

ROYAL RIVER YARMOUTH, MAINE AQUATIC ECOSYSTEM RESTORATION STUDY

CONTINUING AUTHORITIES PROGRAM
SECTION 206

TENTATIVELY SELECTED PLAN MILESTONE
25 APRIL 2024

Presenters:

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New England District,
U.S. Army Corps of Engineers



U.S. ARMY



US Army Corps
of Engineers®
New England District





STUDY LOCATION

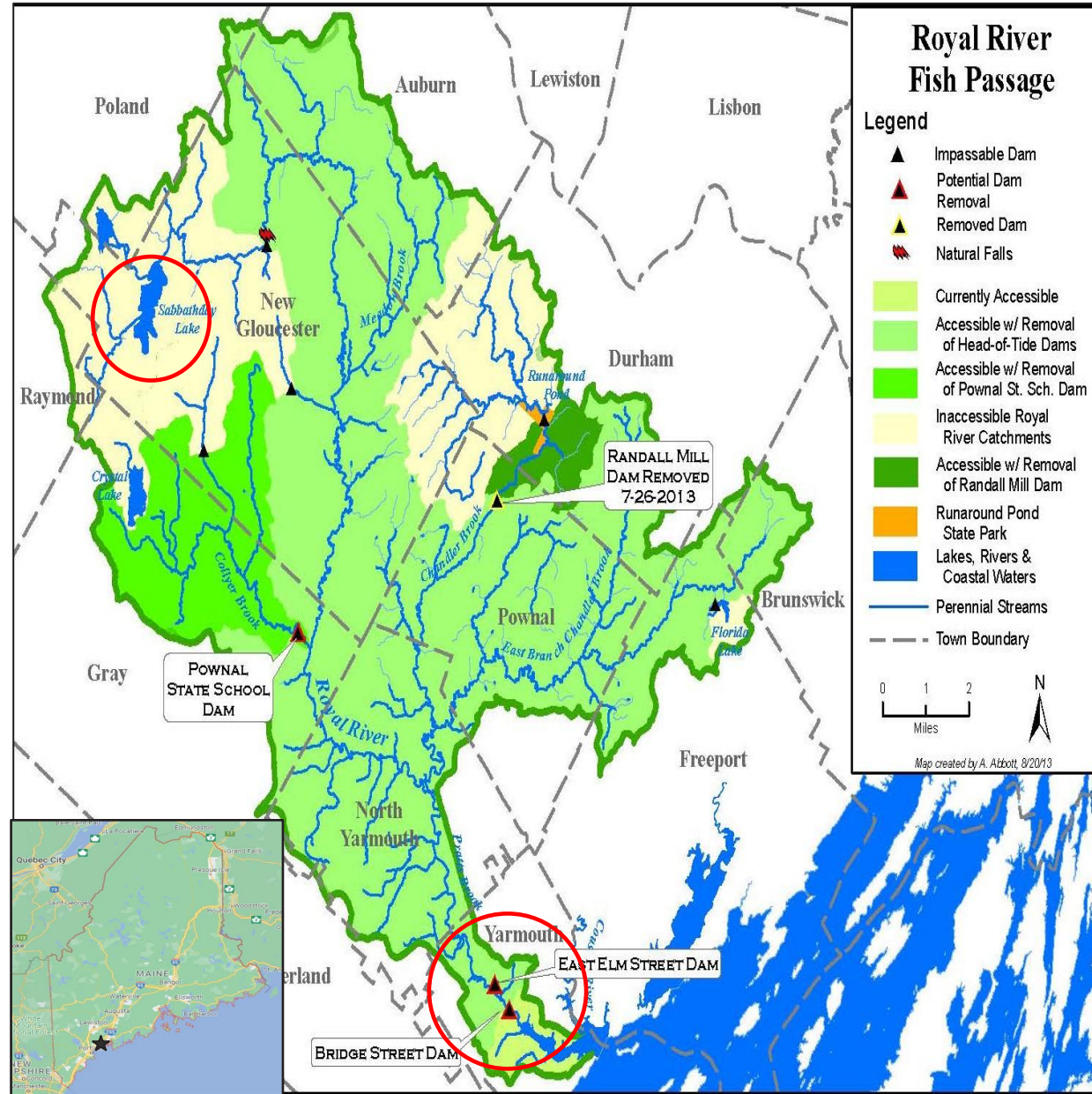
Located in southeastern Maine.

Watershed is approximately 141 square miles – mixed use land

Begins at the outlet of Sabbathday Lake in New Gloucester and flows into Casco Bay in the town of Yarmouth

Dammed beginning in 1674 to facilitate Industry (grain, paper, textiles, lumber, tanneries, poultry processing, and iron forging)

By 1958, eight man-made dams spanning the river/tributaries.





STUDY AREA

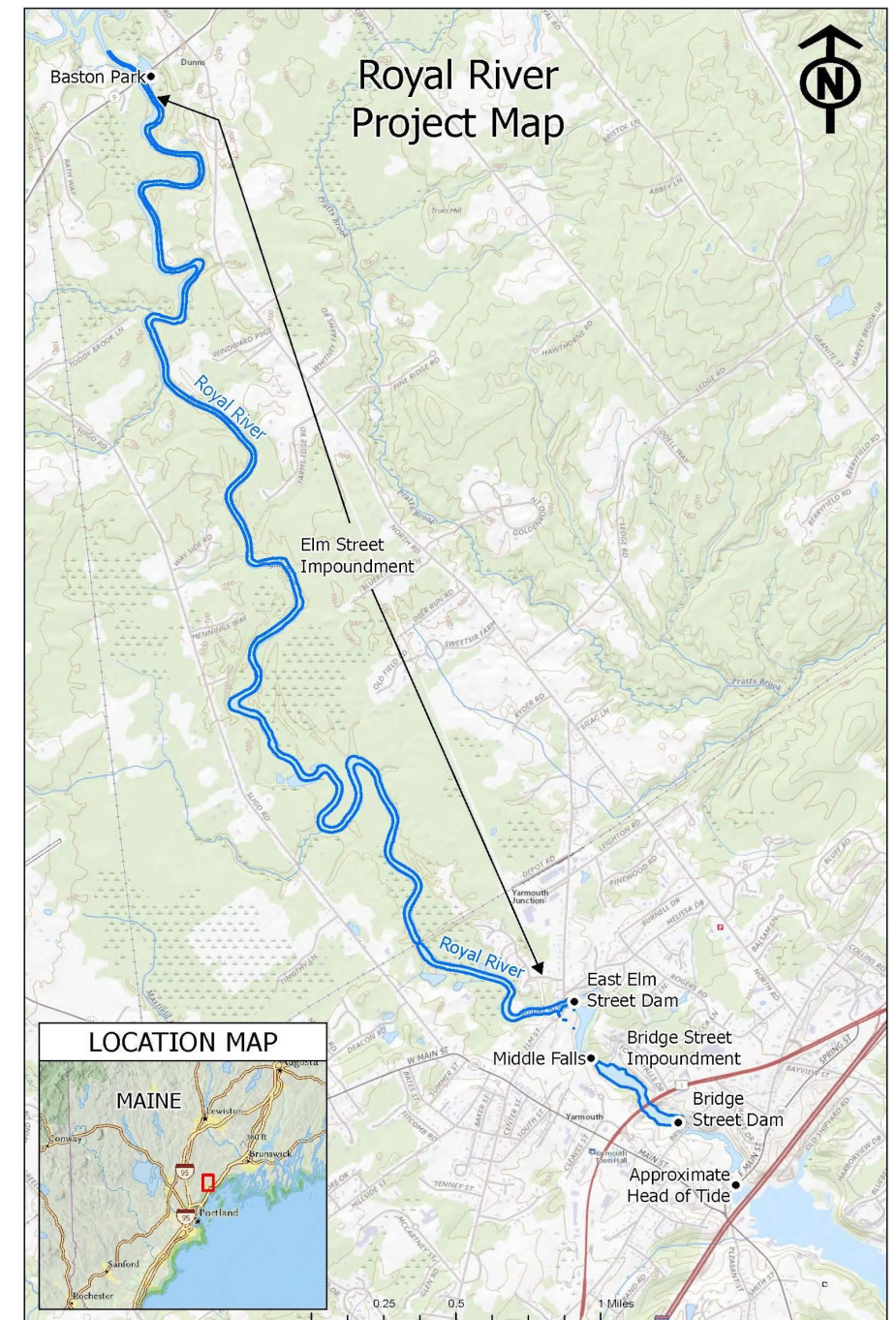
- Located the Town of Yarmouth
- From head-of-tide to Route 9/Baston Park, approximately 7.01 river miles.
- Includes most of the East Elm Street Dam Impoundment.
- Both natural and man-made barriers.

Natural Falls

- 1) Lower Falls – Not a barrier to fish passage
- 2) Middle Falls

Man-Made

- 1) Bridge Street Dam
- 2) East Elm Street Dam





BRIDGE STREET DAM

Dam

- 0.25 miles upstream from the head-of-tide (second falls)
- Reinforced concrete, gravity-type, run-of-river structure. 275 ft in length, 10-foot structural height
- Installed on top of a series of ledge outcrops.
- Hydroelectric dam built in 1870 to provided low-head water to the adjacent Sparhawk Mill through a metal penstock.
- The Sparhawk Mill Hydropower was a FERC operated dam until 2019.
- The Town of Yarmouth owns the dam and fishway

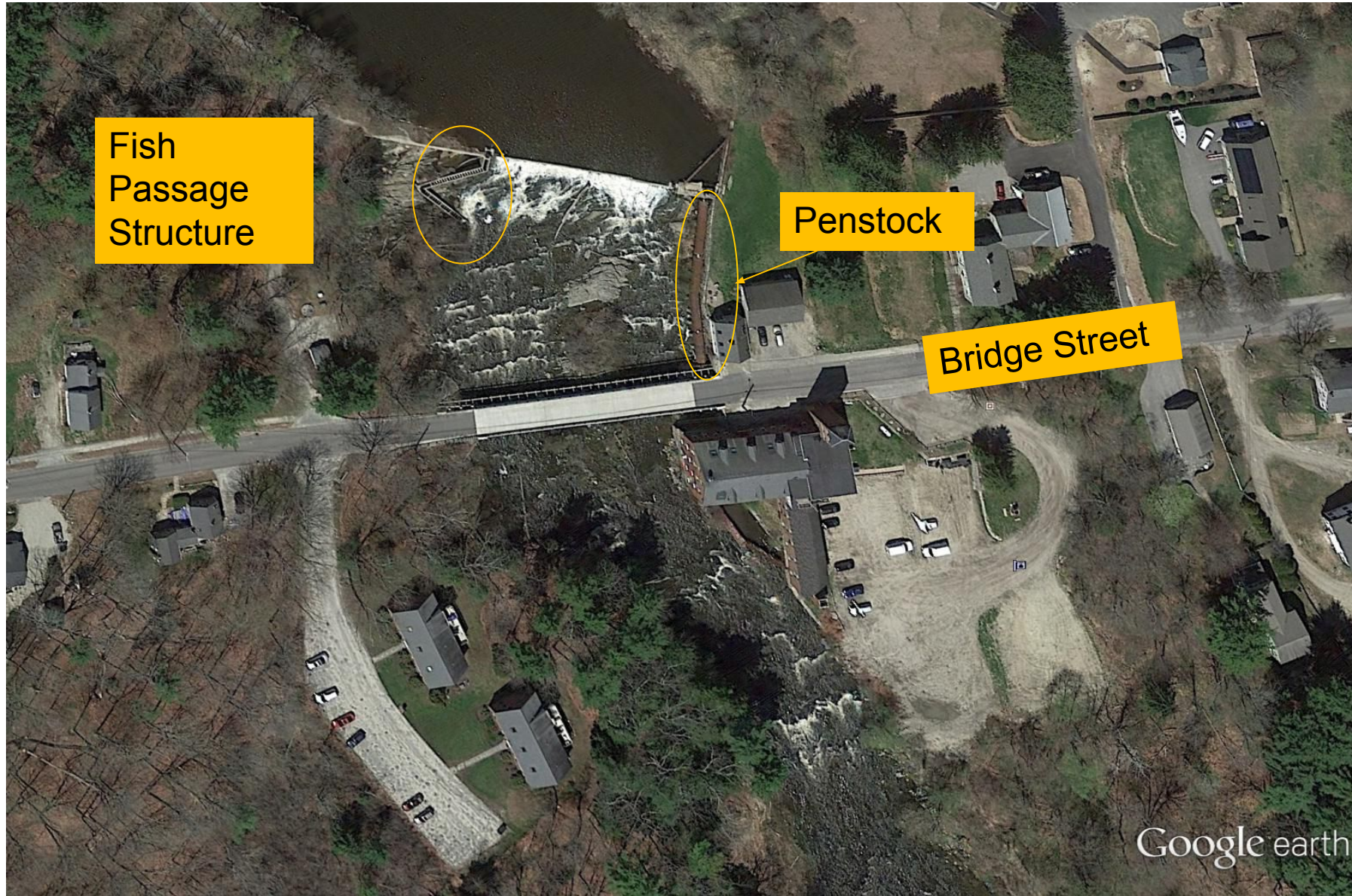
Fishway

- The dam was retrofitted in 1974 with a concrete Denil-type fishway at the southwest end of dam spillway.
- Design suitable for alewife, but problematic for other native anadromous species
- Location (40ft downstream of dam) is not ideal - lack of attraction flows, lack of suitable downstream holding pool
- Effectiveness dependent on many conditions (water flows, operational constraints, regular maintenance and debris removal)
- Years of disrepair; Recently a local volunteer group has repaired the ladder.





BRIDGE STREET DAM





EAST ELM STREET DAM

DAM

- One-half miles upstream from the Bridge Street Dam.
- Stone, run-of-river- gravity-type dam built in 1857
- 250 ft in length, 12-foot structural height
- Built atop ledge outcroppings.
- The dam is very porous with visible leaks observed and spillover occurrences.
- Impoundment extends 7 to 8 miles upstream from the dam (depending on flows).
- The Dam and fishway are owned by the Town.



FISHWAY

- A concrete Denil-type fishway built 1979 at the south end of the dam
- Location (discharge 12ft downstream of dam) is not ideal - lack of attraction flows, lack of suitable downstream holding pool
- Side channels provide competing attraction flows
- Effectiveness dependent on many conditions (water flows, operational constraints, regular maintenance and debris removal)
- Years of disrepair; Recently a local volunteer group has repaired the ladder.





EAST ELM STREET DAM



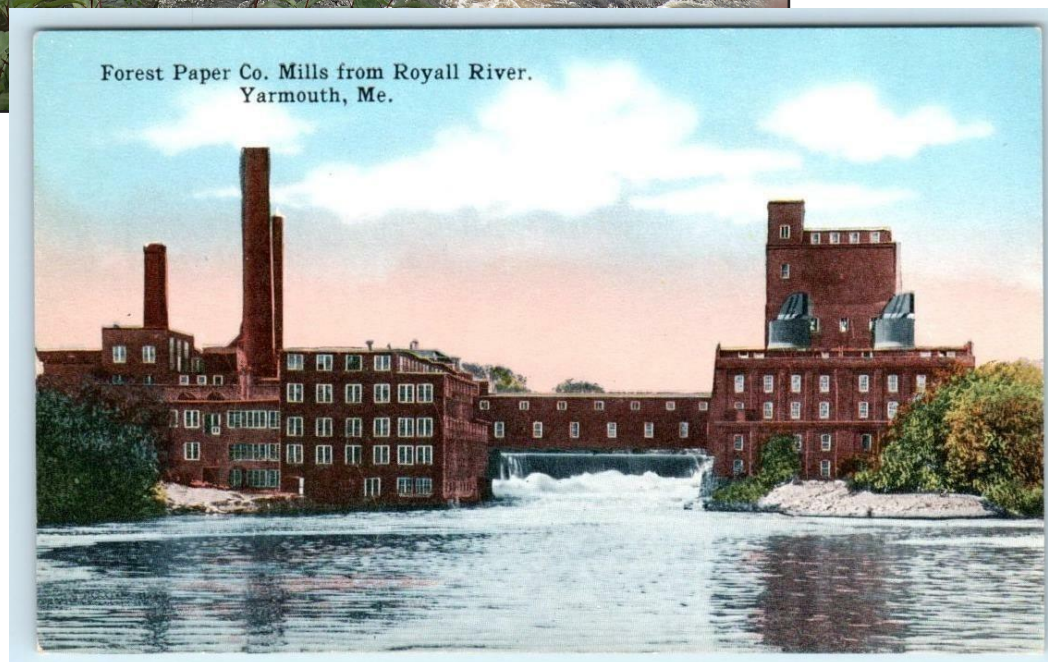
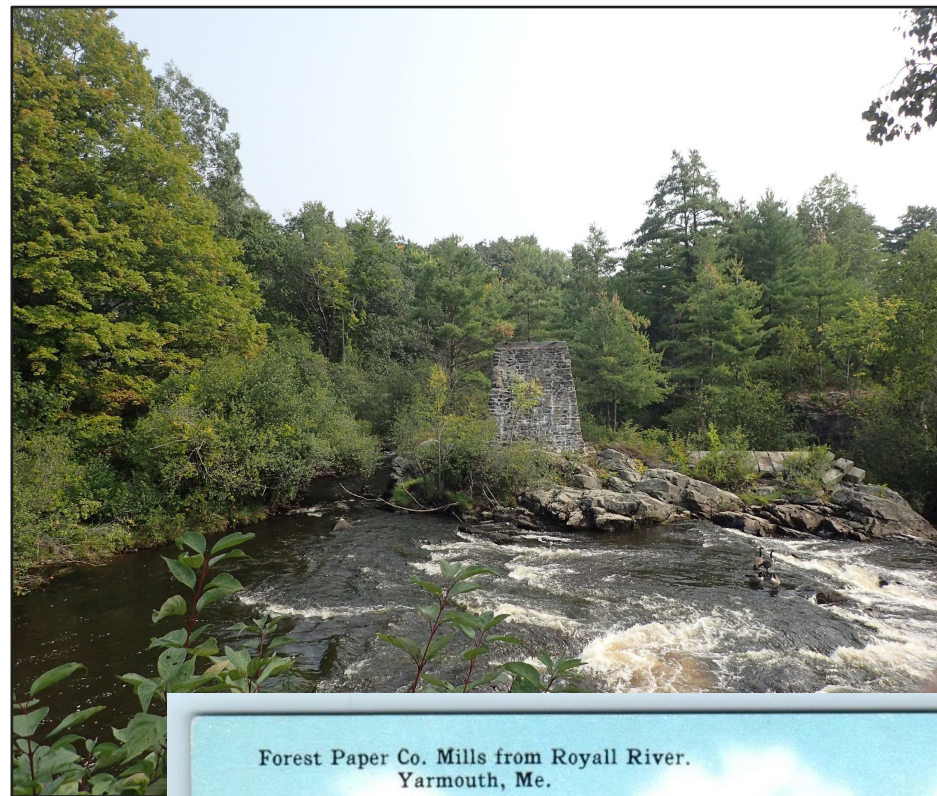
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MIDDLE FALLS

- Located between the two dams and is a barrier to fish passage. Formally the site of the Forest Paper Company mill.
- The River bifurcates around Factory Island – Main Channel and a small side channel.
- Removal of small barrier on the side channel on 2012 partially or substantially improved the channel.
- Side Channel - Predominantly middle slopes with occasional drops and short, steeper slopes over ledge outcroppings.
- Side – Channel USFWS identified two locations may hinder fish movement in 2017.





PROBLEM & OPPORTUNITIES



Problems

- Current dam and fish ladder configurations limits the upriver migration of listed and non-listed migratory fish species.
- Current configuration of Middle Falls partially or completely blocks fish passage
- The existing dams cause ecological impairment including:
 - Loss of riverine and riparian continuity
 - Conversion of riverine to lacustrine habitat
 - Loss of associated resources
- Continued O/M and repair requirements with eventual replacement costs

Opportunities

- Facilitate the passage of migratory anadromous and catadromous fish species.
- Increase connectivity within the Royal River
- Restore riverine habitat with natural temperature and flow regimes
- Enhance the overall productivity of the Royal River ecosystem.
- Restore natural falls and riffles
- Increase safety around the dam sites and reduce town liability
- Reduce O&M, repair and replacement costs associated with the dams



STUDY CONSTRAINTS



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1. **Contamination of river sediment** – Completed sediment sampling efforts to address (next slide)
2. **Downstream transport of sediments or that have accumulated on the upriver side of both dams** – Completed sediment probing upstream of the dams (next slide)
3. **Impacts to private marinas and federal navigation channel downstream of the project location.**
4. **Direct impacts to private property**





SEDIMENT INVESTIGATIONS

- October 2023 – Sediment Sampling and Testing
- November 2023 – ERDC WOTS Investigation
- December 2023 – Sediment Probing

Conclusions

- Riverbed is primarily scoured bedrock & coarse substrate with a fringe of fine sediment along portions of the bank.
- Majority of the sediments within channel profile appear to be highly mobile.
- No trace of the mercury contamination identified from previous sampling downstream of Bridge Street Dam.
- Chemical concentrations documented in sediment samples from sampled areas were generally very low.
- Sediments pose minimal risk to the marine environment (Royal River estuary and Casco Bay) under the TSP.





FORMULATION & EVALUATION OF ALTERNATIVES - MEASURES

Plan must address the three sites that restrict fish passage. Developed measures at both dams and at Middle Falls to achieve the objectives of the study.

Dam Locations

- Fish ladders Replacement (different designs and layouts)
- ~~Fish Ladder Repair~~ - Screened
- Dam/Fish Ladder Removal (full and partial)
- ~~Dam Modification~~ - Screened

Middle Falls

- Side Channel Diversion
- ~~Fish Ladder~~ - Screened
- ~~Main Channel Modification~~ – Screened
- ~~Natural Fish By Pass~~ - Screened





ARRAY OF ALTERNATIVES



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Alternative	East Elm Street Dam	Bridge Street Dam	Middle Falls
1	No Action	No Action	No Action
2	Dam/Fish Ladder Removal	Dam/Fish Ladder Removal	Diversion
3	Dam/Fish Ladder Removal	Dam/Fish Ladder Removal	No Action
4	Fish Ladder Replacement	Fish Ladder Replacement	Diversion
5	Fish Ladder Replacement	Fish Ladder Replacement	No Action
6	Fish Ladder Replacement	Dam/Fish Ladder Removal	Diversion
7	Fish Ladder Replacement	Dam/Fish Ladder Removal	No Action
8	Dam/Fish Ladder Removal	Fish Ladder Replacement	Diversion
9	Dam/Fish Ladder Removal	Fish Ladder Replacement	No Action
10	No Action	Dam/Fish Ladder Removal	Diversion
11	No Action	Dam/Fish Ladder Removal	No Action
12	No Action	Fish Ladder Replacement	Diversion
13	No Action	Fish Ladder Replacement	No Action
14	Dam/Fish Ladder Removal	No Action	Diversion
15	Dam/Fish Ladder Removal	No Action	No Action
16	Fish Ladder Replacement	No Action	Diversion
17	Fish Ladder Replacement	No Action	No Action
18	No Action	No Action	Diversion



BENEFITS ANALYSIS – ENVIRONMENTAL MODELING



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Environmental modelling assessed alewife passage

- % Passage per measure retrieved from Fish Passage Connectivity Index model
- All permutations of measures were combined
- % passage for each measure in each permutation were multiplied together with the estimated carrying capacity (k) of the project area and the area upstream.

Model Inputs

Assumptions:	% Passage
Dam Removal	100%
Natural Bypass	70%
Fish Ladder	50%
No Action	5%

Reach Name	Acres of Habitat	Alewives (117/acre)
Bridge Street Dam to 3rd Falls	6	702
3rd Falls to East Elm Street Dam	9	1053
Above East Elm Street Dam	296	34,632
Total	316	36,972



Alt 2 Bridge St Dam Removal, Factory Island Natural Bypass, East Elm St Dam Removal

k*100%(Bridge Street Removal)	36,972
k*100%(Bridge Street Removal)*70% Natural Bypass Factory Island)	25,880
k*100%(Bridge Street Removal)*70% (Natural Bypass Factory Island)*100%(East Elm St Dam Removal)	25,880





BENEFITS PER ALTERNATIVE

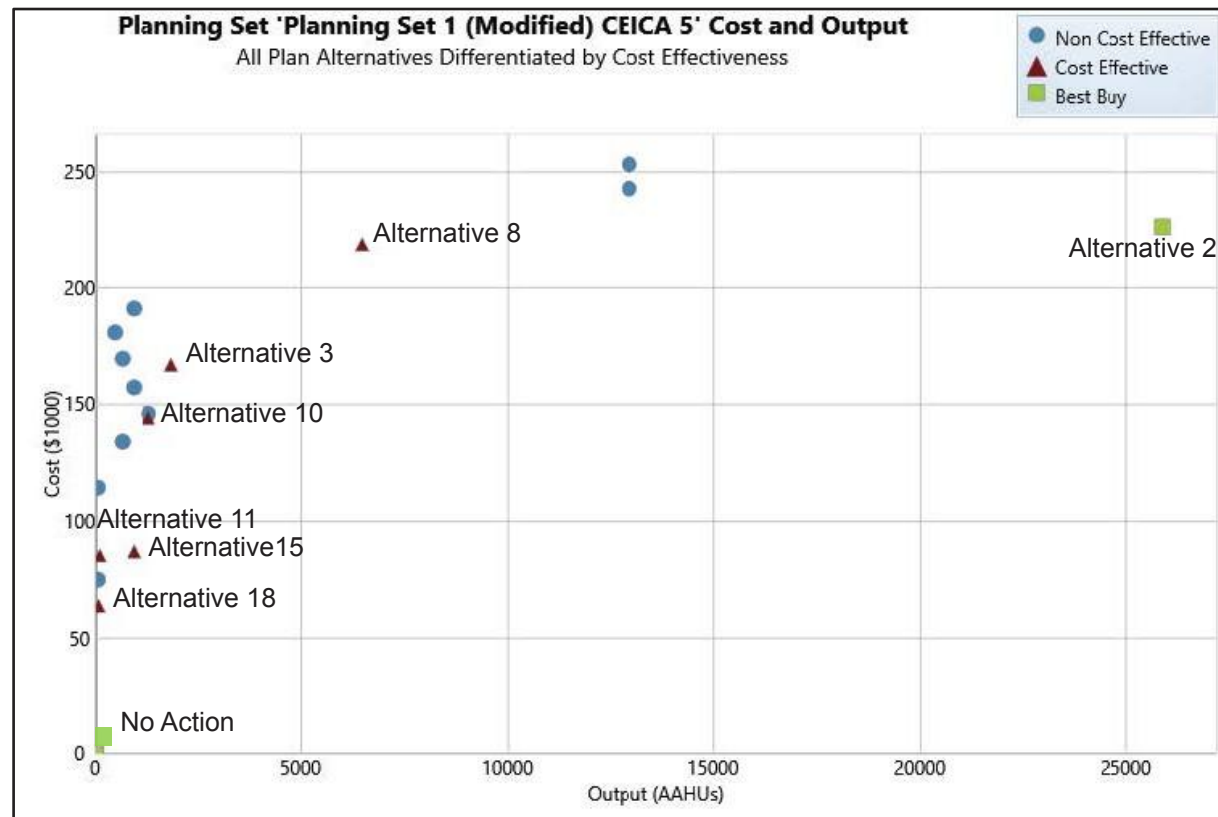
Alternative	East Elm Street Dam	Bridge Street Dam	Middle Falls	Habitat Units
2	Dam/Fish Ladder Removal	Dam/Fish Ladder Removal	Diversion	25880
4	Fish Ladder Replacement	Fish Ladder Replacement	Diversion	12940
6	Fish Ladder Replacement	Dam/Fish Ladder Removal	Diversion	12940
8	Dam/Fish Ladder Removal	Fish Ladder Replacement	Diversion	6470
3	Dam/Fish Ladder Removal	Dam/Fish Ladder Removal	No Action	1849
14	Dam/Fish Ladder Removal	No Action	Diversion	1294
10	No Action	Dam/Fish Ladder Removal	Diversion	1294
9	Dam/Fish Ladder Removal	Fish Ladder Replacement	No Action	924
15	Dam/Fish Ladder Removal	No Action	No Action	924
7	Fish Ladder Replacement	Dam/Fish Ladder Removal	No Action	924
16	Fish Ladder Replacement	No Action	Diversion	647
12	No Action	Fish Ladder Replacement	Diversion	647
5	Fish Ladder Replacement	Fish Ladder Replacement	No Action	462
11	No Action	Dam/Fish Ladder Removal	No Action	92
18	No Action	No Action	Diversion	65
17	Fish Ladder Replacement	No Action	No Action	46
13	No Action	Fish Ladder Replacement	No Action	46
1	No Action	No Action	No Action	0



COST EFFECTIVENESS/INCREMENTAL COST ANALYSIS

Alternative	East Elm Street Dam	Bridge Street Dam	Middle Falls	
1	No Action	No Action	No Action	Best Buy
2	Dam/Fish Ladder Removal	Dam/Fish Ladder Removal	Instream Diversion	Best Buy
3	Dam/Fish Ladder Removal	Dam/Fish Ladder Removal	No Action	Cost Effective
8	Dam/Fish Ladder Removal	Fish Ladder Replacement	Instream Diversion	Cost Effective
10	No Action	Dam/Fish Ladder Removal	Instream Diversion	Cost Effective
11	No Action	Dam/Fish Ladder Removal	No Action	Cost Effective
15	Dam/Fish Ladder Removal	No Action	No Action	Cost Effective
18	No Action	No Action	Instream Diversion	Cost Effective

CE/ICA analysis compares annualized costs to annualized benefits of each alternative.





TENTATIVELY SELECTED PLAN



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Alternative #2

- **Removal of the Bridge Street Dam & Fish Ladder**
 - *Removal of the entire fish ladder and*
 - *Removal of the entire dam (275 ft)*
- **Removal of the East Elm Street Dam & Fish Ladder**
 - *Removal of the entire fish ladder*
 - *120 LF of dam on the right descending bank.*
- **Construction of a Diversion at Middle Falls**
 - *Placement of large boulders to increase flow to the side channel*
 - *Chipping of rock ledges*

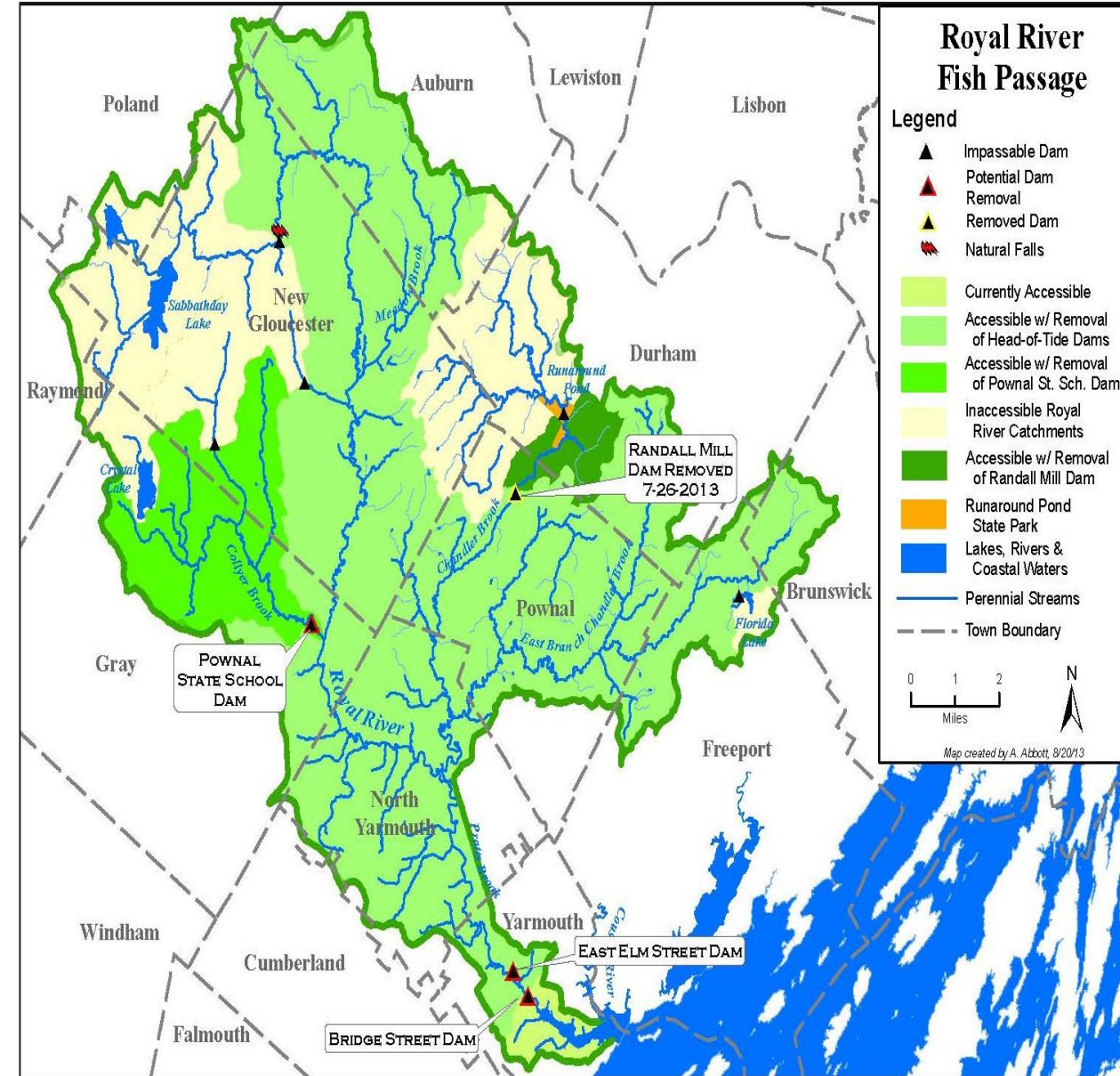




ADDITIONAL BENEFITS



- Increases connectivity providing unhindered upstream (and downstream) fish passage (32 miles on the main stem)
- Restore the currently impounded reaches of the Royal River to Riverine habitat (~6 miles)
- Restore natural river cascades
- Will benefit anadromous species in addition to other native species (white sucker, sea lamprey, brook trout)
- Elimination of millions of dollars in future O&M, repair, and replacement costs
- Improved safety and reduction of liability for the Town.
- Once construction has been completed, will not directly impact private property





CURRENT WORKING COST ESTIMATE

Estimated Total Project Cost: **\$6,281,000***

Cost share: **Federal (65%) - \$4,082,650,**
Non-Federal (35%) - \$2,198,350

ELEMENT	TOTAL COST
Bridge Street Dam/Fish Ladder Removal	\$2,186,000
East Elm Street Dam/Fish Ladder Removal	\$2,130,000
Middle Falls Natural Bypass	\$1,555,000
Cultural Resources Mitigation	\$335,000
Adaptive Management/Monitoring	\$75,000
Total	\$6,281,000

* Initial cost analysis, project costs are not final until the feasibility report has been signed; the project cost estimate may change.



MILESTONE SCHEDULE



- 25 APR 2024**---Tentatively Selected Plan Milestone (*Successfully completed*)
- 25 May 2024**---Complete the draft study report & environmental assessment (EA),
Begin District Quality Control (DQC) Review
- 25 JUN 2024**---Complete DQC Review
- 25 JUN 2024**---Begin concurrent review (includes public review) of the study report & EA. A public meeting will be held at the start of the public review.
- NOV 2024**---North Atlantic Division for review of the study report & EA
- APR 2025**---Resubmit the study report & EA
- MAY 2025**---Receive final approval of the study report & EA
- August 2025**---Execute Project Partnership Agreement to begin Design/Implementation Phase



WHAT WE ARE STILL WORKING ON



Sediment Transport Assessment – To understand the impacts of water level changes upstream of the East Elm Street Dam associated with some alternatives, an expert from ERDC has assisted the study by assessing fluvial geomorphological and sediment production/transport. The expert may revisit the study site and is in the process of completing their assessment.

Middle Falls Measure – Further refinement of the Middle Falls design to ensure fish passage past the falls. We are coordinating with a fish passage expert from US Fish and Wildlife Service, who will perform a site visit and provide input to the design.

Complete the draft study report/EA.

