



# Lowell Hydroelectric Project (FERC No. 2790)

Initial Study Report Meeting

# Project Overview

- Boott Hydropower, LLC (Boott) is the Licensee and operator of the 20 megawatt (MW) Lowell Hydroelectric Project (Project or Lowell Project).
- The Project is located along the Merrimack River in Middlesex County, Massachusetts and in Hillsborough County, New Hampshire.
- The existing license for the Project was issued by the Federal Energy Regulatory Commission's (FERC or Commission) with an effective date of May 1, 1973, for a term of 50 years. The existing license expires on April 30, 2023.



# Initial Study Report Meeting Objectives

- Boott is pursuing a new license for the Project from the Federal Energy Regulatory Commission (FERC or Commission) in accordance with FERC's Integrated Licensing Process (ILP) at 18 CFR Part 5.
- Pursuant to the ILP, Boott filed the Initial Study Report (ISR) on February 25, 2020.
  - The ISR describes Boott's overall progress in implementing the study plan and schedule approved in FERC's March 13, 2019 Study Plan Determination (SPD), the types of data collected to date, and any variances from the study plan and schedule.
- The Commission's regulations at 18 C.F.R. § 5.15(c) requires Boott to hold an ISR Meeting within 15 days of filing the ISR.
- The purpose of this ISR Meeting is to discuss with stakeholders the available study results and any proposals to modify the study plans in light of the progress of studies and data collected.

# Meeting Agenda

Wednesday March 11, 2020	Schedule
Introductions and Overview	9:00 AM – 9:30 AM
Downstream American Eel Passage Assessment	9:30 AM – 10:00 AM
Juvenile Alosine Downstream Passage Assessment	10:00 AM – 10:30 AM
Upstream and Downstream Adult Alosine Passage Assessment	10:30 AM – 11:00 AM
Fish Passage Survival Study	11:00 AM – 11:30 AM
Three-Dimensional Computational Fluid Dynamics (CFD) Modeling	11:30 AM – 12:00 PM
<i>Lunch Break</i>	12:00 PM – 1:00 PM
Instream Flow Habitat Assessment and ZOP Study in the Bypassed Reach	1:00 PM – 1:30 PM
Fish Assemblage Study	1:30 PM – 2:00 PM
Recreation and Aesthetics Study	2:00 PM – 2:30 PM
Resources, Ownership, Boundaries, and Land Rights Study	2:30 PM – 3:00 PM
Water Level and Flow Effects on Historic Resources Study	3:00 PM – 3:30 PM
Operation Analysis of the Lowell Canal Study	3:30 PM – 4:00 PM
Historically Significant Waterpower Equipment Study	4:00 PM – 4:30 PM
Whitewater Boating and Access Study	4:30 PM – 5:00 PM

# Process Plan and Schedule

Major Milestones	Responsible Party	Dates
File PAD and NOI (18 CFR §5.5(d))	Boott	April 30, 2018
Issue Notice of PAD/NOI and SD1 (18 CFR §5.8(a))	FERC	June 15, 2018
File Proposed Study Plan (PSP) (18 CFR §5.11)	Boott	September 28, 2018
Study Plan Meeting(s) (18 CFR §5.11(e))	Boott	October 18 and 19, 2018
Comments on PSP (18 CFR §5.12)	Stakeholders	December 27, 2018
File Revised Study Plan (RSP) (18 CFR §5.13(a))	Boott	January 26, 2019
Comments on RSP (18 CFR §5.13(b))	Stakeholders	February 10, 2019
Issuance of Study Plan Determination (18 CFR §5.13(c))	FERC Director	March 13, 2019
Initial Study Report (18 CFR §5.15(c))	Boott	February 25, 2020
File Draft License Application (18 CFR §5.16(a))	Boott	December 1, 2020
File Updated Study Report (USR) (18 CFR §5.15(f))	Boott	February 24, 2021
File Final License Application (18 CFR §5.17)	Boott	April 30, 2021



# Studies Approved in SPD

- FERC's March 13, 2019 SPD directed Boott to conduct 13 studies:
  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. Resources, Ownership, Boundaries, and Land Rights Study
  10. Water Level and Flow Effects on Historic Resources Study
  11. Operation Analysis of the Lowell Canal Study
  12. Historically Significant Waterpower Equipment Study
  13. Whitewater Boating and Access Study

# Overall Status of Studies

- Boott initiated the approved studies in accordance with the schedule and methods described in the RSP and SPD.
- Field studies are complete for the following 3 of the 13 studies:
  - Downstream American Eel Passage Assessment
  - Juvenile Alosine Downstream Passage Assessment
  - Fish Assemblage Study
- Field studies and/or data collection have been initiated for the remaining studies.
  - In the RSP, Boott noted that studies and report preparation would be on-going at the time of the ISR (and ISR meeting). Notwithstanding this plan, Boott expects to be able to provide the majority of the study reports by the end of Q4 of 2020, with the remaining filed with the USR in Q1 of 2021.



Study Report	Anticipated Schedule	Notes
<b>Downstream American Eel Passage Assessment</b>	Q3 2020	Data collection is complete; Boott is currently compiling and analyzing the data
<b>Juvenile Alosine Downstream Passage Assessment</b>	Q3 2020	Data collection is complete; Boott is currently compiling and analyzing the data
<b>Upstream and Downstream Adult Alosine Passage Assessment</b>	Q3 2020	Data collection is scheduled for Q2 of 2020
<b>Fish Passage Survival Study</b>	Filed with the USR	Study depends on completion of other fisheries studies
<b>Three-Dimensional Computational Fluid Dynamics (CFD) Modeling</b>	Filed with the USR	Data compilation and analysis scheduled through 2020
<b>Instream Flow Habitat Assessment and ZOP Study in the Bypassed Reach</b>	Q4 or Filed with the USR	Data collection scheduled for spring 2020
<b>Fish Assemblage Study</b>	Q3 2020	Data collection is complete
<b>Recreation and Aesthetics Study</b>	Q3 2020	Recreation data collection will occur through May 2020
<b>Resources, Ownership, Boundaries, and Land Rights Study</b>	Filed with the USR	Consultation, data review, and GIS mapping, expected to occur through 2020
<b>Water Level and Flow Effects on Historic Resources Study</b>	Filed with the USR	Water level data collection expected to occur through 2020
<b>Operation Analysis of the Lowell Canal Study</b>	Filed with the USR	Collection of operations data expected to occur up to the filing of the USR
<b>Historically Significant Waterpower Equipment Study</b>	Q4 2020	Site visit with qualified historian expected to take place in Q2 of 2020
<b>Whitewater Boating and Access Study</b>	Q4 2020	Controlled flow releases expected to occur after fish passage operations end on or about July 15, 2020



# Upcoming ILP Milestones

Milestone	Responsible Party	Date
File ISR Meeting Summary	Boott	March 26, 2020
Stakeholders file disagreements with ISR Meeting Summary and/or requests for modified/new studies	FERC and stakeholders	April 10, 2020
Boott files response to any comments on the ISR Meeting Summary and/or requests for modified/new studies	Boott	May 10, 2020
FERC Director of the Office of Energy Projects makes a determination on any disputes/amendments to the approved study plan	FERC	June 9, 2020
Complete ongoing studies	Boott	March 1, 2020 – February 1, 2021

# Downstream American Eel Passage Assessment



## Downstream American Eel Passage: **Goals and Objectives**

- **Study Goal:** Determine Project impact on the outmigration of adult silver-phase American eels (*Anguilla rostrata*).
- **Specific Objectives:**
  - Quantify the movement rates and relative proportion of eels passing via various routes at the project (i.e., turbines, downstream bypass, and spill).
  - Evaluate mortality of eels passed via each potential route.

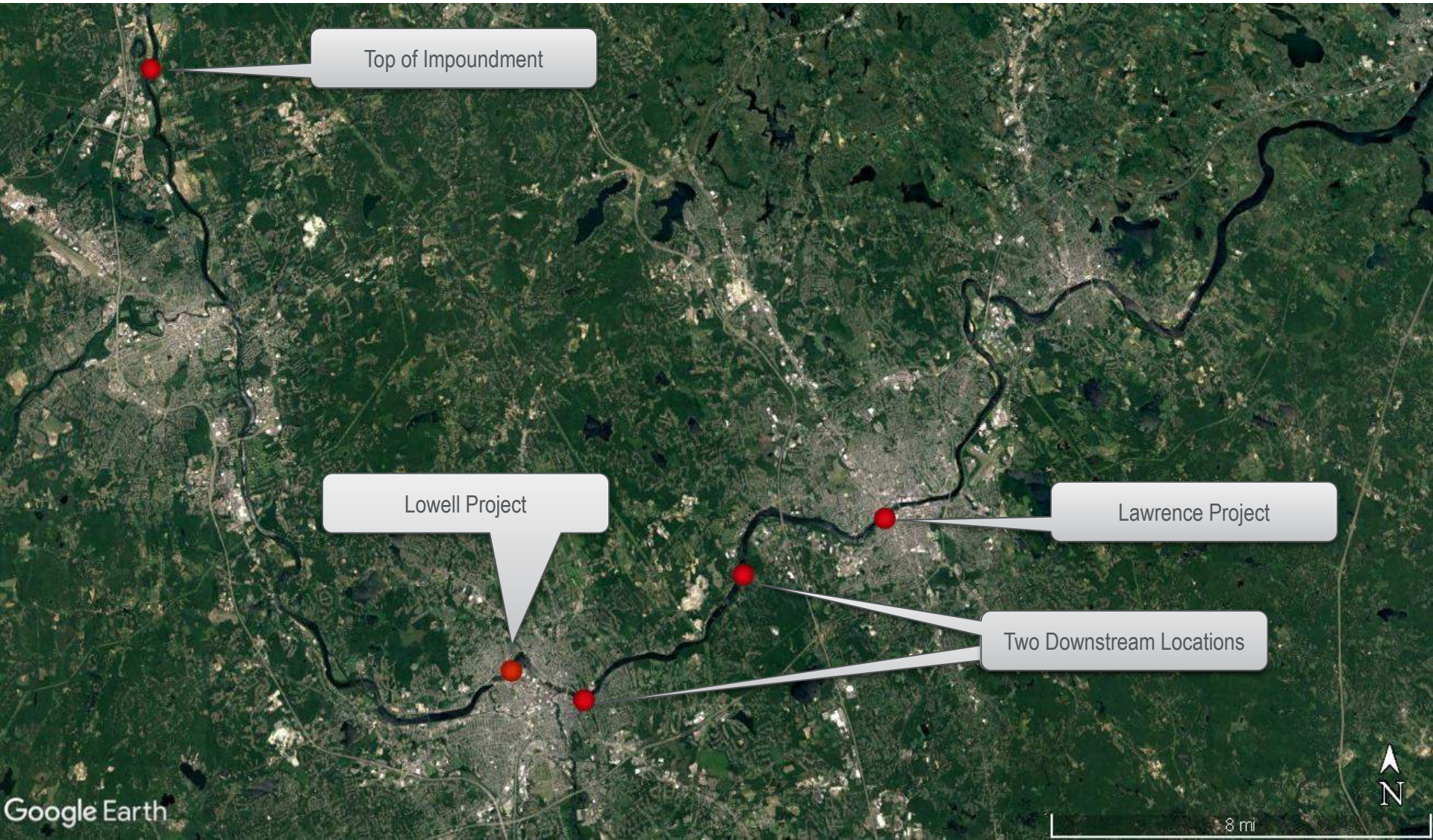




# Downstream American Eel Passage: **Receiver Locations**

- **12 Remote Monitoring Stations**

- Installed late-September / early-October, 2019





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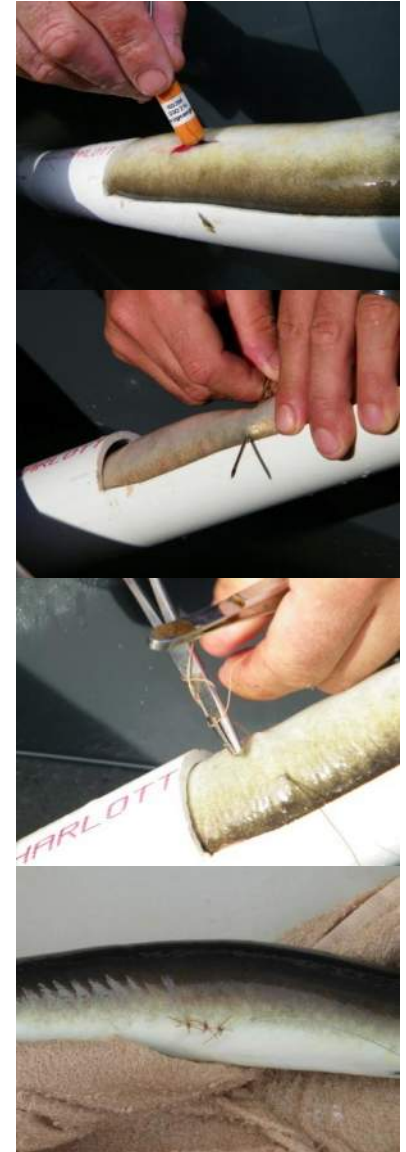
## Downstream American Eel Passage: **Test Fish Collection**

- Commercial trapper on St. Croix River, Maine
  - 60 eels transported to Kennebec River Biosciences (August 27)
    - Fish Health Inspection Report issued on September 25
    - Negative test results for suite of viral and bacterial pathogens
  - 110 eels transported to Garvins Falls (early October)



# Downstream American Eel Passage: **Tagging and Releases**

- Tagging protocol:
  - Anesthetized using diluted clove oil
  - Collect biological information – eye measurements, body length
  - Surgically tagged following standard procedures
  - Held for a 24-hr period post tagging to evaluate prior to release
- Total of 100 individuals were tagged and released
  - Five release groups of 20 individuals each
    - » October 9, 11, 16, 18, 23, 2019
  - Individuals transported by truck to release site near upper end of Project impoundment and released during evening hours
- Drift Assessment
  - A total of 10 dead eels tagged and released downstream of E.L. Field powerhouse
    - Two dead eels released in conjunction with each live eel group
    - Rate of travel and downstream extent of drift monitored to help inform estimates of passage survival



## Downstream American Eel Passage:

- The Downstream American Eel Passage Assessment was conducted in full conformance with the Commission's SPD.
- **COMPLETED:**
  - All field data collection
  - Initial processing of all raw stationary receiver files
- **TO DO:**
  - Incorporate station operations data to finalize passage route utilization
  - Identify arrival/passage times to determine transit durations and project residence time
  - Construct encounter histories to inform mark-recapture model for passage success estimates
  - Examine passage and operations data to identify covariates which may have influence on residence duration or passage success







## **Juvenile Alosine Downstream Passage Assessment**

## Juvenile Alosine Downstream Passage Assessment: **Goals and Objectives**

- **Study Goal:** To (1) conduct a field study of juvenile alewife outmigration in the Lowell impoundment, the power canal, and at the Pawtucket Dam, to determine if Project operations negatively impact juvenile alosine survival and production; and (2) determine if Project operations affect juvenile alosine outmigration survival, recruitment, and production.
- **Specific Objectives:**
  - Assess the effects of the Pawtucket Dam on the timing, orientation, passage routes, and migration rates of juvenile alewife;
  - Determine the proportion of juvenile alewife that select the Pawtucket Canal versus the E.L. Field Powerhouse, downstream bypass facility, or dam spill as a downstream passage route, under varied operational conditions; and
  - Determine if there are any delays associated with downstream movement related to either dam spill or the E.L. Field Powerhouse due to operations.

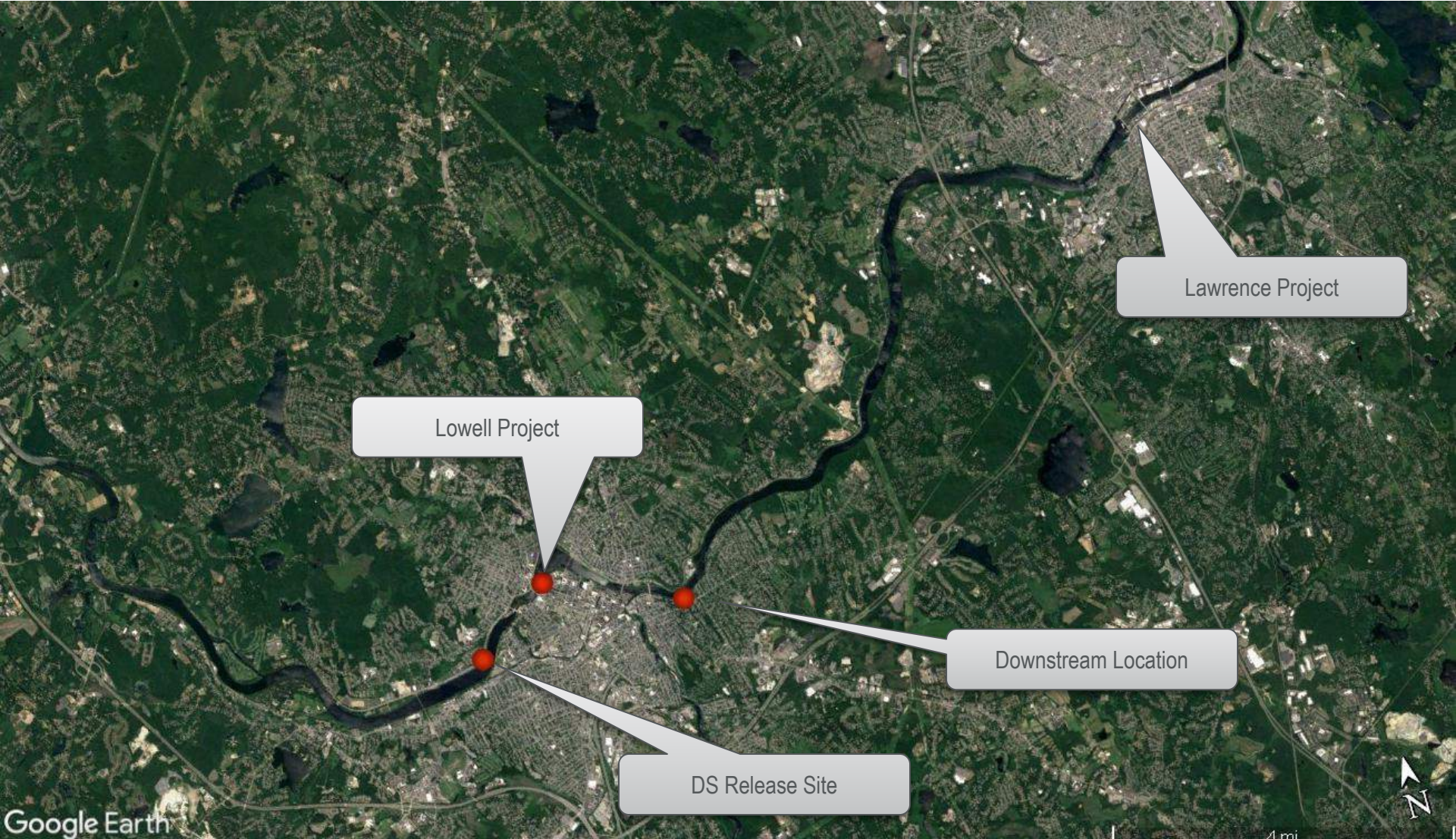




# Juvenile Alosine Downstream Passage Assessment: Receiver Locations

- **10 Remote Monitoring Stations**

  - Installed late-September / early-October, 2019





# Juvenile Alosine Downstream Passage Assessment: Receiver Locations

- **10 Remote Monitoring Stations**

- Installed late-September / early-October, 2019



# Juvenile Alosine Downstream Passage Assessment: **Test Fish Collection**

- Juvenile fish collected from Turtletown Pond, Concord NH
  - NHFG stocked ~1,600 adult river herring during May 2019
- Collection efforts (Normandeau & NHFGD) occurred during Sept-Oct
  - Utilized boat electrofishing
  - Targeted lake areas likely to hold juveniles (i.e., pond outlet, edges of areas of SAV)
- Test fish held in tank set up installed at Garvins Falls
- Tagging protocol:
  - Anesthetized using diluted soda water
  - Verified total length was greater than 100 mm
  - Tag hooked into dorsal musculature at a point posterior to dorsal fin and oriented so it layed flat against body wall and antenna trailed towards tail
  - Tagged fish placed in holding cans and maintained in ambient river water until release





## Juvenile Alosine Downstream Passage Assessment: **Tagging and Release**

- Total of 146 individuals were tagged and released
  - Per RSP – divided into 10 separate release groups and introduced upstream of Project over a range of dates (October 9 through 25)
  - Individuals transported by boat to release site approximately 1 mile upstream of dam and released during evening hours
  - Group split across both sides of river and released in conjunction with untagged juveniles
- Utilized Lotek NTQ-1 transmitters



## Juvenile Alosine Downstream Passage Assessment:

- The Juvenile Alosine Downstream Passage Assessment was conducted in full conformance with the Commission's SPD.
- COMPLETED:
  - All field data collection
  - Initial processing of all raw stationary receiver files
- TO DO:
  - Incorporate station operations data to finalize passage route utilization
  - Identify arrival/passage times to determine transit durations and project residence time
  - Evaluate proportional split of mainstem river versus downtown canal system
  - Examine passage and operations data to identify covariates which may have influence on residence duration or passage use





# Upstream and Downstream Adult Alosine Passage Assessment



# Upstream and Downstream Adult Alosine Passage Assessment: **Goals and Objectives**

- **Study Goal:** To assess the behavior, approach routes, passage success, survival, and residence duration of adult American shad and river herring as they encounter the Lowell Project during their upstream and downstream migrations to determine if Project operations negatively impact their survival and production.

- **Specific Objectives: Upstream**

- Proportional split between tailrace and bypassed reach
- Nearfield attraction, entrance efficiency and overall efficiency of lift
- Nearfield attraction, entrance efficiency and overall efficiency of ladder
- Residence duration and fallback associated with Northern canal gatehouse
- Examine passage and operations data to identify covariates which may have influence on residence duration or passage

- **Specific Objectives: Downstream**

- Proportional split between mainstem and downtown canal system
- Downstream passage route distribution
- Project residence duration prior to downstream passage – for fish both at EL Field and within downtown canal system
- Examine passage and operations data to identify covariates which may have influence on residence duration or passage

# Upstream and Downstream Adult Alosine Passage Assessment: **Study Methodology**

## ▪ Tagging Procedures:

- Sigma-Eight model TX-PSC-I-80 or TX-PSC-I-80D transmitters
  - TX-PSC-I-80 measures approximately 10 x 10 x 27 mm, weighs 4.2 g, and has an estimated battery life of 64 days when set at a 2.0 second burst rate
  - TX-PSC-I-80D measures approximately 10 x 10 x 22 mm, weighs 3.3 g and has an estimated battery life of 64 days when set at a 2.0 second burst rate
- Oregon RFID half duplex PIT tags
  - PIT tag will measure 3.65 mm in diameter, 32 mm long, and weigh 0.8g
- Adult shad and herring will be collected at the Essex Dam fish lift in Lawrence
- Tagging protocol:
  - Visual examination to assess suitability for tagging
  - Measured to total length and gender determined
  - Fish receiving radio-tags will be gastrically tagged using a flexible tube to insert transmitter into stomach and leave antenna trailing
  - PIT tags will be implanted into the peritoneal cavity through a small incision in the ventral side of the fish



Release Location	American Shad			River Herring			Total
	Dual Tag	PIT Only	Radio Only	Dual Tag	PIT Only	Radio Only	
Upstream	180	200	0	150	200	0	730
Downstream (mainstem)	0	0	100	0	0	100	200
Downstream (Pawtucket Canal)	0	0	50	0	0	50	100
Total	180	200	150	150	200	150	1030



# Upstream and Downstream Adult Alosine Passage Assessment: **Study Methodology**

## ▪ Release Procedures:

### ○ Upstream Evaluation –

- Total of 360 tagged adult shad and 350 tagged adult river herring will be collected at the Essex lift
- Proposing a total of 5 release dates with each release consisting of approximately:
  - » 36 dual-tagged adult shad; 40 PIT-tagged adult shad
  - » 30 dual-tagged adult river herring; 40 PIT-tagged adult river herring

### ○ Downstream Evaluation –

- Total of 150 tagged adult shad and 150 tagged adult river herring will be collected at the Essex lift
  - » Proposing a total of 5 mainstem release dates with each release consisting of approximately 20 radio-tagged adult shad and 20 radio-tagged adult river herring
  - » Proposing a total of 3 canal release dates with each release consisting of approximately 17 radio-tagged adult shad and 17 radio-tagged adult river herring
- Proposed release locations (1) into Lowell impoundment at point several miles above project and (2) into Pawtucket Canal system downstream of the Guard Locks
- Initiation of releases dependent on run timing for both species (expected May)



# Upstream and Downstream Adult Alosine Passage Assessment: **Study Methodology**

- **Drift Assessment**

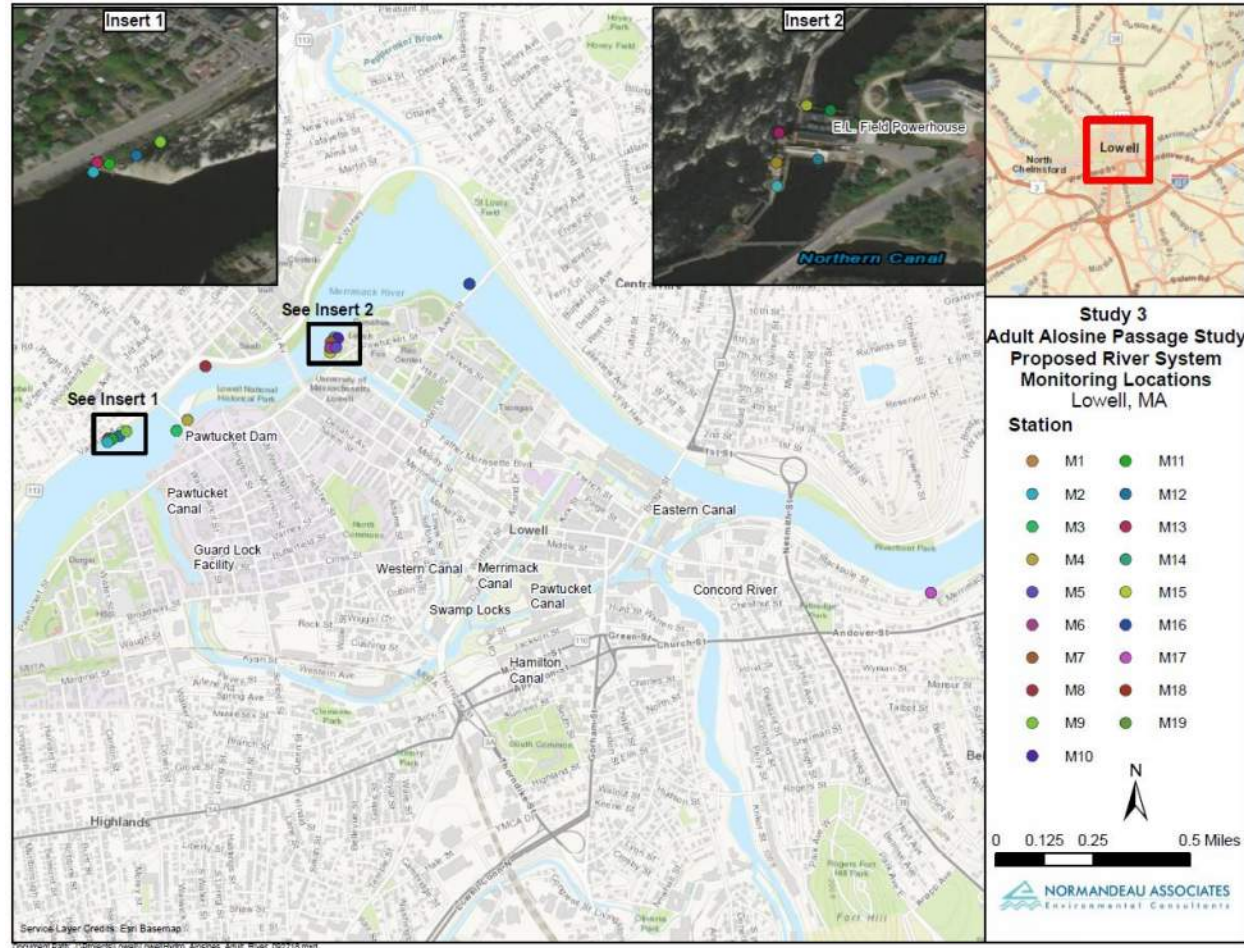
- A total of 10 freshly dead adult American shad and 10 freshly dead adult river herring will be tagged and released downstream of E.L. Field powerhouse
  - Will monitor rate of travel and downstream extent of known dead individuals to help inform estimates of passage survival



# Upstream and Downstream Adult Alosine Passage Assessment: **Study Methodology**

## Monitoring stations (mainstem):

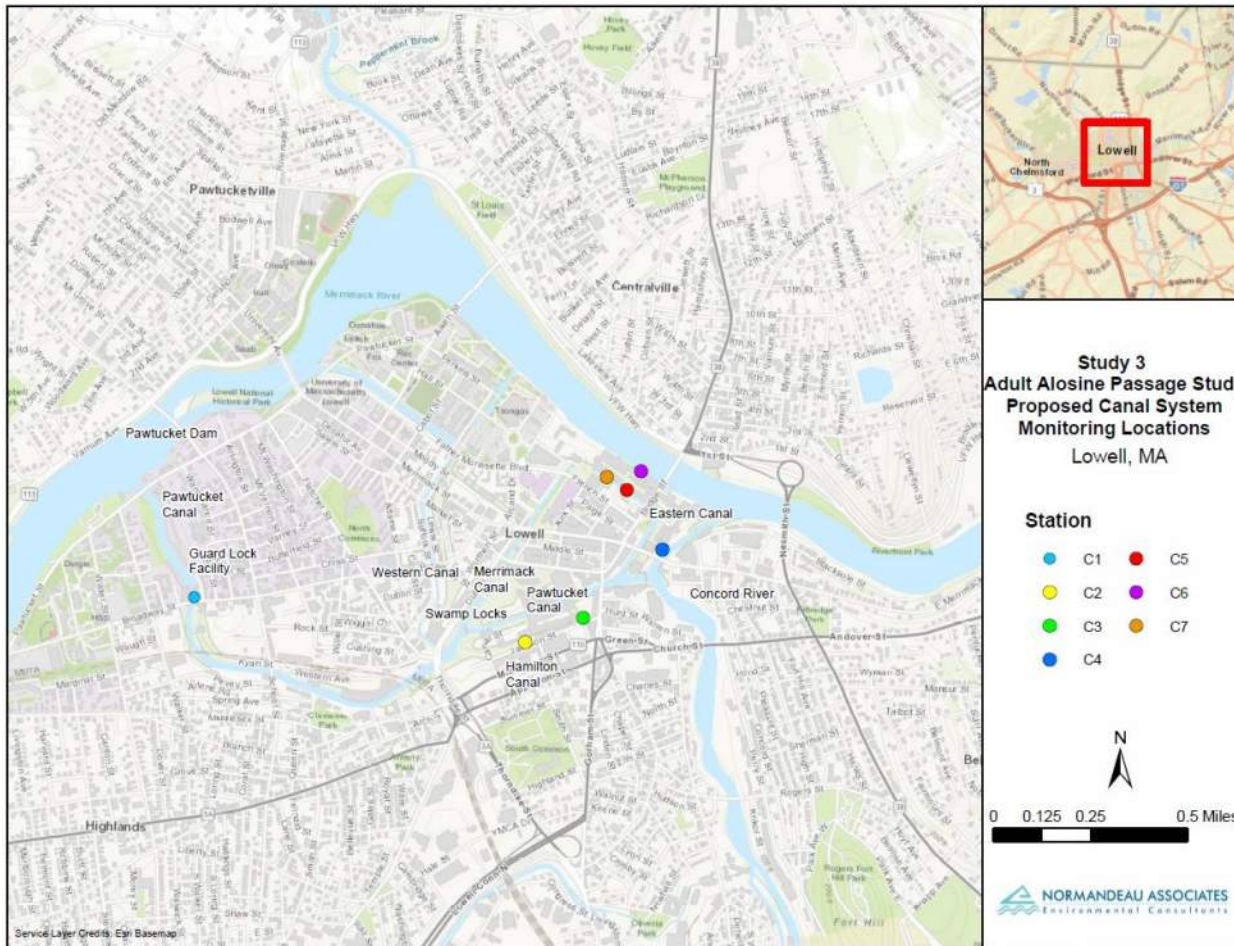
- Lowell impoundment
- Upstream Approach
- Upstream side Pawtucket Gatehouse
- Downstream side Pawtucket Gatehouse
- E.L. Field forebay
- Downstream bypass
- E.L. Field tailrace
- Lower bypassed reach
- Mid bypassed reach
- Upper bypassed reach
- Fish ladder entrance (PIT)
- Fish ladder turn pool (PIT)
- Fish ladder exit (PIT)
- Fish lift entrances (PIT)
- Fish lift exit (PIT)
- Downstream Approach
- DS Merrimack/Concord
- Mid-reach – Lowell/Lawrence
- Lawrence Approach





# Upstream and Downstream Adult Alosine Passage Assessment: **Study Methodology**

- Monitoring stations (canal system)
  - Downstream of Guard Locks
  - Hamilton Power Station
  - Hamilton Wasteway (PIT)
  - Bridge Street Power Station discharge
  - John Street Power Station intake
  - John Street Power Station discharge
  - Boott Dam sluice gate (PIT)



# Upstream and Downstream Adult Alosine Passage Assessment

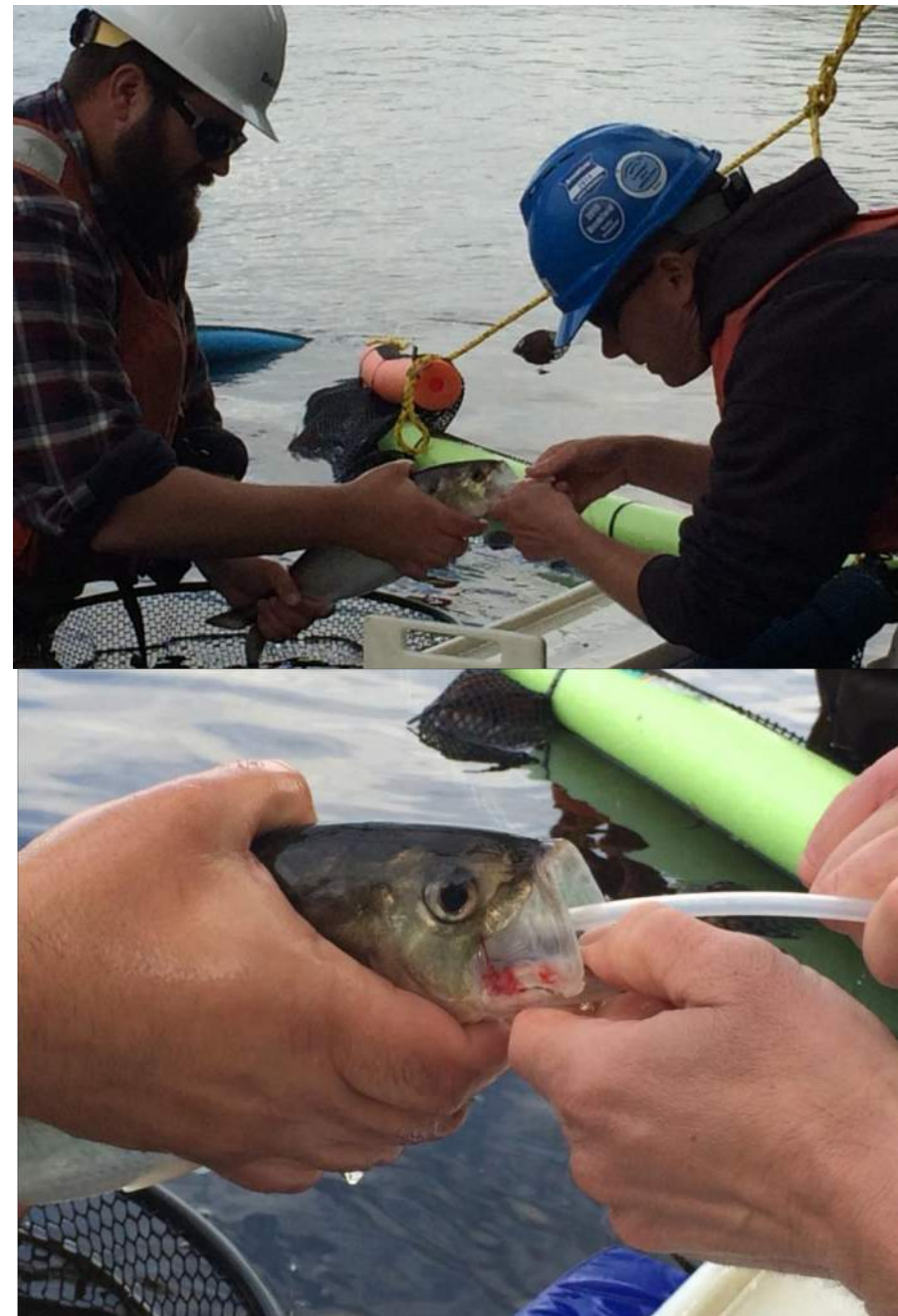
- COMPLETED:
  - Radio transmitter order
  - Site visit for PIT equipment
- TO DO:
  - April 2020 – equipment installation and testing
  - May-June 2020 field monitoring
  - Post spring 2020 field effort:
    - Obtain project operations data
    - Process all receiver files
    - Compile study findings into initial report
      - » Upstream passage effectiveness
      - » Downstream passage route utilization
      - » Evaluation of residence prior to US and DS passage
      - » Proportional use of mainstem river versus bypassed reach (US) and canal system (DS)
      - » Examine passage and operations data to identify covariates which may have influence on residence duration or passage use
    - Development of report document for inclusion in March 2021 USR



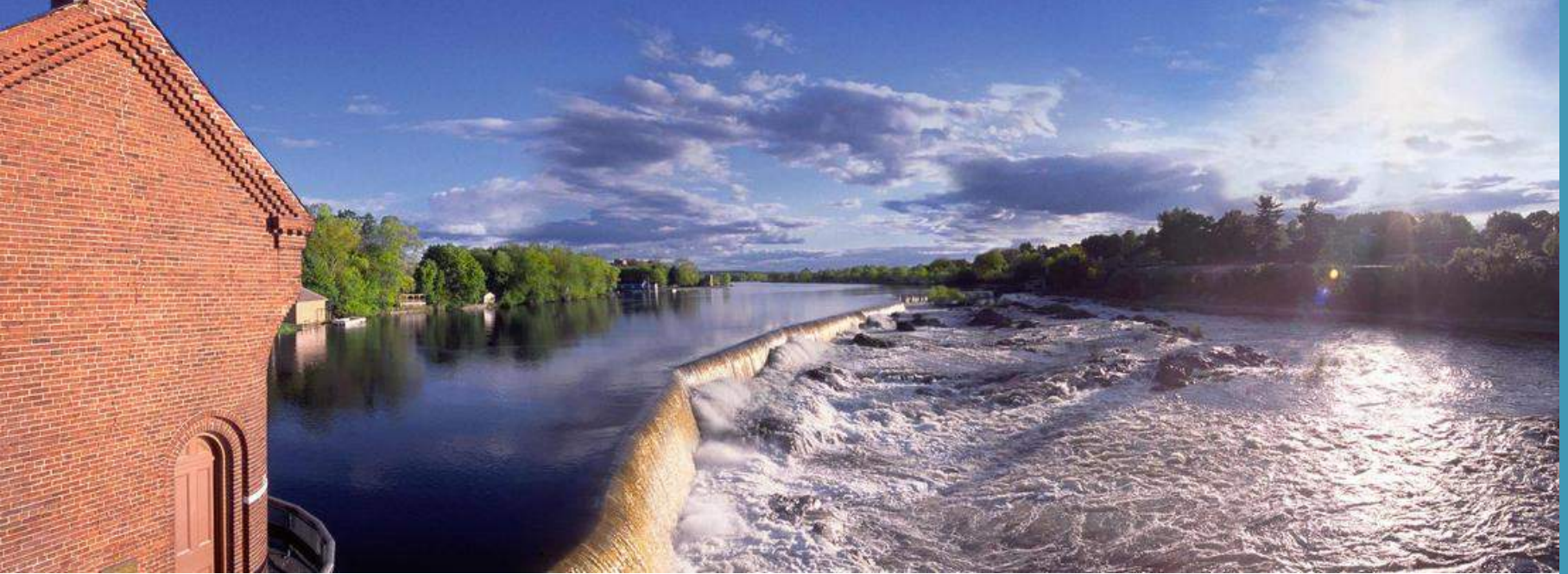


# Upstream and Downstream Adult Alosine Passage Assessment

- Boott anticipates that the Upstream and Downstream Adult Alosine Passage Assessment will be conducted in full conformance with the Commission's SPD; however,
  - Boott encountered delays in the proposed rock ledge excavation downstream from the E.L. Field Powerhouse.
  - Based on consultation and guidance provided by the Merrimack River Technical Committee (MRTC), Boott is proposing to conduct the Upstream and Downstream Adult Alosine Passage Assessment in spring 2020 as provided in the SPD, however prior to excavation of the rock ledge.
  - Boott will continue to consult with the MRTC to determine if additional study measures are appropriate.







# Fish Passage Survival Study

## Fish Passage Survival Study: **Goals and Objectives**

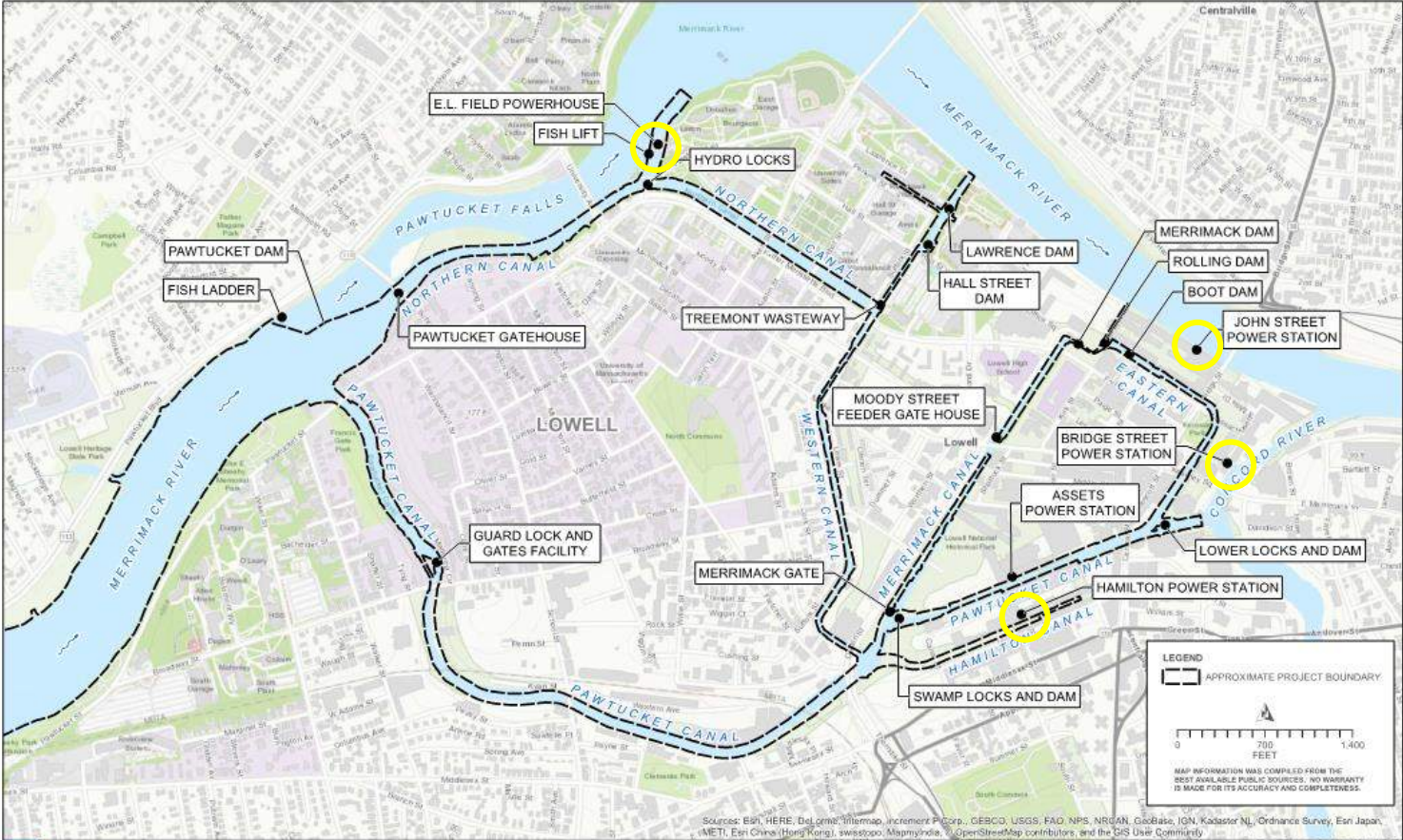
- **Study Goal:** To assess the potential survival of fish passing downstream through the E.L. Field, Bridge Street, Hamilton, and John Street turbines and to inform estimates of Project passage survival for emigrating diadromous species (adult and juvenile American Shad and Alewife and adult American Eel).
- **Specific Objectives:**
  - Assess the potential for impingement and estimate survival rates for the target species and life stages;
  - Assess the potential for entrainment and estimate survival rates for target species and life stages;
  - Conduct a desktop survival analysis to estimate passage survival of target species and life stages for each active turbine type; and
  - Assess total Project survival for the target species and life stages.





# Fish Passage Survival Study: Study Area

- The study area includes the E.L. Field, Bridge Street, Hamilton, and John Street units.



**LEGEND**

— APPROXIMATE PROJECT BOUNDARY

0 700 1,400  
FEET

MAP INFORMATION WAS COMPILED FROM THE BEST AVAILABLE PUBLIC SOURCES. NO WARRANTY IS MADE FOR ITS ACCURACY AND COMPLETENESS.

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, Geobase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, Mapbox, OpenStreetMap contributors, and the GIS User Community



# Fish Passage Survival Study: **Study Methodology**

- Desktop analysis of impingement, entrainment, and turbine passage survival of diadromous species
  - Seven unique turbine designs will be evaluated: E.L. Field units 1,2; Bridge Street units 4, 5, 6; Hamilton units 1,4,5, unit 2, and unit 3; John Street units 3,4,5, and unit 6
    - Boott has decommissioned Assets units and the Commission amended the Project's existing license to authorize Boott to remove Bridge Street units 1, 2, 3, and 12
  - Impingement/entrainment potential will be assessed based on the intake characteristics, swim speeds, and life history characteristics of target species. Review of entrainment studies will be conducted to derive entrainment rates for target species.
  - Survival of alosines will be estimated by review of survival studies for similar facilities and use of the USFWS TBSA tool. Survival of adult eels will be estimated using multiple linear regression models fit by Alden (2017)
  - Total Project downstream passage survival will be characterized for adult and juvenile American shad and alewife, and adult American eels, using the turbine passage survival estimated in this study and passage survival and proportional route selection data collected in the American Eel Downstream Passage, Juvenile Alosine Downstream Passage, and Adult Alosine Passage Studies

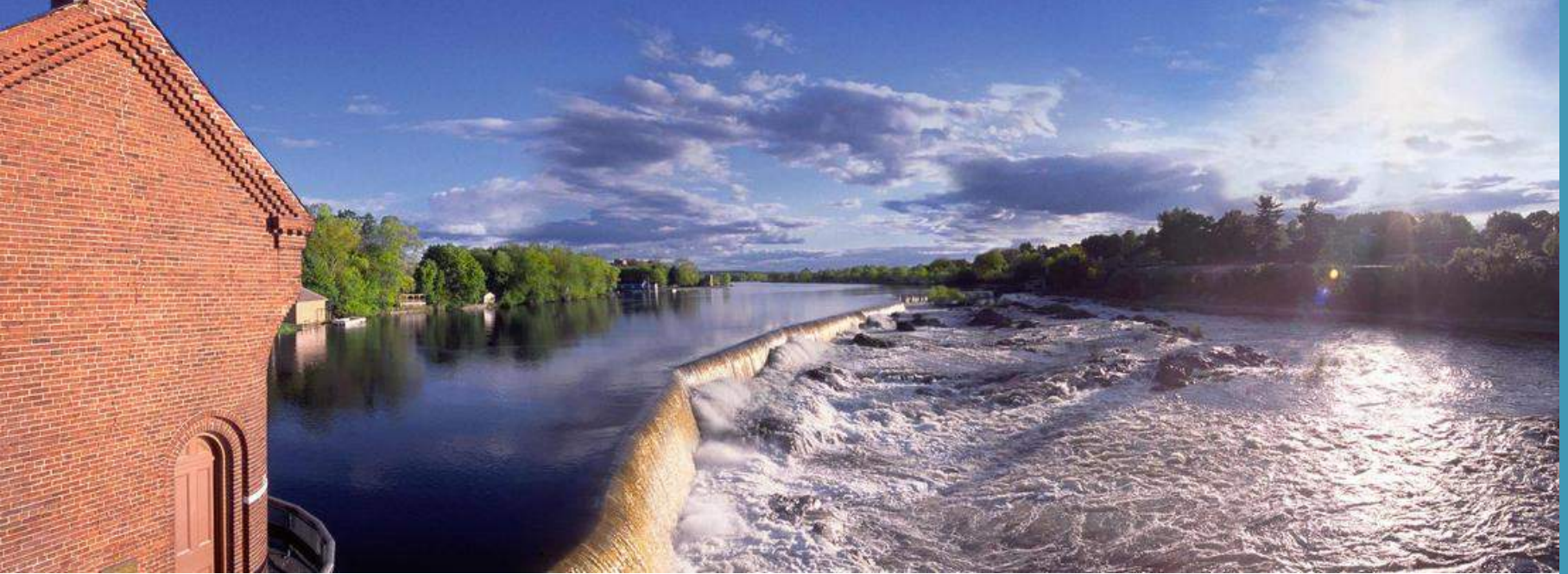


## Fish Passage Survival Study :

- Boot anticipates that the Fish Passage Survival Study will be conducted in full conformance with the Commission's SPD.
  
- TO DO:
  - Compilation of project specs
  - Assembly of species-specific swim speed and life history information
  - EPRI review, TBSA model runs
  - Synthesis of findings from fall 2019 and spring 2020
  - Determination of project passage success estimates
  - Development of report document for inclusion in March 2021 USR







# Three-Dimensional Computational Fluid Dynamics (CFD) Modeling



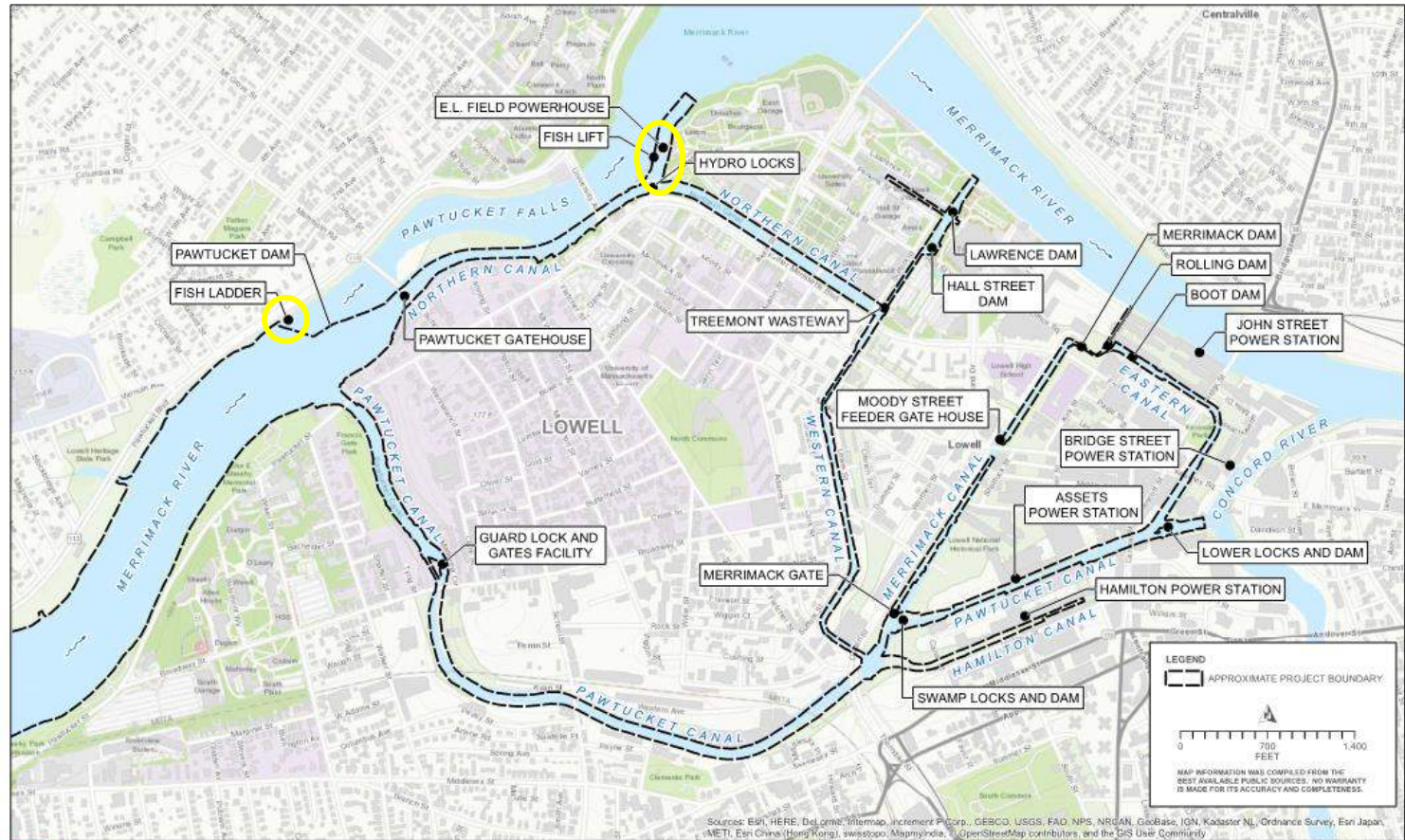
# Three-Dimensional Computational Fluid Dynamics (CFD) Modeling: **Goals and Objectives**

- **Study Goal:** To determine the flow field conditions that exist in and around the Lowell Project's fish passage facilities, including around the fishway entrances, within fishway structures, and in the E.L. Field Powerhouse forebay.
- **Specific Objectives:**
  - Develop and calibrate three-dimensional models of areas pertinent to fish passage structure;
  - Simulate various operational conditions using each model; and
  - Produce a series of color contour maps depicting flow fields relating to fishway attraction, fishway hydraulics, and forebay and bypass approach.



# Three-Dimensional Computational Fluid Dynamics (CFD) Modeling: **Study Area**

- The study area includes the E.L. Field Powerhouse forebay, tailrace, and fish lift, the bypass reach in the vicinity of the Pawtucket Dam fish ladder entrance, and within the fish ladder.





# Three-Dimensional Computational Fluid Dynamics (CFD) Modeling : **Study Methodology**

- Boott has proposed to model areas pertinent to fish passage:
  - E.L. Field powerhouse forebay;
  - E.L. Field powerhouse fish lift and tailrace; and
  - Pawtucket Dam fish ladder.
- Boott anticipates conducting a working group meeting(s) to discuss the appropriate domains and mesh size of areas to be surveyed and modeled.





# Three-Dimensional Computational Fluid Dynamics (CFD) Modeling : **Study Methodology**

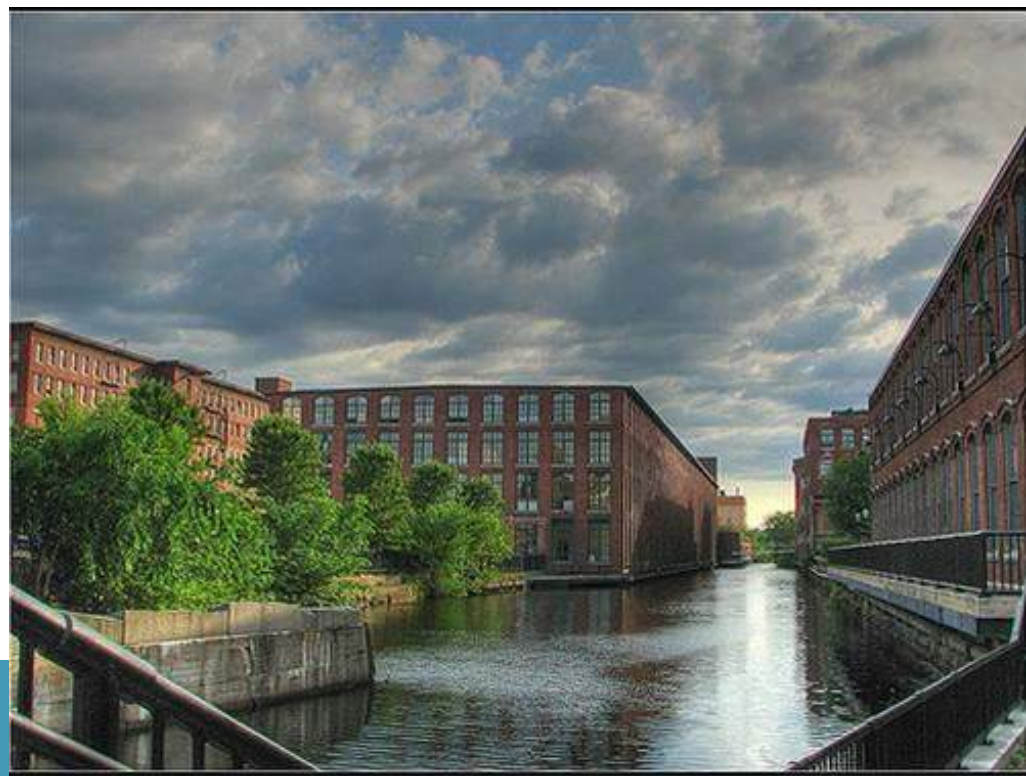
- Calibrated and validated models will be used to run simulations under various input operational scenarios
- RSP lists a suite of potential simulation runs based on stakeholder study requests:
  - E.L. Field Powerhouse Forebay Model
    - Simulation #1:
      - » E.L. Field at full capacity
      - » Bypass discharge at 5% of station discharge (~330 cfs)
    - Simulation #2:
      - » E.L. Field – Unit 1 or 2 at minimum flow
      - » Bypass discharge at 5% of station discharge
    - Simulation #3:
      - » Merrimack River at 5% exceedance level for migratory period of record (~26,000 cfs)
      - » E.L. Field at full capacity
      - » Bypass discharge at 5% of station discharge
    - Simulation #4:
      - » Merrimack River at 75% exceedance level for migratory period of record (~2,750 cfs)
      - » E.L. Field at typical unit settings for flow condition
      - » Bypass discharge at 5% of station discharge

# Three-Dimensional Computational Fluid Dynamics (CFD) Modeling : **Study Methodology**

- E.L. Field Powerhouse Fish Lift and Tailrace Model
  - Simulation #1:
    - » Fish lift in operation under recommended settings
    - » E.L Field at full capacity
    - » High tailrace condition (i.e., 5% exceedance level)
  - Simulation #2:
    - » Fish lift in operation under recommended settings
    - » E.L. Field at full capacity
    - » Low tailrace condition (i.e., 50% exceedance level)
- Pawtucket Dam Fish Ladder Model
  - Simulation #1:
    - » Auxiliary water supply at recommended setting
    - » 500 cfs minimum flow provided via the adjacent crest gate
  - Simulation #2:
    - » Auxiliary water supply at recommended setting
    - » 500 cfs minimum flow provided via the sluice gate
  - Simulation #3:
    - » Auxiliary water supply at recommended setting
    - » Merrimack River at 5% exceedance level for migratory period of record (~26,000 cfs)
    - » E.L. Field at full capacity

## Three-Dimensional Computational Fluid Dynamics (CFD) Modeling:

- Boot anticipates that the Three-Dimensional CFD Modeling will be conducted in full conformance with the Commission's SPD.
- TO DO:
  - Identify working group members and organize first meeting to discuss specifics related to survey areas, etc.
  - Summer 2020 – collect necessary field information required for modeling efforts
  - Development of report document for inclusion in March 2021 USR







# **Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study**

# Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study: **Goals and Objectives**

## ○ **Instream Flow Habitat Assessment Study Goals:**

- To determine an appropriate flow regime that will protect and enhance the aquatic resources in the bypass reach. Specifically to conduct an instream flow habitat study to assess the impacts of a range of Project discharges on the wetted area and optimal habitat for key species, including the quantity and location of suitable habitat

## ○ **Specific Objectives:**

- Characterize and map wetted perimeter of the bypass reach over a range of bypass flows;
- Survey and evaluate the water depth and mean channel velocity at transects within the bypass reach over a range of flows; and
- Map and assess the value of aquatic habitat in the bypass reach over a range of flows, focusing on potential habitat for resident species, and spawning and migration habitat or rest/regrouping areas for migratory species.





# Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study: **Goals and Objectives**

- **Bypass Zone of Passage Assessment Study Goals:**
  - To determine flows in the bypass reach that facilitate safe, timely, and effective fish passage through the Project
- **Specific Objectives:**
  - Complete a detailed survey of the bypass reach;
  - Develop a high-resolution, two-dimensional hydraulic model of the bypass reach;
  - Release multiple flows from the dam to collect calibration data for the model;
  - Simulate additional flows through the bypass reach with the calibrated model; and
  - Determine minimum and optimal zone-of-passage flows for the Project





# Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study

- Boott issued technical memo to working group on May 5, 2019 to provide initial recommendations on:
  - Target species and habitat suitability criteria
  - Spatial extent of model area and flow sources
  - Range of calibration flows
  - Range of modeled flows
- Memo was discussed via conference call on May 21, 2019
- USFWS provided written comments on May 31, 2019

## Target Species: Zone of Passage

- American shad (adult)
- River herring (adult)

HSC to be borrowed from recent FERC relicensing studies on the Connecticut River

## Target Species: Aquatic Habitat

- Smallmouth bass (fry, juv, adult, spawn)
- Fallfish (juv, adult)
- White sucker (fry, juv, adult, spawn)
- Tesselated darter (adult, juv)
- American shad/river herring (juv, spawn)
- Freshwater mussels\*
- Macroinvertebrates\*
- Sea lamprey (juv, spawn)\*

# Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study

## Spatial Extent of Model Reach – Zone of Passage Component

- Dam downstream to bypass/tailrace confluence
- Calibration flow data collection limited to discharge volumes from fish ladder and associated AWS plus the 220 foot pneumatic crest gate section

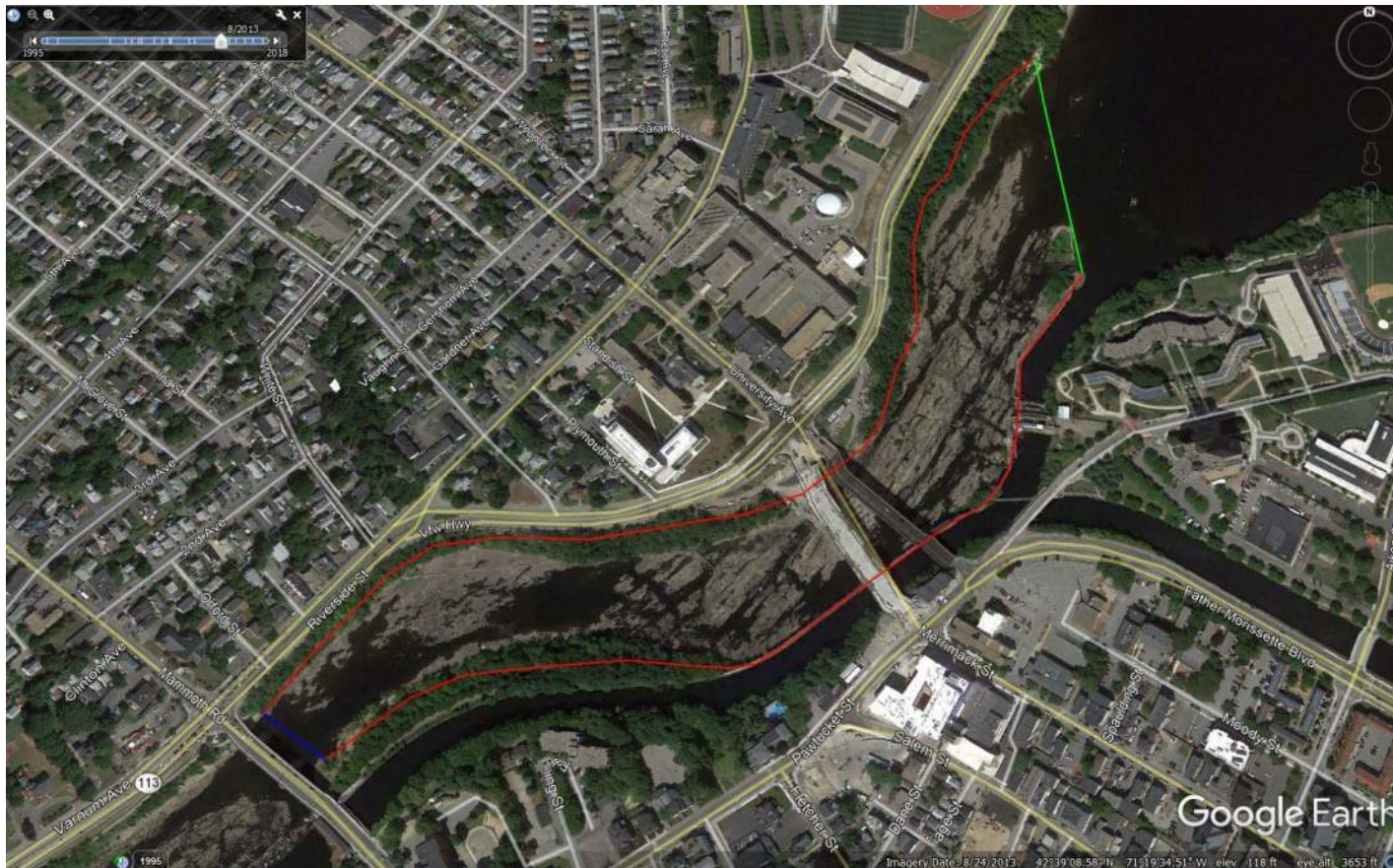




# Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study

## Spatial Extent of Model Reach – Aquatic Habitat Component

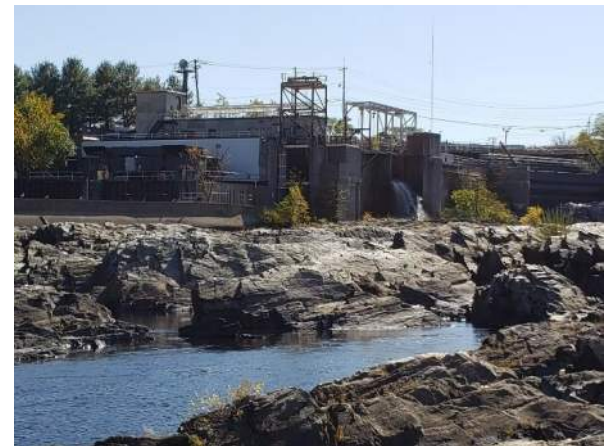
- School Street Bridge downstream to bypass/tailrace confluence
- Upstream boundary placement at bridge will allow for modelling over a higher range of flows due to linear nature of flow at that point in bypassed reach





# Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study

- Calibration flows proposed in the project technical memo included:
  - ~500 cfs – baseline operating flow for the upstream fish ladder at upper extent of bypassed reach;
  - ~7,800 cfs – maximum combined discharge for the fish ladder and associated AWS system and 220 foot pneumatic crest gate section at upstream boundary for zone of passage component; and
  - ~4,150 cfs – mid-point of the minimum and maximum calibration flows.
- Supportive of modeled output up to 19,500 cfs
  - Modeled flows for zone of passage component
    - Limited to flows up to highest calibration discharge for full reach
    - Up to maximum (19.5 kcfs) for section downstream of School St. Bridge\*
  - Modeled flows for aquatic habitat component
    - Up to maximum of 19.5 kcfs for the full modeled reach

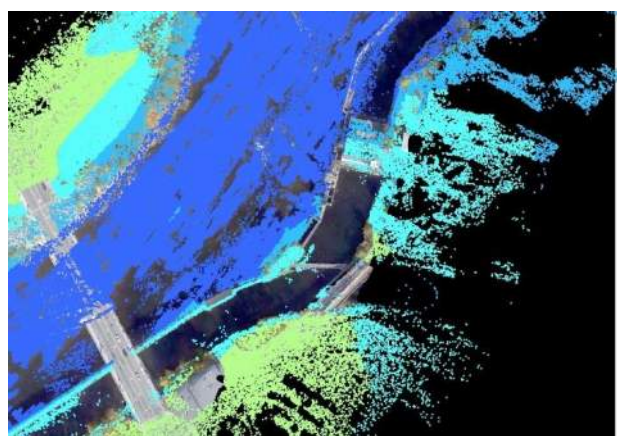


# Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study

## 2019 Field Efforts:

- Targeted periods of lowest flow possible (post upstream fish passage season)

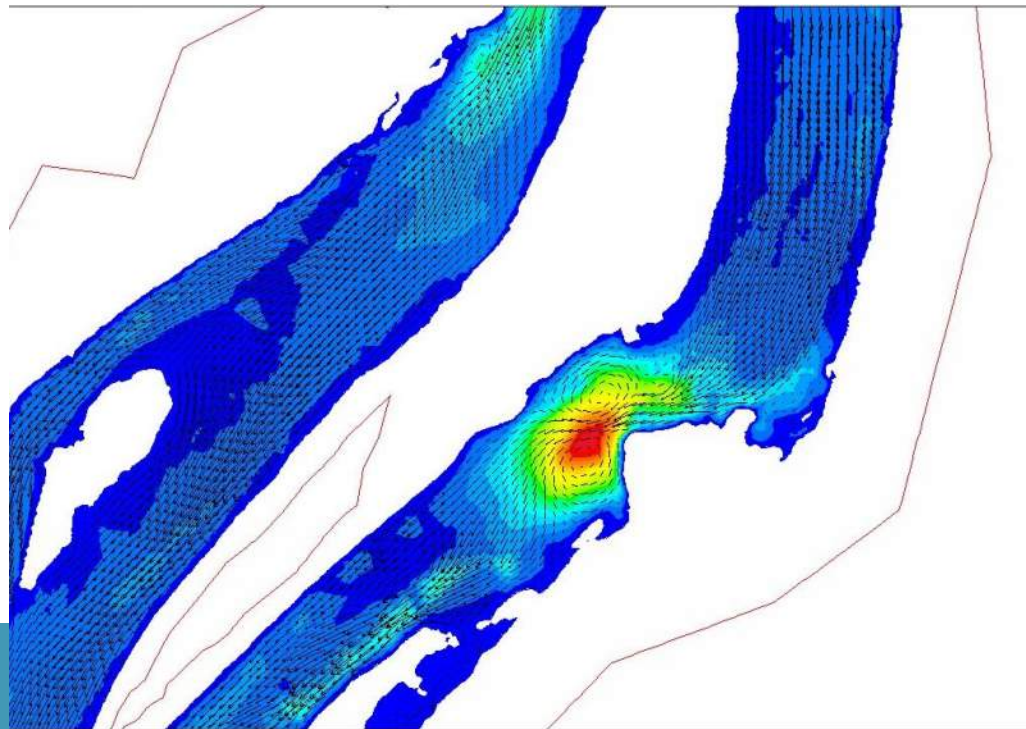
Required Flow Condition	Field Activity	Status
Low Calibration Flow (500 cfs)	Lidar overflight under driest possible condition	Complete
	Bathymetry in any deeper watered areas	Initiated
	RTK survey for shallow watered areas or beneath bridges	Complete
	WSE and Q at upstream boundary	Complete
	WSE at downstream boundary	Complete
	Delineation of substrate polygons (i.e., fish habitat)	Complete
Mid Calibration Flow (4,150 cfs)	WSE and Q at upstream boundary	Remaining
	WSE at downstream boundary	Remaining
High Calibration Flow (7,800 cfs)	WSE and Q at upstream boundary	Remaining
	WSE at downstream boundary	Remaining





# Instream Flow Habitat Assessment and Zone of Passage in the Bypassed Reach Study:

- **COMPLETED:**
  - Technical committee concurrence with project plan
  - Lidar data survey and substrate mapping
  - Low calibration discharge
- **TO DO:**
  - Collect mid and high discharge measurements
  - Construct hydrodynamic and digital elevation models in River 2D
  - Run hydraulic simulations using calibrated model
  - Zone of Passage – identify areas of suitable depths and velocities for target spp.
  - Aquatic Habitat – generate estimates of WUA for target species/life stages over range of model flows
  - Development of report document for inclusion in March 2021 USR







**Fish Assemblage Study**

## Fish Assemblage Study: **Goals and Objectives**

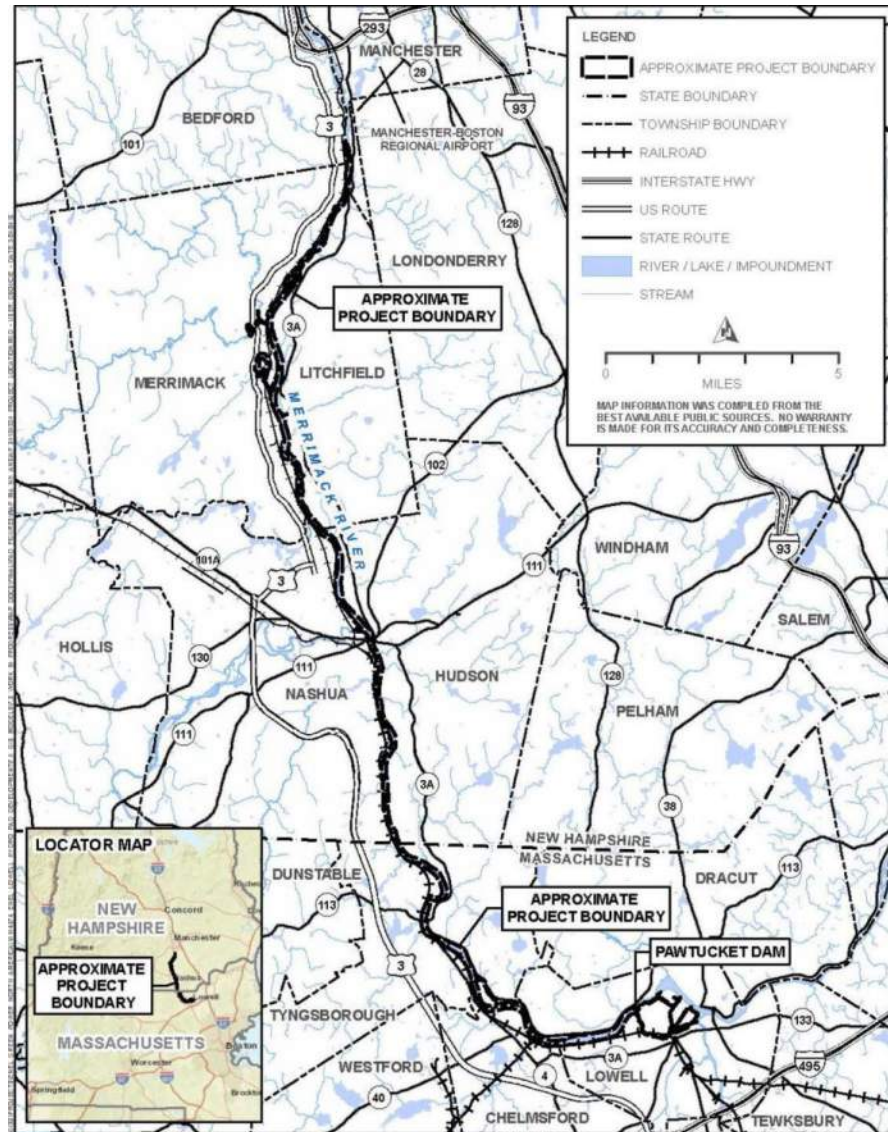
- **Study Goal:** To characterize the fish assemblage in areas affected by the Lowell Project, specifically the impoundment and bypass reach.
- **Specific Objectives:**
  - Conduct field sampling to describe fish assemblage structure, distribution, and abundance within the Project affected area along spatial and temporal gradients; and
  - Compare historical records of fish species occurrence in the Project area to results of this study.





## Fish Assemblage Study: Study Area

- The study area includes the mainstem Merrimack River from the Pawtucket Dam to the upper extent of the Project's impoundment located approximately 23 river miles upstream, and the Project's 0.7-mile-long bypass reach.





# Fish Assemblage Study: **Study Methodology**

- Impoundment site selection:
  - Stratified based on mesohabitat characteristics (determined during visual boat survey, May 2019)
    - Divided into 74 individual 500 m segments
      - » 78% = impoundment habitat
      - » 7% = run habitat
      - » 15% = pool habitat
  - 12 segments were randomly selected within the reach on a seasonal basis (3 run, 3 pool, 6 impoundment)
  
- Bypass Reach site selection:
  - Stratified based on general habitat conditions associated with:
    - Upper chute (i.e., area between Pawtucket Dam and School Street Bridge),
    - Pooled section immediately downstream of the School Street Bridge,
    - Ledge channel area in the vicinity of the University Ave Bridge, and
    - Lower bypassed reach downstream of the power canal surge gate
  - Effort focused on middle two reaches due to access/equipment effectiveness (upper chute) and safety (lower bypassed reach)



# Fish Assemblage Study: **Sampling Methodology**

- Conducted on a seasonal basis:
  - Spring – June 24-29, 2019
  - Summer – August 19-27, 2019
  - Fall – October 21-30, 2019
- Sampling gears:
  - Boat electrofish (all impoundment sites)
    - Three person crew (driver and 2 netters), nighttime
  - Experimental gill nets (all impoundment sites)
    - 1.0, 2.0, 3.0, 4.0 mesh nets, four hour sets, nighttime
  - Baited minnow traps (all impoundment sites)
    - Paired traps, four hour set, nighttime
  - Backpack electrofish (all bypass reach sites)



## Fish Assemblage Study: **Study Methodology**

- All fish captured were identified to species, classified by life stage, measured, enumerated, weighed
  - Large numbers ( $N > 25$ ) of small fish were grouped, enumerated, batch-weighed, and representative samples of small and large individuals measured
- Additional data:
  - Start and end date/time
  - Sampling gear
  - Measure of effort (e.g., time, distance)
  - Mesohabitat type
  - Water depth, velocity, river flow
  - Water quality parameters
  - Dominant substrate, cover density, and proportion of vegetation cover.
- Sample locations were geo-referenced





# Fish Assemblage Study: Impoundment Sampling Results

Common Name	No. Individuals			
	Total	Spring	Summer	Fall
Spottail Shiner	422	159	79	184
Redbreast Sunfish	373	137	191	45
Smallmouth Bass	222	126	46	50
Pumpkinseed	154	10	125	19
Fallfish	140	33	32	75
Bluegill	121	23	77	21
Alewife	111		19	92
White Sucker	51	22	7	22
Largemouth Bass	41	2	32	7
Tessellated Darter	31	14	14	3
Yellow Bullhead	29	7	19	3
Sea Lamprey	21	7	6	8
Yellow Perch	18	16	1	1
American Eel	17	6	10	1
Golden Shiner	12	1	4	7
Margined Madtom	8	2	5	1
Rock Bass	7	3	2	2
Black Crappie	5	2	2	1
Common Carp	4	1	2	1
Lepomis spp.	4	1	3	
White Perch	1		1	

Common Name	No. Individuals			
	Total	Spring	Summer	Fall
Yellow Bullhead	25		23	1
Redbreast Sunfish	5		5	
Smallmouth Bass	5	1	4	
White Sucker	4	2	2	
Fallfish	3	1	2	
Alewife	2		2	
Spottail Shiner	2	1		1
Yellow Perch	2		2	
Bluegill	1	1		
Channel Catfish	1		1	
Common Carp	1		1	
Golden Shiner	1		1	
Margined Madtom	1	1		
Pumpkinseed	1		1	
Walleye	1		1	

## Gill Nets:

- 54 fish, 15 species
- Yellow bullhead most abundant

## Boat Electrofish:

- 1,792 fish, 20 species
- Spottail shiner, redbreast sunfish and smallmouth bass most abundant

## Minnow traps:

- No catch

# Fish Assemblage Study: Bypassed Reach

## Sampling Results

Common Name	No. Individuals			
	Total	Spring	Summer	Fall
Fallfish	210	22	187	1
Smallmouth Bass	107	2	37	68
Spottail Shiner	88	39	49	
White Sucker	33		30	3
American Eel	33	10	18	5
Margined Madtom	17	1	2	14
Redbreast Sunfish	13	1	5	7
Tessellated Darter	10	1	5	4
Yellow Bullhead	5		4	1
Bluegill	3	2	1	
Longnose Dace	2	1		1
Largemouth Bass	2		2	
Sea Lamprey	1			1
Lepomis spp.	1			1
Brown Trout	1	1		

### Backpack Electrofish:

- 526 fish, 14 species
- Fallfish, smallmouth bass and spottail shiner most abundant

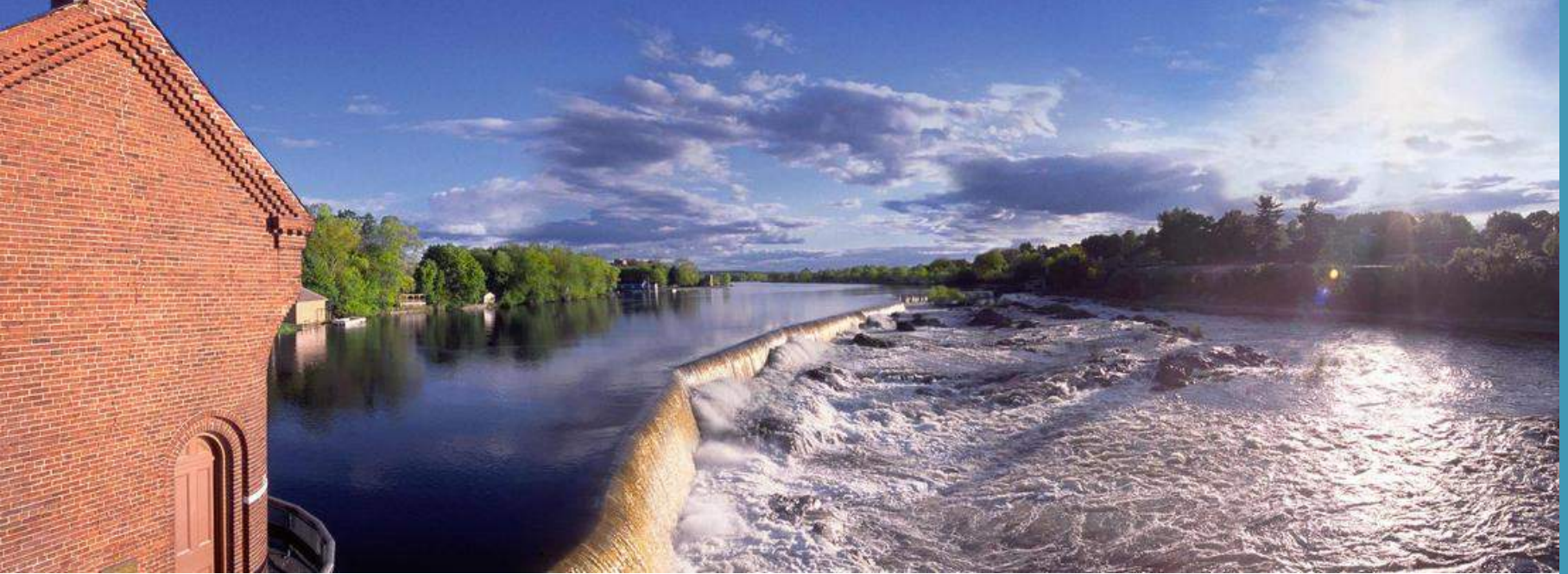


## Fish Assemblage Study:

- The Fish Assemblage Study was conducted in full conformance with the Commission's SPD.
- COMPLETED:
  - Habitat evaluation and sample site selection
  - Seasonal sampling (spring, summer, fall 2019)
  - Data entry and QC
  - Initial summary of catch data
- TO DO:
  - Completion of 2019 study report document for inclusion in March 2021 USR







# Recreation and Aesthetics Study

# Recreation and Aesthetics Study: **Goals and Objectives**

## ▪ **Study Goals**

- Document recreation resources and recreational activities that occur in the Project,
- Determine the adequacy and capacity of existing recreational facilities to accommodate existing recreational activities as well as proposed new recreational activities,
- Assess potential effects of water levels and flow rates on existing recreational facilities,
- Assess the potential for expanded access to the canal system for recreation, and
- Identify areas within the canal system where vegetation growth on historic canal walls and waterborne trash are a concern.

## ▪ **Specific Objectives**

- Identify existing recreation facilities in the Project area,
- Quantify current recreational use based on recent and new surveys and interviews and consultation with stakeholders, regional and statewide plans, and other available data (including NPS and MDCR planning documents),
- Identify proposed recreational uses based on surveys and interviews in consultation with stakeholders,
- Evaluate the potential effects of continued operation of the Project (including water levels and flow rates) on recreation resources and activities in the Project area,
- Assess the potential for expanded recreational access to the canal system in consultation with the NPS, MADCR, City of Lowell, Lowell Parks and Conservation Trust, the Lowell Heritage Partnership, and other partners in recreation,
- Identify areas of concern related to waterborne trash and vegetation growth on historic canal walls and other structures or historic properties owned or under the control of Boott, and
- Gather information on the condition of Boott's recreation facilities and identify any need for improvement.

# Recreation and Aesthetics Study: **Study Methods**

## ▪ **Literature Review**

- Conduct a literature review to identify and describe recreational uses in the Project area.

## ▪ **Field Inventory**

- Document existing formal and informal recreation facilities, including:
  - A description of the type and location of existing recreation facilities;
  - Ownership;
  - The type of recreation provided (boat access, angler access, picnicking, etc.);
  - Existing amenities and sanitation;
  - The type of vehicular access and parking (if any);
  - Suitability of facilities to provide recreational opportunities and access for persons with disabilities (i.e., compliance with current ADA standards for accessible design); and
  - Photographic documentation of recreation facilities.

## ▪ **Visitor Use Data**

- Conduct personal interviews and field reconnaissance.
- Collect online visitor survey data.

## ▪ **Expanded Recreational Access in Project Canals**

## ▪ **Document Current Water Levels and Flows**

## ▪ **Conduct Visual Surveys for Vegetation and Waterborne Trash**



## Recreation and Aesthetics Study: **Study Status**

- Boott initiated the Recreation and Aesthetics Study in conformance with the Commission's SPD.
- Boott is completing a background literature review and consulting with stakeholders regarding aesthetics and recreational access at the Project.
- Visitor use data was collected in 2019.
- Pursuant to the approved SPD, a recreation inventory and vegetation mapping along the canal system were conducted in 2019.
- Boott anticipates mapping waterborne trash in the spring of 2020 following a period of higher flows, as well as continuing documentation of water levels and flows in the canal system.



# Recreation and Aesthetics Study: **Study Summary**

## ▪ **Personal Interviews**

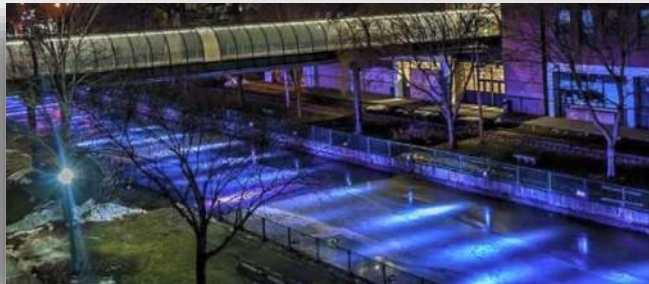
- By letter dated May 7, 2019, Boott consulted with stakeholders to identify specific recreation survey locations.
- Personal interviews were conducted one two weekdays and two weekend days per month from May through October 2019
- During each survey event, Boott spent approximately one hour at each site conducting interviews and collecting visitor use data, including observed recreation activities, estimated numbers of vehicles, and approximate numbers of recreationists.
- Respondents answered questions verbally, while a technician recorded their responses using the Qualtrics® offline survey platform to record and submit answers.
- In total, Boott has conducted approximately 130 personal interviews since May 2019. Boott is continuing to review and compile the personal interview data.



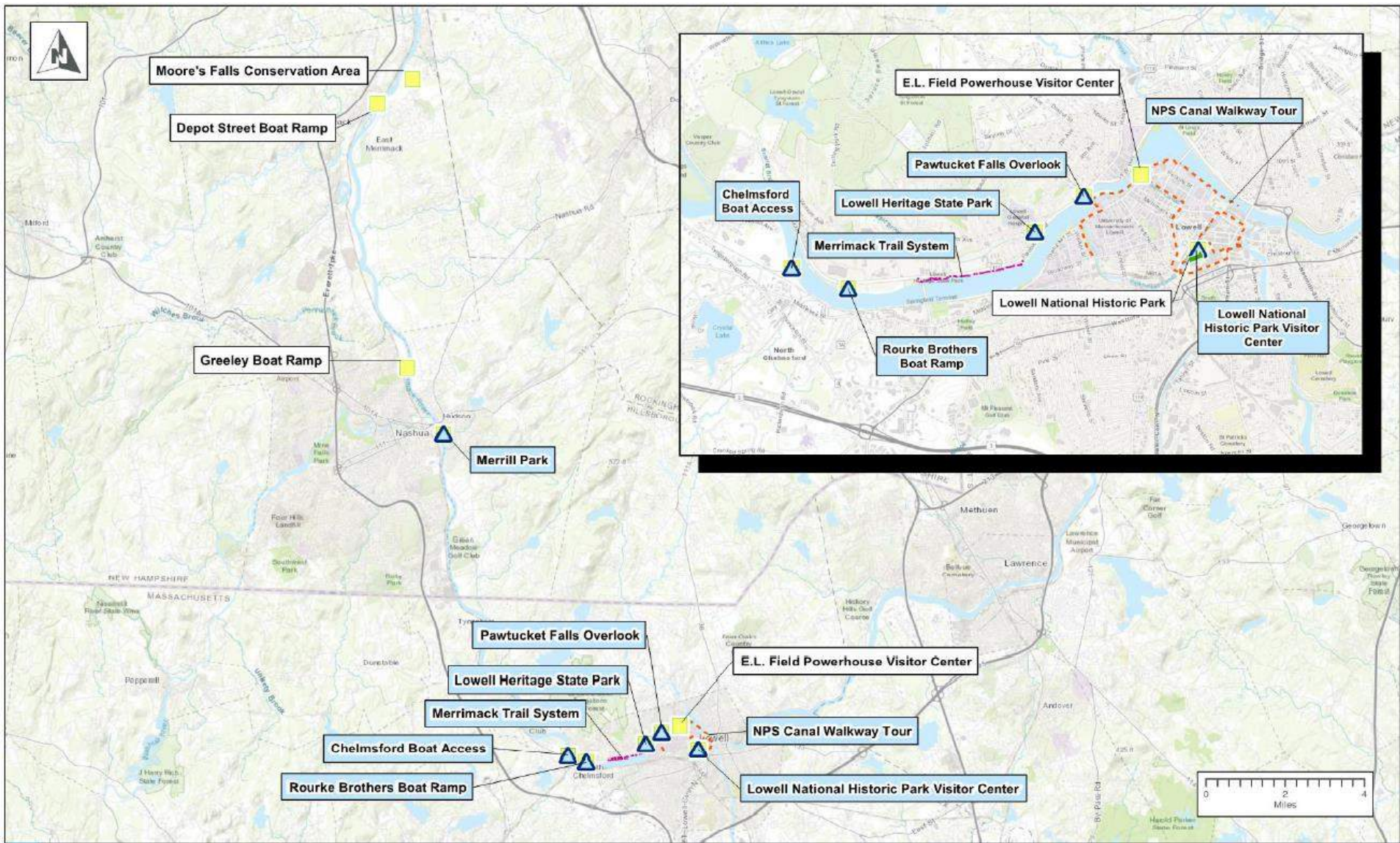
# Recreation and Aesthetics Study: **Study Summary**

## ▪ **Inventory and Documentation of Recreation Facilities**

- Recreation sites inventoried in 2019 included the
  - Chelmsford Boat Access;
  - Depot St. Boat Ramp;
  - Greeley Boat Ramp;
  - Lowell Heritage State Park;
  - Lowell National Historical Park;
  - Merril Park;
  - Merrimack Trail System;
  - Moores Falls Conservation Area;
  - NPS Canal Walkway;
  - Pawtucket Falls Overlook; and
  - Rourke Brothers Boat Ramp.
- Boott collected information regarding each area, including the type and location of existing recreation facilities, the type of recreation provided (e.g., boat access, angler access, picnicking, etc.), existing amenities and sanitation, and photographic documentation of recreation facilities.
- Boott is continuing to review and analyze the inventory data.









# Recreation and Aesthetics Study: **Study Summary**

## ▪ **Online Visitor Use Survey**

- The online recreation survey was posted on the Project's public relicensing website in June 2019.
- Boott posted signs at recreation facilities in the Project area directing visitors to the online survey.
- Boott also provided handouts to visitors informing them of the online survey and providing the web address for the survey instrument.
- In total, approximately 100 online visitor use surveys have been completed since June 2019.

## ▪ **Vegetation Mapping**

- Boott mapped vegetation along the canal system. Surveys were conducted using GPS to map and delineate vegetation types (e.g., scrub-shrub, trees, herbaceous, forested, and mixed vegetation) along the canal wall. Field technicians conducted vegetation mapping on foot, and via an NPS canal boat to observe areas with limited access.
- Approximately 120 individual polygons and vegetation points were mapped in the field. Boott collected representative photos of vegetation mapped along the canal system.
- Boott is currently compiling and analyzing the vegetation survey data collected in 2019.



# Recreation and Aesthetics Study: **Study Summary**

## ▪ **Expanded Recreational Access in Project Canals**

- Boott held a Study Workshop with the NPS, City of Lowell, MADCR, and other interested stakeholders on December 18, 2019.
- Stakeholders provided additional information regarding recreational access to the Project's canal system, and issues related to visitor safety were discussed
- Boott anticipates additional consultation with stakeholders regarding this issue.

## ▪ **Water Levels and Flows in the Canals**

- Boott is documenting current water levels and flows by collecting photos, videos, and from direct observations of flows under varying flow conditions.

## ▪ **Waterborne Trash**

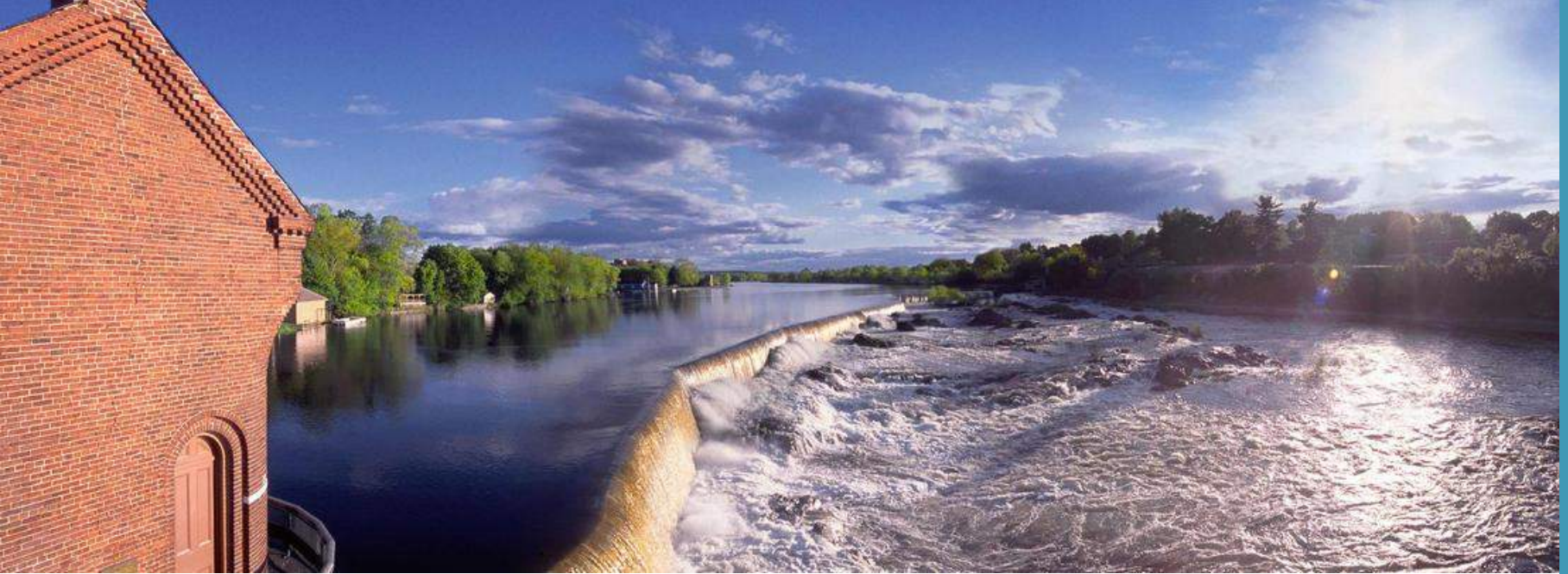
- Boott anticipates conducting surveys of waterborne trash in the spring of 2020





## Recreation and Aesthetics Study: **Variances from FERC-approved Study Plan**

- The Recreation and Aesthetics Study is being conducted in full conformance with the Commission's SPD.
  - When conducting personal interviews at the recreation facilities identified in consultation with stakeholders, field technicians generally attempted to visit each of the selected recreation facilities during every survey event. In some instances, field technicians encountered conditions at recreation facilities that presented safety risks. In such instances, field technicians avoided those facilities during the survey event and documented the unsafe conditions encountered that prevented personal interviews from occurring.
- Boott is not proposing any modifications to the Recreation and Aesthetics Study.



# **Resources, Ownership, Boundaries, and Land Rights Study**

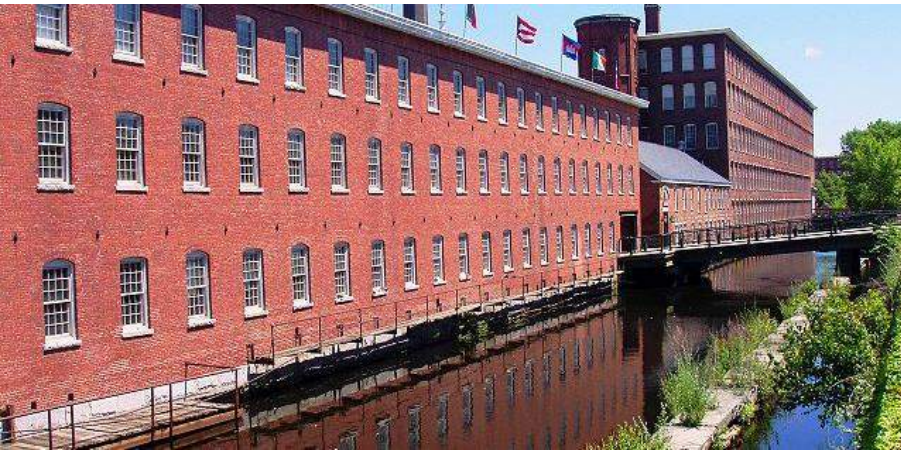
# Resources, Ownership, Boundaries and Land Rights Study: **Goals and Objectives**

## ▪ **Study Goals:**

- Determine current ownership of resources within the canal system and Project Boundary, and document maintenance responsibilities, access rights, and FERC jurisdiction.

## ▪ **Specific Objectives**

- Determine the current ownership of resources within the canal system in a comprehensive manner;
- Record maintenance responsibilities and obligations to resources within the canal system;
- Clarify FERC jurisdiction;
- Document recreational, educational, or other land access rights to resources within the canal system; and
- Work with the MADCR, NPS, City of Lowell, and other parties to develop a GIS database of resources, ownership, boundaries, and land rights.





# Resources, Ownership, Boundaries and Land Rights Study: **Study Methods**

## ▪ **Review Existing Information**

- Compile and review available land rights documentation, including:
  - Land ownership and mapped information in GIS;
  - Property and land rights obtained by Boott, the NPS, MADCR, City of Lowell, and private entities;
  - Property boundary survey information;
  - Rights-of-way;
  - Property title information;
  - Land easements;
  - Any existing maintenance agreements between entities;
  - Any other relevant ownership and land rights information.

## ▪ **Develop a GIS Database and Supporting Report**



# Resources, Ownership, Boundaries and Land Rights Study: **Study Status and Summary**

## ▪ **Review Existing Information**

- Boott initiated the literature review and data collection associated with the Resources Study in conformance with the Commission's SPD.
- To inform the Resources Study, Boott has initiated a review of the 1984 Great Deed, the 1986 Order of Taking, and the lease from the Commonwealth of Massachusetts to the NPS.
- A Study Workshop was held with the NPS, MADCR, City of Lowell, and other stakeholders in 2019 to discuss data needs, the overall format of this study, and a collaborative approach to defining ownership and responsibilities for lands and structures within the Project boundary.
- A review of available documentation related to ownership, boundaries, and land rights is ongoing.
- Although not required by the SPD, Boott anticipates holding Resources Study Working Group Meetings in 2020 to coordinate a review of relevant documents regarding ownership, land rights, and responsibilities.
- Boott expects that data collection and review will occur in consultation with the NPS, MADCR, and City of Lowell through Q2 of 2020.

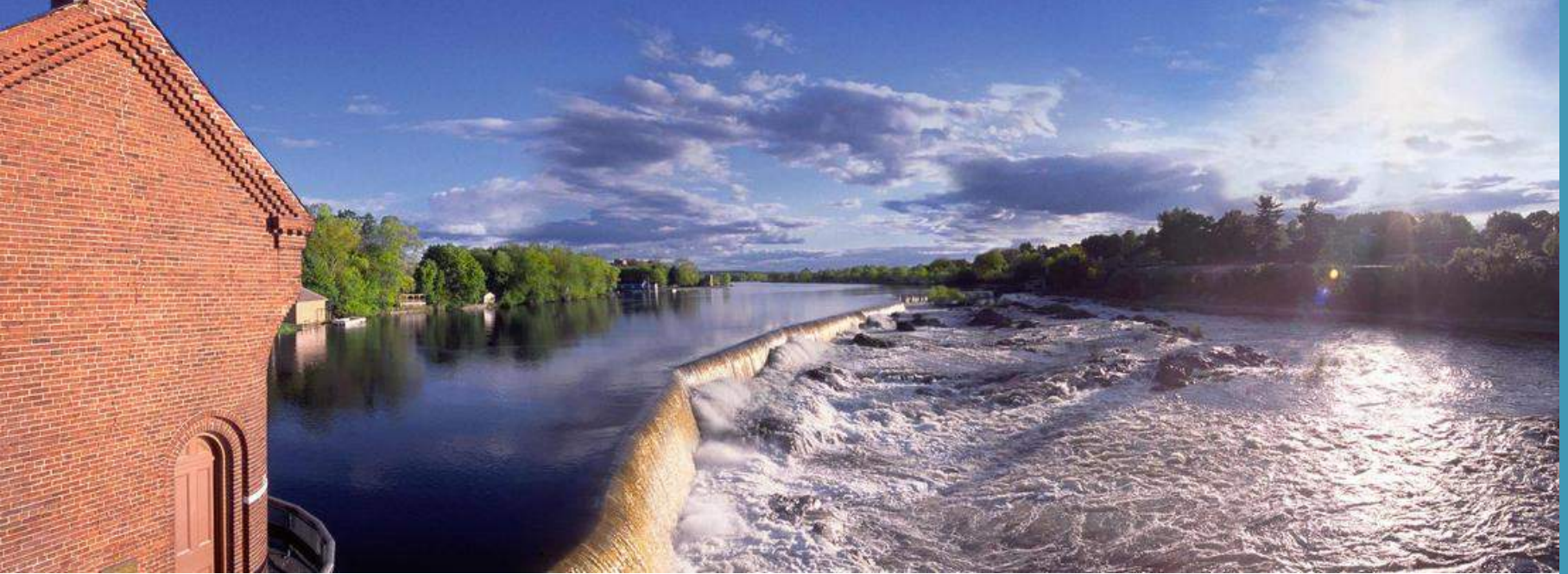


## Resources, Ownership, Boundaries and Land Rights Study: **Variations from FERC-approved Study Plan**

- The Resources Study is being conducted in full conformance with the Commission's SPD.
- Boott is not proposing any modifications to the Resources Study. To the extent practical, Boott anticipates providing the Resources, Ownership, Boundaries, and Land Rights with the filing of the USR in Quarter 1 of 2021.







# **Water Level and Flow Effects on Historic Resources Study**

# Water Level and Flow Effects on Historic Resources Study: **Goals and Objectives**

## ▪ **Study Goals**

- Evaluate potential Project effects to historic resources resulting from the operation of the new crest gate system at the Project.

## ▪ **Specific Objectives**

- Evaluate how Project operations, including manipulation of the new crest gate system, canal headgates, spillways, locks, fish passage structures, and generating units will change water levels in any location within the canal;
- Determine the extent to which water flows or elevations are having an effect on historic resources;
- Conduct a structural assessment of the Great River Wall; and
- Identify potential impacts of current Project operations on nationally significant historic resources, including a structural assessment of the Great River Wall.





# Water Level and Flow Effects on Historic Resources Study: **Study Methods**

## ▪ **Document Review of Existing Condition**

- Review available engineering and architectural evaluations of canal structures.
- Conduct a site visit with the NPS to identify issues related to flow and water levels.
- Identify properties that have previously been affected by water level or flow conditions.
  - Document dimensions of significant structural features of these properties relative to the water levels in the canal system so that the effects of flow into the canal system and changes in water levels can be assessed.
- Conduct a structural engineering assessment of the Great River Wall.

## ▪ **Water Levels and Flow Effects**

- Install temporary pressure transducers (level loggers) to record water elevations.

## ▪ **Assess Water Levels, Flows, and Project Effects**





## Water Level and Flow Effects on Historic Resources Study: **Study Status**

- Boott has initiated the data collection and the literature review in conformance with the SPD.
- Pressure transducers (level loggers) were installed in the Project's canal system in 2019, and Boott is currently collecting water level data associated with this study.
- Boott anticipates collecting water level data through 2020.
- Boott held a Study Workshop in December 2019 and has refined the data needs for this study based on consultation with the NPS. Boott will continue to review and compile data and will develop a technical study report based on the information collected and analyses conducted in support of this study.



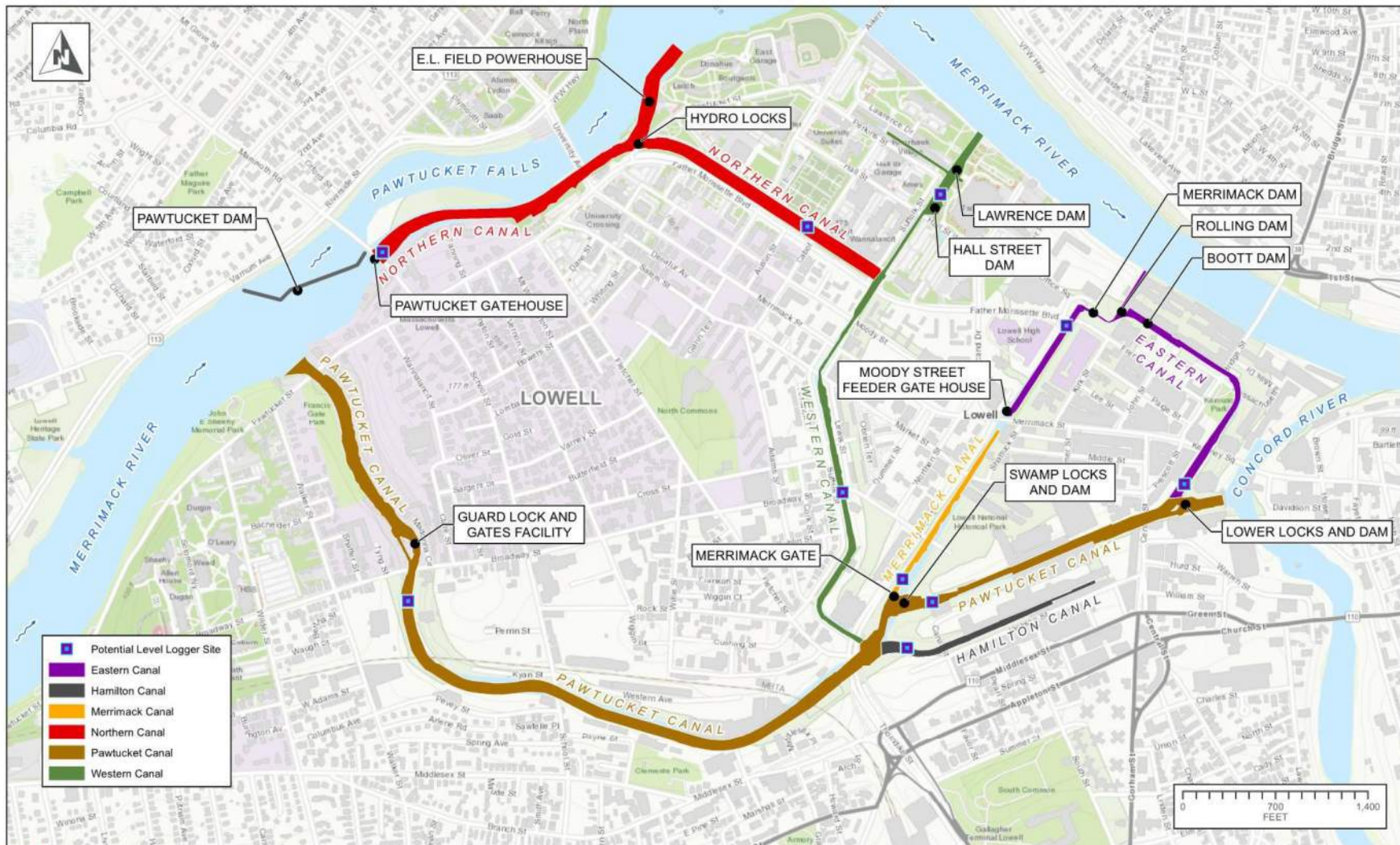
# Water Level and Flow Effects on Historic Resources Study: **Study Summary**

## ▪ **Document Review of Existing Condition**

- Boott is currently obtaining and reviewing available architectural and engineering evaluations of historic canal structures from the NPS and other stakeholders.
- Boott is planning a site visit during Q2 of 2020 with the NPS to identify issues previously noted by the NPS related to flow and water levels on historic structures.

## ▪ **Water Levels and Flow Effects**

- Boott temporarily installed level loggers at ten locations within the canal system.
- The locations were determined in consultation with the NPS.
- The loggers have collected relative water depths since June 1, 2019 at 15-minute increments. This data is currently being processed and analyzed.
- On December 18, 2020, Boott held a Study Workshop with the NPS, MADCR, City of Lowell, and other interested stakeholders to discuss a range of issues including the Water Level and Flow Effects on Historic Resources Study.
  - During the Workshop, the NPS clarified that their interest is related to the effects of the new crest gate system and potential effects on historic resources at higher water levels.
  - Stakeholders and Boott agreed that Boott should move level loggers to those locations (Upper Pawtucket Canal and Northern Canal), and remove the remaining level loggers from the downtown canal system. Boott intends to relocate level loggers to the Upper Pawtucket Canal and Northern Canal in March 2020 to capture higher spring flows.



**WATER LEVEL AND FLOW EFFECTS ON HISTORIC RESOURCES STUDY**

**LOWELL HYDROELECTRIC PROJECT**

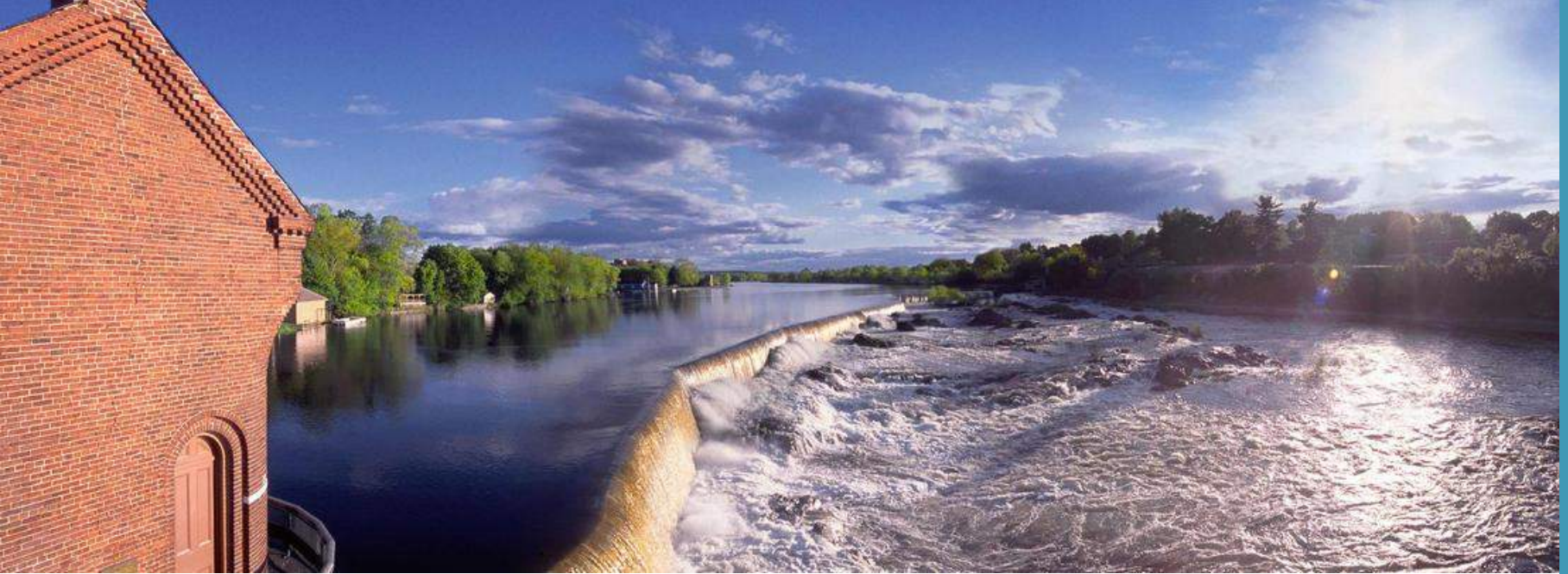
**FERC NO. 2790**



## Water Level and Flow Effects on Historic Resources Study: **Variances from FERC-approved Study Plan**

- The RSP stated the level loggers would collect water level data from May 1, 2019 through May 1, 2020. The level loggers were deployed on June 1, 2019.
- During 2019, sections of the Project's canal system were temporarily dewatered to facilitate necessary structural repairs to and replacement of bridges in the City of Lowell. As a result of this dewatering, the data collected by the level loggers does not reflect normal canal operations.
- Stakeholders and Boott agreed that Boott should move level loggers to the Upper Pawtucket Canal and Northern Canal, and remove the remaining level loggers from the downtown canal system.
- Boott intends to relocate level loggers in March 2020 to capture higher spring flows.





# Operation Analysis of the Lowell Canal Study



# Operation Analysis of the Lowell Canal Study: **Goals and Objectives**

## ▪ **Study Goals**

- Understand the operations of the Project's canal system.

## ▪ **Specific Objectives**

- Describe the operations of the canal system, which include, but are not limited to:
  - How all of the canal units interact with the main units,
  - How the canal units are sequenced,
  - how often each of the units operate,
  - the prioritization sequence of canal unit operations,
  - the amount of time the units are operated during the downstream passage season, etc.





# Operation Analysis of the Lowell Canal Study: **Study Methods**

## ▪ **Review Current Project Operations**

- Examine current Project operations, and develop a detailed description of the operational protocol used to determine when and how much water flows into the canal at a time scale relevant to the migratory fish species expected to potentially utilize the canal as a passage route (e.g., May, June, and July for spent alosines; August through November for adult eels and juvenile alosines).
- Describe:
  - How all of the canal units interact with the main units;
  - How the canal are sequenced;
  - How often each of the units operate;
  - The prioritization sequence of canal unit operations,
  - The amount of time the units are operated during the downstream passage season, as well as other operations that may potentially affect fish passage in
  - the Lowell canal.
- Boott will compile and analyze historical operations data relative to historic hydrological data to determine the percent of time the canal units would be expected to operate during each passage month.



## Operation Analysis of the Lowell Canal Study: **Study Status and Summary**

- Boott has initiated the data collection associated with the Operation Analysis of the Lowell Canal Study in conformance with the Commissions SPD.
- Boott is currently reviewing operational data for the canal system, including historical generation data.
- Boott will continue to review and compile data and will develop a technical study report based on the information collected and analyses conducted in support of this study.



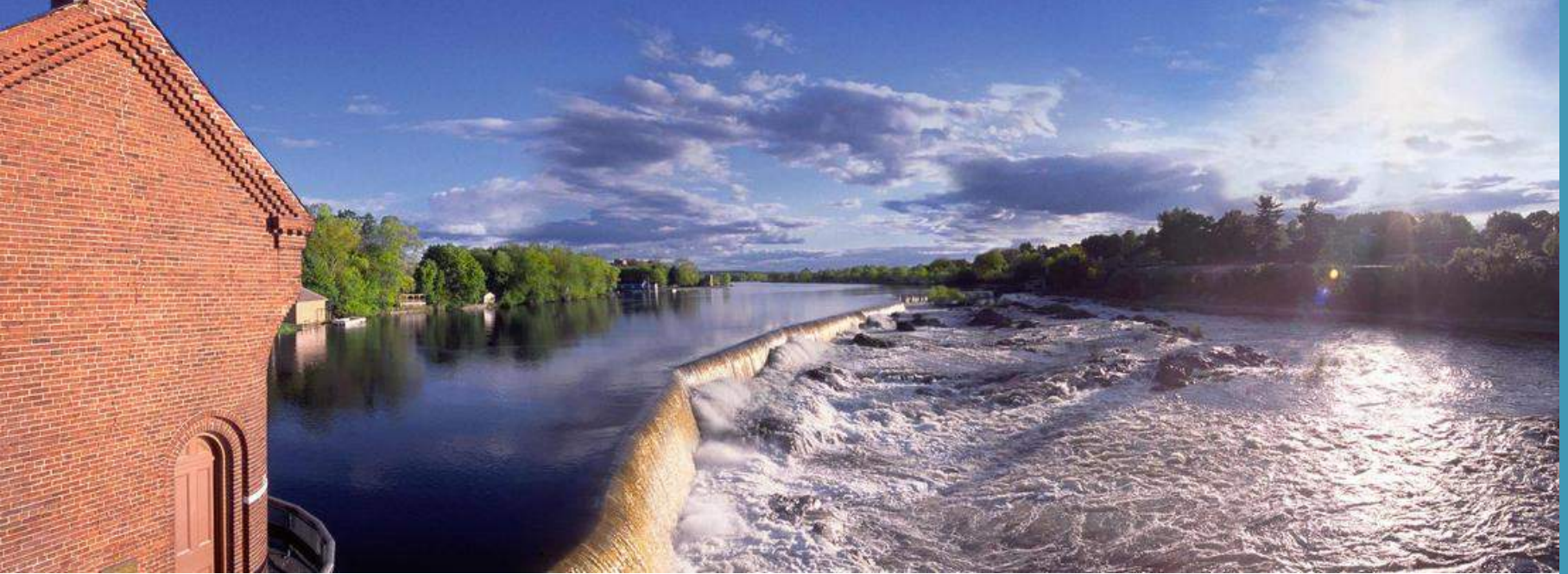


## Operation Analysis of the Lowell Canal Study: **Variances from FERC-approved Study Plan**

- The Operations Analysis is being conducted in full conformance with the Commission's SPD.
- Boott is not proposing any modifications to the Operation Analysis of the Lowell Canal Study. To the extent practical, Boott anticipates providing the Study Report with the filing of the USR in Quarter 1 of 2021.







# Historically Significant Waterpower Equipment Study

# Historically Significant Waterpower Equipment Study: **Goals and Objectives**

## ▪ **Study Goals**

- Identify and document historically significant waterpower equipment in consultation with the NPS.

## ▪ **Specific Objectives**

- Consult with the NPS and conduct a site visit to identify historically significant waterpower equipment of interest to the NPS for potential future interpretation, exhibition, or as scrap equipment to maintain and operate other historic machinery;
- Photo-document historically significant waterpower equipment identified in consultation with the NPS;
- Conduct background research on the history of identified waterpower equipment, including designer/engineer, dates of manufacture and use, and an explanation of how the equipment was or is used;
- Document current ownership of historically significant waterpower equipment; and
- Prepare a report summarizing the results of the Historically Significant Waterpower Equipment Study.



# Historically Significant Waterpower Equipment Study: **Study Methods**

## ▪ **Site Visit and Consultation**

- Coordinate with the NPS to conduct a site visit and visual inspection of Project facilities, including powerhouses and civil works.
- The purpose of the site visit will be to identify, in consultation with the NPS, historically significant Project waterpower equipment that is recommended for additional documentation.

## ▪ **Photography**

- Digitally photo-document historically significant waterpower equipment identified in consultation with the NPS, including:
  - Any extant machinery and equipment, also capturing the spatial arrangements;
  - Machinery details, such as the governor on a turbine, valves, or other details that reveal a machine's function;
  - Power transmission systems, such as line shafting; and
  - General views and details of structural framing systems.

## ▪ **Documentation**

- Research, document, and summarize relevant information of the history of significant waterpower equipment, including designer/engineer, dates of manufacture and use, and an explanation of how the equipment was or is used.
- Document current equipment ownership



# Historically Significant Waterpower Equipment Study: **Study Status and Summary**

## ▪ **Study Status**

- Boott has initiated the data collection associated with the Historically Significant Waterpower Equipment Study in full conformance with the Commissions SPD.
- Boott will continue to review and compile data and will develop a technical study report.

## ▪ **Study Summary:**

- Boott compiled, reviewed, and analyzed information from the 1976 and 1983-1984 Historic American Engineering Record (HAER) report on the history of the canal system in Lowell, as well as extensive documentation from the Lowell National Historical Park and Historic Preservation District Cultural Resources Inventory (Shepley et al. 1980), the 1976 Lowell Locks and Canals Historic District Nomination Form, and records available from the Massachusetts Cultural Resources Inventory.
- Boott expects to conduct a site visit in Q2 of 2020 with the NPS and a qualified architectural historian to review Project facilities and identify historically significant waterpower equipment (if any) for documentation.

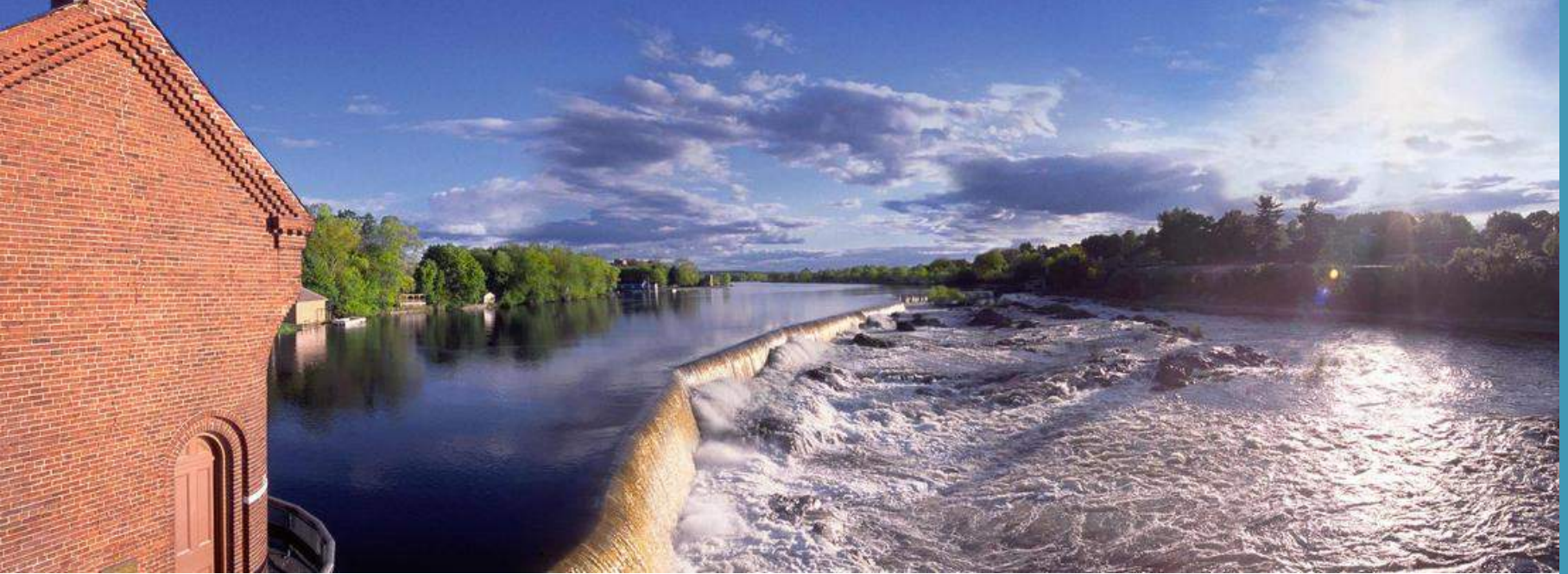


## Historically Significant Waterpower Equipment Study: **Variances from FERC-approved Study Plan**

- The Historically Significant Waterpower Equipment Study is being conducted in full conformance with the Commission's SPD.
- Boott is not proposing any modifications to the Historically Significant Waterpower Equipment Study. To the extent practical, Boott anticipates providing the Historically Significant Waterpower Equipment Study in Quarter 4 of 2020.







# Whitewater Boating and Access Study



# Whitewater Boating and Access Study: **Goals and Objectives**

## ▪ **Study Goals**

- Assess the Project's bypass reach for whitewater boating and access.

## ▪ **Specific Objectives**

- Assess a range of flows on whitewater boating opportunities in the Project's bypass reach;
- Assess the frequency, timing, duration, and predictability of paddling flows under current and proposed Project operations;
- Define the need for put-in and take-out points for boaters; and
- Assess the flow information needs for whitewater boating and the current and potential flow information distribution system.



# Whitewater Boating and Access Study: **Study Methods**

## ▪ **Study Planning and Preparation**

- Formation of a Study Working Group;
- Identification of river access locations, boating feasibility, and selection of study flows;
- Development of Safety Plan;
- Flow verification method; and
- Development of survey forms.

## ▪ **Controlled Whitewater Releases**

## ▪ **Whitewater Recreational Access**

- Conduct an evaluation of prospective whitewater recreational access to the bypass reach in consultation with the Working Group and NPS.



# Whitewater Boating and Access Study: **Study Status and Summary**

## ▪ **Study Status**

- Boott has initiated the Whitewater Boating and Access Study, including planning activities and formation of the Working Group.

## ▪ **Study Summary**

- Boott met with the Working Group on August 8, 2019 to coordinate study planning, identify potential volunteers to participate in controlled flow releases, and to identify potential put-in and take-out locations.
  - Stakeholders who attended included AW, the NPS, the City of Lowell, and Zoar Outdoor.
- On October 28, 2019, Boott distributed a Whitewater Flow Documentation Plan to the Working Group that proposed to document flows in the bypass reach using cellular-enabled trail cameras and to provide the Working Group with a summary report that presents photographs of the bypass reach under various flow conditions.
- Boott will deploy the cellular-enabled trail cameras March of 2020, and intends for the cameras to remain installed through May 15, 2020.
  - The cameras record photos on an hourly basis during daylight hours, and the photographs will be date- and time-stamped.
- Boott will consult with the Working Group based on the Whitewater Flow Documentation Report to determine the appropriate flows for the controlled flow releases in early summer of 2020, and will schedule the controlled flow releases after fish passage operations at the Project end around July 15, 2020.





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**HR** BOOTT HYDRO, LLC.

● Proposed Location of Cellular-Enabled Trail Cameras and Approximate Field of View  Project Boundary

**WHITewater FLOW DOCUMENTATION**  
**LOWELL HYDROELECTRIC PROJECT**  
 FERC NO. 2790

NOVEMBER 2013

PATH: \\SRV01\PROJECTS\LOWELL\RELIEF\2013\1417\ENR\_CSM\1\_STUDYMAP\_DOCUMENT\MAP\_SATELLITE\ARRR\LOCATIONS.MXD - USER: RAUSTIN - DATE: 11/08/13



## Whitewater Boating and Access Study: **Variances from FERC-approved Study Plan**

- The Working Group met in August 2019, rather than April or May of 2019 (as stated in the RSP), to refine the protocols specific to this study.
- As described in the Whitewater Flow Documentation Plan, Boott originally intended to deploy cameras in December 2019. Camera procurement and deployment were delayed; therefore Boott expects that the cameras will be deployed in March 2020.
  - Boott believes that this is adequate to capture significant spring flows in the bypassed reach.
- Boott is not proposing any modifications to the Whitewater Boating and Access Study. To the extent practical, Boott anticipates providing the Study Report in Quarter 4 of 2020.





**Closing**



# Upcoming ILP Milestones

Milestone	Responsible Party	Date
File ISR Meeting Summary	Boott	March 26, 2020
Stakeholders file disagreements with ISR Meeting Summary and/or requests for modified/new studies	FERC and stakeholders	April 10, 2020
Boott files response to any comments on the ISR Meeting Summary and/or requests for modified/new studies	Boott	May 10, 2020
FERC Director of the Office of Energy Projects makes a determination on any disputes/amendments to the approved study plan	FERC	June 9, 2020
Complete ongoing studies	Boott	March 1, 2020 – February 1, 2021

# Contact Information

- Stakeholders can contact Boott with questions or comments:

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