the NPS filed comments on the USR. On January 28, 2022, Boott filed a response to stakeholder comments on the USR meeting and subsequent USR meeting summary.

FERC issued Scoping Document 3 (SD3) on February 1, 2022. The SD3 was intended to advise stakeholders as to key differences in proposed actions between the PAD and the license application. FERC received seven comment letters on SD3, including comments from the University of Massachusetts, the City of Lowell, Northeast Legal Aid, NPS, Greater Lowell Community Foundation, the Lowell Historic Board, and individuals. Additionally, on March 3, 2022, Boott filed comments on SD3.

On August 22, 2022, Boott filed the Lowell Hydroelectric Project Settlement Agreement for Fish Passage (2022 Fish Passage Settlement) between Boott, USFWS, NMFS, the New Hampshire Fish and Game Department (NHFGD), the Massachusetts Division of Marine Fisheries (MDMF), and the Massachusetts Division of Fisheries and Wildlife (MDFW), which set forth a proposal for the issuance of New License for the Project and license requirements related to fish passage and bypass flows.

On May 11, June 14, and October 10, 2023, Boott filed an Extension of Time (EOT) request to revise the Exhibit F drawings and respond to additional information requests under the previous license proposal. On November 9, 2023, the Commission issued an EOT until January 10, 2024.

In review of the comments and information received since Boott filed the FLA in April 2021, Boott reconsidered its proposal to remove the canals from the Project. On January 10, 2024, Boott filed a request that Commission staff delay issuance of the notice that the Project is ready for environmental analysis (REA notice) to allow Boott time to reevaluate its relicensing proposal to remove the downtown canal system from the Project boundary and its proposed fish passage measures outlined in the fish passage settlement agreement included with the license application. On January 31, 2024, the Commission issued an AIR requesting Boott provide a schedule for consultation and timeline outlining the proposed date that the amended application would be filed, to which Boott responded on February 9, 2024. On February 21, 2024, FERC granted the request to delay the notice until after September 30, 2024.

Boott filed quarterly progress reports in April, July, and September 2024 that outlined consultation efforts related to potential amendments to the application. In its September 13, 2024 progress report, Boott requested an extension of time to continue consulting with the resource agencies and other stakeholders to develop the amended FLA. On October 7, 2024, the Commission approved Boott's request to delay the REA notice until after December 31, 2024.

On October 23, 2024, Boott provided the National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (USFWS) with a preliminary draft version of select Exhibits of the amended FLA. On December 5, 2024, Boott received comments from NMFS on the preliminary draft exhibits. On December 9, 2024 USFWS responded that they concurred with NMFS comments. Those comments are generally addressed within this document. On December 23, 2024, the National Park Service (NPS) filed information with the Commission related to various water retaining structures within the canal system that are owned by the Federal Government under fee ownership or

easement. Boott requested a third request for EOT on December 31, 2024, to further consult on comments received on the preliminary draft and issues raised by the resource agencies. On January 22, 2025, the Commission denied Boott's EOT request. In preparation of this license application, Boott has continued consultation and anticipates further consultation with the agencies and consulting entities regarding the potential need for additional canal related measures.

ES.4 Summary of Proposed Action and Enhancement Measures

Based on the studies conducted in support of this relicensing, consultation with stakeholders to date, and operation plans and agreements approved by relicensing parties, Boott proposes the following measures to be included in the new Project license:

Project Facilities and Operations

- Boott proposes to operate the Project in a ROR mode using automatic pond level control of the E.L. Field powerhouse units, for the purpose of protection of fish and wildlife resources downstream from the Project. ROR operation may be temporarily modified for short periods to allow flow management for other project and non-project needs, e.g., downtown canal water level management, raising the crest gates following a high-water event, or for recreational purposes.
- On a seasonal basis during the upstream passage season (i.e., typically from early May through late June/early July – and to be defined annually in consultation with the Merrimack River Technical Committee (MRTC))[3] , Boott will provide a zone of passage flow of 500 cfs or inflow, whichever is less, into the Project's bypassed reach to provide appropriate fish passage conditions.
- Boott proposes to release a minimum flow of 100 cfs or inflow, whichever is less, to the bypassed reach downstream of the Pawtucket Dam during the period outside of the upstream fish passage season for the protection of aquatic and recreational resources. The minimum flow would be provided as spillage over one or more of the crest gate zones.
- Boott proposes to entirely suspend generation and operations of the downtown canal units during the downstream fish passage season for alosines and American eel. Downstream passage season is typically May through July for alosines, and August through November for American eel. The specific suspension of generation will be defined annually in consultation with the MRTC. At the start of the downstream fish passage season, all downtown canal units will be shut off and flows will not be diverted into the downtown canal system (*except as noted below under Canal Water Elevations and Canal Water Flows*). At the end of the fish passage season, when

[3] The Merrimack River Technical Committee is comprised of the following state and federal agencies: New Hampshire Department of Fish and Game (NHDFG), Massachusetts Division of Fisheries and Wildlife (MADFW), Massachusetts Division of Marine Fisheries (MADMF), United States Fish and Wildlife Service (USFWS), United States Forest Service (USFS), and National Marine Fisheries Service (NMFS).

river flows exceed the hydraulic capacity of the E.L. Field units (6,600 cfs for both units) and the bypass flow, excess flows up to approximately 2,000 cfs may be routed through the downtown canal system and to the canal units.

- Between August 15 and November 15 of each year until the proposed downstream passage protection measures are fully implemented (as discussed more under Section A.2.12 and Section B.1.3.5), Boott is proposing nighttime shutdowns at the E.L. Field as an interim measure to protect out-migrating adult American eel. The downtown units will also be shutdown during this period as per measure above.
- Boott is proposing to decommission the Assets power station and remove it from the new license. Within one year of license issuance, Boott will file a decommissioning plan with the Commission including measures to avoid, minimize, or mitigate Project-related effects during decommissioning.
- From May 15 to October 15, Boott maintains an operating agreement with the NPS to allow tour boat operations to navigate the canal system. Boott maintains canal water levels within appropriate limits during the May 15 to October 15 tour boat operating season, and typically will not be operating the downtown canal units, due to flow conditions and fish passage considerations.
- In support of the NPS's canal boat operations and additional recreational activities (provided by others), as well as for aesthetics, canal wall integrity, and vegetation control, Boott will make a good-faith effort to maintain the water elevations within the canal system consistent with the elevations established in a Canal Operations and Maintenance Plan (COMP) that will be prepared by Boott in consultation with NPS and other stakeholders and filed with FERC for inclusion in the new license. See below for Boott's proposed operations as they pertain to *Canal Water Elevations* and *Canal Water Flows*.
- Boott proposes continued adherence to the requirements of the Project's existing Crest Gate Operation Plan (approved by FERC on March 30, 2015).

Canal Water Elevations

- Boott is actively collaborating with key stakeholders to finalize the COMP. Once the COMP is finalized, a copy of the Plan will be submitted to FERC. One of the primary components being addressed in the COMP is the management of canal water elevations.

Canal Water Flows

- Boott is actively collaborating with key stakeholders to finalize the COMP, which will include provisions for canal water flows. Once the COMP is finalized, it will be submitted to FERC for approval and inclusion in the new license. One of the primary components being addressed is the management of canal water flows.

Trash Management

- Boott is actively collaborating with key stakeholders to finalize the COMP. Once it is finalized, a copy of the COMP will be submitted to FERC for approval and inclusion

in the new license. One of the primary components being addressed is trash management in the canals.

Vegetation Management

- Boott is actively collaborating with key stakeholders to finalize the COMP. Once it is finalized, a copy of the COMP will be submitted to FERC for approval and inclusion in the new license. One of the primary components being addressed is vegetation management in the canals.

Fish Passage

Boott is proposing modifications to the existing upstream and downstream fish passage structures consistent with August 12, 2022 Settlement Agreement for Fish Passage. Since 2022, fish passage technology has continued to advance, and Boott remains open to meeting passage requirements under the Settlement Agreement for Fish Passage through innovative and emerging solutions that may be available or anticipated to enter the market. Boott will continue to collaborate with all relevant stakeholders and FERC in exploring potential options, if any. Proposed fish protection measures include:

- Boott proposes to replace the existing fish lift with a short fish ladder to pass migratory fish from the E.L. Field powerhouse tailrace to the bypass reach, such that fish would be passed upstream of the Project via the existing fish ladder at the Pawtucket Dam. As approved by the MRTC, the proposed fish ladder will be operated on a seasonal basis. In accordance with the Settlement Agreement, Boott will consult with USFWS and NMFS to determine the design and installation schedule for the proposed ladder. Boott may consult with the MRTC to discuss the possibility of requesting a reevaluation of new technology in the future.
- Following installation and operation of the proposed upstream fish passage structure, Boott proposes to cease operation of the fish elevator and associated operations described above. Cessation of the fish elevator operations will be determined based on consultation with relevant agencies and Boott should not have to continue to incur maintenance costs once the upstream passage structure is constructed and tested.
- Boott proposes to install a new fish exclusion structure or approved equivalent at the E.L. Field Powerhouse to prevent entrainment of fish through the turbines. Downstream passage of fish will continue to be provided via the existing sluice gate in the left forebay wall of the E.L. Field Powerhouse. Boott will consult with the MRTC member agencies to determine the design and installation schedule for the proposed downstream fish exclusion system. Boott plans to seasonally deploy the new exclusion facility only during the downstream fish passage season.
- Between August 15 and November 15 of each year until the proposed downstream fish passage protection measures are fully implemented, Boott is proposing nighttime shutdowns as an interim measure to protect out-migrating adult American eel. Interim nighttime shutdowns will be implemented in accordance with the provisions of the Interim Nighttime Shutdown Plan for Downstream Eel Passage developed in consultation with the MRTC pursuant to Section 4.2 of the Settlement Agreement.

- Additionally, Boott proposes to release a minimum flow of 100 cfs or inflow, whichever is less, to the bypass reach downstream of the Pawtucket Dam during the period outside of the upstream fish passage season. The minimum flow would be provided as spillage over one or more of the crest gate zones. On a seasonal basis during the upstream passage season (i.e., typically from early May through late June/early July – and to be defined annually in consultation with the MRTC), the Licensee will provide a zone of passage flow of 500 cfs or inflow, whichever is less, into the Project's bypassed reach to provide appropriate fish passage conditions.
- Consistent with the 2022 Settlement Agreement, within three months of the issuance of the new license, Boot will develop a Fishway Operations and Management Plan (FOMP) in consultation with the resource agencies and approved by the USFWS and NMFS.

Historic Properties

- Within one year of license issuance, Boott will develop a Historic Properties Management Plan (HPMP) for the Project that will describe appropriate management measures to avoid, minimize, or mitigate Project-related adverse effects on historic and archaeological resources over the term of the new license issued for the Project. The measures provided in the HPMP will direct the Licensee's management of NRHP-listed or eligible historic properties within the proposed Project boundary. Boott will develop the HPMP in consultation with the NPS, MHC, New Hampshire Division of Historic Resources (NHDHR), and Indian tribes.

Recreation

- Within one year of license issuance, Boott will develop a Recreation Access and Facilities Management Plan in consultation with the stakeholders to continue to manage the Project's recreation facility, the E.L. Field Powerhouse Visitor Center.

ES.5 Amended Final License Application Roadmap

This Amended FLA is composed of three volumes.

VOLUME I OF III

Volume I contains Public information and exhibits as follows:

- Table of Contents
- Executive Summary
- Exhibit A – Project Description: Describes the existing and proposed Project facilities.
- Exhibit B – Project Operation and Resource Utilization: Describes the existing and proposed operation of the Project and how the resource is utilized.
- Exhibit C – Construction History and Proposed Construction Schedule: Provides a construction history and schedule for proposed construction activities.
- Exhibit D – Cost and Financing: Provides information on the cost and financing of the Project.

- Exhibit F – Public list of General Design Drawings and Supporting Design Report.
- Exhibit G – Project Maps: Includes maps showing the Project boundary for the Lowell Hydroelectric Project.
- Exhibit H – Description of Project Management and Need for Project Power: Describes the commitment and responsibility of Boott as a Licensee to continue to operate and maintain the Project and the needs and costs for power from the Project or alternate sources.

VOLUME II OF III

Volume II contains public information and includes Exhibit E.

VOLUME III OF III (Critical Energy Infrastructure Information (CEII))

Volume III contains CEII materials associated with Exhibit F.

- Exhibit F – General Design Drawings

BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Application for a New License for a Major Waterpower Project – Existing Dam

Initial Statement

(1) Boott Hydropower, LLC (Boott or Applicant) applies to the Federal Energy Regulatory Commission (FERC or Commission) for a new license for the Lowell Hydroelectric Project (Lowell Project or Project), FERC No. 2790, as described in the attached Exhibits. Pursuant to Section 6 of the Federal Power Act, as well as the Commission's Policy Statement on Establishing Terms for Hydroelectric Projects, the Applicant respectfully requests that the Commission issue a license for a term of 50 years for the Lowell Project.

(2) The location of the Project is:

State or Territory:	Massachusetts and New Hampshire
County:	Middlesex County, Massachusetts Hillsborough County, New Hampshire
Township or nearby town:	City of Lowell
Stream or other body of water:	Merrimack River

(3) The exact name, address, and telephone number of the applicant are:

Boott Hydropower, LLC
4747 Bethesda Avenue
Bethesda, MD 20814
856-906-0180

The exact name, address, and telephone number of each person authorized to act as agent for the applicant in this application are:

Jillian Lawrence, P.E.
Boott Hydropower, LLC
4747 Bethesda Avenue
Bethesda, MD 20814
856-906-0180

(4) The Applicant is a domestic corporation and is not claiming preference under Section 7(a) of the Federal Power Act.

(5)(i) The statutory or regulatory requirements of the State of Massachusetts and New Hampshire that affect the Project as proposed, with respect to bed and banks and to the appropriation,

diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing and transmitting power and in any other business necessary to accomplish the purpose of the license under the Federal Power Act are:

Massachusetts

a. Boott is a limited liability company organized under the laws of the State of Massachusetts and registered to do business in Massachusetts, and, as such, can engage in the activities set forth in its organizational documents, which includes the generation, transmission, and distribution of electricity from the Project.
b. Section 401 of the Federal Clean Water Act, 33 United States Code (USC) § 1341 (Section 401) requires that any applicant for a federal license or permit to conduct an activity that will or may discharge into waters of the United States (as defined in the Clean Water Act) must present the federal authority with a Water Quality Certification (WQC). Pursuant to Massachusetts General Law (M.G.L.) Chapter 27(3), the Massachusetts Department of Environmental Protection (MADEP) is the state agency designated to carry out the certification requirements prescribed in Section 401 of the Clean Water Act for waters of the Commonwealth of Massachusetts. The Massachusetts Clean Waters Act (M.G.L. Chapter 21 §§ 26-53) directs the MADEP to take all action necessary or appropriate to secure to the Commonwealth the benefits of the Clean Water Act, 33 USC § 1251 et seq. Regulations promulgated thereunder at 314 Code of Massachusetts Regulations (CMR) 9.00, establish procedures and criteria for the administration of Section 401 of the Federal Clean Water Act within the Commonwealth.
c. M.G.L. Chapter 91 (Chapter 91) (Waterways Act) and regulations promulgated thereunder at 310 CMR 9.00 et seq., protects the public's interest in and access to waterways of the Commonwealth, and is intended to ensure that public rights to fish, fowl, and navigate are not unreasonably restricted and that unsafe or hazardous structures are repaired or removed. Chapter 91 requires a license from the MADEP for certain structures in tidelands, Great Ponds, and rivers and streams, as defined in 310 CMR 9.00 et seq.

New Hampshire

a. NH RSA Section 498:6. Water Rights. Allows a cause of action for riparian rights in equity regardless of available remedies at law.

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

Massachusetts

a. The Applicant has complied with the requirements of the laws of the Commonwealth of Massachusetts with respect to the right to engage in the business of developing and transmitting power.
b. The Applicant will file a request for §401 Water Quality Certification with the Massachusetts Department of Environmental Protection within 60 days following FERC's notification of its acceptance of the license and ready for environmental analysis.
c. The Applicant currently holds four Waterways Licenses issued pursuant to M.G.L. Chapter 91 (Chapter 91) (Waterways Act). These include: License No. 1025 which allows Boott to construct and maintain the E.L. Field powerhouse and the fish passageway structures; License No. 1166 which allows Boott to construct and maintain the submarine power transmission line in the bed of the Concord River; and Licenses No. 1949 and 2200 which each allow Boott to construct and maintain three of the water control weirs in the bed of the Merrimack River within the Project bypass reach, for fish passage purposes. The Licensee anticipates that a new Waterways License may be required for modifications to the bypassed reach and to construct a new fish ladder from the powerhouse tailrace to the bypassed reach of the Merrimack River, as described in the attached exhibits.

New Hampshire

a-f. The Applicant has complied with the requirements of the laws of the New Hampshire Department of Environmental Services.

(6) Boott owns and operates the Lowell Project and there are no federal facilities or land associated with the Project. Portions of the historic infrastructure and associated property are owned by the Commonwealth of Massachusetts and administered by the Massachusetts Department of Conservation and Recreation.

Additional Information Required by 18 CFR §5.18(a)

(1) *Identify every person, citizen, association of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary right necessary to construct, operate, or maintain the project:*

Boott presently holds, and will continue to hold, the proprietary rights necessary to operate and maintain the Project works.

(2) *Identify (providing names and mailing addresses):*

(i) *Every county in which any part of the project and any Federal facilities that would be used by the project would be located:*

Middlesex County
375 Merrimack Street
Lowell, MA 01852

Hillsborough County
19 Temple Street
Nashua, NH 03060

There are no Federal lands or facilities used by the Project.

(ii) *Every city, town, or similar local subdivision:*

(A) *In which any part of the project, and any Federal facilities that would be used by the project, would be located:*

City of Lowell
375 Merrimack Street
Lowell, MA 01852

City of Nashua
229 Main Street
Nashua, NY 03060

Town of Chelmsford
50 Billerica Road
Chelmsford, MA 01824

Town of Litchfield
2 Liberty Way
Litchfield, NH 03052

Town of Hudson, NH
12 School Street
Hudson, NH 03051

Town of Merrimack
6 Baboosic Lake Road
Merrimack, NH 03054

Town of Tyngsborough
25 Bryant Lane
Tyngsborough, MA 01879

(B) *That has a population of 5,000 or more people and is located within 15 miles of the project dam:*

City of Lowell
John Leahy
Mayor
375 Merrimack Street
Lowell MA, 01852

Town of Groton
Mark Haddad
Town Manager
173 Main Street
Groton, MA 01450

Town of Ayer
Town Manager
Robert Pontbriand
1 Main Street
Ayer, MA 01432

Town of Littleton
Joseph Laydon
Town Administrator
37 Shattuck Street
3rd Floor, Room 306
Littleton, MA 01460

Town of Harvard
Timothy Bragan
Town Administrator
13 Ayer Road
Harvard, MA 01451

Town of Acton
John Mangiaratti
Town Manager
472 Main Street
Acton, MA 01720

Town of Andover
Andrew P. Flanagan
Town Manager
36 Bartlet Street
Andover, MA 01810

Town of Atkinson
David Cressmand
Town Administrator
19 Academy Avenue
Atkinson, NH 03811

Town of Bedford
Sarah Stanton
Town Manager
10 Mudge Way
Bedford, MA 01730

Town of Billerica
John Curran
Town Manager
365 Boston Road
Billerica, MA 01821

Town of Boxford
Alan Benson
Town Administrator
7A Spofford Road
Boxford, MA 01921

Town of Burlington
Paul Sagarino
Town Administrator
29 Center Street
Burlington, MA 01803

Town of Chelmsford
Paul Cohen
Town Manager
50 Billerica Road
Chelmsford, MA 01824

Town of Concord
Stephen Crane
Town Manager
P.O. Box 535
Concord, MA 01742

Town of Derry
David Caron
Town Administrator
14 Manning Street
Derry, NH 03038

Town of Dracut
Ann Vandal
Town Manager
62 Arlington Street
Dracut, MA 01826

City of Haverhill
James J. Fiorentini
Mayor
4 Summer Street
Haverhill, MA 01830

Town of Hollis
Lori Radke
Town Administrator
7 Monument Square
Hollis, NH 03049

Town of Hudson
Steve Malizia
Administrator
12 School Street
Hudson, NH 03051

City of Lawrence
Dan Rivera
Mayor
200 Common Street
3rd Floor Room 309
Lawrence, MA 01840

Town of Lexington
James Malloy
Town Manager
1625 Massachusetts Avenue
2nd Floor, Town Office Building
Lexington, MA 02420

Town of Lincoln
Timothy Higgins
Town Administrator
16 Lincoln Road
Lincoln, MA 01773

Town of Litchfield
Troy Brown
Town Administrator
2 Liberty Way Suite 2
Litchfield, NH 03052

Town of Londonderry
Kevin Smith
Town Manager
268B Mammoth Road
Londonderry, NH 03053

Town of Lynnfield
Robert Dolan
Town Administrator
55 Summer Street
Lynnfield, MA 01940

Town of Merrimack
Eileen Cabanel
Town Manager
6 Baboosic Lake Road
Merrimack, NH 03054

City of Methuen
Neil Perry
Mayor
41 Pleasant Street
Methuen, MA 01844

Town of Middleton
Andrew Sheehan
Town Administrator
48 South Main Street
Middleton, MA 01949

City of Nashua
Jim Donchess
Mayor
229 Main Street
Nashua, NH 03060

Town of North Andover
Melissa Rodrigues
Town Manager
120 Main Street
North Andover, MA 01845

Town of North Reading
Michael Gilleberto
Town Administrator
235 North Street
North Reading, MA 01864

Town of Pelham
Brian McCarthy
Town Administrator
6 Village Green
Pelham, NH 03076

Town of Pepperell
Andrew Maclean
Town Administrator
One Main Street
Pepperell, MA 01463

Town of Reading
Robert LeLacheur
Town Manager
16 Lowell Street
Reading, MA 01867

Town of Salem
Christopher Dillon
Town Manager
33 Geremonty Drive
Salem, NH 03079

Town of Shirley
Michael McGovern
Town Administrator
7 Keady Way
Shirley, MA 01464

Town of Stoneham
Dennis Sheehan
35 Central Street
2nd Floor
Stoneham, MA 02180

Town of Tewksbury
Richard Montuori
Town Manager
1009 Main Street
2nd Floor
Tewksbury, MA 01876

Town of Tyngsborough
Matt Hanson
Town Administrator
25 Bryants Lane
Tyngsborough, MA 01879

Town of Westford
Jodi Ross
Town Manager
55 Main Street
Westford, MA 01886

Town of Wilmington
Jeffrey Hull
Town Manager
121 Glen Road
Room 11
Wilmington, MA 01887

Town of Windham
David Sullivan
Town Administrator
3 North Lowell Street
Windham, NH 03087

City of Woburn
Scott Galvin
Mayor
10 Common Street
Woburn, MA 01801

(iii) *Every irrigation district, drainage district, or similar special purpose political subdivision:*

(A) *In which any part of the project, and any Federal facilities that would be used by the project, would be located:*

The Project is not located in any irrigation district, drainage district, or similar special purpose political subdivision and does not utilize any federal facilities.

(B) *That owns, operates, maintains, or uses any project facilities or any Federal facilities that would be used by the project:*

There are no irrigation districts, drainage districts, or similar special purpose political subdivisions that own, operate, maintain, or use any Project facilities. The Project does not use any federal facilities.

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

There are no political subdivisions in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

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

Mashpee Wampanoag Tribe
483 Great Neck Road South
Mashpee, MA 02649

Wampanoag Tribe of Gay Head (Aquinnah)
20 Black Brook Road
Aquinnah, MA 02535

Penobscot Nation
23 Wabanaki Way
Indian Island, Maine 04468

Narragansett Indian Tribe
PO Box 268
Charlestown, RI 02813

Stockbridge Munsee Tribe of Mohican Indians
N8467 Moh He Con Nuck Road
Bowler, WI 54416

(3) *For a license (other than a license under section 15 of the Federal Power Act) state that the applicant has made, either at the time of or before filing the application, a good faith effort to give notification by certified mail of the filing of the application.*

This section is not relevant because Boott is applying for a license under section 15 of the Federal Power Act.

Exhibit A Project Description (18 C.F.R. §4.51(b))

A.1 Project Location and Facilities

The Lowell Hydroelectric Project (Project) is located on the Merrimack River in the City of Lowell in Middlesex County, Massachusetts. The Project is located approximately 11 miles upstream of the Lawrence Project (FERC No. 2800) and approximately 30 miles downstream of the Amoskeag Dam (a development of the Merrimack River Project, FERC No. 1893) in Manchester, New Hampshire. The Project's proposed impoundment extends approximately 16 miles upstream of the Project's dam to the limit of the 92.2 feet NGVD 29 contour located in Litchfield, New Hampshire.

The 116-mile-long Merrimack River begins at the confluence of the Winnipesaukee and Pemigewasset rivers in Franklin, New Hampshire; flows southward through New Hampshire into Massachusetts; and then travels northeast until it discharges to the Atlantic Ocean in Newburyport, Massachusetts. As proposed, the Project includes the 15.0 MW Eldred L. Field (E.L. Field) powerhouse constructed in 1985-1986 during Project redevelopment, and three smaller generating stations (Bridge Street, Hamilton, and John Street), which are located within large nineteenth-century mill buildings sited along the 5.5-mile-long canal system within the City of Lowell. The three canal power stations have a combined installed capacity of approximately 4.372 MW. Because the Project includes these generating units, the Project includes the Lowell canal system (as it relates to support power generation and the easement(s) granted to hydropower facility), as well as the turbines and associated equipment within these downtown mill sites. The total installed capacity of the Project is 19.372 MW. A Project location map is presented as Figure A.1-1 and Project facilities are presented in Figure A.1-2.

The Project's impoundment is created by Pawtucket Dam and the Pawtucket Dam Gatehouse. The gatehouse provides flows to the Northern Canal, which serves as the power canal for E.L. Field powerhouse. Approximately 2,200 feet downstream of the gatehouse, the Northern Canal bifurcates, providing flows up to 6,600 cfs to both E.L. Field powerhouse and the Northern Canal as it continues downstream of Hydro Locks. Flows from the Northern Canal to the powerhouse flow through the powerhouse's intake structure, through the Project's two turbine-generator units, and discharge through the Project's 440-foot tailrace channel. Additional primary Project works located near the Project's E.L. Field powerhouse include upstream and downstream fish passage facilities and the Northern Canal surge gate.

Flows to the Project's three canal power stations are provided by the Pawtucket Canal. The Hamilton Power Station draws water from the Hamilton Canal and discharges into the Lower Pawtucket Canal. The Bridge Street Power Station (also known as "Section 8") draws water from the Eastern Canal and discharges to the Concord River. The John Street Power Station also draws water from the Eastern Canal and discharges to the Merrimack River. The flows from the Hamilton Station are reused for power generation at the Bridge and John Street facilities.

As presented in Figure A.1-2, the Project's 5.5-mile canal system includes the canals and primary features listed below. With respect to the canals, the licensed Project works are comprised of only the canal beds, bottoms, and walls, up to and encompassing the exterior plane of the canal walls, caps, and bottoms. For purposes of this Exhibit A, references to the "Lowell canal system" does not include Pawtucket Dam, nor does it include any adjacent lands, sidewalks, pathways, buildings, powerhouses, gate houses, or other infrastructure above the canals or adjacent to the exterior planes of the canal walls, caps, and bottoms, both horizontally and vertically. Additional information regarding the canal and features, as well as additional canal features are presented in this Exhibit.

- Northern Canal - Hydro Locks, Pawtucket Gatehouse
- Pawtucket Canal - Guard Lock and Gates Facility, Swamp Locks and Dam, Lower Locks and Dam
- Hamilton Canal - Hamilton Power Station
- Merrimack Canal - Merrimack Gate
- Eastern Canal - Moody Street Feeder Gate House, Merrimack Dam, Rolling Dam, Boott Dam, John Street Power Station, Bridge Street Power Station
- Western Canal - Lawrence Dam, Hall Street Dam, Tremont Wasteway

The Project as described herein, consisting of the E.L. Field powerhouse and the three power stations (Bridge Street, Hamilton, and John Street)—a combined 19.372 MW—and associated structures, is intended to fully develop, conserve, and utilize the water resource of the Merrimack River at the Pawtucket Dam, and the 5.5-mile-long canal system.

Figure A.1-1. Lowell Hydroelectric Project Location and Proposed Project Boundary

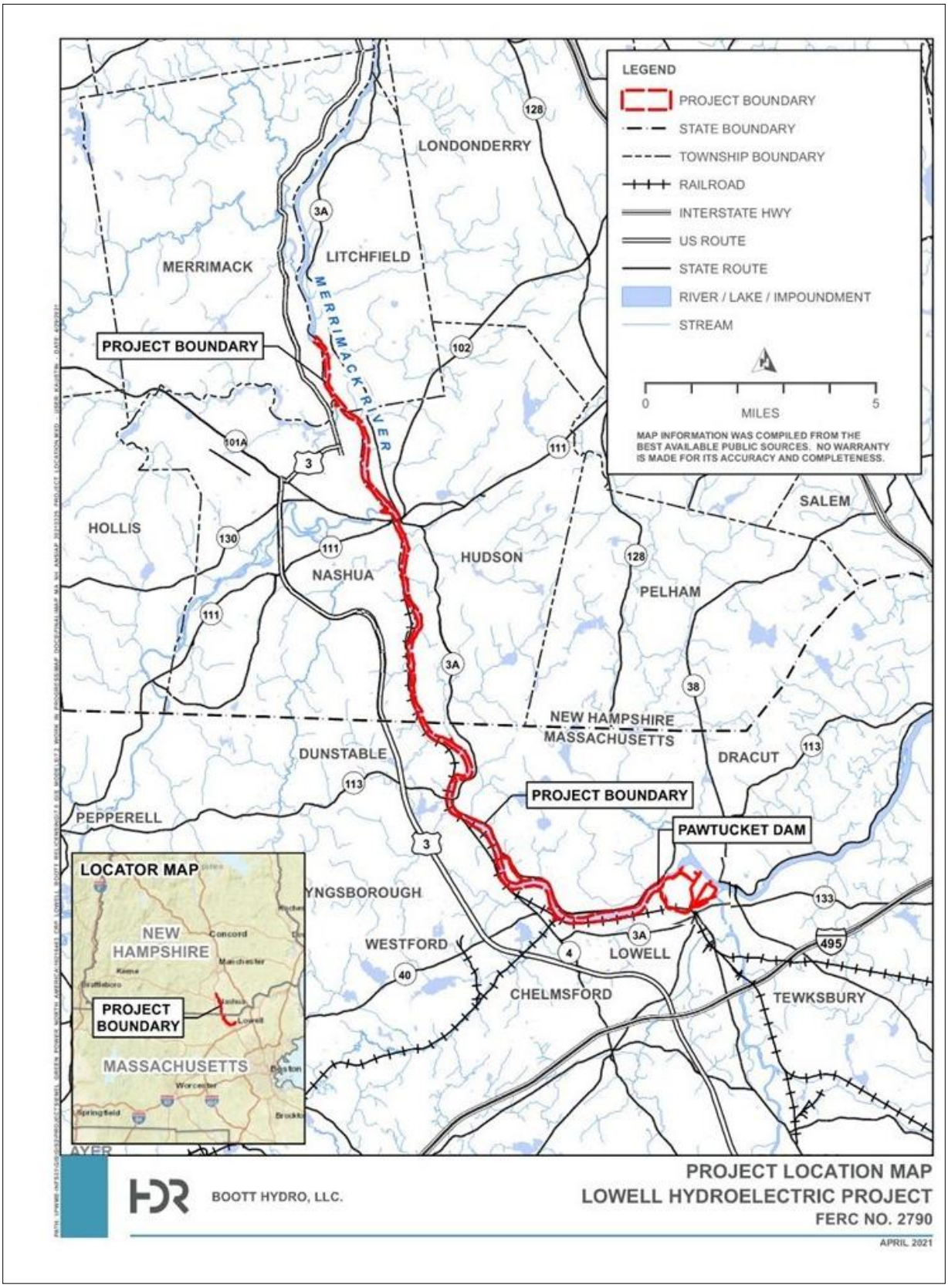
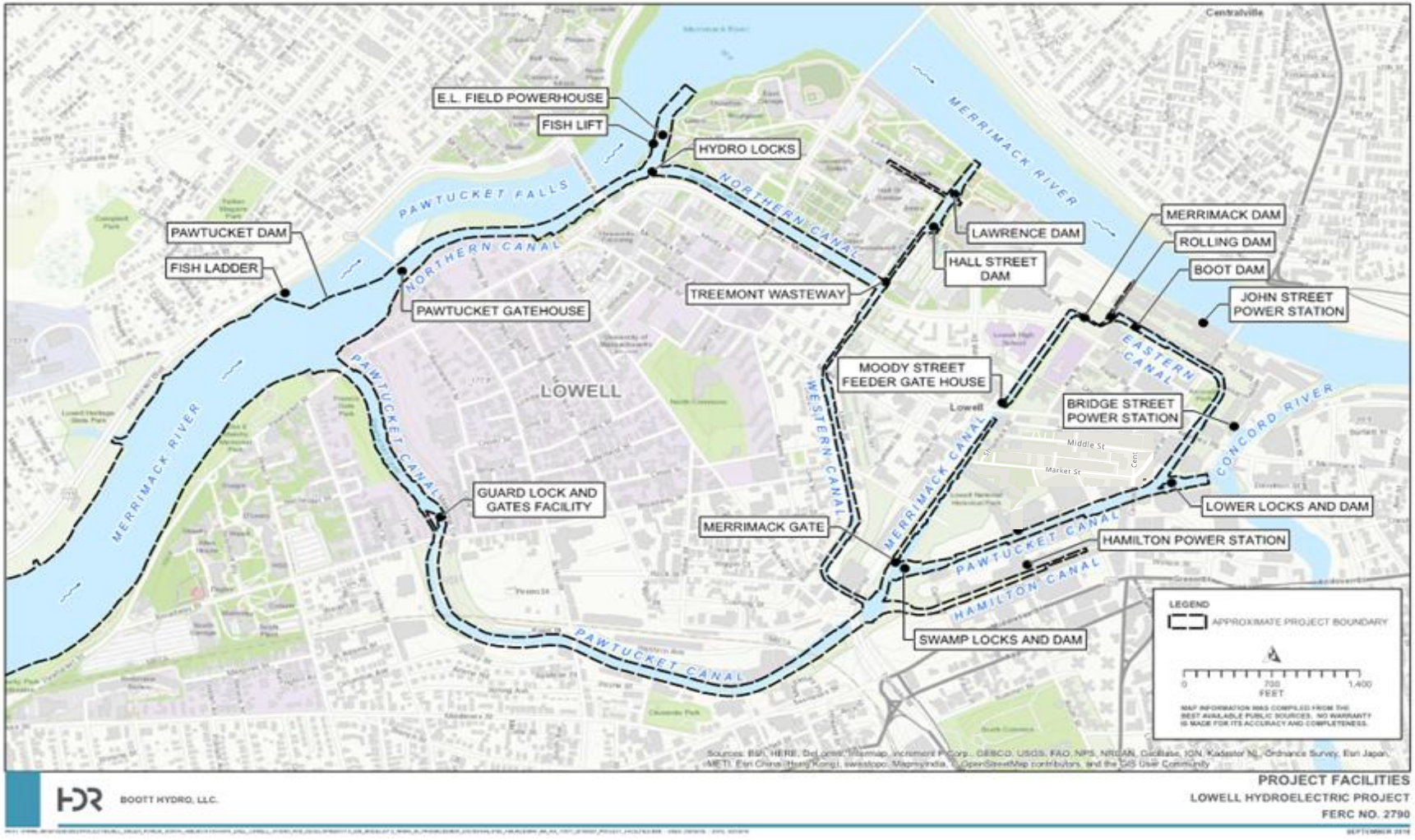


Figure A.1-2. Lowell Hydroelectric Proposed Project Facilities



A.2 Physical Composition, Dimensions, and General Configuration (18 C.F.R. §4.51 (b)(1))

The site of the Lowell Project was historically used for hydromechanical and hydroelectric power for various mill operations throughout the City of Lowell, Massachusetts. The majority of the Project's civil works were constructed during the 19th and early 20th centuries, and existed prior to Project licensing and redevelopment in the 1980's. These structures are described below.

A.2.1 Pawtucket Dam

Pawtucket Dam is of dressed masonry gravity construction with a length of 1,092.5 feet, a spillway crest length of 982.5 feet, a spillway crest elevation of 87.2 feet NGVD 29, and an average height of 15 feet. The dam was built in two sections in 1847 and 1875, the latter being grouted during construction. The dam foundation rests on bedrock, except for a short section on hardpan. The Pawtucket Dam fishway is located at the left dam abutment (looking downstream), and the Pawtucket Gatehouse, which provides flows the Northern Canal, is at the right abutment.

A pneumatically-operated crest gate system is mounted on the dam's spillway crest to maintain the Project's upstream impoundment at its normal elevation of 92.2 feet NGVD 29. The pneumatic crest gate system consists of five-foot-high, 20-foot-long, hinged, steel panels that are raised and lower by tubular rubber air bladders installed immediately downstream of the panels. The crest gate system is installed in five independently controllable zones. Air compressors, which supply system inflation and deflation pressure, and the crest gate control system are housed in a building located near the fish ladder and the left abutment of the dam.

A.2.2 Northern Canal

The Northern Canal is approximately 4,300 feet in length, consisting of mixed materials lining the bottom, including masonry, wood, or existing bedrock. The width of the Northern Canal varies along its length. At the head of the canal, the canal is approximately 95 feet wide. The canal's most narrow point is approximately 78 feet wide where the canal flows under the University Bridge overpass. Approximately 2,200 feet downstream of the Pawtucket Gatehouse, the canal widens to approximately 80 feet as it bifurcates and discharges into the E.L. Field Powerhouse forebay. The canal then turns southeasterly at Pawtucket Street and Hydro Locks, widening to 105 feet between Pawtucket Street and the Tremont Gatehouse. The Great River Wall is the left retaining wall of the Northern Canal. The Great River Wall runs from the Pawtucket Gatehouse to a natural rock outcrop upstream of the E.L. Field Powerhouse. The wall is a mixed masonry structure that is 2,485 feet long and 32 feet in height. The first 1,000 feet combines masonry walls and an earth dike (with masonry core) as the river wall. The second length is a dressed mixed masonry gravity structure to the site of the E.L. Field powerhouse. The crest of the Great River Wall is approximately 103.0 feet NGVD 29 adjacent to the Pawtucket Gatehouse and varies in elevation along its length. The lowest

point of the wall is approximately 93.3 feet NGVD at the University Bridge overpass. The width of the wall varies from 8 feet upstream at the Pawtucket Gatehouse to 10 feet at the downstream end.

A.2.3 Pawtucket Gatehouse

The Pawtucket Gatehouse (also known as the “Northern Canal Gatehouse”) is located at the right abutment of the Pawtucket Dam (looking downstream) and controls flow to the Northern Canal. The Pawtucket Gatehouse is 125 feet long by 22 feet wide, and approximately 55 feet high from the base of the foundation to the roof peak. The gatehouse contains the guard sluice gates, brick gatehouse, and a navigation lock. These structures were a part of the Northern Canal construction project of 1846-47. The gatehouse is principally constructed of dressed mixed masonry with concrete over lintels and contains ten 8-foot-wide by 15-foot-high, motor-operated, timber sliding gates that feed the Northern Canal. An additional intake feeds a historic Francis-designed turbine, which formerly powered the gate mechanisms through a line shaft. The structure's water passages are nearly 80 feet in length. Most of the original equipment, including the Francis turbine, is intact, although alteration and modernization of the gates and associated equipment has been performed in the past to support hydropower operations. Other alterations include a watertight enclosing wooden cover in the turbine pit in 1872 to prevent flooding of the turbine chamber in high water.

The navigation lock, which is constructed of dressed mixed masonry with two sets of wooden miter gates (upstream and downstream), is located at the southern end of the Pawtucket Gatehouse. The navigation lock is approximately 12-feet wide and 97.8-feet long.

A.2.4 Pawtucket Canal

The Pawtucket Canal branches off the Merrimack River approximately 950 feet upstream of the Pawtucket Gatehouse and feeds water into the downtown canal system. From its starting point, the 9,000-foot-long canal curves south and then east, then northeast to meet the Concord River near its junction with the Merrimack River. The width of the Pawtucket Canal varies from 80 to 100 feet and the average depth is approximately 8 feet. The walls consist of materials ranging from granite, ledge, or concrete materials. The canal beds are of ledge, concrete, or wood-planked virgin soil. Over the Project lifetime, the canal’s characteristics have changed as it was repaired with various materials, which is observed throughout the system; changing the overall visual aesthetics.

A.2.5 Additional Canals

The Project’s three downtown power stations (Bridge Street, Hamilton, and John Street Power Stations) are fed by various sections of the 5.5-mile-long canal system. The primary canals in the system are the Pawtucket Canal and the Northern Canal, as described above. Multiple secondary canals receive flows from the system’s two primary

canals. The canal wall construction throughout the system is a combination of granite, ledge, and/or concrete materials. There are several examples of modernization improvements throughout all of the canals. The canal beds consist of ledge, concrete, or wood-planked virgin soil. Again, significant sections of the canals have been repaired or improved over time using a variety of materials.

The Hamilton Canal branches off the Pawtucket Canal and begins upstream of Swamp Locks and Dam and continues northeast. The Hamilton Canal is 1,936 feet in length, has an average depth of 10 feet deep, and is 35 to 100 feet wide. The Hamilton canal is generally rectangular in shape.

The Merrimack Canal is 2,580 feet in length and branches off the Pawtucket Canal, where it flows to the northeast. Portions of the Merrimack Canal are rectangular in shape; however, the majority of the canal was gouged out of the native rock and is irregular in shape. In general, the Merrimack Canal is 10 feet deep and 40 to 50 feet wide.

The Eastern Canal begins just upstream of Lower Locks of the Pawtucket Canal and continues northeast then west. The Eastern Canal runs for 2,037 feet and is rectangular in shape. The Eastern Canal averages 8 feet in depth and 65 feet in width.

The Western Canal connects the Northern Canal to the Pawtucket Canal and flows into the Tremont Wasteway. The Western Canal historically served as a two-level waterpower system; however, the lock structures were removed and filled in 1840. The total length of the Western Canal is 4,964 feet. Its width varies from 35 to 55 feet, and its average depth is 9 feet. The Western Canal is not used for power generation at the Project and no power stations draw water from the canal for generation; nor are any of the power generating facilities located along the Western Canal.

A.2.6 Additional Canal Structures

Over time, the additional canal structures have been owned, operated, and maintained by various parties. The structures throughout the canal system have been repaired and improved throughout their existence using a variety of materials and repair techniques. In many cases, the original materials of the canal structures are unknown.

Guard Lock and Gates Facility

Pawtucket Guard Lock and Gates are the most upstream facility located on the Pawtucket Canal and controls flows into the Pawtucket Canal. The facility consists of a five-bay gatehouse located and a series of three gate structures located within the adjacent boat lock. The gatehouse includes a variety of building materials, including dressed masonry, brick masonry, and wood frame. The adjacent boat lock consists of the upper locking gate, Great Guard Gate (i.e., Francis Gate), and lower locking gate. The gates span the lock chamber, which is 24 feet wide with masonry walls. The upper locking gate and Great Guard Gate are housed in frame buildings. The nominal flow capacity of the downtown canal system via the Pawtucket Canal and the Guard Lock and Gates Facility is approximately 2,000 cfs. The only features at this location that are

owned/operated by the Licensee is the five gates and actuating apparatus. The other gates (miter and lock) and gate house structures are operated/owned by others.

The original Great Guard Gate was a large portcullis gate located within the lock chamber between the upstream and downstream lock gates. This 25-foot-wide by 25-foot-high wooden gate was designed to be lowered into the lock chamber during extreme flood conditions on the Merrimack River to prevent flooding of downtown Lowell via the Pawtucket Canal. A wood frame structure, the Francis Gatehouse, houses the Great Gate. Historically, the Great Gate could have been dropped under its own weight to the bottom of the lock chamber, thereby closing off any flow through the boat lock channel at the Guard Locks, preventing flooding in downtown Lowell via the Pawtucket Canal. The original Great Gate was only used twice during its history, the year following its construction, 1852, and 1936. The Great Guard Gate is no longer functional or tested. This structure has mixed ownership, owned in part by MADCR and Proprietors of the Locks and Canals on the Merrimack River (Proprietors).

Due to the historic nature, public safety concerns, and questionable functionality of the historic Great Guard Gate, in 2005 Boott designed and implemented a replacement gate in consultation with the FERC and NPS. The replacement gate is a segmented structural steel stoplog gate and frame that is stored on-site. The steel stoplog gate was designed to replace the historic Great Guard Gate, which remains in place within the Francis Gatehouse. The steel stoplog gate fits immediately upstream of the Francis Gate House within existing stoplog slots in the granite masonry. When required, installation of the steel stoplog gate can be accomplished within a day via a crane operator.

Moody Street Feeder and Gate House

Moody Street Feeder is a 1,400-foot-long, underground conduit that allows flow to be passed from the Northern Canal to the Merrimack Canal. It terminates at the Moody Street Feeder Gate House which is located on the Merrimack Canal at the intersection of Dutton Street and Merrimack Street. Three 10-foot-wide gates allow closure of the three separate, arched water passages. The gates are housed in a brick building measuring 62.5 feet long by 22.5 feet wide. The Moody Street feeder is primarily constructed of stone, with sections of brick and concrete integrated throughout. Certain areas reflect improvements made to the facility over the years as technology, construction material, and mechanical techniques evolved.

Moody Street Feeder Gatehouse controls flows from the Moody Street Feeder Canal to the Merrimack Canal. Two consecutive dam structures occur downstream of the Moody Street Feeder Gatehouse on the Merrimack Canal, including the 8-foot-high Merrimack Dam and the 19-foot-high Rolling Dam. The Rolling Dam was originally constructed using locally sourced stone and has undergone repairs over time with additional stone and standard grouting imported from other regions. The gate consists of a wooden stoplog system. The Merrimack Dam consists of concrete block abutments paired with wooden stoplogs. The canal is primarily built of stone, with newer concrete sections indicating a later modification to raise the canal walls. The Merrimack Canal flows into the Merrimack Wasteway, which flows into the Merrimack River.

Lawrence Dam

The Lawrence Street dam is located approximately 300 feet downstream of the Hall Street dam and 300 feet upstream of the confluence with the Merrimack River. The Lawrence wasteway is located just downstream of Lawrence Street dam.

The Lawrence Dam's original construction consisted of a rock-filled, timber-crib substructure with a three-tiered apron. The upper apron was timbers overlaying rubble masonry. The second and third aprons consist of massive masonry. Over time, the dam has undergone significant modifications, including the replacement of certain sections with concrete gravity structures and smaller spillways that appear to be constructed of stone. These changes reflect substantial improvements made to the structure over the years. The superstructure is made of steel beams, fitted with wood bay boards. The crest of the spillway is approximately 75.0 feet in elevation. The structure is 100 feet long by 12 feet high and is located at the head of the 49-foot-wide Lawrence Wasteway, which leads to the Merrimack River. The Lawrence wasteway is constructed from stone and concrete materials; several sections have been modernized with complete sections of wall from floor to cap with concrete material.

Tremont Wasteway

The Tremont Gate House is located at the confluence of the Northern and Western Canals and at the head of the Tremont Wasteway. The gatehouse consists of brick superstructure with masonry substructure. The gatehouse is a 32.5-foot long by 11-foot-wide building consisting of brick superstructure with granite block / masonry substructure. Housed in the gatehouse are two 9-foot-wide gates control the flow of water into the Tremont Wasteway.

The Tremont Wasteway is adjacent to Suffolk Street and forms the water passageway between the Northern Canal and the Hall Street Dam. The wasteway is a canal structure constructed of masonry and granite walls and is 30 feet wide by 600 feet long. The wasteway forms the water passageway between the Northern Canal and the Hall Street Dam.

Hall Street Dam

The Hall Street Dam is located on the Tremont Wasteway. The Hall Street Dam consists of a rubble masonry structure with a noted stepped construction, masonry/rubble apron. The length of the structure is 115 feet with a maximum height of 15 feet, and a width of 29 feet. The crest of the spillway is approximately at elevation 81.0 feet with the toe approximately at elevation 66.0 feet. From the Hall Street Dam water flows downstream to the Lawrence dam via several open sections of the dam.

Lower Locks and Dam

The Lower Locks and Dam is located on the Lower Pawtucket Canal and empties to the Concord River. The dam is located at the west end of the upper lock and has a maximum height of 12 feet and an approximate length of 120 feet. The dam consists of a rubble masonry structure with a sloping timber apron. Energy dissipation is accomplished by large rubble masonry located downstream of the dam. The superstructure is constructed of cast iron frames, fitted with wood bay boards. A gated sluiceway is also provided on

the north side of the dam. The lock structure contains two 30.5 feet wide by 85 feet long chambers. The width at the gate passageway is 12.5 feet. The lock walls are of hand-laid masonry. Subsequent repairs since the original construction likely involved alternative materials and construction techniques as part of ongoing constructive modifications.

Swamp Locks and Dam

The Swamp Locks and Dam are at the head of the Lower Pawtucket Canal. The complex at the Swamp Locks and Dam consists of a left concrete dam section, right concrete dam section and gatehouse, and a two-chamber lock structure. The maximum height of the dam is 15 feet and the length is approximately 105 feet. The dam consists of a concrete apron overlaying a rubble masonry structure. The superstructure is made of cast iron frames, fitted with wood bay boards.

The left concrete dam section is an originally masonry structure with a concrete cover. The concrete crest supports 6 foot long by 4.6 feet high stanchion bays and a wood-frame structure which houses a plank walkway. The right concrete dam section supports the southern segment of the wood-frame structure over the spillway and its interior planked walkway. The canals near this area have been substantially modernized with concrete on river left.

A sluiceway is provided on the south side of the dam. The lock structure extends from the right side of the sluiceway to a point downstream where it re-enters the Pawtucket Canal. The two-chamber lock with narrowest width of 12.5 feet is constructed of rubble masonry and allows passage by the Swamp Locks and Dam. The canal walls at Swamp Locks and Dam consist of mixed materials from stone to conventional smooth concrete.

Merrimack Dam, Merrimack Gate and Boott Dam

Merrimack Dam is located on the Merrimack Canal downstream of Moody Street Feeder Gate House and just upstream of Rolling Dam. Merrimack Dam consists of a sloping apron, rubble masonry structure. The apron is protected with timber planks. The maximum height of the dam is 8 feet, and the approximate length is 47 feet. The dam acts as a submerged weir, no longer used to control water elevations.

The Merrimack Gate is located at the beginning of the Merrimack Canal and consists of a concrete dam structure with a sloping upstream face and vertical downstream face with concrete abutments; this gate controls flow from Merrimack Canal to the Pawtucket Canal. The center portion of the structure is fitted with a 10-foot-wide by 6-foot-high timber gate. The maximum height of the dam is 9 feet.

The Boott Dam is located 80 feet southeast of the Merrimack Wasteway, adjacent to Boott Mills. It consists of a masonry structure 40 feet long with a maximum height of 7 feet and includes a gated sluiceway.

Rolling Dam

Rolling Dam is located downstream of the Merrimack Dam and consists of a masonry and concrete structure with a curved apron protected by wood planks. The maximum height of the dam is 19 feet, and the width is approximately 16 feet. The masonry construction is carried downstream of the dam to provide scour protection but appears to have repointing work completed along with concrete / shotcrete work just above the

waterline. The gate structure just upstream allows for flows to be diverted into the Eastern Canal. The gate structure consists of concrete and the wooden stoplogs.

A.2.7 Power Stations and Mill Buildings

The Bridge Street (“Section 8”), Hamilton, and John Street power stations are housed within three former mill buildings associated with and located adjacent to the Project’s canal system. However, the various buildings throughout the City of Lowell and located adjacent to the canal system are not needed for Project purposes and, as such, are not included as licensed Project works, nor are they included within the FERC Project boundary. Rather, they are used principally for small industrial manufacturers, storage space, and/or apartment/condominium units. The FERC license is limited to structures and equipment required for power generation.

The Bridge Street power station is located on the Concord River near its confluence with the Merrimack River. It draws water from the Eastern Canal and discharges to the Concord River. Bridge Street includes three 360 kW generating units, with a total authorized generation of 1,080 kW. The units are designed for 22 feet of head and a hydraulic capacity of 333 cfs each (total: 999 cfs). The intake entrance trifurcates into three separate intakes for each unit, each approximately 10-feet wide by 8.3-feet high. The powerhouse inlets are situated behind 13-feet high by 119-feet wide trashracks that have clear bar spacing of 1.25 inch, and bar thickness of 0.75 inch.

The John Street power station is located on river right (looking downstream) of the Merrimack River, just upstream of its confluence with the Concord River. It draws water from the Eastern Canal and discharges to the Merrimack River. John Street includes four units—three 300 kW generating units with a design head of 21 feet and a hydraulic capacity of 250 cfs, and one 1,200 kW generating unit with a design head of 21 feet and a hydraulic capacity of 1,025 cfs. The John Street Unit No. 1 intake consists of three 9-foot-wide archways and one 7-foot-wide square opening that are 6-feet high. The intake of John Street Unit No. 6 conveyance consists of five bays that are 6-foot by 6-foot. John Street Unit Nos. 3, 4 and 5 share a single conveyance is identical to that of Unit No. 6. Trashracks over the intakes are 8-feet high by 100-feet long.

The Hamilton power station is located on the Hamilton Canal and draws water from the Hamilton Canal and discharges into the Lower Pawtucket Canal. Hamilton includes five units of varying capacities, with a total authorized capacity of 1,180 kW and a total hydraulic capacity of 1,638 cfs (See Table A.4-1). Trashracks over the intakes are in sections 12 feet high by 73 feet long and 12 feet high by 62 feet long.

A.2.8 E.L. Field Powerhouse

E.L. Field powerhouse is a reinforced concrete structure, located on river right (looking downstream). The powerhouse is approximately 109-feet-long by 96-feet-wide and houses two 7.5 MW generating units with a total authorized capacity of 15.0 MW. The powerhouse incorporates a separate conventional intake structure for each of the station’s two identical units. Each intake is approximately 50 feet wide and 50 feet high and is equipped with

trashracks; intake and draft tube gate slots with permanent or bulkhead style gates for emergency shutdown and dewatering purposes are also provided. The powerhouse is equipped with a traversing trash rake to remove debris at the intake. Both mobile and on-site cranes are used for heavy equipment movement at the facility. The E.L. Field powerhouse forebay is an excavated rock channel approximately 200 feet long, 50 feet deep, and 80 feet wide. The left (northern) side of the forebay is a reinforced-concrete wall and includes an exit channel for the downstream movement of fish that enter the canal system.

A.2.9 Tailrace Channel

The Project's tailrace channel consists of a 440-foot-long channel that was excavated out of the river's existing bedrock floor. The channel excavation is approximately 60 feet wide by an average of 20 feet deep. The tailrace is protected from high river flows by a 10- to 16-foot-high concrete training wall, which directs bypassed river flows away from the tailrace.

A.2.10 Crest Gate System

A pneumatically-operated crest gate system is mounted on the dam's spillway crest to maintain the Project's upstream impoundment at its normal elevation of 92.2 feet NGVD 29. The pneumatic crest gate system consists of five-foot-high, 20-foot-long, hinged, steel panels that are raised and lower by tubular rubber air bladders installed immediately downstream of the panels. The crest gate system is installed in five independently controllable zones. Air compressors, which supply system inflation and deflation pressure, and the crest gate control system are housed in a building located near the fish ladder and the left abutment of the dam.

A.2.11 Control Structures

A concrete control structure known as "Hydro Locks" was constructed during project redevelopment in the 1980s. Hydro Locks is located at the bend in the Northern Canal upstream of the E.L. Field intake and immediately underneath the Pawtucket Street Bridge. The control structure includes a navigation lock and was constructed to maintain the effective net head at the E.L. Field Powerhouse by isolating the powerhouse forebay from the remainder of the Lowell canal system. The control structure runs 100 feet long, underneath the Pawtucket Street Bridge, and is 26 feet high by 22.25 feet wide. The lock structure is approximately 88 feet long, located on the canal side along Father Morissette Boulevard, with sets of butterfly wicket lock gates approximately 15 feet high and 56 feet apart on either end of the lock. The lock structure is also equipped with stoplog slots and rubber fenders.

Located just downstream of the Great River Wall is the Northern Canal surge gate, constructed in the bedrock in the left forebay wall just upstream of the E.L. Field Powerhouse. The steel gate is pneumatically operated and is 15-feet-high by 78-feet-wide set on a masonry weir with a crest elevation of 77.0 feet. This system is designed to attenuate the surge wave in the canal that occurs when there is a sudden plant

shutdown. When flow is less than 3,500 cfs, the surge suppressor gate is manually disabled. Should the flow increase to over 3,500 cfs, the gate is returned to the automatic operating condition. A safety boom has been installed in the canal above the gate.

A.2.12 Fish Passage and Protection Facilities

Existing upstream and downstream fish passage facilities at the Project include a fish lift and downstream fish bypass at the E.L. Field powerhouse, and a vertical-slot fish ladder at the Pawtucket Dam. All existing fish passage facilities were designed in consultation with the applicable resource agencies. The fish ladder at the Pawtucket Dam is designed to allow for controlled fish passage at river flows up to 25,000 cfs. The fishway operates at 200 cfs, including attraction flow, with an additional 300 cfs of supplemental attraction flow released from a slide gate adjacent to the passage facility. The fish ladder is a vertical slot design with 13-foot-wide by 10-foot-long pools. A counting station is incorporated into the ladder.

The existing upstream fishway at the powerhouse is a fish lift (i.e., elevator). The design discharge capacity is 200 cfs. A fish collection gallery with two entrances spans the downstream wall of the powerhouse to collect fish migrating upstream via the Project's tailrace channel, however only the westerly "river side" entrance has been used since the 1990's, by agreement with the fishery agencies. The fish are artificially attracted into the 30-foot crowding pool, trapped, and crowded with supplemental attraction flows. From the crowding pool, fish enter the elevator and are lifted in a hopper to the exit channel which provides access to the Northern Canal, which leads to the Merrimack River.

The existing downstream fishway at the E.L. Field powerhouse consists of an adjustable-flow sluiceway and bypass adjacent to the Project's intake headwall. On a seasonal basis, fish moving downstream of the Project via the Northern Canal may enter the sluiceway and be discharged to the Merrimack River adjacent to the powerhouse.

Boott is proposing modifications to the existing upstream and downstream fish passage structures consistent with *August 12, 2022 Settlement Agreement for Fish Passage.* Since 2022, fish passage technology has continued to advance, and Boott remains open to exploring innovative and emerging solutions that are currently available or anticipated to enter the market. Boott will collaborate with all relevant stakeholders and FERC once the information review is complete and the fishway retrofit design, particularly at the tailrace, for the Project are prepared.

A.3 Impoundment Characteristics (18 C.F.R. §4.51 (b)(2))

The Project operates in run-of-river (ROR) mode and has no usable storage capacity. The existing Project boundary extends approximately 23 miles upstream to Moore's Falls in Litchfield and Merrimack, New Hampshire, and is shown in Figure A.1-1. In order to more accurately follow the 92.2 feet NGVD 29 contour upstream of the Pawtucket Dam, Boott is proposing to modify Project's existing upstream project boundary. This proposed impoundment extends approximately 16 miles upstream to the limit of the 92.2 feet

NGVD 29 contour located at Cromwell's Falls in Litchfield and Merrimack, New Hampshire. The surface area of the proposed Project impoundment encompasses approximately 1,236 acres. The gross storage capacity between the normal surface elevation of 92.2 feet NGVD 29 and the minimum pond level of 87.2 feet NGVD 29 is approximately 6,180 acre-feet.

A.4 Generating Equipment (18 C.F.R. §4.51 (b)(3))

Turbine and generator data for the E.L. Field Powerhouse and downtown powerhouses are provided below in Table A.4-1. The existing Project capacity is 19,372 kW.

Table A.4-1. Lowell Hydroelectric Proposed Project Turbine, Generator, and Unit Capacity Data

		TURBINES							GENERATORS						
Powerhouse	Unit #	Type	Size In	Speed RPM	Head Feet	Flow cfs	Power HP	Power kW	Type	kVA	Power Factor	Power kW	Voltage Volts	Speed RPM	Unit Capacity
E. L. Field	1	Fuji Horizontal Full Kaplan	152.4	120	39	3,300	11,540	8,655	Fuji Electric	8,340	0.9	7,506	4,160	120	7,506
E. L. Field	2	Fuji Horizontal Full Kaplan	152.4	120	39	3,300	11,540	8,655	Fuji Electric	8,340	0.9	7,506	4,160	120	7,506
Bridge Street	4	Hercules Type D Single Runner	42	138.5	22	333	655	491	General Electric ATB	450	0.8	360	600	138.5	360
Bridge Street	5	Hercules Type D Single Runner	42	138.5	22	333	655	491	General Electric ATB	450	0.8	360	600	138.5	360
Bridge Street	6	Hercules Type D Single Runner	42	138.5	22	333	655	491	General Electric ATB	450	0.8	360	600	138.5	360
Hamilton	1	Leffel Type Z Single Runner	45	120	13	374	459	344	Westinghouse Electric Co.	350	0.8	280	600	120	280
Hamilton	2	Leffel Type Z Single Runner	39	133	13	279	341	256	Electric Machinery Co.	225	0.8	180	600	133	180
Hamilton	3	Leffel Type Z Single Runner	36	150	13	237	287	215	Electric Machinery Co.	200	0.8	160	600	150	160
Hamilton	4	Leffel Type Z Single Runner	45	120	13	374	459	344	Electric Machinery Co.	350	0.8	280	600	120	280
Hamilton	5	Leffel Type Z Single Runner	45	120	13	374	459	344	Electric Machinery Co.	350	0.8	280	600	120	280
John Street	3	Leffel Single Runner	33	200	21	250	482	362	General Electric	375	0.8	300	600	200	300
John Street	4	Leffel Single Runner	33	200	21	250	482	362	General Electric ATI	375	0.8	300	600	200	300
John Street	5	Leffel Single Runner	33	200	21	250	482	362	General Electric ATI	375	0.8	300	600	200	300
John Street	6	Allis Chalmers Single Runner	72	100	21	1,000	1,925	1,444	Allis-Chalmers AV	1,500	0.8	1,200	600	100	1,200
											TOTAL PROPOSED PROJECT CAPACITY:				19,372

A.5 Transmission Facilities (18 C.F.R. §4.51 (b)(4))

Generator leads connect the turbine-generating units at the E.L. Field Powerhouse to a transformer adjacent to the powerhouse. From the E.L. Field Powerhouse substation, a 13.8-kilovolt (kV) submarine cable in the canal beds carries electricity generated at the Project approximately 1.3 miles through the canal system in the City of Lowell and an additional 0.5 mile along the Concord River to National Grid's Perry Street substation. From the Perry Street substation, Project output is delivered to the regional utility grid at 115 kV. Electricity generated by the canal power stations are also connected to the Perry Street substation via submarine cables located within the canal system and Concord River.

A.6 Ancillary Equipment (18 C.F.R. §4.51 (b)(5))

A.6.1 Electrical and Transmission

The design of the electrical equipment and station protection equipment provides completely automatic E.L. Field station operation with load control on a float to measure water level at the dam. This equipment controls the two synchronous generators connected via 4.16-kV circuit breakers to a common bus. One station transformer is connected directly to this bus and delivers power to the system. Protective relaying comprises one overall differential relaying scheme (with harmonic and percent bias) enclosing within its protected zone the generators, 4.16-kV switchgear, and the transformer.

With the exception of the station transformer and the line circuit breaker, all electrical equipment is housed inside the powerhouse structure. The transformer is located within a fenced enclosure adjacent to the powerhouse. The station transformer has the normal protective devices, such as lightning surge, gas and winding temperature detectors. Power for station metering is derived from 4.16-kV potential transformers connected to the station bus and current transformers installed in the low-voltage connections to the main transformer.

A.7 United States Lands within Project Boundary ((18 C.F.R. §4.51 (b)(6))

The project does not occupy any reservation or other lands of the United States (*see* 16 U.S.C. s. 796(2) (excluding national parks from the definition of "reservation")) but is located within the administrative boundary of the Lowell National Historical Park. NPS holds easements from the Commonwealth of Massachusetts granting the right to use certain structures consistent with their use as a park and consistent with the Lowell Act, which purposes include but are not limited to: conducting canal tours, running interpretive programs, and the maintenance, improvement and restoration of gatehouses and support structures, dams and lock chambers. These rights are subject to the easement rights of the Commonwealth of Massachusetts, stating that such easement uses "shall not include any use that would interfere with the use, maintenance, or operation by Boott for hydroelectric power production."

Exhibit B Project Operation and Resource Utilization

B.1 Description of Plant Operations (18 C.F.R. §4.51(c)(1))

Under the Project's existing FERC license, Boott operates the Project in run-of-river (ROR) mode using the Project's automatic pond level control capability. Through these operations, the project is operated to provide the required fishway flows, maintain established water elevations in the Project's canal system, and provide flows to the E.L. Field Powerhouse and canal power stations when available. Given that the E.L. Field turbine-generator units are more efficient and operate at a higher head than the Project's canal units, when the canal units are available, the E.L. Field turbine-generator units (primary units) are the Project's primary units during normal operations.

When river flows exceed the hydraulic capacity of the E.L. Field units (6,600 cfs for both units) and the bypass flow (year round 100 cfs; 500 cfs during the upstream fish passage season), excess flows up to approximately 2,000 cfs may be routed through the downtown canal system and to the canal units. Therefore, when the canal units are available for generation, flows in excess of approximately 8,600 cfs, and flows required for fish passage, are passed over the Pawtucket Dam spillway. This is how the Project currently uses the available flows. Boott proposes to continue this existing operation during the term of the Project's new license. In addition, even when the canal units are not available for generation, Boott proposes to provide between 50 and 100 cfs to the canal system in support of maintaining canal water elevations and water quality. In addition, Boott proposes to provide a minimum of 100 cfs to the Project's bypassed reach on a year-round basis and 500 cfs during the upstream fish migration season.

In addition to this operating approach, Boott operates the Project in accordance with additional management and operating plans (e.g., Crest Gate System Operation Plan, Canal Operation and Maintenance Plan, and Emergency Action Plan) as described below and in Exhibit E.

B.1.1 Canal Operations

The Project includes a two-tiered network of man-made canals, totaling 5.5 miles in length. Much of the flow to support the canal system enters upstream of the Pawtucket Dam via the Pawtucket Canal and is controlled by the Guard Lock and Gates Facility. The flow capacity of the downtown canal system via the Pawtucket Canal and the Guard Lock and Gates Facility is approximately 2,000 cfs. Additionally, flows enter the Northern Canal just before the ELF Powerhouse. No power generation for the Project occurs along the Northern Canal. Additionally, no power generation occurs along the Western Canal.

Project works include three power stations located within mill buildings along the downtown canal system. The Hamilton Power Station contains five units and draws water from the Hamilton Canal in the upper canal system and discharges into the Lower Pawtucket Canal in the lower canal system at a head of approximately 13 feet. In the lower canal system, the Bridge Street and John Street Power Stations each draw from the Eastern Canal and discharge to the Merrimack River or the Concord River, at a head of approximately 21 feet. The John Street Power Station contains four units and discharges into the Merrimack River. The Bridge Street Power Station has three units known as “Section 8” and discharges into the Concord River. The authorized installed capacity of the above units is provided in Table B.2-2.

In general, when all the canal units are available, the canal unit dispatch sequence is intended to maximize the efficiency of the downtown canal units. Due to the imbalance of unit flow capacities between the units along the Hamilton Canal and the lower Pawtucket and Eastern canals, the Hamilton units would generally be the first units to be dispatched. Flows through the Hamilton units (up to 1,638 cfs total) are discharged into the Lower Pawtucket Canal, which then flow through the Eastern Canal to feed to units at John Street (1,700 cfs) and/or Bridge Street (999 cfs), or discharge at Lower Locks into the Concord River. The Bridge Street units and the John Street units along the Eastern Canal are typically sequenced to match the operating Hamilton canal units. By diverting canal flows through Hamilton units first, Boott can “reuse” canal flows at John Street and Bridge Street, while staying under the total canal flow of 2,000 cfs.

Boott will entirely suspend generation and operations of the downtown canal units during the downstream fish passage season for alosines and American eel (typically May through November – and to be defined annually in consultation with the MRTC). At the start of the downstream fish passage season, all downtown canal units will be shut off and flows will not be diverted into the downtown canal system (except as needed to maintain the canal water level and flows as per the Canal Operation and Maintenance Plan). At the end of the fish passage season, when river flows exceed the hydraulic capacity of the E.L. Field units (6,600 cfs for both units) and the bypass flow, excess flows up to approximately 2,000 cfs may be routed through the downtown canal system and to the canal units.

From May 15 to October 15, Boott maintains an operating agreement with the NPS to allow tour boat operations to navigate the canal system. Boott maintains canal water levels within appropriate limits during the May 15 to October 15 tour boat operating season and typically will not be operating the downtown canal units, due to flow conditions and fish passage considerations.

B.1.2 Pneumatic Crest Gate Operations

On April 18, 2013, FERC authorized Boott to replace the existing wooden flashboard system on the Project’s Pawtucket Dam with a pneumatic crest gate system. FERC approved the amended Crest Gate System Operation Plan on March 30, 2015. The plan describes the operation of the pneumatic crest gate system under normal and high-water operations.

The pneumatic crest gate system works in conjunction with the automatic pond level control system at the E.L. Field Powerhouse to maintain consistent headpond elevations.

Table B.1-1 provides a tabular description of the operating scheme used for existing crest gate operations.

Table B.1-1. Pneumatic Crest Gate System Operational Scheme

Approximate Spillway Flow (cfs) †	Crest Gate Status	Target Pond Level (ft NGVD 1929)	Unit Operation
0	Full elevation	92.2 ft (Normal pond)	Pond level control maintained at E.L. Field Powerhouse; additional flow passed through downtown canal system as necessary.
0 – 3,250	Full elevation	Rising to ± 93.2 ft	Full available output
3,250 - ± 23,000 (est.)	Automatic pond level control	± 93.2 ft	Full available output
± 23,000 (est.) – 35,000††	Automatic pond level control if High Water Operations Protocol is not triggered.	± 93.2 ft	Full available output
	Fully lowered if High Water Operations Protocol is triggered	Pond level follows spillway rating curve based on spillway flow.	Full available output
>35,000	Fully lowered	Rises above 93.2 ft as spillway discharge increases.	Full available output

Source: FERC 2015.
† Flow over the spillway is the inflow to the headpond minus any flow through the turbines at the E.L. Field Powerhouse, through the downtown canal system or through the fish ladder. The maximum combined hydraulic capacity of E.L. Field Powerhouse and the canal system is approximately 8,600 cfs, but may be restricted by unit availability, debris accumulation at the Northern Canal Gatehouse, high tailwater conditions, and other factors.
†† The potential range of spillway flows over which the crest gate may be fully lowered per the High-Water Operations Protocol. The estimated flow over the spillway is the flow at the Merrimack River (U.S. Geological Survey [USGS] gage No. 01100000) minus the flow at the Concord River (USGS gage No. 01099500) and minus any flow released through Boott's turbines and the downtown canal system.

B.1.3 Normal Operation

Under normal operations, the crest gate is maintained at full elevation, and the E.L. Field Powerhouse control system operates the units in run-of-river mode, adjusts the main units' output to match inflow and maintain the impoundment water level at the normal, authorized pond elevation of 92.2 feet NGVD 29.

B.1.4 Operations During Low Water and Adverse Conditions

During low inflow conditions, Boott operates the Project to maintain the impoundment level of 92.2 feet NGVD 29 and provides the required minimum downstream releases

and flows necessary for operation of the fish passage structures in accordance with Articles 36 and 37 of the Project's license. In addition, during low inflow conditions, Boott operates that Project to maintain established water elevations within the Project's canal system. Boott is proposing to continue this operational strategy through a new FERC license for the Project.

B.1.5 Operations During High Water and Adverse Conditions

Under the current license, when river flows exceed the flows required for the Project's fishway and the hydraulic capacity of the E.L. Field Powerhouse units, excess flows up to approximately 2,000 cfs can be routed through the downtown canal system and to the canal units (as described below). Flows in excess of these flows are passed over the Pawtucket Dam spillway into the bypassed reach.

During high-water conditions, when flows in the Merrimack River exceed the Project's hydraulic capacity, the crest gate control system at the E.L Field Powerhouse automatically adjusts the gates to maintain the impoundment elevation no higher than 93.2 feet NGVD 29, or one foot above the normal pond elevation. When under automatic control, the crest gates are fully lowered at spillway flows of approximately 35,000 cfs and above. In addition, the approved Crest Gate Operations Plan requires Boott to fully lower the crest gate panels in anticipation of potential flood events. This minimizes the upstream backwater effect of the Pawtucket Dam to the extent possible. (FERC 2015).

In the canal system, the Great Guard Gate, a large portcullis gate was constructed in 1851 at the Guard Lock and Gates facility, to prevent flooding in downtown Lowell via the Pawtucket Canal. The Great Guard Gate and gatehouse is operated and maintained by NPS. However, in 2005, Boott designed and implemented a replacement for the Great Guard Gate under a FERC recommendation. The replacement is a frame and steel stoplogs that are stored on-site. The stoplog gate structure replaces the Great Guard Gate, which remains in place within the Francis Gate House. When deployed, the steel stoplogs are installed immediately upstream of the Francis Gate House within existing stoplog slots in the granite masonry. Installation of the steel stoplog gate can be accomplished within a day via a crane. The Project's Emergency Action Plan provides that the stoplogs should be installed when the water level at the Pawtucket Dam rises above 98.0 ft NGVD 29. Boott proposes to continue implementation of the existing Emergency Action Plan associated with the facility.

B.2 Estimated Energy Production and Dependable Capacity (18 C.F.R. §4.51(c)(2))

B.2.1 Plant Factor

Based on the average annual gross energy produced during calendar years 2008 through 2017 and the rated E.L. Field Powerhouse plant capacity of 15.0 MW, the estimated annual plant factor for the Lowell Hydroelectric Project is 0.643.

B.2.2 Estimated Average Annual Energy Production

The average annual energy generation of the Lowell Hydroelectric Project for the period of 2008 through 2017 was 84,501 megawatt-hours (MWh). The Project operates in a ROR mode and, therefore, experiences seasonal and annual variations in generation based on natural hydrologic conditions in the Merrimack River Watershed. Table B.2-1 provides a summary of monthly Project generation for a 10-year period from 2008 through 2017 in MWh. Given that the E.L. Field Powerhouse has recently been offline due to a flood and subsequent facility refurbishment, Boott believes that this 10-year period provides a good representation of the Project's annual energy production.

Table B.2-1. Lowell Hydroelectric Project Monthly and Annual Generation (MWh)

Month	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
January	10,610	2,574	6,403	7,163	10,272	8,064	10,422	6,624	9,258	9,325
February	10,955	3,851	6,672	5,228	8,928	8,304	5,232	3,216	9,312	6,335
March	11,727	5,088	8,555	10,176	12,432	12,784	10,536	5,820	10,042	9,395
April	10,876	7,341	8,061	11,088	7,872	13,392	10,959	10,128	8,427	8,387
May	7,690	10,147	8,094	11,472	11,712	9,600	9,264	5,219	7,244	8,181
June	4,512	10,464	4,752	8,304	9,792	11,551	3,075	6,563	2,577	9,716
July	5,615	11,252	2,963	3,552	3,216	11,520	4,608	6,432	1,010	6,635
August	4,810	8,026	2,072	4,416	4,560	6,144	5,472	2,412	1,044	2,959
September	4,962	4,012	1,677	10,128	3,696	6,214	4,428	1,898	498	3,462
October	5,287	5,703	8,457	11,136	7,344	3,894	4,314	5,297	1,059	3,332
November	4,726	4,404	10,216	10,272	6,384	5,376	6,880	6,367	3,649	7,380
December	4,656	4,747	9,687	10,272	8,880	7,772	10,700	8,395	9,025	7,946
Annual	86,425	77,609	77,608	103,207	95,088	104,614	85,890	68,371	63,146	83,053

B.2.3 Estimated Dependable Capacity

Dependable capacity is generally defined as the amount of load a hydroelectric plant can carry under adverse hydrologic conditions during a period of peak demand; for example, during the hot, dry conditions typical of August in the Project area. The estimated dependable capacity is also determined by the minimum flow requirements included in the existing license. Under the current license, the Project's estimated dependable capacity is approximately 4.9 MW, based on the August median flow of 1,940 cfs at the Project site.

B.2.4 Hydraulic Capacity of Powerhouses

The maximum hydraulic capacity of E.L. Field Powerhouse is approximately 6,600 cfs, but may be restricted by unit availability, debris accumulation at the Northern Canal Gatehouse, high tailwater conditions, and other factors (Table B.2-2). The hydraulic capacity of the downtown canal system generation units is provided in Table B.2-2.

Table B.2-2. Lowell Hydroelectric Project Hydraulic Capacity

TURBINES				
			Runner Diameter	Hydraulic Capacity
Powerhouse	Unit #	Type	Inches	cfs
E. L. Field	1	Fuji Horizontal Full Kaplan	152.4	3,300
E. L. Field	2	Fuji Horizontal Full Kaplan	152.4	3,300
Bridge Street	4	Hercules Type D Single Runner	42	333
Bridge Street	5	Hercules Type D Single Runner	42	333
Bridge Street	6	Hercules Type D Single Runner	42	333
Hamilton	1	Leffel Type Z Single Runner	45	374
Hamilton	2	Leffel Type Z Single Runner	39	279
Hamilton	3	Leffel Type Z Single Runner	36	237
Hamilton	4	Leffel Type Z Single Runner	45	374
Hamilton	5	Leffel Type Z Single Runner	45	374
John Street	3	Leffel Single Runner	33	250
John Street	4	Leffel Single Runner	33	250
John Street	5	Leffel Single Runner	33	250
John Street	6	Allis Chalmers Single Runner	72	1,000

B.2.5 Project Flows

The Pawtucket Dam is the main impounding structure that provides head and flow for all the Lowell Hydroelectric Project's generating stations and the canal system. The normal operating pool level behind the dam is 92.2 ft NGVD 29. Flow passes from the Pawtucket Dam reservoir into the Pawtucket Canal and the Northern Canal. The Northern Canal Gatehouse controls flow into the Northern Canal, which leads to the E.L. Field Powerhouse; normally all flow in the Northern Canal passes through the turbines at E.L. Field and is discharged back to the Merrimack River. A lock control structure controls flow into the lower portion of the Northern Canal downstream of the E.L. Field Powerhouse. The Guard Lock and Gates Facility controls flow into the Pawtucket Canal.

Flow over the spillway is the inflow to the headpond less any flow through the turbines at the E.L. Field Powerhouse, through the downtown canal system, or through the fish ladder.

The majority of flows through the Lowell Project are a direct result of the annual hydrologic cycle. The river receives higher inflows during the annual spring runoff and in the wetter fall and winter months. There are several U.S. Army Corps of Engineers flood control reservoirs in the Merrimack River basin upstream of the Lowell Project. Boott and other licensees in the Merrimack River basin pay Headwater Benefits annual charges to offset the costs of operation and maintenance of these flood control facilities.

Two USGS Gages were reviewed to establish Project hydrology:

- USGS Gage No. 01100000 Merrimack River Below Concord River at Lowell, MA; and,
- USGS Gage No. 01099500 Concord River Below River Meadow Brook, at Lowell, MA.

Flows from USGS Gage No. 01099500 *Concord River Below River Meadow Brook, at Lowell, MA* were subtracted from flows at USGS Gage No. 01100000 *Merrimack River Below Concord River at Lowell, MA, MA* to calculate the hydrologic data tabulated in Table B.2-3, presenting data at the Project from the past 37 years (1987-2024). . Monthly flow duration curves have been developed for the Lowell Project using the USGS gage data for the period of record from 1987 through 2024. Flow duration curves are provided below in Figure B.2 1 through Figure B.2 4.

Table B.2-3. Lowell Hydroelectric Project Hydrologic Data (1987-2024)

Month	Minimum Flow (cfs)	90% Exceedance (cfs)	Average Flow (cfs)	10% Exceedance (cfs)	Maximum Flow (cfs)
January	916	3,808	7,614	14,394	39,710
February	1,478	3,475	6,840	12,160	39,180
March	1,914	4,737	12,038	20,639	50,220
April	4,340	6,898	18,796	30,564	78,890
May	2,218	4,112	11,383	18,782	88,410

Month	Minimum Flow (cfs)	90% Exceedance (cfs)	Average Flow (cfs)	10% Exceedance (cfs)	Maximum Flow (cfs)
June	1,004	2,100	6,774	12,541	44,660
July	670	1,350	4,058	10,724	29,820
August	569	1,077	3,659	7,233	30,030
September	460	986	3,349	6,725	32,264
October	787	1,386	6,305	11,730	50,150
November	1,345	2,594	8,459	15,307	30,990
December	1,839	3,500	9,171	18,016	34,810
Annual	460	1,682	8,202	17,040	88,410

Source: USGS 2024.

B.2.6 Area-Capacity and Rule Curves

The Project operates in ROR mode and has no useable storage capacity. The gross storage capacity between the normal surface elevation of 92.2 feet NGVD 29 and the minimum pond level of 87.2 feet is approximately 6,180 acre-feet. Given the Project's current and proposed ROR operations, the minimal fluctuations in the reservoir level cause very little change in the surface area of the impoundment. Consequently, a site-specific area-capacity curve and impoundment rule curve for the E.L. Field Powerhouse or the three power stations has not been developed, nor are they necessary for the current and future operation of the Project.

Figure B.2-1. Monthly Flow Duration Durves at Pawtucket Dam (January – March)

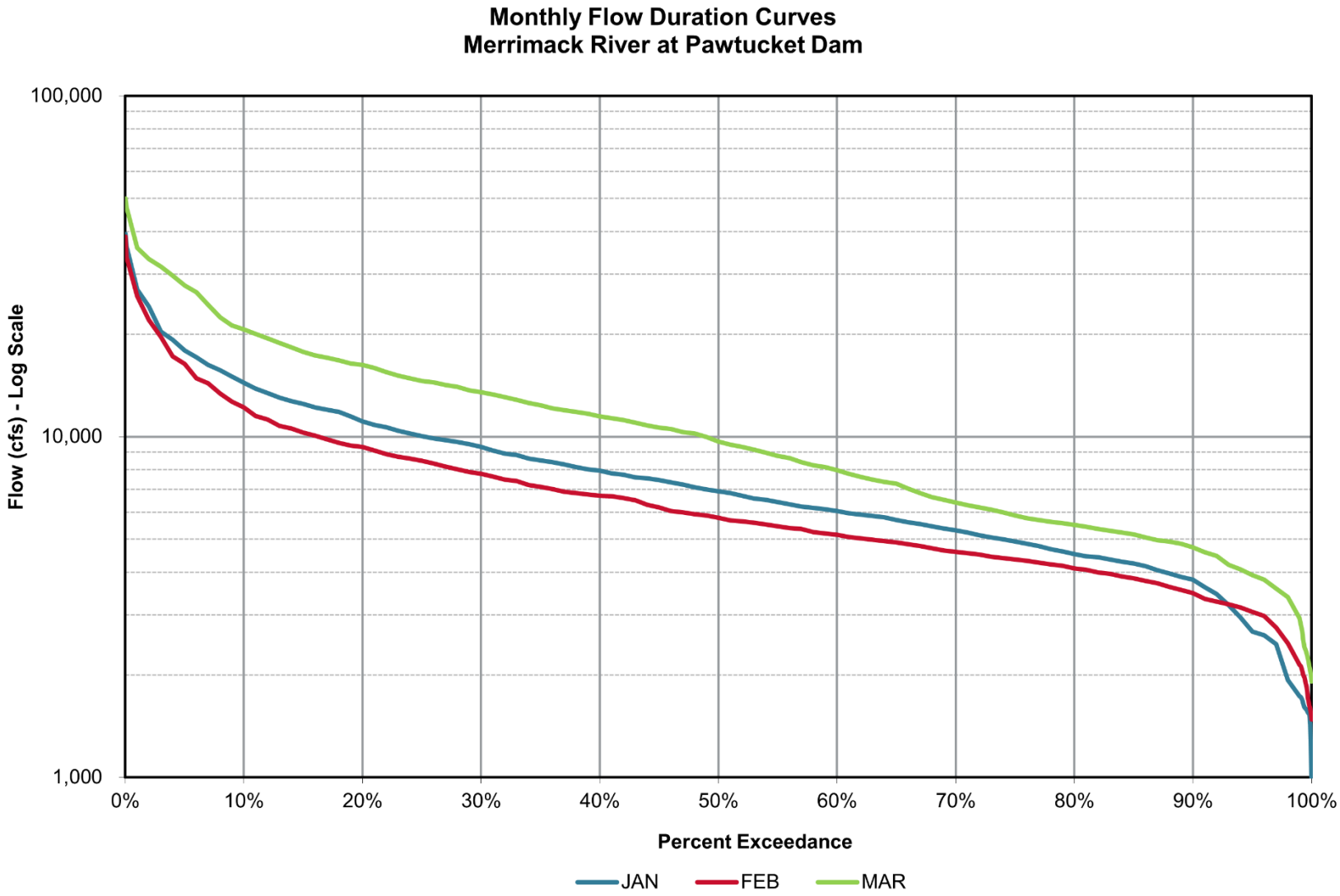


Figure B.2-2. Monthly Flow Duration Durves at Pawtucket Dam (April – June)

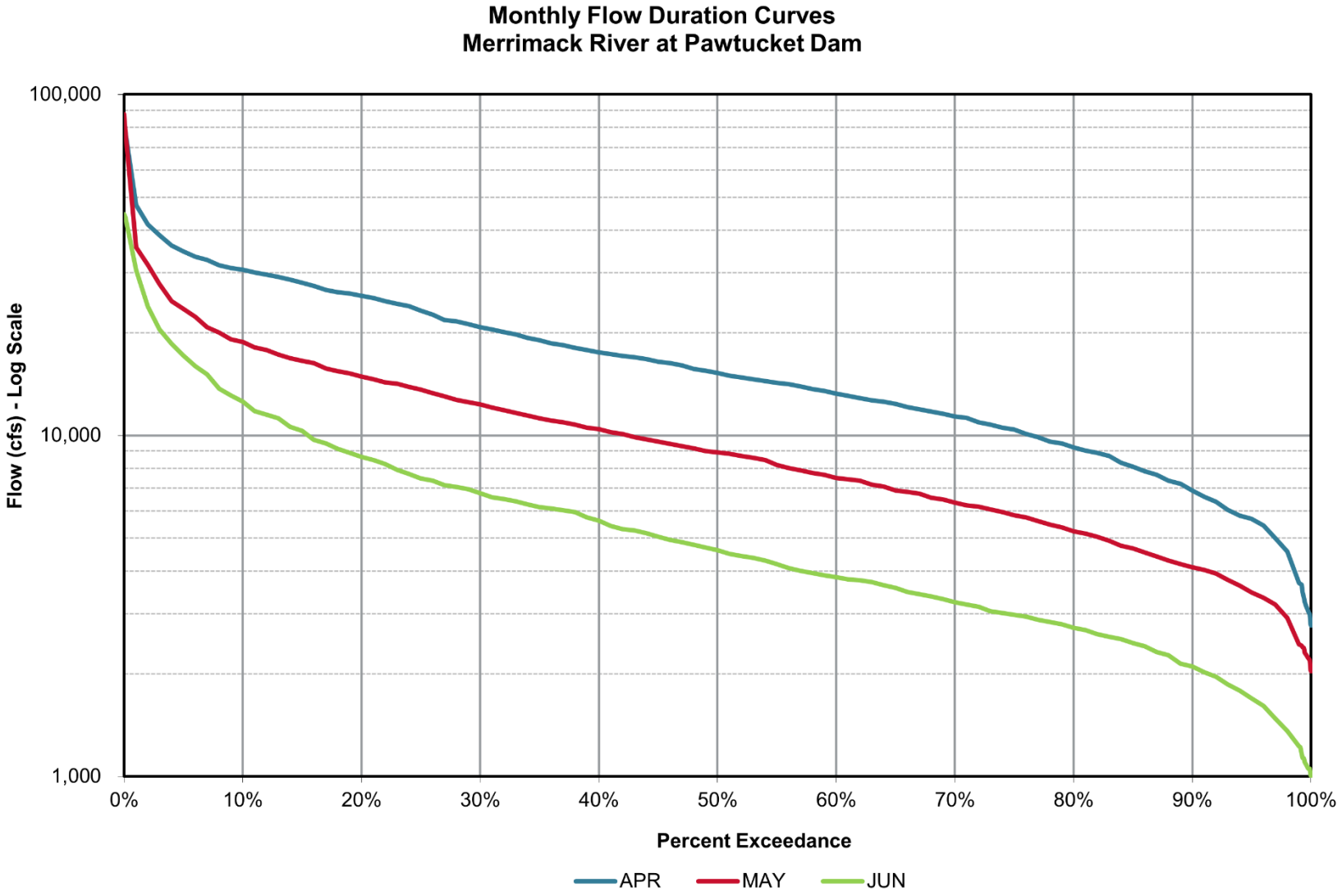


Figure B.2-3. Monthly Flow Duration Durves at Pawtucket Dam (July – September)

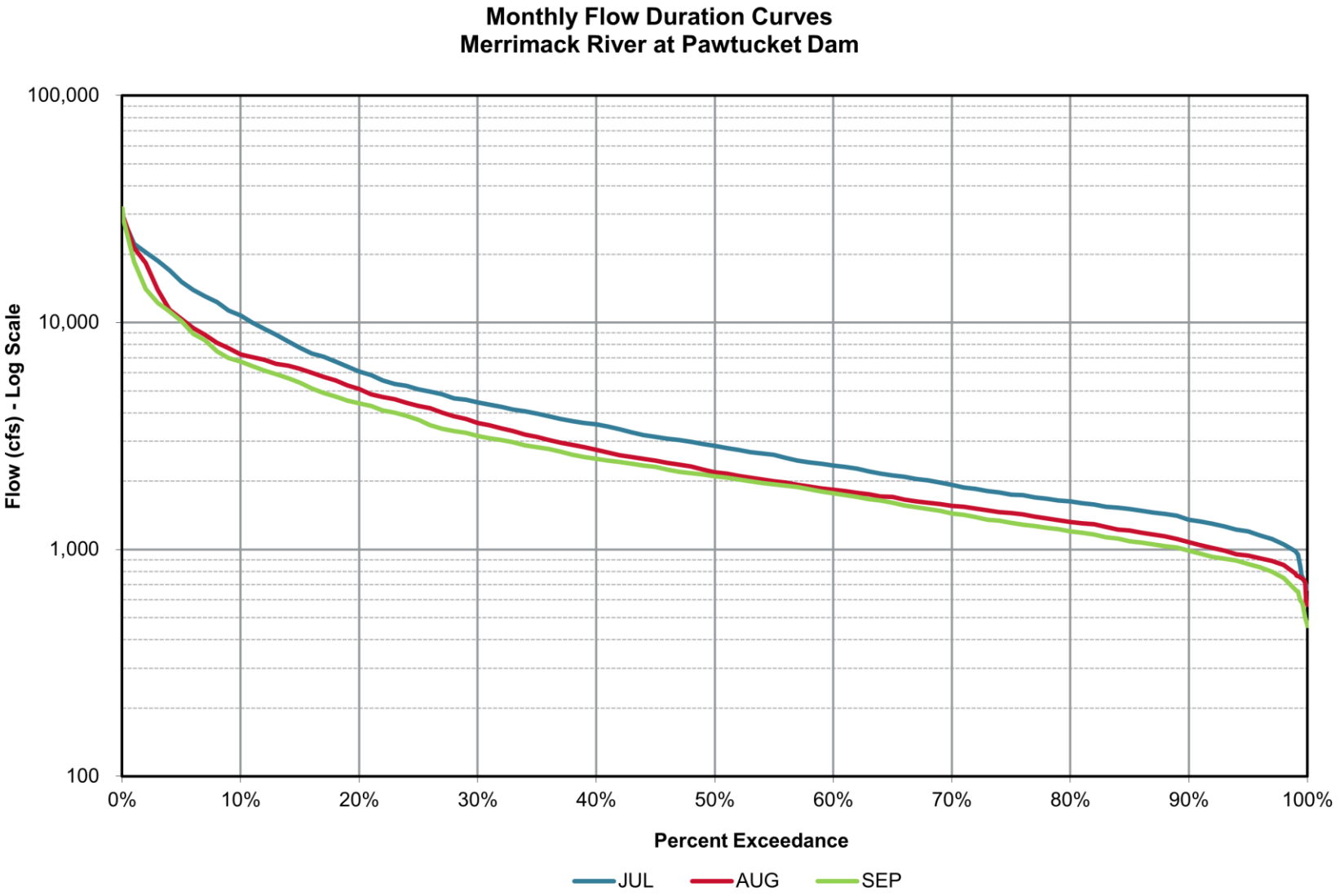
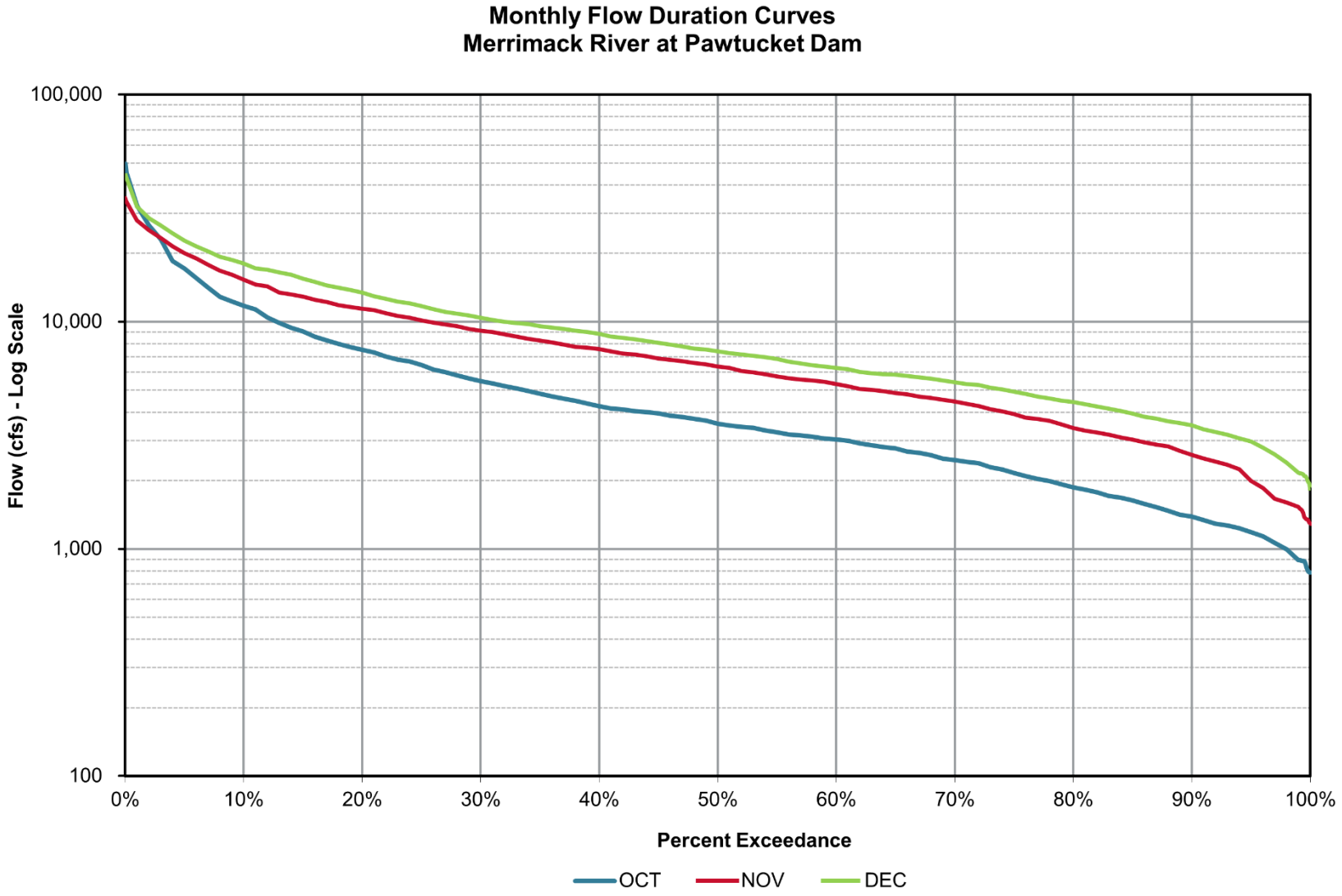


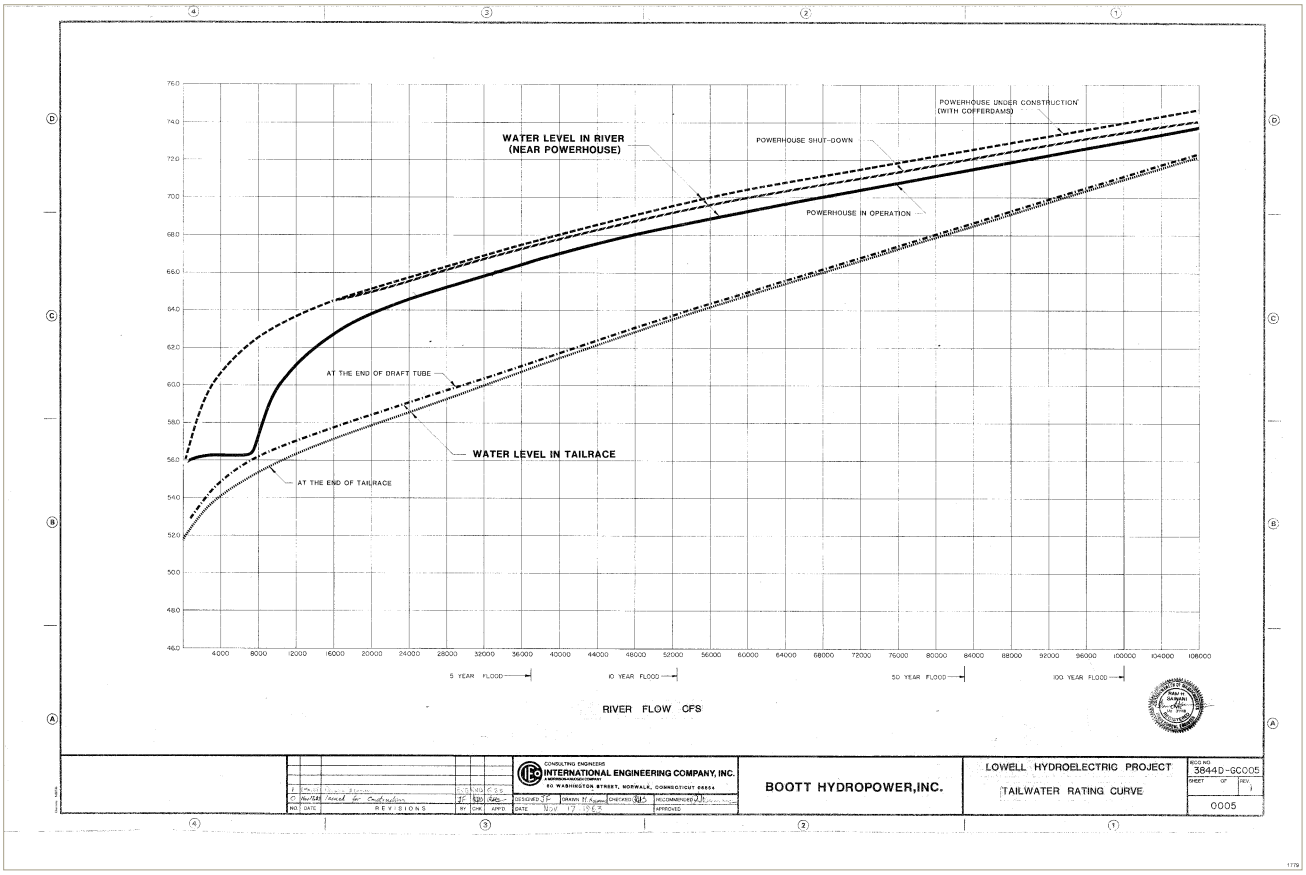
Figure B.2-4. Monthly Flow Duration Durves at Pawtucket Dam (October – December)



B.2.7 Tailwater Rating Curve

The tailwater rating curve for the E. L. Field Powerhouse is presented in Figure B.2-5. Tailwater rating curves are not necessary for the operation of the power stations and, therefore, have not been developed.

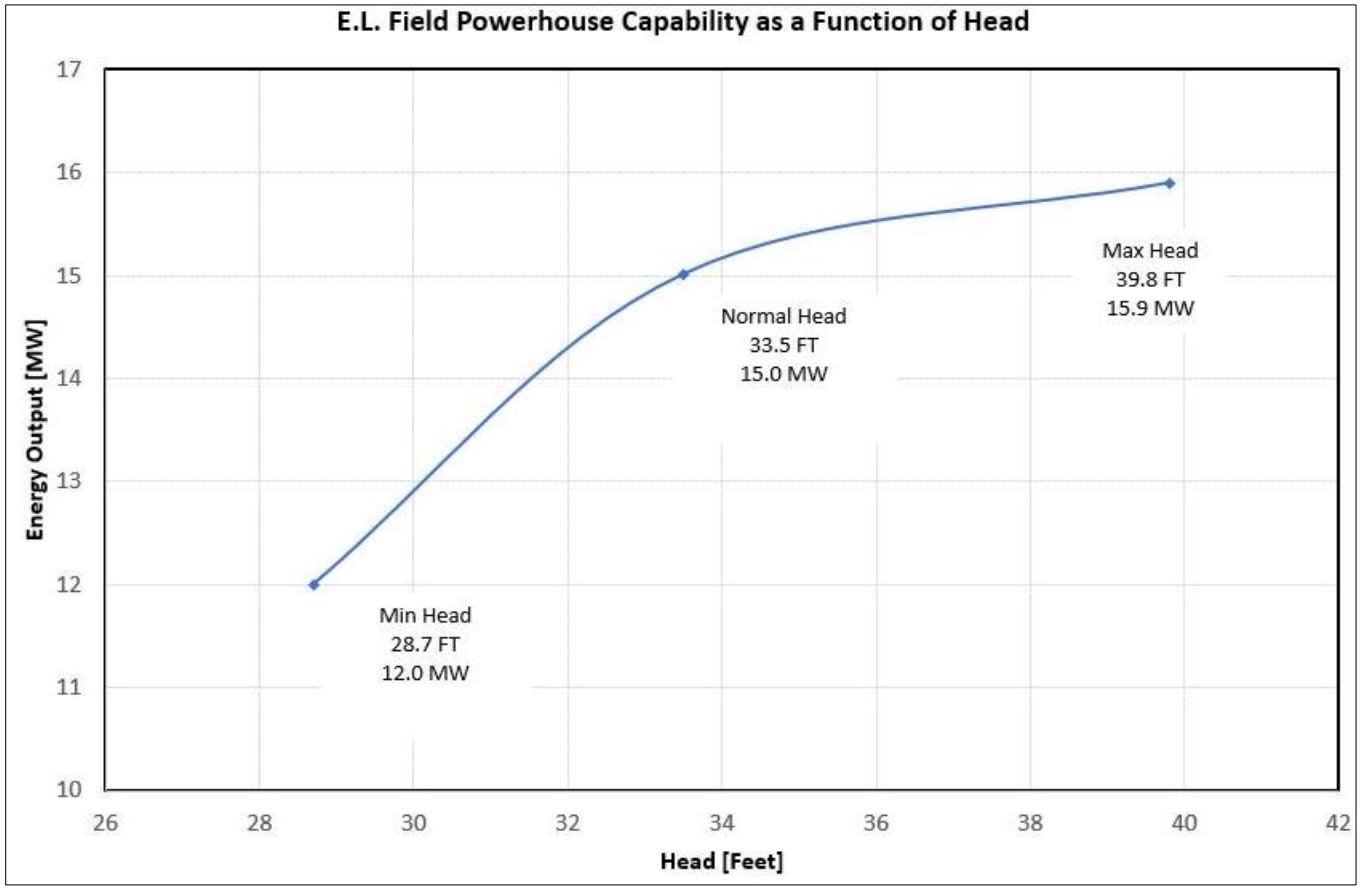
Figure B.2-5. Tailwater Rating Curve



B.2.8 Powerplant Capacity versus Head

Curves indicating powerplant capability versus head for the E.L. Field Powerhouse are presented below. Curves indicating powerplant capability versus head are not necessary for the operation of the power stations and, therefore, have not been developed.

Figure B.2-6. Powerplant Capacity versus Head



B.3 Statement of Power Utilization (18 C.F.R. §4.51(c)(3))

Boott proposes to continue to operate the Project in a ROR mode while maintaining reservoir elevations pursuant to the new license. Power generated at the Project is sold to meet the demands of the regional grid.

A 13.8-kilovolt (kV) submarine cable in the canal beds carries electricity generated at the Project approximately 1.3 miles through the canal system in the City of Lowell and an additional 0.5 miles along the Concord River to National Grid's Perry Street substation. From the Perry Street substation Project output is delivered to the regional utility grid at 115 kV.

A single-line diagram for the Project and its interconnection to the grid are provided in Volume III of this Amended FLA and filed as Critical Energy Infrastructure Information (CEII).

B.4 Future Development (18 C.F.R. §4.51(c)(4))

Boott is not proposing any new Project facilities or modifications to Project operations currently. However, as economic conditions continue to change, Boott periodically performs evaluations of Project facilities for potential upgrades and will continue to do so in the future.

B.5 References

Boott Hydropower, LLC (Boott). 2017. Application for Amendment of License. Andover, MA.

Cleantech Analytics, LLC. 2017. Certification Application to the Low Impact Hydro Institute, Lowell Hydroelectric Facility. July 26, 2017.

Federal Energy Regulatory Commission (FERC). 2015. Order Approving Amended Crest Gate System Operation Plan. Issued March 30, 2015.

Massachusetts Executive Office of Energy and Environmental Affairs (MEOEEA). 2002. Merrimack River A Comprehensive Watershed Assessment Report 2001. [Online] URL: http://www.mass.gov/eea/docs/eea/water/assess-rpt-merrimack-2000.pdf (October 1, 2020).

U.S. Geological Survey (USGS). 2018. National Water Information System: Web Interface. [Online] URL: https://waterdata.usgs.gov/ma/nwis/uv/?site_no=01100000&PARAmeter_cd=00065,00060 (Accessed March 23, 2018).

Exhibit C Construction History (18 C.F.R. §4.51(d))

C.1 Introduction

Because this Application is not for an initial license, a "tabulated chronology of construction for the existing project structures" is not required under Section 4.51(d)(1) of the Commission's regulations.

By way of overview, the site of the Lowell Project was historically used for hydromechanical and hydroelectric power for various mill operations. Much of the Project's civil works were constructed during the 19th and early 20th centuries and existed prior to initial Project licensing. In 1796, construction of the Pawtucket Canal was complete. The Pawtucket Canal had to be deepened, and its locks rebuilt or repaired several times during its first decade of operation. By 1821, three single locks were constructed along the canal, the Guard Locks, Swamp Locks, and a flight of three locks in a row known as the Lower Locks. By 1836 the canal system comprised a two-level system, with the Western, Merrimack, and Hamilton canals, all of which took their water from above Swamp Lock Dam, comprising the upper portion of the system, and the Lower Pawtucket and Eastern Canals, fed from below Swamp Locks Dam, comprising the lower portions. The second great phase of construction was completed by 1848 with construction of the Northern Canal and the Pawtucket Gatehouse.

Prior to the 1983 FERC license for the hydropower facility, three of the power stations were in operation and continue to be proposed in this new license. The Bridge Street Power Station was constructed in 1910. The Hamilton Power Station was constructed in 1918. The John Street Power Station was constructed in 1919. On April 13, 1983, FERC issued an original license for the Lowell Hydroelectric Project in accordance with the FERC's delegated authority under the Federal Power Act, including these three power stations. Construction of new Project features, including the E.L. Field Powerhouse, Hydro Locks and fishway facilities, were initiated in 1983 and the Project was commissioned and placed into service on November 21, 1985.

Since the license was transferred to Boott in 1983[4], Boott has engaged in a series of operations and maintenance and life extension activities to maintain the reliability of the Project.

C.2 Project Schedule of New Development

Boott does not propose any new development as part of this Application. Accordingly, Section 4.51(d)(2) of the Commission's regulations does not require a proposed schedule for post-relicensing construction.

[4] Order Approving Transfer of License, 23 FERC ¶ 62,043 (1983)

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Exhibit D Costs and Financing (18 C.F.R. §4.51(e))

D.1 Original Cost of Existing Unlicensed Facilities

Per 18 C.F.R. §4.51(e)(1), this section is only applicable to initial license applications, and thus, not applicable to the Lowell Hydroelectric Project.

D.2 Project Takeover Cost Pursuant to Section 14 of the FPA

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

D.2.1 Fair Market Value

Fair market value is not defined in the FPA or its implementing regulations. The fair market value of the Project depends on prevailing power values and license conditions, both of which are currently subject to change. The best approximation of fair value is likely to be the cost to construct and operate a comparable power generating facility. Because of the high capital costs involved with constructing new facilities and the increase in fuel costs associated with operating such new facilities (assuming a fossil-fueled replacement), the fair value would be considerably higher than the net investment amount.

The fair market value of the Project is currently estimated at $4,261,428.69 If a takeover were to be proposed, the Licensee would calculate fair value based on then-current conditions.

D.2.2 Net Investment

The FPA defines “net investment” as the original cost, plus additions, minus the sum of the following items (to the extent that such items have been accumulated during the period of the license from earnings in excess of a fair return on such investment): (a) unappropriated surplus; (b) aggregate credit balances of current depreciated accounts; and (c) aggregate appropriations of surplus or income held in amortization, sinking fund, or similar reserves.

The Licensee’s current net investment in the Project is approximately $28,870,669.

D.2.3 Severance Damages

Severance damages are determined either by the cost of replacing (retiring) equipment that is “dependent for its usefulness upon the continuance of the License” (Section 14, FPA), or the cost of obtaining an amount of power equivalent to that generated by the Project from the least expensive alternative source, plus the capital cost of constructing any facilities that would be needed to transmit the power to the grid, minus the cost savings that would be realized by not operating the Project. These values would need to be calculated based on power values and license conditions at the time of Project takeover.

D.3 Estimated Cost of New Development

D.3.1 Land and Water Rights

The Licensee currently holds all land and water rights necessary to construct, operate and maintain the Project, and is not proposing expansion of its land or water rights as a consequence of this license application.

D.3.2 Cost of New Facilities

The Licensee is not proposing any capacity-related developments at the Project. The Licensee proposes to install upstream and downstream fish passage measures at the Project following issuance of the new license. The cost to construct and maintain these facilities are provided in Exhibit E – Section E.8.

D.4 Estimated Average Annual Cost of the Project

This section describes the annual costs of the Project as proposed. The Licensee’s estimated annual average cost of the total Project is approximately $36,921,000. This estimate includes costs associated with existing and projected project operations and maintenance, as well as property and real estate taxes, but excludes income taxes, depreciation, and costs of financing.

D.4.1 Capital Costs

Actual capital costs are based on a combination of funding mechanisms that includes stock issues, equity, debt issues, revolving credit lines, and cash from operations. Boott does not have any capital costs.

D.4.2 Taxes

Property taxes for the 2019 fiscal year were approximately $713,000. Taxes for the Project are incorporated into costs of the Licensee’s consolidated business and are not separated out for the Project.

D.4.3 Depreciation and Amortization

The annualized composite rate of depreciation for the Project is approximately 6.19 percent.

D.4.4 Operation and Maintenance Expenses

The estimated annual operation and maintenance expenses for the Project are approximately $3,501,000 including corporate support costs but excludes property and real estate taxes.

D.5 Estimated Annual Value of Project Power

The Licensee sells all electricity generated at the Project into the regional grid as wholesale energy in the ISO-NE market. The projected future average annual gross energy production for the Project is 86,000 MWh. The estimated annual value of Project power is approximately $8,542,000 based on the wholesale ATC price.

D.6 Sources and Extent of Financing

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

D.7 Cost to Develop the License Application

The approximate cost to prepare the application for new license for the Project was approximately $1,900,000.

D.8 On-Peak and Off-Peak Values of Project Power

The Lowell Hydroelectric project operates in ROR mode. As per 18 C.F.R. §4.51(e)(8), this section is not applicable to hydroelectric projects operating in run of river mode.

D.9 Estimated Average Annual Increase or Decrease in Generation

Boott proposes to release a minimum flow of 100 cfs or inflow, whichever is less, to the bypass reach below the Project dam during the period outside of fish passage season (typically July 15 to April 30). The minimum flow release will result in an estimated loss of approximately 1,100 MWh of generation annually. Boott does not propose any change to the existing fish ladder and bypass reach flow of 500 cfs currently released during the fish passage season.

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Exhibit F Project Description (18 C.F.R. §4.51(g))

F.1 Design Drawings

The General Design Drawings showing overall plan views, elevations, and sections of the principal Project works are described in Table F.1-1.

In accordance with FERC's regulations and guidelines,[5] Boott is requesting that the General Design Drawings for the Lowell Hydroelectric Project be treated as containing Controlled Unclassified Information (CUI) and Critical Energy Infrastructure Information (CEII). This request for privileged treatment is being made to the Commission in accordance with the Final Rule (Order No. 630-A) issued by the Commission on July 23, 2003 (revised August 8, 2003).

Therefore, in conjunction with filing this License Application, the Exhibit F General Design Drawings listed in Table F.1-1 are being filed with the Federal Energy Regulatory Commission ("FERC or "Commission") in Volume III of this application as CUI/CEII.

Table F.1-1. Lowell Hydroelectric Project Exhibit F Project Boundary Drawings

Exhibit No.	Drawing Title
F-1	Key Plan
F-2	Canal and River Plan
F-3	Canal and River Plan
F-4	Canal and River Plan
F-5	Powerhouse and Tailrace Detailed Layout
F-6	Powerhouse Longitudinal Section
F-7	Powerhouse Upstream Downstream Elevations
F-8	Powerhouse Fish Passage
F-9	Powerhouse Floor Plans and Sections
F-10	Powerhouse Trashrack Guides Plan Section Details
F-11	Powerhouse Trashrack Guides Plan Section Details
F-12	Powerhouse and Tailrace Layout Plan

[5] "Designation of Incoming Dam Safety Documents" https://www.ferc.gov/enforcement-legal/ceii/designation-incoming-dam-safety-documents

Exhibit No.	Drawing Title
F-13	Surge Gate Plan and Sections
F-14	Surge Gate Plan and Sections
F-15	Control Structure and Lock General Layout
F-16	Northern Canal Waste Gatehouse Weir Plan
F-17	Northern Canal Waste Gatehouse Weir Plan and Sections
F-18	Northern Canal Waste Gatehouse Weir Plan and Sections
F-19	Northern Canal Waste Gatehouse Weir Plan and Sections
F-20	Pawtucket Dam Plan
F-21	Fish Ladder General Layout Plan
F-22	Fish Ladder Reinforcing Plan and Sections
F-23	Fish Ladder Sections
F-24	Fish Ladder Sections
F-25	Northern Canal Gatehouse Plans Sections Elevations
F-26	Old Guard Locks
F-27	River Sections
F-28	River Sections
F-29	River Sections
F-30	Canal Sections
F-31	Canal and River Plan
F-32	Canal and River Plan
F-33	Canal and River Plan
F-34	Canal and River Plan
F-35	Bridge Street Power Station Plan
F-36	Bridge Street Power Station Sections
F-37	Bridge Street Power Station Sections
F-38	Bridge Street Power Station Sections
F-39	Hamilton Power Station Plan
F-40	Hamilton Power Station Sections
F-41	Hamilton Power Station Sections
F-42	John Street Power Station Plan
F-43	John Street Power Station Sections
F-44	John Street Power Station Sections
F-45	John Street Power Station Sections

Exhibit No.	Drawing Title
F-46	Hamilton Gatehouse Plan Sections
F-47	Moody Street Feeder Gatehouse Plan and Sections
F-48	Moody Street Feeder Gatehouse Sections
F-49	Lawrence Dam Tremont Wasteway Hall St. Dam Plan and Sections
F-50	Lawrence Dam Tremont Wasteway Hall St. Dam Sections
F-51	Lower Locks Dam Swamp Lock Dam Plan and Sections
F-52	Lower Locks Siphons Plan
F-53	Lower Locks Siphons Sections
F-54	Lower Locks Siphons Sections
F-55	Rolling Dam Merrimack Dam Boott Dam Plan and Sections
F-56	Massachusetts Wasteway Plan
F-57	Massachusetts Wasteway Sections
F-58	Canal Sections
F-59	Canal Sections

F.2 Supporting Design Report

Pursuant to 18 C.F.R. §4.41(g)(3) and (4), Pursuant to 18 CFR §4.41(g)(3), an applicant for a new license is required to file with the Commission two copies of a Supporting Design Report (SDR) when the applicant files a license application. An SDR summarizes the studies that have been performed to date and the assumptions that have been made related to the development of the existing Project. The information contained within the SDR demonstrates that the existing structures are safe and adequate to fulfill their stated functions. In accordance with 18 CFR Part 388, Boott is requesting that the SDR for the Project be given privileged treatment because the drawings contain CUI/CEII material.

Boott's Final License Application filed April 30, 2021, included the first SDR. On April 19, 2022, the Commission requested additional information for the SDR to include stability and stress analyses for all major structures and critical abutment slopes under all probable loading conditions as well as the spillway and tailwater rating curves for applicable structures. Boott complied on October 17, 2022, with a supplemental SDR[6]. On July 14, 2023, Boott filed an updated supplemental SDR[7] to further detail information regarding Project facilities.

[6] Accession # 20221017-5139

[7] Accession # 20230714-5209

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Exhibit G Project Maps (18 C.F.R. §4.51(h))

G.1 Project Boundary Maps

The Project boundary Maps for the Lowell Hydroelectric Project were prepared in accordance with the requirements of 18 C.F.R. §§ 4.39, 4.41(h), and 4.51(h) and show the Project vicinity, location, and boundary to provide an understanding of the Project's location. They are presented after this exhibit. The electronic files associated with the Project boundary Map are being efiled with the Commission concurrently as shapefiles with their associated metadata.

The preparation of this boundary map in support of obtaining a new license for the Project has provided Boott the opportunity to make corrections and modifications consistent with the Project's operations. Boott is proposing to remove approximately 480 acres of the Project impoundment, or about 7.4 miles from the upper limit of the current Project boundary. This removal more accurately follows the 92.2 NGVD 29 contour located at Cromwell's Falls in Litchfield and Merrimack, New Hampshire. This decision is supported by LiDAR (light detection and ranging) data downloaded from the New Hampshire Statewide GIS Clearinghouse GRANIT LiDAR Distribution Site, as well as aerial imagery indicating a hydraulic change in the Merrimack River. Accordingly, Boott is proposing to remove those lands from the Project boundary as they are not needed for Project purposes.

Boott possesses the property and/or easement rights associated with all minor corrections and modifications, as well as all areas associated within the defined Project Boundary.

Table G.1-1. Lowell Hydroelectric Project Exhibit G Project Boundary Drawings

Exhibit No.	FERC Drawing No.
G-1	Project Boundary Map
G-2	Project Boundary Map
G-3	Project Boundary Map
G-4	Project Boundary Map
G-5	Project Boundary Map
G-6	Project Boundary Map

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Exhibit H Ability to Operate (18 C.F.R. §5.18(c))

H.1 Licensee's Ability to Provide Efficient and Reliable Electric Service (18 C.F.R. §5.18(c)(1)(i)(A))

H.1.1 Increase in Capacity or Generation

As discussed in Exhibit B, Boott currently has no plans to increase the capacity or generation of the Project. The Licensee expects to maintain the high degree of process and controls to maintain the efficient use of the water supply to maximize the generation output and provide a reliable and environmentally sound source of generation.

H.1.2 Coordination of Operation with Upstream and Downstream Projects

As a ROR facility and given the distance between the upstream and downstream projects, Boott does not routinely coordinate the operation of the Project with other projects located either upstream or downstream of the Project.

H.1.3 Coordination of Operation with Electrical Systems to Minimize Cost of Production

Boott does not coordinate the operation of the Project with other projects or electric systems in order to minimize the cost of production.

H.2 Need for Project Power (18 C.F.R. §5.18(c)(1)(i)(B))

H.2.1 Cost and Availability of Alternative Sources of Power

The Project's generating facilities provide low-cost, emissions-free, renewable power for the benefit of New England. This is an increasingly important fact in New England where all six New England states have enacted legislation to reduce the dependence on fossil fired generation through the introduction of Renewable Portfolio Standards (RPS), or similar legislation, that encourages and requires the use of renewable power sources in the state's total resource output.

If Boott is not granted a new license, the replacement of energy and capacity provided by the Project would be met through other sources, likely to be fossil-fired generating units, whose fuel and other variable costs would be significantly higher than those of the Project. The equivalent amount of power would be provided through the Independent System Operator (ISO) and the costs are based on market pricing. Therefore, it is

difficult for the Licensee to speculate about the cost and availability of such alternative sources of power since the price and source can vary hourly.

H.2.2 Increase in Fuel, Capital, and Other Costs to Purchase or Generate Replacement Power

If Boott is not granted a new license, this Project would cease to provide clean and renewable energy. Costs to the market of replacing services that the Project provides would include reduced efficiency of other generation sources, such as coal, gas-fired and diesel generation, as they would need to modify operations to meet demand. Replacement of the Project would also likely result in additional carbon emissions within Massachusetts and/or the Northeast.

H.2.3 Effect of Alternative Power Sources on Licensee’s Customers, Operating and Load Characteristics, and Communities Served

H.2.3.1 Effects on Licensee's Customers

This section is not relevant as the Licensee does not sell its electricity directly to customers. However, as a hydropower facility, the Project is an important source of renewable electricity. Alternative sources of power would need to be used to generate electricity, many of which would most likely be sourced by fossil fuel generation such as coal, gas-fired and diesel generation. Energy production costs, environmental costs, and construction costs would be higher than the utilization of hydropower used by the Project. None of these increased costs would be beneficial to a consumer base.

H.2.3.2 Effects on Operating and Load Characteristics

The Licensee is an independent power producer and, as such, does not maintain a separate transmission system which could be affected by replacement or alternative power sources.

H.2.3.3 Effect on Communities Served by the Project

Because the Licensee cannot predict with any certainty the actual type or location of a potential alternative facility providing replacement power, Boott cannot specifically discuss potential effects on any particular community.

H.3 Need, Reasonable Cost, and Availability of Alternative Sources of Power (18 C.F.R. §5.18(c)(1)(i)(C))

H.3.1 Average Annual Cost of Power

The estimated annual costs for the Lowell Project are presented in Table H.3-1. The average annual cost of the power produced by the Project includes capital costs, operating costs, and costs associated with Project relicensing, including the proposed recreation enhancements. The Licensee has performed an analysis of the costs of producing Project power. The total average annual cost of power produced by the Project is approximately $2,471,000 based on the Project's average annual generation of 83,400 MWh of energy, a license term of 50 years and a discount rate of 10%.

Table H.3-1. Lowell Project Current Average Annual Costs

	Capital Cost	Annual Cost	Levelized Cost
Cost of capital (debt and equity)	$0	$0	$0
Annual operations and maintenance	$0	$222,686	$202,442
Annual insurance, taxes, and administrative costs	$0	$999,666	$908,787
Cost of Relicensing	$1,900,000	$0	$148,256
Downstream fish protection	$5,200,000	$10,000	$302,573
Upstream fish passage	$2,600,000	$10,000	$186,849
Decommission fish lift	$75,000	$0	$4,693
Existing fish ladder and weir improvements	$100,000	$5,000	$11,701
Historic Properties Management Plan	$75,000	$5,000	$9,619
Recreation Plan	$50,000	$10,000	$12,422
Total	$10,000,000	$1,262,352	$1,787,342

H.3.2 Projected Resources to Meet Licensee's Capacity and Energy Requirements over the Short and Long Term

Boott is an independent electric generator; as such, this section is not applicable.

H.4 Use of Power for Applicant-owned Industrial Facility (18 C.F.R. §5.18(c)(1)(i)(D))

Boott does not own any industrial facilities; therefore, this section is not applicable.

H.5 Native American Tribe as Applicant (C.F.R. §5.18(c)(1)(i)(E))

Boott is not a Native American tribe; therefore, this section is not applicable.

H.6 Impacts of Receiving or not Receiving a License on Licensee's Operations of the Transmission Facility (18§5.18(c)(1)(i)(F))

The Licensee is an independent power producer and, as such, does not maintain a separate transmission system that could be affected by power flow redistribution. A one-line diagram for the Project is provided in Volume III of the Final License Application filed as Controlled Unclassified Information (CUI)/Critical Energy Infrastructure Information (CEII).

H.7 Modifications to Project Facilities and Consistency with Comprehensive Plans (18 C.F.R. §5.18(c)(1)(i)(G) and (H))

Section 10(a)(1) and (2) of the Federal Power Act (FPA) requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by a project. The Commission's Scoping Document 2 (SD2) identified twenty-eight comprehensive plans that are potentially relevant to the Project. On December 19, 2018, the National Park Service filed five additional comprehensive plans, and by letter dated March 20, 2019, the Commission accepted four of the five plans. The Licensee has reviewed the Commission's list of comprehensive plans, which are listed below. For the reasons noted in this application, Boott has determined that the continued operation of the Project, as proposed in this Amended FLA, is consistent with these plans.

1. Atlantic States Marine Fisheries Commission. 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic sturgeon (Acipenser oxyrhynchus oxyrhynchus). (Report No. 31). July 1998.
2. Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.
3. Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (Anguilla rostrata). (Report No. 36). April 2000.

4. Atlantic States Marine Fisheries Commission. 2000. Technical Addendum 1 to Amendment 1 of the Interstate Fishery Management Plan for shad and river herring. February 9, 2000.
5. Atlantic States Marine Fisheries Commission. 2008. Amendment 2 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2008.
6. Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.
7. Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.
8. Atlantic States Marine Fisheries Commission. 2013. Amendment 3 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. August 2013.
9. Atlantic States Marine Fisheries Commission. 2014. Amendment 4 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2014.
10. Massachusetts Department of Environmental Management. Commonwealth connections: A greenway vision for Massachusetts. Boston, Massachusetts.
11. Massachusetts Department of Fish and Game. 2006. Comprehensive wildlife conservation strategy. West Boylston, Massachusetts. September 2006.
12. Massachusetts Executive Office of Energy and Environmental Affairs. Statewide Comprehensive Outdoor Recreation Plan (SCORP): Massachusetts Outdoor 2006. Boston, Massachusetts.
13. Merrimack River Policy and Technical Committees. 1990. Strategic plan for the restoration of Atlantic salmon to the Merrimack River, 1990 through 2004. Concord, New Hampshire. April 1990.
14. National Marine Fisheries Service. 1998. Final Amendment #11 to the Northeast Multispecies Fishery Management Plan; Amendment #9 to the Atlantic sea scallop Fishery Management Plan; Amendment #1 to the monkfish Fishery Management Plan; Amendment #1 to the Atlantic salmon Fishery Management Plan; and Components of the Proposed Atlantic herring Fishery Management Plan for Essential Fish Habitat. Volume 1. October 7, 1998.
15. National Marine Fisheries Service. 1998. Final Recovery Plan for the shortnose sturgeon (Acipenser brevirostrum). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. December 1998.
16. National Park Service. 1981. Lowell National Historical Park General Management Plan. Lowell, Massachusetts.
17. National Park Service. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.
18. National Park Service. 2002. General Management Plan Addendum for Lowell National Historical Park. Lowell, Massachusetts.

19. National Park Service. 1980. Details of the Preservation Plan. Lowell National Historical Park. Lowell, Massachusetts.

20. National Park Service. 1990. Preservation Plan Amendment. Lowell National Historical Park. Lowell, Massachusetts.

21. New Hampshire Office of State Planning. 1977. Wild, scenic, & recreational rivers for New Hampshire. Concord, New Hampshire. June 1977.

22. New Hampshire Office of State Planning. 1989. New Hampshire wetlands priority conservation plan. Concord, New Hampshire.

23. New Hampshire Office of Energy and Planning. New Hampshire SCORP: 2008-2013. Concord, New Hampshire. December 2007.

24. New Hampshire Office of State Planning. 1991. Public access plan for New Hampshire's lakes, ponds, and rivers. Concord, New Hampshire. November 1991.

25. New Hampshire Office of State Planning. 1991. Upper Merrimack River corridor plan-volume 2: management plan. Concord, New Hampshire. March 1991.

26. Policy Committee for Anadromous Fishery Management of the Merrimack River Basin. 1985. A strategic plan for the restoration of Atlantic salmon to the Merrimack River Basin, 1985 through 1999. Laconia, New Hampshire. May 1985.

27. State of New Hampshire. 1991. New Hampshire rivers management and protection program [as compiled from NH RSA Ch. 483, HB 1432-FN (1990) and HB 674-FN (1991)]. Concord, New Hampshire.

28. State of New Hampshire. 1991. New Hampshire rivers management and protection program, including rivers in the Merrimack River basin:

    (1) 1994 Contoocook and North Branch Rivers, river corridor management plan;
    (3) 1999 Piscataquog River management plan;
    (6) 2008 Lower Merrimack River corridor management plan;
    (7) 2009 Cold River watershed management plan;
    (10) 2001 Pemigewasset River corridor management plan;
    (11) 2006 Souhegan River watershed management plan; and
    (12) 2007 Upper Merrimack River management and implementation plan.

29. U.S. Fish and Wildlife Service (USFWS). n.d. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

30. USFWS. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

31. USFWS. 1989. Atlantic salmon restoration in New England: Final environmental impact statement 1989-2021. Department of the Interior, Newton Corner, Massachusetts. May 1989.

32. USFWS. 2010. A Plan for the Restoration of American Shad: Merrimack River Watershed. Concord, New Hampshire. 2010.

33. MRTC. 2021. MERRIMACK RIVER WATERSHED COMPREHENSIVE PLAN FOR DIADROMOUS FISHES. Filed with the Federal Energy Regulatory Commission.

H.8 Financial and Personnel Resources (18 C.F.R. §5.18(c)(1)(i)(I))

H.8.1 Financial Resources

Boott is dedicated to operating the Project in a safe and reliable manner to provide clean renewable electric energy to the electricity grid. As demonstrated under the existing license, Boott has the financial resources to meet the operation, maintenance, and capital requirements of the Project.

H.8.2 Personnel Resources

Operations, maintenance, environmental and license compliance, modification, technical and administrative activities required for the Project are performed and supported by employees and contractors of Boott.

H.9 Expansion of Project Lands (18 C.F.R. §5.18(c)(1)(i)(J))

At this time, Boott does not anticipate a proposed expansion of Project boundaries at the Project.

H.10 Electricity Consumption Efficiency Improvement Program (18 C.F.R. §5.18(c)(1)(i)(K))

Boott is an independent electric generator; as such, this section is not applicable.

H.11 Names and Addresses of Native American Tribes with land on Which the Project is located or Tribes that May Be Affected by the Project as Proposed (18 C.F.R. §5.18(c)(1)(i)(L))

The Project is not located on Native American lands. Boott and the Commission consulted with the following federally recognized Native American tribes that may be affected by the Project throughout the relicensing process and in support of cultural resource studies. Points of contact associated with each of these Native American Tribes are presented in the Initial Statement of this application, the associated distribution list, and below in Table H.11-1.

Table H.11-1. Tribal Contact Information

Tribe / Nation	Address
Mashpee Wampanoag Tribe	483 Great Neck Road South Mashpee, MA 02649
Wampanoag Tribe of Gay Head (Aquinnah)	20 Black Brook Road Aquinnah, MA 02535
Penobscot Nation	23 Wabanaki Way Indian Island, Maine 04468
Narragansett Indian Tribe	PO Box 268 Charlestown, RI 02813
Stockbridge Munsee Tribe of Mohican Indians	N8467 Moh He Con Nuck Road Bowler, WI 54416

H.12 Safe Management, Operation, and Maintenance of the Project (18 C.F.R. §5.18(c)(1)(ii)(B))

H.12.1 Operating During Flood Conditions

Under past and current operations, when river flows exceed the hydraulic capacity of the E.L. Field Powerhouse units (approximately 3,300 cfs per unit or 6,600 cfs for both units), excess flows up to approximately 2,000 cfs can be routed through the downtown canal system and to the canal units (as described below). Any flows in excess of these flows are passed over the Pawtucket Dam spillway.

During these high-water conditions, the crest gate control system will automatically adjust the gates to maintain the impoundment elevation no higher than 93.2 feet NGVD, or one foot above the normal pond elevation. When under automatic control, the crest gates would all be fully lowered at spillway flows of approximately 35,000 cfs. In addition, the approved crest gate operations plan requires Boott to fully lower the crest gate panels in anticipation of potential flood events. This minimizes the upstream backwater effect of the Pawtucket Dam to the extent possible.

Under very high flow conditions when the water level at the Pawtucket Dam reaches 98.0 feet NGVD 29, Boott initiates the installation of the steel stoplogs upstream of the Great Guard Gate, per the provisions of the Emergency Action Plan (EAP). These stoplogs are designed to functionally replace the historic Great Guard Gate, to prevent the potential flooding of downtown Lowell via the Pawtucket Canal.

H.12.2 Proposed Project Operation and Emergency Action Plan

Boott proposes operations of the Project very similar to current operations with no proposed modifications that would affect the EAP maintained for the Project.

H.12.3 Warning Devices for Downstream Public Safety

Boott maintains public safety measures at the Project for public safety upstream, in the vicinity of, and downstream of the Project pursuant to the Commission-approved Public Safety Plan. Warning devices for public safety include an audible alarm, visual alarm, signage in multiple locations at the Project, seasonal upstream boat barriers, and additional measures consistent with the Project's Public Safety Plan on file with the Commission.

H.12.4 Monitoring Devices

The Project is maintained by Boott in accordance with manufacturers' instructions and industry best practices and monitored as described in the Dam Safety Surveillance and Monitoring Plan (DSSMPs) that are maintained for the Project and is on file with the Commission's Division of Dam Safety and Inspections – New York Regional Office.

As described in the DSSMP for the Project, instrumentation at the Project includes water level transducers located in the impoundment, the Northern Canal and in the tailrace. Boott also regularly monitors USGS Gage No. 1100000, Merrimack River below Concord River, Lowell, MA which is located immediately downstream of the Project, as well as the National Weather Service's Advanced Hydrologic Prediction Service web page associated with this gage.[8] (Gage No. 1100000).

H.12.5 Employee Safety and Public Safety Record

The Licensee manages the Project consistent with their long-standing commitment to employee safety. This commitment begins with compliance with applicable local, state, and federal regulations regarding the safe operation of industrial and electrical facilities. As the Licensee operates the Project's generation facilities, this commitment is implemented primarily through a rigorous safety program. Detailed inspection and maintenance programs ensure employee and contractor safety relative to operating equipment and facilities. The safety program involves employee and contractor training sessions, as well as making safety information available to employees.

The Licensee places a high priority on public safety at the Project, and maintains public safety measures (signage, markers, fencing, boat barriers, etc.) consistent with plans filed with the FERC's Regional Office.

[8] https://water.weather.gov/ahps2/hydrograph.php?wfo=box&gage=lowm3

H.13 Current Operation of the Project (18 C.F.R. §5.18(c)(1)(ii)(C))

The Project has been operated in a manner consistent with the requirements of the current license. Details regarding operation and constraints of the Project are discussed in Exhibit B of this application. The Project will continue to operate in a manner consistent with the requirements of the current license until the new license is issued, after which time the Project will be operated in accordance with the requirements and conditions of the new license.

H.14 Project History (18 C.F.R. §5.18(c)(1)(ii)(D))

A summary of the history of the Project is provided in Exhibit C of this application.

H.15 Summary of Generation Lost at the Project Due to Unscheduled Outages (18 C.F.R. §5.18(c)(1)(ii)(E))

Table H.15-1 presents the unscheduled outages for the Project over a 5 year time period (2016-2021).[9] In order to maximize energy production from the facility, Boott has a consistent record of addressing outages immediately and preventative measures taken in order to prevent future occurrences.

Table H.15-1. Summary of Unscheduled Outages

Date /Time Off	Date/Time On	Duration (hrs)	Unit(s) Affected	Description
2/19/2016 12:00	2/24/2016 16:00	124:00	John St. 6	Broken head gate / winch cables
2/27/2016 10:00	4/7/2017 16:00	1 year 2 months	John St. 6	Penstock water leak
3/6/2016 12:00	3/11/2016 18:30	126:30	John St. 4	Electrical issues
3/12/2016 12:00	3/16/2016 12:00	96:00	John St. 4	Exciter issues
3/21/2016 9:45	3/22/2016 13:30	27:45	Hamilton 4	No remote gate control
4/3/2016 12:00	4/6/2016 12:00	72:00	John St. 4	Loss of gate operator control
4/9/2016 21:00	4/10/2016 12:08	15:08	John St. 5	Loss of DC / Breaker not functioning properly

[9] Boott was owned by Enel Green Power North America, Inc. (Enel) until January 2020 before becoming acquired by Central Rivers Power US, LLC. Enel did not provide any information regarding unplanned outages for 2019. On September 2, 2022, Boott notified the Commission that the Project was offline and filed an incident report on September 19, 2022. During the summer of 2024, units at E. L. Field were returned to service. Therefore, Boott considers this timeframe of 2016-2021 to provide the most accurate representation of outages during normal operations over a five year period.

Date /Time Off	Date/Time On	Duration (hrs)	Unit(s) Affected	Description
4/15/2016 14:30	4/18/2016 11:00	68:30	John St. 5	Loss of DC
4/28/2016 6:35	4/28/2016 9:18	2:43	ELF 1	Low carbon seal / loss of permissives at start up/ low headtank level
9/20/2016 19:14	9/21/2016 0:47	5:33	ELF 2	Loss of permissives
10/25/2016 13:55	10/25/2016 15:31	1:36	ELF 1	Loss of station service
10/25/2016 13:59	10/25/2016 15:16	1:17	ELF 2	Loss of station service
12/17/2016 22:28	12/18/2016 8:24	9:56	ELF 1	Gland seal pressure low
12/24/2016 4:30	12/24/2016 12:05	7:35	ELF 1	Blown fuse
12/24/2016 4:30	12/24/2016 12:07	7:37	ELF 2	Blown fuse
2/27/2017 10:00	3/3/2017 13:00	99:00	Hamilton 5	HPU pump failed
4/5/2017 12:00	7/7/2017 8:00	93 days	John St. 6	Penstock repairs
9/8/2017 10:00	10/23/2017 16:00	1086:00	Hamilton 2	Wicket gate control issues
9/10/2017 8:00	9/10/2017 10:15	2:15	ELF 1	Utility trip
1/12/2018 8:00	1/25/2018 14:00	318:00	All mill units	Canals frozen over
6/30/2018 3:30	6/30/2018 23:45	20:15	ELF 1	Burned wire on CT connection
6/30/2018 18:15	6/30/2018 23:55	5:40	ELF 2	Unit 2 taken offline to ensure Bus is deenergized in order to perform repairs on ELF Unit 1
4/7/2020 9:47	4/7/2020 9:56	0:09	ELF 1	High vibration caused by debris in unit
4/17/2020 1:22	4/17/2020 2:20	0:58	ELF 1	High vibration caused by debris in unit
5/1/2020 13:46	5/1/2020 14:33	0:47	ELF 1&2	Low seal pressure, possibly caused by low municipal water pressure.
5/15/2020 20:30	5/16/2020 7:00	10:30	ELF 1&2	Output reduced from 13.5 MW to 1.2 MW due to faulty transducer, possibly caused by thunderstorm.
6/11/2020 11:25	6/11/2020 14:50	3:25	ELF 1	Moose swimming in Northern Canal; Unit 1 shut down to facilitate rescue.

Date /Time Off	Date/Time On	Duration (hrs)	Unit(s) Affected	Description
7/2/2020 13:20	7/2/2020 13:39	0:19	ELF 1	Low water pressure during filter change on Unit 2.
7/12/2020 3:45	7/12/2020 10:24	6:39	ELF 1	High bearing temperature.
7/18/2020 20:23	7/18/2020 21:56	1:33	ELF 1	High vibration caused by debris in unit
8/11/2020 21:00	8/13/2020 15:32	42:32	ELF 2	Utility power outage, followed by station service breaker issues.
8/11/2020 21:00	9/2/2020 14:00	21 days	ELF 1	Damage to proportional valve caused by utility outage
9/13/2020 6:58	9/13/2020 10:20	3:22	ELF 2	Utility trip caused by squirrel in transformer.
9/15/2020 0:00	9/15/2020 8:55	1:36	ELF 2	Utility trip caused by "wildlife" in transformer.
10/7/2020 23:32	10/8/2020 0:45	1:13	ELF 1	Low seal pressure due to low municipal water pressure.
10/26/2020 6:24	10/26/2020 7:15	0:51	ELF 1&2	High vibration caused by debris in unit
11/20/2020 8:18	11/20/2020 13:02	4:44	ELF 2	Trash rack transducer and PLC issues
11/30/2020 18:11	11/30/2020 20:24	2:13	ELF 1&2	Utility outage caused by storm
12/4/2020 15:46	12/5/2020 5:12	13:34	ELF 1&2	Bad bus connection, possibly exacerbated by rodent.
12/5/2020 9:55	12/5/2020 10:22	0:27	ELF 2	Low turbine oil return flow, possibly related to outage on previous day.
12/17/2020 10:07	12/18/2020 12:54	13:32	ELF 2	Several outages totaling 13:32 caused by low turbine oil return flow, cold oil and possibly a bad flow switch.
12/18/2020 10:02	12/18/2020 12:54	2:52	ELF 1	Loss of flow to gland seal
1/25/2021 9:40	1/25/2021 10:20	0:40	ELF 1	Frozen trash rack transducer
2/2/2021 9:50	2/2/2021 10:11	0:21	ELF 2	Lube oil pump accidently turned off
2/26/2021 9:55	2/26/2021 10:37	0:42	ELF 1&2	GSU lockout trip over under frequency trip
3/28/2021 13:19	3/28/2021 13:25	0:06	ELF 1	High vibration caused by debris in unit

Date /Time Off	Date/Time On	Duration (hrs)	Unit(s) Affected	Description
4/1/2021 0:00	Ongoing	--	All canal units	All downtown canal units offline.
4/10/2021 0:39	4/10/2021 7:01	6:22	ELF 1	GOV PLC comms

H.16 Record of Compliance (18 C.F.R. §5.18(c)(1)(ii)(F))

Boott has continued to operate the Project in compliance with the Project license except for two violations, one relating to the operation of the Project's only FERC-approved recreational facility (E. L. Field Powerhouse Visitor Center). FERC issued a letter on December 2, 1994, stating a violation of Article 38 had occurred. In accordance with the license, the Project visitor center was to open to the public by May 30, 1993; however, the opening was delayed by design changes to the powerhouse and development of display signage. The visitor center was opened to the public on July 21, 1994. FERC did not issue any penalties related to this violation.

The other violation was issued by FERC on May 2, 2022. Boott deviated from the minimum flow requirement on August 17, 2021. Operations staff closed the North Canal surge gate in response to decreasing inflow into the Project. During this time, the Project was offline and passing flows through the North Canal surge gate. The decreased inflow caused the reservoir to drop approximately one foot in elevation—in an effort to restore reservoir levels to the Project's target elevation level, operations staff closed North Canal surge gate, which allowed the reservoir level to rise, and eventually, flow to spill over the crest gates of Pawtucket Dam. Between the time it took to restore the reservoir level and for flow to spill down the bypass reach, flows fell below the required 1,990 cfs for a period of approximately four hours. The lowest flow recorded during the deviation was 888 cfs. Throughout the deviation, a constant leakage flow of 300 cfs from the downtown canal system was being released into the bypass reach. No adverse environmental impacts were observed as a result of the deviation, nor is Boott aware of any river users being impacted. All appropriate resource agencies were notified but Boott did not receive any comments. Boott notified the Commission on August 30, 2021, providing a list of actions Boott is taking to prevent similar future occurrences. These include: 1) providing staff training to emphasize the Project's flow requirements and the cause/effect relationships of changing flows at the Project; 2) discontinuing the use of the surge gate while the Project remains offline to ensure that all inflow is passed via spill into the bypass reach and compliments the leakage flow from the downtown canal system; and 3) developing an outage-specific standard operating procedure to ensure that all staff will be trained and familiar with conditions and measures necessary to provide the required inflow when the Project is offline.

H.17 Actions that Affect the Public (18 C.F.R. §5.18(c)(1)(ii)(G))

Boott holds that past actions and future actions related to the Project will not adversely affect the public. To the contrary, Boott believes that actions by the Licensee are favorable to the public in that the Project provides clean, renewable electric energy as well as other non-power benefits associated with the Project.

H.18 Ownership and Operating Expenses Affected by Transfer of License (18 C.F.R. §5.18(c)(1)(ii)(H))

There is presently no proposal or application to transfer the Project license from the existing Licensee; therefore, this section is not applicable.

H.19 Annual Fees Under Part I of the Federal Power Act (FPA) (18 C.F.R. §5.18(c)(1)(ii)(I))

Given that there are no federal or Native American lands associated with the Project, Boott does not pay annual fees under Part 1 of the FPA.