Oyster River Dam Removal at Mill Pond

Durham, New Hampshire

PREPARED FOR

The Town of Durham
8 Newmarket Road
Durham, NH 03824

PREPARED BY

2 Bedford Farms Drive, Suite 200
Bedford, NH 03110
603.391.3900

February 2024

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STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION

Water Division/Land Resources Management

Wetlands Bureau

Check the Status of your Application

RSA/Rule: RSA 482-A/Env-Wt 100-900

APPLICANT'S NAME: Town of Durham **TOWN NAME:** Durham

Administrative Use Only	Administrative Use Only	Administrative Use Only	File No.:
			Check No.:
			Amount:
			Initials:

A person may request a waiver of the requirements in Rules Env-Wt 100-900 to accommodate situations where strict adherence to the requirements would not be in the best interest of the public or the environment but is still in compliance with RSA 482-A. A person may also request a waiver of the standards for existing dwellings over water pursuant to RSA 482-A:26, III(b). For more information, please consult the Waiver Request Form.

SECTION 1 - REQUIRED PLANNING FOR ALL PROJECTS (Env-Wt 306.05; RSA 482-A:3, I(d)(2))

Please use the Wetland Permit Planning Tool (WPPT), the Natural Heritage Bureau (NHB) DataCheck Tool, the Aquatic Restoration Mapper, or other sources to assist in identifying key features such as: priority resource areas (PRAs), protected species or habitats, coastal areas, designated rivers, or designated prime wetlands.

Has the required planning been completed?	☒ Yes ☐ No
Does the property contain a PRA? If yes, provide the following information:	☒ Yes ☐ No
• Does the project qualify for an Impact Classification Adjustment (e.g. NH Fish and Game Department (NHF&G) and NHB agreement for a classification downgrade) or a Project-Type Exception (e.g. Maintenance or Statutory Permit-by-Notification (SPN) project)? See Env-Wt 407.02 and Env-Wt 407.04.	☒ Yes ☐ No
• Protected species or habitat? ○ If yes, species or habitat name(s): Various species - see report ○ NHB Project ID #: 23-2114	☒ Yes ☐ No
• Bog?	☐ Yes ☒ No
• Floodplain wetland contiguous to a tier 3 or higher watercourse?	☒ Yes ☐ No
• Designated prime wetland or duly-established 100-foot buffer?	☐ Yes ☒ No
• Sand dune, tidal wetland, tidal water, or undeveloped tidal buffer zone?	☒ Yes ☐ No
Is the property within a Designated River corridor? If yes, provide the following information: • Name of Local River Management Advisory Committee (LAC): Oyster River LAC • A copy of the application was sent to the LAC on Month: 02 Day: 09 Year: 2024	☒ Yes ☐ No

For dredging projects, is the subject property contaminated? • If yes, list contaminant: Not a "dredging" project. See application narrative for sediment sampling results.	☐ Yes ☐ No
Is there potential to impact impaired waters, class A waters, or outstanding resource waters?	☒ Yes ☐ No
For stream crossing projects, provide watershed size (see WPPT or Stream Stats): N/A	

SECTION 2 - PROJECT DESCRIPTION (Env-Wt 311.04(i))

Provide a **brief** description of the project and the purpose of the project, outlining the scope of work to be performed and whether impacts are temporary or permanent. DO NOT reply "See attached"; please use the space provided below.

The Town of Durham proposes to permanently impact approximately 70,400 sq ft within palustrine wetlands and approximately 310 sq ft within the developed tidal buffer zone (DTBZ) and temporarily impact approximately 23,340 sq ft within palustrine wetlands and approximately 4,350 sq ft within the developed tidal buffer zone (DTBZ) to remove the Mill Pond Dam on the Oyster River, restore a portion of the Oyster River, promote natural vegetation establishment and invasive species management efforts within the drained impoundment, and stabilize the outlets of existing stormwater outfalls along the perimeter of the impoundment. Refer to the **Application Narrative** for more detailed information.

SECTION 3 - PROJECT LOCATION

Separate wetland permit applications must be submitted for each municipality within which wetland impacts occur.

ADDRESS: South of Mill Pond Road and west of Newmarket Road
TOWN/CITY: Durham
TAX MAP/BLOCK/LOT/UNIT: Various
US GEOLOGICAL SURVEY (USGS) TOPO MAP WATERBODY NAME: Oyster River (impounded as "Mill Pond") ☐ N/A
(Optional) LATITUDE/LONGITUDE in decimal degrees (to five decimal places): 43.130475° North -70.92076° West

SECTION 4 - APPLICANT (DESIRED PERMIT HOLDER) INFORMATION (Env-Wt 311.04(a)) If the applicant is a trust or a company, then complete with the trust or company information.		
NAME: Town of Durham c/o Rich Reine (Public Works Director)		
MAILING ADDRESS: 100 Stone Quarry Drive		
TOWN/CITY: Durham	STATE: NH	ZIP CODE: 03824
EMAIL ADDRESS: rreine@ci.durham.nh.us		
FAX:	PHONE: 603-868-5578	
ELECTRONIC COMMUNICATION: By initialing here: RR, I hereby authorize NHDES to communicate all matters relative to this application electronically.		
SECTION 5 - AUTHORIZED AGENT INFORMATION (Env-Wt 311.04(c)) ☐ N/A		
LAST NAME, FIRST NAME, M.I.: Walker, Peter, J.		
COMPANY NAME: VHB		
MAILING ADDRESS: 2 Bedford Farms Drive, Suite 200		
TOWN/CITY: Bedford	STATE: NH	ZIP CODE: 03110
EMAIL ADDRESS: pwalker@vhb.com		
FAX:	PHONE: 603-391-3900	
ELECTRONIC COMMUNICATION: By initialing here PJW, I hereby authorize NHDES to communicate all matters relative to this application electronically.		
SECTION 6 - PROPERTY OWNER INFORMATION (IF DIFFERENT THAN APPLICANT) (Env-Wt 311.04(b)) If the owner is a trust or a company, then complete with the trust or company information. ☒ Same as applicant		
NAME:		
MAILING ADDRESS:		
TOWN/CITY:	STATE:	ZIP CODE:
EMAIL ADDRESS:		
FAX:	PHONE:	
ELECTRONIC COMMUNICATION: By initialing here , I hereby authorize NHDES to communicate all matters relative to this application electronically.		

SECTION 7 - RESOURCE-SPECIFIC CRITERIA ESTABLISHED IN Env-Wt 400, Env-Wt 500, Env-Wt 600, Env-Wt 700, OR Env-Wt 900 HAVE BEEN MET (Env-Wt 313.01(a)(3))

Describe how the resource-specific criteria have been met for each chapter listed above (please attach information about stream crossings, coastal resources, prime wetlands, or non-tidal wetlands and surface waters):
All jurisdictional areas were delineated by a NH Certified Wetlands Scientist and classified in accordance with the requirements of Env-Wt 400. The proposed project will meet the applicable rule requirements; however, Env-Wt 700, Env-Wt 800, and Env-Wt 900 are not applicable to this Project. There are no prime wetlands within the vicinity of the site, mitigation is not triggered or proposed for this minimum impact restoration project, and there are no proposed stream crossings. The project-specific criteria in Env-Wt 500 (i.e., 514 and 525 for bank stabilization and restoration / enhancement activities) and Env-Wt 600 (for tidal waters) are addressed in detail in the Application Narrative.

SECTION 8 - AVOIDANCE AND MINIMIZATION

Impacts within wetland jurisdiction must be avoided to the maximum extent practicable (Env-Wt 313.03(a)).* Any project with unavoidable jurisdictional impacts must then be minimized as described in the Wetlands Best Management Practice Techniques For Avoidance and Minimization and the Wetlands Permitting: Avoidance, Minimization and Mitigation Fact Sheet. For minor or major projects, a functional assessment of all wetlands on the project site is required (Env-Wt 311.03(b)(10)).*

Please refer to the application checklist to ensure you have attached all documents related to avoidance and minimization, as well as functional assessment (where applicable). Use the Avoidance and Minimization Checklist, the Avoidance and Minimization Narrative, or your own avoidance and minimization narrative.

**See Env-Wt 311.03(b)(6) and Env-Wt 311.03(b)(10) for shoreline structure exemptions.*

SECTION 9 - MITIGATION REQUIREMENT (Env-Wt 311.02)

If unavoidable jurisdictional impacts require mitigation, a mitigation pre-application meeting must occur at least 30 days but not more than 90 days prior to submitting this Standard Dredge and Fill Permit Application.

Mitigation Pre-Application Meeting Date: Month: 12 Day: 07 Year: 2023

(☐ N/A - Mitigation is not required) ***Also 7/12/2023, 9/25/2023, and 11/6/2023.***

SECTION 10 - THE PROJECT MEETS COMPENSATORY MITIGATION REQUIREMENTS (Env-Wt 313.01(a)(1)c)

Confirm that you have submitted a compensatory mitigation proposal that meets the requirements of Env-Wt 800 for all permanent unavoidable impacts that will remain after avoidance and minimization techniques have been exercised to the maximum extent practicable: ☐ I confirm submittal.

(☒ N/A – Compensatory mitigation is not required)

SECTION 11 - IMPACT AREA (Env-Wt 311.04(g))

For each jurisdictional area that will be/has been impacted, provide square feet (SF) and, if applicable, linear feet (LF) of impact, and note whether the impact is after-the-fact (ATF; i.e., work was started or completed without a permit).

For intermittent and ephemeral streams, the linear footage of impact is measured along the thread of the channel. *Please note, installation of a stream crossing in an ephemeral stream may be undertaken without a permit per Rule Env-Wt 309.02(d), however other dredge or fill impacts should be included below.*

For perennial streams/rivers, the linear footage of impact is calculated by summing the lengths of disturbances to the channel and banks.

Permanent impacts are impacts that will remain after the project is complete (e.g., changes in grade or surface materials).

Temporary impacts are impacts not intended to remain (and will be restored to pre-construction conditions) after the project is completed.

JURISDICTIONAL AREA		PERMANENT			TEMPORARY		
		SF	LF	ATF	SF	LF	ATF
Wetlands	Forested Wetland			☐			☐
	Scrub-shrub Wetland			☐			☐
	Emergent Wetland			☐			☐
	Wet Meadow			☐			☐
	Vernal Pool			☐			☐
	Designated Prime Wetland			☐			☐
	Duly-established 100-foot Prime Wetland Buffer			☐			☐
Surface Water	Intermittent / Ephemeral Stream			☐			☐
	Perennial Stream or River			☐			☐
	Lake / Pond	66,570	740	☐	21,340	540	☐
	Docking - Lake / Pond			☐			☐
	Docking - River			☐			☐
Banks	Bank - Intermittent Stream			☐			☐
	Bank - Perennial Stream / River			☐			☐
	Bank / Shoreline - Lake / Pond	3,830	195	☐	2,000	60	☐
Tidal	Tidal Waters			☐			☐
	Tidal Marsh			☐			☐
	Sand Dune			☐			☐
	Undeveloped Tidal Buffer Zone (TBZ)			☐			☐
	Previously-developed TBZ	310		☐	4,350		☐
	Docking - Tidal Water			☐			☐
TOTAL		70,710	935		**27,690**	**600**	

SECTION 12 - APPLICATION FEE (RSA 482-A:3, I)

☒ **MINIMUM IMPACT FEE**: Flat fee of $400.

☐ **NON-ENFORCEMENT RELATED, PUBLICLY-FUNDED AND SUPERVISED RESTORATION PROJECTS, REGARDLESS OF IMPACT CLASSIFICATION:** Flat fee of $400 (refer to RSA 482-A:3, 1(c) for restrictions).

☐ **MINOR OR MAJOR IMPACT FEE:** Calculate using the table below:

Permanent and temporary (non-docking):	98,400 SF	× $0.40 =	$ N/A
Seasonal docking structure:	0 SF	× $2.00 =	$ 0
Permanent docking structure:	0 SF	× $4.00 =	$ 0
Projects proposing shoreline structures (including docks) add $400 =			$ 0
		Total =	$ 400

The application fee for minor or major impact is the above calculated total or $400, whichever is greater = $ 400

SECTION 13 - PROJECT CLASSIFICATION (Env-Wt 306.05)

Indicate the project classification.

☒ Minimum Impact Project	☐ Minor Project	☐ Major Project

SECTION 14 - REQUIRED CERTIFICATIONS (Env-Wt 311.11)

Initial each box below to certify:

Initials: RK RK RK	To the best of the signer's knowledge and belief, all required notifications have been provided.
Initials: RR RR RR	The information submitted on or with the application is true, complete, and not misleading to the best of the signer's knowledge and belief.
Initials: RR RR RR	The signer understands that: • The submission of false, incomplete, or misleading information constitutes grounds for NHDES to: 1. Deny the application. 2. Revoke any approval that is granted based on the information. 3. If the signer is a certified wetland scientist, licensed surveyor, or professional engineer licensed to practice in New Hampshire, refer the matter to the joint board of licensure and certification established by RSA 310-A:1. • The signer is subject to the penalties specified in New Hampshire law for falsification in official matters, currently RSA 641. • The signature shall constitute authorization for the municipal conservation commission and the Department to inspect the site of the proposed project, except for minimum impact forestry SPN projects and minimum impact trail projects, where the signature shall authorize only the Department to inspect the site pursuant to RSA 482-A:6, II.
Initials: NA NA NA	If the applicant is not the owner of the property, each property owner signature shall constitute certification by the signer that he or she is aware of the application being filed and does not object to the filing.

SECTION 15 - REQUIRED SIGNATURES (Env-Wt 311.04(d); Env-Wt 311.11)

SIGNATURE (OWNER):	PRINT NAME LEGIBLY: Town of Durham c/o Rich Reine (Public Works Director)	DATE: 2.5.24
SIGNATURE (APPLICANT, IF DIFFERENT FROM OWNER):	PRINT NAME LEGIBLY:	DATE:
SIGNATURE (AGENT, IF APPLICABLE): Peter J Walker	PRINT NAME LEGIBLY: Peter J. Walker	DATE: 2/6/24

SECTION 16 - TOWN / CITY CLERK SIGNATURE (Env-Wt 311.04(f))

As required by RSA 482-A:3, I(a)(1), I hereby certify that the applicant has filed four application forms, four detailed plans, and four USGS location maps with the town/city indicated below.

TOWN/CITY CLERK SIGNATURE:	PRINT NAME LEGIBLY:
TOWN/CITY: Durham	DATE:

DIRECTIONS FOR TOWN/CITY CLERK:
Per RSA 482-A:3, I(a)(1)

1. IMMEDIATELY sign the original application form and four copies in the signature space provided above.
2. Return the signed original application form and attachments to the applicant so that the applicant may submit the application form and attachments to NHDES by mail or hand delivery.
3. IMMEDIATELY distribute a copy of the application with one complete set of attachments to each of the following bodies: the municipal Conservation Commission, the local governing body (Board of Selectmen or Town/City Council), and the Planning Board.
4. Retain one copy of the application form and one complete set of attachments and make them reasonably accessible for public review.

DIRECTIONS FOR APPLICANT:
Submit the original permit application form bearing the signature of the Town/City Clerk, additional materials, and the application fee to NHDES by mail or hand delivery at the address at the bottom of this page. Make check or money order payable to "Treasurer – State of NH".

STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION ATTACHMENT A: MINOR AND MAJOR PROJECTS

Water Division/Land Resources Management

Wetlands Bureau

Check the Status of your Application

RSA/ Rule: RSA 482-A/ Env-Wt 311.10; Env-Wt 313.01(a)(1); Env-Wt 313.03

APPLICANT'S NAME: **Town of Durham** **TOWN NAME:** Durham

Attachment A is required for *all minor and major projects*, and must be completed *in addition* to the Avoidance and Minimization Narrative or Checklist that is required by Env-Wt 307.11.

For projects involving construction or modification of non-tidal shoreline structures over areas of surface waters having an absence of wetland vegetation, only Sections I.X through I.XV are required to be completed.

PART I: AVOIDANCE AND MINIMIZATION

In accordance with Env-Wt 313.03(a), the Department shall not approve any alteration of any jurisdictional area unless the applicant demonstrates that the potential impacts to jurisdictional areas have been avoided to the maximum extent practicable and that any unavoidable impacts have been minimized, as described in the Wetlands Best Management Practice Techniques For Avoidance and Minimization.

SECTION I.I - ALTERNATIVES (Env-Wt 313.03(b)(1))

Describe how there is no practicable alternative that would have a less adverse impact on the area and environments under the Department's jurisdiction.

The Town of Durham proposes to remove the Oyster River Dam at Mill Pond due to concerns regarding its structural integrity and stability and to restore habitat for anadromous fish. Additional proposed work includes active restoration of the Oyster River channel upstream of the dam and invasive species management in the drained impoundment area. Refer to **Section 3** of the **Application Narrative** for more project details. A detailed alternatives analysis is discussed in **Section 7.3** of the **Application Narrative** and in the Feasibility Study, while various design component alternatives are discussed throughout the Application Narrative. In summary, we believe that the proposed design minimizes adverse impacts to the extent feasible while maximizing beneficial environmental restoration outcomes. Sediment accumulation and transport potential from Mill Pond and the upper limits of the impoundment beyond the pond were assessed in detail. The proposed active channel restoration and associated excavation of the existing loose fine sediments within the river channel will minimize the initial downstream sediment release while allowing the Oyster River to resume a natural sediment transport function (typical of rivers in equilibrium) that will benefit the sediment starved downstream salt marshes. Although sediment sampling within the impoundment identified some contaminates typical of urban-suburban environments, the proposed active channel restoration (i.e., excavation, channel stabilization, and grade controls) will mitigate any potential adverse affects by reducing sediment transport. Some of the many project benefits include improved upstream fish passage, improved water quality (given the existing eutrophication), restoration of tidal flow farther upstream, increased habitat diversity, improved public safety (via removal of unsafe and unnecessary dam infrastructure), and increased flood resiliency.

SECTION I.II - MARSHES (Env-Wt 313.03(b)(2))

Describe how the project avoids and minimizes impacts to tidal marshes and non-tidal marshes where documented to provide sources of nutrients for finfish, crustacean, shellfish, and wildlife of significant value.

This section is not applicable to the proposed Project, as there are no known tidal or non-tidal marshes within the Project area in accordance with the definition of a "marsh" in Env-Wt 103.37 or mapped in the NHDES Wetlands Permit Planning Tool (WPPT). There are areas of emergent (PEM) fringes along Mill Pond within the Project area and tidal marsh habitat downstream of the Project area.

Nevertheless, this project minimizes potential impacts to marshes through the proposed active channel restoration. This portion of the proposed work will remove a high volume of existing loose fine sediment, stabilize the restored upstream river channel, and add a stone cross vane grade control at the upstream limit of channel restoration to minimize sediment transport from the upstream reaches of the impoundment. Refer to **Section 3.2** of the **Application Narrative** for more details of the proposed design.

SECTION I.III - HYDROLOGIC CONNECTION (Env-Wt 313.03(b)(3))

Describe how the project maintains hydrologic connections between adjacent wetland or stream systems.

This project will improve the hydrologic connections between adjacent wetland and stream systems. The proposed dam removal will allow the Oyster River to flow normally. The existing impoundment (primarily Mill Pond but also the Middle Impoundment and Hamel Brook) will recede into the central Oyster River channel and transition into bordering wetland and riparian habitat. Since the existing dam is located at the head of tide, tidal flow will be able to extend farther upstream and potentially expand tidal wetland habitats over time. Refer to **Section 5.2** of the **Application Narrative** for more information regarding hydrology and hydraulics.

SECTION I.IV - JURISDICTIONAL IMPACTS (Env-Wt 313.03(b)(4))

Describe how the project avoids and minimizes impacts to wetlands and other areas of jurisdiction under RSA 482-A, especially those in which there are exemplary natural communities, vernal pools, protected species and habitat, documented fisheries, and habitat and reproduction areas for species of concern, or any combination thereof.

The overall limits of work within jurisdictional areas were minimized to the extent practical while still achieving the project objectives. As previously described, the proposed active channel restoration in conjunction with the dam removal will minimize downstream sediment transport and stabilize the river channel, making these proposed impacts worth while. Construction access to the upstream river channel is proposed through the drained impoundment on a temporary access road that will be removed and restored post-construction. No vernal pools are present within the Project area.

Consultation with both NHB and NHF&G is detailed in **Section 6** of the **Application Narrative**. Both agencies acknowledge that there will be temporary (and permanent in the case of some plant species) impacts to the rare, threatened, and endangered species that may be present within the Project area. However, the overall benefits of the project outweigh any negatives. Wildlife species will be able to adapt to the habitat changes and fish in particular will benefit from increased upstream access. We will continue to coordinate project details (such as draw down timeframe) with NHF&G. We will also continue to work with NHB to develop best management practices for the potential rare plant populations (whether that includes a plant rescue plan, top soil salvage and reuse, or a combination thereof).

Section 7 consultation through the USFWS IPaC system relative to the northern long-eared bat and roseate tern are pending input from the USACE as the lead federal agency. However, we anticipate that this project will not adversely affect these species. Refer to **Section 6** of the **Application Narrative** for more information.

SECTION I.V - PUBLIC COMMERCE, NAVIGATION, OR RECREATION (Env-Wt 313.03(b)(5))

Describe how the project avoids and minimizes impacts that eliminate, depreciate or obstruct public commerce, navigation, or recreation.

Given the existing dam, the Oyster River within the Project area is not used for navigation or commerce. However, Durham residents do recreate in and around Mill Pond. Recreational activities include, but are not limited to, kayaking, bird watching, and fishing. Despite the proposed dam removal that will drain the existing impoundment, the Project area will still be open for public enjoyment from the abutting public parks post-construction.

SECTION I.VI - FLOODPLAIN WETLANDS (Env-Wt 313.03(b)(6))

Describe how the project avoids and minimizes impacts to floodplain wetlands that provide flood storage.

The implementation of this Project will remove the dam (a hydraulic barrier within the Oyster River) which will decrease flood elevations within Mill Pond and upstream. Dam removal will drain the existing Mill Pond impoundment which will transition into wetland and riparian habitat around the Oyster River. This adjacent low lying land will be better able to receive and retain flood flows compared to the existing inundated conditions, protecting the adjacent and downstream properties.

According to the NHDES WPPT, the entire Project area is mapped as a Floodplain Wetland Adjacent to a Tier 3 Watercourse Priority Resource Area (PRA). Additionally, the FEMA-mapped regulatory floodway occupies most of the Mill Pond impoundment and 100-year floodplain borders the floodway in low topographic areas within the Project area.

SECTION I.VII - RIVERINE FORESTED WETLAND SYSTEMS AND SCRUB-SHRUB – MARSH COMPLEXES (Env-Wt 313.03(b)(7))

Describe how the project avoids and minimizes impacts to natural riverine forested wetland systems and scrub-shrub – marsh complexes of high ecological integrity.

There are no scrub-shrub-marsh complexes or riverine forested wetland systems within the Project area. The wetlands delineated within the Project area are primarily palustrine unconsolidated and aquatic bed with few occurrences of emergent and scrub-shrub wetland classifications along the pond perimeter. Although many parts of the pond have become dominated by aquatic and emergent vegetation, it is not an area of high ecological integrity due in part to eutrophication and algal blooms.

SECTION I.VIII - DRINKING WATER SUPPLY AND GROUNDWATER AQUIFER LEVELS (Env-Wt 313.03(b)(8))

Describe how the project avoids and minimizes impacts to wetlands that would be detrimental to adjacent drinking water supply and groundwater aquifer levels.

The proposed dam removal and associated work for this project will not adversely impact drinking water supply or groundwater aquifer levels.

According to the NH GRANIT View aquifer transmissivity data, the Project area is not underlain by an aquifer and Mill Pond is not a drinking water supply. The University of New Hampshire Dam (also known as the Oyster River Reservoir Dam) is located approximately 1.5 miles upstream of the Project area and impounds the Oyster River Reservoir, which is a drinking water supply. This upstream resource will not be impacted by the proposed work.

SECTION I.IX - STREAM CHANNELS (Env-Wt 313.03(b)(9))

Describe how the project avoids and minimizes adverse impacts to stream channels and the ability of such channels to handle runoff of waters.

This project will restore the upstream Oyster River channel which is currently ill defined within the existing impounded Mill Pond. This project will restore the natural flow regime of the Oyster River and drain the existing impoundment which will increase the capacity of this area to handle runoff waters and other high flow or flood events.

SECTION I.X - SHORELINE STRUCTURES - CONSTRUCTION SURFACE AREA (Env-Wt 313.03(c)(1))

Describe how the project has been designed to use the minimum construction surface area over surface waters necessary to meet the stated purpose of the structures.

This section is not applicable to the proposed Project, as no shoreline structures are proposed.

SECTION I.XI - SHORELINE STRUCTURES - LEAST INTRUSIVE UPON PUBLIC TRUST (Env-Wt 313.03(c)(2))

Describe how the type of construction proposed is the least intrusive upon the public trust that will ensure safe docking on the frontage.

This section is not applicable to the proposed Project, as no shoreline structures are proposed.

SECTION I.XII - SHORELINE STRUCTURES – ABUTTING PROPERTIES (Env-Wt 313.03(c)(3))

Describe how the structures have been designed to avoid and minimize impacts on ability of abutting owners to use and enjoy their properties.

This section is not applicable to the proposed Project, as no shoreline structures are proposed.

SECTION I.XIII - SHORELINE STRUCTURES – COMMERCE AND RECREATION (Env-Wt 313.03(c)(4))

Describe how the structures have been designed to avoid and minimize impacts to the public's right to navigation, passage, and use of the resource for commerce and recreation.

This section is not applicable to the proposed Project, as no shoreline structures are proposed.

SECTION I.XIV - SHORELINE STRUCTURES – WATER QUALITY, AQUATIC VEGETATION, WILDLIFE AND FINFISH HABITAT (Env-Wt 313.03(c)(5))

Describe how the structures have been designed, located, and configured to avoid impacts to water quality, aquatic vegetation, and wildlife and finfish habitat.

This section is not applicable to the proposed Project, as no shoreline structures are proposed.

SECTION I.XV - SHORELINE STRUCTURES – VEGETATION REMOVAL, ACCESS POINTS, AND SHORELINE STABILITY (Env-Wt 313.03(c)(6))

Describe how the structures have been designed to avoid and minimize the removal of vegetation, the number of access points through wetlands or over the bank, and activities that may have an adverse effect on shoreline stability.

This section is not applicable to the proposed Project, as no shoreline structures are proposed.

PART II: FUNCTIONAL ASSESSMENT
REQUIREMENTS Ensure that project meets the requirements of Env-Wt 311.10 regarding functional assessment (Env-Wt 311.04(j); Env-Wt 311.10).
FUNCTIONAL ASSESSMENT METHOD USED: **USACE Highway Methodology Workbook, dated 1993, together with the USACE New England District Highway Method Workbook Supplement, dated 1999.**
NAME OF CERTIFIED WETLAND SCIENTIST (FOR NON-TIDAL PROJECTS) OR QUALIFIED COASTAL PROFESSIONAL (FOR TIDAL PROJECTS) WHO COMPLETED THE ASSESSMENT: **Nicole Martin (NH CWS #316) and Lauren Frank**
DATE OF ASSESSMENT: **November 2023**
Check this box to confirm that the application includes a NARRATIVE ON FUNCTIONAL ASSESSMENT: ☒
For minor or major projects requiring a standard permit without mitigation, the applicant shall submit a wetland evaluation report that includes completed checklists and information demonstrating the RELATIVE FUNCTIONS AND VALUES OF EACH WETLAND EVALUATED. Check this box to confirm that the application includes this information, if applicable: ☒ Note: The Wetlands Functional Assessment worksheet can be used to compile the information needed to meet functional assessment requirements.

Dam Removal Project Attachment for the Wetlands Permit Application

Water Division, Dam Bureau

RSA/Rule: Env-Wr 602.03, RSA 482-A

INSTRUCTIONS: The applicant shall attach the following information to the Wetlands Permit Application so that both the NHDES Wetlands Bureau and NHDES Dam Bureau can assess the Dam removal project. Responses to most questions may be provided in a narrative format, although plans, figures or calculations will assist in providing a more complete response. For assistance in completing this form, contact the NHDES Dam Bureau, River Restoration Coordinator at (603) 271-8870 or damremoval@des.nh.gov.

Dam Owner	**Applicant (if different)**
Name: **Town of Durham c/o Rich Reine (Public Works Director)**	Name: **Same as owner**
Mailing Address: **100 Stone Quarry Drive, Durham, NH 03824**	Mailing Address:
Phone: **603-868-5578**	Phone:

Location of Dam

Tax Map and Lot Number: **Map 108, Lot 87**	State Dam number: **71.03**
City or Town: **Durham**	Waterbody:**Oyster River (impounded = Mill Pond)**

Description of Dam

Dam Hazard Classification: **Low**	Current Use: **Recreation, Aesthetics**
Length of Dam: **140 feet**	Height of Dam: **10 feet**
Construction Type (timber, concrete, earthen, masonry): **Concrete**	Surface Area (acres): **0.01 AC of dam itself**

Person(s) Proposing to Perform the Work

Name(s): **Town of Durham c/o Rich Reine**	Mailing Address(es): **100 Stone Quarry Drive, Durham, NH 03824**
Phone: **603-868-5578**	

Description of Proposed Project

NOTE: The following information must be included in the application package in order to **address questions identified in the guidance and attachment documents associated with the Wetlands Permit Application**.
Attach separate pages providing the following information:

- Description of proposed methods to remove dam including construction sequence and methods to control in-stream turbidity during removal. **Refer to the Staging and Construction Sequence Plan (provided in Appendix A) and the Application Narrative (esp. Section 5.3) for this information.**
- Plans showing removal design and restoration of site; including existing conditions, overhead view and a cross section of dam to be removed. **Refer to the Project Plans provided in *Appendix A.***
- Description of method and location of disposal of dam materials. **In an upland location to be selected by the contractor. Refer to Section 3.2 of the Application Narrative.**
- Supporting materials, as required in the Wetlands Permit Application, including:
    - USGS topographic map with property lines indicated **Figure 1 is a USGS Overview Map. Due to scale, property lines are excluded. Property lines are shown on the plans (in *Appendix A)* and the abutter map (in *Appendix B).***
    - Tax map showing property lines and abutters' properties labeled **Refer to the labeled abutter map provided in *Appendix B.***
    - List of abutters and their mailing addresses **Refer to the abutter list provided in *Appendix B.***
    - Original, dated photos mounted on 8.5" x 11" sheets of paper clearly illustrating project impact area with locations of photographs noted on plans **Refer to the Representative Site Photographs provided in *Appendix D.***

Description of Impacts of Proposed Project

NOTE: **The following questions are provided as a guide to address the Requirements for Application Evaluation** (New Hampshire Administrative Rule Env-Wt 302.04: http://des.nh.gov/organization/commissioner/legal/rules/index.htm#wetlands). They are intended to assist the applicant in providing detailed information unique to a dam removal project. Please substantiate any answers provided (i.e., why the project will minimize impacts in the manner described).

Wetland Impacts

- Describe direct impacts to the river and its adjacent banks and wetlands that result from any dredging or filling associated with the dam removal project, including the removal of the dam itself. Identify whether impacts are temporary or permanent. Explain why each impact is necessary to complete the project. Direct impacts should be minimized to the maximum extent possible and must be identified clearly on project plans. **Refer to Sections 3 and 7.1.1 of the Application Narrative for this information.**
- Describe indirect impacts to wetlands associated with the drawdown of the impoundment created by the dam. If wetland areas are adjacent to the impoundment, describe or indicate their location and the type of wetland that may be affected by the drawdown of the impoundment (emergent, forested, etc.). **Refer to Sections 4 and 7.1.1 of the Application Narrative for this information.**

Wildlife Impacts

Describe overall project impacts on plants, fish and wildlife. **Refer to Section 6 of the Application Narrative for this information.**

Social Impacts Refer to Section 7.1.3 of the Application Narrative for the bulleted information below, in addition to the other referenced sections.

- Describe project impacts on public commerce, navigation and recreation. No impacts to public commerce or navigation. Recreational uses will change but persist post-construction.
- Describe project impacts upon abutting property owners, including those abutting the impoundment. Refer to Section 2.4 of the Application Narrative.
- Describe project impacts on local fire suppression systems. It may be necessary to contact the local fire department to learn if dry hydrants or other firefighting supplies may be affected by the project.
- Describe project impacts to the health, safety and well-being of the general public. Refer to Section 5.3.4 of the Application Narrative.

Aesthetic Impacts Refer to Section 7.1.3 of the Application Narrative for this information.

Describe how the project will alter the aesthetics of the site for the general public.

Sediment Impacts (see Guidance for Assessing and Managing Sediment Behind Dams/Barriers) Refer to Sections 3 and 5.3 of the Application Narrative for the bulleted information below.

- Describe the known potential for current and historic sources of pollution from upstream (e.g., wastewater discharges, existing and former manufacturing facilities, tanneries, hazardous waste sites, etc.).
- Describe the extent of sediment that has accumulated above the dam. Provide information on the following:
    - Estimated volume of impounded sediment that might be transported downstream due to dam removal.
    - Physical characteristics of impounded sediment (grain size distribution, organic content).

  NOTE: Based upon the applicant's answers to the questions above and the location and type of potential upstream sources of pollution, NHDES may determine that chemical analysis of the sediment is necessary. If potential upstream sources of pollution are identified in the process of completing the application, the applicant is encouraged to contact the NHDES River Restoration Coordinator at (603) 271-8870 or damremoval@des.nh.gov for further guidance.
- Describe whether the project will cause or increase erosion or sedimentation. For example, will downstream or upstream banks erode as a result of dam removal? What measures, if any, will be taken to stabilize exposed sediments?
- Describe whether the project will reflect or redirect current or wave energy that might cause damage or hazards.

Water Quality and Water Supply Impacts Refer to Sections 5.2 and 5.4 of the Application Narrative for this information.

- Describe project impacts to the availability and quality of surface and ground water.
- Describe project impacts to surface water withdrawals and nearby water supply wells.

Floodplain Impacts Refer to Section 5.1 of the Application Narrative for this information.

Describe whether the dam provides any significant flood control benefits. If it does, describe how the removal of the dam may affect flooding upstream and downstream of the project site.

Historic Impacts **Refer to Section 8 of the Application Narrative for this information.**

As early as possible during the project planning process, applicants should consult with the local historical society, if one exists, to learn if there are known historic resources at the site or nearby.

The applicant should then contact the NHDES River Restoration Coordinator [(603) 271-8870, damremoval@des.nh.gov or NHDES, Water Division-Dam Bureau, 29 Hazen Drive, PO Box 95, Concord, NH 03302-0095] with the following information:

- Name(s), address(es) and telephone number(s) of the project's principal contact person.
- Exact location of the proposed dam removal project (e.g., State Dam Identification Number, latitude-longitude coordinates, USGS map with project area clearly identified, etc.).
- Any known history of the dam and surrounding site.
- Any known nearby historic resources.

The NHDES River Restoration Coordinator will coordinate with the relevant Federal agencies to determine a lead Federal agency for the project, as required by the National Historic Preservation Act. If needed, NHDES will then assist the applicant and lead Federal agency with the Request for Project Review (RPR) submittal to the State Historic Preservation Office (SHPO). The SHPO will review the information and determine whether additional study on the historic resources of the site may be warranted for the purpose of avoiding, minimizing or mitigating the project's impact to historic resources. The type of study that is recommended may necessitate the services of a historical consultant.

The applicant should include a copy of the completed RPR form that includes the SHPO response in their permit application package to the NHDES Wetlands Bureau. Alternatively, the applicant can send the SHPO the required RPR information and a complete copy of their permit application package at the same time it is submitted to the NHDES Wetlands Bureau. Please note by signing the Wetlands Permit Application you are certifying that you have submitted the completed RPR information to the SHPO while coordinating with the lead Federal agency for NHPA 106 compliance.

NOTE: This is a Federal requirement, not a NHDES requirement. **Early coordination may help prevent delays in obtaining the necessary U.S. Army Corps of Engineers approval for the project.**

Application Narrative

1

Introduction

On behalf of the Town of Durham ("the Applicant"), this Wetlands Permit Application was prepared by VHB pursuant to the New Hampshire Revised Statutes Annotated (RSA) Chapter 482-A, Fill and Dredge in Wetlands, and Wetland Bureau Code of Administrative Rules, Chapters Env-Wt 100 through Env-Wt 900, as applicable. The Town proposes to remove the Oyster River Dam at Mill Pond in Durham due to concerns regarding its structural integrity and stability. Additional proposed work includes the active restoration of the Oyster River channel upstream of the dam and invasive species management in the drained impoundment area. All aspects of the proposed work comprise what will be referred to throughout this application as "the Project." All work will be contained within two Town-owned parcels (Tax Map 108, Lot 87 and 90), a portion of Mill Pond Road that will be temporary closed during construction, and the limits of the existing impoundment, all of which comprise what will be referred to as "the Project area" throughout this application. Refer to **Figures 1** and **2** for USGS and Aerial Project location mapping, respectively, along with **Figure 3** for an annotated photo of the dam components. The **Project Plans** are provided in ***Appendix A.***

VHB published the *Oyster River Dam at Mill Pond Feasibility Study*[1] in November 2020 (aka "the Feasibility Study") to review five alternatives and published the *Oyster River Dam at Mill Pond Supplemental Analysis*[2] dated July 2021 (aka "the Supplemental Analysis") to expand upon two of the alternatives. The Town Council voted to proceed with Alternative 5 (Dam Removal) in September 2021, which prompted the citizens petition to rescind the Town Council Decision in October 2021. The question of whether to remove the dam was included on a March 2022 referendum ballot; 74% of Durham voters supported removing the dam, upholding the previous Town Council decision.

This Project is being submitted as a Minimum Impact Wetlands Permit Application in accordance with the project-type exception stipulated in Env-Wt 407.04(b); this is a publicly funded environmental

[1] The Feasibility Study can be accessed at: ci.durham.nh.us/sites/default/files/fileattachments/public_works/page/54315/oyster_river_dam_at_mill_pond_feasibility_study_-_final.pdf

[2] The Supplemental Analysis can be accessed at: https://www.ci.durham.nh.us/sites/default/files/fileattachments/public_works/page/54315/oyster_river_dam_at_mill_pond_-_supplemental_analysis_final.pdf

restoration project that is not being proposed to restore any area that is subject to a removal or restoration order and will be conducted under the supervision of the applicable agencies, since both NHDES and NOAA are funding this project and have been involved in project planning and technical review. As such, the project classification does not rely on the resource type impacted, nor the size of the proposed impacts, per Env-Wt 407.03(b)(2).

Permit Description: *The Town of Durham proposes to permanently impact approximately 70,400 sq ft within palustrine wetlands and approximately* 310 sq ft within the developed tidal buffer zone (DTBZ) *and temporarily impact approximately 23,340 sq ft within palustrine wetlands and approximately 4,350* sq ft within the developed tidal buffer zone (DTBZ) *to remove the Mill Pond Dam on the Oyster River, restore a portion of the Oyster River, promote natural vegetation establishment and invasive species management efforts within the drained impoundment, and stabilize the outlets of existing stormwater outfalls along the perimeter of the impoundment.*

2

Project Context

This section provides an overview of the Oyster River Dam and project history to date, while touching on property ownership details.

2.1 Oyster River Dam at Mill Pond

The Oyster River Dam (NHDES Dam #071.03, also known as the Mill Pond Dam) is located at the head of tide and impounds the main stem of Oyster River for approximately 0.8 miles upstream of the dam (as well as portions of the Hamel Brook extending as far as the 0.4 miles upstream) prior to its discharge into the Great Bay. The Oyster River Dam impounds approximately 20 acres, including the 9.5-acre "Mill Pond," a surface water feature historically used for numerous recreational activities such as fishing, boating, and birdwatching. Over the years, water quality in the pond has declined and portions of the pond have filled with sediment, converting much of the former open water area to emergent wetland habitat.

Built in 1913, the dam is a concrete Ambursen-style dam consisting of a spillway, a set of gated outlets at the right[3] abutment (previously used to supply the mill downstream with hydropower), and a Denil (baffle) fish ladder at the left abutment (that was added by the NH Fish and Game Department [NHF&G] in 1975 to improve upstream fish passage for anadromous fish). It is approximately 140 feet long with a maximum structural height of approximately 13 feet. Due to its age, engineering significance, and associated with local history, this dam is listed in the State Register of Historic Places and located within the National Register-listed Downtown Durham Historic District.

Dam Deficiencies

The dam has experienced significant structural deterioration, specifically on the ribs supporting the spillway; the spillway is also hydraulically undersized and only passes about 352 cubic feet per second (cfs) of water, approximately one-tenth of the necessary discharge capacity to meet modern dam safety

[3] In this application narrative, "river right" and "river left" refer to the river as viewed when looking downstream.

standards. Mill Pond is a shallow aquatic bed and emergent system that functions more as a wetland than a pond. The former river thalweg can be seen in the center of the impoundment on aerial imagery.

The NHDES Dam Bureau identified several safety deficiencies associated with the current dam, including concerns with its overall structural integrity and stability. The dam does not meet current NHDES dam safety standards which require such "low-hazard" dams to pass a 50-year storm event with at least one foot of freeboard between the water surface and the top of the dam abutments. The Town was notified of these problems in multiple Letters of Deficiency (LOD), most recently in February 2018.

A visual inspection of the dam conducted in December 2019 identified the following deficiencies (excerpted from the Feasibility Study):

- *Concrete deterioration was found to have occurred along the spillway cells and ribs. More specifically, cracks and spalls were observed with evidence of water seepage, loss of the rib occurred between Cell 1 and Cell 2, delamination of the repaired concrete was noted, and debonded rebar was observed within multiple cells.*
- *Seepage at the downstream corner of the right abutment wall.*
- *Seepage through the downstream side of the gate structure.*
- *Inoperable right gate outlet.*
- *Concrete deterioration of the gate outlet structure in the form of delamination, cracking, and spalling.*
- *Insufficient capacity to pass the storm design freeboard at the dam, which could result in the potential for flooding during major storms.*

Additional deficiencies such as the presence of scour and efflorescent staining were noted along multiple sections of the spillway slab and training walls.

Despite the noted deficiencies, the dam is only listed as low-hazard due to the dam height (which exceeds six feet) and storage capacity of over 50 acre-feet. Nevertheless, the existing and worsening deficiencies are a cause for concern.

The existing dam contains a fish ladder that was constructed by the NH Fish and Game Department in 1975 to improve upstream fish passage with the dam in place. However, the number of returning fish has continued to decline, exemplifying the limitations of this structure. Dam removal would drastically improve upstream fish passage within the Oyster River.

In designating the Mill Pond Dam as a priority dam for removal in the 2020–2024 New Hampshire Nonpoint Source Management Program Plan, NHDES has further demonstrated the need for the proposed project. NHDES has prioritized the dam's removal because of the Oyster River's inclusion on the Section 303(d) Clean Water Act priority list as an impaired water body. Dam removal is expected to improve oxygen levels, lower water temperatures, and reduce aquatic plant biomass in the impounded reach, helping restore vital riparian and tidal habitat. Removing the barrier to upstream fish passage would greatly benefit anadromous fish, particularly rainbow smelt and blueback herring.

2.2 Grant Funding

The Town of Durham received the following funding for this Project:

- *Critical Flood Risk Infrastructure Grant Program (CFRING):* This nature-based flood resilience Project aims to attenuate flood risk and promote habitat protection and restoration. These considerations align with the goals of CFRING, which has awarded $284,226 to this Project.
- *National Fish and Wildlife Foundation (NFWF):* This Project aligns with the goals of the NFWF, especially the organization's emphasis on accounting for future conditions and innovating traditional habitat restoration techniques. Consequently, NFWF awarded $100,000 to this Project.
- *National Oceanic and Atmospheric Administration (NOAA):* The removal of the Oyster River Dam prioritizes conservation and restoration measures for migratory fish, especially the river herring population. Historically, the Oyster River hosted a major herring run in the state of New Hampshire. A direct result of removing the Dam and (regaining) the historically significant river herring run will support commercial and recreational fisheries in the Gulf of Maine. These considerations align with the goals of NOAA's Restoring Fish Passage through Barrier Removal Notice of Funding Opportunity, which has awarded $3,537,201 to this Project.
- *NHDES Watershed Assistance and Restoration:* The project was selected from among 15 project applicants due to numerous factors including its water quality improvement or protection; cost/benefit ratio; local capacity to complete the project; relative value or significance of the water body; consideration of the project's impact on communities with environmental justice concerns; and incorporation of changing environmental conditions. NHDES granted $150,000 to the Town of Durham to complete the project.

2.3 Natural Resource Desktop Review

The following information is based on a review of the NHDES Wetlands Permit Planning Tool (WPPT).

- *ARM Funded Sites:* There are no Aquatic Resource Mitigation (ARM) Funded Sites within the vicinity of the Project area.
- *Conservation or Public Lands:* Developed public land (Town-owned property including the Milne Tract) borders the northern edge of Mill Pond west of the Oyster River Dam between the intersection of Church Hill Road with Mill Pond Road until the intersection of Mill Pond Road with College Brook. More information on the surrounding public and conservation lands is available in Section 3.7 of the Feasibility Study. Temporary construction access through the Town-owned properties may be required but any impact to those areas will be minimal and restored post-construction.
- *Priority Resource Areas (PRAs):* The Oyster River (including Mill Pond) is mapped as a Floodplain Wetland Adjacent to a Tier 3 Stream PRA. Additionally, tidal waters and wetlands (i.e., mudflats, open water, and low marsh) which are also classified as PRAs are mapped downstream of the NH 108 bridge crossing.

  PRAs include bogs/peatlands, floodplain wetlands contiguous to tier 3 or higher watercourses, prime wetlands, 100-foot prime wetland buffers, sand dunes, tidal waters or tidal wetlands, and areas that have documented occurrences of protected species or habitat in accordance with Env-Wt 103.66. Refer to **Section 6** of this **Application Narrative** below for more information regarding rare, threatened, and endangered species both within and in the vicinity of the Project area.

- *Impairments:* The Project area is located within the vicinity of a watershed that has a listed impairment for chloride (NHRIV600030902-09). The Project area also falls within the quarter mile buffer of the Upper Oyster River and Oyster River–Mill Pond Dam water bodies. The Oyster River-Mill Pond Dam water body has listed impairments for Chlorophyll-a, Dissolved Oxygen Saturation, *Escherichia coli*, and Dissolved Oxygen Concentrations (NHIMP600030902-04). The Upper Oyster River water body has listed impairments for Chlorophyll-a, Dissolved Oxygen Saturation, *Enterococcus*, Estuarine Bioassessments, Light Attenuation Coefficient, Total Nitrogen, and Dissolved Oxygen Concentration (NHEST600030902-01-03). The proposed activities are expected to improve water quality and reduce these impairments.

  Water quality conditions within both the upstream and downstream portions of the Oyster River are impaired largely due to the abundance of nutrient inputs linked to excessive algae and rooted aquatic plant growth, sedimentation, low dissolved oxygen (DO) concentrations, nitrogen levels, and increased water temperatures. Most of the impairment issues in Mill Pond specifically are related to over-enrichment of the pond with phosphorus, which is typically the limiting nutrient in freshwater bodies. As a result, the Oyster River is unable to support designated uses such as aquatic life integrity, fish consumption, primary recreation, and potential drinking water supply.

  Removing the dam and returning the river to a free-flowing state would result in a substantial improvement in dissolved oxygen levels which would possibly eliminate the existing dissolved oxygen impairment. The reduced surface water size, increased travel time, and reduced solar thermal inputs will help to lower water temperatures, which would also improve dissolved oxygen conditions. The improved dissolved oxygen levels and lower water temperatures will positively affect the river's ability to provide suitable conditions for supporting a balanced, integrated, and adaptive community of aquatic organisms. A more free-flowing riverine environment would also reduce the amount of algae and aquatic plant biomass generated on an annual basis compared to the existing impoundment. Algal and plant biomass growth can affect the nutrient dynamics and although the impoundment may temporarily retain nitrogen during the summer months, a potentially greater release of dissolved organic nitrogen could occur following plant die-off and the decomposition process. The decomposition of organic material also exerts a dissolved oxygen demand. Eliminating or reducing this biomass production could diminish the dissolved oxygen and nitrogen fluctuations produced under existing conditions, helping restore vital riparian and tidal habitat.
- *Other Water Types:* The Oyster River and all its tributaries in Barrington, Durham, Lee, and Madbury from their sources to the crest of the Oyster Reservoir Dam are designated as Class A waters by the New Hampshire General Court. All other portions of the Oyster River downstream of the Oyster Reservoir Dam are designated as Class B. Therefore, the Oyster River within the Project area is designated as Class B. There are no National Wild and Scenic Rivers within or near the Project area.
- *Designated River Corridor:* The Project area falls within Designated River Corridor of the Oyster River. Therefore, coordination with the Oyster River Local Advisory Committee (LAC) is required, as detailed in **Section 9** of this **Application Narrative** below.
- *Shoreland Jurisdiction:* The Oyster River is a fourth order stream, and therefore is subject to the Surface Water Quality Protection Act (SWQPA). Permitting through the NHDES Shoreland Program is required for this Project for any impacts located landward of the delineated top-of-bank (outside of the NHDES Wetlands Bureau jurisdiction) within the 250-foot Protected Shoreland of the Oyster River.

› *Coastal Layers:* There are no mapped occurrences of eel grass beds or shellfish sites within the vicinity of the Project area. The predicted marsh migration layer shows a stark contrast between conditions on either side of the dam (tidal downstream and freshwater upstream). Post-dam removal, tidal habitats will be able to migrate farther upstream over time due to sea level rise.

2.4 Property Ownership and Abutters

All proposed activities will be contained within Town-owned parcels (Tax Map 108, Lot 87 and 90), Mill Pond Road, and the limits of the existing impoundment. As such, no direct impacts are proposed to the abutting properties. In accordance with Env-Wt 307.13(d), written or signed consent has been obtained from one of the applicable abutting property owners where jurisdictional impacts are proposed within 10 feet of that abutting property line (Tax Map 108, Lot 88). Signatures from the remaining two abutting property owners (Tax Map 108, Lots 86 and 89) have not been obtained. Refer to the applicable **Waiver Request** provided in ***Appendix B*** for more information.

All other abutting property owners will be notified prior to the filing of this permit application as defined in Env-Wt 102.04, per Env-Wt 306.06(a). A map and list of the abutting properties, sample abutter notification letter, and certified mail receipts are provided in ***Appendix B***.

3

Proposed Project Description

3.1 Design Overview and Phasing

The proposed Project will consist of various phases; refer to the **Staging and Construction Sequence Plan** provided in ***Appendix A***. The **Natural Resource Agency Coordination Meeting Notes** provided in ***Appendix C*** also cover much of this information.

Phase 1 – Initial Drawdown and Dam Breach

The project will begin with a drawdown by opening the dam outlet at the southern abutment and a subsequent partial dam breach to drain the Mill Pond impoundment. The purpose of the partial breach is to reduce the risk of an uncontrolled sediment release downstream if there is a large rainfall event during construction; the partial breach could be sealed with a temporary cofferdam to limit the release of water downstream and reduce the risk of flood flows eroding and scouring away exposed sediments in the upstream work area.

Phase 2 – Channel Restoration

A temporary construction access road will be installed from Mill Pond Road. Additional Phase 2 tasks will include the establishment of the staging and sediment handling area, storm drain outlet stabilization, installation of the western most cofferdam at the upstream limits of work, installation of the eastern most cofferdam at the downstream limits of work (to prevent site flooding during high tide), construction of the boulder riffle crest, and installation of a water bypass flume to divert river flow around the work area. To leave some flexibility for the selected contractor to determine the most cost-effective construction means and methods, the bypass flume may be an open lined channel or a buried culvert pipe.

Phases 2A through 2C will comprise the active channel restoration portion of the Project, starting at the western end of the proposed channel restoration (approximately 650 feet upstream of the location of the existing dam) and progressing east towards the existing dam. Breaking this effort into multiple separate phases will allow the contractors to focus on smaller areas at a time to improve the dewatering

and water bypass feasibility so that work can occur in "dry" conditions. The river channel will be reshaped with a natural channel design by excavating accumulated sediment within the Mill Pond impoundment. The restored river channel will be stabilized using bioengineered techniques and traditional engineered approaches, as appropriate.

Phase 3 – Final Dam Demolition

The contractor will complete the demolition of the dam following stabilization of the upstream work area. Most of the existing dam structure will be removed, including the fish ladder, but the southern abutment (including a portion of the spillway, gated outlet structure, and masonry walls) will remain in place. The river channel will be reshaped within the footprint of the existing dam and immediately upstream and downstream of the existing dam to ensure upstream fish passage through the restored reach.

Phase 4 – Restoration

will involve restoration of all temporarily impacted areas that were used for access, staging, and/or dewatering, along with invasive species management. Refer to **Section 4.3** of this **Application Narrative** below for more information regarding invasive species.

3.2 Design Components

Dam Removal

Most of the existing dam structure will be removed, including the fish ladder. Primary access during the removal will be from the northern riverbank near Newmarket Road within Town-owned property to facilitate the dam removal. To mitigate historic impacts, one cell of the dam spillway and the adjacent the southern abutment and mill remnants will remain in place. The southern abutment will be partially buried to address safety and aesthetic concerns. Refer to the dam removal detail sheet provided in the **Project Plans** in ***Appendix A*** for more information.

Active Channel Restoration Details

After dam removal, the Oyster River channel will be restored, and sediment transport will be actively managed to maximize project benefits and avoid adverse effects. This will occur in up to three phases (Phases 2A through 2C mentioned above). The contractor will excavate to subgrade from the deepest deposit of sediment along the proposed natural channel alignment within the existing Mill Pond impoundment and will stockpile the sediment to dry in staging areas for off-site disposal (likely at a landfill). The Town intends to temporarily close Mill Pond Road during construction, so that the channel restoration staging and sediment handling area is expected to be set up within Mill Pond Road, contiguous with the proposed temporary access road. Up to 4,500 cubic yards (CY) of sediment would be removed during this process, with a focus on removing soft sediments in deeper water to prevent mass sediment flow downstream during construction. Any remaining material that is not removed or disposed of off-site will be stabilized in-place using restoration plantings.

The design of the active channel restoration was developed to achieve a number of design goals:

- The proposed channel has a sinuous alignment that follows a naturally-occurring area of deeper water in the center of Mill Pond, following the historic path of the river channel and reducing the volume of earthwork excavation.
- Similarly, the vertical profile of the proposed channel (4 feet drop per 1000 feet of length) is intended to match the macro-scale longitudinal profile of the Oyster River through the impoundment; the proposed channel ties into the existing armored cobble bed below the dam.
- The bankfull width (BFW) of the proposed channel (42 feet) is consistent with field measurements of the natural channel upstream of the impounded area and with calculated regression estimates for BFW for the watershed size of the river. Bankfull channel geometry was developed using hydraulic modeling of the Oyster River over a range of flow conditions to contain the channel-forming discharge within channel banks while maintaining a low-flow channel with adequate water depth for fish passage under drought conditions.
- Outside of the channel, the floodplain follows the existing bathymetry of the pond - widening where the pond bed is deeper and narrowing in locations where it is shallower.
- The channel incorporates a series of shallow riffles and deeper pools located at bends in the channel where they would naturally form, creating a varied geometry with corresponding variety of hydraulic conditions and habitat zones.
- As the proposed channel is located at the head of tide of the Oyster River, the design accommodates tidal impacts by creating a high marsh floodplain along the downstream reach of active channel restoration where high tide levels will rise above the top of the channel.
    - However, due to the elevations of the project area relative to the range of tidal elevations in the Oyster River estuary, the majority of the constructed channel and floodplain will be riverine rather than tidal following dam removal.
    - The existing riverbed below the dam is 1.6 feet higher than the Mean Tide Level (MTL) and 2.3 feet lower than the Mean High Higher Water (MHHW) elevation; as a result, tidal influence is limited entirely within the bankfull channel for the majority of the project area.
    - Additionally, because tidal flows are so shallow and the volume of the tidal prism is so small, hydraulic modeling indicates that the rising tide will not create a reversing flow in the channel and water is expected to remain fresh to slightly brackish.

Additional considerations will be implemented during channel restoration to mitigate potential harm to fish and wildlife. The Town proposes to drawdown the impoundment beginning on or soon after July 1, 2024, in coordination with NHF&G as a pre-construction mobilization. Invasive species will be removed from the work area, and the NH Best Management Practices for Roadside Invasive Species (2008) will be followed to avoid introducing new invasives to the area. Coordination with NHDES, NHF&G, NOAA/NMFS, and NFWS would occur following construction to adaptively manage the project to optimize river restoration potential and take remedial action as may be necessary.

Stream Bed Restoration and Stabilization Details

Along with the active channel restoration excavation, approximately 1,800 CY of clean sand/cobble/gravel mixture (also referred to as simulated streambed material) will be used to stabilize the channel bed. To be efficient with the depth of simulated streambed material, the depth will vary based on the characteristics of each component of the restored channel (i.e., thicker in the riffle crest sections and thinner at the bottom of the pools). Channel restoration will focus on following a natural

channel planform and sinuosity representative of a stream channel in quasi-equilibrium, as well as accommodating tidal influence where feasible with appropriate habitat zones and vegetation.

Bioengineering techniques will be prioritized for stabilizing the channel, banks, and floodplain. Coir logs, root wads, log vanes, boulder j-hooks, feature boulders, vegetated habitat zones, and a sand/cobble/gravel streambed that will support the natural habitats being restored along the channel.

A grade control consisting of a buried boulder riffle crest (also referred to as a stone cross-vane) will span the full width of the stream channel at the upstream limit of work to prevent degradation, or "head cutting," of the upstream river channel that could cause sediment discharge downstream. This grade control is a key component of the project design as it stabilizes the transition from the reconstructed channel and floodplain (active channel restoration) and to the upstream reach of the Oyster River outside of the limit of construction (passive channel restoration). Riffle crest geometry, materials, and orientation within the channel were designed in accordance with Rosgen geomorphic channel design and NRCS stream restoration design (NEH 654-11) guidance. The location, elevation, and geometry of the grade control will influence the hydraulic and geomorphic conditions of the upstream channel.

The location of the grade control was selected as a natural pinch-point in the post-removal floodplain between two elevated "islands" of shallow water that are currently vegetated with shrubs and small trees; these islands funnel floodplain flows into the reconstructed channel and prevent potential lateral migration of the channel into the emergent wetlands in the northern or southern lobes of the pond. The buried boulder construction and U-shape of the grade control direct high-velocity flows into the center of the channel and armor the floodplain at this constricted location. This location is also characterized by a shallow deposit of firm sand and gravel confirmed by field sediment probes; this deposit provides a stable subgrade to support the boulders of the grade control to prevent against the structure settling by sinking into soft sediment.

The elevation of the channel bed at the grade control (4.0 feet NAVD88) is a function of the reconstructed channel profile and the existing bathymetry of Mill Pond; this elevation reflects the macro-scale longitudinal profile of the Oyster River and is consistent with the dynamic equilibrium profile of the river. Setting the grade control elevation higher would result in an extended deep pond-like channel upstream, while setting the grade control lower would increase the risk of head cutting and mass mobilization of sediments from the upstream reach.

Four pools are proposed along the restored channel, separated by boulder clusters to form riffle areas. Refer to **River Channel Grading Plan and Profile** and detail sheets provided in ***Appendix A*** for more information.

There are also two tributary inlets proposed on either side of the reconstructed upstream river channel at the lowest elevations to provide a natural flow channel for runoff from the adjacent wetland areas to enter the river channel without eroding the floodplain. Refer to the Tributary Inlet Detail provided in the **Project Plans** in ***Appendix A.***

Storm Drain Outlet Stabilization

There are four storm drains that discharge into Mill Pond from catch basins on Mill Pond Road. Some of these outlet pipes are partially buried but are assumed to be 24-inch reinforced concrete pipes (RCP). To prevent erosion at these outlet pipes that could discharge sediments into the restored impoundment once drained, riprap aprons are proposed around each pipe outlet at the request of NHDES. Since the

Department suggested this stabilization to minimize scour and potential sediment inputs into the Oyster River (as opposed to separate infrastructure work added on to this project), this portion of the proposed work should also be exempt from mitigation requirements under the minimum impact restoration/enhancement project classification. Refer to the applicable detail provided in the **Project Plans** in ***Appendix A*** for dimensions. There are two additional storm drain outlets from Newmarket Road located just upstream of the bridge over the Oyster River below the proposed limit of work, but the streambank and channel are already stabilized by boulders and exposed bedrock at this location and no further stabilization is needed.

3.3 Site Restoration Overview

Within the floodplain of the reconstructed river channel, the proposed design establishes different habitat zones reflecting the post-construction topography and proximity to the river channel. These areas consist of the proposed high marsh immediately adjacent to the river channel downstream of the existing dam, proposed riparian floodplain immediately adjacent to the river channel upstream of the existing dam, and proposed riparian buffer on either side of the river channel not directly abutting the proposed riverbed. Refer to the **Restoration and Planting Plan** provided in ***Appendix A*** for more detailed information on the selected species, sizes and planting densities proposed in each of these areas. Outside of the limit of active channel and floodplain restoration, invasive species management is proposed within the drained impoundment to promote the establishment of native vegetation species. Refer to **Section 4.3** of this **Application Narrative** below for more information.

3.4 Project Benefits

Below is a brief overview of some of the many benefits that will result from this Project. Each of the items listed below is elaborated on in the applicable section of this **Application Narrative**.

- Increase public safety through the removal of unsafe and unnecessary dam infrastructure.
- Flood risk to adjacent upstream properties will be reduced through the reduction in flood depth, area, and duration in Mill Pond. Enhanced nature-based flood resilience will help the community better adapt to a changing climate.
- Tidal influence will be restored upstream of the existing dam, and over time will gradually increase salinity levels within the Project area due to sea level rise. This may eventually result in the restoration of a brackish tidal marsh system and habitat for fish, wildlife, and plants. The predicted tidal influence upstream of the existing dam is discussed in **Section 3.2 and 7.1.1** of this **Application Narrative**.
- The proposed dam removal and re-establishment of the upstream Oyster River channel will restore downstream sediment transport consistent with a naturally functioning stream system. This sediment transport will help to restore salt marsh habitat downstream of the project; UNH Professor Tom Ballestero has noted that steady supply of riverine sediment deposits is important to maintain the health of estuarine salt marshes. Refer to **Section 5.3** of this **Application Narrative** below for more information regarding sediment and turbidity management during construction.
- No adverse impacts to the surrounding infrastructure are expected.
- Water quality in the Oyster River will be improved with the reduction or elimination of water quality impairments, especially dissolved oxygen, lower water temperatures, and reduce the algal and plant

biomass within the river by restoring it to its free-flowing natural state. This will likely result in the removal of the impoundment from the Section 303(d) list of impaired waters.

- The barrier to upstream fish passage will be eliminated, resulting in an increase in anadromous fish runs. The restored low-gradient, well-defined channel with cobble-gravel streambed within the active channel restoration reach at the limit of tidal action provides conditions highly suitable for smelt spawning, and NHF&G and NOAA fisheries biologists have noted that the restored channel could restore smelt spawning habitat to the Oyster River.
- The restored river will provide a destination for anglers, birdwatchers, kayakers, and others seeking to enjoy the Oyster River.
- There will be no substantive change to the Oyster River depths, widths, or water velocities downstream of the existing dam, despite the substantial reduction in the depth and width of the Oyster River and Hamel Brook upstream of the existing dam.

4

Natural Resources and Existing Conditions

VHB Senior Environmental Scientist, Kristopher Wilkes (NH CWS #288), delineated the jurisdictional limits of Mill Pond (top-of-bank and associated wetland inclusions), upstream of the Mill Pond Dam on May 4 and 5, 2023. Delineation work was performed in accordance with the procedures and standard outlined in the *1987 Corps of Engineers Wetland Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, Version 2.0* (January 2012) using alpha-numerically coded pink flagging tape. Wetland delineation also relied upon the *Field Indicators for Identifying Hydric Soils in the United States, Version 8.2*, published by the Natural Resource Conservation Service and the *Field Indicators for Identifying Hydric Soils in New England, Version 4.0*, published by the New England Interstate Water Pollution Control Commission in June 2020. Dominant wetland vegetation was assessed using the *National Wetland Plant List* published by the U.S. Army Corps of Engineers.

Mill Pond and the associated wetland habitat was classified using *the USFWS Methodology Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979, Revised 1985). TOB was delineated in accordance with NHDES Rule Env-Wt 102.15 utilizing alpha-numerically coded blue flagging tape affixed to vegetation. Delineation flags were mapped in the field with a handheld GPS unit capable of sub-meter accuracy. Refer to the **Representative Site Photographs** provided in ***Appendix D.***

Wetland function and values were assessed in accordance with the *Highway Methodology Workbook Supplement* (US Army Corps of Engineers [USACE], 1999). This assessment was conducted by VHB Environmental Scientist Lauren Frank, under the guidance and supervision of VHB Environmental Scientist Nicole Martin (NH CWS #316). Although a functional assessment is not required for a Project classified as "minimum impact" in accordance with Env-Wt 311.10(a) at the state level, it is required at the federal level for projects that propose greater than one acre of permanent impact.

Due to the existing impoundment, the ordinary high water (OHW) mark upstream of the dam was set to a reference elevation of 11.4 feet NAVD88 based on historic (2009-2022) field-surveyed water levels

associated with the dam. The Highest Observable Tide Line (HOTL) below the dam was set to a reference elevation of 4.5 feet NAVD88 based on field-surveyed water levels associated with the October 2019 Highest Astronomical Tide (HAT), commonly known as the "king tide."

4.1 Oyster River

The Oyster River is a part of the Great Bay Estuary in coastal New Hampshire, is a tributary of the Piscataqua River, and is located within the Piscataqua-Salmon Falls (HUC 8) Watershed. It runs for approximately 21 miles, beginning in Barrington, and flowing generally southeast through the towns of Lee, Madbury, and Durham, before discharging into the Great Bay in Durham. The freshwater portion of the Oyster River traverses approximately 14 miles before reaching the Oyster River Dam at Mill Pond, which defines the break between freshwater and saltwater influences. Downstream of the dam, the remaining 7 miles of the river reach is tidally influenced to its confluence with Great Bay.

At the Project area, the Oyster River is impounded by the Oyster River Dam, which has caused the creation of Mill Pond. The impounded river channel through Mill Pond upstream of the dam is classified as Palustrine, Unconsolidated Bottom, Mud, Permanently Flooded, Diked/Impounded (PUB3Hh), while the river channel downstream of the Dam is classified as Estuarine, Subtidal, Unconsolidated Bottom, Cobble-Gravel, Subtidal (E1UB1L).

4.2 Wetlands

The impounded nature of the Oyster River that formed Mill Pond has created palustrine aquatic bed, emergent, and scrub-shrub habitat to the north and south of the main stem of the channel upstream of the dam. Due to slower water velocities and the opportunity for prolonged periods of inundation, these fringe areas have developed into what would be considered the open water component of Mill Pond and bordering vegetated wetland areas with varying hydroperiods depending on location and elevation. The open water and bordering vegetated wetland components fall within the jurisdictional limits (TOB) of Mill Pond and have been classified based on site observations coupled with aerial interpretation. These areas are depicted and classified on the **Existing Conditions Plan** included as ***Appendix A***, with the Cowardin Distinction Line (CDL) style.

4.3 Functions and Values

The Oyster River brings a myriad of functions and values to the impounded Mill Pond wetland system. Mill Pond is an approximately 9.5-acre resource within the Piscataqua-Salmon Falls Watershed (HUC 01060003) that plays an important role in the local ecology. Principal functions and values of Mill Pond include:

- Groundwater Recharge/Discharge – Mill Pond provides opportunity for groundwater recharge/discharge, as the system displays variable water levels, and its outlet is currently constricted by the Oyster River Dam.
- Fish Habitat – Mill Pond provides a large, slow-moving, and vegetated habitat ideal for fish species. Fish can travel downstream of Mill Pond via a fish ladder at the Oyster River Dam.
- Sediment/Toxicant Retention – Due to Mill Pond's flood flow storage ability, its vegetation and fine grained/organic soils, and a known presence of impaired waters at the wetland and Oyster River, Mill Pond provides ample opportunity for sediment and toxicants to be retained.

- Nutrient Removal – The impounded nature of Mill Pond allows more time for vegetation to uptake excess nutrients.
- Wildlife Habitat – Mill Pond provides both deep and shallow water, and wetland areas of various vegetation types ideal for supporting fish, reptiles, amphibians, and birds.
- Recreation – For the town of Durham, Mill Pond and adjacent Mill Pond Park provides a nearby area with public access for fishing, canoeing, and other activities.
- Uniqueness/Heritage – Mill Pond and the Oyster River Dam have been a well-known feature of the community for many years.
- Visual Quality/Aesthetics – Mill Pond is located in a residential part of town. The visibility of Mill Pond is good from nearby residential properties, Mill Pond Road, and Mill Pond Park.

Refer to the **Wetland Function-Value Evaluation Form** provided in ***Appendix E*** for more information.

The proposed Project includes dam removal and restoration of the upstream Oyster River channel through the currently impounded Mill Pond. Many of the functions and values of Mill Pond attributed to the impoundment including slow-moving waters and storage capacity will be altered. However, the area will retain ecological and public value for the Town of Durham with the restored Oyster River and the drained impoundment area that will likely transition to bordering wetland habitat. Since the proposed work includes bio-engineered techniques along the restored channel and detailed Planting and Integrated Vegetation Management Plans will be implemented within the drained impoundment (as detailed elsewhere in this application package), the quality of the system in respect to wildlife and fish habitat will not deteriorate. Considering the transition this area will undergo as a result of this Project, the natural habitat that was likely present within this area prior to the dam construction will be restored, allowing conditions to revert to a more natural and healthy state. Some functions of Mill Pond will be altered but the functions of the Oyster River overall will be improved (i.e., restore natural sediment transport, improve water quality, improve aquatic organism passage, etc.).

4.4 Invasive Species

Invasive species observed within the Project area include glossy buckthorn (*Frangula alnus*), multiflora rose (*Rosa multiflora*), bush honeysuckle (*Lonicera* sp.), oriental bittersweet (*Celastrus orbiculatus*), autumn olive (*Elaeagnus umbellata*), Japanese barberry (*Berberis thunbergii*), burning bush (*Euonymus alatus*), purple loosestrife (*Lythrum salicaria*), Japanese knotweed (*Reynoutria japonica*), and common reed (*Phragmites australis*).

The proposed dam removal will drain the Mill Pond impoundment and expose currently flooded lands. Much of the dewatered impoundment will initially have no vegetation and will resemble mud flat habitats, but vegetation is expected to quickly grow on this bare ground. Typically, these mudflats would become fully vegetated within the first growing season. It should be noted that invasive species are often "pioneer species"— ones that tend to quickly colonize disturbed or bare soils. To prevent colonization of these areas by invasive plant species, VHB has developed an Integrated Vegetation Management Plan (IVMP) in collaboration with Ellen Snyder (Ibis Wildlife Consulting), Tom Lee (UNH Professor), and Doug Cygan (NH Department of Agriculture Invasive Species Coordinator). The goal of the IVMP is to limit the spread of invasive species to allow natural vegetation to establish.

Common methods to reduce the spread of invasive species within wetland communities include mechanical (i.e., cutting and pulling), chemical (i.e., herbicide application), and environmental (i.e., manipulating moisture, pH, or light) controls. Another common method, biological control, is

complicated to implement (usually involving herbivorous insects to reduce specific invasive species) and is not included in this IVMP. Please refer to the **IVMP** provided in ***Appendix F*** for our proposal on how to manage invasive species within the Project area.

5

Hydraulics and Sediment Management

5.1 Floodplains and Floodways

The Project area is overlapped by Federal Emergency Management Agency (FEMA) Special Flood Hazard Areas (SFHAs) including the Zone AE regulatory floodway, which occupies most of the Mill Pond impoundment and Zone AE 100-year floodplain which borders the floodway in low topographic areas within the Project area. The Project area is located within FEMA Map Panel 33017C0318E (effective 9/30/2015). Refer to **Figure 4**. Once the Project is completed, the Town may pursue a letter of map revision to refine the floodplain and floodway boundaries upstream of the dam.

Public safety is an important driver for this Project. In a 2018 Letter of Deficiency, NHDES identified the significant safety concerns of the dam, most notably its lack of capacity to accommodate a 50-year flood event. Hydraulic modeling shows that the insufficient freeboard could result in flooding of adjacent properties during major storms. After evaluating alternatives in the Feasibility Study, the Town selected dam removal as the most cost-effective, constructable, and sustainable solution for addressing the safety issues as well as the environmental concerns. This is a flood resilience project that aims to attenuate flood risk.

As part of the Feasibility Study, a HEC-RAS hydraulic model of the Oyster River was built. Modeling showed that removal of the dam would increase the Oyster River's flood resilience in all flow conditions analyzed. In a 10-year storm, the inundated area would see a pronounced 47% decrease from 27.5 acres to 14.5 acres. The 100-year storm shows a less pronounced change due to the contracted hydraulic opening of the Newmarket Road bridge controlling flood elevations, but still a decrease of up to 0.5 feet in flood elevation and 2% decrease in floodplain area. These storm impact reductions demonstrate the effectiveness of dam removal in mitigating flood risk within the Project area. Dam removal would alleviate flooding of adjacent properties, including a private residence at 20 Newmarket Road that undergoes flooding in major storm events.

5.2 Hydrology and Hydraulics

A hydraulic model of the Oyster River and Hamel Brook, both upstream and downstream of the Oyster River Dam, was used during the Feasibility Study phase to evaluate the changes in water depth, width, and velocity if the dam were to be removed or modified. Refer to Section 3.2 of the Feasibility Study for more detailed information regarding this analysis. Some of the key findings are summarized below:

- The proposed dam removal will substantially reduce the upstream depth and width of the Oyster River and Hamel Brook by draining the existing impoundment. According to the Supplemental Analysis, the dam removal will reduce the surface area of the impoundment by about 73-77% as well as its average depth by 61-71%.
- The proposed dam removal will restore tidal influence for a short reach upstream of the dam. The dam is located at the head of tide of the Oyster River approximately 7 miles from the Great Bay, with correspondingly low salinity levels. Hydraulic modeling shows that water levels in the channel will be affected by regular tides extending approximately 500 feet upstream of the current dam, but tidal influence will be limited as freshwater flows from the upstream river are too large for the incoming tide to reverse flow direction. The estimated mean higher-high water (MHHW) elevation is approximately 3.6 feet NAVD88, while the highest astronomical tide is approximately 4.5 feet NAVD88. Refer to the **Oyster River Channel Profile** provided in the **Project Plans** in ***Appendix A***. Also refer to **Section 12.1.4** of this **Application Narrative** below for more information regarding the projected sea level rise within the Project area.

Refer to Section 2 of the Supplemental Analysis for more information regarding hydrology and hydraulics along the Oyster River upstream of the Project area. That document also clarified that drinking water withdrawals from the upstream Oyster River Reservoir have a negligible impact on inflows to the Mill Pond impoundment during a typical year. The reason for that analysis was to determine if summertime releases from the reservoir might have been able to increase flow rates and reduce residence times (i.e., increase flushing) in the downstream Mill Pond impoundment to improve water quality. That document also compared typical conditions against the 2020 drought conditions for Oyster River/Mill Pond.

5.3 Sediment Transport

5.3.1 Sediment Transport Overview

Rivers transport both water and sediment. Even under the existing condition, sediment is transported from the upper reaches of the Oyster River watershed, through the project reach, then downstream to the tidal portion of the Oyster River and the Great Bay. Before the construction of the Mill Pond Dam, sediment deposition from the Oyster River watershed would have been an important component of salt marsh health downstream of the dam location. However, the dam has acted to impound a substantial amount of sediment as the channel has adjusted to an impounded equilibrium point. Its removal would result in a shift of that equilibrium, which could result in the rapid mobilization of accumulated sediments if not properly managed. So, while uncontrolled downstream sediment transport presents a risk, the restoration of a natural level of sediment transport would be beneficial to the Great Bay ecosystem.

Sediment sampling in the Oyster River and Hamel Brook indicates that the accumulated sediment within the impoundment is relatively uniform silt/clay with some fine sand and organic material (i.e., muck). The organic content of the soils sampled increased along the vegetated perimeter of the impoundment.

The largest deposit is mound (or "wedge") of sediment located about 300-400 feet upstream of the existing dam that is the most susceptible to mobilizing following dam removal (refer to **Figure 5**). This wedge is estimated to total approximately 3,000 CY. This deposit is significantly deeper than deposits upstream (up to 8 feet of soft sediments in some locations in Mill Pond, compared to an average of 2 feet upstream of Mill Pond), and sample data indicates these sediments have the smallest median particle diameter and highest level of metals and PAHs compared to sediments elsewhere in the impoundment.

Sediment transport modeling from the Feasibility Study indicates that a large portion of this deposit (approximately 700 to 800 CY) could be mobilized and deposited in the downstream estuary in the first year following dam removal (either by continuous flow or by a single large flood event). Therefore, this sediment deposit presents a risk of downstream sediment transport that could have impacts to downstream ecological resources or infrastructure. However, sediment transport would occur from all portions of the impoundment, including the following areas progressing upstream from the dam: Mill Pond, the middle impoundment (area between Mill Pond and Hamel Brook), mainstem (upper Oyster River channel to the west), and Hamel Brook (the southernmost limit of the impoundment).

The proposed project incorporates several design features to manage sediment transport. First, the project proposes appropriate construction best management practices (as detailed in **Section 7.2** of this **Application Narrative** below) to reduce downstream transport of accumulated sediments in the impoundment. Secondly, the project proposes an active channel restoration which would remove the sediments most at risk for sudden downstream transport. Finally, the project proposes to apply natural channel design features such grading a channel profile, planform, and cross-section that is set to near equilibrium conditions, as well as to install a grade control feature (riffle crest) and apply other permanent erosion control measures to limit the potential for headcutting.

5.3.2 Feasibility Study Analysis versus Proposed Design

Based on the analyses included in the Feasibility Study, we have reached the following conclusions listed below regarding the impacts of the proposed dam removal on sediment transport. Refer to Section 3.3 of the Feasibility Study for more detailed information regarding this analysis. Please note that the sediment transport analysis in the Feasibility Study only evaluated a simple dam removal scenario and did not model sediment transport that would be expected following implementation of the proposed project design (i.e., active channel restoration). The proposed active channel restoration was designed specifically to reduce the volume of accumulated sediments released downstream, as detailed below.

- Removal of the dam with no upstream channel modification (i.e., no active channel restoration) would mobilize some of the accumulated sediments in the impoundment and restore the natural downstream sediment transport process. The existing dam prevents the river function of sediment transport; dam removal is expected to restore sediment transport to the tidal reach downstream of NH 108. If dam removal were proposed without active channel restoration, the following sediment transport scenarios would be expected:

- Under a single post-removal flood event scenario for the 2-year storm event, net sediment loss to the estuary would be approximately 800 CY, with 790 CY of that volume from the fine sediment deposit in Mill Pond. The 10- and 100-year storm event scenarios yield similar results, resulting in net sediment losses of 970 and 670 CY, respectively.
- Under a long-term simulation (mimicking the period 1970-2019), long-term net sediment loss to the estuary would likely be approximately 9,800 CY: about 2,350 CY from Mill Pond, 2,250 CY from the middle impoundment, 4,900 CY from the mainstem, and 300 CY from Hamel Brook.
- Sediment transport model simulations from the Feasibility Study suggest that sediment would initially be deposited in a relatively short reach, roughly located between the Three Chimneys Inn and Durham Landing. However, tidal action will likely disseminate the sediment over a wider range, reducing the depth of deposition. If deposited uniformly in the tidally-influenced Oyster River from NH Route 108 down to the confluence of Johnson Creek, the location of historic oyster populations and current oyster reef restoration efforts, an area of more than 300,000 square yards, 50 years' worth of sediment released from the former Mill Pond dam impoundment would cover the area in a layer of sediment approximately 1.1 inches thick. The 970 CY potentially released to the tidal Oyster River during a 10-year storm event is equivalent to 0.1 inches over this same area.

› Even if no active channel restoration occurs, not all sediment in the impoundment is subject to downstream transport. Sediment probe data indicates sediment deposit depths ranging from 0.8 to 2.5 feet through this upstream impoundment; the impounded channel width of the Oyster River and Hamel Brook through the impounded reach ranges from 60 to 150 feet and has a total length of 5,800 feet. Therefore, the total volume of potentially-mobile sediments within the impoundment upstream of Mill Pond is estimated to be on the order of 48,000 CY – roughly five times the total 9,700 CY volume that the sediment transport model predicts could be transported downstream under a passive sediment management strategy.

› The detrimental effects of downstream sediment transport will be minimized by the proposed active channel restoration. Active channel restoration will involve removal of approximately 4,500 CY of sediment from the large deposit in the center of Mill Pond; the material in this deposit consists of very fine particles and is more vulnerable to mobilization leading to a sudden mass deposit downstream in the event of a single flood event after dam removal as supported by sediment transport modeling. Following removal of the sediment deposit, the river would be reconstructed, extending approximately 650 feet upstream of the dam to stabilize the channel and adjacent floodplain, including the installation of a grade control structure at the upstream end of the restored channel. In the long-term, but also specifically if a large storm occurs immediately following the project, an active channel restoration would minimize the potential for adverse downstream impacts and improve the stability and ecological integrity of the upstream area following dam removal. The design intent of the proposed upstream grade control which is included in the proposed active channel restoration is to prevent uncontrolled degradation of the upstream channel bed ("head cutting"); by establishing a minimum channel bed profile, the grade control is expected to increase the volume of existing sediment deposits that will be retained in the Middle Impoundment.

  There is an existing deep pool ("scour hole") located at the western inlet of Mill Pond, just upstream of the proposed grade control at the limit of work. This scour hole is expected to act as a sink

trapping some of the mobilized sediment (up to 1,330 CY) from the impounded reach upstream of Mill Pond.

Consequently, the proposed active channel restoration is expected to significantly reduce the total downstream transport of accumulated sediments from the impoundment from approximately 9,800 CY to approximately 4,000 CY over a 50-year period following dam removal – a rough average of approximately 80 CY per year. Refer to **Table 1** below for more details, along with the **Natural Resource Agency Coordination Meeting Notes** from November 6, 2023, provided in ***Appendix C***.

Table 1: Downstream Sediment Transport Quantities

	Change	Volume Transported Downstream	Comments
Total Mobilized Sediment from Oyster River (50-year simulation)	N/A	9,780 CY Total	Feasibility Study Model: Assumes dam removal only with no active channel stabilization outside of dam footprint
Active Channel Restoration: Off-Project area Disposal	(-4,530 CY)	5,250 CY Total	Material excavated from Mill Pond impoundment as part of active channel restoration
Potential Additional Capture in Mill Pond	(-1,330 CY)	3,920 CY Total	Volume of "scour hole" at upstream end of Mill Pond below proposed grade control (elevation 4.0 ft)
Average Annual Transport	N/A	78 CY/year	Average volume of sediment/year over 50-year simulation time period.

Source: 2020 Feasibility Study, 2024 VHB active channel design quantities
Note: This table estimates the volume of sediment that could be transported downstream of Newmarket Road over a 50-year period. All quantities are in cubic yards (CY). Total sediment volume quantity is from Feasibility Study sediment transport analysis. Active Channel Restoration quantity represents material excavated and removed off-project area during construction. Additional capture represents potential additional material captured within the Mill Pond impoundment. Average annual transport is total sediment volume divided by number of years.

5.3.3 Sediment Management Alternatives Analysis

At the request of NHDES, VHB and the Town of Durham evaluated the benefits and drawbacks of alternative design approaches for sediment management above and beyond the proposed active channel restoration. Specifically, VHB evaluated three additional alternatives that could be used to manage the transport of sediments downstream, discussed below.

Sediment Management Alternative 1 - Impoundment Sediment Excavation

This alternative would extend the limit of work into the impounded Oyster River channel upstream of Mill Pond, removing an additional 3,850 CY of soft sediment from the bed of the channel. As noted above, this would not eliminate sediment transport from the upstream reach – it would only remove an additional 3,850 CY of potentially-mobile sediment so that the total volume of excavated or captured sediment is equal to the downstream transport volume predicted by the Feasibility Study sediment transport model.

Figure 6 shows the limit of work for this alternative; sediment would be excavated and disposed off-project area, with the work area limited to the closest reach of the Oyster River to Mill Pond, covering a length of approximately 500 feet. This would expand the permanent impact area of construction within the impoundment by 1.2 acres and would require the construction of an additional 900 feet of temporary construction access roadway to provide equipment access to the excavation area. There is no public access to the Oyster River upstream of Mill Pond Park, so any equipment access would need to run up along the channel. This alternative would also require additional cofferdams, river flow bypass diversion, dewatering, and sediment handing and staging area. VHB has estimated the total cost of this additional sediment removal to be approximately $1,900,000; refer to ***Appendix G*** for a conceptual cost estimate.

Sediment Management Alternative 2 - Middle Impoundment Grade Controls

Figure 7 shows the limit of work for this alternative, which would add five (5) additional grade controls along the Oyster River within the reach extending 600 feet upstream of Mill Pond, raising the elevation of the streambed at the upstream limit of work an additional 2 feet above the grade control elevation of the proposed design; **Figure 8** illustrates the elevations of the alternative relative to the longitudinal riverbed profile. The top elevation of these grade controls corresponds to the highest elevation of the existing channel thalweg within this reach, based on available bathymetry. The existing channel bed through this reach consists of sand and silt sediment deposits approximately 2 feet deep; after the dam is removed, the high points along the channel profile would be expected to be eroded down until the equilibrium channel bed elevation is controlled by the grade control at the proposed limit of active channel restoration. This alternative would reduce the erosion of those high points of the channel by raising the effective maximum grade control elevation and could potentially trap some additional sediments being transported from further upstream. However, like Alternative 1, it would not prevent the transport of potentially contaminated sediment deposits downstream.

By raising the channel elevation and creating additional riffle crests, this alternative would reduce the effectiveness of the proposed dam removal project to restore upstream fish passage to anadromous river herring. Although the grade controls would be designed in accordance with best practices for fish passage design, each additional riffle crest could present a barrier to less-mobile fish and reduce the total population of fish passing upstream to spawn.

The additional impact areas for this alternative would be comparable to Alternative 1; as it would have roughly the same construction footprint, it would result in a similar additional impact area and would require similar additional cofferdams, river flow bypass, work area dewatering, and temporary equipment access roadways. VHB has estimated the total cost of this additional grade controls to be approximately $500,000; refer to ***Appendix G*** for a conceptual cost estimate.

Sediment Management Alternative 3 – Lowered Grade Control Elevation

Unlike Alternatives 1 and 2, the purpose of this alternative would be to expand the tidally-influenced area of the Oyster River channel and floodplain after dam removal, instead of reducing potential sediment transport. The proposed active channel restoration design incorporates an average riverbed longitudinal profile slope of 0.4% (4 feet drop per 1,000 feet of channel), consistent with the macro-scale channel gradient of the Oyster River through the overall impoundment. The resulting elevation of the proposed grade control (buried boulder cross-vane) at the upstream limit of the reconstructed channel is 4.0 feet NAVD88, by coincidence just slightly higher than the daily high tide elevation (MHHW = 3.6 feet) of the Oyster River in Durham.

Based on feedback from NHDES, VHB evaluated a potential alternative re-grading of the proposed reconstructed channel to lower the grade control elevation by 1.8 feet (below the high tide elevation) so that tidal influence could extend beyond the limit of active channel restoration immediately following dam removal. **Figure 8** illustrates the elevations of this alternative compared to the longitudinal riverbed profile, to the current proposed active channel restoration design, and to Alternative 2.

The lowered channel profile would increase the length of the tidally-influenced reach of the Oyster River channel by approximately 350 feet compared to the proposed active channel restoration design. However, tidal influence would be limited entirely within the channel of the river and would not contribute to the establishment of tidal wetlands in the riparian floodplain on either side of the channel. The bathymetry of the western portion of Mill Pond that would be affected by this enlarged tidal influence consists of a relatively narrow (50 to 100 feet) deep channel with shallow areas (over elevation 8.0 feet) on either side characterized by emergent and shrub-scrub wetland vegetation. **Figure 9** illustrates the limited influence of tidal conditions; the orange line is representative of the maximum extent of tidal influence under an astronomical high tide scenario (HAT = 4.5 feet NAVD88).

Because the purpose of this alternative is to lower the bed elevations of active channel restoration and shift the limit of tidal influence upstream, it would increase the potential for head cutting and mass transport of sediment from the middle impoundment reach of the Oyster River above Mill Pond. With the grade control elevation lowered by 1.8 feet, the long-term equilibrium elevations of the upstream channel bed profile would similarly be lowered, exposing additional sediment deposits to potential downstream transport. Because the lowered channel profile of this alternative is similar to the expected channel profile that would be controlled by bedrock outcrops without any active channel restoration, this alternative would be expected to result in sediment transport volumes from above Mill Pond similar to the volumes estimated in the Feasibility Study for simple dam removal without active channel restoration.

Lowering the proposed grade control at the upstream limit of work from elevation 4.0 to 2.2 feet would require the excavation and disposal of additional soft sediments within the Mill Pond impoundment – estimated to be approximately 2,000 CY additional volume assuming an average additional excavation depth of 0.9 feet along the full 700-foot length of the reconstructed channel and floodplain. It should be noted that this additional removal volume would extend below the elevation of soft sediments, into pre-impoundment riverbed sands and buried bedrock; these deep deposits would not be considered at risk of mobilization due to existing bedrock grade control and therefore removal would provide only marginal benefit over the proposed active channel restoration design. Assuming the same excavation, stockpiling, dewatering, characterization, and off-project area disposal costs as Alternative 1, the estimated cost for this alternative would be an additional $600,000.

5.3.4 Sediment Quality

It should also be noted that results of screening-level human health and ecological risk assessments conducted as part of the 2020 Feasibility Study indicate that sediments in the impoundment are impacted by relatively low-levels of certain chemical constituents, including polycyclic aromatic hydrocarbons (PAHs) and various metals.

The human health screening found that arsenic was consistently reported in sediment samples at concentrations, which exceeded the NHDES S-1 soil standard. However, the range of concentrations and distribution of arsenic are consistent with regional background conditions. In only a limited number of

instances, concentrations of PAHs also exceeded the applicable NHDES S-1 standards – specifically, one or two PAHs (benzo(a)pyrene and/or benzo(b)fluoranthene) were detected slightly above applicable S-1 standards in two of the 21 sediment samples tested as part of the study. In general, the levels and distribution of PAHs found in the study are typical of urban/suburban areas (i.e., not indicative of a regulated "release") and not anticipated to pose an unacceptable risk to human receptors.

Regarding ecological risk, the study results indicated that sediment samples collected throughout the study area contained concentrations of PAHs and/or metals with a moderate to high potential for adverse effects to ecological receptors (marine and/or freshwater). While the reported concentrations of these chemicals were similar across the study area (i.e., the range of reported concentrations were generally within an order of magnitude), greater concentrations of certain constituents (i.e., PAHs and mercury) tended to be associated with finer-grained and/or more organic sediments (i.e., sediment samples located within the ponded area immediately upstream of the dam).

In 2023, at the request of NHDES, VHB conducted a supplemental analysis of select sediment data available in the NHDES Environmental Monitoring Database (EMD). Specifically, VHB identified 10 stations (sample locations)[4] with relevant chemical data for sediment samples in downstream reach of the Oyster River up to discharge at Little Bay/Piscataqua River. Review of these publicly available data indicates that several inorganic constituents (e.g., arsenic, chromium, lead) are present at concentrations similar to, or greater than, those in the FS study area. The data also suggest that certain contaminants (notably PAHs & mercury) are present at lower concentrations in the downstream reach of Oyster River compared to the FS study area – but that the distribution of these sediments is likely influenced by the physical/chemical properties of the sediments (i.e., coarser grain size and lower organic content in river sediments compared to the impoundment). That said, screening-level risk assessment (consistent with FS protocols) suggests even the lower levels of these contaminants in the downstream samples have the potential to adversely impact ecological receptors.

Together, the findings from the FS and supplemental data analysis reinforce the benefits of the proposed active channel restoration, as the proposed design will remove sediments from the area where sediment sampling indicated the highest levels of metals and PAHs. Overall, the contaminants found within the impounded sediments are not expected to result in adverse or unacceptable human health impact and the potential risks to ecological receptors will be mitigated through the active channel restoration sediment removal. Refer to the **Natural Resource Agency Coordination Meeting Notes** from September 25 and November 6, 2023, provided in ***Appendix C*** for a more in-depth discussion of sediment quality within the Project area.

5.4 Water Quality

Based on the analyses included in the Feasibility Study, we have reached the following conclusions listed below regarding the impacts of the proposed dam removal on water quality. Refer to Section 3.5 of the Feasibility Study for more detailed information regarding this analysis.

[4] According to the EMD, the subject stations (sample locations) are associated with the National Coastal Assessment (NCA) – Northeast Database for Years 2000-2006, and include Station 00-0049A, Station 00-0053A, Station 01-0042A, Station 01-0046A, Station 01-0048A, Station 02-0249A, Station 03-0244A, Station 04-0252A, Station 05-0248A, and Station 06-0042A.

- The dissolved oxygen levels within the Oyster River will be substantially improved. This improvement of dissolved oxygen levels may eliminate the existing dissolved oxygen impairment. The reduced surface water size, increased travel time, and reduced solar thermal inputs will help to lower water temperatures, which would also improve dissolved oxygen conditions. The improved dissolved oxygen levels and lower water temperatures will positively affect habitat conditions for diadromous fish.
- The algal and aquatic plant biomass generated on an annual basis will be reduced. Algal and plant biomass growth can affect the nutrient dynamics and although the impoundment may temporarily retain nitrogen during the summer months, a potentially greater release of dissolved organic nitrogen could occur following plant die-off and the decomposition process. The decomposition of organic material also exerts a dissolved oxygen demand. Eliminating or reducing this biomass production would diminish the dissolved oxygen and nitrogen fluctuations produced under the existing conditions.
- Salinity levels upstream of the existing dam are expected to increase over time due to tidal activity. Although hydraulic modeling indicates no reversal of flow during flood tide upstream of the Mill Pond dam location for current tidal elevations, as sea level rise causes average tide elevations to increase the influence of tidal action will extend farther upstream. Increased salinity will result from the upstream migration of high tide levels caused by sea level rise after the dam is removed, which over time will affect the distribution of vegetation species and aquatic organisms that prefer brackish conditions in tidally influenced areas. The predicted tidal influence upstream of the existing dam is detailed in **Section 7.1.1** of this **Application Narrative** below.

Refer to Section 1 of the Supplemental Analysis for more information regarding water quality within the Project area. However, to briefly summarize, the impairment issues within Mill Pond are related to the over-enrichment of the impoundment with nutrients (primarily phosphorus). Meaningful improvement in the water quality at Mill Pond would require a watershed-wide effort with substantial investment from multiple stakeholders. Some potential nutrient management techniques include dilution/flushing, dredging, and side stream aeration. However, these techniques were determined to not be worth advancing without addressing the nutrient sources themselves.

Mixing Zone

The Town of Durham requests approval for a mixing zone pursuant to the Clean Water Act Section 404(b)(1) Guidelines to ensure compliance with State Water Quality Standards as described in Env-Wq 1707. Details of the proposed turbidity best management plan includes a mixing zone, sampling, and control measures for in-water work. Refer to the **Turbidity Sampling and Control Plan** provided in ***Appendix H.***

6

Rare, Threatened and Endangered Species

The following is a discussion of rare, threatened, and endangered (RTE) species identified within the vicinity of the Project area by the NH Natural Heritage Bureau (NHB) DataCheck tool and US Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) system.

6.1 Natural Heritage Bureau and NH Fish and Game Department

A search for the occurrence of rare plant, animal, or natural communities associated with this Project was completed using the NHB online DataCheck tool. The NHB DataCheck Results Letter (NHB23-2114) dated July 21, 2023, identified the potential presence of one natural community, six plant species, and ten vertebrate species within the vicinity of the Project area. Refer to the **NHB DataCheck Results Letter** provided in ***Appendix I***.

Natural Heritage Bureau

The identified "sparsely vegetated intertidal system" natural community is mapped downstream of the Oyster River Dam and could be impacted by sediment release associated with dam removal. However, sediment deposition from the Oyster River is an important component of salt marsh health farther downstream.

The NHB DataCheck Results Letter also identified numerous plant species. The plant species are listed in **Table 2** below, along with their recommended survey time frames. Based on coordination with Amy Lamb in 2020 as a part of VHB's Feasibility Study for this project, she recommended that surveys for all the rare plant species identified occur throughout the Project area. Refer to the correspondence provided in ***Appendix I.*** Based on this request, VHB coordinated with Dr. Gregg Moore, Associate

Professor of Biological Sciences at UNH and an expert in coastal ecology, who agreed to assist with field surveys. In the fall of 2023, Dr. Moore and his student were able to confirm that *Lemna trisulca* is present in Mill Pond, as well as *Sparganium natans* and *S. eurycarpum*. VHB anticipates completion of additional surveys in the Spring and Summer of 2024.

Table 2: Identified Plant Species and Relative Recommended Survey Timeframes

Plant Species	Recommended Survey Timeframe
arctic bur-reed (*Sparganium natans*)	When flowering (beginning in mid-July) through fruiting (mid-September)
Beck's water-marigolds (*Bidens beckii*)	When in flower: early August to early September
great bur-reed (*Sparganium eurycarpum*)	When in flower (early July) or with mature achenes (mid-July to mid-September)
ivy-leaved duckweed (*Lemna trisulca*)	July to August
lake quillwort (*Isoetes lacustris)*	Mature megaspores required for identification: July to September

Source: NHB DataCheck Results Letter (NHB23-2114).

Ultimately, the proposed Project will impact plant species that are present within the Project area due to the limited proposed sediment excavation, significant change in water level, and potential increase in salinity. Some of the identified plant species (if present within the Project area) may be able to persist within the wetland area in the drained impoundment, while others that rely on the pond habitat for survival (i.e., lake quillwort and ivy-leaved duckweed) would be more severely impacted and potentially eradicated from the Project area. Refer to Section 3.12.2 of the Feasibility Study for more detailed information regarding potential impacts to the identified species.

VHB also met with NHB on December 19, 2023, to present this project and obtain input. Overall, NHB concurred that this project will yield environmental benefits despite some initial adverse impacts to plant populations within the Mill Pond impoundment. The feasibility of retaining and reusing the excavated topsoil within the project area was discussed in case there is seed bank of the identified species. Plant rescue and relocation plans may also be coordinated with NHB following the wetlands permit application submission. The notes from this meeting and the applicable correspondence are provided in ***Appendix I***.

New Hampshire Fish and Game

The NHB DataCheck Results Letter identified the following vertebrate species:

- State Endangered: American brook lamprey (*Lethenteron appendix*), Blanding's turtle (*Emydoidea*), New England cottontail (*Sylvilagus transitionalis*), and shortnose sturgeon (*Acipenser brevirostrum*). Note that the shortnose sturgeon is also listed as Federally endangered.
- State Threatened: Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and spotted turtle (*Clemmys guttata*). Note that the Atlantic sturgeon is also listed as Federally threatened.

- State Special Concern: American eel (*Anguilla rostrata*), banded sunfish (*Enneacanthus obesus*), sora (*Porzana carolina*), and swamp darter (*Etheostoma fusiforme).*

Ultimately, the proposed dam removal will benefit aquatic fauna through the removal of this barrier to upstream fish passage and the identified vertebrate species will be able to access and pass through the Project area within the restored Oyster River channel post-construction. Conditions would temporarily be affected during construction, as noise and vibrations should deter wildlife from entering the Project area during construction. The proposed control of water plan requires the contractor to divert river flows around the active construction area via a piped or open-channel flume with no pumping, maintaining a clear path for downstream aquatic organism passage during construction.

The NHF&G has been actively involved in this Project over the years during the development of the Feasibility Study and Supplemental Analysis. Additionally, since this Project pre-dated the Fis 1004 rules that outline NHF&G consultation requirements, formal Fis 1004 was not completed. Rather, coordination was directed through Mike Dionne to gather and disseminate NHF&G conservation recommendations for this Project. In an email dated October 26, 2023, it was determined that although there are NHB records for several fish and wildlife species in the vicinity of the Project area, they are not expected to be impacted significantly by the proposed project. Refer to the **NHF&G Email Correspondence** provided in ***Appendix I***.

6.2 US Fish and Wildlife Service

The Project area was reviewed for the presence of federally listed or proposed, threatened, or endangered species, designated critical habitat, or other natural resources concerning the USFWS IPaC System. Results dated January 19, 2024, indicate the potential presence of the federally endangered northern long-eared bat (*Myotis septentrionalis*, "NLEB"), the federally endangered roseate tern (*Sterna dougallii dougallii*), and the federal candidate monarch butterfly (*Danaus plexippus*) within the vicinity of the Project area. Refer to the **USFWS IPaC Species List** provided in ***Appendix J***.

Northern Long-Eared Bat

The proposed Project is located within the federally protected range of the NLEB, which is a federally endangered species. Tree clearing activities are one of the largest threats to the NLEB, however, this Project only proposes very minimal tree clearing/trimming for construction access off Mill Pond Road.

Consultation for this species was drafted using the NLEB Range Wide Determination Key which resulted in a preliminary determination of *may affect* since the Project area is located within a known sensitive area for the NLEB. We are currently pending input from the USACE as the lead federal agency prior to initiating this consultation, as we believe the preliminary determination is inaccurate and anticipate that this Project is not likely to adversely affect the NLEB.

Roseate Tern

The roseate tern is a federally endangered bird species. Consultation for this species was conducted using the Northeast Endangered Species Determination Key in IPaC which resulted in a *no effect* determination. We are currently pending input from the USACE as the lead federal agency prior to initiating this consultation; however, we believe the preliminary determination is accurate for this Project.

Monarch Butterfly

Since the monarch butterfly is a candidate species but is not listed as threatened or endangered, conservation measures are not required but should be implemented when feasible to demonstrate environmental stewardship. This species can be found anywhere where nectar producing plants are present, especially in open fields or meadows. Monarch butterflies will only breed in places with milkweed since that is the primary food source for their larva. Due to the lack of observed milkweed, we do not believe that suitable habitat for this species exists within the Project area. The candidate status of this species does not provide protection under the Endangered Species Act, and no further coordination with the USFWS is required.

6.3 Wildlife Action Plan Habitat

The NH Fish & Game Department (NHF&G) has developed the *New Hampshire Wildlife Action Plan* (New Hampshire Fish and Game Department, 2015, "WAP") to assist with conserving and protecting wildlife species and habitat types throughout NH. The WAP identifies ranked habitat tiers that recognize the highest quality habitats in the state. Habitat tiers were created by NHF&G using biological data, landscape data, and human influence information. Habitat tiers are separated into three rankings, which are 1) *Highest Ranked Habitat in the State*, 2) *Highest Ranked Habitat in Biological Region*, and 3) *Supporting Landscape*.

Downstream of the Oyster River Dam and beyond the proposed limits of work, the Oyster River is classified as the Highest Ranked Habitat in NH. Two small sections of the impounded Mill Pond upstream of the Oyster River Dam are classified as the Highest Ranked Habitat in the Biological Region and Supporting Landscape. Refer to **Figure 10**. The impounded areas within the Project area, Mill Pond, are primarily classified as open water. Mill Pond includes an area of temperate swamp habitat and is bordered by hemlock-hardwood-pine forest, marsh and shrub wetlands, developed impervious or barren land habitat types. Refer to **Figure 11**. Refer to Section 3.9 of the Feasibility Study for more detailed habitat type and rank information.

6.4 Fisheries

The Oyster River provides a critical and diverse habitat for several ecologically important native freshwater and anadromous fish species. Eighteen species of fish are known to use the river, including a mixture of warm water, cold water, and anadromous species.[5] In total, the Oyster River watershed is home to nine fish species of special conservation concern listed in the WAP. These include ecologically important native diadromous fish species such as the anadromous blueback herring (*Alosa aestivalis*), rainbow smelt (*Osmerus mordax*), and alewife (*Alosa pseudoharengus*), and the catadromous American eel (*Anguilla rostrata*). Refer to Section 3.8 of the Feasibility Study for more detailed information.

The NHF&G constructed the Oyster River Fishway (a concrete Denil-style fish ladder) in 1975 in cooperation with the Town of Durham and US Fish and Wildlife Service to restore a portion of the upstream fish passage lost with the dam in place. However, the number of returning fish has continued to decline. Historically, the river herring returns to the Oyster River had been one of the highest yearly

[5] Anadromous fish species are those that spawn in freshwater and then migrate to the sea to grow to maturity before returning to freshwater. These species rely on gaining access to upstream freshwater river habitat for spawning and nursery life cycle functions annually during the spring and early summer.

returns among all coastal rivers monitored by NHF&G. Presently, however, the numbers of returning river herring have generally been declining since 1990 and are now less than 5 percent of those seen at the peak from 1990-1992. This decrease in number is largely attributed to a decrease in water quality and water levels along the river and throughout Mill Pond, as well as impediments to downstream migration.

Dam removal would restore approximately 1.8 miles of free-flowing habitat along the Oyster River mainstem from head of tide to the Oyster Reservoir Dam and restore as much as 3.4 river miles of tributaries to a free-flowing condition. A separate fishway project currently under design at the UNH Reservoir Dam located 1.8 miles upstream of the Mill Pond Dam would restore an additional 12.6 river miles of the Oyster River and 22 river miles of tributaries. In addition to removing the barrier to upstream fish passage, the declining water quality in Mill Pond and the upstream impoundment would be addressed. As a result, diadromous fish species would be able to successfully ascend the restoration reach that would be exposed following dam removal, supporting a self-sustaining river run. The restored gravel-bed channel constructed as part of the active channel restoration could also create new smelt spawning habitat near the head of tide.

Essential Fish Habitat

Based on a review of the National Oceanic and Atmospheric Administration (NOAA) Essential Fish Habitat (EFH) Mapper for the New England / Mid-Atlantic Region, the Project area is listed as EFH for numerous different species. Refer to the **EFH Mapper Reports** provided in ***Appendix K***. Separate reports were generated for upstream and downstream of the dam to better represent the species that may be able to access the Project area post-dam removal. Both reports identified the same 16 species, while the downstream report resulted in the addition of Atlantic salmon and bluefin tuna.

The proposed activities are expected to benefit EFH habitat through the dam removal (removal of the existing barrier to fish passage) and upstream river channel restoration. Since the proposed action is not expected to adversely affect EFH, we do not believe formal consultation is required. However, this will be confirmed by the lead federal agency (the USACE) during their review of this application.

It should also be noted that this Project was awarded funding through NOAA's Restoring Fish Passage through Barrier Removal Notice of Funding Opportunity. Refer to **Section 2** of this **Application Narrative** for an overview of this grant.

7

Impact Analysis, Best Management Practices, and Avoidance and Minimization

7.1 Proposed Impacts

7.1.1 Natural Resource Impacts (Wetland and Stream)

The proposed elimination of the impoundment resulting from removal of the Oyster River Dam will have both direct and indirect impacts to the existing palustrine systems associated with Mill Pond upstream of the dam. Direct permanent and temporary impacts to these areas will occur from the proposed construction activities depicted and quantified on the **Wetland Impact Plan** provided in ***Appendix A***. Indirect impacts to areas outside of the proposed limits of work will occur from the altered Project area hydrology resulting from draining the existing Mill Pond impoundment.

Direct Impacts

This Project proposes to permanently impact approximately 70,400 sq ft (1.62 acres) within palustrine wetlands and 310 sq ft within the developed tidal buffer zone (DTBZ) and temporarily impact approximately 23,340 sq ft (0.54 acres) within palustrine wetlands and 4,350 sq ft within the DTBZ. These impacts are proposed to remove the Oyster River Dam at Mill Pond, excavate, and dispose off-project area potentially mobile sediment deposits, reconstruct the upstream Oyster River channel and riparian floodplain, promote natural vegetation establishment and invasive species management efforts within the drained impoundment, and stabilize the outlets of existing stormwater outfalls along the perimeter of the impoundment. It should be noted that the proposed temporary construction access through the

drained impoundment will not be in place for longer than one growing season[6]; if the temporary access duration were to extend into a second growing season, it would be considered a permanent impact, as opposed to temporary. Total proposed impacts within the NHDES Wetlands Bureau jurisdiction are approximately 98,400 sq ft (2.26 ac), resulting from approximately 70,710 sq ft of permanent impacts and approximately 27,690 sq ft of temporary impacts.

Potential Indirect Impacts

As natural riverine flow returns through the restored Oyster River channel, areas upstream of the dam will revert to a more natural riparian habitat. These areas will flood less frequently and will be inundated for shorter periods. As such, it is expected that the palustrine scrub-shrub and emergent cover types existing along the outermost limits of Mill Pond will transition from semi-permanently flooded and seasonally flooded/saturated (F and E, respectively) hydroperiods to saturated or seasonally flooded (B or C, respectively) hydroperiods, while the inner aquatic bed and emergent cover types will transition from intermittently exposed and permanently flooded (G and H, respectively) hydroperiods to seasonally flooded or seasonally flooded/saturated (B or C, respectively) hydroperiods. As hydrology dries out, the plant communities will also be impacted. The aquatic bed components of Mill Pond are expected to transition to emergent vegetative cover types and additional shrub species are expected to become established within present areas of emergent wetland vegetation.

Other Natural Resource Considerations

Based on the analyses included in the Feasibility Study, we have reached the following conclusions listed below regarding the impacts of the proposed dam removal on natural resources. Refer to Sections 3.8-3.12 of the Feasibility Study for more detailed information regarding this analysis.

- The existing barrier to upstream fish passage will be eliminated and the existing declining water quality within the Mill Pond impoundment will be addressed. These two effects will have a significant net benefit on fishery resources. The proposed Project will restore a more natural profile of the Oyster River at and immediately above the existing dam. This suggests that river herring will successfully ascend the restoration reach that would be exposed following dam removal, supporting a self-sustaining river herring run.
- Tidal wetlands will be restored within the lower portion of the Project area. In this area, the proposed finish grades on either side of the channel are set slightly below the Mean High Higher Water (MHHW) elevation, creating a periodically-submerged area suitable for high marsh wetland habitat. As predicted sea level rise occurs over the next century, this tidal wetland habitat is expected to migrate farther upstream as the wetland community shifts towards more salt water tolerant species. Outside of the immediate river channel, existing salt tolerant species observed downstream of the dam could provide a seed source for salt tolerant vegetation to become established in the new tidally influenced zone. The existing salt tolerant vegetation species include saltmeadow cordgrass (*Spartina patens*), prairie cordgrass (*Spartina pectinata*), blackgrass (*Alopecurus myosuroides*), and saltmarsh bulrush (*Scirpus robustus*).

[6] The USACE General Permit NAE-2022-00849 defines the "growing season" as May 1 – October 1.

7.1.2 Infrastructure Impacts

Based on the analyses included in the Feasibility Study from the hydraulic model results, we have concluded that the proposed dam removal will not adversely affect the surrounding infrastructure. NHDOT Bridge No. 114/111 (which carries NH 108/Newmarket Road over the Oyster River) and the Town of Durham footbridge are scour-stable under existing conditions and hydraulic modeling indicates no significant change to hydraulic conditions at these crossings that would adversely affect scour after dam removal.

Furthermore, the proposed dam removal will mitigate flooding of adjacent properties as it will lower the predicted 50-year flood elevation below the basement floor at 20 Newmarket Road (located southwest of the bridge) and, therefore, reduce the risk of the building flooding. The 100-year flood elevation will similarly be lowered. It should be noted that the relatively small hydraulic opening of the NH 108 bridge restricts flood flows and the 100-year flood headwater elevation upstream of the bridge is predicted to remain above the basement flood elevation of the building at 20 Newmarket Road even after the dam is removed. Refer to Section 3.4 of the Feasibility Study for more detailed information regarding this analysis.

7.1.3 Social and Aesthetic Impacts

Social

The Town of Durham—a community of more than 15,000 residents—would be the primary beneficiary of the removal of the Mill Pond Dam. If the Mill Pond Dam were removed, not only would dam- and climate change-related public safety issues related to flooding be addressed, but the restoration of natural flows in the river by removing the dam, fish ladder, and associated structures would have positive impacts on water quality in the Oyster River, help to restore important fish and wildlife habitat, and reduce the costs associated with continued dam infrastructure. Anglers, kayakers, birders, and other recreational visitors would experience the enhancements of the river's improved ecological integrity firsthand.

Dam removal would also honor the enduring desire of the indigenous Abenaki/Wabanaki peoples to return the river to its free-flowing state. The Abenaki/Wabanaki people who are indigenous to the region that includes the Mill Pond Dam impoundment have supported this project as an environmental justice milestone. From the standpoint of this community, the river's history under their ancestors' stewardship extended long before European settlement and the subsequent damming of the river. Restoration of the Oyster River to its natural, free-flowing state represents acknowledgment of the ecological ethos of the Abenaki/Wabanaki people and their ancestors. The Mill Pond Dam removal/river restoration project gives voice to the Abenaki/Wabanaki peoples' centuries-long concern for the environmental well-being of the Oyster River, affording them an opportunity for meaningful involvement in the decision-making process relating to the future of this cherished waterway.

The Project will not impact any local fire suppression systems. This Project has undergone extensive public and community involvement during the alternatives analysis/Feasibility Study phase and no concerns of this nature were raised.

Aesthetics

This Project will significantly alter the appearance of the Project area post-construction. The proposed dam removal will drain the currently impounded Mill Pond, temporarily exposing previously submerged bare sediments. Although these exposed sediments may be temporarily unappealing, they will dry out, subside, and revegetate. With the implementation of the **IVMP** provided in ***Appendix F***, invasive species populations will be managed to allow for native vegetation to colonize those areas. Once revegetated, the drained impoundment area should look nice and draw a variety of wildlife for people to observe.

The restored upstream river channel will follow a natural channel design with bioengineered stabilization techniques to mimic a natural stream system and will look visually appealing.

7.2 Mitigation and Best Management Practices

Mitigation Consideration

In accordance with Env-Wt 313.04(b)(4) and (5), compensatory mitigation is not required for restoration or enhancement activities conducted in accordance with Env-Wt 407.04(b) and Env-Wt 525.

Although Env-Wt 605.03 states that compensatory mitigation is required for all permanent impacts to tidal surface waters, tidal wetlands, the tidal buffer zone, and sand dunes, it is subject to Env-Wt 313.04 mentioned above.

General Best Management Practices

Standard Best Management Practices (BMPs) will be applied throughout construction in accordance with applicable NHDES and NHDOT BMP Manuals to reduce the risk of erosion and sediment-laden runoff from entering the surrounding habitat areas. Perimeter controls such as silt fence and/or silt sock will be installed where necessary upslope of the wetlands to ensure that surface water runoff from unstabilized areas does not carry silt, sediment, and other debris outside of the limits of work. All installed temporary erosion control measures shall be inspected daily and repaired/replaced as necessary.

In accordance with the *New Hampshire Stormwater Manual, Volume 3, Erosion and Sediment Controls During Construction* dated December 2008, areas remaining un-stabilized for a period of more than 30 days shall be temporarily seeded and mulched. Erosion control blankets shall be installed on all slopes that are greater than 3 feet horizontal and 1 foot vertical (3:1). Upon the completion of the proposed work, all disturbed and graded areas located upslope of the erosion control measures will be seeded and mulched as needed. Disturbed areas that have been seeded and mulched will be considered stable once 75- to 85-percent vegetative growth has been achieved. Refer to the **Erosion and Sediment Control Plan** included as ***Appendix A*** for further details.

Since invasive plants are known to occur within the Project area (as detailed in **Section 4.3** of this **Application Narrative** above), all work including daily removal of plant material from construction equipment, shall be constructed in accordance with NHDOT's *Best Management Practices for Roadside Invasive Plants Manual* (2008) and *Best Management Practices for the Control of Invasive and Noxious Plant Species* (2018). Only clean equipment that is free of plant material and debris shall be delivered to the Project area and utilized during construction. All machinery entering and leaving any area containing invasive plants will be inspected for foreign plant matter (i.e., stems, flowers, and roots) and soil

embedded in the tracks or wheels. If foreign plant matter or soil is present, the operator shall remove the plant material and soil from the machine using hand tools.

Additional information regarding the sediment management is detailed in **Section 5.3** of this **Application Narrative** above.

7.3 Alternatives Analysis – Avoidance and Minimization

In accordance with Env-Wt 311.07 and 313.03(b), the proposed limits of disturbance were minimized to the extent practical while still accomplishing the Project objectives. Since this Project revolves around the specific dam, consideration of alternative properties or locations was not applicable. Jurisdictional impacts were minimized where applicable while ensuring that the upstream restored river channel is constructed and stabilized appropriately to convey the river flows post-dam removal. Avoidance and minimization efforts relative to this Project are incorporated throughout this application. However, avoidance and minimization efforts were especially prevalent during the alternatives analysis detailed below.

In accordance with the Oyster River Dam at Mill Pond Feasibility Study (dated November 2020), five preliminary alternatives were considered to address the known structural deficiencies of the Oyster River Dam, considering the cost, constructability, and compliance with regulatory requirements. Note that the goal of these alternatives was to preserve the existing spillway capacity rather than increase the capacity to meet the design criteria of a low-hazard dam (i.e., pass the 50-year storm with one foot of freeboard). The five alternatives are briefly listed below, but more detailed information is available in the Feasibility Study.

1. Alternative 1 - No Action: This alternative would have jeopardized the structural condition of the dam by failing to address the deficiencies and could have resulted in a sudden structural failure and loss of the impoundment.
2. Alternative 2 – Dam Repair: This alternative would have addressed the immediate structural concerns of the dam. However, since the scope of this alternative did not involve replacement of the deteriorated concrete components, the design life of this alternative may have been limited compared to some of the other alternatives and was the most expensive alternative considered. Cost = >$5.5 million (including pond restoration dredging and 30-year life cycle[7] costs).
3. Alternative 3 – Dam Stabilization: This alternative would have included the installation of independent structures that could have provided a longer-term solution to the existing dam concerns, as opposed to Alternatives 1 or 2. Cost = >$5 million (including pond restoration dredging and 30-year life cycle costs).
4. Alternative 4 – Dam Redesign: This alternative would have resulted in the construction of a new dam that would have been compliant with the NHDES design requirements but would have resulted in substantial impacts to abutting properties to achieve that compliance due to the

[7] Life Cycle Costs = costs associated with the operation, maintenance, and capital replacement more than the initial construction expenditures.

increased spillway length. Cost = >$5 million (including pond restoration dredging and 30-year life cycle costs).

5. Alternative 5 – Dam Removal (Selected Alternative): This alternative involves dam removal, abutment preservation, channel shaping, and upstream channel restoration. Cost = >$1 million (including active channel restoration and 30-year life cycle costs). This was the selected alternative due to the increased environmental benefits (detailed in **Section 3** of this **Application Narrative** above) and drastically reduced costs compared to the other alternatives.[8]

With Alternatives 2, 3, and 4, pond restoration dredging (option 1) was proposed to address public concerns regarding the declining pond quality due to sediment accumulation behind the dam and the prolific aquatic plant establishment via both mechanical and hydraulic dredging. This may have required ongoing maintenance and future dredging as areas would have refilled with sediment over time. On the other hand, active channel restoration (option 2) was proposed with Alternative 5 (the Selected Alternative). This option would allow for natural downstream sediment transport (mimicking natural systems) as opposed to needing to repeatedly dredge sediment accumulation behind a dam.

Of these alternatives, 3 (dam stabilization) and 5 (dam removal) were determined to have the most merit and were therefore advanced for detailed study in the Feasibility Study briefly summarized below.

Alternative 3 would have filled the interior spillway cells with reinforced concrete along with scour repairs of the existing right training wall and undermining of the fish ladder downstream of the spillway. This alternative would retain the dam in its current configuration, and therefore maintain the impoundment, with no measurable changes in water depths or surface area. However, this alternative would not comply with NHDES Dam Safety regulations and would require a waiver. The associated dredging would have involved the removal of approximately 11,000 cubic yards of sediment from the pond and would have required ongoing future dredging. Dredging of this scale would have been challenging if not impossible to permit.

Alternative 5 (the Selected Alternative) will include the removal of the existing dam structure, upstream channel restoration, storm drain outlet stabilization, and integrated vegetation management. Refer to **Section 3** of this **Application Narrative** above for more detailed information regarding the proposed design.

[8] As further detailed in **Section 1** of this **Application Narrative**, the question of whether to remove the dam was included on a March 2022 referendum ballot; 74% of Durham voters supported removing the dam, upholding the previous Town Council decision.

8

Cultural Resources

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires federal agencies to consider the effects of their undertakings on historic properties. Consequently, an assessment regarding potential impacts to above-ground historic and archaeological resources, along with the corresponding mitigation is ongoing.

A Request for Project Review (RPR) was submitted to the NHDHR on November 5, 2020. NHDHR responded on November 25, 2020, requesting further coordination regarding survey requirements for above-ground resources and coordination with the Durham Historic District Commission/Heritage Commission (HDC/HC) to preserve the character defining characteristics of the dam. This response is provided in ***Appendix L***.

Above-Ground Historic Resources

As detailed below, the above-ground historic resources identified within and adjacent to the Project area include the Oyster River Dam, also known as the Mill Pond Dam, and the Durham Historic District. The dam and historic district are historic resources protected by state and federal law, including Section 106 of the NHPA and NH RSA 227-C relative to historic preservation.

The Oyster River Dam at Mill Pond (DUR0018) was listed on the New Hampshire State Register of Historic Places in 2014 under State Register Criteria A and C for its associations with local history and for its engineering significance. The Oyster River Dam is a contributing resource to the Durham Historic District (DUR0030), which was listed in the National Register of Historic Places (NRHP) in 1980. The historic district contains 35 contributing resources representing the Town of Durham from the early seventeenth century to the 1830s. This period of significance is inclusive of the origins of the town through its height of prosperity as a shipbuilding and trading center.

The proposed dam removal will eliminate the State Register-listed dam, which would require mitigation to offset this adverse effect to both the dam as an individual resource and the historic district due to the dam's contributing status. Coordination with the Town of Durham, the Durham HDC/HC, U.S. Army Corps of Engineers (USACE), NH Department of Historical Resources (NHDHR), National Oceanic and

Atmospheric Administration (NOAA), and other consulting parties with a vested interest is ongoing to assess the appropriate commensurate mitigation.

Archaeological Resources

The Phase IA archaeological sensitivity assessment conducted in 2020 identified the full extent of the area surrounding the impoundment as sensitive for pre-contact archaeological resources and broad portions of the area as sensitive for post-contact resources. Potential archaeological resources within the Project area include seventeenth-century homestead project areas, unmarked burials for the victims of the 1694 Oyster River Raid, eighteenth and nineteenth century domestic dwelling project areas and archaeological resources associated shipyards, wharves, landings, warehouses, and stores. NHDHR also concurred with the Phase IA archaeological sensitivity assessment, noting that an additional Phase IB study may be necessary depending on the selected alternative.

The Phase IB survey conducted in 2022 included testing at two spatially distinct locations: the dam removal direct impact area and a meander bend at the confluence of Hamel Brook and the Oyster River where the potential for post-dam removal landform erosion was identified. This survey at the dam removal direct impact area revealed significant past disturbance and artificial landforms with no evidence of pre-contact or post-contact archaeological resources. Consequently, no further archaeological survey was recommended in this area. However, the survey identified one previously undocumented archaeological site within the meander bend test area. Although the site is likely eligible for listing in the NRHP, the erosion of the meander bend test area is a potential event rather than a definitive occurrence. Therefore, a Phase II determination of eligibility (DOE) is not recommended at this time, but a monitoring plan will be established.

Additional Phase IB archaeological investigation at a third identified impact area at the Mill Pond Park off Mill Pond Road is ongoing. USACE and NHDHR will be consulting throughout all necessary phases of archaeology if additional survey is recommended or if future design changes require additional survey.

Permit Area Determination

The USACE issued a Permit Area Determination via a letter dated March 6, 2023, provided in ***Appendix L***. An Identification of Cultural Resources Report (dated July 7, 2023) was prepared to record all previously unidentified resources that could be impacted by the proposed project. The report included a recommendation that the Durham Historic District boundary should be expanded to include additional resources surrounding the Mill Pond impoundment with associations to the historical context of downtown Durham. For this project's purposes, the NHDHR considers the recommended boundary expansion eligible for listing in the NRHP. The USACE is currently evaluating the potential effects, in coordination with NHDHR, of the project on the historic aboveground and archaeological resources. It is anticipated USACE will determine the project will have an adverse effect on the Mill Pond Dam and Durham National Register Historic District.

Note that due to the extensive Section 106 coordination for this Project in close coordination with the USACE and others, ***Appendix L*** only contains the limited cultural resource documentation referenced above. Additional documentation can be provided upon request.

9

Federal Agency and Local Coordination

US Army Corps of Engineers

The proposed work includes approximately 66,570 sq ft (1.53 acres) of permanent impacts and 21,340 sq ft (0.49 acres) of temporary impacts to palustrine wetlands and is subject to the USACE Section 404 jurisdiction through the New Hampshire General Permit No. NAE-2022-00849. As such, Appendix B – Corps Secondary Impacts Checklist has been completed. Refer to the **USACE Appendix B Checklist** provided in ***Appendix M.***

Durham Conservation Commission

In accordance with Env-Wt 311.06(h) and RSA 482-A:3(I)(a)(1), the Conservation Commission will receive a complete copy of this application concurrent with the NHDES submission to provide them with the opportunity to review and comment. We will provide any comments received from the Conservation Commission along with our responses to the NHDES Wetlands Bureau when we receive them, if applicable.

Oyster River Local Advisory Committee (LAC)

Since this Project is located within the Designated River Corridor of the Oyster River, the Oyster River LAC will be sent a copy of this complete application for their review and comment, in accordance with Env-Wt 311.06(i). A certified mail receipt will be included in the NHDES hard copy of the application in ***Appendix B***. Any comments received from the LAC will be forwarded to the NHDES Wetlands Bureau, along with our responses.

Summary of Project Meetings

Refer to the bulleted list below for a summary of Project meetings with regulatory agencies and the public. Although this list may not be fully comprehensive, it exemplifies the Project timeline and depth of agency and public involvement throughout the process.

2019

- August 19, 2019 - Town Council Briefing
- December 5, 2019 - Historic District Commission

2020

- January 16, 2020 - Public Information Meeting
- February 24, 2020 - Durham Conservation Commission Briefing
- June 15, 2020 - Town Council Briefing
- July 6, 2020 - Town Council Briefing
- July 17, 2020 - Natural Resource Agency Meeting
- August 6, 2020 - Durham Heritage Commission Mitigation Discussion
- November 9, 2020 - River Restoration Task Force Briefing
- November 16, 2020 - Town Council Briefing
- December 28, 2020 - Durham Conservation Commission Briefing

2021

- January 7, 2021 - Durham Heritage Commission Mitigation Discussion
- January 11, 2021 - Public Hearing for Alternative Actions
- February 15, 2021 - Town Council
- April 5, 2021 - Town Council
- July 12, 2021 – Town Council Briefing
- August 16, 2021 - Town Council
- September 13, 2021 - Town Council
- October 18, 2021 - Town Council
- November 1, 2021 - Town Council

2022

- July 14, 2022 - Public Information Meeting
- October 20, 2022 - Consulting Party Meeting
- May 23, 2022 - Natural and Cultural Resource Agency Meeting

2023

- March 21, 2023 - Consulting Party Meeting
- June 26, 2023 - Town Council Update
- June 15, 2023 - Sediment Quality and Management Review Meeting with NHDES Staff
- July 12, 2023 - Natural Resource Agency Meeting
- August 31, 2023 - Integrated Vegetation Management Meeting
- September 18, 2023 - Consulting Party Meeting
- September 25, 2023 - Natural Resource Agency Meeting
- October 16, 2023 - Town Council Update
- November 6, 2023 – Natural Resource Agency Meeting (with a sediment management focus)
- November 14, 2023 – Consulting Party Meeting
- December 7, 2023 – NHDES Mitigation Pre-Application Meeting

10

Bank/Shoreline Stabilization (Env-Wt 514.02)

Since this Project proposes to reconstruct the natural Oyster River stream channel along with the dam removal (including bank stabilization), the standards outlined in New Hampshire Administrative Rule Env-Wt 514 must be addressed.

(a) *In addition to meeting the applicable conditions established in Env-Wt 300, the department shall not approve a hard-scope stabilization proposal such as rip-rap or a retaining wall unless the applicant demonstrates that the bank or shoreline in that location cannot be stabilized by preserving or restoring natural vegetation, landscape, or bioengineering.*

This design proposes bioengineered techniques to stabilize the restored riverbed, banks, and floodplain. Specific to the banks, coir logs, log vanes, boulder j-hooks, and root wads will be used along the outer edges of the stream curves to prevent erosion. An in-stream boulder riffle crest (stone cross-vane) grade control will be installed to protect against degradation of the channel bed and guide river flows into the constructed channel at the upstream limit of work. This reduction in the erosion potential of the water makes the implementation of bioengineered techniques more feasible, as opposed to hardscape alternatives. Refer to Section 3 of this Application Narrative above for more details on the proposed bank stabilization.

Erosion control riprap is proposed at the outlets of the existing stormwater outfalls that discharge into the impoundment to prevent scour once the impoundment is drained. Any stone proposed within or along the river channel (i.e., for the stone cross vanes and boulder clusters) will consist of smooth river stone.

(b) Bank/shoreline stabilization shall:

(1) Be designed to be the least intrusive practicable method in accordance with Chapter 8 of the A/M BMPs, available as noted in Appendix B;

(2) Conform to the natural alignment of the bank/shoreline;

(3) Not adversely affect the stream course such that water flow will be transported by the stream channel in a manner that the stream maintains it dimensions, general pattern, and slope with no unnatural raising or lowering of the channel bed elevation along the stream bed profile;

(4) Not adversely affect the physical stream forms or alter the local channel hydraulics, natural stream bank stability, or floodplain connectivity;

(5) Avoid and minimize impacts to shoreline resource functions as described in Env-Wt 514.01 and Chapter 8 of the A/M BMP's, available as noted in Appendix B.

(6) If the project is a wall on a great pond or other surface water where the state holds fee simple ownership of the bed, locate the wall on the shoreward side of the normal high water line; and

(7) If the project is to install rip-rap, locate the rip-rap shoreward of the normal high water line, where practicable, and extend it no more than 2 feet lakeward of that line at any point.

The proposed design meets these criteria; it is the least intrusive practical method to accomplish the dam removal and habitat restoration objectives. This Project balances the proposed jurisdictional environmental impacts (detailed throughout this application) with the long-term ecological benefits associated with dam removal, especially at the head of tide. Active channel restoration upstream of the existing dam will reestablish the Oyster River channel within the currently impounded area and restore the natural pre-dam functions and values. The restored channel will have a sinuous alignment following the natural alignment of an existing underwater channel within the bed of Mill Pond. Bioengineered techniques will be implemented in place of hardscape or riprap alternatives to stabilize the riverbed, banks, and adjacent floodplain areas. Simulated streambed material, boulder clusters, and boulder riffle crests/stone cross-vanes will be used in the channel to stabilize it, create habitat diversity (i.e., riffles and pools), and slow water velocity. The riverbanks will be stabilized with coir logs, log vanes, j-hooks, and root wads. Refer to Section 5 of this Application Narrative above for more details regarding key factors considered during the design, including special flood hazard areas and hydraulics.

It should also be noted that the adjacent riparian and floodplain areas surrounding the restored river channel will be stabilized with targeted plantings. Additionally, the remainder of the drained impoundment area will undergo invasive species management to encourage the establishment of native vegetation within the newly exposed areas for additional stabilization.

(c) The hierarchy of bank stabilization practices shall be as follows:

(1) Soft vegetative bank stabilization, including regrading and replanting of slopes, in which all work occurs above ordinary high water or normal high water;

(2) Bioengineered bank stabilization or naturalized design techniques that uses a combination of live vegetation, woody material, or geotextile matting and may include regrading and replanting of slopes;

(3) Semi-natural form design hall be allowed only where the applicant demonstrates that anticipated turbulence, flows, restricted space, or similar factors, render vegetative or soft stabilization methods, bioengineering, and natural process design stabilization methods physically impractical;

(4) Hard-scope or rip-rap design shall be allowed only where anticipated turbulence, flows, restricted space, or similar factors render vegetative, bio-engineering, semi-natural form design and diversion methods physically impractical and where necessary to protect existing infrastructure; and

(5) Wall construction shall be allowed as the last available option, only where lack of space or other limitations of the project area make alterative stabilization methods of bioengineering, semi-natural, and rip-rap impractical. Wherever sufficient room exists, slopes shall be cut back to eliminate the requirement for a wall.

As previously mentioned, no riprap is proposed for streambank stabilization. Once the upstream river channel is restored following a natural channel design, it will be stabilized with bioengineered techniques (such as coir logs and root wads). Soft vegetative bank stabilization alone would not be adequate to stabilize the river channel under water flow volumes and velocities predicted by hydraulic modeling. However, riparian and floodplain plantings along the river are proposed. Refer to the Project Plans provided in *Appendix A* for details on the proposed bioengineered techniques and plantings.

(d) Stream bank-stabilization project plans shall be developed in accordance with the following techniques, as applicable:

(1) Naturalized and semi-natural design techniques where practicable in accordance with "Guidelines for Naturalized River Channel Design and Bank Stabilization" dated February 2007, R. Schiff, J.G. MacBroom, and J. Armstrong Bonin, available as noted in Appendix B and at https://www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/r-wd-06-37.pdf;

(2) Forr bioengineering projects, National Engineering Handbook Part 654 (NEH 654), Technical Supplement 141, Streambank Soil Bioengineering, dated August 2007, NRCS, available as noted in Appendix B and at https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17818.wba; and

(3) For stream restoration projects, NEH 654, Stream Restoration Design, dated August 2007, NRCS, available as noted in Appendix B and at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/manage/restoration/?cid=stelprdb1044707.

The design incorporates the applicable stream bank stabilization techniques, as applicable; refer to the Project Plans provided in *Appendix A*.

11

Restoration/Enhancement Activities (Env-Wt 525)

Since this Project proposes to remove the Oyster River Dam both due to safety concerns and to restore the natural upstream Oyster River channel for fish passage, the standards outlined in New Hampshire Administrative Rule Env-Wt 525 must be addressed. Note that the Project will meet the design criteria in Env-Wt 525.04, further outlined below, and does not include unnatural stream channelization or conversion of wetlands to uplands.

Note that although some sediment will be excavated to accomplish the Project goal of restoring/reconstructing the Oyster River channel within the Project area to a stabile configuration, this is not a dredging project. Consequently, we have not explicitly addressed Env-Wt 523 or Env-Wt 607 in this application.

Additionally, although the proposed work includes dam removal, Env-Wt 526 does not apply to this Project. In accordance with Env-Wt 526.01(a), that section of the rules only applies to the "construction, reconstruction, modification, repair, or replacement of a dam."

11.1 Env-Wt 525.03 Application Requirements for Restoration/Enhancement Activities.

The project-specific information required by Env-Wt 310.01(c)(1) or Env-Wt 311.03(b)(11), as applicable, shall be as follows:

(a) A description of the project goals explaining how the project will achieve restoration/enhancement of desired functions and values in accordance with Env-Wt 805.02(d) and Env-Wt 300;

Refer to the applicable preceding sections of this Application Narrative. In summary, this Project proposes to restore a portion of the Oyster River by removing the Mill Pond Dam. This will restore the tidal interface at the existing dam location and improve the water quality of this resource that has degraded within Mill Pond. Integrated vegetation management will be implemented within the

drained impoundment to prevent colonization by invasive species and promote native vegetation establishment. These measures will restore the historic natural functions and values of this area prior to the original dam construction.

(b) For wetland restoration/enhancement projects, all the information or documents specified in Env-Wt 805.03 except for a list of activities that will or will not be allowed within the project area;
Not applicable. This Project is focused on dam removal and stream restoration within the existing palustrine Mill Pond impoundment (as opposed to wetland restoration), with wetland areas expected to form naturally within the drained impoundment. Regardless, much of the criteria stipulated in Env-Wt 805.03 is included on the Project Plans provided in *Appendix A*, including existing and proposed grades, construction sequence, planting details, erosion control details, etc.

(c) For stream restoration/enhancement projects:

(1) Subject to (2), below, the information or documents specified in the applicable provisions of Env-Wt 806.04 except for activities that will or will not be allowed within the project area; or
The criteria stipulated in Env-Wt 806.04 is included on the Project Plans provided in *Appendix A*, as detailed in the response to Env-Wt 525.03(d)(1) below.

(2) For projects that are limited to wood addition, the information specified in Env-Wt 806.04(b) and (d);
Not applicable.

(d) For restoration/enhancement projects that include dam removal:

(1) The information and documents specified in the applicable provisions of Env-Wt 806.04 except for a list of activities that will or will not be allowed within the project area;
See excerpt below.

> *Env-Wt 806.04 Plans for Stream Restoration and Enhancement Projects. The applicant shall include the following in the report and plan required by Env-Wt 803.01:*
>
> *(a) Existing and proposed channel forms, including both cross section and profile;*
> **Refer to the Project Plans provided in *Appendix A*.**
>
> *(b) Channel width and length of reach;*
> **The reconstructed upstream river channel will be approximately 42 feet wide from bank to bank, as measured on the appended plans. The length of the proposed restored river channel will be approximately 700 feet as measured along the thalweg.**
>
> *(c) Sediment transport model and the reference reach;*
> **Refer to Section 5.3 of this Application Narrative above for information regarding sediment transport modeling for this Project.**
>
> *(d) Construction procedures, sequence, and timing;*
> **For construction procedures, sequence and timing details, refer to Section 3 of this Application Narrative above, as well as the notes on the Project Plans provided in *Appendix A*.**
>
> *(e) A planting proposal, with preference given to native plants and natural communities as required in Env-Wt 805.03(c);*

Native plantings are proposed along the restored river channel within the designated high marsh, riparian floodplain, and riparian buffer zones. Plantings will include herbaceous plugs and woody shrubs, along with the application of suitable native seed mixes. Refer to the Restoration and Planting Plan sheet in the Project Plans provided in *Appendix A*.

(f) Information on the floodplain, including the level of connectivity between the stream and the floodplain, the permanence of coarse woody material in the floodplain, and the width of the floodplain;

The existing floodplain extends slightly beyond the impounded area above the dam, which ranges in width from approximately 500 feet through Mill Pond to 100 feet in the upstream impoundment. Removing the dam will reduce the effective channel width to approximately 40 feet through the proposed active channel restoration area in Mill Pond and extending upstream along the upstream impoundment, with the remaining currently impounded area transitioning to floodplain. This restored floodplain will be directly connected to the restored channel for the full range of flood magnitudes from slightly exceeding bankfull (2-year) to the regulatory FEMA floodplain (100-year). Hydraulic modeling indicates that post-removal floodplain widths corresponding to the 100-year flood magnitude would be effectively equal to existing conditions, as the downstream Newmarket Road bridge is the primary factor influencing flood elevations under the base flood. The edges of the current impoundment are heavily forested along the south side of Mill Pond and on both sides extending up the middle impoundment. Following removal, coarse woody material would naturally accumulate in the newly-created floodplain over time as adjacent trees fall and new saplings take root.

(g) Erosion control specifications to prevent sediment from entering adjacent, undisturbed wetlands or surface waters;

A combination of land-based erosion controls (i.e., straw wattle) and water-based erosion controls (i.e., cofferdams) will be implemented to prevent sediment laden runoff or turbid waters from exiting the limits of work and entering the surrounding habitat areas during construction. The excavated sediment will be dewatered on project area before being trucked away for offsite disposal. Refer to the Project Plans provided in *Appendix A* for more information regarding the proposed erosion controls.

(h) If any invasive plant species are within 100 feet of each stream bank, identification of the type and location of the species and an invasive species control plan;

For information regarding invasive species, refer to Section 4.4 of this Application Narrative above, as well as the IVMP provided in *Appendix F*.

(i) Photographs of the channel, banks, and side slopes; and

Refer to the Representative Site Photographs provided in *Appendix D*. However, the Oyster River channel upstream of the dam is not very discernable within the limits of the existing palustrine Mill Pond impoundment.

(j) A list of activities that will be allowed and not allowed within the mitigation area.

Not applicable. The Project will not be located within a conservation easement where activity restrictions would normally be imposed. Members of the public will have access

to the Project area post-construction as they do currently for sight-seeing, bird watching, etc.

(2) *Plans for the project stamped by a professional engineer; and*
Refer to the Project Plans provided in *Appendix A* that have been stamped by Mr. David Cloutier, VHB, NH Professional Engineer #15589.

(3) *A sediment report that includes:*
See Section 5.3 of this Application Narrative and the Feasibility Study and Supplemental Analysis for additional information.

a. *An explanation of the known potential for current and historic sources of sediment contamination from upstream sources, including but not limited to wastewater discharges, hazardous waste project areas, and existing and former manufacturing facilities and tanneries;*
The sediments within the impoundment contain some PAHs and metals in levels that are commonly found in urban environments and may be the result of anthropogenic or naturally occurring sources. Furthermore, the contaminant distributions were similar throughout the study area, suggesting a natural origin as opposed to a point source release. Although the sediments within the study area are unlikely to pose a human health risk, excavated sediment will be managed in accordance with NHDES Waste Management rules. Refer to Section 5.3 of this Application Narrative above for more information regarding sediment contamination.

b. *An estimate of the volume of sediment that will be removed or potentially become mobile as a result of the project;*
Approximately 4,500 CY of accumulated sediment within the existing Mill Pond impoundment is proposed to be removed as part of the active channel restoration to reconstruct the upstream Oyster River channel. Refer to Section 5.3 of this Application Narrative above for more detailed information.

c. *If a dam is to be removed, the estimated volume of impounded sediment that could be transported downstream due to dam removal; and*
Refer to Section 5.3 of this Application Narrative above for more detailed information regarding sediment transport.

d. *A description of the physical characteristics of the impounded sediment, including grain size distribution and organic content.*
Sediment sampling in the Oyster River and Hamel Brook indicates that the accumulated sediment within the impoundment is relatively uniform silt and/or fine sand size particles. Refer to Section 3.2.4.1 of the Feasibility Study for more information on sediment particle size and stability.

(e) *A restoration/enhancement monitoring plan that identifies:*
An Implementation Monitoring Plan was developed for this Project as part of the NOAA grant application. Below is a summary of that plan which is driven by NOAA's standard monitoring protocols.

(1) The metrics by which project success will be measured; and

As part of this Project, the Town and project partners plan to conduct pre- and post-dam removal monitoring of parameters that evaluate short-term structural changes, the presence of target fish species, enhancement of the surrounding community, and elimination of safety hazards. Specific functional parameters and target values will be established to demonstrate the success of the proposed project and will be re-evaluated within approximately one year after project implementation. Parameters may include channel restoration, photo stations, water quality components such as dissolved oxygen, diadromous fish passage assessment, and socioeconomic benefits. The Town and project partners will also determine other appropriate parameters that are both relevant to the project and that will yield verifiable and quantifiable results (e.g., measuring the consequences associated with the reduction of flooding that is expected as a result of the proposed Project). Monitoring efforts will utilize the *Gulf of Maine Stream Barrier Removal Monitoring Guide,* published in December 2007, to address many of the monitoring techniques and protocol.

To implement the monitoring plan, Town officials will work with local, state, and Federal agency representatives, local community partners, and interested parties. NHDES will continue to monitor water quality data throughout the dam removal process and NHF&G will continue to monitor fish assessments and counts along the Oyster River post-dam removal. Project performance will be demonstrated through the continued interaction and communication with state and federal agency representatives throughout the duration of this Project.

Agency representatives will be invited to attend regular project meetings with Town officials, the contractor, and the consultant representative. Updates will be discussed, along with the work planned for the following week and any ad hoc concerns/issues that need to be addressed. Comparison of as-built conditions to final designs will be completed to verify that the Project was constructed in accordance with the plans. The consultant representative will provide regular on-project area construction monitoring and will manage the weekly meetings to ensure the project meets expectations. Pre- and post-implementation data will be reported as part of the standard NOAA progress reporting process.

(2) A schedule showing anticipated construction phases, timing of plantings, dates of submission of monitoring reports, and a final date of completion;

In accordance with NOAA's guidelines for the monitoring and evaluation of fish passage barrier removal projects, the Tier 1 Metrics listed in Table 3 below will be addressed as part of the Implementation Monitoring Plan. However, for details on the proposed plantings, refer to the Restoration and Planting Plan sheet in the Project Plans provided in *Appendix A*.

Table 3: Oyster River Dam Removal Project Success Metrics

Tier 1 Metrics	Target Measure	Target Year	Pre-Implementation	Target Post-Implementation	Description/Notes
Project area Passability: Channel Width	Increase fish passage through the removal of the dam barrier.	2024	Dam in Place	42-foot bankfull width with 12-foot wide low-flow fish passage channel	Minimum channel width during low flow conditions, with greater widths during normal fish passage flows; width will be measured at each cross section, and at pinch-points if identified in restored reach, during low flows (greater than 95% exceedance probability flow).
Project area Passability: Channel Gradient	Increase fish passage through the removal of the dam barrier	2024	Dam in Place	0.4% (typical) 3.0% (max)	Slope determined from longitudinal profile through the restored reach.
Project area Passability: Max Jump Height	Increase fish passage through the removal of the dam barrier	2024	Dam in Place	9 inches	Maximum jump height under normal flow conditions should not exceed 9 inches; jump height will be measured at each cross section, and problem areas if identified within the restored reach, during low flows (greater than 95% exceedance probability flows).
Presence of Diadromous Fish Species	Strengthen the natural ecosystem of the Oyster River and allow for upstream fish passage to benefit the diadromous fish population	2025	Fish count <5% of those seen at the peak from 1990-1992.	Create 2.6 miles of free-flowing stream habitat along the river and its tributaries.	As a result of dam removal, diadromous fish species would be able to successfully ascend the restoration reach that would be exposed following dam removal, supporting a self-sustaining river run. Post dam removal, New Hampshire Fish and Game (NHF&G) will continue river herring monitoring by conducting visual assessments at 3-4 locations to determine river herring presence/absence. Visual observation will be conducted by NHF&G Biologists according to established time count methodologies. NHF&G biologists will also observe river herring behavior through the restored channel to determine the primary zones of passage (ZOP). This qualitative observation will occur over the range of flows that are typical during the river herring migration season as the ZOP.

Table 3: Oyster River Dam Removal Project Success Metrics

Tier 1 Metrics	Target Measure	Target Year	Pre-Implementation	Target Post-Implementation	Description/Notes
Water Quality	Improve the overall water quality of the Oyster River with the reduction or elimination of water quality impairments, especially dissolved oxygen	2025	%DO saturation levels <75% threshold.	%DO saturation levels >75% threshold.	Higher %DO saturation levels will be obtained by returning the Oyster River to its free-flowing state and eliminating algal build-up and increased water temperatures within the impoundment area. NHDES will continue to monitor water quality data throughout the dam removal process using the 05-OYS Environmental Monitoring Project area located within the Oyster River near the Mill Pond impoundment.
Annual Operating, Maintenance, and Liability Costs	Eliminate annual operating, maintenance, costs associated with dam stabilization and restoration	2024	$4,063,000	Less than $1,000 annually	The preliminary costs of stabilizing Mill Pond Dam to a state that would sufficiently address the safety hazards listed by the NHDES Dam Bureau would equate to over $4 million as depicted in the 2020 feasibility study. After dam removal, the annual operating and maintenance costs would account for monitoring and maintenance of historic wall infrastructure.
Safety Hazards	Removal of unsafe dam infrastructure	2024	The NHDES Dam Bureau has identified safety problems with structural integrity and stability of the Mill Pond Dam.	Dam removal would eliminate safety hazards and concerns.	The dam does not meet current NHDES dam safety standards which require it to pass a 50-year storm event with at least one foot of freeboard between the water surface and the top of the dam abutments. Based on hydraulic modeling results, the dam abutments as currently configured would be overtopped by high-flow flood waters, which is an unsafe condition. NHDES has determined that the dam is appropriately classified as a "Low Hazard Structure" based upon the potential impacts that dam failure may have on adjacent or downstream properties.

Table 3: Oyster River Dam Removal Project Success Metrics

Tier 1 Metrics	Target Measure	Target Year	Pre-Implementation	Target Post-Implementation	Description/Notes
Community Enhancement and Socioeconomic Benefits.	The return on investment for removing the Oyster River Great Dam would take several forms, including: Improvements in fish habitat quality Improvements in water quality Avoided costs related to future flood damages Avoided costs related to the maintenance and operation of dam	2025	Existing Mill Pond impoundment surface areas by flow conditions: 10-year: 27.5 acres 100-year: 32.0 acres	10-year: 47% decrease to 14.5 acres 100-year: 2% decrease in floodplain area	As part of the 2020 feasibility study, a HEC-RAS hydraulic model of the Oyster River was built. Dam removal would lower the hydraulic control of the river by approximately 9.6 feet. Modeling showed that removal of the Mill Pond Dam would increase the Oyster River's flood resilience in all of the flow conditions analyzed. Once the dam is removed and the natural flow of the river is restored, the Town and Consultant will monitor floodplain restoration of the approximately 9.5-acre dewatered area within the existing Mill Pond. In a 10-year storm after dam removal, the impoundment's surface average depth would be reduced from about 3.3 feet to about 1.4 feet. River depth would decrease by 14%. As a result, dam removal would help alleviate flooding of adjacent properties.

Source: The Town of Durham's grant application for NOAA's Restoring Fish Passage through Barrier Removal Notice of Funding Opportunity.

(f) A description of stakeholder engagement conducted to assist in determining any potential impacts to upstream and downstream property owners, if any;

Extensive stakeholder engagement has occurred over the years throughout the development and planning phases of this Project and is ongoing. The Town of Durham values the opinions and input of all stakeholders (i.e., regulatory agencies, advisory commissions, and members of the public). The Town considered feedback and concerns received from all entities and adjusted various design elements when applicable to avoid and minimize the proposed impacts. Refer to the bulleted list in Section 9 of this Application Narrative above for details regarding public meetings throughout the development of this Project.

(g) A description of any on-project area features, conditions, or past work that might restrict excavation or access; and

The proposed work (including excavation and access) depicted on the Project Plans and detailed throughout this application has taken all applicable factors into account. Since the Mill Pond impoundment is publicly owned land and is bordered by some Town-owned parcels, access to the Project area during construction will not be an issue. The design team is also aware of bedrock elevations within the proposed work areas in the impoundment and the proposed channel design will not need to impact or remove bedrock. There are underground utilities within the vicinity of the Project area, but no documented utilities within the proposed limit of work that would restrict excavation.

(h) Identification of the source of any hydric soils and plantings to be used.

Refer to the Restoration and Planting Plan sheet in the Project Plans provided in *Appendix A* for details regarding the proposed plantings along the proposed active channel restoration. Hydric soils are currently prevalent within the Project area due to the impounded Mill Pond that contains fine sediments and a mucky organic substrate.

11.2 Env-Wt 525.04 Design and Construction Requirements for Restoration/Enhancement Activities.

In addition to the design and construction requirements specified in Env-Wt 300, a restoration/ enhancement project shall be designed and constructed to:

(a) Restore or increase wetland function, stream function, water quality, or other functions of resources within jurisdictional areas;

The proposed dam removal, coupled with the active channel restoration, will restore the natural path of the Oyster River. Removal of the dam will also promote upstream fish passage, allow tidal influence to extend farther upstream, improve water quality (especially dissolved oxygen, lower water temperatures, and reduce the algal and plant biomass), and decrease flood elevations, among numerous other benefits detailed in Section 3 of this Application Narrative above.

(b) Create hydrologic conditions, organism passage, or land connections that will support or enhance wetland functions and values of the resources proposed to be restored or enhanced;

The goal of this Project is to restore the Oyster River to its historic free-flowing natural state. Since the existing dam is located at the head of tide, removing this infrastructure will allow tidal influence to extend farther upstream and will restore a natural transitional wetland where riverine freshwater

flows mix with brackish estuarine water. The barrier to upstream fish passage will be eliminated, resulting in an increase in anadromous fish runs. Additionally, plantings are proposed around the restored upstream channel, along with an integrated vegetation management plan (IVMP) to promote the establishment of native vegetation within the drained impoundment to prevent excessive colonization by invasive plant species and create valuable wildlife habitat.

(c) *For stream restoration/enhancement projects, meet as many of the goals specified in Env-Wt 806.02(a) as practicable;*

This Project will meet many of the goals specified in Env-Wt 806.02(a), including (but not limited to) the following: *(1) Increase or restore native ecosystem productivity and biodiversity; (2) Increase or restore sediment, nutrient, and particulate transport and retention/recycling dynamics; (3) Restore the natural hydrologic regime; (4) Support or improve migration and movement of aquatic biota; (5) Increase or restore the availability or accessibility of upstream aquatic habitats; (8) Improve thermal regimes, such as adding riparian vegetation to provide shade; (9) Improve water quality; (10) Improve access to refuge and reproductive habitat for aquatic organisms; and (11) Reduce the likelihood of water surges and flash flooding.*

(d) *Where applicable, preserve access to the restoration/enhancement areas; and*

The existing abutting publicly accessible Town-owned parcels (including Mill Pond Park and the Milne Sanctuary) will persist post-construction for public use.

(e) *For wood addition, comply with the "Practical Guide to Adding Wood to Streams in NH" dated 2018, published by the NRCS, available as noted in Appendix B.*

The proposed root wads and log vanes will comply with the above noted guide.

12

Coastal Lands and Tidal Waters/Wetlands (Env-Wt 600)

Since this Project proposes impacts within tidal waters, the standards outlined in New Hampshire Administrative Rule Env-Wt 600 must be addressed. However, it should be noted that the proposed impacts within tidal areas are limited to a small area downstream of the existing dam. Most of the proposed work will occur upstream of the dam within the existing freshwater conditions.

12.1 Env-Wt 603: Additional Application Information for Projects in Coastal Areas

12.1.1 Env-Wt 603.02: Required Information

All information requested in this section has been thoroughly addressed in the preceding sections of this **Application Narrative**.

12.1.2 Env-Wt 603.03: Data Screening

Refer to the applicable sections of this **Application Narrative**, including **Sections 2.3, 4**, **6.4** and **12.1.4**.

12.1.3 Env-Wt 603.04: Coastal Functional Assessment

Refer to **Section 4.3** of this **Application Narrative** above for details regarding the functional assessment for this Project.

12.1.4 Env-Wt 603.05: Vulnerability Assessment

Since no new infrastructure is proposed to be constructed, coupled with the drained impoundment area, this Project has a high tolerance for flood risk. The effects of the proposed Project (i.e., dam removal and upstream Oyster River channel restoration) are expected to persist in perpetuity and increase the Town of Durham's flood resiliency. This reach of the Oyster River will be better suited to handle projected sea level rise post-construction compared to the existing conditions.

Following dam removal, tidal influence would be limited to the restored river channel and portions of the floodplain extending approximately 100 feet upstream of the NH 108 bridge. Based on current measured tidal elevations, areas lower than 3.6 feet (NAVD88) would likely be inundated or influenced by tidal waters daily, and areas up to elevation 4.5 feet (NAVD88), corresponding to the highest astronomical tide (HAT), would be subject to potential tidal influence. However, tidal influence would be limited to a change in water levels as riverine flows at this location are too large to allow reversal of flow carrying salt water upstream. Over time, future tidal action on adjacent wetland areas is possible as predicted sea level rise occurs over the next century, and the wetland community would shift towards salt water tolerant species.

The hydraulic and habitat analysis for the Feasibility Study accounted for relative sea-level rise (RSLR) based on data published by Wake, et al. (2019) and the New Hampshire Coastal Flood Risk Science and Technical Advisory Panel (2019). This data indicates a 67% probability that coastal New Hampshire's RSLR will be between one foot and 2.9 feet by the year 2100, and a 5% chance of a 3.8-foot rise. Under these scenarios, the Feasibility Study predicted that much of the Mill Pond impoundment would be subject to tidal flow and may be converted to salt marsh habitat.

The area subject to tidal action daily would eventually acquire some of the characteristics of the portion of the Oyster River located immediately downstream of the dam, which is classified as a subtidal estuarine system with an unconsolidated bottom. Within this habitat type, brackish tidal water enters from the ocean, while the river carries nutrients, organic matter, and sediments to the downstream estuaries. These inputs combine to make estuaries extremely productive habitats with a great abundance of plants and animals. Outside of the immediate river channel, existing salt tolerant species observed downstream of the dam could provide a seed source for salt tolerant vegetation to become established in the new tidal influenced zone. The existing salt tolerant vegetation species include saltmeadow cordgrass (*Spartina patens*), prairie cordgrass (*Spartina pectinata*), blackgrass (*Alopecurus myosuroides*), and saltmarsh bulrush (*Scirpus robustus*).

12.1.5 Env-Wt 603.06: Project Design Narrative Required

This **Application Narrative** constitutes the Project Design Narrative and includes all information required by this section of the rules.

12.1.6 Env-Wt 603.07: Design Plans

Refer to the **Project Plans** provided in ***Appendix A*** that meet the specified requirements.

12.1.7 Env-Wt 603.08: Water Depth Support Information Required

Water depth supporting information is presented in **Table 4** below. This data was published on December 6, 2021, by the NOAA Center for Operational Oceanographic Products and Services.

The data is reported from the tidal benchmarks at Station ID 8419870, Seavey Island, Portsmouth Harbor, New Hampshire. While this data is representative of the nearest NOAA tidal benchmark to the Project area, tidal elevations and conditions at the Project area vary from benchmark elevations below (Dr. Thomas Ballestero, personal communication). Field measurements in conjunction with tidal measurements at Wagon Hill indicate that high tide levels at the Project area are approximately 0.4 feet lower than the Seavey Island NOAA gage (3.6 ft and 3.3 ft NAVD88, respectively). The highest observable tide line (HOTL) immediately downstream of the dam was set to a reference elevation of 4.5 feet NAVD88 based on field-surveyed water levels associated with the October 2019 Highest Astronomical Tide (HAT), commonly known as the "king tide" – this elevation at the project area was approximately 1.4 feet lower than the corresponding elevation at the Seavey Island NOAA gage.

Table 4: Elevations of Tidal Datums at Seavey Island[1]

Unit	Abbreviation	Meters	Feet
Highest Observed Water Level (1978)[2]		2.41	7.89
Mean Higher High Water[1]	MHHW	1.28	4.18
Mean High Water[1]	MHW	1.15	3.76
North American Vertical Datum[1]	NAVD88	0.00	0.00
Mean Sea Level[1]	MSL	-0.08	-0.25
Mean Tide Level[1]	MTL	-0.10	-0.32
Mean Low Water[1]	MLW	-1.34	-4.39
Mean Lower Low Water[1]	MLLW	-1.44	-4.71
Predicted Sea-Level Rise (by 2100)[3]		1.16	3.80

[1]Numbers are referenced to NAVD88.

[2]Data Source: https://tidesandcurrents.noaa.gov/benchmarks.html?id=8419870

[3]See Section 12.1.4 of this Application Narrative for more information.

12.1.8 Env-Wt 603.09: Statement Regarding Impact on Navigation and Passage

Not applicable. This project does not propose to construct a structure in tidal waters/wetlands nor extend an existing structure seaward. The proposed dam removal will improve navigation and passage along the Oyster River.

12.2 Env-Wt 604: General Criteria for Project Impacts in Coastal Areas

12.2.1 Env-Wt 604.01: General Criteria for Tidal Beaches, Tidal Shoreline, and Sand Dunes

Refer to the applicable sections of this **Application Narrative** for the required information. No impacts are proposed to tidal beaches or sand dunes.

12.2.2 Env-Wt 604.02: General Criteria for Tidal Buffer Zones

The tidal buffer zone (TBZ) extends 100 feet out from the highest observable tide line (HOTL). Based on the definitions of "developed upland" (Env-Wt 602.12) and "tidal buffer zone" (Env-Wt 602.52), the TBZ surrounding the Project area is developed due to the presence of abutting public roads and residential properties. Consequently, no impacts to an undeveloped TBZ are proposed. Refer to the applicable sections of this **Application Narrative** for the required information.

12.2.3 Env-Wt 604.03: General Criteria for Tidal Waters/Wetlands

Refer to the applicable sections of this **Application Narrative** for the required information.

12.3 Env-Wt 605: Avoidance and Minimization; Compensatory Mitigation

12.3.1 Env-Wt 605.01: Avoidance and Minimization Requirements in Coastal Areas

Impacts to wildlife (aquatic and terrestrial) have been avoided and minimized to the extent practicable throughout the Project design. Overall, the proposed dam removal will benefit aquatic organisms by removing the barrier to upstream fish passage. Integrated vegetation management will occur within the drained impoundment area to allow natural vegetation to establish that would further stabilize the Project area and increase post-construction wildlife habitat value. Additionally, over time sea level rise may naturally expand tidal habitat areas to further benefit saltwater tolerant species.

This Project will improve the hydrology and hydraulics of the Oyster River through the proposed dam removal and active channel restoration by restoring the historic natural free-flowing state of this river. The restored upstream river channel will be stabilized to prevent erosion and unnatural/excessive downstream sediment transport, as described elsewhere in this application (i.e., root wads, coir logs, and stone cross vanes).

Given the existing dam, the Project area is not used for navigation or commerce. However, Durham residents do recreate in and around Mill Pond. Recreational activities include, but are not limited to, kayaking, bird watching, and fishing. Despite the proposed dam removal that will drain the existing impoundment, the Project area will still be open for public enjoyment from the abutting public parks post-construction.

12.3.2 Env-Wt 605.02: Additional Requirements for Projects in or Adjacent to Tidal Waters/Wetlands and Tidal Buffer Zones

Potential adverse environmental impacts from this Project have been avoided and minimized to the extent practicable. There are no beaches or tidal flats within the Project area. There are also no tidal wetlands within the Project area. The tidal portion of the Project area is limited to a relatively small area between the existing dam and the Newmarket Road bridge. The natural resource delineation in that area resulted in the confirmation of wetland absence along the tidal riverbanks. However, the proposed design includes establishment of high marsh tidal wetlands in the area downstream of the current dam. This tidal wetland restoration would allow for the dissipation of wave energy and/or storm surge. Excess

flows would be able to access the riparian, floodplain, and wetland areas within the drained impoundment for temporary storage until flows recede.

The proposed activities are not expected to adversely impact salinity levels in tidal environments due to runoff. The existing maintenance of the surrounding public roads during winter conditions (i.e., the addition of road salt) are not proposed to be altered because of this Project and no new impervious areas or additional stormwater outfalls are proposed that would increase runoff into the Project area.

As for the movement of sediments, refer to **Section 5.3** of this **Application Narrative** above for detailed information. But, in summary, many BMPs will be implemented throughout construction to contain suspended sediments and prevent/reduce unnatural downstream sediment transport (i.e., cofferdams, bypass, etc.) during the dam removal and active channel restoration. Post-construction, the natural downstream sediment transport function of the Oyster River is expected to be restored and resemble that of a river system in equilibrium.

12.3.3 Env-Wt 605.03: Impacts Requiring Compensatory Mitigation

Not applicable. Although Env-Wt 605.03 states that compensatory mitigation is required for all permanent impacts to tidal surface waters, tidal wetlands, the tidal buffer zone, and sand dunes, it is subject to Env-Wt 313.04 mentioned in **Section 7.2** of this **Application Narrative** above.

12.4 Env-Wt 610: Protected Tidal Zone

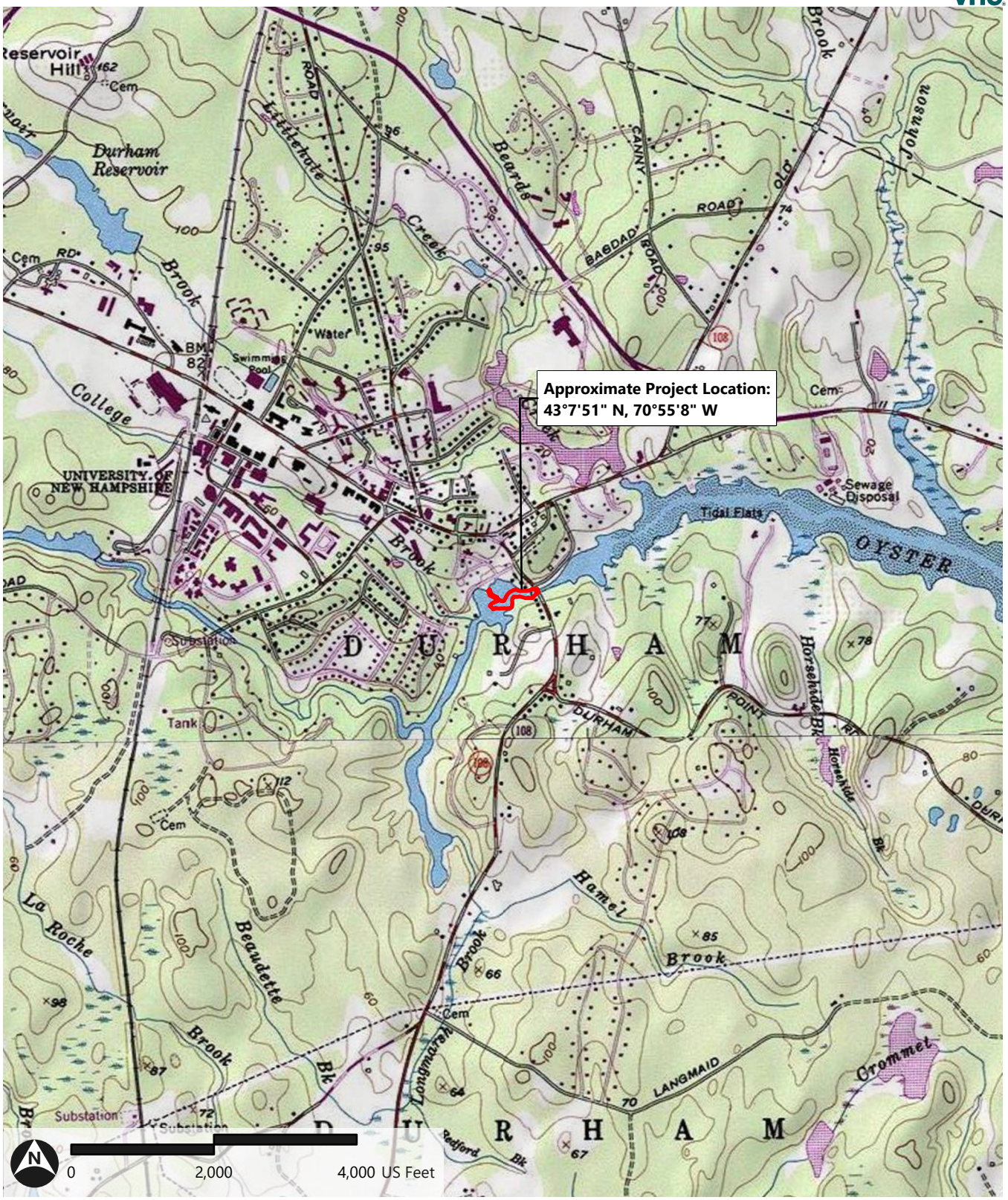
This section applies to work proposed within the TBZ, but since most of the proposed work will occur waterward of the delineated TOB line, impacts within the TBZ are minimal. The proposed TBZ impacts are mainly temporary construction area staging and sediment dewatering, with a small amount of permanent impact proposed north of the existing fish ladder to establish a vegetated slope after the fish ladder is demolished. No structures will be constructed within the TBZ, nor will any additional impervious surface be added.

Project Figures

List of Figures

Figure 1: USGS Overview Map

Oyster River Dam Removal at Mill Pond | Durham, NH



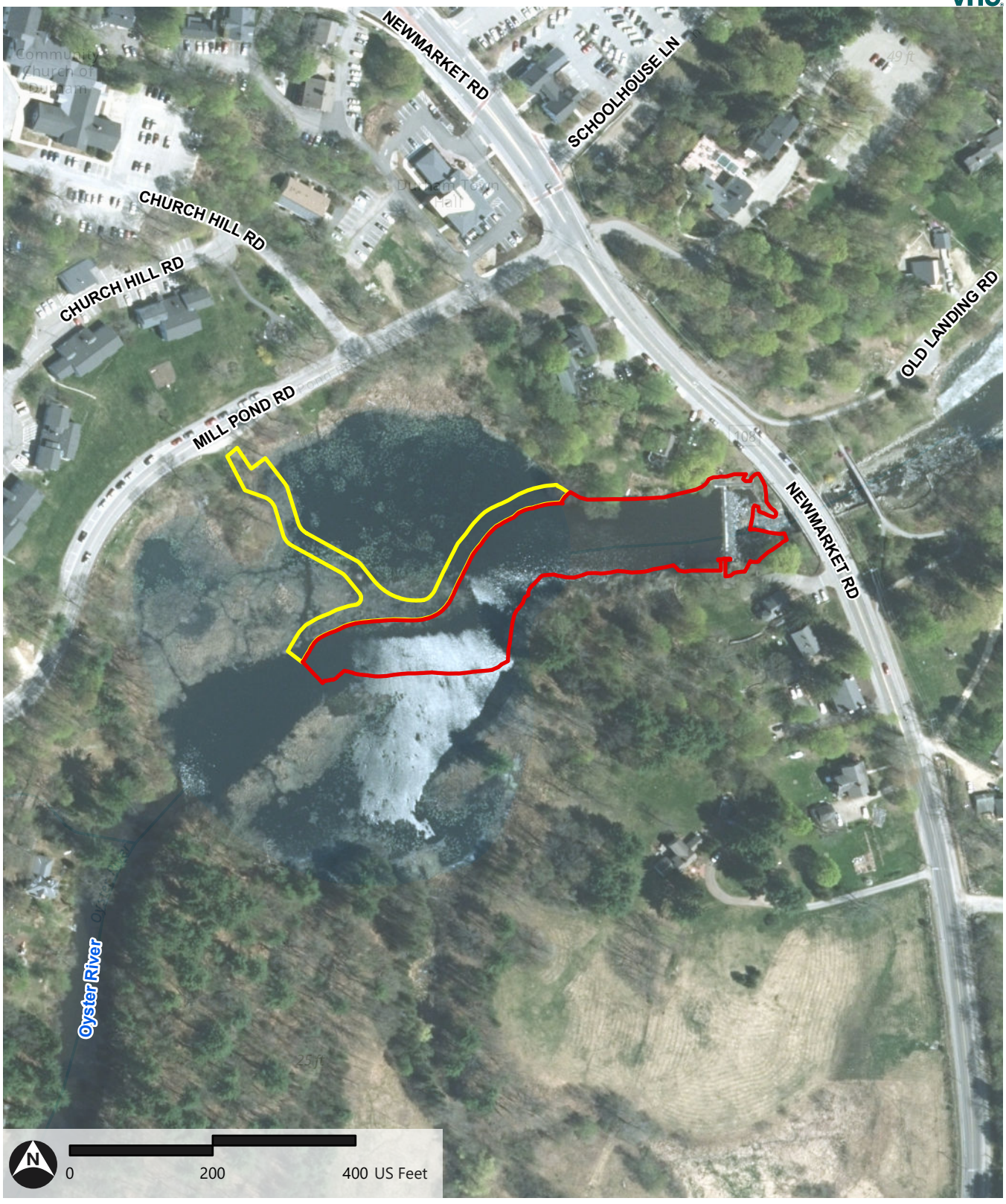
Approximate Project Boundary

Path: \\vhb\gis\proj\Bedford\52633.02 Mill Pond Final Design\Project\Oyster River Dam Removal\OysterRiverDamRemoval.aprx (kinfanti, 1/26/2024)

Source: USGS, VHB

Figure 2: Aerial Overview Map

Oyster River Dam Removal at Mill Pond | Durham, NH



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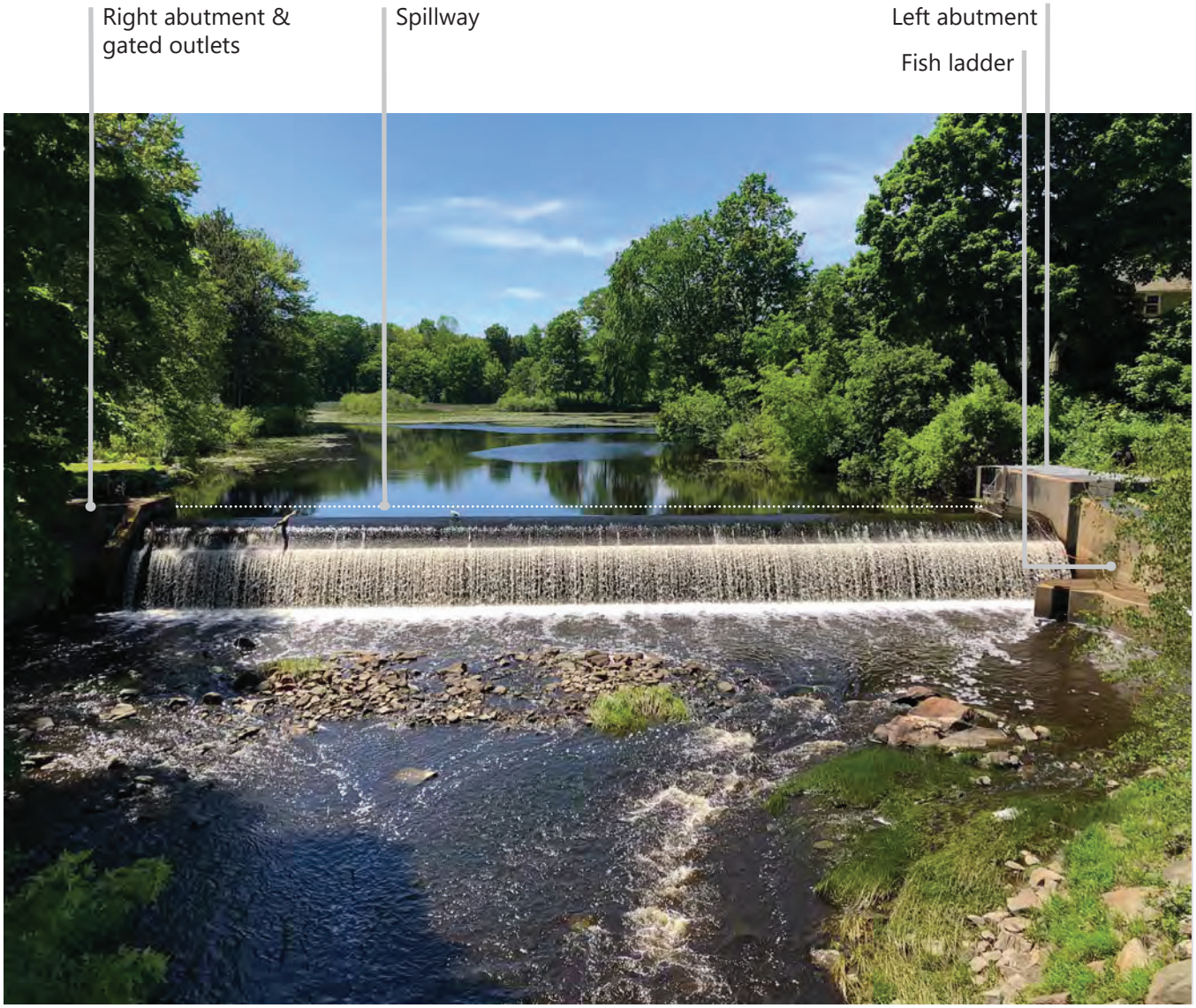
Source: NHGRANIT, VHB

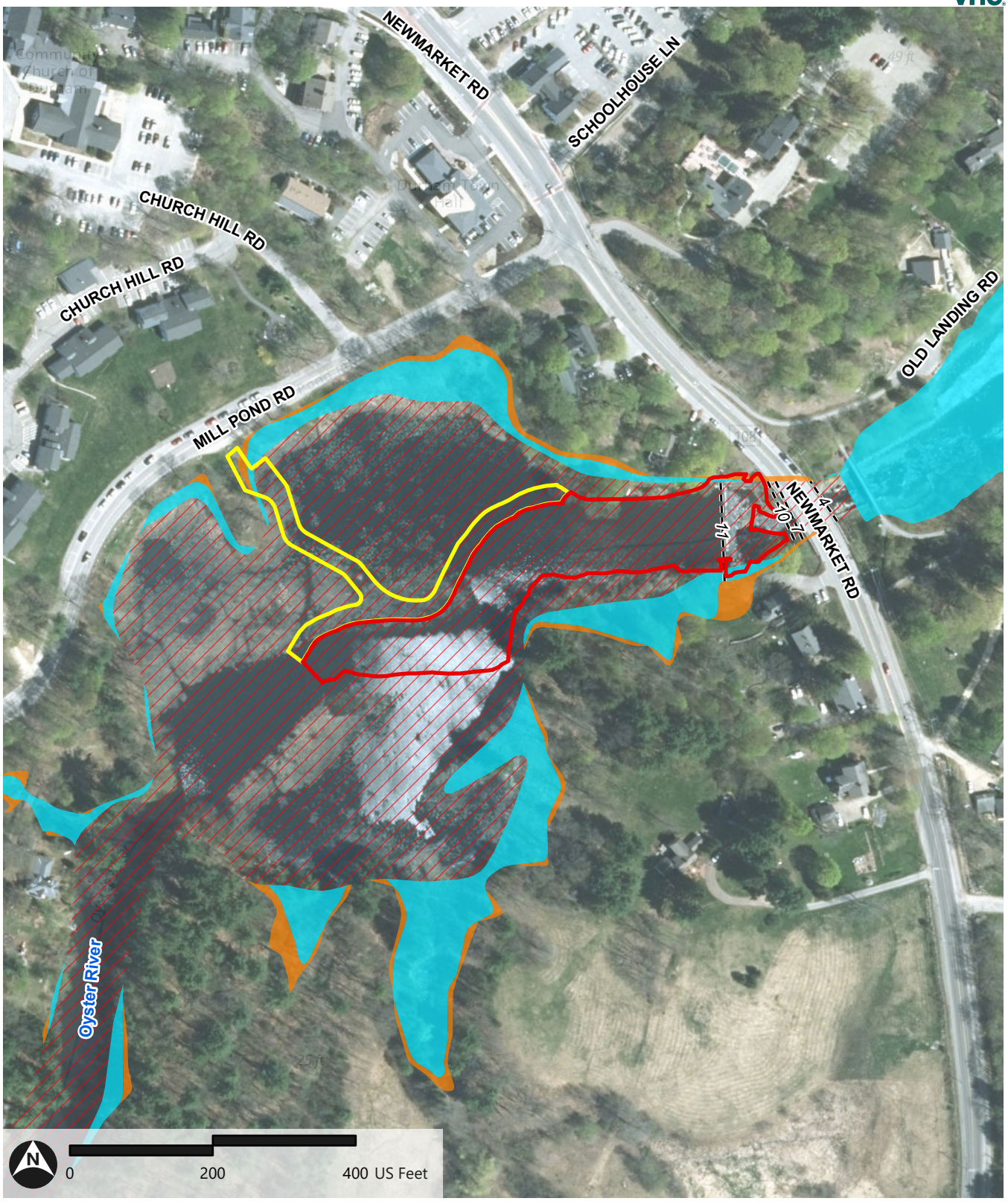
Figure 3: Annotated Dam Photo
Oyster River Dam Removal at Mill Pond | Durham, NH



A view of the Oyster River Dam, looking upstream from the NH 108 Bridge.

Figure 4: Floodplain Map

Oyster River Dam Removal at Mill Pond | Durham, NH



Dam Removal & Active Channel Restoration

Temporary Construction Access

Base Flood Elevations

1 pct. Annual Chance Flood Hazard

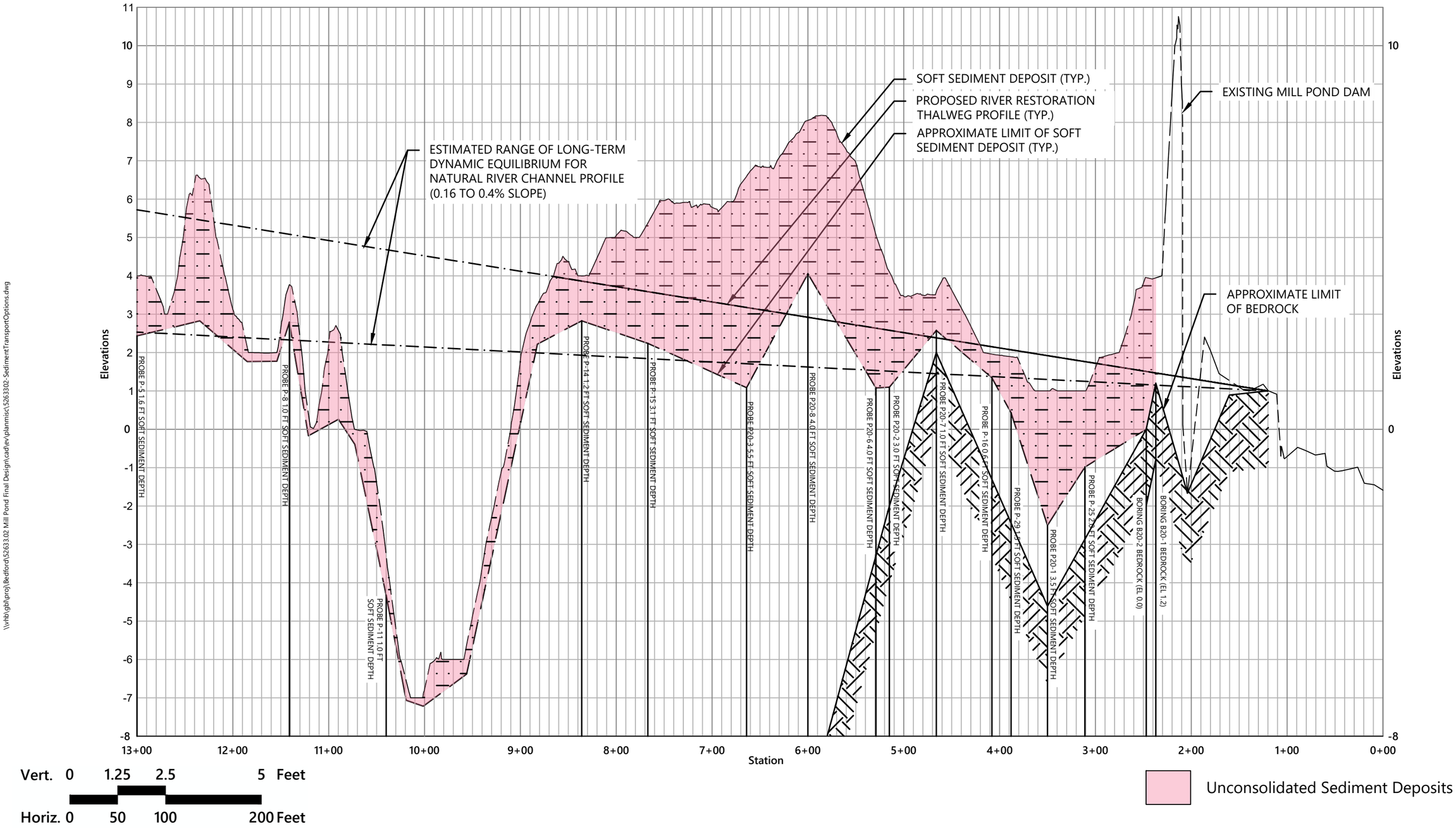
Floodway

0.2 pct. Annual Chance Flood Hazard

Path: \\vhb\gis\proj\Bedford\52633.02 Mill Pond Final Design\Project\Oyster River Dam Removal\OysterRiverDamRemoval.aprx (kinfanti, 1/25/2024)

Source: NHGRANIT, FEMA, VHB

Figure 5: Unconsolidated Sediment Deposits
Oyster River Dam Removal at Mill Pond | Durham, NH



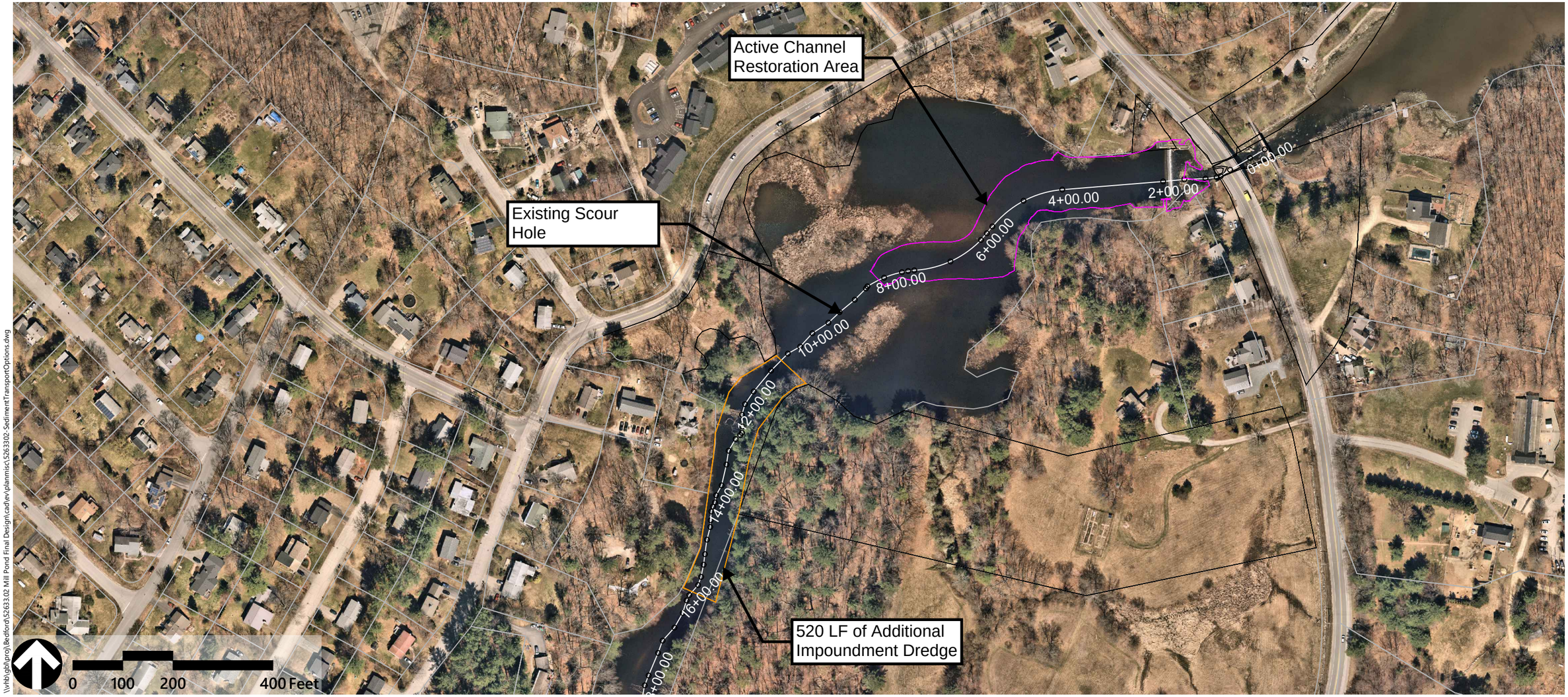
Vert. 0 1.25 2.5 5 Feet

Horiz. 0 50 100 200 Feet

Unconsolidated Sediment Deposits

Figure 6: Middle Impoundment Dredging

Oyster River Dam Removal at Mill Pond | Durham, NH



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Town of Durham Parcels

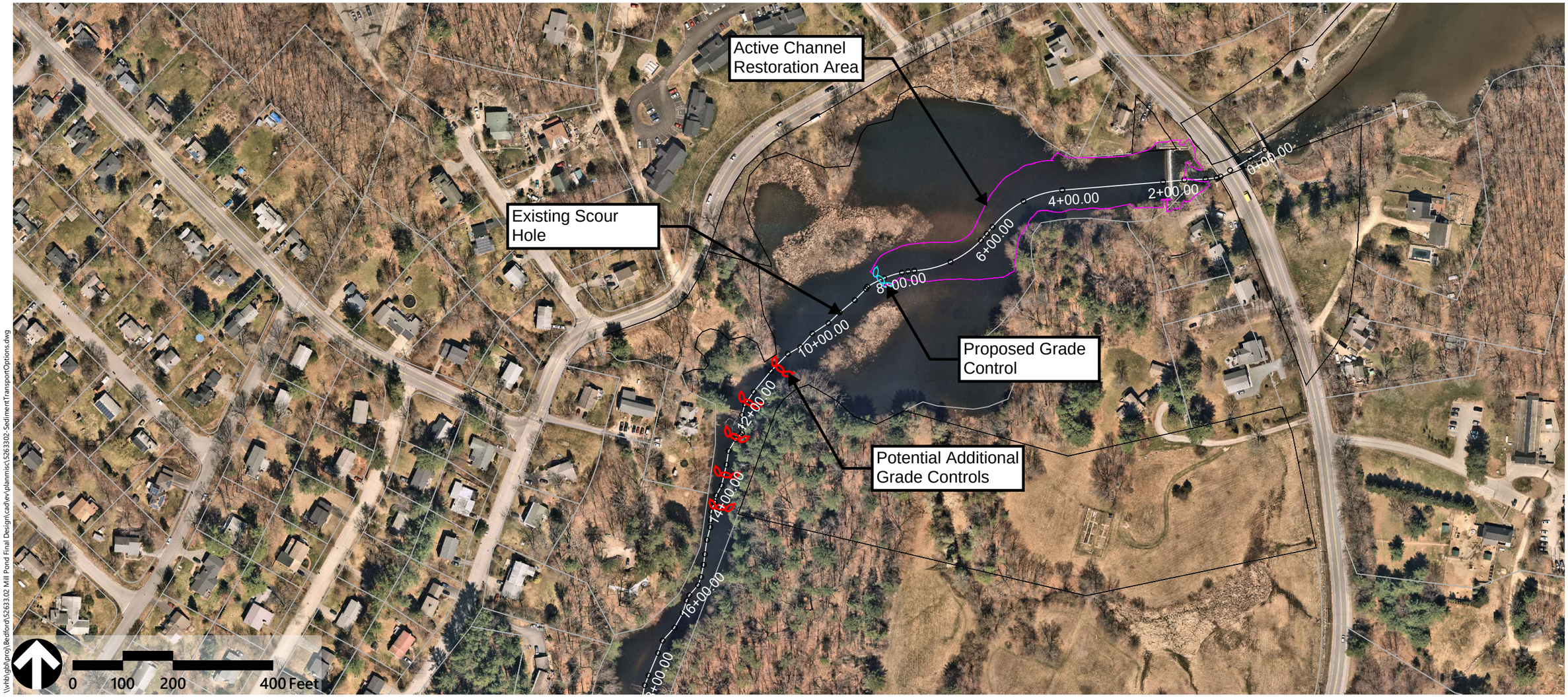
- Town Owned
- Privately Owned

Sediment Predicted for Transport if Dam is Removed and No Action is taken:	9,713 CY
Sediment Predicted to be Removed through Active Channel Restoration:	-4,530 CY
Sediment Predicted to be Captured through Scour Hole:	-1,330 CY
Total Sediment Recommended for Dredging:	**3,850 CY**
	103,950 CFT

Reach Proposed for Sediment Dredge			
Sediment Depth	Channel Width	Required Dredge Length	Total Volume
2 FT	100 FT	520 FT	**104,000 CFT**
			3,850 CY

Figure 7: Middle Impoundment Grade Control

Oyster River Dam Removal at Mill Pond | Durham, NH



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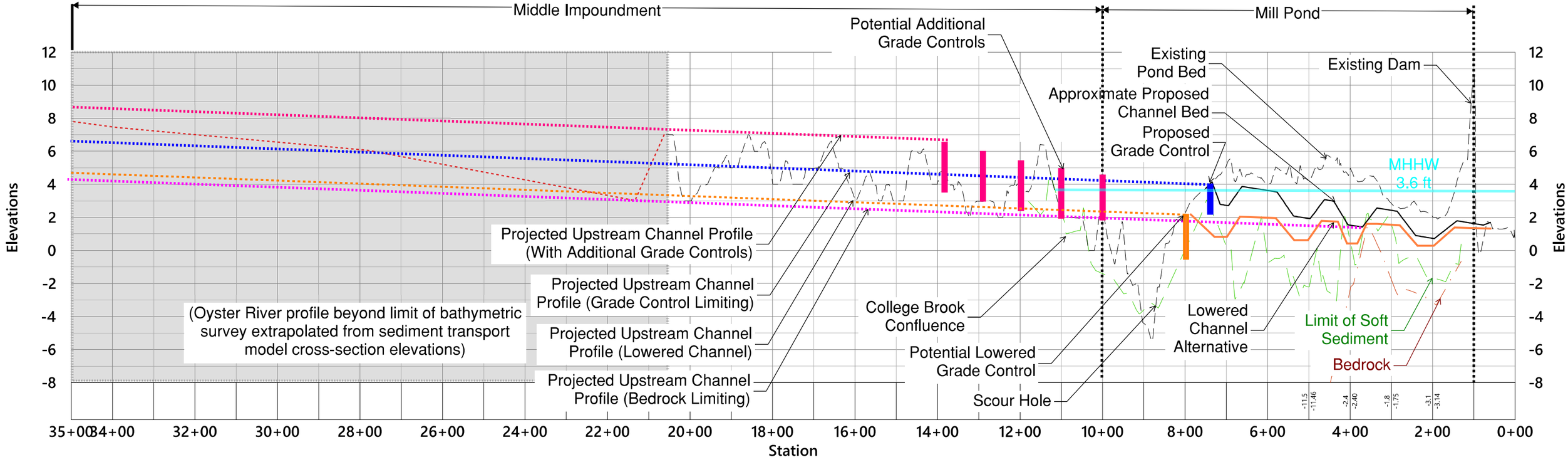
Town of Durham Parcels

- Town Owned
- Privately Owned

Figure 8: Middle Impoundment Grade Control

Oyster River Dam Removal at Mill Pond | Durham, NH

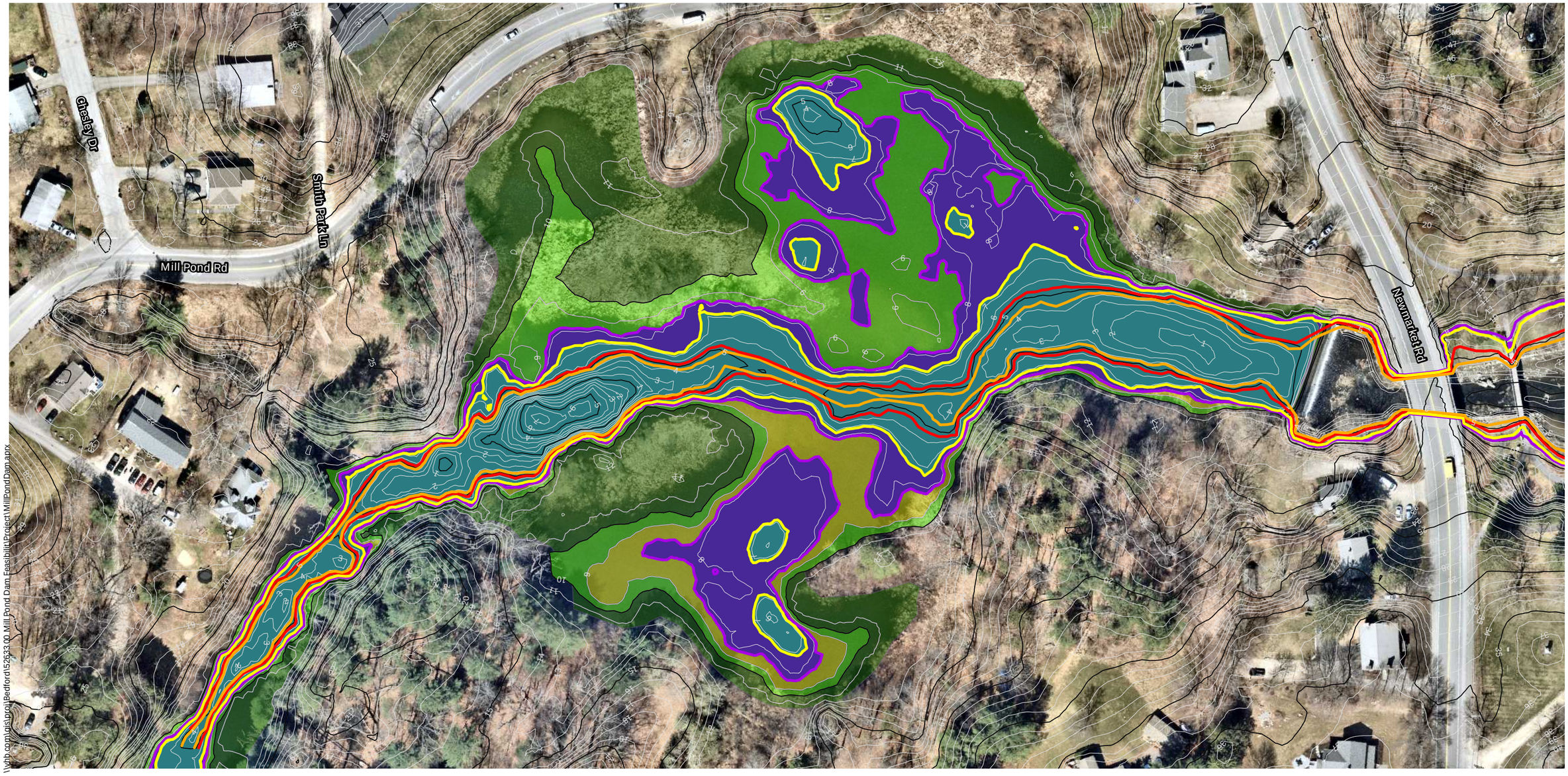


Oyster River Profile

(Stations in feet upstream of Newmarket Road Bridge)

Figure 9: Dam Removal Predicted Tidal Influence and Wetland Habitats

Oyster River Dam Removal at Mill Pond | Durham, NH



Source : NHDES, VHB, ArcGIS Online

0 50 100 200 Feet

Anticipated Vegetation Transition Zones

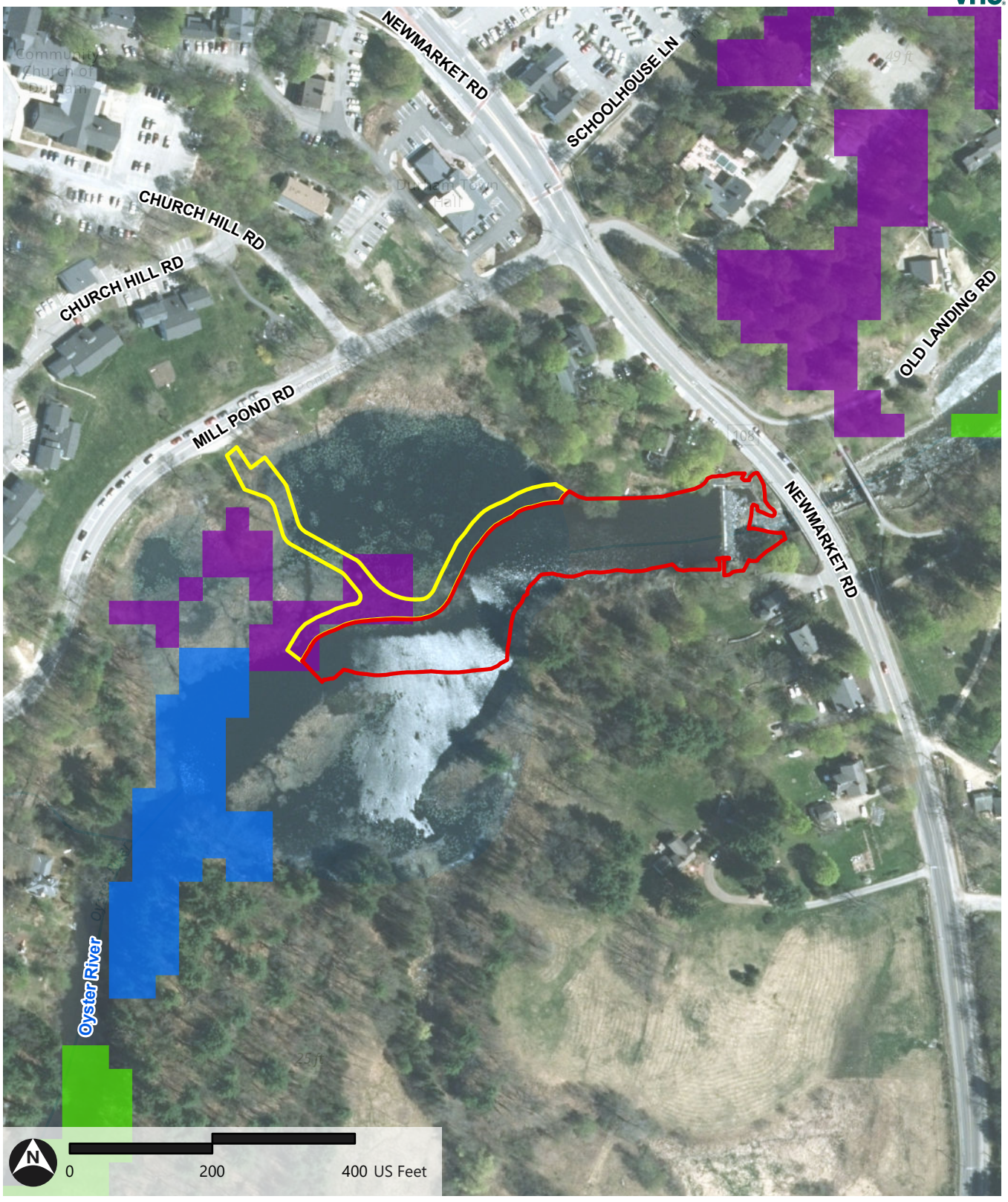
- < 5' Open Water
- 5'-6' Emergent Wetland
- 6'-8' Freshwater Emergent Marsh/Shrub
- 9'-10' Marsh/Shrub/Forested Wetland
- >10' Shrub/Forested Wetland/Upland Transition

Anticipated High Water Lines

- Mean Higher High Water - 4.4' - Higher Low Marsh
- Head of Tide Limit - 5.4' - High Marsh
- Mean Higher High Water + 2.9' RSLR (Likely Range)
- Mean Higher High Water + 3.8' RSLR (5% Chance)
- Index Contour (5 ft)
- 1' Contour Intervals

Figure 10: NHF&G WAP Ranked Habitat Map

Oyster River Dam Removal at Mill Pond | Durham, NH



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- Dam Removal & Active Channel Restoration
- Temporary Construction Access

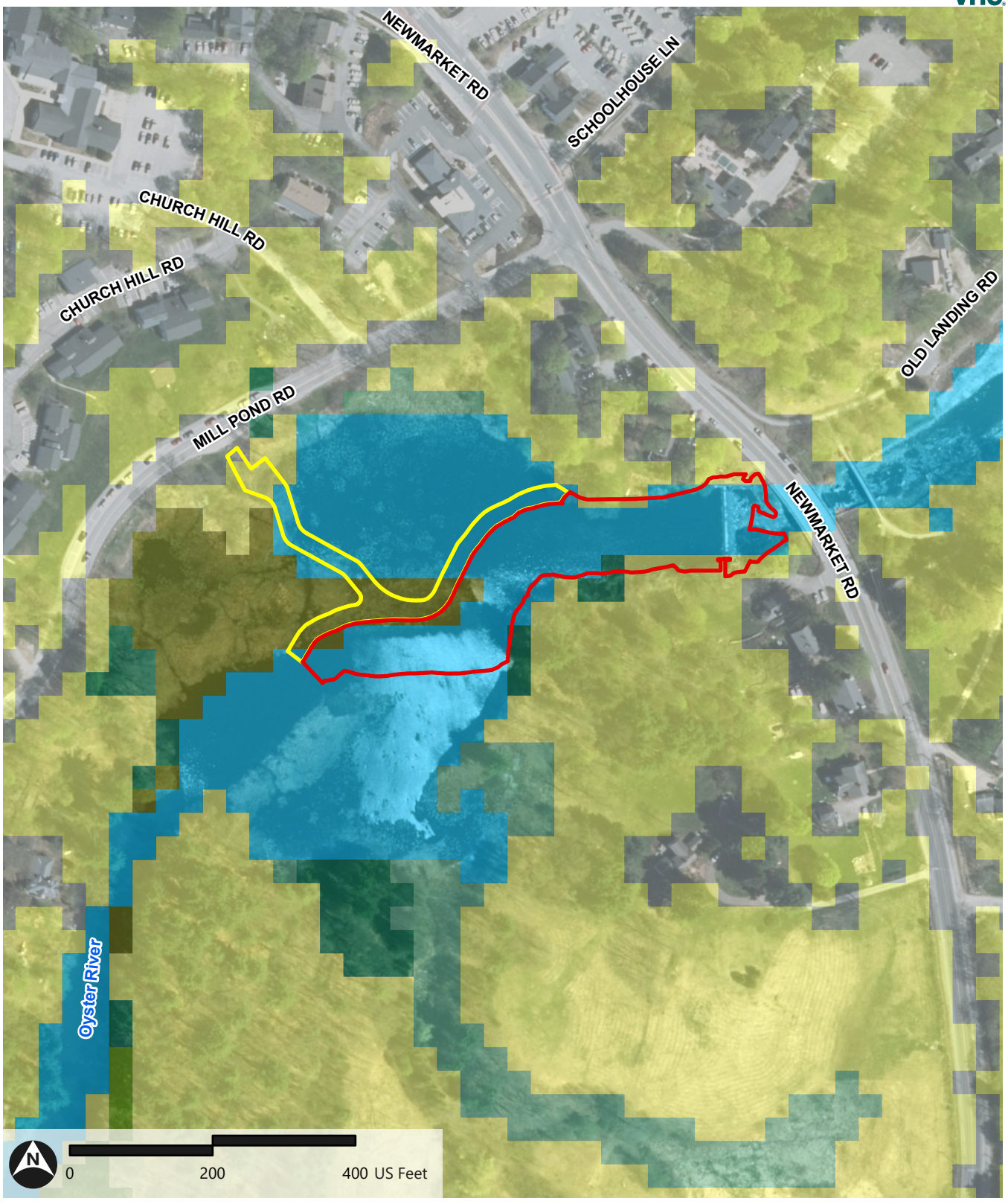
WAP Tiers

- 1: Habitats of Highest Relative Rank by Ecological Condition in New Hampshire
- 2: Habitats of Highest Relative Rank by EcologicalCondition in Biological Region
- 3: Supporting Landscapes

Source: NHGRANIT, VHB

Figure 11: NHF&G WAP Habitat Type Map

Oyster River Dam Removal at Mill Pond | Durham, NH



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Dam Removal & Active Channel Restoration

Temporary Construction Access

WAP Habitat

- Appalachian oak-pine
- Developed Impervious
- Developed or Barren land
- Hemlock-hardwood-pine
- Open water
- Temperate swamp
- Wet meadow/shrub wetland

Source: NHGRANIT, VHB

Project Appendices

List of Appendices

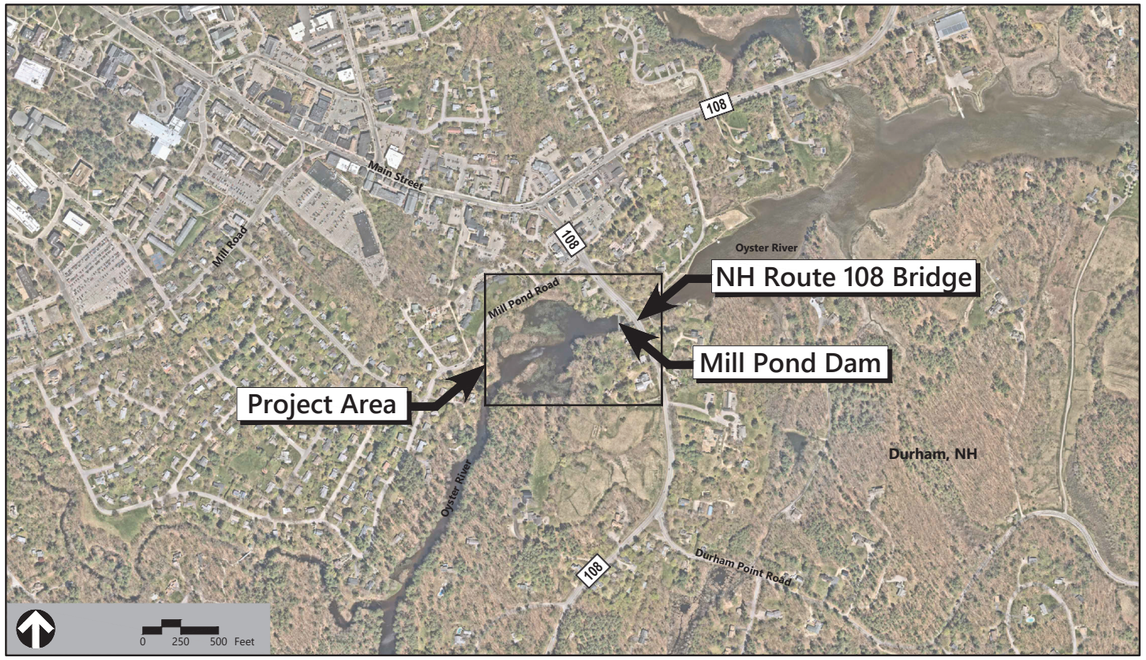
Appendix A: Project Plans

Site Plans

Issued for	**Permitting**
Date Issued	**January 17, 2024**
Latest Issue	**January 17, 2024**

Mill Pond Dam Removal and Oyster River Restoration

Durham, NH



Town of Durham - Town Council
Sally Needell, Chair
James Lawson, Chair Pro Tem
Wayne Burton
Joe Friedman
Emily Friedrichs
Charles "Chuck" Hotchkiss
Eric Lund
Carden Welsh

Town Administrator
Todd Selig

Director of Public Works and Engineering
Richard Reine M.S.C.E., CA

Assistant Director of Public Works
Sam Hewitt

Town Engineer
April Talon, P.E.

Sheet Index

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Streamworks

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FOXBORO, MA 02035
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STATE OF NEW HAMPSHIRE
KRISTOPHER P. WILKES
No. 288
CERTIFIED WETLAND SCIENTIST

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER
No.15589
LICENSED
PROFESSIONAL ENGINEER

VHB Project : 52633.02 Mill Pond Dam Removal and Oyster River Restoration
Issued for : Review 4/13/2023

\\VHB\GBL\PROJ\BEDFORD\52633.02 MILL POND FINAL DESIGN\CAD\EVPLANSET\52633302-COV 17 January 2024

Legend

Exist.	Prop.	
		PROPERTY LINE
		LIMIT OF WORK
		RIGHT-OF-WAY/PROPERTY LINE
10+00 +	10+00 +	BASELINE
		CONSTRUCTION LAYOUT
		APPROXIMATE RIGHT-OF-WAY
		GIS PARCEL LINES
WB50		50-FT WATERFRONT BUFFER
FW		FLOODWAY
FP100		100 YEAR FLOODPLAIN
EOW		EDGE OF WATER
TOB		TOP OF BANK
OHW		ORDINARY HIGH WATER
HOTL		HIGHEST OBSERVABLE TIDE LINE
DTBZ		DEVELOPED TIDAL BUFFER ZONE
NWB150		NATURAL WOODLAND BUFFER
PS250		PROTECTED SHORELAND
CDL		COWARDIN DISTINCTION LINE
		GRAVEL ROAD
EOP		EDGE OF PAVEMENT
BC	BC	BITUMINOUS CURB
CC	CC	CONCRETE CURB
CC	PCC	PRECAST CONC. CURB
SGE	SGE	SLOPED GRAN. EDGING
VGC	VGC	VERT. GRAN. CURB
		LIMIT OF CURB TYPE
		BUILDING
		BOLLARD
		BOLLARD W/LIGHT
		SIGN
		DOUBLE SIGN
		TREE
		FLOOD LIGHT
		MARSH
		BOULDER
		ROOTWAD
		STEEL GUARDRAIL
		WOOD GUARDRAIL
		FENCE
		TREE LINE
		CONSTRUCTION FENCE
		TREE PROTECTION FENCE
		STOCKADE FENCE
		WIRE FENCE
		STONE WALL
		RETAINING WALL
		STREAM / POND / WATER COURSE
		COFFERDAM/SAND BAGS
		DEMOLITION
		SILT FENCE
		SILT SOCK / STRAW WATTLE
		COIR LOGS
4	4	MINOR CONTOUR
20	20	MAJOR CONTOUR

Exist.	Prop.	
		CONCRETE
		COBBLE STREAMBED MATERIAL
		ROUGHENED BEDROCK CHANNEL
		LOAM AND SEED
		RIPRAP
		CONSTRUCTION ENTRANCE
132.75 × 45.0 TW 38.5 BW	132.75 × 45.0 TW 38.5 BW	SPOT ELEVATION
		TOP & BOTTOM OF WALL ELEVATION
B-1		BEDROCK PROBE
S-1		SEDIMENT PROBE
F.F.E.=45.27'		FINISHED FLOOR ELEVATION
UD	UD	UNDERDRAIN
12"D	12"D	DRAIN
6"RD	6"RD	ROOF DRAIN
12"S	12"S	SEWER
OHE	OHE	OVERHEAD WIRE
6"W	6"W	WATER
3"G	G	GAS
T	T	TELEPHONE
CATV	CATV	CABLE TV
E	E	UNDERGROUND ELECTRIC
		CATCH BASIN
		DOUBLE CATCH BASIN
		GUTTER INLET
		DRAIN MANHOLE
		PLUG OR CAP
CO	CO	CLEANOUT
		FLARED END SECTION
		HEADWALL
S	S	SEWER MANHOLE
WV	WV	WATER VALVE & BOX
HYD	HYD	FIRE HYDRANT
		WATER GATE
		MONITORING WELL
W	W	WELL
EMH	EMH	ELECTRIC MANHOLE
TMH	TMH	TELEPHONE MANHOLE
T	T	TRANSFORMER PAD
		UTILITY POLE
		GUY POLE
		GUY WIRE & ANCHOR
HH G	HH G	HAND HOLE
		GAS GATE

Abbreviations

General

ABAN	ABANDON
ACR	ACCESSIBLE CURB RAMP
ADJ	ADJUST
APPROX	APPROXIMATE
BF	BANKFULL
BIT	BITUMINOUS
BS	BOTTOM OF SLOPE
BWLL	BROKEN WHITE LANE LINE
CNO	COULD NOT OPEN
CONC	CONCRETE
DYCL	DOUBLE YELLOW CENTER LINE
EL	ELEVATION
ELEV	ELEVATION
EOW	EDGE OF WATER
EX	EXISTING
EXIST	EXISTING
FDN	FOUNDATION
FFE	FIRST FLOOR ELEVATION
FP100	100 YEAR FLOODPLAIN
FW	REGULATORY FLOODWAY
GRAN	GRANITE
LSA	LANDSCAPE AREA
MAX	MAXIMUM
MIN	MINIMUM
NIC	NOT IN CONTRACT
NPV	NO PIPE VISIBLE
NTS	NOT TO SCALE
OHW	ORDINARY HIGH WATER
PERF	PERFORATED
PROP	PROPOSED
REM	REMOVE
RET	RETAIN
R&D	REMOVE AND DISPOSE
R&R	REMOVE AND RESET
SQ	SQUARE
TBM	BENCHMARK
TOB	TOP OF BANK
TRC	TRUSLOW RESOURCE CONSULTING LLC
TS	TOP OF SLOPE
TYP	TYPICAL
WB50	50 FOOT WETLAND BUFFER
WF	WETLAND FLAG
WSE	WATER SURFACE ELEVATION

Utility

CB	CATCH BASIN
CMP	CORRUGATED METAL PIPE
CO	CLEANOUT
DCB	DOUBLE CATCH BASIN
DMH	DRAIN MANHOLE
CIP	CAST IRON PIPE
COND	CONDUIT
DIP	DUCTILE IRON PIPE
FES	FLARED END SECTION
F&G	FRAME AND GRATE
F&C	FRAME AND COVER
HDPE	HIGH DENSITY POLYETHYLENE PIPE
HH	HANDHOLE
HW	HEADWALL
HYD	HYDRANT
INV	INVERT ELEVATION
I=	INVERT ELEVATION
LP	LIGHT POLE
MES	METAL END SECTION
PVC	POLYVINYLCHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
R=	RIM ELEVATION
SMH	SEWER MANHOLE
TSV	TAPPING SLEEVE, VALVE AND BOX
UG	UNDERGROUND
UP	UTILITY POLE

Description of Work

1. THE GOALS OF THIS PROJECT ARE TO: REMOVE THE MILL POND DAM AND CONDUCT ACTIVE CHANNEL RESTORATION OF THE OYSTER RIVER TO STABILIZE SEDIMENTS WITHIN THE MILL POND IMPOUNDMENT TO PROTECT ADJACENT PROPERTIES WHILE CREATING UPSTREAM PASSAGE FOR DIADROMOUS FISH SPECIES SUCH AS ALEWIFE.
2. THE MILL POND DAM IS A CONCRETE AMBURSEN-STYLE DAM WITH A DENIL FISHWAY AT THE LEFT ABUTMENT, SQUARE-TOP SPILLWAY, AND LOW-LEVEL OUTLET GATES AT THE RIGHT ABUTMENT. THE DAM SPILLWAY IS APPROXIMATELY 100 FEET LONG BY APPROXIMATELY 11 FEET HIGH MEASURED FROM THE TOP OF SPILLWAY TO THE DAM FOOTING. INCLUDING THE FISHWAY AND GATE STRUCTURE, THE TOTAL STRUCTURE WIDTH IS APPROXIMATELY 130 FEET.
3. THE WORK CONSISTS OF FULL REMOVAL OF THE FISHWAY AND REMOVAL OF THE MAJORITY OF THE SPILLWAY; THE RIGHT ABUTMENT, GATE STRUCTURE, AND RIGHTMOST PORTION OF THE DAM SPILLWAY SHALL REMAIN IN PLACE. THE LIMITS AND EXTENT OF DAM REMOVAL ARE DEPICTED IN THE DAM REMOVAL DETAIL. BECAUSE REMOVAL OF THE DAM COULD RESULT IN AN UNSTABLE RIVERBED, APPROXIMATELY 650 LINEAR FEET OF THE RIVER CHANNEL WILL BE RE-GRADED AND STABILIZED. POTENTIALLY MOBILE SEDIMENT WITHIN THE EXISTING DAM IMPOUNDMENT WILL BE REMOVED ALONG THE RE-GRADED RIVER CHANNEL.
4. EQUIPMENT AND MATERIAL SHALL BE STAGED WITHIN TOWN PROPERTY ALONG NEWMARKET ROAD AND MILL POND ROAD. SITE ACCESS SHALL BE LIMITED TO THE CONSTRUCTION ENTRANCES DEPICTED ON THE PLANS.
5. REMOVE SEDIMENT FROM THE DAM IMPOUNDMENT TO THE EXTENTS INDICATED ON THE PLANS, AND HAUL FOR DISPOSAL TO A NHDES-APPROVED DISPOSAL FACILITY.
6. THE PROJECT IS IN A FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) ZONE AE, SPECIAL FLOOD HAZARD AREA, WHICH IS DEFINED AS AN AREA SUBJECT TO INUNDATION BY THE 1-PERCENT-ANNUAL-CHANCE (100-YEAR) FLOOD EVENT DETERMINED BY DETAILED METHODS. ADDITIONALLY, MUCH OF THE WORK IS LOCATED WITHIN THE ASSOCIATED REGULATORY FLOODWAY AS DETERMINED BY FEMA. THE REGULATORY FLOODWAY IS THE CHANNEL OF A RIVER OR WATERCOURSE AND THE ADJACENT LAND AREAS THAT MUST BE RESERVED IN ORDER TO DISCHARGE THE BASE FLOOD WITHOUT CUMULATIVELY INCREASING THE WATER SURFACE ELEVATION MORE THAN A DESIGNATED HEIGHT. FEDERAL REGULATIONS PROHIBIT CONSTRUCTION ACTIVITIES IN THE REGULATORY FLOODWAY THAT WOULD RESULT IN ANY INCREASE TO THE 100-YEAR FLOOD ELEVATION. THE DAM REMOVAL AND RIVER RESTORATION GRADING DEPICTED ON THIS PLAN HAS BEEN DESIGNED TO REDUCE FLOOD ELEVATIONS TO BE IN COMPLIANCE WITH NATIONAL FLOOD INSURANCE PROGRAM (NFIP) REGULATION 60.3(D)(3).

Flood Contingency Plan

THE CONTRACTOR SHALL OPEN THE EXISTING DAM GATES PRIOR TO CONSTRUCTION TO LOWER IMPOUNDED WATER LEVELS. THE EXISTING DAM SPILLWAY MAY BE PARTIALLY BREACHED TO LOWER IMPOUNDED WATER LEVELS SUFFICIENTLY TO CONDUCT ACTIVE CHANNEL RESTORATION (REMOVING UPSTREAM SEDIMENTS AND PLACING STREAMBED MATERIAL, STREAMBANKS, AND FLOODPLAIN FILL). DURING ACTIVE CHANNEL RESTORATION, THE CONTRACTOR SHALL MAINTAIN A FLOOD CONTINGENCY PLAN TO PLUG ANY OPEN GATE OR BREACH IN THE DAM IN ORDER TO PREVENT THE MASS RELEASE OF SEDIMENTS FROM THE ACTIVE WORK AREA.

DURING CONSTRUCTION THE CONTRACTOR SHALL MONITOR THE NATIONAL WEATHER SERVICE FORECAST OFFICE FOR RAINFALL FORECASTS AND WEATHER UPDATES. THE CONTRACTOR SHALL INITIATE A FLOOD CONTINGENCY PLAN UNDER THE FOLLOWING CONDITIONS:

- WHEN MORE THAN 1.0" OF RAINFALL IS FORECAST OVER A 24-HOUR PERIOD.
- WHEN WATER LEVELS RISE TO WITHIN 12" OF THE TOP OF THE TEMPORARY COFFERDAM.
- ALL PHASES: WHEN A FLOOD WATCH HAS BEEN ISSUED FOR THE OYSTER RIVER.

RAINFALL FORECASTS AND FLOOD WATCHES ARE ISSUED BY RADIO BROADCAST AND ARE AVAILABLE VIA THE INTERNET AT HTTPS://WWW.WEATHER.GOV/. THE CONTRACTOR SHALL REMOVE ALL CONSTRUCTION VEHICLES FROM THE FLOODPLAIN AREA EXCEPT THOSE NECESSARY TO IMPLEMENT THE FLOOD CONTINGENCY PLAN WHEN A "FLOOD WARNING" HAS BEEN ISSUED. THE CONTRACTOR SHALL HAVE STAFF AND MATERIALS AVAILABLE SEVEN DAYS PER WEEK TO IMPLEMENT THE FLOOD CONTINGENCY PLAN IF NEEDED. ONCE A FLOOD WATCH HAS BEEN ISSUED, THE PLAN SHALL INCLUDE:

1. NOTIFICATION OF THE OWNER AND ENGINEER WITHIN FOUR (4) HOURS OF ANY INTENDED ACTIONS AS WELL AS ALL COMPLETED ACTIONS DESCRIBED IN THIS SECTION.
2. REMOVAL OF ALL CONSTRUCTION VEHICLES AND EQUIPMENT FROM THE FLOODPLAIN AREA AS SOON AS IS REASONABLY POSSIBLE.
3. STABILIZING WITH COBBLE STREAMBED MIX/STONE FILL IN EXPOSED CHANNEL AREAS CONTAINED WITHIN THE TEMPORARY COFFERDAM.
4. COVER EXPOSED SEDIMENT AND/OR SUBGRADE WITHIN THE TEMPORARY COFFERDAM WITH SIX-MILLIMETER PLASTIC SHEETING. PLASTIC SHEETING SHOULD OVERLAP AT SEAMS A MINIMUM OF THREE FEET. THE PLASTIC SHEETING AROUND THE PERIMETER SHALL BE KEYED INTO THE SURROUNDING SOIL SIX INCHES. THE SEAMS AND PERIMETER OF THE PLASTIC SHEETING SHALL BE COVERED WITH 3/4-INCH CRUSHED STONE BALLAST.
5. THE CONTRACTOR SHALL BE REQUIRED KEEP ON HAND SUFFICIENT PLASTIC SHEETING AND CRUSHED STONE TO COVER AND PROVIDE BALLAST OVER EXPOSED SOIL DEWATERING STOCKPILES.
6. IN THE EVENT OF FLOODING, NO ACTIVE WORK WILL BE ALLOWED TO TAKE PLACE WITHIN THE WORK ZONE UNTIL THE FLOOD WATERS HAVE RECEDED, AND ANY DAMAGE TO EROSION CONTROL MEASURES HAVE BEEN REPAIRED.

General

1. NOTIFY "DIG-SAFE" (1-888-344-7233) AT LEAST 72 HOURS BEFORE EXCAVATING.
2. ENSURE SITE SECURITY AND JOB SAFETY. CONSTRUCTION ACTIVITIES SHALL BE IN ACCORDANCE WITH OSHA STANDARDS AND LOCAL REQUIREMENTS.
3. APPLY FOUR (4) INCHES OF LOAM AND SEED (UNLESS OTHERWISE NOTED) TO ANY UPLAND AREAS DISTURBED DURING CONSTRUCTION AND NOT RESTORED WITH IMPERVIOUS SURFACES (PAVEMENTS, WALKS, ETC.)
4. PERFORM ALL WORK IN STRICT COMPLIANCE WITH NH WETLANDS PERMIT, US ARMY CORPS OF ENGINEERS PERMIT, AND ALL OTHER APPLICABLE PERMITS AND REGULATIONS. THE CONTRACTOR SHALL HAVE A COPY OF ALL NECESSARY PERMITS AVAILABLE ON SITE AT ALL TIMES.

UPON AWARD OF CONTRACT, MAKE NECESSARY CONSTRUCTION NOTIFICATIONS AND APPLY FOR AND OBTAIN NECESSARY PERMITS, PAY FEES, AND POST BONDS ASSOCIATED WITH THE WORK INDICATED ON THE DRAWINGS, IN THE SPECIFICATIONS, AND IN THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL NOT CLOSE OR OBSTRUCT ROADWAYS, SIDEWALKS, AND/OR FIRE HYDRANTS, WITHOUT APPROPRIATE PERMITS. THE CONTRACTOR SHALL NOT BLOCK ACCESS TO THE DRIVEWAYS/PARKING LOTS OF ADJACENT PROPERTIES AT ANY TIME.

5. ALL DISTURBANCES ASSOCIATED WITH CONSTRUCTION SHALL BE CONTAINED WITHIN THE LIMITS OF WORK DEPICTED ON THIS PLANS.
6. IN THE EVENT THAT SUSPECTED CONTAMINATED SOIL, GROUNDWATER, OR OTHER MEDIA ARE ENCOUNTERED DURING EXCAVATION AND CONSTRUCTION ACTIVITIES BASED ON VISUAL, OLFACTORY, OR OTHER EVIDENCE, STOP WORK IN THE VICINITY OF THE SUSPECT MATERIAL TO AVOID FURTHER SPREADING OF THE MATERIAL, AND NOTIFY THE ENGINEER IMMEDIATELY SO THAT THE APPROPRIATE TESTING AND SUBSEQUENT ACTION CAN BE TAKEN.
7. PREVENT DUST, SEDIMENT, AND DEBRIS FROM EXITING THE SITE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CLEANUP, REPAIRS AND CORRECTIVE ACTION IF SUCH OCCURS.
8. DAMAGE RESULTING FROM CONSTRUCTION LOADS SHALL BE REPAIRED BY THE CONTRACTOR AT THEIR OWN EXPENSE.
9. CONTROL STORMWATER RUNOFF DURING CONSTRUCTION TO PREVENT ADVERSE IMPACTS TO OFF SITE AREAS, AND REPAIR RESULTING DAMAGES, IF ANY, AT NO COST TO ADJACENT PROPERTY OWNERS. DAMAGE RESULTING FROM STORMWATER RUNOFF SHALL BE REPAIRED BY THE CONTRACTOR AT THEIR OWN EXPENSE.
10. FOR PURPOSES OF THIS PLAN SET AND CONSTRUCTION SPECIFICATIONS, THE TERMS "ENGINEER" AND "MONITOR" SHALL BE SYNONYMOUS AND SHALL MEAN THE INDIVIDUAL OR FIRM RETAINED BY THE TOWN OF DURHAM TO CONDUCT CONSTRUCTION MONITORING.

Layout and Materials

1. ANY EXISTING PROPERTY LINE MONUMENTATION DISTURBED DURING CONSTRUCTION SHALL BE SET OR RESET BY A LICENSED LAND SURVEYOR (LLS).
2. IN ORDER TO PROVIDE VISUAL CLARITY ON THE PLANS, NOT ALL DEPICTED ITEMS ARE DRAWN TO THEIR ACTUAL DIMENSIONS. REFER TO THE LABELED DIMENSIONS AND THE PROVIDED DETAILS FOR ACTUAL DESIGN INFORMATION.

Utilities

1. THE LOCATIONS, SIZES, AND TYPES OF EXISTING UTILITIES ARE SHOWN AS AN APPROXIMATE REPRESENTATION ONLY. VHB HAS NOT INDEPENDENTLY VERIFIED THIS INFORMATION AS SHOWN ON THE PLANS. THE UTILITY INFORMATION SHOWN DOES NOT GUARANTEE THE ACTUAL EXISTENCE, SERVICEABILITY, OR OTHER DATA CONCERNING THE UTILITIES, NOR DOES IT GUARANTEE AGAINST THE POSSIBILITY THAT ADDITIONAL UTILITIES MAY BE PRESENT THAT ARE NOT SHOWN ON THE PLANS. PRIOR TO BEGINNING CONSTRUCTION, THE CONTRACTOR SHALL VERIFY THAT THERE ARE NO INTERFERENCES WITH EXISTING UTILITIES INCLUDING ROUTES WITHIN THE PUBLIC RIGHTS OF WAY.
2. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, OR EXISTING CONDITIONS DIFFER FROM THOSE SHOWN, SUCH THAT THE WORK CANNOT BE COMPLETED AS INTENDED, THE LOCATION, ELEVATION, AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR, AND THE INFORMATION FURNISHED IN WRITING TO THE ENGINEER FOR THE RESOLUTION OF THE CONFLICT. CONTRACTOR'S FAILURE TO NOTIFY PRIOR TO PERFORMING ADDITIONAL WORK RELEASES OWNER AND OTHER PROJECT PARTNERS FROM OBLIGATIONS FOR ADDITIONAL PAYMENTS WHICH OTHERWISE MAY BE WARRANTED TO RESOLVE THE CONFLICT.
3. NOTIFY ALL CORPORATIONS, COMPANIES, INDIVIDUALS, OR LOCAL AUTHORITIES OWNING OR HAVING JURISDICTION OVER UTILITIES RUNNING TO, THROUGH, OR ACROSS AREAS TO BE AFFECTED BY CONSTRUCTION ACTIVITIES.
4. LOCATE AND IDENTIFY EXISTING UTILITIES THAT ARE TO REMAIN AND PROTECT THEM FROM DAMAGE.

Existing Conditions Information

1. PLAN REFERENCES ARE:
   1.1. PLAN ENTITLED "COLLEGE BROOK INTERCEPTOR EXTENSION" DATED: JULY, 1968 PREPARED BY CAMP, DRESSER, & MCKEE.
   1.2. NHDOT RIGHT-OF-WAY PLANS FEDERAL AID PROJECT STP-TE-X-5133(009) N.H. PROJECT NO. 13080 N.H. ROUTE 108, TOWNS OF DURHAM & NEWMARKET, DATED: 04/18.
   1.3. PLAN OF LAND DOUGLAS R. WORTHEN DURHAM, N.H. DATED: MARCH 1990, RECORDED AT SCRD PLAN #20D-10
2. PROPERTY LINES SHOWN WERE TAKEN FROM PLAN REFERENCES 1, 2, AND 3.
3. THE EXISTING CONDITIONS SHOWN ON THIS PLAN ARE COMPILED FROM PLAN REFERENCE 1, AND AN ACTUAL ON-THE-GROUND INSTRUMENT SURVEY PERFORMED BY VHB IN DECEMBER 2019, JANUARY 2020, AND MAY 2023.
4. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES SHOWN ON THIS PLAN ARE BASED ON FIELD OBSERVATIONS AND INFORMATION OF RECORD. THEY ARE NOT WARRANTED TO BE EXACTLY LOCATED NOR IS IT WARRANTED THAT ALL UNDERGROUND UTILITIES OR OTHER STRUCTURES ARE SHOWN ON THIS PLAN.
5. HORIZONTAL DATUM IS N.A.D. 1983.
6. CONTOURS AND SPOT ELEVATIONS SHOWN ARE BASED UPON N.A.V.D. 1988.
7. PARCELS 108-86, 108-87, 108-88, AND 108-89 LIE PARTIALLY WITHIN THE REGULATORY FLOODWAY, ZONE AE AND ZONE X AS SHOWN ON THE FLOOD INSURANCE RATE MAP FOR THE TOWN OF DURHAM, NH MAP NUMBER 33017C0318E, EFFECTIVE DATE SEPTEMBER 30, 2015.

Demolition

1. SUBMIT THE FOLLOWING INFORMATION TO THE ENGINEER FOR REVIEW BEFORE COMMENCING WORK.
   1.1. PERMITS FOR TRANSPORT AND DISPOSAL OF DEBRIS AND SEDIMENT.
   1.2. DEMOLITION PROCEDURES AND OPERATIONAL SEQUENCE.
   1.3. CALCULATIONS
2. DISPOSE OF DEMOLITION DEBRIS AND SEDIMENT IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS, ORDINANCES AND STATUTES.
3. THE DEMOLITION LIMITS DEPICTED ON THE PLANS ARE INTENDED TO AID THE CONTRACTOR DURING THE BIDDING AND CONSTRUCTION PROCESS AND IS NOT INTENDED TO DEPICT EACH AND EVERY ELEMENT OF DEMOLITION. THE CONTRACTOR IS RESPONSIBLE FOR IDENTIFYING THE DETAILED SCOPE OF DEMOLITION BEFORE SUBMITTING ITS BID/PROPOSAL TO PERFORM THE WORK AND SHALL MAKE NO CLAIMS AND SEEK NO ADDITIONAL COMPENSATION FOR CHANGED CONDITIONS OR UNFORESEEN OR LATENT SITE CONDITIONS RELATED TO ANY CONDITIONS DISCOVERED DURING EXECUTION OF THE WORK.
4. UNLESS OTHERWISE SPECIFICALLY PROVIDED ON THE PLANS OR IN THE SPECIFICATIONS, THE ENGINEER HAS NOT PREPARED DESIGNS FOR AND SHALL HAVE NO RESPONSIBILITY FOR THE PRESENCE, DISCOVERY, REMOVAL, ABATEMENT OR DISPOSAL OF HAZARDOUS MATERIALS, TOXIC WASTES OR POLLUTANTS AT THE PROJECT SITE. THE ENGINEER SHALL NOT BE RESPONSIBLE FOR ANY CLAIMS OF LOSS, DAMAGE, EXPENSE, DELAY, INJURY OR DEATH ARISING FROM THE PRESENCE OF HAZARDOUS MATERIAL AND CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS THE ENGINEER FROM ANY CLAIMS MADE IN CONNECTION THEREWITH. MOREOVER, THE ENGINEER SHALL HAVE NO ADMINISTRATIVE OBLIGATIONS OF ANY TYPE WITH REGARD TO ANY CONTRACTOR AMENDMENT INVOLVING THE ISSUES OF PRESENCE, DISCOVERY, REMOVAL, ABATEMENT OR DISPOSAL OF ASBESTOS OR OTHER HAZARDOUS MATERIALS.
5. CEASE OPERATIONS IMMEDIATELY IF ANY DAMAGE, SETTLEMENT, OR OTHER ADVERSE EFFECT ON ADJACENT STRUCTURES OCCUR. HOWEVER, IF AN UNSAFE CONDITION IS CREATED THAT WOULD POTENTIALLY CAUSE INJURY TO PERSONS OR UNDUE HARM TO PROPERTIES, TAKE WHATEVER MEASURES ARE WARRANTED TO PREVENT SUCH INJURY OR HARM. IMMEDIATELY NOTIFY THE ENGINEER AND REGULATORY AGENCIES. DO NOT RESUME OPERATIONS UNTIL CONDITIONS ARE CORRECTED, DAMAGE REPAIRED, AND APPROVAL HAS BEEN RECEIVED FROM THE APPROPRIATE AUTHORITIES AND THE OWNER'S REPRESENTATIVE.
6. OBTAIN WRITTEN PERMISSION FROM ADJACENT PROPERTY OWNERS WHEN DEMOLITION EQUIPMENT WILL TRANSVERSE, INFRINGE UPON, OR AFFECT ACCESS TO THEIR PROPERTY. COPIES OF THE PERMISSION DOCUMENTS SHALL BE SUBMITTED TO THE ENGINEER.
7. PROVIDE HOSES AND WATER CONNECTIONS AND SPRAY WATER ON DEMOLITION DEBRIS TO MINIMIZE DUST.
8. CLEAN ADJACENT STRUCTURES AND IMPROVEMENTS OF DUST, DIRT, AND DEBRIS CAUSED BY DEMOLITION OPERATIONS. RETURN ADJACENT AREAS TO THE CONDITION WHICH EXISTED PRIOR TO START OF WORK.
9. ALL HAZARDOUS WASTE REMOVAL SHALL BE PERFORMED BY A HAZARDOUS WASTE CONTRACTOR QUALIFIED AND DULY LICENSED IN THE STATE OF NEW HAMPSHIRE TO REMOVE, TRANSPORT, AND DISPOSE OF EACH TYPE OF HAZARDOUS SUBSTANCE.

Erosion Control

1. INSPECT AND MAINTAIN EROSION CONTROL MEASURES WITHIN 24 HOURS AFTER EACH STORM EVENT (0.25" OF RAINFALL OR GREATER PER 24 HOUR PERIOD) AND DISPOSE OF DEPOSITED SEDIMENTS IN AN UPLAND AREA SUCH THAT THEY DO NOT ENCUMBER OTHER DRAINAGE STRUCTURES, EROSION CONTROL MEASURES AND PROTECTED AREAS.
2. CONTROL CONSTRUCTION SUCH THAT SEDIMENTATION DOES NOT AFFECT REGULATORY PROTECTED AREAS, WHETHER SUCH SEDIMENTATION IS CAUSED BY WATER, WIND, OR DIRECT DEPOSIT.
3. PERFORM CONSTRUCTION SEQUENCING SUCH THAT EARTH MATERIALS ARE EXPOSED FOR A MINIMUM OF TIME BEFORE THEY ARE COVERED, SEEDED, OR OTHERWISE STABILIZED TO PREVENT EROSION.
4. UPON COMPLETION OF CONSTRUCTION AND ESTABLISHMENT OF PERMANENT GROUND COVER, REMOVE AND DISPOSE OF EROSION CONTROL MEASURES AND CLEAN SEDIMENT AND DEBRIS.
5. TEMPORARILY SEED AND MULCH AREAS REMAINING UNSTABILIZED FOR A PERIOD OF MORE THAN 7 DAYS. CLEAN, WEED FREE, STRAW MULCH SHALL BE APPLIED AT A MINIMUM RATE OF 1-1/2 TONS/ACRE, WHICH EQUALS A THICKNESS OF APPROXIMATELY 1 INCH.
6. PERMANENT SEEDING SHALL OCCUR BETWEEN APRIL 1 AND JUNE 1, AND/OR BETWEEN AUGUST 15 AND OCTOBER 15. ALL SEEDING SHALL BE STRAW MULCHED.
7. APPLY WATER AS NEEDED TO CONTROL DUST
8. TEMPORARILY SEED AND MULCH SOILS TO BE STOCKPILED FOR A PERIOD OF MORE THAN 7 DAYS. INSTALL STAKED STRAW LOGS ALONG DOWNHILL SIDE OF STOCKPILES.
9. PROVIDE NECESSARY EROSION CONTROL MEASURES TO ENSURE THAT SURFACE WATER RUNOFF FROM UNSTABILIZED AREAS DOES NOT CARRY SILT, SEDIMENT, AND OTHER DEBRIS OUTSIDE OF THE LIMITS OF WORK.
10. AN AREA SHALL BE CONSIDERED STABLE IF ONE OF THE FOLLOWING HAS OCCURRED:
    a. A MINIMUM OF 85% VEGETATED COVER HAS BEEN ESTABLISHED;
    b. A MINIMUM OF 3-IN OF NON-EROSIVE MATERIAL, SUCH AS STONE OR RIPRAP, HAS BEEN INSTALLED;
    c. EROSION CONTROL BLANKETS HAVE BEEN PROPERLY INSTALLED. THE ENGINEER SHALL BE RESPONSIBLE FOR MAKING A DETERMINATION AS TO WHETHER AN AREA IS STABLE.
11. ALL DITCHES, SWALES, AND DRAINAGE BASINS SHALL BE STABILIZED PRIOR TO DIRECTING RUNOFF TO THEM.
12. LOAM, SEED, MULCH, OR MAT FILL ALL CUT AND FILL SLOPES, IF REQUIRED, WITHIN 72 HOURS OF ACHIEVING FINISHED GRADE.
13. ALL PERMANENT AND TEMPORARY SEEDING SHALL BE FREE OF NOXIOUS WEED SEED.
14. NO FERTILIZERS (EXCEPT LIMESTONE) SHALL BE USED WITHIN 25 FEET OF THE RIVER. FROM 25-250 FEET, LOW PHOSPHATE, SLOW RELEASE NITROGEN FERTILIZER MAY BE USED. THESE FERTILIZERS MUST BE GUARANTEED ON THE PACKAGE LABEL TO CONTAIN NOT MORE THAN 2 PERCENT PHOSPHOROUS AND AT LEAST 50 PERCENT SLOW RELEASE NITROGEN.
15. INSTALL STABILIZED CONSTRUCTION ENTRANCES AT CONSTRUCTION ENTRANCES. DETERMINE FINAL LOCATION PRIOR TO CONSTRUCTION.

Winter Construction

1. WINTER CONSTRUCTION IS NOT ANTICIPATED BUT IS A POSSIBILITY FOR THIS PROJECT. STABILIZE ALL PROPOSED VEGETATED AREAS WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15TH, OR WHICH ARE DISTURBED AFTER OCTOBER 15TH. STABILIZATION METHODS INCLUDE SEEDING AND INSTALLING EROSION CONTROL BLANKETS ON SLOPES GREATER THAN 4:1, SEEDING AND PLACING 3 TO 4 TONS OF MULCH PER ACRE AND SECURED WITH ANCHORED NETTING, ELSEWHERE. COMPLETE THE INSTALLATION OF EROSION CONTROL BLANKETS OR MULCH AND NETTING IN ADVANCE OF THAW OR SPRING MELTS, DO NOT INSTALL OVER ACCUMULATED SNOW OR FROZEN GROUND.
2. TEMPORARILY STABILIZE ALL DITCHES OR SWALES, WITH STONE OR EROSION CONTROL BLANKETS APPROPRIATE FOR THE DESIGN FLOW CONDITIONS, WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15TH, OR WHICH ARE DISTURBED AFTER OCTOBER 15TH.

State Regulations

1. ALL WORK SHALL COMPLY WITH THE FOLLOWING STATE PERMITS. CONDITIONS IN PERMIT SHALL GOVERN OVER PLANS UNLESS OTHERWISE DIRECTED OR APPROVED BY THE ENGINEER.
2. (ANTICIPATED) RSA 482-A, WETLAND DREDGE AND FILL, NH DEPARTMENT OF ENVIRONMENTAL SERVICES, WETLANDS BUREAU.
3. (ANTICIPATED) CLEAN WATER ACT, SECTION 401 WATER QUALITY CERTIFICATION, NH DEPARTMENT OF ENVIRONMENTAL SERVICES, WATERSHED MANAGEMENT BUREAU.
4. (ANTICIPATED) RSA 483-B, COMPREHENSIVE SHORELAND PROTECTION ACT, NH DEPARTMENT OF ENVIRONMENTAL SERVICES, WETLAND BUREAU.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SECURING AN EXCAVATION PERMIT WITH NHDOT FOR REMOVAL OR GUARDRAIL ALONG ROUTE 108.

Federal Regulations

1. (ANTICIPATED) CLEAN WATER ACT, SECTION 404, WETLAND DREDGE AND FILL PERMIT, US ARMY CORPS OF ENGINEERS.
2. (ANTICIPATED) USFWS ENDANGERED SPECIES ACT AND BIOLOGICAL OPINION.
3. (ANTICIPATED) NATIONAL HISTORIC PRESERVATION ACT, SECTION 106 CONSULTATION, NH STATE HISTORIC PRESERVATION OFFICE (NH DIVISION OF HISTORICAL RESOURCES).

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Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
Durham, NH

No.	Revision	Date	Appvd.

Designed by BJM | Checked by

Issued for: Permitting — Date: January 17, 2024

Not Approved for Construction

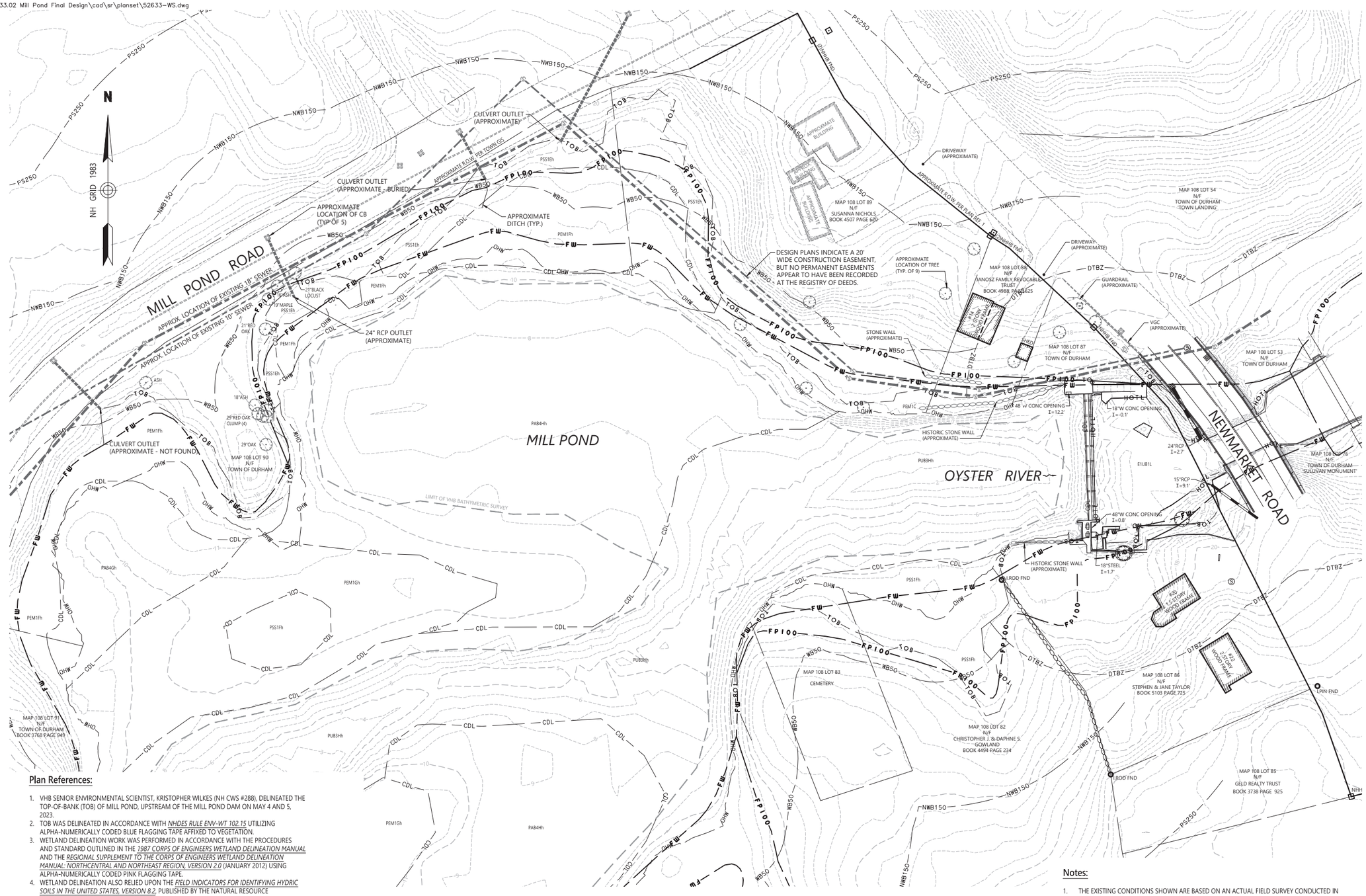
Drawing Title: Legend and General Notes

Drawing Number: C-1

Sheet 1 of 11

Project Number: 52633.02

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER No.15589 LICENSED PROFESSIONAL ENGINEER



Plan References:

1. VHB SENIOR ENVIRONMENTAL SCIENTIST, KRISTOPHER WILKES (NH CWS #288), DELINEATED THE TOP-OF-BANK (TOB) OF MILL POND, UPSTREAM OF THE MILL POND DAM ON MAY 4 AND 5, 2023.
2. TOB WAS DELINEATED IN ACCORDANCE WITH *NHDES RULE ENV-WT 102.15* UTILIZING ALPHA-NUMERICALLY CODED BLUE FLAGGING TAPE AFFIXED TO VEGETATION.
3. WETLAND DELINEATION WORK WAS PERFORMED IN ACCORDANCE WITH THE PROCEDURES AND STANDARD OUTLINED IN THE *1987 CORPS OF ENGINEERS WETLAND DELINEATION MANUAL* AND THE *REGIONAL SUPPLEMENT TO THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL: NORTHCENTRAL AND NORTHEAST REGION, VERSION 2.0* (JANUARY 2012) USING ALPHA-NUMERICALLY CODED PINK FLAGGING TAPE.
4. WETLAND DELINEATION ALSO RELIED UPON THE *FIELD INDICATORS FOR IDENTIFYING HYDRIC SOILS IN THE UNITED STATES, VERSION 8.2*, PUBLISHED BY THE NATURAL RESOURCE CONSERVATION SERVICE THE FIELD INDICATORS FOR IDENTIFYING HYDRIC SOILS IN NEW ENGLAND, VERSION 4.0, PUBLISHED BY THE NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION IN JUNE 2020.
5. DOMINANT WETLAND VEGETATION WAS ASSESSED USING THE *NATIONAL WETLAND PLANT LIST* PUBLISHED BY THE U.S. ARMY CORPS OF ENGINEERS.
6. MILL POND AND BORDERING AREAS WERE CLASSIFIED USING THE USFWS METHODOLOGY *CLASSIFICATION OF WETLANDS AND DEEPWATER HABITATS OF THE UNITED STATES (COWARDIN ET AL., 1979, REVISED 1985)*.
7. COWARDIN CLASSIFICATION AREAS DEPICTED ON THE PLANS WERE DERIVED FROM A COMBINATION OF FIELD OBSERVATION AND INTERPRETATION OF DESKTOP AERIAL IMAGERY.
8. TOB FLAGS WERE LOCATED IN THE FIELD WITH A HANDHELD GPS UNIT CAPABLE OF SUB-METER ACCURACY.
9. DUE TO THE EXISTING IMPOUNDMENT, THE ORDINARY HIGH WATER (OHW) MARK UPSTREAM OF THE MILL POND DAM WAS SET TO A REFERENCE ELEVATION OF 11.4 FT NAVD88 BASED ON HISTORIC (2009-2022) FIELD-SURVEYED WATER LEVELS ASSOCIATED WITH THE DAM.
10. THE HIGHEST OBSERVABLE TIDE LINE (HOTL) DOWNSTREAM OF THE MILL POND DAM WAS SET TO A REFERENCE ELEVATION OF 4.5 FT NAVD88 BASED ON FIELD-SURVEYED WATER LEVELS ASSOCIATED WITH THE OCTOBER 2019 HIGHEST ASTRONOMICAL TIDE (HAT), COMMONLY KNOWN AS THE "KING TIDE."

STATE OF NEW HAMPSHIRE KRISTOPHER P. WILKES No. 288 CERTIFIED WETLAND SCIENTIST

Wetland Classification Codes

CODE	CODE DESCRIPTION
PEM1C	- PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED
PEM1E	- PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED/SATURATED
PEM1Fh	- PALUSTRINE, EMERGENT, PERSISTENT, SEMI-PERMANENTLY FLOODED, DIKED/IMPOUNDED
PEM1Gh	- PALUSTRINE, EMERGENT, PERSISTENT, INTERMITTENTLY EXPOSED, DIKE/IMPOUNDED
PAB4Gh	- PALUSTRINE, AQUATIC BED, FLOATING VASCULAR, INTERMITTENTLY EXPOSED, DIKED/IMPOUNDED
PAB4Hh	- PALUSTRINE, AQUATIC BED, FLOATING VASCULAR, PERMANENTLY FLOODED, DIKED/IMPOUNDED
PUB3Hh	- PALUSTRINE, UNCONSOLIDATED BOTTOM, MUD, PERMANENTLY FLOODED, DIKED/IMPOUNDED
PSS1Fh	- PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS, SEMI-PERMANENTLY FLOODED, DIKED/IMPOUNDED
E1UB1L	- ESTUARINE, SUBTIDAL, UNCONSOLIDATED BOTTOM, COBBLE-GRAVEL, SUBTIDAL

Plan References:

1. NHDOT RIGHT-OF-WAY PLANS FEDERAL AID PROJECT STP-TE-X-5133(009) N.H. PROJECT NO. 13080 N.H. ROUTE 108, TOWNS OF DURHAM & NEWMARKET, DATED: 04/18.
2. PLAN OF LAND DOUGLAS R. WORTHEN DURHAM, N.H. DATED: MARCH 1990, RECORDED AT SCRD PLAN #20D-10.

40 0 40 80
SCALE IN FEET

Notes:

1. THE EXISTING CONDITIONS SHOWN ARE BASED ON AN ACTUAL FIELD SURVEY CONDUCTED IN DECEMBER 2019, JANUARY 2020 AND MAY 2023.
2. THE PROPERTY LINES SHOWN ARE APPROXIMATE AND ARE BASED ON LIMITED PROPERTY RESEARCH AND LIMITED FIELD WORK.
3. THE HORIZONTAL DATUM IS BASED ON THE NEW HAMPSHIRE STATE PLANE COORDINATE SYSTEM 1983.
4. THE VERTICAL DATUM IS BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988.
5. THE LOCATION OF OYSTER RIVER IS BASED ON HISTORICAL PLANS AND THE TOWN OF DURHAM'S GIS MAPPING, AND HAS NOT BEEN SURVEYED.
6. FEATURES LABELED AS "APPROXIMATE" ARE BASED ON NON-SURVEY GRADE GPS OR TRACED FROM AERIAL PHOTOGRAPHY AND HAVE NOT BEEN FIELD SURVEYED.
7. SEWER LINES ARE BASED ON DESIGN PLANS ENTITLED "COLLEGE BROOK INTERCEPTOR EXTENSION LANDING ROAD AND CROSS-COUNTRY STA. 0+00 TO STA. 10+53" PREPARED BY CAMP, DRESSER & McKEE, DATED: JULY 1968.

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Legend

- DRAIN MANHOLE
- CATCH BASIN
- SEWER MANHOLE
- ELECTRIC MANHOLE
- TELEPHONE MANHOLE
- MANHOLE
- HAND HOLE
- WATER GATE
- FIRE HYDRANT
- GAS GATE
- BOLLARD w/LIGHT
- STREET SIGN
- LIGHT POLE
- UTILITY POLE
- GUY WIRE
- MONITORING WELL
- FLOOD LIGHT
- WELL
- MARSH
- F.F.E.=45.27' FINISHED FLOOR ELEVATION
- EDGE OF PAVEMENT
- VERTICAL GRANITE CURB
- GUARDRAIL
- CHAIN LINK FENCE
- DRAINAGE LINE
- SEWER LINE
- UNDERGROUND ELECTRIC
- TELEPHONE LINE
- GAS LINE
- WATER LINE
- STONE WALL
- TREE LINE
- ORDINARY HIGH WATER
- TOP OF BANK
- HIGHEST OBSERVABLE TIDE LINE
- DEVELOPED TIDAL BUFFER ZONE
- WATERFRONT BUFFER
- NATURAL WOODLAND BUFFER
- PROTECTED SHORELAND
- COWARDIN DISTINCTION LINE
- APPROXIMATE RIGHT-OF-WAY
- GIS PARCEL LINES

Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
Durham, New Hampshire

No.	Revision	Date	Appvd

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Drawing Title

Existing Conditions Plan of Land

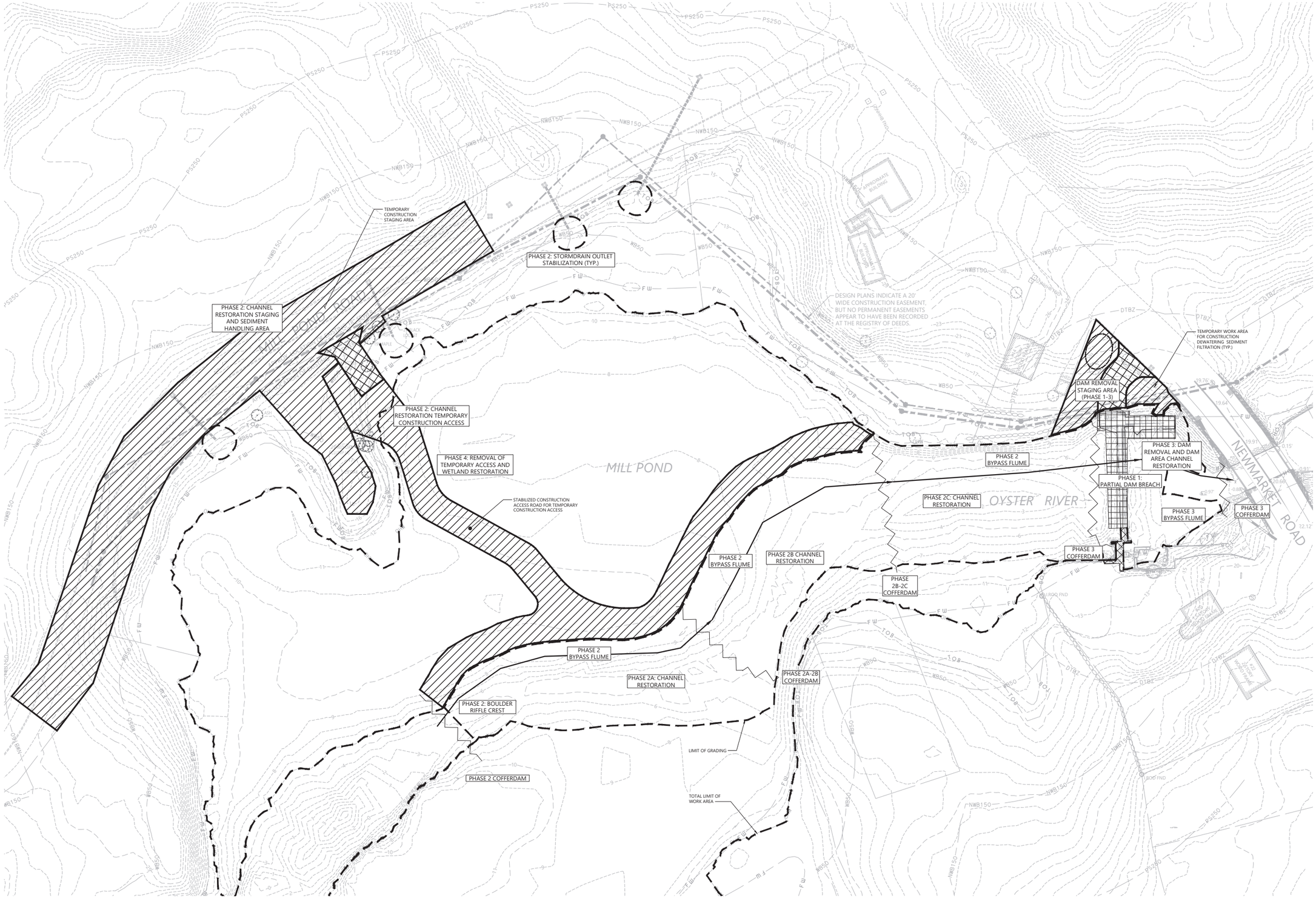
Drawing Number

C-2

Sheet 2 of 10

Project Number 52633

2-5-2024
STATE OF NEW HAMPSHIRE DAVID WILLIAM CLOUTIER No.15589 LICENSED PROFESSIONAL ENGINEER



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CONSTRUCTION SEQUENCE:

1. OPEN DAM GATES, BEGIN LOWERING IMPOUNDMENT.
2. MOBILIZATION: SET UP STAGING AREAS AND TEMPORARY ACCESS ROUTE.
3. PARTIAL BREACH OF DAM TO LOWER WATER LEVELS FOR ACTIVE CHANNEL RESTORATION. CONTRACTOR TO RETAIN THE MAJORITY OF DAM SPILLWAY (OR CONSTRUCT COFFERDAM AT DAM LOCATION) TO PREVENT LOSS OF SEDIMENT IN WORK AREA IN THE EVENT OF MAJOR RAIN EVENT.
4. CONTRACTOR TO BEGIN CHANNEL RESTORATION WORK IN PHASES, MOVING UPSTREAM TO DOWNSTREAM. PROVIDED PLAN ILLUSTRATES RESTORATION CONSTRUCTION IN THREE PHASES. CONTRACTOR TO PROVIDE A CONTROL OF WATER PLAN; FINAL NUMBER OF PHASES IS AT THE CONTRACTOR'S DISCRETION.
5. STRIP AND STOCKPILE 4,445 CY OF TOPSOIL TO USE DURING RESTORATION OF THE TEMPORARY ACCESS ROAD.
6. REMOVE SEDIMENT AND CONSTRUCT CHANNEL RESTORATION. INSTALL COFFERDAM AND BYPASS FLUME PIPE FOR EACH PHASE PRIOR TO MOVING EARTH. CONSTRUCT BOULDER RIFFLE CREST GRADE CONTROL BEFORE ANY OTHER STREAM RESTORATION.
7. DEWATER ACTIVE WORK AREA WITHIN COFFERDAM. DISCHARGE DEWATERING TO DEWATERED IMPOUNDMENT BED, DOWNSTREAM OF ACTIVE WORK AREA.
8. STOCKPILE, SEGREGATE, CHARACTERIZE, AND DRY EXCAVATED SEDIMENT IN THE STAGING AREA. DISPOSE OFFSITE.
9. FOLLOWING THE COMPLETION OF SEDIMENT REMOVAL AND CHANNEL RESTORATION, RELOCATE COFFERDAMS AND ROUTE FLOW THROUGH DAM GATE. REMOVE THE REMAINING DAM AND FISHWAY STRUCTURE PER DETAIL SHEET 8.1. RESTORE CHANNEL THROUGH DAM AREA PER DESIGN.
10. REMOVE ALL COFFERDAMS, BYPASS FLUMES, AND TEMPORARY ACCESS. RESTORE AREA AT THESE LOCATIONS.
11. REMOVE AND RESTORE STAGING AREAS.

Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
Durham, NH

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Date: October 13, 2023

Not Approved for Construction

Drawing Title
Staging and Construction Sequence Plan

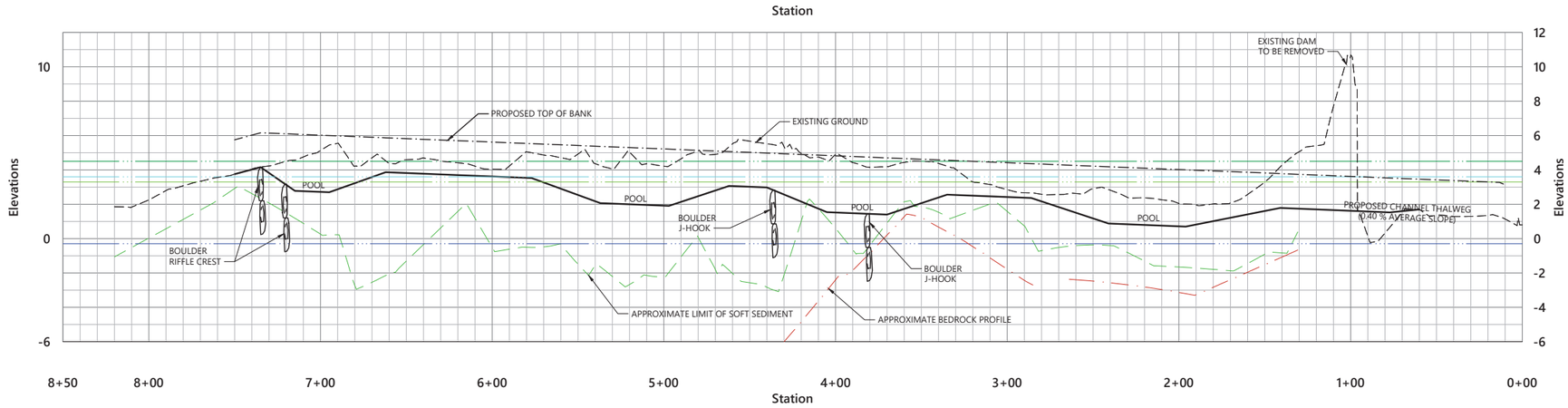
Drawing Number
C-3

Sheet 3 of 11

Project Number
52633.02

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER
No. 15589
LICENSED PROFESSIONAL ENGINEER

Saved Tuesday, January 9, 2024 2:10:09 PM AFLEUROCK Plotted Wednesday, January 17, 2024 9:44:55 PM Annique Fleurock

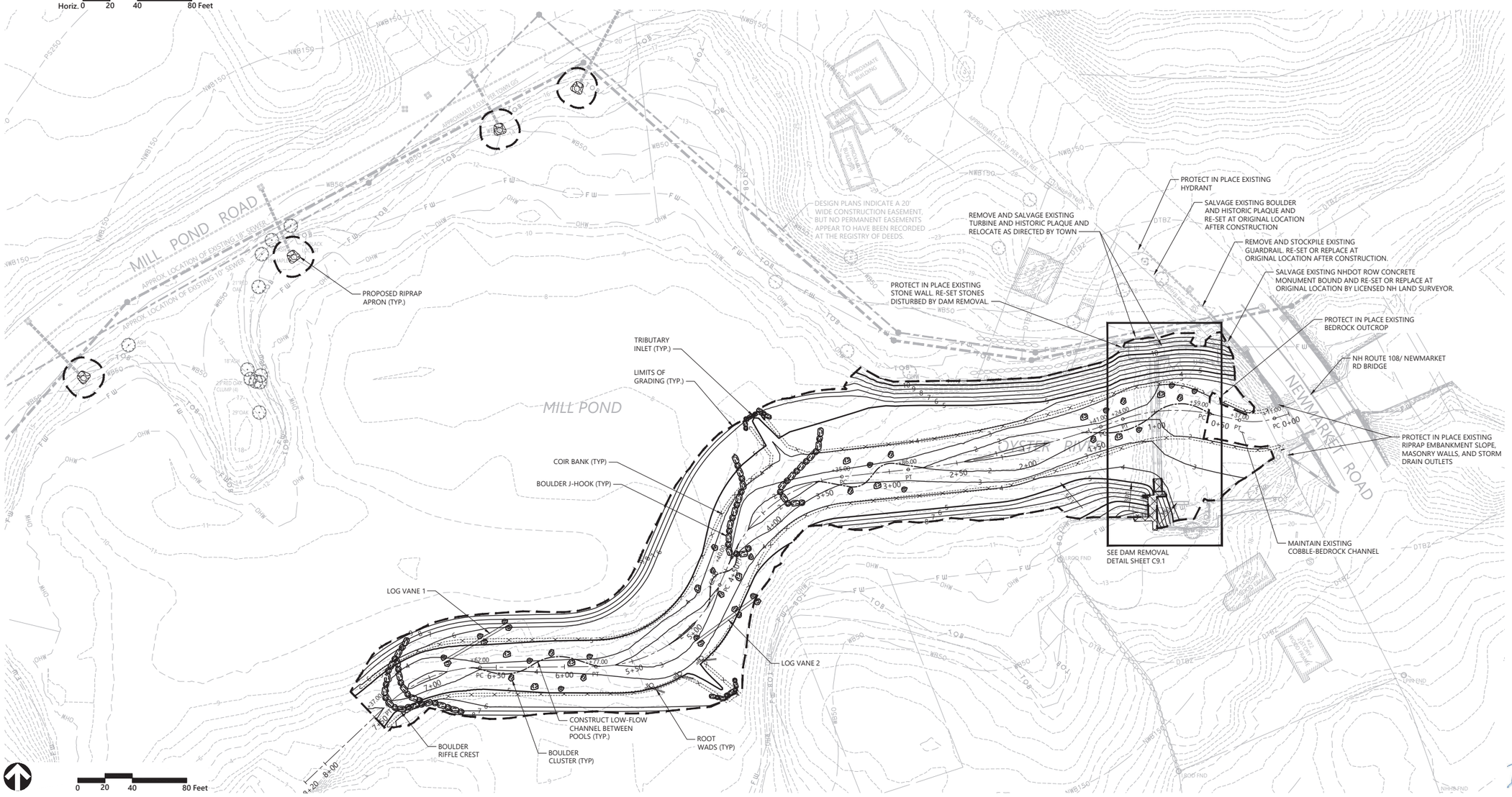


PROFILE LEGEND

- EXISTING SURFACE
- PROPOSED SURFACE
- PROPOSED TOP OF BANK
- SOFT SEDIMENT LIMITS
- BEDROCK SURFACE
- HIGHEST ASTRONOMICAL TIDE (ELEV. 4.5)
- MEAN HIGHER-HIGH WATER (ELEV. 3.6)
- MEAN HIGH WATER (ELEV. 3.3)
- MEAN TIDE LEVEL (ELEV. -0.3)

Vert. 0 2 4 8 Feet
Horiz. 0 20 40 80 Feet

Oyster River Channel Profile



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Mill Pond Dam Removal and Oyster River Restoration

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Drawing Title
River Channel Grading Plan and Profile

Drawing Number
C-4

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER
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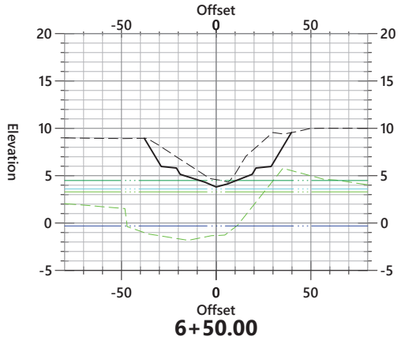
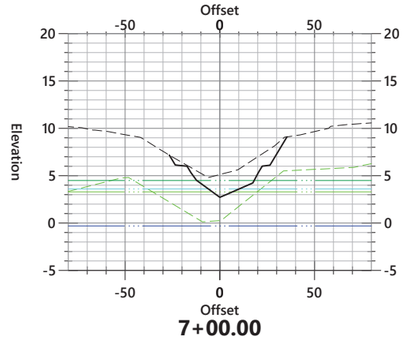
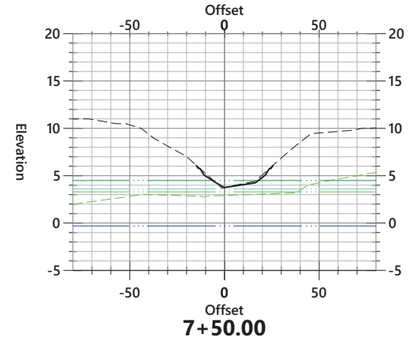
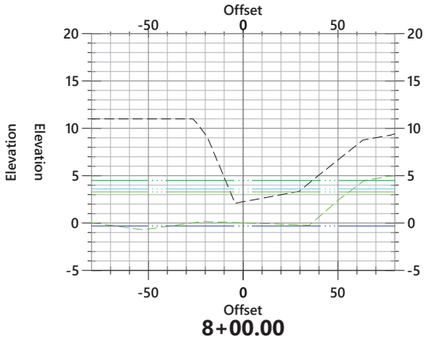
Sheet 4 of 11

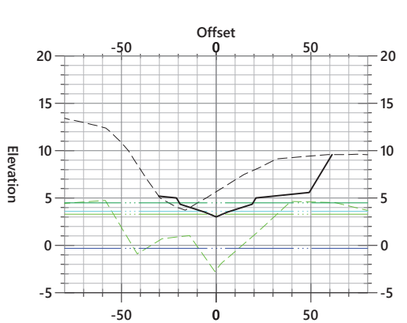
Project Number 52633.02

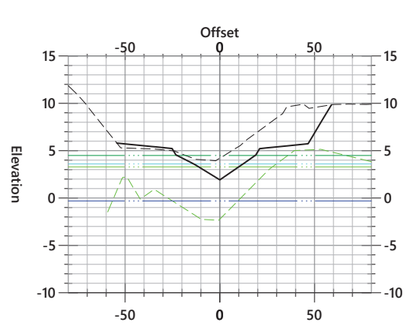


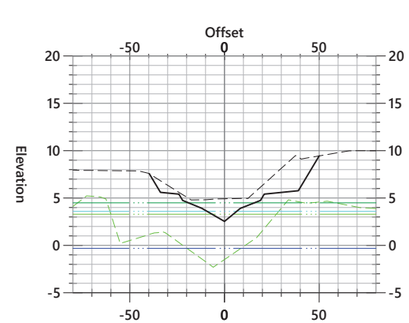


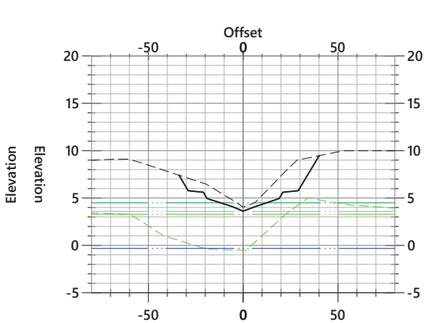


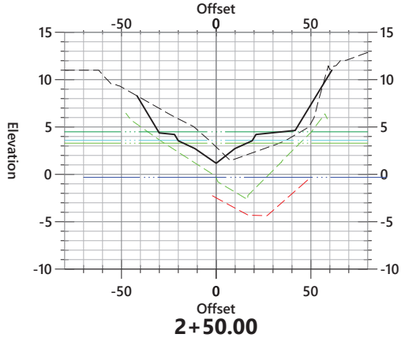


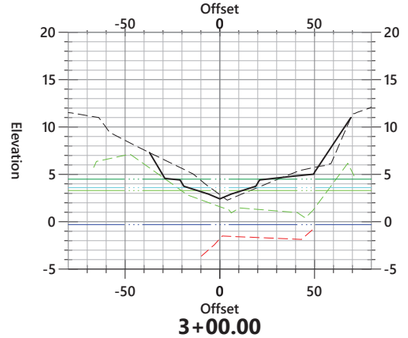


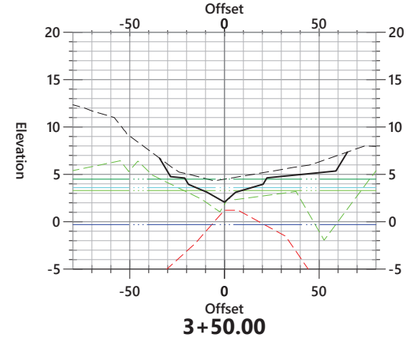


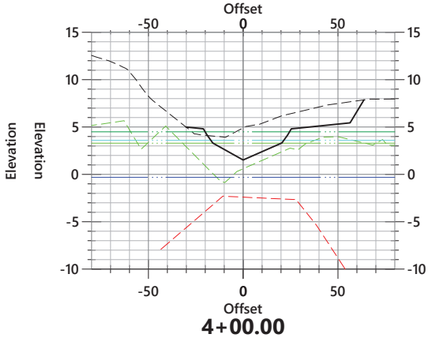


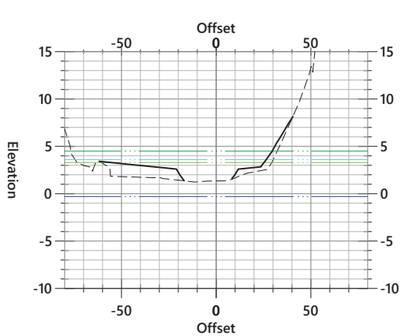


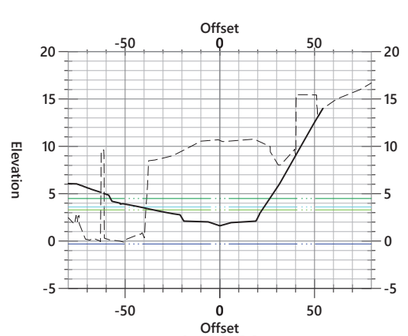


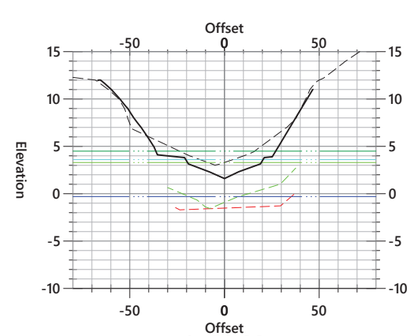


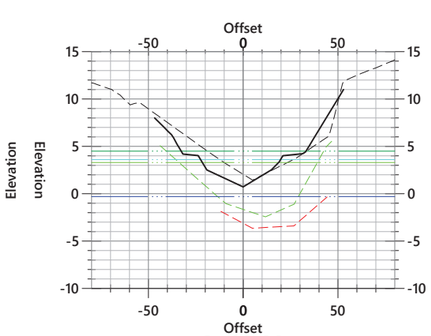












LEGEND

- EXISTING SURFACE
- PROPOSED SURFACE
- SOFT SEDIMENT LIMITS
- BEDROCK SURFACE
- HIGHEST ASTRONOMICAL TIDE (ELEV. 4.5)
- MEAN HIGHER-HIGH WATER (ELEV. 3.6)
- MEAN HIGH WATER (ELEV. 3.3)
- MEAN TIDE LEVEL (ELEV. -0.3)

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Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
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Drawing Title: River Channel Cross Sections

Drawing Number: C-5

Sheet 5 of 11

Project Number: 52633.02

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER No.15589
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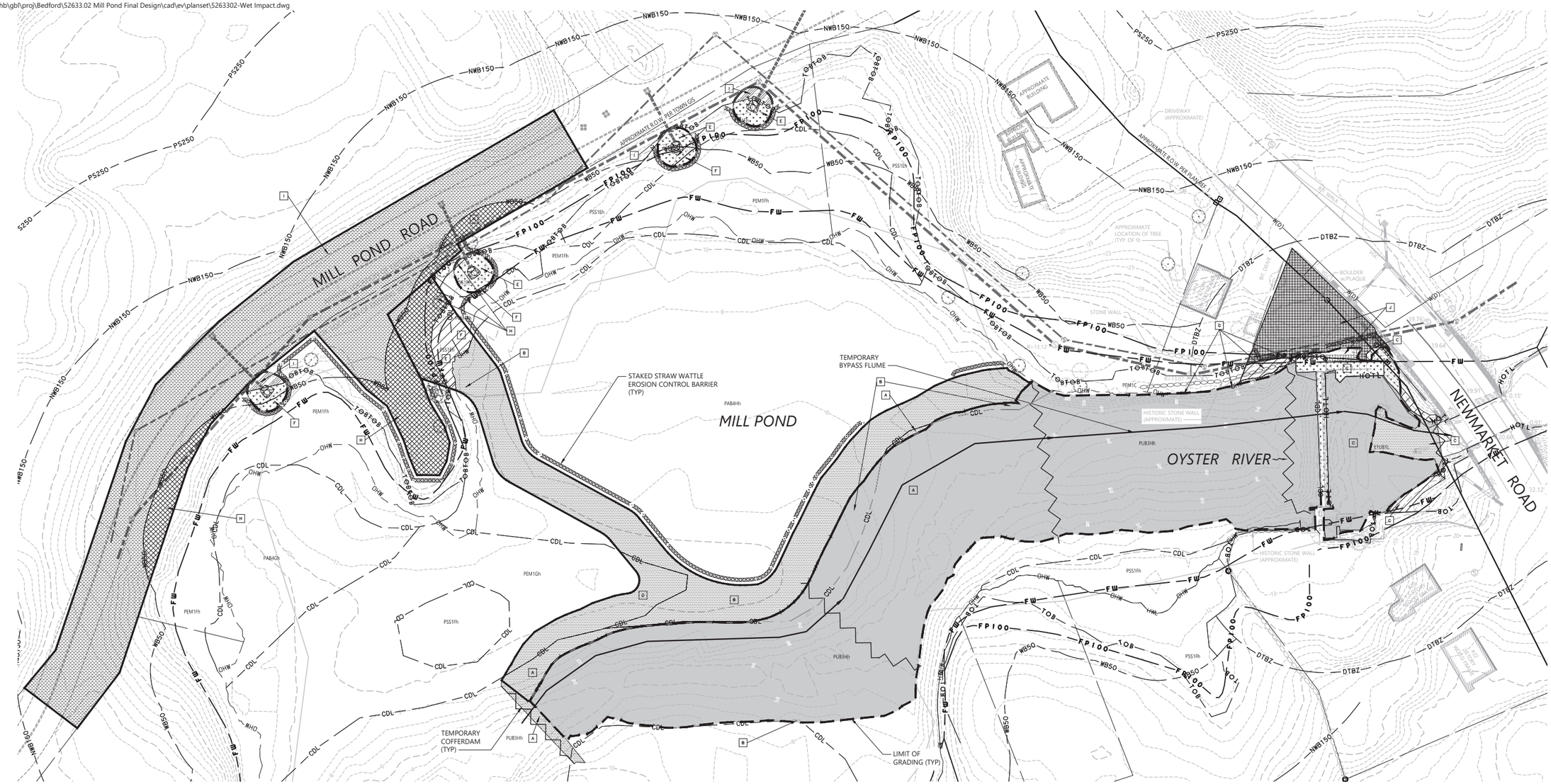

0 20 40 80 Feet

Legend

- LIMIT OF DISTURBANCE
- PEM1C — WETLAND DESIGNATION NUMBER
- A — WETLAND IMPACT LOCATION
- N.H. WETLANDS BUREAU AND U.S. ARMY CORPS WETLAND PERMANENT IMPACT (BED/WETLAND)
- N.H. WETLANDS BUREAU AND U.S. ARMY CORPS WETLAND TEMPORARY IMPACT (BED/WETLAND)
- N.H. WETLANDS BUREAU PERMANENT IMPACT (BANK)
- N.H. WETLANDS BUREAU TEMPORARY IMPACT (BANK)
- 50 FT. WATERFRONT BUFFER PERMANENT IMPACT
- 50 FT. WATERFRONT BUFFER TEMPORARY IMPACT
- 150 FT. NATURAL WOODLAND BUFFER PERMANENT IMPACT
- 150 FT. NATURAL WOODLAND BUFFER TEMPORARY IMPACT
- DEVELOPED TIDAL BUFFER ZONE (DTBZ) PERMANENT IMPACT
- DEVELOPED TIDAL BUFFER ZONE (DTBZ) TEMPORARY IMPACT

Wetland Classification Codes

CODE	CODE DESCRIPTION
PEM1C	- PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED
PEM1E	- PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED/SATURATED
PEM1Fh	- PALUSTRINE, EMERGENT, PERSISTENT, SEMI-PERMANENTLY FLOODED, DIKED/IMPOUNDED
PEM1Gh	- PALUSTRINE, EMERGENT, PERSISTENT, INTERMITTENTLY EXPOSED, DIKE/IMPOUNDED
PAB4Gh	- PALUSTRINE, AQUATIC BED, FLOATING VASCULAR, INTERMITTENTLY EXPOSED, DIKED/IMPOUNDED
PAB4Hh	- PALUSTRINE, AQUATIC BED, FLOATING VASCULAR, PERMANENTLY FLOODED, DIKED/IMPOUNDED
PUB3Hh	- PALUSTRINE, UNCONSOLIDATED BOTTOM, MUD, PERMANENTLY FLOODED, DIKED/IMPOUNDED
PSS1Fh	- PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS, SEMI-PERMANENTLY FLOODED, DIKED/IMPOUNDED
E1UB1L	- ESTUARINE, SUBTIDAL, UNCONSOLIDATED BOTTOM, COBBLE-GRAVEL, SUBTIDAL

RSA 482-A Impacts

Wetland and River Impacts (SF)

PERMANENT IMPACTS:	70,710 SF
TEMPORARY IMPACTS:	27,690 SF
TOTAL IMPACTS =	98,400 SF

Wetland and River Impacts (LF)

PERMANENT BANK IMPACTS:	195 LF
TEMPORARY BANK IMPACTS:	60 LF
TOTAL BANK IMPACTS:	255 LF
PERMANENT BED IMPACTS:	740 LF
TEMPORARY BED IMPACTS:	540 LF
TOTAL BED IMPACTS:	1,280 LF
TOTAL PROJECT IMPACTS:	1,535 LF

RSA 483-B Impacts

PERMANENT IMPACTS:	530 SF
TEMPORARY IMPACTS:	37,820 SF
TOTAL IMPACTS =	38,350 SF

Dam Removal & River Restoration
Wetland Impact Summary

Wetland Classification	Impact Location	Area (sf)						Purpose
		Permanent Impacts			Temporary Impacts			
		Bed/Wetland SF	Bank SF	Buffer SF	Bed/Wetland SF	Bank SF	Buffer SF	
PUB3Hh	A	57,860			1,920			CHANNEL SHAPING & STABILIZATION, DAM REMOVAL & CONSTRUCTION ACCESS
PAB4Hh	B	2,700			15,030			CHANNEL SHAPING & STABILIZATION AND CONSTRUCTION ACCESS
E1UB1L	C	6,010	1,660		1,590	590		CHANNEL SHAPING & STABILIZATION AND DAM REMOVAL
PEM1Gh	D				2,800			CONSTRUCTION ACCESS
PSS1Eh	E		1,610			730		DRAINAGE OUTFALL GRADING/ STABILIZATION & CONSTRUCTION ACCESS
PEM1Fh	F		520			350		DRAINAGE OUTFALL GRADING/ STABILIZATION & CONSTRUCTION ACCESS
PEM1C	G		40			330		CHANNEL SHAPING & STABILIZATION
WATERFRONT BUFFER	H			40			7,380	DRAINAGE OUTFALL GRADING, TEMP. STAGING & CONSTRUCTION ACCESS
WOODLAND BUFFER	I			490			30,440	DRAINAGE OUTFALL GRADING, TEMP. STAGING & CONSTRUCTION ACCESS
DTBZ	J			310			4,350	CHANNEL SHAPING & STABILIZATION AND TEMP. STAGING
TOTAL		66,570	3,830	840	21,340	2,000	42,170	

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Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
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Not Approved for Construction

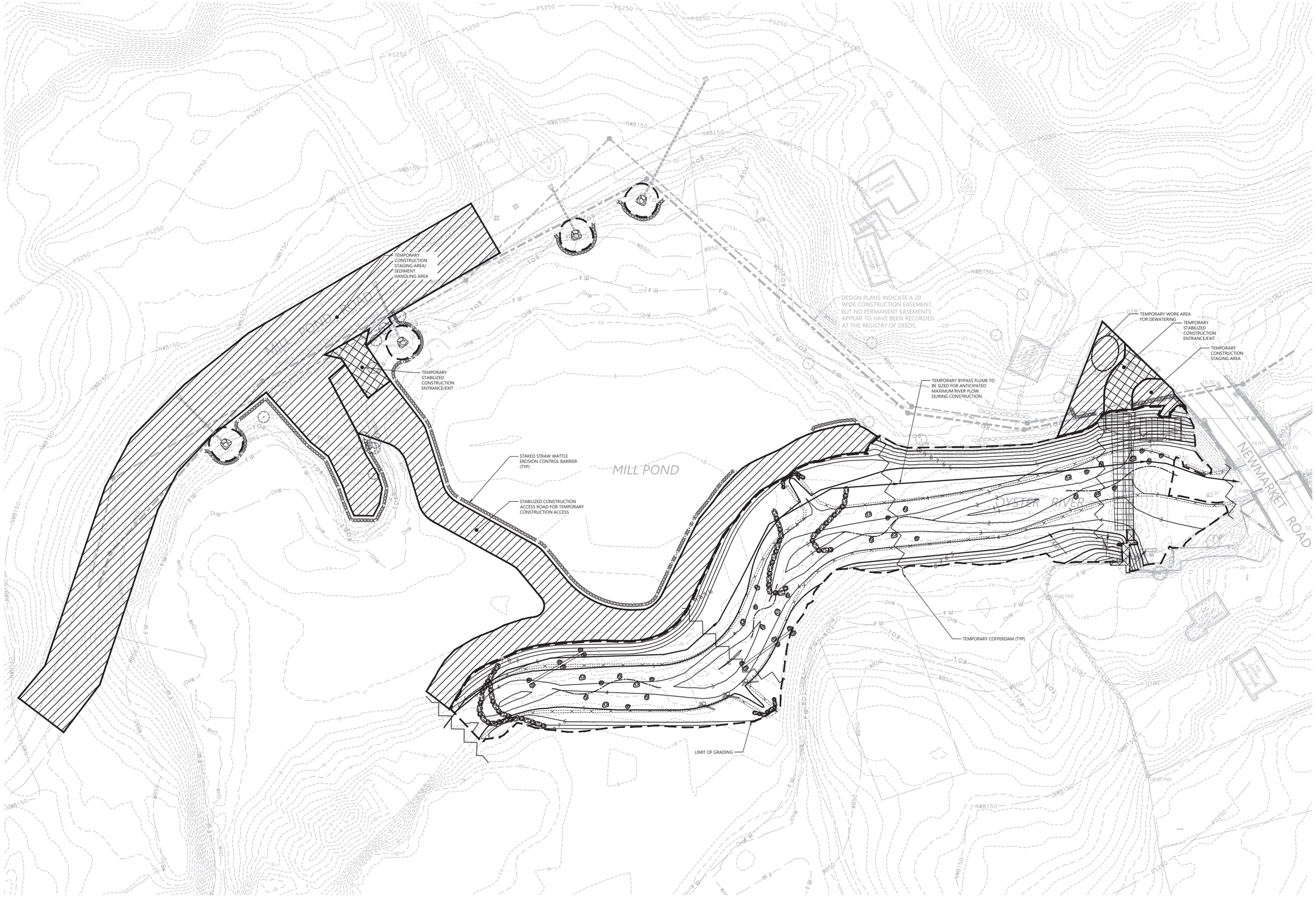
Drawing Title: **Wetland and Shoreland Impact Plan**

Drawing Number: C-6

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER No.15589 LICENSED PROFESSIONAL ENGINEER

Sheet 6 of 11

Project Number: 52633.02



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Mill Pond Dam Removal and Oyster River Restoration

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Drawing Title

Erosion and Sediment Control Plan

Drawing Number

C-7

Sheet 7 of 11

Project Number 52633.02

2-5-2024
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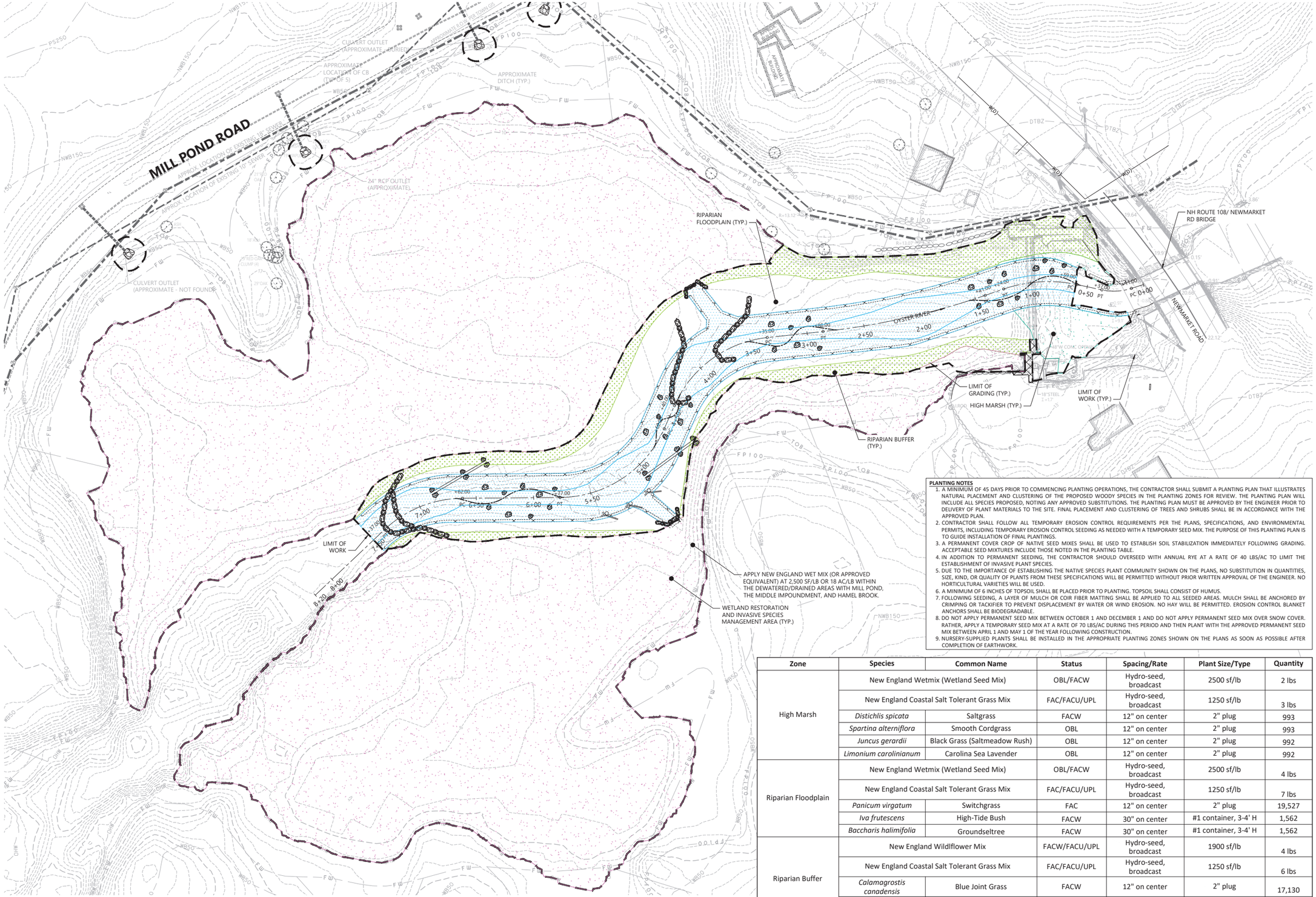

LEGEND

- PROPOSED STREAMBED
- PROPOSED HIGH MARSH
- PROPOSED RIPARIAN FLOODPLAIN
- PROPOSED RIPARIAN BUFFER
- PROPOSED WETLAND RESTORATION AND INVASIVE SPECIES MANAGEMENT

PLANTING NOTES

1. A MINIMUM OF 45 DAYS PRIOR TO COMMENCING PLANTING OPERATIONS, THE CONTRACTOR SHALL SUBMIT A PLANTING PLAN THAT ILLUSTRATES NATURAL PLACEMENT AND CLUSTERING OF THE PROPOSED WOODY SPECIES IN THE PLANTING ZONES FOR REVIEW. THE PLANTING PLAN WILL INCLUDE ALL SPECIES PROPOSED, NOTING ANY APPROVED SUBSTITUTIONS. THE PLANTING PLAN MUST BE APPROVED BY THE ENGINEER PRIOR TO DELIVERY OF PLANT MATERIALS TO THE SITE. FINAL PLACEMENT AND CLUSTERING OF TREES AND SHRUBS SHALL BE IN ACCORDANCE WITH THE APPROVED PLAN.
2. CONTRACTOR SHALL FOLLOW ALL TEMPORARY EROSION CONTROL REQUIREMENTS PER THE PLANS, SPECIFICATIONS, AND ENVIRONMENTAL PERMITS, INCLUDING TEMPORARY EROSION CONTROL SEEDING AS NEEDED WITH A TEMPORARY SEED MIX. THE PURPOSE OF THIS PLANTING PLAN IS TO GUIDE INSTALLATION OF FINAL PLANTINGS.
3. A PERMANENT COVER CROP OF NATIVE SEED MIXES SHALL BE USED TO ESTABLISH SOIL STABILIZATION IMMEDIATELY FOLLOWING GRADING. ACCEPTABLE SEED MIXTURES INCLUDE THOSE NOTED IN THE PLANTING TABLE.
4. IN ADDITION TO PERMANENT SEEDING, THE CONTRACTOR SHOULD OVERSEED WITH ANNUAL RYE AT A RATE OF 40 LBS/AC TO LIMIT THE ESTABLISHMENT OF INVASIVE PLANT SPECIES.
5. DUE TO THE IMPORTANCE OF ESTABLISHING THE NATIVE SPECIES PLANT COMMUNITY SHOWN ON THE PLANS, NO SUBSTITUTION IN QUANTITIES, SIZE, KIND, OR QUALITY OF PLANTS FROM THESE SPECIFICATIONS WILL BE PERMITTED WITHOUT PRIOR WRITTEN APPROVAL OF THE ENGINEER. NO HORTICULTURAL VARIETIES WILL BE USED.
6. A MINIMUM OF 6 INCHES OF TOPSOIL SHALL BE PLACED PRIOR TO PLANTING. TOPSOIL SHALL CONSIST OF HUMUS.
7. FOLLOWING SEEDING, A LAYER OF MULCH OR COIR FIBER MATTING SHALL BE APPLIED TO ALL SEEDED AREAS. MULCH SHALL BE ANCHORED BY CRIMPING OR TACKIFIER TO PREVENT DISPLACEMENT BY WATER OR WIND EROSION. NO HAY WILL BE PERMITTED. EROSION CONTROL BLANKET ANCHORS SHALL BE BIODEGRADABLE.
8. DO NOT APPLY PERMANENT SEED MIX BETWEEN OCTOBER 1 AND DECEMBER 1 AND DO NOT APPLY PERMANENT SEED MIX OVER SNOW COVER. RATHER, APPLY A TEMPORARY SEED MIX AT A RATE OF 70 LBS/AC DURING THIS PERIOD AND THEN PLANT WITH THE APPROVED PERMANENT SEED MIX BETWEEN APRIL 1 AND MAY 1 OF THE YEAR FOLLOWING CONSTRUCTION.
9. NURSERY-SUPPLIED PLANTS SHALL BE INSTALLED IN THE APPROPRIATE PLANTING ZONES SHOWN ON THE PLANS AS SOON AS POSSIBLE AFTER COMPLETION OF EARTHWORK.

Zone	Species	Common Name	Status	Spacing/Rate	Plant Size/Type	Quantity
High Marsh	New England Wetmix (Wetland Seed Mix)		OBL/FACW	Hydro-seed, broadcast	2500 sf/lb	2 lbs
	New England Coastal Salt Tolerant Grass Mix		FAC/FACU/UPL	Hydro-seed, broadcast	1250 sf/lb	3 lbs
	Distichlis spicata	Saltgrass	FACW	12" on center	2" plug	993
	Spartina alterniflora	Smooth Cordgrass	OBL	12" on center	2" plug	993
	Juncus gerardii	Black Grass (Saltmeadow Rush)	OBL	12" on center	2" plug	992
	Limonium carolinianum	Carolina Sea Lavender	OBL	12" on center	2" plug	992
Riparian Floodplain	New England Wetmix (Wetland Seed Mix)		OBL/FACW	Hydro-seed, broadcast	2500 sf/lb	4 lbs
	New England Coastal Salt Tolerant Grass Mix		FAC/FACU/UPL	Hydro-seed, broadcast	1250 sf/lb	7 lbs
	Panicum virgatum	Switchgrass	FAC	12" on center	2" plug	19,527
	Iva frutescens	High-Tide Bush	FACW	30" on center	#1 container, 3-4' H	1,562
	Baccharis halimifolia	Groundseltree	FACW	30" on center	#1 container, 3-4' H	1,562
Riparian Buffer	New England Wildflower Mix		FACW/FACU/UPL	Hydro-seed, broadcast	1900 sf/lb	4 lbs
	New England Coastal Salt Tolerant Grass Mix		FAC/FACU/UPL	Hydro-seed, broadcast	1250 sf/lb	6 lbs
	Calamagrostis canadensis	Blue Joint Grass	FACW	12" on center	2" plug	17,130
	Clethra alnifolia	Sweet Pepperbush	FAC	30" on center	#1 container, 3-4' H	1,370
	Morella pensylvanica	Northern Bayberry	FAC	30" on center	#1 container, 3-4' H	1,371
Dewatered/Drained Areas	New England Wetmix (Wetland Seed Mix)		OBL/FACW	Hydro-seed, broadcast	2500 sf/lb	276 lbs

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Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
Durham, NH

No.	Revision	Date	Appvd.

Designed by BJM | Checked by

Issued for: Permitting | Date: January 17, 2024

Not Approved for Construction

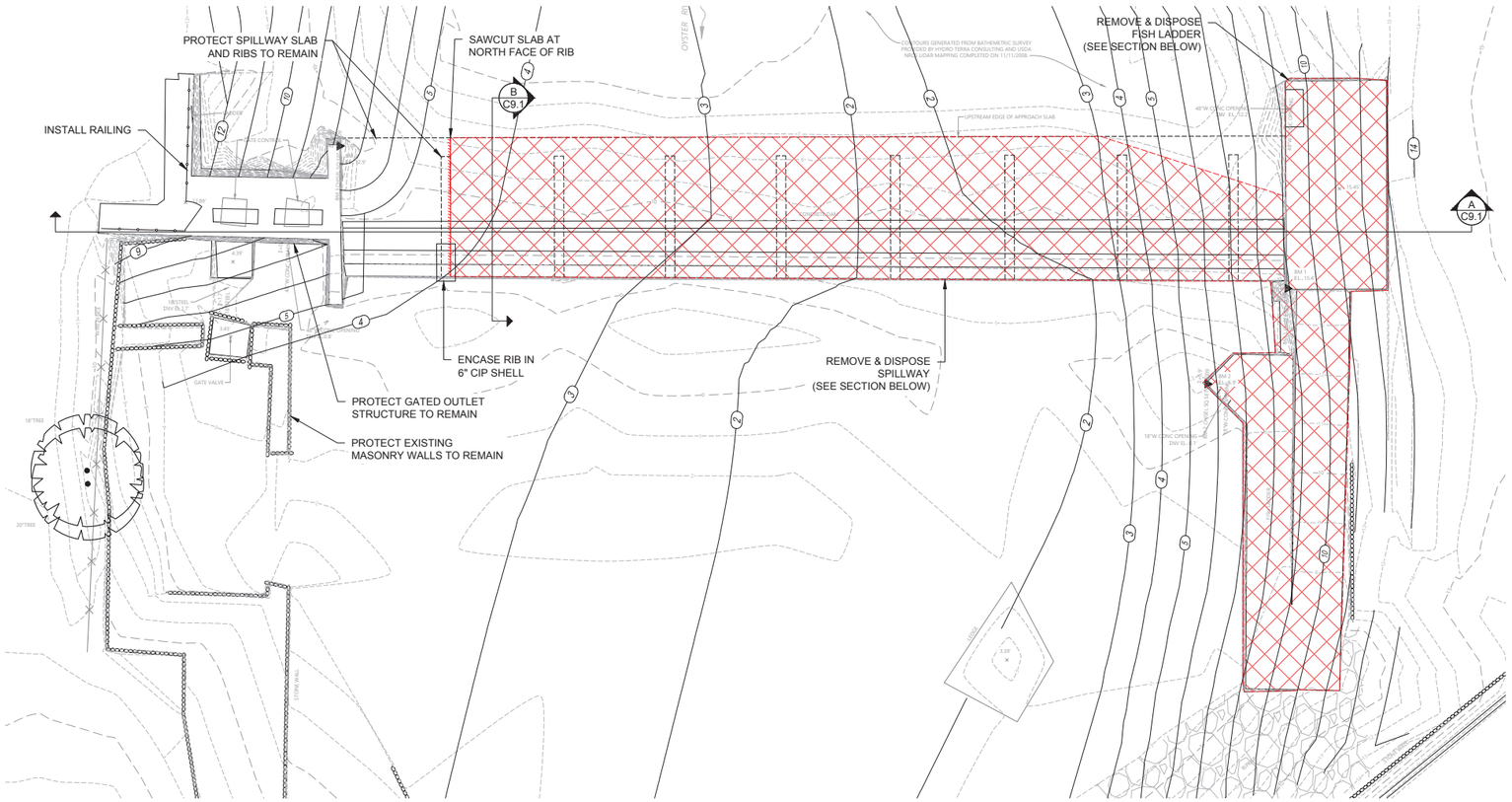
Drawing Title
Restoration and Planting Plan

Drawing Number
C-8

Sheet 8 of 11

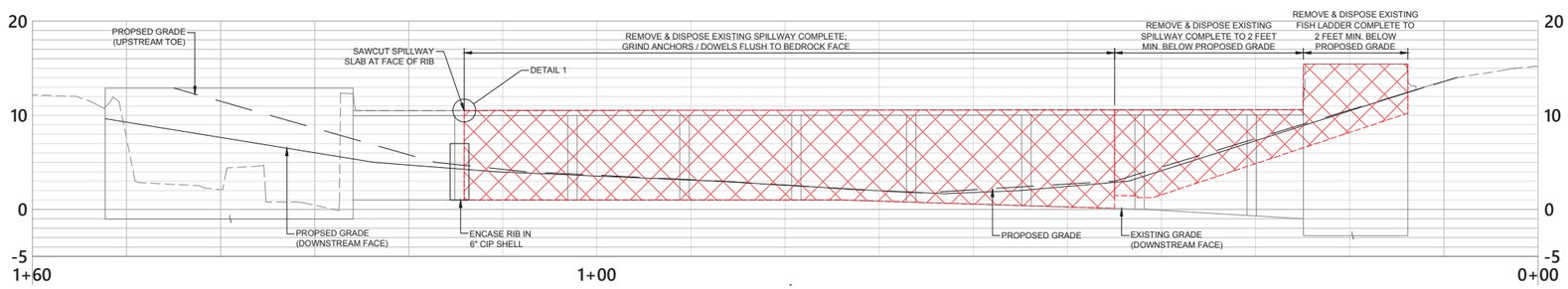
Project Number
52633.02

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER No.15589 LICENSED PROFESSIONAL ENGINEER



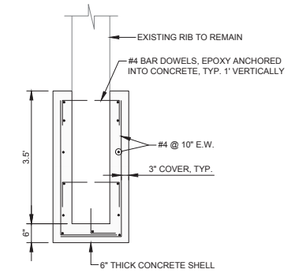
DAM PLAN
SCALE: 1"=8's

Scale: 1"=8'
0 4' 8' 16'

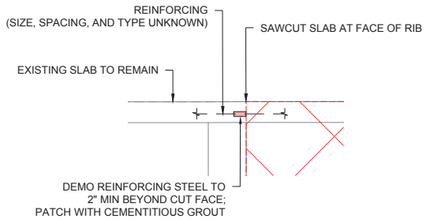


A C9.1 SECTION A
SCALE: 1"=8'

Scale: 1"=8'
0 4' 8' 16'



CONCRETE SHELL DETAIL
NOT TO SCALE



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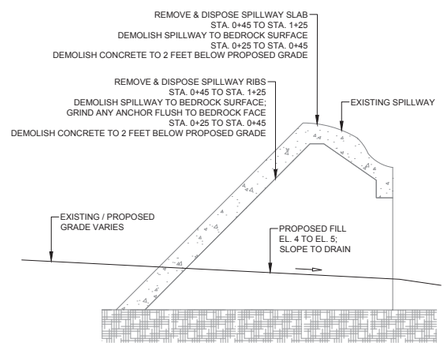

Scale: 1"=2'
0 1' 2' 4'

B C9.1 SECTION B
SCALE: 1"=2'

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Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
Durham, NH

No.	Revision	Date	Appvd.

Designed by | Checked by

Issued for | Date

JANUARY 5, 2024

Not Approved for Construction

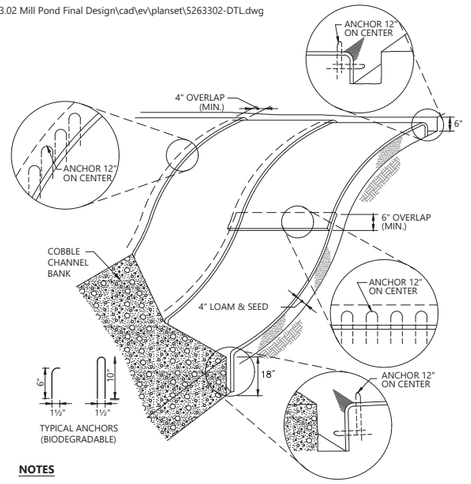
Drawing Title
Detail

Drawing Number
C-9.1

Sheet 9 of 11

Project Number
52633.02

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER
No. 15589
LICENSED PROFESSIONAL ENGINEER



NOTES

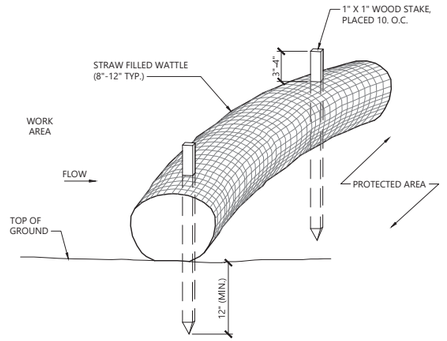
1. BEGIN AT THE TOP OF BLANKET INSTALLATION AREA BY ANCHORING BLANKET IN A 6" DEEP TRENCH BACKFILL AND COMPACT TRENCH AFTER ANCHORING.
2. ROLL THE BLANKET DOWN THE SLOPE IN THE DIRECTION OF THE WATER FLOW. THE EDGES OF BLANKETS MUST BE ANCHORED WITH APPROX. 4 INCH OVERLAP WHERE 2 OR MORE STRIP WIDTHS ARE REQUIRED.
3. ANCHOR BLANKET AT TRANSITION TO COBBLE CHANNEL BANK AT BOTTOM OF SLOPE IN AN 18" DEEP TRENCH. BACKFILL TRENCH WITH COMPACTED COBBLE BED MATERIAL.
4. WHEN BLANKETS MUST BE SPLICED, PLACE UPPER BLANKET END OVER LOWER END WITH 6 INCH (MIN.) OVERLAP AND ANCHOR BOTH TOGETHER.
5. METHOD OF INSTALLATION SHALL BE AS PER MANUFACTURER'S RECOMMENDATIONS (TRITON ENVIRONMENTAL, COIR FIBER MATTING CM400, OR APPROVED EQUAL).
6. EROSION CONTROL BLANKETS SHALL BE USED IN ALL AREAS WHERE LOAM AND SEED ARE TO BE APPLIED. EROSION CONTROL BLANKETS SHALL BE COMPOSED OF WILDLIFE-FRIENDLY MATERIALS WITH NO WELDED PLASTIC THREADS.

REV

Erosion Control Blanket Slope Installation

10/20

N.T.S. Source: VHB LD_680



NOTES

1. STRAW WATTLE SHALL BE AS MANUFACTURED BY EARTHSAVER OR APPROVED EQUAL.
2. STRAW WATTLES SHALL OVERLAP A MINIMUM OF 12 INCHES.
3. STRAW WATTLE SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS, AND REPAIR OR REPLACEMENT SHALL BE PERFORMED PROMPTLY AS NEEDED.
4. TEMPORARY STRAW WATTLES TO BE REMOVED BY CONTRACTOR. ALL OTHERS TO REMAIN IN PLACE UNLESS DIRECTED OTHERWISE BY ENGINEER.
5. IF NON BIODEGRADABLE NETTING IS USED THE NETTING SHALL BE COLLECTED AND DISPOSED OF OFFSITE.

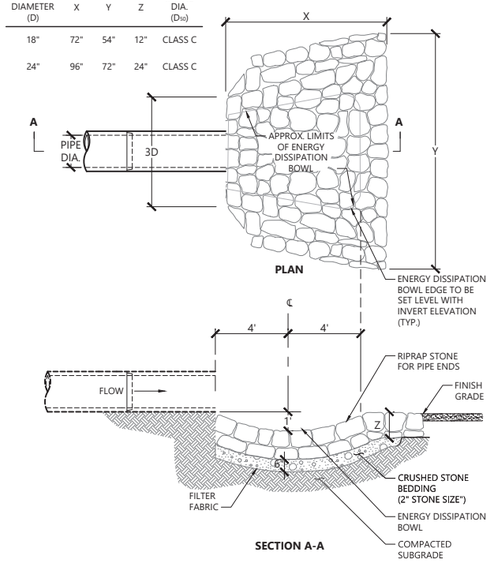
Straw Wattle - Erosion Control Barrier

1/20

N.T.S. Source: VHB LD_659

RIPRAP STONE

PIPE DIAMETER (D)	X	Y	Z	STONE DIA. (D_{100})
18"	72"	54"	12"	CLASS C
24"	96"	72"	24"	CLASS C



Stone Protection at Stormdrain Outlet

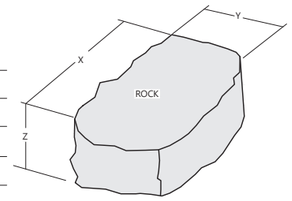
1/16

N.T.S. Source: VHB REV LD_133

*** MINIMUM X-Y-Z DIMENSIONS FOR ALL STRUCTURE STONES TO BE USED FOR RIFFLE CRESTS AND FEATURE BOULDERS SHALL MEET THE MINIMUM SIZE REQUIREMENTS GIVEN IN THE TABLE BELOW.

DIMENSION

X	Y	Z
48"	42"	18"
48"	36"	21"
42"	36"	24"
42"	32"	27"
36"	32"	32"



Boulder Axis Detail

08/23

N.T.S. Source: VHB EV_1100

PERCENT PASSING	SIZE (IN)
D95	5 - 9
D84	3 - 6.5
D50	1.5 - 3.5
D30	0.5 - 1.25
D16	0.1 - 0.5

DESCRIPTION	STATION
RIFFLE	0+00 TO 1+41
POOL	1+41 TO 2+86
RIFFLE	2+86 TO 3+35
POOL	3+35 TO 4+40
RIFFLE	4+40 TO 4+62
POOL	4+62 TO 5+77
RIFFLE	5+77 TO 6+62
POOL	6+62 TO 7+34

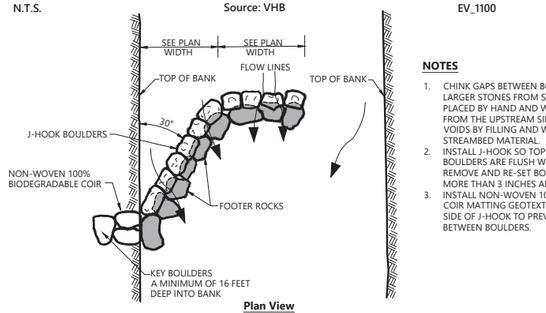
NOTES:

1. CONTRACTOR SHALL ADD UP TO 10% SAND TO GRAVEL-COBBLE BED MIX TO FILL VOIDS.
2. CONTRACTOR TO PLACE MINIMUM 15 INCH DEPTH OF SPECIFIED BED MATERIAL IN POOL SECTIONS AND MINIMUM 21 INCH DEPTH IN RIFFLE SECTIONS. SEE ABOVE TABLE FOR RIFFLE AND POOL STATION RANGES.

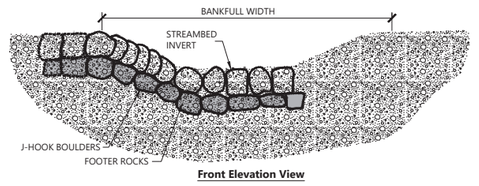
Streambed Material Specification

08/23

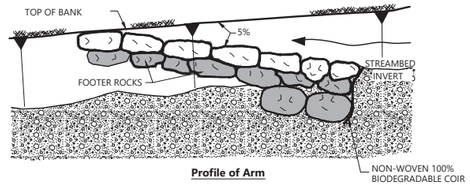
N.T.S. Source: VHB EV_1100



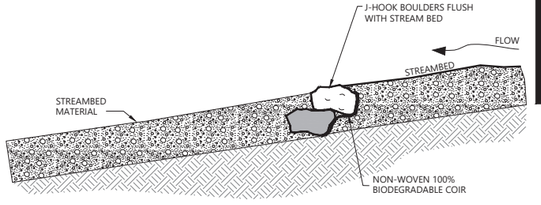
Plan View



Front Elevation View



Profile of Arm



Profile Through Center of Riffle Crest

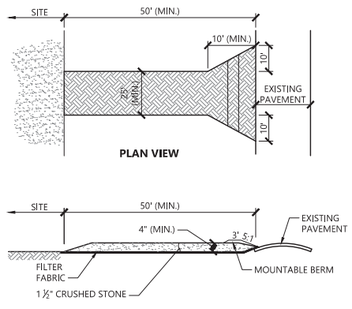
NOTES

1. CHINK GAPS BETWEEN BOULDERS USING LARGER STONES FROM STREAMBED MATERIAL, PLACED BY HAND AND WEDGED INTO PLACE FROM THE UPSTREAM SIDE. BACKFILL ALL VOIDS BY FILLING AND WASHING-IN STREAMBED MATERIAL.
2. INSTALL J-HOOK SO TOPS OF J-HOOK BOULDERS ARE FLUSH WITH FINISH GRADE. REMOVE AND RE-SET BOULDERS THAT EXTEND MORE THAN 3 INCHES ABOVE FINISH GRADE.
3. INSTALL NON-WOVEN 100% BIODEGRADABLE COIR MATTING GEOTEXTILE ALONG UPSTREAM SIDE OF J-HOOK TO PREVENT SOIL PIPING BETWEEN BOULDERS.

J-Hook

10/23

N.T.S. Source: VHB



PLAN VIEW

CROSS-SECTION

NOTES

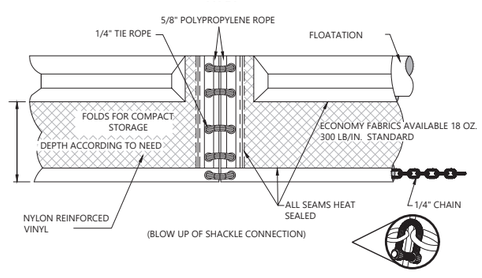
1. EXIT WIDTH SHALL BE A TWENTY-FIVE (25) FOOT MINIMUM, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS.
2. THE EXIT SHALL BE MAINTAINED IN A CONDITION WHICH SHALL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY. BERM SHALL BE PERMITTED. PERIODIC INSPECTION AND MAINTENANCE SHALL BE PROVIDED AS NEEDED.
3. STABILIZED CONSTRUCTION EXIT SHALL BE REMOVED PRIOR TO FINAL FINISH MATERIALS BEING INSTALLED.

Stabilized Construction Exit

1/16

N.T.S. Source: VHB LD_682

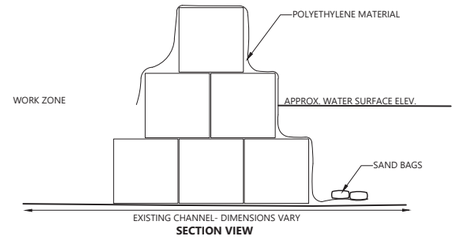
TYPE I



Turbidity Curtain

10/19

N.T.S. Source: VHB EV_1104



SECTION VIEW

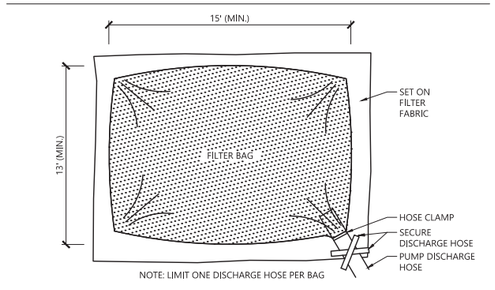
NOTES:

1. CONTRACTOR TO DESIGN AND INSTALL COFFER DAM TO CONTROL OVERTOPPING FLOWS AND PREVENT EROSION OR DAMAGE TO SURROUNDING LAND

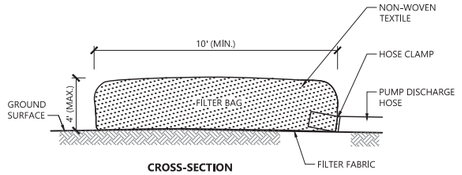
Coffer Dam (Sand Bags)

08/23

N.T.S. Source: VHB EV_1103



PLAN VIEW



CROSS-SECTION

NOTES

1. BAG TO BE USED IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.

Dewatering Filter Bag

1/16

N.T.S. Source: VHB LD_691

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Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
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Permitting January 17, 2024

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Drawing Title

Details

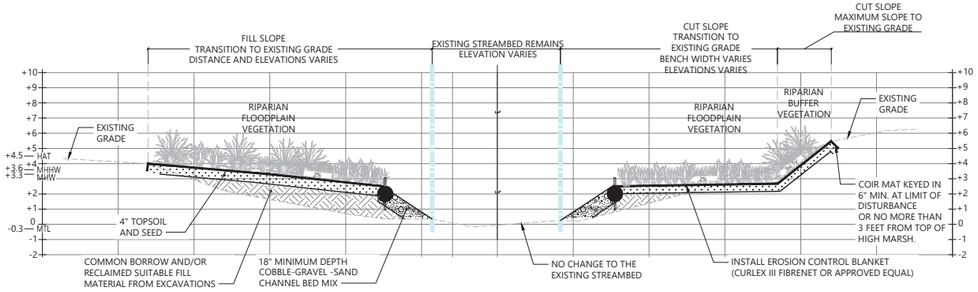
Drawing Number

C-9.2

Sheet 10 of 11

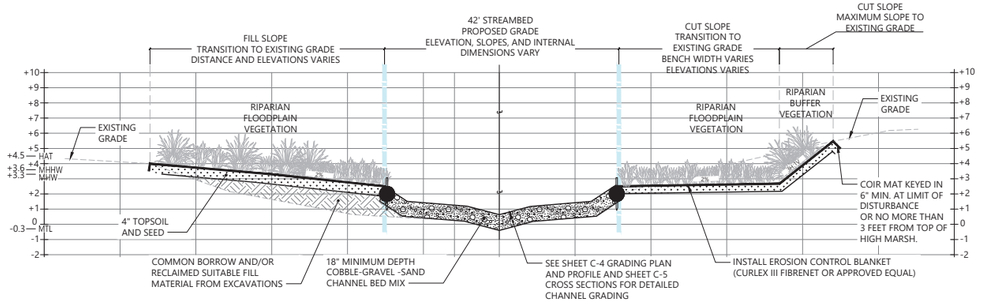
Project Number 52633.02

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER No.15589
PROFESSIONAL ENGINEER
LICENSED



NOTE: ALL ELEVATIONS IN NAVD88.

STATION 0+00 TO 0+60

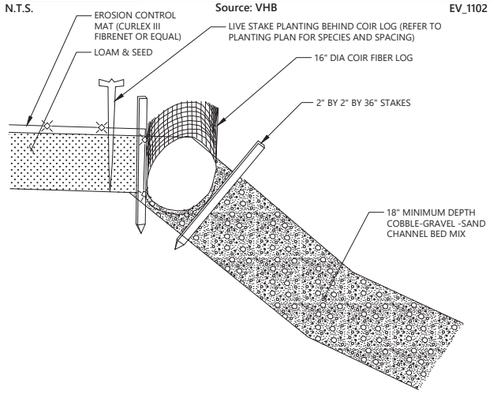


STATION 0+60 TO 7+50

Typical Channel & Floodplain Section

08/23

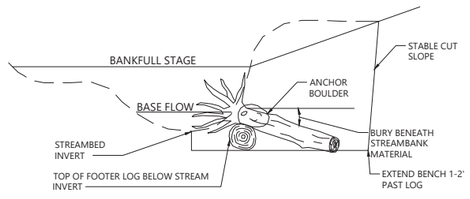
N.T.S. Source: VHB EV_1102



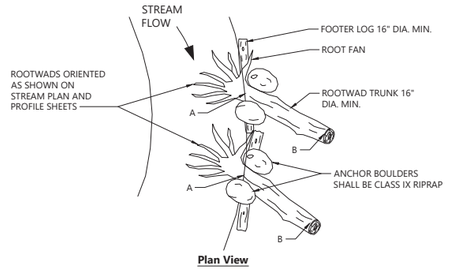
Coir Log Bank

08/23

N.T.S. Source: VHB EV_1104



Cross Section



Plan View

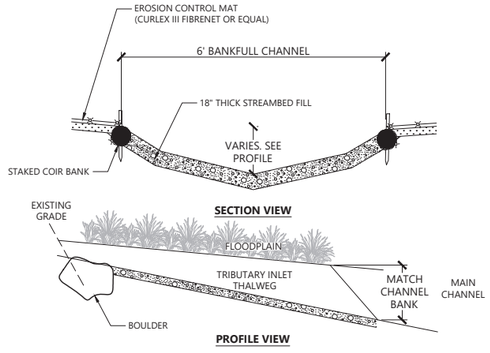
NOTES:

1. ROOTWAD TRUNK PLACED INTO BANK AS SHOWN ON THE STREAM PLAN SHEETS. USE TRENCH PLACEMENT METHOD TO AVOID DESTROYING THE ROOT FAN. BACKFULL TRENCH IN ACCORDANCE WITH CONSTRUCTION SPECIFICATIONS.
2. REFER TO STRUCTURE TABLES AND STREAM PLAN AND PROFILE SHEETS FOR ROOTWAD LOCATIONS.

Rootwad

08/23

N.T.S. Source: VHB EV_1101

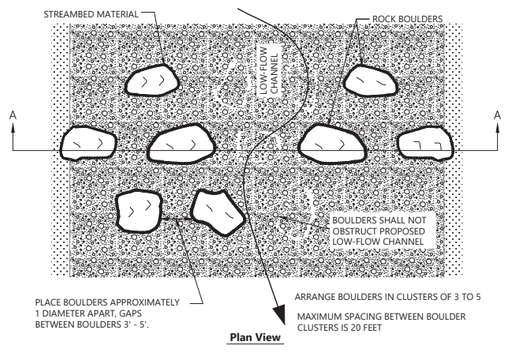


PROFILE VIEW

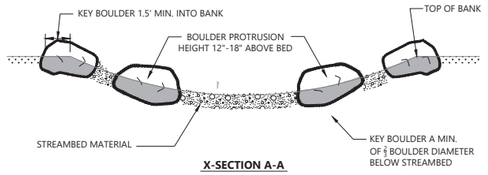
Tributary Inlet

08/23

N.T.S. Source: VHB EV_1105



Plan View

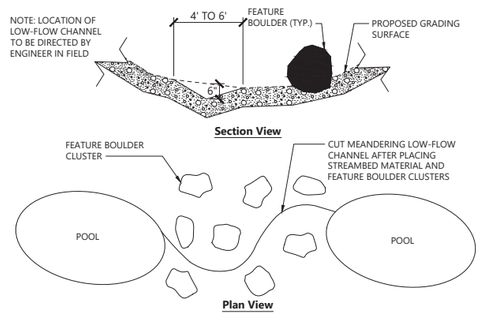


X-SECTION A-A

Feature Boulder Cluster

08/23

N.T.S. Source: VHB EV_1102



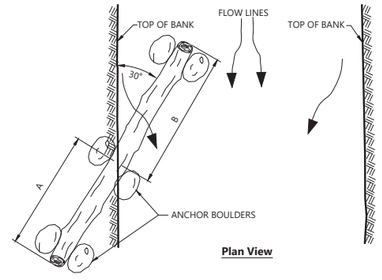
Section View

Plan View

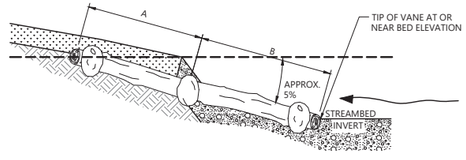
Low Flow Channel

08/23

N.T.S. Source: VHB EV_1106



Plan View



Cross Section

LOG VANE DIMENSIONS

ID	A	B
LOG VANE 1	24 FT	32 FT
LOG VANE 2	16 FT	40 FT

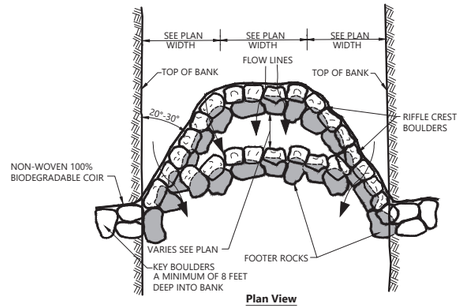
Notes

1. INSTALL ANCHOR BOULDERS TO STABILIZE LOG VANE AT TOP OF BANK, AT END WITHIN CHANNEL, AND AT BURIED END BEHIND BANK.
2. REFER TO STREAM PLAN SHEETS FOR LOG-VANE LOCATIONS.

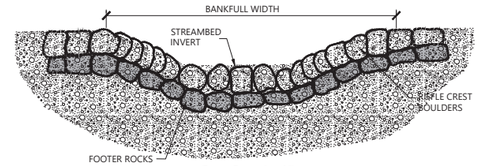
Log-Vane

10/23

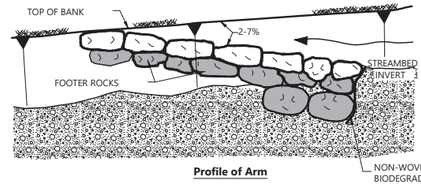
N.T.S. Source: VHB



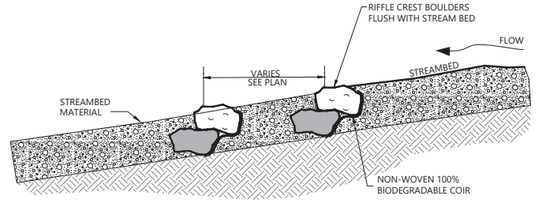
Plan View



Front Elevation View



Profile of Arm



Profile Through Center of Riffle Crest

Riffle Crest

08/23

N.T.S. Source: VHB EV_1103

NOTES

1. CHINK GAPS BETWEEN BOULDERS USING LARGER STONES FROM STREAMBED MATERIAL, PLACED BY HAND AND WEDGED INTO PLACE FROM THE UPSTREAM SIDE. BACKFILL ALL VOIDS BY FILLING AND WASHING-IN STREAMBED MATERIAL.
2. INSTALL RIFFLE CREST SO TOPS OF RIFFLE CREST BOULDERS ARE FLUSH WITH FINISH GRADE. REMOVE AND RE-SET BOULDERS THAT EXTEND MORE THAN 3 INCHES ABOVE FINISH GRADE.
3. INSTALL NON-WOVEN 100% BIODEGRADABLE COIR MATTING GEOTEXTILE ALONG UPSTREAM SIDE OF RIFFLE CREST TO PREVENT SOIL PIPING BETWEEN BOULDERS.

vhb.com

vhb

2 Bedford Farms Drive
Suite 200
Bedford, NH 03110
603.391.3900

Mill Pond Dam Removal and Oyster River Restoration

Newmarket Road
Durham, NH

No.	Revision	Date	Appvd.

Designed by BJM Checked by

Issued for Date

Permitting January 17, 2024

Not Approved for Construction

Drawing Title

Details

Drawing Number

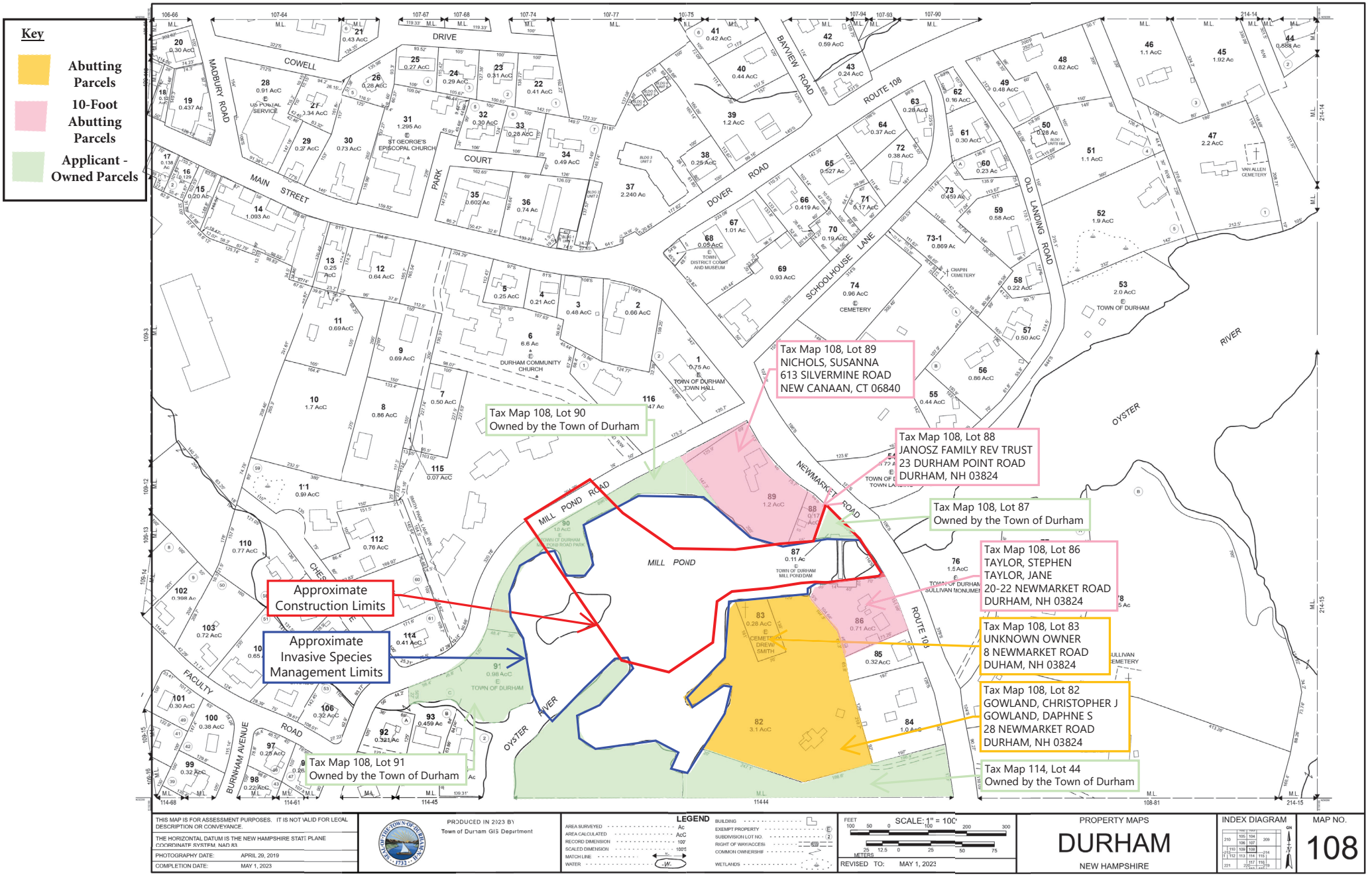
C-9.3

Sheet 11 of 11

Project Number 52633.02

2-5-2024
STATE OF NEW HAMPSHIRE
DAVID WILLIAM CLOUTIER No.15589 LICENSED
PROFESSIONAL ENGINEER

Appendix B: Abutter Information and Application Notifications


Key
Abutting Parcels
10-Foot Abutting Parcels
Applicant - Owned Parcels
Tax Map 108, Lot 89
NICHOLS, SUSANNA
613 SILVERMINE ROAD
NEW CANAAN, CT 06840
Tax Map 108, Lot 90
Owned by the Town of Durham
Tax Map 108, Lot 88
JANOSZ FAMILY REV TRUST
23 DURHAM POINT ROAD
DURHAM, NH 03824
Tax Map 108, Lot 87
Owned by the Town of Durham
Tax Map 108, Lot 86
TAYLOR, STEPHEN
TAYLOR, JANE
20-22 NEWMARKET ROAD
DURHAM, NH 03824
Approximate Construction Limits
Approximate Invasive Species Management Limits
Tax Map 108, Lot 83
UNKNOWN OWNER
8 NEWMARKET ROAD
DURHAM, NH 03824
Tax Map 108, Lot 82
GOWLAND, CHRISTOPHER J
GOWLAND, DAPHNE S
28 NEWMARKET ROAD
DURHAM, NH 03824
Tax Map 108, Lot 91
Owned by the Town of Durham
Tax Map 114, Lot 44
Owned by the Town of Durham
MAIN STREET
COWELL DRIVE
MADBURY ROAD
COURT
PARK
DOVER ROAD
ROUTE 108
BAYVIEW ROAD
SCHOOLHOUSE LANE
OLD LANDING ROAD
NEWMARKET ROAD
MILL POND ROAD
MILL POND
OYSTER RIVER
FACULTY ROAD
BURNHAM AVENUE
SMITH PARK LANE
ROUTE 108
VAN ALLEN CEMETERY
CHAPIN CEMETERY
SULLIVAN CEMETERY
DURHAM COMMUNITY CHURCH
ST GEORGE'S EPISCOPAL CHURCH
TOWN OF DURHAM TOWN HALL
TOWN DISTRICT COURT AND MUSEUM
US POSTAL SERVICE
CEMETERY
TOWN OF DURHAM MILL POND DAM
TOWN OF DURHAM MILL POND ROAD PARK
THIS MAP IS FOR ASSESSMENT PURPOSES. IT IS NOT VALID FOR LEGAL DESCRIPTION OR CONVEYANCE.
THE HORIZONTAL DATUM IS THE NEW HAMPSHIRE STATE PLANE COORDINATE SYSTEM, NAD 83.
PHOTOGRAPHY DATE: APRIL 29, 2019
COMPLETION DATE: MAY 1, 2023
PRODUCED IN 2023 BY
Town of Durham GIS Department
LEGEND
AREA SURVEYED
AREA CALCULATED
RECORD DIMENSION
SCALED DIMENSION
MATCH LINE
WATER
BUILDING
EXEMPT PROPERTY
SUBDIVISION LOT NO.
RIGHT OF WAY/ACCESS
COMMON OWNERSHIP
WETLANDS
SCALE: 1" = 100'
REVISED TO: MAY 1, 2023
PROPERTY MAPS
DURHAM
NEW HAMPSHIRE
INDEX DIAGRAM
MAP NO.
108

Oyster River Dam Removal at Mill Pond - Durham, NH
Abutting Property List

Count	Parcel ID (Map/Lot)	Owner Name	Co-Owner Name	Owner Mailing Address, Part 1	Owner Mailing Address, Part 2
1	108/89	NICHOLS, SUSANNA		613 SILVERMINE ROAD	NEW CANAAN, CT 06840
2	108/88	JANOSZ FAMILY REV TRUST		23 DURHAM POINT ROAD	DURHAM, NH 03824
3	108/86	TAYLOR, STEPHEN	TAYLOR, JANE	20 NEWMARKET ROAD	DURHAM, NH 03824
4				22 NEWMARKET ROAD	
5	108/82	GOWLAND, CHRISTOPHER J	GOWLAND, DAPHNE S	28 NEWMARKET ROAD	DURHAM, NH 03824
Applicant (no letter)	114/44	TOWN OF DURHAM		8 NEWMARKET ROAD	DURHAM, NH 03824
	108/91				
	108/90				
	108/87				
Applicant Address (no letter)	108/83	UNKNOWN OWNER		8 NEWMARKET ROAD	DURHAM, NH 03824

Data accessed from the Durham, NH Vision Government Solutions website on February 6, 2024.

www.vhb.com

February 7, 2024

Ref: 52633.02

Re: NHDES Standard Dredge and Fill Wetlands Permit Application
Mill Pond Dam Removal, Oyster River, Durham, New Hampshire

Dear Property Owner:

On behalf of the Town of Durham, VHB is preparing a NH Department of Environmental Services' (NHDES) Standard Dredge and Fill Wetlands Permit application for the proposed removal of the Mill Pond Dam on the Oyster River in Durham, NH. The Town proposes to remove this dam due to safety concerns (it does not comply with current dam safety regulations) and to restore habitat for anadromous fish. Additional proposed work includes the active restoration of the Oyster River channel upstream of the dam, post-construction restoration planting, and invasive species management in the drained impoundment area. Erosion controls will be implemented, river flow will be temporarily diverted around the proposed work during construction to maintain flow, and all temporarily impacted areas will be restored post-construction. Refer to the attached *USGS Overview Map*.

More information about this project can be accessed through the Town's website at https://www.ci.durham.nh.us/publicworks/oyster-river-dam-mill-pond-current-information-and-feasibility-study.

In accordance with the procedure for submitting a Standard Dredge and Fill Wetlands Permit application to NHDES, you are receiving this notification in accordance with RSA 482-A:3(I)(e)(1) for the proposed project because your property abuts the proposed jurisdictional impact areas and associated easements or otherwise meets the definition of an "abutting property" specified in Env-Wt 102.04. A copy of the submitted application will be on file at the Town Hall Clerk's Office for public review. Please do not hesitate to contact me if you have questions at (603) 391-3900 or pwalker@vhb.com.

Sincerely,

Peter J. Walker
Principal, Environmental Services

cc: April Talon, PE, Town of Durham Engineer

Attachment: USGS Overview Map

2 Bedford Farms Drive
Suite 200
Bedford, New Hampshire 03110
P 603.391.3900
F 603.518.7495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Return Receipt (electronic) $
Certified Mail Restricted Delivery $
Adult Signature Required $
Adult Signature Restricted Delivery $
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City, State, ZIP+4
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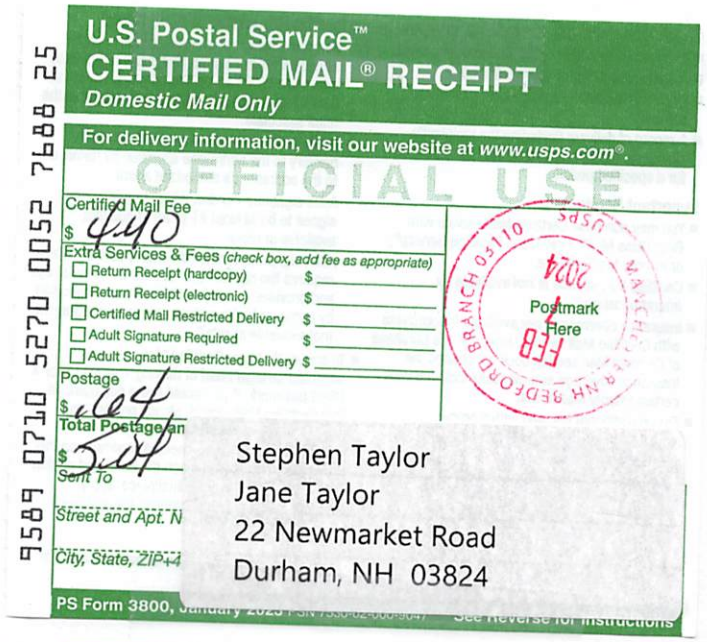
USPS MANCHESTER NH 03110 BEDFORD BRANCH
FEB 1 2024
Postmark Here
Christopher J Gowland
Daphne S Gowland
28 Newmarket Road
Durham, NH 03824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Extra Services & Fees (check box, add fee as appropriate)
Return Receipt (hardcopy) $
Return Receipt (electronic) $
Certified Mail Restricted Delivery $
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FEB 1 2024
Postmark Here
Stephen Taylor
Jane Taylor
22 Newmarket Road
Durham, NH 03824


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Street and Apt. No
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FEB 1 2024
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Stephen Taylor
Jane Taylor
20 Newmarket Road
Durham, NH 03824


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Extra Services & Fees (check box, add fee as appropriate)
Return Receipt (hardcopy) $
Return Receipt (electronic) $
Certified Mail Restricted Delivery $
Adult Signature Required $
Adult Signature Restricted Delivery $
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Total Postage and
$ 5.04
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9589 0710 5270 0052 7688 01
MANCHESTER NH 03110 BEDFORD BRANCH USPS
FEB 1 2024
Postmark Here
Janosz Family Rev Trust
23 Durham Point Road
Durham, NH 03824


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Extra Services & Fees (check box, add fee as appropriate)
Return Receipt (hardcopy) $
Return Receipt (electronic) $
Certified Mail Restricted Delivery $
Adult Signature Required $
Adult Signature Restricted Delivery $
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PS Form 3800,
9589 0710 5270 0052 7687 95
MANCHESTER NH 03110 BEDFORD BRANCH USPS
FEB 1 2024
Postmark Here
Susanna Nichols
613 Silvermine Road
New Canaan, CT 06840

Oyster River Dam Removal at Mill Pond
Durham, NH

Re: NHDES Standard Dredge and Fill Wetlands Permit Application
Abutter Permission per Env-Wt 307.13(d) – Tax Map 108, Lot 88

Per NH Administrative Rule Env-Wt 307.13(d), this letter is to provide written agreement for work resulting in wetland impacts proposed within 10 feet of my property. I understand that this work is associated with the proposed dam removal and active channel restoration components of the Oyster River Dam Removal at Mill Pond Project. I also understand that the project will be conducted in accordance with the plans submitted to the NH Department of Environmental Services (NHDES) as part of the wetlands permit application, and that NHDES may impose permit conditions intended to prevent impacts to my property.

Thomas G Janosz

Property Owner Signature

11/28/23

Date

Janosz Family Revocable Trust
23 Durham Point Road, Durham, NH 03824

WETLANDS RULE WAIVER OR DWELLING OVER WATER WAIVER REQUEST FORM

WATER DIVISION/LAND RESOURCES MANAGEMENT WETLANDS BUREAU

RSA/Rule: RSA 482-A/ Env-Wt 204

Administrative Use Only	Administrative Use Only	Administrative Use Only	File No.:
			Check No.:
			Amount:
			Initials:

A person may request a waiver to requirements in Rules Env-Wt 100-900 to accommodate situations where strict adherence to the requirements would not be in the best interests of the public or the environment. A person may also request a waiver of standard for existing dwellings over water pursuant to RSA 482-A:26, III (b).

SECTION 1 - PROJECT LOCATION INFORMATION (Env-Wt 204.03(c))			
ADDRESS: South of Mill Pond Road	TOWN/CITY: Durham	STATE: NH	ZIP CODE: 03824
TAX MAP/LOT NUMBER: Various			
SECTION 2 - WAIVER REQUESTOR INFORMATION (Env-Wt 204.03(a))			
LAST NAME, FIRST NAME, M.I.: Reine, Richard (Town of Durham Public Works Director)			
MAILING ADDRESS: 100 Stone Quarry Drive			
TOWN/CITY: Durham		STATE: NH	ZIP CODE: 03824
EMAIL ADDRESS (if available): rreine@ci.durham.nh.us or if not FAX NUMBER:		DAYTIME TELEPHONE NUMBER: 603-868-5578	
SECTION 3 - APPLICANT INFORMATION (Env-Wt 204.03(b)) If request is being made on behalf of someone else, include the following information regarding the person being represented. If requestor is the applicant, check the following box and proceed to Section 4. ☒ Requestor is the applicant.			
LAST NAME, FIRST NAME, M.I.:			
MAILING ADDRESS:			
TOWN/CITY:		STATE:	ZIP CODE:
EMAIL ADDRESS (if available): or if not FAX NUMBER:		DAYTIME PHONE NUMBER:	

SECTION 4 - WAIVER INFORMATION

SECTION 4A - WAIVER TO RULE Env-Wt 100-900

☐ N/A - If you are not requesting a rule waiver, check this box and proceed to Section 4b

Provide the number of the specific section of each rule for which a waiver is sought (Env-Wt 204.03(d)):
Env-Wt 307.13(d) - property line setbacks, 10-foot abutter written consent

Provide a complete explanation of why a waiver is being requested, including an explanation of the operational and economic consequences of complying with the requirement and, if the requested waiver would extend the duration of a permit, the reason(s) why the permit holder was not able to complete the project within the specified time (Env-Wt 204.03(f)(1)):

There are three abutting properties where jurisdictional impacts are proposed within 10 feet of the property lines (Tax Map 108, Lots 86 [Stephen & Jane Taylor], 88 [Janosz Family Trust], 89 [Susanna Nichols]). We have received one signature from the Janosz property but not the Taylor or Nichols properties. Extensive and continuing outreach to those two abutting landowners is underway. We believe the proposed restoration and planting plan (once executed) should help alleviate their concerns. Despite the level of effort the Town and VHB have extended to coordinate with these property owners and adjust the project design to reach a compromise, we have been unsuccessful in obtaining their signatures.

The proposed dam removal and associated active channel restoration, integrated vegetation management, and restoration plantings will occur within the limits of the drained impoundment and not directly impact the adjacent properties, nor affect the ability of those property owners to use their land. The appearance of the adjacent area will change as Mill Pond will be drained and the Oyster River channel will be restored. The Site will transition to a more natural state that will yield environmental benefits. The Site post-construction is expected to revegetate quickly with the proposed native seed mixes and woody plantings to provide species texture, height, and color/hue diversity within the landscape.

If applicable, provide a complete explanation of the alternative that is proposed to be substituted for the requirement in Env-Wt, including written documentation or data, or both, to support the alternative (Env-Wt 204.03(g)):

No adverse affects to the adjacent properties will result from this project, so we request this waiver to allow the project to proceed in the absence of those property owner signatures.

SECTION 4B – DWELLING OVER WATERS WAIVER UNDER RSA 482-A:26, III(b).

☐ N/A - If you are not requesting a standard waiver, check this box and proceed to Section 5)

Identify the specific standard to which a waiver is being requested (Env-Wt 204.03(e)):
RSA 482-A: Not applicable.

Provide a complete explanation of why a waiver is being requested, including a complete explanation of how the statutory criteria of RSA 482-A:26, III(b) will be met (Env-Wt 204.03(f)(2)):

Not applicable.

SECTION 5 - ADDITIONAL WAIVER INFORMATION (Env-Wt 204.03(h); Env-Wt 204.03(i))
(applicable to Waivers of Rules *and* Standards under RSA 482-A:26, III(b))

Indicate whether the waiver is needed for a limited duration and, if so, an estimate of when the waiver will no longer be needed (Env-Wt 204.03(h)):

The waiver is requested permanently, not for a limited duration.

Provide a complete explanation of why the applicant believes that having the waiver granted will meet the criteria in Env-Wt 204.05 or 204.06, as applicable (Env-Wt 204.03(i)):

Granting of this waiver would not result in an adverse impact on the environment or natural resources of the state. This project will yield numerous environmental benefits and will occur only upon receipt of required approvals (i.e., from NHDES and USACE) and in close coordination with all relevant agencies (i.e., NOAA, NHF&G, and NHB). No statutory requirement would need to be waived to accommodate this request.

Town Council (Sept 2021) and public referendum (March 2022) demonstrated overwhelming support (74% of Durham voters supported removing the dam). The Town will continue to work in good faith with the Taylors and Nichols property owners in an attempt to address their concerns. Compliance with Env-Wt 307.13(d) would not result in a meaningful change in the proposed design or jurisdictional impacts.

SECTION 6 - REQUIRED CERTIFICATIONS (Env-Wt 204.04)	
Initial each box and sign below to certify:	
Initials: RR	The information provided is true, complete, and not misleading to the knowledge and belief of the signer.
Initials: RR	The signer understands that: • Any waiver granted based on false, incomplete, or misleading information shall be subject to revocation; and • He or she is subject to the penalties for falsification in official matters, currently established in RSA 641.

SECTION 7 - REQUESTOR SIGNATURE (Env-Wt 204.04)		
SIGNATURE (APPLICANT): *	PRINT NAME LEGIBLY: Town of Durham/Rich Reine	DATE: 2.5.24
SIGNATURE (REQUESTOR):	PRINT NAME LEGIBLY:	DATE:

*In lieu of an applicant signature, you may include a separate signed and dated authorization for the requestor to act on the person's behalf in connection with the request.

Appendix C: Natural Resource Agency Meeting Notes

Meeting Notes

Date:	June 15, 2023	**Notes Taken By:**	Paige Cochrane, VHB
Place:	Teams	**Re:**	Sediment Quality and Management Initial Review Mill Pond Dam Removal
Project No.:	52633.00		Oyster River, Durham, New Hampshire

ATTENDEES:
VHB: Peter Walker, VHB; Dave Cloutier, VHB; Rene Nahlik, VHB; Paige Cochrane, VHB
NHDES: Thomas William, NHDES; Pauline Crocker, NHDES; Kevin Lucey, NHDES; Salley Soule, NHDES; Judith Houston, NHDES; James Tilley, NHDES; Karen Craver, NHDES; James O'Rourke, NHDES; Kelly Thrippleton-Hunter, NHDES; Kristin Duclos, NHDES
Town of Durham: April Talon; Richard Reine

The Town of Durham, VHB, and representatives of the NH Department of Environmental Services (NHDES) met to discuss the removal of the Mill Pond Dam from the Oyster River in Durham. Specifically, this meeting focused on sediment quality results, the conceptual design for an active channel restoration, and potential sediment management options for the Project. Following introductions, the group discussed the following items:

VHB Presentation

› **Dam Removal Project Background – Pete Walker, VHB**

- Pete provided an overview of the Project location, the tidal influence downstream, a description of the dam, and the process leading up to the Town's decision to remove the dam. Pete referred attendees to two studies of the project, including a November 2020 Feasibility Study and a July 2021 Supplemental Analysis. Additional information, including a full log of all project related materials and public comments is available on the Town's website using the link previously provided to participants.
- The town and VHB are currently advancing the engineering design, and expect to complete a 50% design this summer. Permit applications are expected late summer or early fall, and the Town hopes to advertise for construction in January 2024, for a summer 2024 construction start.

› **Sediment Quality Assessment – Rene Nahlik, VHB**

- VHB has completed a screening level assessment to determine potential impacts for ecological receptors as well as human health screening to assess potential sediment reuse scenarios.
- Supplemental sediment sampling conducted to support the Feasibility Study was based on environmental due diligence as well as a review of previous sediment studies (i.e., 2009 VHB Study and UNH 2019 study); this information was used to inform proposed samples locations and analytical parameters.
- Results of a conservative, screening-level ecological and human health assessment suggest the sediments in Mill Pond and vicinity are impacted by relatively low-levels of certain chemical constituents (PAHs and metals). Applying ecological risk criteria, VHB determined that there is moderate to high risk of PAHs and metals (i.e., arsenic) to ecological receptors in sediments throughout the Study Area (i.e., upstream and downstream).

\

- For the human health screening, results indicate that only two PAHs were detected in two sediment samples in excess of the NHDES SRS and arsenic was detected in samples throughout the Study Area (i.e., upstream and downstream). Concentrations of arsenic in sediment were attributed to naturally-occurring conditions and concentrations of PAHs were consistent with typical urban/suburban environments.
- In general, the sample results are similar across the study area (upstream, pond, downstream).

› **Active Channel Restoration – Dave Cloutier, VHB**

- The proposed design incorporates active channel restoration, which involves removing deposits of soft sediment most likely to be mobilized within Mill Pond, and using a stream simulation design approach to construct a stable stream channel through the pond with grade control features to prevent further degradation of the channel bed.
- Approximately 4,500 cubic yards (cy) of sediment from the impoundment will require removal to support this design.
- A sediment transport analysis was conducted during VHB's Feasibility Study to assess a passive sediment transport scenario which found that sediment would mobilize downstream, presenting potential impacts to navigation and natural resources downstream. Based on this, VHB recommends an active channel restoration, including development of a new channel plan and profile based on natural channel design principals and stabilization using bioengineering techniques.

Discussion and Questions

› **Judy Houston**: What was the topic of the previous meeting with NHDES and what type of permits, such as from the US Army Corps of Engineers, would be required?

- **P. Walker**: Previous meetings with NHDES discussed outside agency review and permit requirements. A state-wide Army Corps General Permit would applicable to this project.
- **Bill Thomas**: Agrees that Lindsey Lefebvre from the US Army Corps has been involved and a General Permit should be applicable to this project.

› **Kevin Lucey**: Have the sediment analytical results been compared to any type of background data?

- **Rene Nahlik**: VHB attempted to find data via the NHDES Environmental Monitoring Database; however, no nearby sediment samples were identified that were analyzed for the contaminants of concern for our study (e.g., metals, PAHs).

› **Kevin Lucey**: Does the active channel design include a bankfull bench and a stabilized toe?

- **Dave Cloutier**: Yes, both the bankfull bench and stablished toe have been included in the stream restoration design as well as a floodplain shelf.
- **Kevin Lucey**: Agrees with the project's approach for active channel restoration. As a separate note, although the active channel will decrease over sediment transport, sediment transport is still expected to occur.
- **Dave Cloutier**: Confirms that sediment from unreachable areas (i.e., middle and upper impoundments in Hamel Brook) will still be transported downstream after construction as a natural river process. It should be noted that the sediment transport model included in the Feasibility Study only assessed sediment transport in a passive scenario, and volumes of sediment transported from these upstream reaches will be smaller with active channel restoration

scenario. The elevated grade control at the upstream limit of the active channel restoration will serve to prevent channel degradation upstream and manage sediment transport volumes.

› **James O'Rourke**: What are the potential reuse options being considered for the 4,500 cy of sediment being removed as part of the project?

- **Peter Walker**: Different reuse scenarios are being actively considered by the team. For example, the town is considering ways to improve recreational resources at the adjacent Mill Pond Park. One reuse option is to improve the park along Mill Road by filling/expanding along the shoreline. Another option is that fill will be needed to construct an access roadway during construction phases of the project and excess sediment can be used for this. If the entire 4,500 cy were re-used on site, it would fill the entire lobe of Mill Pond between Mill Pond Park, Mill Pond Road, and the active channel restoration limit of work.

› **Peter Walker**: From a sediment quality perspective, are there any concerns from NHDES to reuse sediment generated as part of the project as a park or a temporary roadway?

- **Kristen Duclos**: To use excess sediment to permanently expand the upland would be considered fill for the purpose of making land, which is discouraged. The project would not likely continue to qualify as a restoration project if filling were to occur. Any sediment used for a temporary construction road would be expected to be removed. If water were drained from the Mill Pond area as a result of dam removal and naturally create an upland, that may be acceptable.
- **Bill Thomas**: Agrees that filling would be difficult for a restoration project. This filling would change the square-footage impacts of the project and may affect the applicability of the US Army Corps General Permit. Getting permits for these sediment reuse scenarios would be difficult. Bill referenced difficulties with the recent Sawyer Mill Dam Project.
- **Peter Walker**: On site sediment/soil reuse is often the preferred method for managing many projects types, which is why the team considered reuse options, but we recognize the concerns expressed today.
- **Kevin Lucey**: There are approve techniques to better prepare tidal wetlands for sea level rise that could be considered. A project example was referenced were sediments with S-2 exceedances were proposed for reuse. These sediments were proposed to be reused on property owned by the person generating the sediment, a cap was needed to limit exposure to S-2 sediments, and an Activity and Use Restriction (AUR) would need to be recorded on the property in perpetuity. For this project example, sediments were ultimately disposed off-site to avoid recording an AUR.

› **Peter Walker**: The team is looking to advance the design in preparation for the next steps in the regulatory process. Does the group have any feedback that can be reflected in the plan for the permit application?

- **James Tilley**: If an Army Corps General Permit is applicable, an individual Water Quality Certification may not be required. However, the anti-degradation requirements still apply for the General Permit. This is to ensure that there is not an increase in contaminants in the water column exceeding the surface water quality standards during dredging. Mr. Tilley explained that there may be a need to request a Mixing Zone per NHDES Env-Wq 1707. Mr. Tilley will get back to VHB on how requirements of the anti-degradation policy may apply to this project.
- **Peter Walker:** Dredging for this project will be conducted behind coffer dams and will limit turbidity. If any elevated turbidity levels is generated, it will temporary, likely during transitions between coffer dams. VHB has been successful

at maintaining low turbidity levels during these types of projects. Additionally, VHB's Feasibility Study determined that this project would have an overall net benefit for water quality.

In closing, Pete and Bill explained that they are collaborating to arrange a larger meeting with all resource agencies, likely in July. Participants in today's meeting will be invited. In the meantime, any comments or concerns related to the project can be directed to Pete by email or phone.

Meeting Notes

Date:	7/12/2023	Notes Taken By:	VHB
Place:	NHDES Pease Field Office,222 International Drive, Suite 175, Portsmouth, NH 03801	Re:	Natural Resource Agency Coordination Meeting Mill Pond Dam Removal, Durham, NH
Project No.:	52633.00		

NHDES ATTENDEES: William Thomas, Kevin Lucey, Pauline Crocker, James Tilley, Jamie O'Rourke, Aden Barry, Sally Soule, David Price, Kristin Duclos, Karen Craver (online), Jonathan Petali (online)
NHF&G ATTENDEES: Conor O'Donnell, Kevin Sullivan, and Mike Dionne
USACE ATTENDEES: Lindsey Lefebvre and Stephanie Morrison
US EPA ATTENDEES: Jean Brochi
NOAA ATTENDEES: Eric Hutchins and Brian Kelder
OTHER ATTENDEES: Allen Orsi
VHB ATTENDEES: Peter Walker, Dave Cloutier, Nicole Martin, and Savia Berlucchi.

Meeting Intent

To review the proposed dam removal, focusing on natural resource, water quality, sediment management, and regulatory issues. The Town and consulting team presented project background, current design, and the expected process to advance the project to dam removal during the 2024 construction season.

Key Project Documents

The following information was provided to all meeting participants prior to the meeting:

- November 2020 Feasibility Study: oyster_river_dam_at_mill_pond_feasibility_study_-_final.pdf (durham.nh.us)
- July 2021 Supplemental Analysis: oyster_river_dam_at_mill_pond_-_supplemental_analysis_final.pdf (durham.nh.us)
- Town of Durham Current Information (Including Detailed Public Information Log): Oyster River Dam at Mill Pond Current Information and Feasibility Study | The Town of Durham New Hampshire

Initial Presentation Notes

› **Background Information:** The dam is located at the head of tide. It impounds the main stem of Oyster River and Hamel Brook to the south. It is eligible for listing in the National Register of Historic Places and located within a historic district. Built in 1913, the dam is experiencing significant structural deterioration, specifically on the ribs supporting the spillway. The dam also only passes about 352 cfs, which is about one-tenth of what it should convey to meet modern dam safety standards. Mill Pond is a shallow aquatic bed and emergent system that functions more as a wetland than a pond. The former river thalweg can be seen in the center of the impoundment on aerial imagery. VHB published a Feasibility Study in November 2020 to review alternatives and published a Supplemental Analysis in July 2021. A Town Council meeting occurred on June 26, 2023. Although there has been a significant public debate about the fate of the dam, no members of the public spoke in opposition to the proposed dam removal at that meeting.

- **Anticipated Schedule:** September 2023 is the current target for a Standard Dredge and Fill Wetlands Permit Application submittal. The Section 106 consultation is currently active, with a number of consulting parties. VHB is actively engaged in final engineering design, with the expectation that the project will be advertised for bids in the early 2024, so that construction could occur during low flow season in 2024.

- **Proposed Design Details:** Active channel restoration will occur upstream of the dam, with VHB applying the principles of natural channel design and using bioengineering techniques. The design includes the removal of up to approximately 4,500 cubic yards (CY) of sediment and the installation of simulated streambed material (consisting of a cobble/gravel mixture) to stabilize the restored area. This will be focused on restoring the river channel in the location and dimensions that VHB believes existed prior to the dam. The rest of the impoundment will be stabilized by vegetation. The design follows the natural sinuosity of the river within the current impoundment and minimizes changes to the existing bathymetry. VHB is proposing to stabilize the channel bed with a cobble/gravel mixture, which is larger and less mobile than the existing silty sediment within the pond. Coir logs and erosion control matting will be placed along the banks. Root wads will be placed along the channel banks, which help to dissipate the energy and velocity of the stream flow to prevent erosion and can also provide a shelter habitat for fish. To create different habitat zones within the channel, deeper pools, feature boulder clusters, and two stone riffle crest controls will be incorporated. Abutting riparian and floodplain areas will be created to foster a healthy river system and accommodate floodplain flows. There will be wetlands restoration and invasive species management within the remainder of the drained impoundment. During low tide, this river reach will be free flowing. The tidal influence on river depths and velocities will only be evident during high tide. Kevin Lucey raised concern about the downstream elevation of the active channel restoration, which raises the bed elevation at the downstream extent of the active channel, which would mute the tidal signal. Dave Cloutier responded by explaining that the design ties in at existing grades above the NH 108 bridge. The design would fill a scour hole just below the dam but otherwise lowers the overall grade at and above the dam.

- **Proposed Construction Approach:** The design intent is for the project to be constructed in the dry behind a cofferdam with water diversion in multiple (tentatively four) phases working east to west. The final (fifth) phase would be restoring the temporary access off Mill Pond Road prior to commencing the wetlands restoration and invasive species management. Site access would be from Newmarket Road (NH 108) to the east and Mill Pond Road to the north through the shallowest part of the impoundment. The Mill Pond Road temporary access would need to be constructed with timber mats, geogrids, or other reinforcement over the soft sediment of the impoundment. This second access is necessary since Newmarket Road is heavily travelled and offers little space for equipment. VHB is developing a framework/design approach, but the plans will leave flexibility for the contractor to prepare a river diversion and water management plan for review rather than being prescriptive.

Discussion

- **Riffle Crest Control Justification:** There was discussion regarding the existing bedrock and the feasibility of tying into that as opposed to the proposed stone riffle crests. Although the middle riffle crest may or may not be needed, the proposed riffle crests are intended to provide more of a horizontal control as opposed to vertical within the "S" curve of the channel between meanders. The purpose is to focus flow back into the channel center to prevent bank

erosion. The proposed channel grade will be slightly higher than the shallowest outcrop of bedrock. The existing channel elevation of approximately zero immediately below the dam is the result of scour from flow over the spillway and does not represent the natural channel elevation. The intent of the proposed design is to maintain the existing channel elevation and gradient between Newmarket Road and the dam (at approximately 1.3 feet) while minimizing the amount of proposed sediment removal. There are multiple bedrock outcrops downstream of the dam with occurrences at and above the surface. It was recommended that the bedrock profile downstream of the dam be included in the Wetlands Permit Application.

- **Sediment management:** Reuse of the excavated sediment is not likely given the increase in wetland impacts and the fact that the sediments have some contamination (primarily with arsenic and some PAHs). Depending on the cost, the plan is to remove all dredged sediment from the site. Each phase of the project will be constructed behind a cofferdam to prevent/reduce sediment transport downstream during construction. The type of cofferdam to be used will be up to the discretion of the selected contractor, but will likely be silt sacks, sheet piling, or inflatable porta-dams. Another purpose of the proposed stone riffle crests is to maintain the grade above them and minimize the amount of sediment that will be mobilized from the upstream reach (including Hamel Brook). Grade controls are not proposed in Hamel Brook as that is beyond the proposed limits of work. As such, the proposed erosion and sediment control measures will be confined to the project footprint. It was acknowledged that sediment transport with a natural river system is a natural process. The goal with this project is to prevent a sudden major sediment release due to removal of the dam.

- **Draw down:** There was discussion regarding the potential for a gradual release of water from the impoundment prior to construction to allow the sediment to settle (and dry out) and reduce the quantity of downstream transport. This approach was recommended over the alternative of keeping the impoundment fully wet until the contractor is ready to start. Although it is possible to draw down the impoundment (as was done for past dam inspections), the Town is concerned about the aesthetics and public opposition to the slow yearlong draining of the pond. Kevin Sullivan (NHF&G) noted that the fish ladder would not be functioning during that slow draw down time. So if that slow draw down approach were pursued, it would need to begin after July 1 and any flume diversion of the river would need to begin after August 1; diverting flow through the existing dam gate before August 1 would be acceptable if it allows open-channel flow (not a low-level gate). The goal would be to preserve an open flowing channel through the impoundment and dam gate for downstream fish passage. Once the dewatering has begun, it would likely not be practical to allow the impoundment to refill for fish ladder season. It was agreed that early drawdown should be considered in beginning July 1, 2024 in consultation with NHF&G as a pre-construction mobilization.

- **Dam Removal Sequencing:** Eric Hutchins (NOAA) asked whether the dam should be removed entirely at the beginning of construction (to make working in the dry behind cofferdams more feasible). He suggested that leaving some portion of the dam in place until active channel restoration is complete may help protect against a major sediment release in the event of a large storm during construction. Eric stressed that, based on his project experience, retaining the dam (even partially) could help prevent the site from being washed out, especially during rain events that could overwhelm the cofferdams. VHB will consider the suggestion and attempt to incorporate this measure into the plan set, but would like to allow the contractor to finalize the construction means and methods.

- **Water Bypass:** A flume pipe or a water bypass channel located outside of the channel restoration footprint could be used to divert flows during construction. It was noted that any additional sediment excavation that would be required to install a bypass channel was not included in the current calculation for the project at the time of this presentation (4,500 CY). Given the numerous unanticipated variables that may arise during construction, the goal with this design is to provide the selected contractor with a framework to dewatering and bypass (to show that the project can be constructed without water quality impacts) but to leave room for the contractor's expertise without later needing permit amendments.

- **Fish passage:** NHF&G recommended that if work is being done early in the season in July, there may need to be a water diversion channel to maintain a downstream zone of fish passage as opposed to a water bypass pipe since it is uncertain if fish would use the pipe. VHB noted that the contractor will need to start in July to allow enough time to complete the project in one construction season.

- **Adaptive Management:** NHF&G and NOAA suggested that the project there could require two years of adaptive management following dam removal to ensure that the post-construction conditions are conducive to fish passage. In NHF&G's experience, the two-year timeframe has worked for other projects.

- **Water Quality Generalization:** Eric Hutchins (NOAA) commented that a project of this scale cannot constructed without a water quality impact to some extent; however, the net benefit of the proposed dam removal would outweigh some temporary water quality impacts, which will be mitigated through a variety of construction BMPs. Pete Walker (VHB) indicated that the Town may apply for a mixing zone; it was noted that any downstream monitoring location would be subject to tidal action.

- **Abutters:** Currently, no work on private property is anticipated, although there is some ongoing coordination with the abutters to clarify parcel boundaries. All proposed earth-moving activities will be contained within the limits of the existing impoundment, and only potential temporary construction access would occur outside of that. Dave Price (NHDES Wetlands Bureau) indicated that written permission will be required from the abutters to any proposed permanent and temporary jurisdictional impacts within 10 feet of abutting parcel boundaries, per the NHDES Administrative Rules.

- **Duration of Temporary Access:** It is anticipated that the temporary access matting from Mill Pond Road would only be in place for one season,[1] roughly from July to October of 2024. Per the NHDES Administrative Rules, if the temporary access is used for a second season, it could be considered a permanent impact and mitigation might be necessary. However, because this is a minimum impact restoration project, mitigation should not be required. The permit application will need to say how these temporary impacts would be restored and monitored after construction. Pete Walker (VHB) indicated that, given the project purpose is solely to restore the Oyster River and given that the project is fully funded by NHDES, NOAA, and USFWS, VHB would argue that the project is fully self-mitigating, regardless of the duration of the temporary impact.

[1] The USACE General Permit (NAE-2022-00849) defines the growing season as May 1 to October 1.

- **Stormwater Outfalls:** BMPs will need to be implemented to prevent erosion between the four bordering stormwater outfalls along Mill Pond Road that currently discharge to the dam pond impoundment. Kevin Lucey (NHDES) suggested that there should be openings into the river channel along the bank to allow the remainder of the drained impoundment/wetlands to drain into the river within forming erosion gullies. Any riprap used for this project would be at the stormwater outfall outlets, there would not be long riprap swales to the river nor any riprap along the riverbanks (although the current design does propose some river stone along the banks). Furthermore, the Town has future BMP plans to meet MS4 requirements (perhaps a raingarden or bioretention unit). Kevin Lucey also mentioned Lower Peverly dam removal as an example where flow channels through the floodplain areas were stabilized in part with core logs.

- **Tidal Conditions:** Post-construction, it is expected that the king tide will reach up to the limit of the existing Mill Pond impounded area. The daily high tide (MHHW) will extend approximately 500 feet upstream of the existing dam location.

- **Permit Details:** Dave Price (NHDES) requested that VHB should include turbidity monitoring as part of the wetlands permit application. Dave also pointed out that the Natural Heritage Bureau and NHF&G should be consulted regarding T&E species prior to submitting the application. VHB is actively working on this and will likely visit the NHB office soon to coordinate with them. Dave also suggested that the plans submitted with the permit application should be 100% complete, not 50% as stated during the meeting. Pete Walker (VHB) explained that standard practice is to provide a permitting plan set early enough in the project development to clearly identify the jurisdictional impacts, but to allow for revisions resulting from NHDES comments if needed.

- **Smelt Spawning Habitat:** NHF&G and NOAA mentioned that the project footprint could be a potential smelt spawning habitat. VHB requested any plan details that NHF&G and NOAA might want incorporated to improve smelt spawning habitat. NHF&G advised that a well-defined channel with a low slope would be suitable. A low slope, defined channel, and hard bottom with cobble/gravel substrate is preferred for smelt habitat.

- **Mill Pond Park Enhancements:** During the Town Council meeting on June 26, 2023, potential enhancements to Mill Pond Park were proposed, including a boardwalk to the river. This is currently in the planning phase. NHDES recommended that the potential boardwalk be a separate project from the dam removal and that VHB should coordinate with NHDES early in the process.

- **Post-Construction Monitoring and Adaptive Management:** The details of the proposed post-construction monitoring are still being developed but will likely include some monumented cross sections that can be monitored for stability. The Town would rely on NHF&G for fish monitoring, as has been the case for other dam removals on the NH seacoast. An adaptive management/monitoring plan will be included in the wetlands permit application.

- **Additional Project Coordination:** Given the complexity of this project, a follow-up virtual meeting may be warranted in advance of the wetlands permit application submission.

Meeting Notes

Date:	9/25/2023	Notes Taken By:	VHB
Place:	Virtual, Microsoft Teams 10:30 AM – 12:00 PM	Re:	Second Natural Resource Agency Coordination Meeting Mill Pond Dam Removal, Durham, NH
Project No.:	52633.00		

NHDES ATTENDEES: Bill Thomas, Kevin Lucey, Polly Crocker, James O'Rourke, Sally Soule, Dave Price, Darlene Forst, MaryAnn Tilton, Kristin Duclos, Karen Craver, and Jonathan Petali
NHF&G ATTENDEES: Conor O'Donnell, Kevin Sullivan, and Mike Dionne
NOAA ATTENDEES: Brian Kelder
USFWS ATTENDEES: Jaime Masterson
TOWN ATTENDES: April Talon and Rich Reine
PARE CORP ATTENDEES: Allen Orsi
UNH ATTENDEES: Tom Ballestero and Joel Ballestero
VHB ATTENDEES: Peter Walker, Dave Cloutier, Rene Nahlik, Barbara Beblowski, Paige Cochrane, and Nicole Martin

Meeting Intent

An initial Natural Resource Agency Coordination Meeting (or pre-application meeting) was held on July 12, 2023. This meeting was a follow-up to provide additional details and design updates, as well as to obtain any outstanding comments or concerns from the attendees. Note that action items are underlined throughout these notes.

Presentation and Embedded Discussion Notes

- **July 12 Meeting Review:** Following introductions, Pete Walker briefly reviewed the main topics and questions discussed at the July 12 meeting, highlighting items from the final meeting notes which had been distributed by Bill Thomas prior to the meeting. The final notes reflected edits based on comments from NHDES staff submitted to VHB by Bill.
- **Brief Overview of Project Updates:** The Section 106 consultation is well underway. Progress has been made to coordinate with three abutters (Susanna Nichols, Tom Janosz, and Stephen and Jane Taylor). The design proposes impacts within 10 ft of these properties, so VHB and the Town intend to request written permission as required by wetlands rules. VHB has refined the proposed design because of comments heard at the July 12th meeting as well as a detailed peer review by Tom and Joel Ballestero, and design refinements are continuing. VHB and the Town still hope to submit the wetlands permit application in October 2023 and for construction to commence in the summer/fall of 2024.
- **Potential New Falls:** The Durham Historic District Commission (HDC) requested that a new falls feature be constructed at the location of the existing dam, since they believe there had been a natural bedrock falls in that location prior to the initial dam construction. This feature would consist of a stone riffle crest that would likely create falls during low tide. NDHES and NHF&G commented that even if this feature were inundated at high tide, it would still block upstream fish passage at other points during the tide cycle. Anything that restricts tidal influence (even at lower tides) may prevent species such as rainbow smelt from spawning at the freshwater-saltwater interface.

Consequently, this feature would not be ecologically beneficial. VHB will send the Durham HDC letter to NOAA (Brian Kelder) and NHF&G (Kevin Sullivan), per their request.

This prompted discussion of the proposed riffle crest at the western extent of the proposed active channel restoration, stemming from the concern of creating another dam-like feature farther upstream. Since the Oyster River has a natural average slope of about 0.4%, the selected elevation of the riffle crest is in line with the natural Oyster River slope. The riffle crest is proposed to be flush with the channel elevation (with only the tops of the boulders exposed) and will provide stabilization and erosion protection without impeding fish passage. Refer to the Active Channel Restoration section of these notes below for more information.

- **Sediment Quality:** Rene Nahlik reviewed information on the sediment quality assessment prepared for the 2020 Feasibility Study. This included a review of the NHDES OneStop environmental database, VHB's 2009 sediment sampling results (12 samples that were sent for laboratory analysis of polychlorinated biphenyls [PCBs], pesticides, metals, polycyclic aromatic hydrocarbons [PAHs], and volatile organic compounds), and the results of a 2019 UNH student sediment sampling study (which found that mercury levels were elevated at depths of 8" or greater). The study also included a 2020 supplemental sampling effort involved the collection of six additional sediment samples for laboratory analysis of PCBs, pesticides, metals, and PAHs; consistent with the 2009 data, elevated levels of PAHs and metals were reported in the 2020 results. A conservative, screening-level ecological risk assessment was conducted using the full data set (2009 and 2020 data) in general accordance with NHDES guidance. The findings from the risk assessment suggested that the levels of certain metals and PAHs in the sediment samples have the potential to impact ecological receptors. Relative to human health risk, the sediment data were also compared to the NHDES S-1 soil standards (residential standards). Despite arsenic being above S-1, the concentrations and distribution are still consistent with State background levels. The identified PAHs are within the typical levels of urban/suburban environments (not indicative of an unregulated, point source release) and are unlikely to pose a human health risk. Overall, sample results are similar across the study area (upstream, Mill Pond, and downstream).
    - As a general comment that was directed to NHDES staff, the contaminant exceedances for this project are thought to be higher than for other dam projects that NHDES has considered. This presents a regulatory question on how to handle these sediments, especially considering downstream tidal features (such as oyster beds and/or navigational channels).
    - The RSA 482-A:1 statute purpose was referenced to ensure we considered potential effects to finfish, shellfish, etc. It is important to consider if the dam removal will disperse sediments farther downstream. It was noted that the ecological assessment did consider both freshwater and marine screening criteria.
    - Attendees questioned whether the current extent of sediment sampling is sufficient, or if additional samples are warranted upstream, downstream, and along College Brook. Peter Walker (VHB) clarified that VHB exceeded the number of sediment samples required by the NHDES guidelines. VHB also submitted the sampling plan to NHDES for review prior to conducting that work and received no comments. It was noted that there is additional 2020 UNH student data that we will track down. VHB will also look at more data in the NHDES Environmental Monitoring Database (EMD) as well.
- **Sediment Transport:** The purpose of the sediment transport model in the 2020 Feasibility Study was to determine the quantity of sediment to be transported downstream under a worst-case scenario (dam removal only, not including active channel restoration). This analysis broke the Oyster River into different sections, including Mill Pond,

the Middle Impoundment (between Mill Pond and Hamel Brook), Hamel Brook, and the Mainstem of the river up to the Oyster River Reservoir Dam.

- **Feasibility Study Analysis** (excludes active channel restoration): The results for a year 1/single event immediate post-dam removal showed that approximately 700 cubic yards (CY) of sediment from Mill Pond would mobilize downstream (approximately 3,000 CY total including all river sections). This number increases to approximately 2,400 CY of sediment from Mill Pond under the 50-year/extended simulation scenario (approximately 10,000 CY total including all river sections). Consequently, the difference between the initial flush of sediment over a 50-year scenario equates to approximately 200 CY per year. *It should be emphasized that sediment transport is a natural river function. It can be reduced but not eliminated, and elimination (if feasible) would not be ecologically advantageous, as sediment transport improves the health of downstream salt marshes.*
- **Active Channel Restoration**: The current design proposes to remove approximately 4,500 CY of loose vulnerable sediment (greater than the net volume of sediments that could be moved out of Mill Pond in 50 years per the Feasibility Study analysis). A riffle crest grade control is proposed approximately 650 feet upstream of the existing dam and will be consistent with 0.4% overall river slope. The grade control will minimize head cutting of sediment mounds upstream from the Middle Impoundment, reducing the amount of sediment that could be mobilized and move downstream. There is also a deep scour hole (about 10 feet deep) upstream of the proposed riffle crest where some of the sediments will be deposited to further minimize the volume that will move downstream.
- This design is trying to reach a balance point between all the different variables, including fish passage, natural downstream sediment transport, natural water flow, etc. In summary, the current design proposes to remove the most concerning sediments (based on quality and quantity) and construct an upstream riffle crest to prevent an upstream headcut, since it was determined that bedrock would not be a sufficient grade control. This approach is similar to the approved plans for the Homestead Dam (Ashuelot River), a well as the Great Dam (Exeter River) and Sawyer Mill (Belamy River).

Post-Presentation Discussion Notes

- **Invasive Species Management:** The exposed sediments within the drained impoundment will be seeded immediately following drawdown. VHB is actively developing an Integrated Vegetation Management Plan in collaboration with others (i.e., Doug Cygan from the NH Dept of Ag, Tom Lee from UNH, and Ellen Snyder from Ibis Wildlife Consulting) for inclusion in the wetlands permit application that will be targeted towards invasive species management. The exposed sediments will transform into a softer more natural looking environment over time as they revegetate.
- **Abutters:** Public outreach has been extensive to date and is ongoing regarding this project with a series of public meetings and abundance of information available online. Letters will also be sent to the abutters regarding the project schedule and timing as we get closer to construction.
- **Hamel Brook**: Kevin Lucey reported that he had recently paddled the impoundment. He noted that the streambed seems to contain a lot of sediment, and it was difficult to tell where the channel is. It will be interesting to see what plant community will establish in that area post-dam removal.

- **Riffle Crest**: Additional concerns were raised regarding the proposed riffle crest, as listed below. VHB will further review the proposed location for the riffle crest to make sure the design minimizes the risks, and address the design basis clearly in the wetlands permit application. VHB will consider whether it is appropriate to move the riffle crest upstream to the Middle Impoundment or locate a second grade control in that reach.
    - Whether the proposed riffle crest would be sufficient to hold the upstream riverbed in place;
    - Whether the riffle crest would restrict tidal flows;
        - Although the dam is currently at the head of tide, the salt water is very diluted at that spot. The modelling shows that although the water level will rise to the high tide mark, there's still consistent flow from upstream so that the brackish water will only extend approximately a few hundred feet upstream of the current dam location.
    - Whether the proposed riffle crest would detain/hold the upstream water surface elevation into the Middle Impoundment area; and
    - If additional riffle crest grade controls should be constructed within the Middle Impoundment.
- **Application Timeline/Mitigation Meeting**: Concern was expressed about receiving a complete application in fall 2023. Consequently, a follow-up meeting was requested. A pre-application mitigation meeting is needed with the federal and state partners to confirm/determine whether mitigation would be needed for this project. Mr. Walker (VHB) explained that previous dam removals have been classified as minimum impact projects and were considered to be self-mitigating. Those projects also had similar questions and concerns that have been raised for this project (i.e., sediment transport, contamination, etc.). Pete mentioned that Lindsey Lefebvre (USACE) indicated at a Section 106 meeting on 9/18 that she anticipates that this project will qualify under a NH General Permit.

Meeting Notes

Date:	11/06/2023	Notes Taken By:	VHB
Place:	Hybrid, Microsoft Teams & NHDES Pease Office 10:00 AM – 12:00 PM	Re:	Agency Coordination Meeting – Sediment Management Mill Pond Dam Removal, Durham, NH
Project No.:	52633.00		

NHDES ATTENDEES: Bill Thomas, Kevin Lucey, Polly Crocker, David Price, Kristin Duclos, Jonathan Petali, and Aidan Barry.
NOAA ATTENDEES: Brian Kelder
NHF&G ATTENDEES: Mike Dionne
TOWN ATTENDES: April Talon and Rich Reine
VHB ATTENDEES: Peter Walker, Dave Cloutier, Rene Nahlik, and Nicole Martin.

Meeting Intent

To discuss VHB's review of downstream NHDES Environmental Monitoring Database (EMD) sediment quality data and review management options.

Presentation and Embedded Discussion Notes

Downstream Sediment Quality Assessment Update (presented by Rene Nahlik)

- VHB queried the NHDES EMD as requested at the second Natural Resource Agency Coordination Meeting on September 25, 2023, and found 10 EMD stations downstream of the Oyster River Dam at Mill Pond. VHB reviewed all samples available from the EMD that contained sediment chemical data within the stretch of the Oyster River between the dam and outlet to Little Bay. These EMD samples are associated with the National Coastal Assessment (NCA) Northeast Database for 2000-2006. The NCA is a national monitoring and assessment program with a goal of providing consistent evaluation of estuarine conditions. These samples were analyzed for 77 chemical constituents and physical/chemical parameters.
- The EMD downstream data was compared with the Feasibility Study dataset. The detection limits were generally lower for the EMD samples than the Feasibility Study samples. It is also worth noting that the sampling methods differed between the Feasibility Study (which used minimally disruptive core samples) and the EMD (which used a clam shell sampler that is more disruptive to the sediments and can release/lose the fine-grained material during sampling).
- Consistent with NHDES guidance, the sediment sample analytical results were compared to NHDES recommended threshold effect concentrations (TECs) and probable effect concentrations (PECs) to evaluate whether the sediment quality may pose a risk to aquatic and benthic organisms.
    - TECs represent the estimated chemical concentration threshold below which adverse effects on ecological receptors are unlikely; and
    - PECs represent the estimated chemical concentration threshold above which adverse effects on ecological receptors are likely.
- TEC and PEC thresholds for both fresh water and marine sediments were considered in this analysis since the environment downstream of the dam is tidally influenced.

- Hazard quotients (ratios) were calculated using each of the screening levels (sample concentration/SL). Depending on the value of the HQs, each sample was assigned a 'rating' of low, moderate, or high risk to ecological receptors.
- Based on the screening-level ecological risk assessment, the sediments in the downstream reach of the river have the potential to adversely impact ecological receptors (primarily 'moderate' risk). Arsenic was the only constituent that exceeded human health screening levels in the downstream EMD dataset; this is generally consistent with findings from the Feasibility Study and appears to be attributable to a natural, regional background condition.
- A graphical review of the combined datasets indicated several inorganic constituents (e.g., arsenic and lead) are present at concentrations similar to, or greater than, those in the previous study area, and certain contaminants (e.g., PAHs and mercury) are present at slightly lower concentrations in the downstream reach of the Oyster River compared to the Feasibility Study data.
- Review of grain size and total organic content (TOC) data for both datasets indicate that finer grained material, with higher TOC is generally present upstream (i.e., in the pond) and courser grained material with lower TOC is generally present downstream. This tracks with the general distribution of the more hydrophobic contaminants (i.e., PAHs/mercury concentrations slightly higher in the pond and slightly lower in the downstream reach), as the physical/chemical characteristics influence the ability of the sediments to bind these types of chemicals.
- Rene Nahlik noted that, overall, the EMD data is not significantly different than the Feasibility Study data; in her professional experience, the types and levels of contaminants in this reach of the river (and study area in general) are typical of urban/suburban environments like this one.
- Peter Walker added that the high ecological risk sediments are concentrated within the Mill Pond impoundment, and we are proposing to remove much of that sediment (~4,500 cubic yards [CY]) via the active channel restoration.
- Kevin Lucey expressed concern regarding downstream sediment transport of contaminants to oyster farms. David Price concurred and wants to get Chris Nash (from NHDES) involved with this project given his experience with shellfish. It must be demonstrated somehow in the permit application that there will not be adverse impacts to downstream oyster beds or other organisms. VHB and the Town believe that the current design minimizes the risks of downstream impacts (especially with the proposed sediment excavation associated with the active channel restoration). Since it is not possible to fully eliminate this risk, we are open to further input and suggestions from NHDES and others on how best to proceed. The Town and VHB are available to participate in a follow up meeting with Chris Nash, Kevin Lucey, David Price, and Jonathan Petali to further investigate this topic.
- Jonathan Petali acknowledged that the presentation was helpful to understand the background of what the downstream conditions are and that these were conservative screening levels. He suggested it may be useful to verify the basis for the screening levels used in the ecological risk assessment (sometimes these levels are based on either freshwater or marine studies).

Sediment Management (presented by Dave Cloutier and Peter Walker)

- Peter Walker indicated that a project goal is to reduce the risk of sediment transport while still removing the dam.
- The highest risk sediments will be excavated from Mill Pond during the active channel restoration for off-site disposal and the upstream riffle crest/grade control structure will prevent further head cutting of the channel bed farther upstream and outside of the proposed limits of work.
- Potential sediment management alternatives include a free release/passive restoration (dam removal and nothing else), active channel restoration (proposed, as previously noted), full impoundment dredging, and full impoundment stabilization (both of which would increase wetland impacts).

- There is a benefit to restoring natural sediment transport for downstream salt marsh health (as noted by Tom Ballestero in previous meetings).
- With the active channel restoration sediment removal, ~10,000 CY of sediment that could be mobilized downstream (as noted in the Feasibility Study) was be reduced to ~5,000 CY of sediment due to the active channel restoration. Additionally, about ~1,300 CY of that sediment will likely settle in a scour hole in Mill Pond just upstream of the proposed active channel restoration. Consequently, ~4,000 CY of sediment is the final amount that is expected to be transported downstream over time. This equates to ~80 CY of material annually over a 50-year period. This 50-year simulation helps account for the average (includes both wet and dry years), which mimics a natural river system in this area, as river flows (and corresponding sediment transport volumes) fluctuate significantly from year to year.

- **College Brook and Scour Hole:** The scour hole near the College Brook confluence with Mill Pond is the result of turbulent water flows entering the impoundment. In this case, turbulence is created when concentrated flows through a highly constricted area (such as the Oyster River channel upstream of Mill Pond) expand into a wide area of deeper water (such as Mill Pond). It was also discussed that College Brook isn't impounded or influenced by the existing dam, which is why it wasn't included in the Feasibility Study. That study focused on the impounded areas where the water surface elevation is affected by the dam.

- **Grade Control:** Active channel restoration is proposed within the deepest soft sediment deposits to remove this vulnerable sediment. From the Newmarket Road bridge to the upstream limits of the impoundment, the average channel slope is between 0.1% and 0.4%, which is relatively flat. A grade control structure/riffle crest is proposed at the upper limits of the project to lock in the channel bed elevation (preventing channel degradation below that elevation) and prevent a large-scale mass wasting of material upstream from the Middle Impoundment. Although it will reduce the amount of sediment transport from the Middle Impoundment by retaining more sediment behind it, this is a secondary benefit rather than main design intent of this structure; the primary intent of this structure is to establish the upstream channel elevation to prevent excessive head cutting.
    - Additional grade controls farther upstream into the Middle Impoundment are not proposed due to the relatively flat channel slope, as it only makes sense to install these structures where there is a significant elevation drop along the channel. More grade controls would require expanding the currently proposed construction footprint and costs by a factor of roughly seven. We also don't want to raise the elevation of these structures above the natural channel grade as that could create a barrier to fish passage.
    - Another consideration is that the Middle Impoundment is abutted by private properties which would necessitate temporary construction access up the river channel for about a mile. Furthermore, any contributing contamination coming into the project area from minor tributaries, stormwater outfalls, or precipitation would not be eliminated as part of this project. No modelling has been completed at this time to determine the potential effect of additional upstream grade controls given the level of effort associated with this task and the high likelihood that the results would indicate only a marginal benefit over the proposed design. VHB is confident in the current estimate of ~4,000 CY of sediment transport over 50 years (or ~80 CY of sediment transport estimated per year).

- **Existing Sediment Transport:** April Talon inquired about the amount of sediment that is currently being transported downstream with the dam in place. Dave Cloutier noted that downstream sediment transport currently occurs mainly

during large flow events with several feet of water flowing over the dam. With the dam removed, we would see sediment transport with smaller rain/flow events as well.

- **Sediment Contamination:** Kevin Lucey stated that he assumes that all sediment within the impoundment is high risk based on the current data presented (in terms of sediment contamination) and that more bioassays should not be necessary. He doesn't fully understand VHB's explanation of what may move downstream. The turbulent conditions in the current scour hole may continue to mobilize contaminated fine sediments while allowing the larger particles to settle.

  It is currently uncertain how the contaminated sediment will affect contaminants in the water column. Jonathan Petali inquired about the modeling potential to determine what quantity/concentration may reach the downstream oyster beds (if the highest concentration sediments move downstream and get diluted in the estuary waters) compared to the existing conditions.

  It is currently unclear what the sediment transport impact may be downstream, and it is difficult to determine this since the sediment contamination will not stay in the same quantity/concentration as it moves downstream. Furthermore, the sediment particles downstream are larger/coarser than those within the project area and less able to bind many of the contaminants (such as PAHs). The proposed sediment removal associated with the active channel restoration is a form a remediation, but we cannot eliminate all risks.

- **Timeline:** Peter Walker stated that by continuing to wait to submit the wetlands permit application, we are at risk of delaying the project by a full year given the anticipated back and forth with the agencies during the permit review process. The advertising date could be pushed out to April 2024 (assuming we have permits in hand by then, since contractors would be unlikely to bid on this project without permits given its complexity). He noted that a project schedule was submitted with the NOAA grant and other grant applications that assumed a 2024 removal.

- **Public Input:** VHB is actively coordinating with three abutters along Newmarket Road where impacts are proposed within ten feet of their properties (Taylors, Janosz, and Nichols). Two of the owners seem amenable to signing the authorization letter, while coordination with Ms. Nichols is still ongoing. Additionally, the Section 106 process for this project had many consulting parties. Pete noted that this group includes many parties who had actively opposed the dam removal, but now appear to be engaged in helping to identify mitigation for the project.

Meeting Notes

Date:	12/07/2023	Notes Taken By:	VHB
Place:	Virtual, Microsoft Teams 10:30 AM – 11:30 PM	Re:	NHDES Mitigation Pre-Application Meeting Mill Pond Dam Removal, Durham, NH
Project No.:	52633.00		

NHDES ATTENDEES: Bill Thomas, Kevin Lucey, Dave Price, MaryAnn Tilton, Seta Detzel, Eben Lewis, Kristin Duclos
USACE ATTENDEES: Lindsey Lefebvre
NOAA ATTENDEES: Brian Kelder
EPA ATTENDEES: Jean Brochi
TOWN ATTENDES: April Talon
VHB ATTENDEES: Peter Walker, Dave Cloutier, and Nicole Martin

Meeting Intent

This was a follow up meeting to the previous Natural Resource Agency Coordination Meetings (or pre-application meetings) held on July 12, September 25, and November 6, 2023. This meeting includes NHDES Wetlands Bureau mitigation program staff, with the goal of determining whether this project triggers mitigation.

Presentation and Embedded Discussion Notes

- Peter Walker (VHB) described the project background and proposed impacts. For brevity in these notes, please refer to the previously provided meeting notes for the past pre-application meetings for project details.
    - Wetlands Bureau Jurisdiction: Approximately 1.57 acres of permanent wetland impact are proposed within the Mill Pond impoundment to restore the upstream Oyster River channel and stabilize the outlets of existing stormwater outfalls. Approximately 0.45 acres of temporary wetland impact is proposed within the Mill Pond impoundment for construction access to the river channel through the drained impoundment and construction staging areas. Finally, approximately 0.07 acres of impact within the developed tidal buffer zone is proposed.
    - Shoreland Jurisdiction: Approximately 0.01 acres of permanent impact and approximately 0.37 acres of temporary impact are proposed within the Protected Shoreland (i.e., Waterfront and Natural Woodland Buffers) for construction staging areas outside of the Mill Pond impoundment.
- The Town recognizes that the proposed permanent impacts are large, however, the purpose of the impacts are to restore the Oyster River.
- In accordance with Env-Wt 313.04(b)(4 & 5), this is a restoration/enhancement project that should be exempt from mitigation.

Post-Presentation Discussion Notes

- **Sediment:** For a brief overview of sediment transport and quality, the model used during the Feasibility Study phase predicted about 10,000 cubic yards (CY) of transport over a 50-year period with no active channel restoration. We currently propose to remove approximately 4,500 CY of fine particle size material that would otherwise be mobilized.

An agency meeting held on November 6, 2023 included a detailed presentation regarding sediment quality and transport considerations for this project.

- **Temporary Access:** The temporary access through the drained impoundment should only be in place for one construction season (not to exceed one growing season or overlap two growing seasons). Construction would occur during a low flow period, with drawdown/construction commencement likely to occur in early July and construction completion by November/late fall.

- **Public Hearing:** MaryAnn Tilton (NHDES) inquired about a public hearing. The project will result in a large amount of stream impact as well as some impact to tidal buffer zone and riverbed. Pete explained that numerous public meetings have been held during the previous study phase, including regular updates with the Durham Town Council. The dam removal was approved through a town wide referendum. There is no current plan for any formal public hearing.

- **Construction Sequencing:** Construction will begin with a drawdown of the impoundment using the existing dam gates, and construction of temporary access roads to the work area, followed by a partial dam breach. The initial partial dam removal is intended to reduce the risk of a uncontrolled sediment release downstream if there is a large flood event during construction. A cofferdam will then be installed at the upstream limits of proposed work and Oyster River flow will be diverted around the construction area. The method of water diversion may be a flume pipe or a lined bypass channel at the discretion of the selected contractor. A cofferdam will also be installed at the downstream limits of proposed work to keep high tide waters out of the construction area. The approximately 4,500 CY of sediment will be removed and the upstream river channel and all associated elements (i.e., riffle create/stone cross-vane) will be constructed. Whether or not the construction is broken in multiple phases between the two cofferdams or will occur all at once will be up to the discretion of the selected contractor based on dewatering and construction feasibility. Once the active channel construction is complete, the dam will be fully removed, the water bypass will be removed, and the flow would be allowed to enter the constructed channel. Lastly, the temporary impacts would be restored (i.e., removal of temporary access and site stabilization/seeding).

- **Tidal Influence:** The project area is only influenced by the tide under high tide conditions up to the dam. The high tide line would extend up to the upstream work limits through the restored reach at elevation 3.6 feet. The water elevation within the project area would move up and down based on the tidal conditions but the water would be freshwater or only slightly brackish since the project area is located around the head of tide.

- **Flow Scenarios:** The "50-year" flow design storm is relevant to dam safety, but the hydraulic section of the Feasibility Study includes a number of different river flow scenarios including low flow and various flood magnitudes. There is also a detailed sediment transport analysis the Feasibility Study that evaluates multiple single-event and multi-year sediment transport scenarios, including a 50-year quasi-unsteady model of long-term sediment transport. It should be clarified that the 50-year (duration) sediment scenario and 50-year (magnitude) single flood scenario are separate and unrelated.

- **Project Classification:** Seta Detzel (NHDES) noted that this project may qualify as a stream restoration project and, if it is classified as a minimum impact project, would meet the mitigation exemption. A final decision on this would

occur during the wetlands permit application technical review, ensuring that the restoration goals would be achievable by the proposed design. Ms. Detzel mentioned that NHDES has seen projects that proposed log vanes, etc. that have later required hard armoring so would like to avoid that outcome.

- **Outfall Stabilization:** Ms. Detzel advised that the outfall stabilization component should be reviewed carefully. Since Mill Pond/the Oyster River within the project area is a Priority Resource Area, a look into the rules may be warranted to ensure that work is part of the restoration mitigation exemption. If this work is an add on to another infrastructure project, those impacts might be reviewed differently and require mitigation. Dave Cloutier replied that the outlet stabilization was added to the project plan following a comment from NHDES staff that expressed concerns about post-removal erosion at these areas.

- **Shellfish Coordination:** Dave Price (NHDES) noted that they must ensure the protection of shellfish and finfish under RSA 482-A. Although NHDES staff have already initiated coordination with Chris Nash, Mr. Price requested that additional coordination be conducted. Mr. Walker will be in touch with Mr. Price and Bill Thomas (NHDES) soon regarding next steps relative to shellfish/finfish coordination.

- **Functional Assessment:** Despite the minimum impact project classification, all components of a standard wetlands permit application should be included (i.e., functional assessment and NHDES Attachment A Form) given the size and complexity of this project. A functional assessment in accordance with the US Army Corps of Engineers Highway Methodology will be completed and included in the final wetlands permit application. This assessment will document the existing conditions so we can compare those functions and values to the post-construction functions and values.

- **Additional Coordination:** Mr. Walker stressed that maintaining the 2024 construction season is important to the Town. Mr. Walker will coordinate with Mr. Price and Mr. Thomas further to discuss next steps and determine if additional meetings are needed to address agency concerns prior to submitting the wetlands permit application.

Appendix D: Representative Site Photographs

Representative Site Photographs
Oyster River Dam Removal at Mill Pond - Durham, NH

Photo 1: View west of the Oyster River Dam taken from Newmarket Road. *Date uncertain.*

Photo 2: View southwest of the dam with the fish ladder in the foreground. 07/12/2023.

Photo 3: View northwest of the fish ladder and the Town-owned parcel to the right. 05/05/2023.

Photo 4: View southeast of the upstream side of the Newmarket Road bridge over the Oyster River. 05/05/2023.

Photo 5: View west of the dam and surrounding area during a drawdown. 09/22/2008.

Photo 6: Closeup view west of the mill remnants and southern dam abutment. 09/22/2008.

Photo 7: Representative view south of the western portion of Mill Pond, taken from near Mill Pond Park. 07/12/2023.

Photo 8: Representative view northeast of Mill Pond taken from Mill Pond Park. Note the prevalence of algae and floating vascular plants covering the water surface. 07/12/2023.

Photo 9: View east of Mill Pond taken from Mill Pond Park. Note the Newmarket Road bridge in the background (red arrow). 07/12/2023.

Photo 10: View east of Mill Pond during a drawdown, taken from near Mill Pond Park. Note the Newmarket Road bridge in the background (red arrow). 11/18/2009.

Photo 11: View southeast of Mill Pond, taken from Mill Pond Park facing the Oyster River channel location within the impoundment. 07/12/2023.

Photo 12: View east of the Oyster River within the drained Mill Pond impoundment during a drawdown. 11/18/2009.

Photo 13: View west of the downstream side of the Newmarket Road bridge over the Oyster River, taken from the pedestrian bridge. 07/12/2023.

Photo 14: View east of the tidally-influenced Oyster River outside of the proposed Project, taken from the pedestrian bridge. 07/12/2023.

Appendix E: Wetland Function-Value Evaluation Form

Wetland Function-Value Evaluation Form

Total area of wetland ~9.5 ac Human made? Impounded Is wetland part of a wildlife corridor? Yes or a "habitat island"? No

Adjacent land use Riverine, Residential, Roadways Distance to nearest roadway or other development Adjacent

Dominant wetland systems present Various, see plans (PUB, PAB) Contiguous undeveloped buffer zone present Partial (South)

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Low (Head of tide)

How many tributaries contribute to the wetland? Many Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Mill Pond

Latitude 43.13033 Longitude -70.92106

Prepared by: NM, LF Date 11/13/2023

Wetland Impact:
Type Dredge and Fill Area ~1.5 ac: see plans

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y X N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	Y	2, 7, 9, 15	X	The impounded pond provides opportunity for recharge/discharge. Some shallow bedrock near the dam. The dam constricts river outlet.
Floodflow Alteration	Y	1, 4, 5, 6, 7, 8, 9, 11, 13, 15, 16		The pond is associated with the Oyster River and water level is dam-controlled (reducing water retention potential and increasing upstream flood risk due to the impoundment).
Fish and Shellfish Habitat	Y	1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 15, 16	X	Existing dam is a barrier to upstream fish passage, which is mitigated with fish ladder.
Sediment/Toxicant Retention	Y	2, 3, 4, 5, 9, 10, 11, 12, 15	X	The slow moving ponded water allows suspended sediment/pollutants to settle.
Nutrient Removal	Y	1, 2, 3, 5, 6, 7, 9, 10, 12, 13, 14	X	Impounded water allows more time for vegetation to uptake excess nutrients.
Production Export	Y	1, 4, 6, 8, 9, 10		Consistent water flow through the site could facilitate nutrient export.
Sediment/Shoreline Stabilization	N			Specific to wetlands along stream banks; current site consists of impounded river flow comprising Mill Pond.
Wildlife Habitat	Y	2, 6, 9, 11, 15, 16, 19, 20, 21	X	Pond provides habitat for fish, reptiles, amphibians, and birds.
Recreation	Y	2, 5, 7, 8, 9, 10, 11, 12	X	Public access at Mill Pond Park and parking on Mill Pond Road. People are known to fish and paddle within Mill Pond.
Educational/Scientific Value	Y	1, 3, 5, 8, 9, 10, 12, 16		Some University of New Hampshire science professors host class field trips to Mill Pond and map plant populations.
Uniqueness/Heritage	Y	1, 3, 4, 5, 6, 8, 9, 12, 13, 14, 16, 17, 19, 21, 22, 23, 24, 27	X	Oyster River Dam impounds Mill Pond upstream through Hamel Brook. The impoundment and dam have become well-known features of the community.
Visual Quality/Aesthetics	Y	1, 2, 3, 6, 7, 8, 9, 12	X	There is good visibility and access to Mill Pond from the surrounding areas, especially from Mill Pond Road.
ES Endangered Species Habitat	Y	1		Numerous threatened and endangered plant and vertebrate species were identified on NHB23-2114. Consultation with NHB and NHF&G is ongoing.
Other				

Notes:

* Refer to backup list of numbered considerations.

Appendix F: Integrated Vegetation Management Plan

Oyster River Dam Removal at Mill Pond

Integrated Vegetation Management Plan

Durham, New Hampshire

PREPARED FOR

The Town of Durham
105 Main Street
Durham, NH 03824

PREPARED BY

2 Bedford Farms Drive, Suite 200
Bedford, NH 03110
603.391.3900

February 2024

Table of Contents

Attachments

1

Introduction

1.1 Project Overview

The Town of Durham proposes to remove the Oyster River Dam at Mill Pond due to concerns regarding its structural integrity and stability and in an effort to improve habitat. Additional proposed work includes the restoration of the Oyster River channel upstream of the dam and invasive species management in the drained impoundment area. All work will be contained within the following Town-owned parcels and the limits of the existing impoundment: Tax Map 108, Lot 87 and 90.

The Oyster River Dam is located at the head of tide and impounds the main stem of the Oyster River approximately 0.8 miles upstream of the dam, forming the 9.5-acre "Mill Pond." Mill Pond is a shallow aquatic bed and emergent system in which water quality has declined and sediment has accumulated, converting much of the former open water area to aquatic bed and emergent wetland.

1.2 Purpose and Need

The proposed dam removal will drain the Mill Pond impoundment and expose currently flooded lands. These areas will initially have no vegetation and will resemble mud flat habitats, but vegetation is expected to grow quickly on this bare ground. These mudflats typically become fully vegetated within the first growing season. However, invasive species are often "pioneer species"— those that tend to quickly colonize disturbed or bare soils.

To prevent colonization of these areas by invasive plant species, we have developed this Integrated Vegetation Management Plan (IVM) in collaboration with Ellen Snyder (Ibis Wildlife Consulting), Dr. Tom Lee (UNH Emeritus Professor), and Doug Cygan (NH Department of Agriculture Invasive Species Coordinator), with the goal of limiting the spread of invasive species and allowing natural vegetation to establish. We acknowledge that eradication of invasive species would be impractical; therefore, the goal of this plan is to manage and control the invasive plant populations with ongoing monitoring and maintenance requirements.

2

Invasive Plant Species

An invasive plant species is one that is not native to the region and is likely to cause harm to the environment, economy, or human health. Invasive plants have several traits that allow them to spread quickly and become widespread: lack of natural predators in their new environment, high production of fruits or seeds, rapid growth rates, and tolerance of a range of conditions. Invasive plants can change how natural systems look and function, suppress native plant regeneration, change availability of insects for nesting songbirds, harbor higher densities of ticks that transmit Lyme disease, and choke freshwater wetlands, affecting habitat for wildlife and other aquatic organisms.

The economic and environmental impacts of invasive plants are so great that many states, including New Hampshire, maintain a list of "prohibited" plant species that are "illegal to collect, transport, sell, distribute, propagate, or transplant." The New Hampshire Department of Agriculture, Markets and Food oversees the State's efforts to monitor, manage, and control invasive plants. Mr. Cygan is active in educating the general public, conservation commissions, municipal and state highway departments, and others about invasive plants.

2.1 Town of Durham Invasive Plant Efforts

For several years, the Town of Durham has worked on invasive plant control on several conservation areas, including Doe Farm, Milne Nature Sanctuary, Mill Pond Park, Oyster River Forest, Thompson Forest, and Wagon Hill Farm North (Snyder, 2020). These efforts have been implemented with the help of Town staff, volunteers, interns, contractors, and local, state, and federal partners. The goal for much of this work is to reduce the density of invasive plants and recover a healthier native plant community.

In 2019, the Town of Durham initiated a pilot project with Mr. Cygan to treat invasive Japanese knotweed behind the Town Hall and along Mill Pond Road, as well as other invasive plants in the focus area, including glossy buckthorn, oriental bittersweet, burning bush, multiflora rose, bush honeysuckle, Autumn olive, privet, and Japanese barberry.

This first year of treatment included cutting the knotweed to the ground in June, which was completed by Durham's Land Stewardship Coordinator and two UNH summer interns. Although time-intensive, this

resulted in less vegetative growth that needed follow-up herbicide treatment in the Fall (after the flowering period). In September 2019, Mr. Cygan used a low volume foliar spray herbicide application on invasive plants covering about one acre along the northern limits of Mill Pond roughly between Town Hall and Milne Nature Sanctuary.

The same methods were replicated in 2020. Given the effective treatments in 2019, the density of knotweed was considerably less and thus much less effort and herbicide were needed in 2020. In both years, a selection of other invasive shrubs along the north shore of Mill Pond were also treated. The goal is not to treat everything in one year, to lessen the visual impact of many dead stems and to allow for a slow transition to more native vegetation (such as arrowwood viburnum, silky dogwood, speckled alder, red maple, red oak, and other species that grow there).

The Town of Durham also owns and manages the one-acre Milne Nature Sanctuary, which borders Mill Pond and College Brook. The Milnes donated this land to the town as a wildlife sanctuary and the Trustees have recommended that no herbicides be used on this parcel. Beginning in 2017, a small committee was formed to guide stewardship of this parcel, including management of invasive plants. The Milne Trust funded the removal of several dozen invasive Norway maple trees by Orion Tree Service. The Land Stewardship Coordinator has organized volunteers, students, and interns each year to hand lop, pull, and dig invasive plants. This was augmented with the planting of native shrubs and herbaceous plants to restore a native plant community to the sanctuary.

In 2018, the Town received the donation of the 5-acre property on south side of Mill Pond, called The Meadows. No invasive species management has occurred yet on this property, but this offers an opportunity to manage invasive plants more effectively on the south side of Mill Pond.

2.2 Invasive Species at Mill Pond

The previous studies and discussions around the Mill Pond Dam offer an opportunity to continue and expand on the invasive plant control efforts that the Town has initiated along the north shore of Mill Pond and along College Brook. With the planned removal of the dam, control of invasive plants is an important part of the restoration of native plant communities in and around this ecologically significant waterway in the heart of Durham.

In May 2021, the invasive species management team met at Mill Pond Park to discuss the options for invasive plant control as part of the Mill Pond decision-making, as well as the potential for invasive plants to spread into areas that were previously inundated when the dam is removed.

Glossy buckthorn (*Frangula alnus*) is currently abundant around Mill Pond, on islands within the pond and upstream, and along the shores of the Oyster River, College Brook, and Hamel Brook. Buckthorn is aggressive in colonizing canopy openings, does well under a white pine canopy and along the fringes of water bodies; it is less productive under a dense canopy of hardwood trees. Buckthorn spreads solely by seed dispersal, not vegetatively (Godwin, 1943). Given its dense population around the banks, there is a likelihood of a concentration of seeds in the sediment of the river, brook, and pond bottom. In upland soils, glossy buckthorn seeds can survive in a dormant state for at least three years until conditions are right for germination (Godwin, 1943). These seeds are not salt tolerant, so pose no threat to existing downstream tidal areas, nor brackish habitats that are expected to form once the dam is removed. However, it is unknown how long seeds can survive in sediment under water, where lack of oxygen may limit survival.

It may be useful to determine the viability of buckthorn seeds in the existing sediment. There are at least two methods to investigate this issue. One is to take substrate samples and simulate post dam removal conditions to determine germination potentials. Another is to drop the existing surface water elevation of the pond to expose a fringe that could then be studied/monitored for germination potential. The latter method would yield a more representative result but could have other impacts and issues. For example, abutting landowners would likely be opposed to the poor aesthetics of the partially drained pond.

The removal of the dam and subsequent water drawdown could lead to the spread of buckthorn (and other invasive plants). As much as 6.5 acres of fertile, moist former pond and stream bed would offer habitat for buckthorn seeds that drop from parent plants along the shore. Additionally, if dormant seeds in the sediment are still viable, they could germinate following drawdown. Buckthorn seeds will continue to be dispersed by birds and mammals, before and after dam removal.

The risk posed by the potential spread of invasive species is difficult to predict, considering every ecosystem is different, and portions of the restored area will be exposed to periodic tidal flow while other areas will continue to retain their freshwater characteristics. However, freshwater areas will likely be the most susceptible to invasive plant establishment.

Preemptive steps can be taken to begin controlling the existing seed sources along the shorelines. This will decrease the quantity of new seed added to the environment each year. After drawdown, the fate of new buckthorn seedlings may depend on what other plant species establish on the newly exposed substrate. If there are few other plants, buckthorn could proliferate. But if native herbaceous plants establish quickly and form dense vegetation, buckthorn and other invasive plant species may be inhibited.

To minimize the threat of invasive species spread, and to aid in the restoration and protection of native plant diversity, we recommend an Integrated Vegetation Management (IVM) Program to manage the invasive species surrounding Mill Pond and upstream. This approach entails mechanical, cultural, and chemical methods over a 3- to 5-year period and includes actions before and after dam removal. This time span allows a transition period from invasive-dominated to native-dominated plant communities. It should be noted that there are currently no biological controls available for glossy buckthorn. The primary target is glossy buckthorn; however, other invasive species should be treated as well, including Japanese knotweed (*Reynoutria japonica*), oriental bittersweet (*Celastrus orbiculatus*), burning bush (*Euonymus alatus)*, multiflora rose (*Rosa multiflora*), bush honeysuckle (*Lonicera* sp.), Autumn olive (*Elaeagnus umbellata*), blunt-leaved privet (*Ligustrum obtusifolium*), European barberry, (B*erberis vulgaris*), Japanese barberry (*Berberis thunbergii*), purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*) Norway maple (*Acer platanoides*), and common buckthorn (*Rhamnus cathartica*). Although not on the NH state invasive species lists, yellow-flag iris (*Iris pseudacorus*) has been observed in the pond and is another species that Mr. Cygan recommended also be controlled. Refer to the **Invasive Species Fact Sheets** provided as **Attachment A**.

Complete eradication of invasive plants is not feasible. The goal of the IVM Program is to reduce the existing seed sources, limit the survival of new sprouts from the seed bank, and encourage the establishment of native grasses, sedges, wildflowers, vines, shrubs, and trees.

3

IVM Program Components

The information below lays out our plan for integrated vegetation management. Refer to the attached spreadsheet for a table version of this information with responsible parties and deadlines identified.

3.1 Prior to Dam Removal

Map Extent of Invasive Plant Populations and Assess Seed Viability

- Map the extent (and species) of invasive plants in the focus area, using EDDMapS[1] or another mapping tool. Request landowner permission to conduct field mapping of invasive plants on private property around the impoundment. There is potential to involve members of the public in identifying and submitting invasive species GIS points to EDDMapS. Refer to the annotated **Invasive Species Management Focus Areas Figure** provided as **Attachment B**. The focus areas are further defined in **Section 3.3** below of this IVMP.
- Map the extent (and species) of invasive plants in the focus areas via drone flight, focusing on target invasive species. Since the leaves of glossy buckthorn, oriental bittersweet, and other invasives turn yellow quickly in the fall, it is possible to identify them from aerial imagery.
- If time allows, conduct a seed viability study in pond and stream sediments, using either or both of following methods:
  - *Preferred Approach:* Collect sediment samples from the impounded substrate and see if glossy buckthorn germinates from it in a controlled lab setting. Since glossy buckthorn seeds require a cold period to germinate (about 8 weeks of <36 degrees Fahrenheit conditions), seed bank viability testing would need to be performed in a specialized lab facility where these conditions are replicated. It is possible this study can be a UNH student research project.

[1] https://www.eddmaps.org/

- *Less Likely Option:* Partially draw down the water level within the impoundment to expose sediment along the perimeter and observe what species naturally germinate. However, there could be public opposition to the poor aesthetics of the partially drained impoundment.

Continue and Expand Invasive Plant Control Efforts

- Continue the pilot project of herbicide treatment of Japanese knotweed and other invasive plant control along Mill Pond Road, along the east side of Mill Pond and below the road bridge over College Brook (abutting the Milne Sanctuary – but avoid herbicide application on the Milne Sanctuary). This is currently the preferred option for invasive species control, and the most cost-effective for the town-owned lands and the impoundment to minimize soil disturbance and realize some invasive plant reduction in advance of the dam removal.
- Once the impoundment is drawn down in advance of construction, herbicide application to the invasive species should occur along the banks and surrounding upland areas to remove the seed sources promptly. The preferred herbicide would be a glyphosate chemical mixture, applied by an authorized contractor/licensed herbicide applicator. According to a UNH study, 5-10% glyphosate may be effective to kill invasives, as opposed to the industry standard of 20-25%. The contractor would need a Watershed Special Permit for herbicide application within the focus areas post-dam removal (would not be an aquatic application once the impoundment is drained and dried). Oyster beds within the river downstream of the project area, as well as threatened and endangered plants in the impoundment, should be considered during herbicide application. Excess herbicide spray is minimal when applied by professionals.
- Any application of herbicide should be phased and coupled with public education about the program to manage and avoid concerns regarding impacts. The goal should be to promptly stop seed production in full and make the public aware of this in advance.
- Empower the Durham Land Stewardship Coordinator to engage volunteers and interns in the removal of dead invasive plants after herbicide has been applied. This will engage the public in the project, improve the aesthetics, and remove suitable perches for birds that often excrete invasive plant species seeds. However, engaging volunteers to hand pull invasive plant species over large areas is inefficient.
- Engage private landowners in the applicable focus areas to assist in reducing seed sources by pulling, digging, or smothering invasive plants via workshops.
    - Ensure that volunteers and landowners are aware of proper disposal or drying of viable plant parts by distributing a one-page fact sheet on proper treatment of common invasive plant species of the area, and potentially holding workshops to teach interested land-owners plant identification and different management techniques to implement on their land.
    - Target a reduction of the large seed-producing woody plants using mechanical methods, such as cut-and-smother using small, 1-gallon size black plastic bags (i.e., Buckthorn Baggies). The stems are cut about 6-8" off the ground and the black bags placed over the shoots and zip-tied at the base. The plants are tricked into suckering, which occurs inside the baggie, but the leaves don't get any sunlight, so the plants die. This will reduce the

quantity of plants that disperse seeds onto the pond as the water is drawn down. Private landowners may also be taught this technique.

3.2 Post Dam Removal (1-5) Years

The "Continue and Expand Invasive Plant Control Efforts" section detailed above is also applicable to the invasive species work 1-5 years post dam removal.

- Spread wetland seed mix on newly exposed sediment to suppress invasive plant growth.
  - Contractors could transplant cattail plugs into the drained impoundment area even before dam removal, but they should be planted in tandem with a New England Wetland Seed Mix (Wet Mix) to avoid cattail monoculture and promote ecological diversity.
  - Contractors will avoid planting woody/shrubby species within the drained impoundment, since these are not critical to the project's success, would be too much work to plant, and may seed-in naturally over time.
- During the first year, monitor for flush of invasive plant seedlings in the newly exposed sediments and hand pull as feasible. This will likely require visits once a month from late April to September by VHB or another monitoring party (six visits total).
- Continue to monitor for flush of invasive plant seedlings in years 2-5 and hand pull or cut as feasible. This will likely require three visits per year by VHB or another monitoring party (April/May, June/July, and August/September).
- Develop and implement a 5-year plan to control invasive plants in and around Mill Pond and upstream using a combination of techniques (i.e., pulling, digging, cutting, smothering, and herbicide) to reduce the density of invasive plants.
  - Shrubby invasive plants killed the previous year along the shoreline should be removed by contractors by mechanically clipping and removing the dead plant material to allow native vegetation to recolonize the space. Removal of all dead standing woody plants is essential to eliminate suitable perches for birds that often excrete invasive plant species seeds. Town volunteers could assist with this effort to increase public involvement with the project and improve aesthetics.
  - Apply cut-stem or low volume foliar spray herbicide to invasive plants in the focus areas. This should only be performed by contractors authorized for herbicide application.
  - A recent study by UNH provides guidance on percent solution of Glyphosate and Garlon that results in mortality of glossy buckthorn after one treatment using cut-stem (Glyphosate 5% solution) and surface application to the lower 1.5 feet of bark stem (Garlon 5% solution) (Lee, 2020).

Refer to the **IVMP Matrix** provided as **Attachment C** which organizes this information and assigns responsible parties and deadlines to each task.

3.3 Project Phasing and Focus Areas

The IVM Program can be divided into three focus areas, detailed below. Refer to the annotated **Invasive Species Management Focus Areas Figure** provided as **Attachment B**.

- **Focus Area 1:** Upland invasive species treatment around the Mill Pond impoundment (focusing on glossy buckthorn and Japanese knotweed). This area is approximately 3.5 acres, including portions of both the north side (approximately 2 acres) and south side (approximately 1.5 acres) of the existing Mill Pond impoundment.
- **Focus Area 2:** When the dam is removed, monitoring for the establishment of invasive species within the dewatered area focusing on glossy buckthorn, Japanese knotweed, and common reed and hand pull these species. Hand pulling knotweed and common reed may not be an option depending on the depth of their rhizomes and feasibility for extracting the rhizomes in their entirety. In that case, repeated cutting may be an option. No or limited herbicide treatment would be recommended in the dewatered wetland area. This area is about 6.5 acres (about 4 acres north and 2.5 acres south of the proposed restored Oyster River channel).
- **Focus Area 3:** Upland invasive species treatment around the Middle Reach and Hamel Brook impounded areas, focusing on glossy buckthorn and Japanese knotweed. Conservatively assuming this focus area extends about 100 feet from the existing impoundment on either side, this would be approximately 18 acres.

4

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Attachment A: Invasive Species Fact Sheets

Glossy buckthorn

Rhamnus frangula / Frangula alnus

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Glossy buckthorn** Latin Name: ***Rhamnus frangula / Frangula alnus***
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*) Native to: **Japan**


leaves (spring)


Glossy buckthorn invasion


Sapling (summer)


Flowers (spring)


Roadside invasion of saplings


Fleshy fruits (fall)


Gray bark w/ lenticels (Summer)


Emodin in berries - effects to birds


Fall foliage (Autumn)

Description: Deciduous shrub or small tree measuring 20' by 15'. **Bark:** Grayish to brown with raised lenticels. **Stems:** Cinnamon colored with light gray lenticels. **Leaves:** Alternate, simple and broadly ovate. **Flowers:** Inconspicuous, 4-petaled, greenish-yellow, mid-May. **Fruit:** Fleshy, 1/4" diameter turning black in the fall. **Zone:** 3-7. **Habitat:** Adapts to most conditions including pH, heavy shade to full sun. **Spread:** Seeds are bird dispersed. **Comments:** Highly Aggressive, fast growing, outcompetes native species. **Controls:** Remove seedlings and saplings by hand. Larger trees can be cut or plants can be treated with an herbicide.

General Considerations

Glossy buckthorn can either grow as a multi-stemmed shrub or single-stemmed tree up to 23' (7 m) tall. Leaves are deciduous, simple, and generally arranged alternately. Leaves are dark-green and glossy above while dull-green below. The leaf margins are smooth/entire and tend to be slightly wavy. Flowers are small, about ¼" and somewhat inconspicuous forming in May to June. They develop and in small clusters of 2-8. Fruits form in mid to late summer and contain 2-3 seeds per berry. In the fall the foliage turns a pale yellow and persists long after most native plants have dropped their foliage.

It is also an alternative host to alfalfa mosaic virus; and crown rust (*Puccinia coronata*) fungi that causes oat rust disease. It has also been linked as a host for the soybean aphid.

Glossy buckthorn is becoming more widespread throughout New Hampshire being spread mainly by frugivorous birds and small mammals. The greatest negative affect of both glossy and common buckthorns is their production anthroquinone, a metabolite occurring in the fruit, bark, and roots. Since berries are essentially the only portion of the plant utilized for food, wildlife foraging in the fall can be exposed to high doses of anthroquinone. Anthroquinone, once ingested, is metabolized into emodin, a laxative. Emodin can have paradoxical effects: in high doses it acts as a cathartic (resulting in moderate to severe diarrhea), whereas at low concentrations/doses it causes retention of stomach/gut contents, both of which cause nutritional deficiencies.

Glossy buckthorn is also one of the first species to invade a forested site where tree and shrub layers have been removed or altered allowing greater levels of light to penetrate to the forest floor. When wildlife that has been feeding on buckthorn fruits seek cover in natural woodland habitats they can create an immense seed bank that lays dormant awaiting for optimum conditions to allow the seeds to germinate. Once they sprout, they grow rapidly and outcompete the desirable forest species allowing it to becoming dominant. Fortunately, Glossy buckthorn seed germination rate is very high and most seeds (in the seed bank) will germinate the first year whereas the second year seedling establishment is significantly diminished.

Control Options

See the following control guides: Integrated Pest Management (IPM) for Woody Plants or the Control of Invasive Species by Numbers

Cutting mature Glossy buckthorn plants down without treating or removing the rooting system will not kill the plant, it will just promote extensive sucker sprouts to develop, which can make the plant stronger.

Glossy buckthorn Rhamnus frangula/Frangula alnus	
Plant Type	Shrub
Habitat Type	Forests, fields, roadsides, wetlands
USDA Hardiness Zone	3-7
Rooting Structure	Fibrous, shallow and extensive
Environmental Impacts	Contains levels of anthroquinone, which when ingested is metabolized into emodin, a laxative.
Wildlife Impacts	Nutritional deficiencies in birds and small mammals
Leaf arrangement	Alternate
NWI Ranking	FAC
Soil Type	
Soil pH Range	?
Light Requirements	Prefers partial to full sun, shade
Growing Season	
Growth Rate	2 to 4 feet (0.6-1.2 m) per year
Mature Height	10 ft. (3m)
Life Span	Moderate
Reproductive Age	2 years
Flowering Period	April-June
Flower Type	Dioecious
Pollination	Insects
Seed Set	July - August
Seed Per Plant	15,000 -54,000
Scarification Required	No
Cold Stratification	Yes
Seed Longevity	2-6 years
Seed Germination Rate	91%
Seedling Density	?
Other Propagules	Layering, suckering
Dispersal Vectors	Wildlife, water

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, http://www.eddmaps.org/ipane/ipanespecies/shrubs/frangula_alnus.htm

USDA Forest Service invasive species website: http://www.fs.fed.us/database/feis/plants/shrub/fraaln/all.html

Invasives.org: http://www.invasive.org/browse/subinfo.cfm?sub=5649&desc=17

Bugwood: http://wiki.bugwood.org/Frangula_alnus

Common buckthorn

Rhamnus cathartica

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Common buckthorn**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)

Latin Name: ***Rhamnus cathartica***
Native to: **Eurasia**


leaves (spring)


Common buckthorn invasion


Sapling (summer)


Flowers (spring)


Roadside invasion of saplings


Fleshy fruits (fall)


Tannish-gray bark w/ lenticels


Emodin in berries - effects to birds


Fall foliage (Autumn)

Description: Deciduous shrub or small tree measuring 20' by 15'. **Bark:** Grayish to brown with raised lenticels. **Stems:** Cinnamon colored with terminal spine. **Leaves:** Alternate, simple and broadly ovate with toothed margins. **Flowers:** Inconspicuous, 4-petaled, greenish-yellow, mid-June. **Fruit:** Fleshy, 1/4" diameter turning black in the fall. **Zone:** 3-7. **Habitat:** Adapts to most conditions including pH, heavy shade to full sun. **Spread:** Seeds are bird dispersed. **Comments:** Highly aggressive, fast growing, outcompetes native species. **Controls:** Remove seedlings and saplings by hand. Larger trees can be cut or plants can be treated with an herbicide.

General Considerations

Common buckthorn is a multi-stemmed shrub or occasionally a single-stemmed tree up to 25' (7.6 m) tall. Twigs are armed with terminal spines that can be a safety hazard. Leaves are deciduous, simple, and usually arranged sub-opposite, but examples of opposite and/or alternate arrangements do exist. Leaves are medium to dark green above and a lighter green below, oval, slightly serrate with 3 to 4 pairs of curving veins and a slightly curved tip. In the fall the foliage turns a pale yellow and persists long after most native plants have dropped their foliage.

Small umbels of small ¼" greenish yellow flowers develop from the axils of the leaves. Usually, the flowers are dioecious and less often perfect. Flowers occur from late spring to early summer and lasts about 2 weeks. Fertile female flowers are replaced by small drupes that ripen in August through September turning dark purple to black and each containing 3-4 seeds. The seeds are narrowly grooved. Seed dispersal is usually by birds. Small mammals are also a vector. Common buckthorn contains anthroquinone in all plant parts, including its fruits, which is metabolized into emodin when ingested by wildlife. Emodin can have paradoxical effects: in high doses it acts as a cathartic (resulting in moderate to severe diarrhea, see photon previous page); at low concentrations/doses it causes retention of stomach/gut contents. Common buckthorn is considered a poisonous plant in the United States and Canada. Common buckthorn is also an alternative host to alfalfa mosaic virus; and crown rust (Puccinia coronata) fungi that causes oat rust disease. It has also been linked as a host for the soybean aphid.

Control Options

See the following control guides: Integrated Pest Management (IPM) for Woody Plants or the Control of Invasive Species by Numbers

Common buckthorn Rhamnus cathartica	
Plant Type	Shrub
Habitat Type	Forests, fields, roadsides, wetlands
USDA Hardiness Zone	3-7
Rooting Structure	Fibrous, shallow and extensive
Environmental Impacts	Contains levels of anthroquinone, which when ingested is metabolized into emodin, a laxative. Common buckthorn is considered a poisonous plant in the United States and Canada
Wildlife Impacts	Ingestion of plant parts can be toxic to wildlife
Leaf arrangement	Alternate
NWI Ranking	FAC
Soil Type	
Soil pH Range	6.5 to 8.5
Light Requirements	Prefers partial to full sun, shade
Growing Season	
Growth Rate	Medium to fast
Mature Height	25 ft. (7.6m)
Life Span	50-75 years
Reproductive Age	2 years
Flowering Period	May-June
Flower Type	Dioecious
Pollination	Insects
Seed Set	August through September
Seed Per Plant	15,000 -54,000
Scarification Required	No
Cold Stratification	Yes
Seed Longevity	~2-6 years
Seed Germination Rate	88%
Seedling Density	?

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, http://www.eddmaps.org/ipane/ipanespecies/shrubs/Rhamnus_cathartica.htm

USDA Forest Service invasive species website: http://www.fs.fed.us/database/feis/plants/shrub/rhaspp/all.html

Invasives.org: http://www.invasive.org/search/action.cfm?q=common%20buckthorn

Bugwood: http://wiki.bugwood.org/Rhamnus_cathartica

USDA Plants Database: http://plants.usda.gov/core/profile?symbol=rhca3

Japanese knotweed

Polygonum cuspidatum / Falopia japonica

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Japanese knotweed** Latin Name: ***Polygonum cuspidatum / Falopia japonica***
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*) Native to: **Japan**


leaves (summer)


Japanese knotweed – Concord, NH


Rhizomatous rooting system


Flowers (spring)


Calyx with seeds (late summer)


Stem node /joint


Variegated leaf form


Dead persistent stalks (Fall)


Structural damage

Description: Perennial reaching 10' in height and width. Bohemian Knotweed (*Polygonum x bohemicum*) is similar. **Stems**: Greenish, hollow and jointed, similar to bamboo. **Leaves**: Alternate, broadly ovate, 3-7'' long. **Flowers**: Small, whitish, forming panicles, August-September. **Seeds**: Calyx, brown, triangular. **Habitat**: Found in woodland sites, open spaces, ditches, roadsides, riverbanks. Prefers moist, well-drained soils. **Spread**: Stem & root fragments, and by seed. **Comments**: Aggressive, spreads quickly along surface waters and in right-of-ways. **Controls**: Do not mow, cut stems at base then smother by covering area with heavy-duty fabric/plastic, herbicides also recommended.

General Considerations

Japanese knotweed is a tall upright perennial with a large rhizomatous rooting system and hollow stems. The stems can reach heights of up to 10' (3 m) tall, with some records indicating they can grow to 13' (3.9 m) tall. The stems are glaucous and hollow with nodes / joints, similar to bamboo shoots. The older shoots tend to get woody near the base as they age. Leaves are alternate and broadly ovate with a flat-truncate base. Flowers emerge in late summer as small white to off-white racemes / panicles. Pollination is by insects, primarily by bees. The three-winged seeds (Calyx) were often thought to be sterile; however, a basic germination test showed that 95% of seeds collected from various populations spread

throughout NH were viable, but not seen as a significant vector for its spread. Seedlings often succumb to frost, desiccation, shade, predation and smothering.

The rooting system, which is composed of numerous intertwined rhizomes that can grow up to 3" (8 cm) in diameter, is the primary reproductive propagule that enables it to quickly spread to new locations. The rhizomes have the potential to spread laterally 23 to 65 feet (7-20 m) away from the crown. Most also have a deep taproot. Based on the extensive rooting system, the majority (2/3) of Japanese knotweed plants occurs below ground. The greatest advantage of having this type of rhizomatous rooting system enables the plant emerges in the spring earlier than most native plants. It also helps to ensure the plant will rebound if damage to the shoots occurs. In addition, perennating buds found on the root crown and along the rhizomes will also react to shoot damage, i.e. mowing/cutting, by sending up additional shoots along the root. This typically results in radial/clonal spread of the plant and increases its shoot density.

The movement of soil containing living and viable root/rhizome fragments is a violation unless the material shall be treated in a manner to render the propagules inert and non-viable. Root fragments as small as ½" (12.7 mm) have the ability to regenerate into a new plant creating adventitious roots and shoots within a short period of time. The larger the root fragment the greater its ability to survive. Regeneration has occurred as deep as 20" (50 cm).

Anecdotal evidence of seed germination by the NH Department of Agriculture, Markets & Food, Division of Plant Industry, indicates 95% germination rate from seeds collected throughout the state. This suggests that seed germination may be a factor in the plants ability to spread. However, field observations indicate that this is typically not a significant method of dispersal.

Polygonum cuspidatum / Falopia japonica Japanese knotweed	
Plant Type	Herbaceous - Perennial
Habitat Type	Road sides, disturbed sites, riparian habitats, wetlands
USDA Hardiness Zone	3-7
Rooting Structure	Rhizomes have a diameter of 3 inches (8 cm) and may spread 23 to 65 feet (7-20 m) laterally. Also has a deep central taproot
Environmental Impacts	Increase the risk of stream bank erosion. Loss of native species diversity.
Wildlife Impacts	Impedes the movement of wildlife
Leaf arrangement	Alternate and broadly ovate
NWI Ranking	UPL-FACU
Soil Type	Not limited by soil type
Soil pH Range	Can tolerate 3.5
Light Requirements	Prefers full sun, but grows in light shade
Growing Season	April - October
Growth Rate	Fast
Mature Height	13 feet (4 m) tall
Life Span	?
Reproductive Age	First growing season
Flowering Period	August to September
Flower Type	Dioecious
Pollination	Insects - bees
Seed Set	September - October
Seed Per Plant	50,000 to 150,000 per stem
Scarification Required	No
Cold Stratification	Yes
Seed Longevity	4-6 years
Seed Germination Rate	82%
Seedling Density	?
Other Propagules	Root fragments
Dispersal Vectors	Wind, erosion, roadside mowing, construction projects, movement of contaminated soil, dumping

Control Options

See the following control guide: Control Methods for Japanese knotweed

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, *Alliaria petiolata:* http://www.eddmaps.org/ipane/ipanespecies/herbs/Polygonum_cuspidatum.htm

USDA Forest Service invasive species website: http://www.fs.fed.us/database/feis/plants/forb/polspp/all.html

Invasives.org: http://www.invasive.org/browse/subinfo.cfm?sub=3414

Oriental bittersweet

Celastrus orbiculatus

Control Guidelines

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Oriental Bittersweet**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)

Latin Name: ***Celastrus orbiculatus***
Native to: **Japan, China, Korea**






Photos by: Douglas Cygan

Description: Deciduous vine reaching heights of 40-60'. **Bark**: Tannish, furrowed. **Leaves**: Alternate, ovate, bluntly toothed, 3-4" long by 2/3's as wide, tapered at the base. **Flowers**: Small, greenish, blooming in spring. **Fruit**: Yellow dehiscent capsule surrounding an orange-red aril. **Fruits** occur in the axils of the stems whereas native bittersweet (Celastrus scandens) fruits at the ends. **Zone**: 4-8. **Habitat**: Disturbed edges, roadsides, fields, forests and along rivers and streams. **Spread**: Birds and humans. **Comments**: Very aggressive, climbs up and over trees and smothers them. Do not buy wreaths made of these vines. **Controls**: Difficult to manage. Cutting, pulling, or recommended herbicide use applied to foliage, bark, or cut-stump.

General Considerations

The introduction of Oriental bittersweet to non infested areas is generally associated with birds and small mammals feeding on the abundant fruits in the fall and excreting the seeds as they move from one area to another. Dispersal is also associated with human activities where earth moving activities occur or when the vines and fruits are collected in the fall for ornamental wreathes and decorations (*which is prohibited*) and then carelessly discarded. Seed viability and germination rate is relatively high at 90% in the spring of the subsequent growing season, but drops off significantly the following year. Fruits that remain on the vine eventually drop to the ground and decompose leaving behind three seeds per berry. These seeds ultimately become part of the seed bank, which usually remains viable for only 1-year. Anyone involved with control practices or site development should take precautionary measures to ensure that fruits and soil material containing seeds are not moved off site. Preventative measures to avoid this may necessitate the creation of a cleaning station where soils/seeds and/or propagules can be removed from vehicles, tires, and equipment. Heavy deposits of soil may require pressure washing.

Another factor that warrants consideration is the rejuvenation of Oriental bittersweet from root fragments left in the ground. Control measures that involve cutting the upper portion of the vine and leaving the rooting system intact

typically results in new shoot emergence, known as suckering. These can form at the crown or along the root itself. Subsequent monitoring and control measures may be necessary to manage this reoccurrence.

Since there are no known biological controls, and cultural controls are generally ineffective, the standard management practices involve mechanical and chemical controls. Depending on the method employed it can take less than one year or up to several years to eliminate Oriental bittersweet from the management area.

To easily identify and locate where Oriental bittersweet occurs in any habitat, simply scout areas of concern in the fall when native plant species have reached their peak colors. At this point most native species will have dropped their leaves leaving the bright lemony-yellow foliage of Oriental bittersweet as a key indicator. In New Hampshire, this generally occurs around late October to early November. This method is very effective for early detection and rapid response (EDRR) by enabling managers to map out areas of concern and implement control strategies early on.

Control Options

See the following control guides: **Integrated Pest Management (IPM) for Woody Plants**; or the **Control of Invasive Species by Numbers**

(*Although native American bittersweet, Celastrus scandens, is not prevalent in New Hampshire, it is important to properly identify which bittersweet you have and confirm that it is Oriental bittersweet before control measures begin.*)

Celastrus orbiculatus Oriental bittersweet	
Plant Type	Liana
Habitat Type	Mostly forest edge
USDA Hardiness Zone	4-8
Rooting Structure	Lateral
Environmental Impacts	Hybridizing with American bittersweet. Weaken mature trees by girdling the trunk and weighting the crown.
Wildlife Impacts	
Leaf arrangement	Alternate
NWI Ranking	UPL, FACU
Soil Type	
Soil pH Range	5-7.5
Light Requirements	Prefers partial to full sun
Growing Season	
Growth Rate	0.3-3.0 m (1-12 ft)
Mature Height	60 ft. (18.3 m)
Life Span	
Reproductive Age	3-5 years
Flowering Period	May - June
Flower Type	Dioecious & monoecious
Pollination	Insects, mostly bees, and wind
Seed Set	August through September
Seed Per Plant	5 seeds per fruit
Scarification Required	Yes
Cold Stratification	Yes
Seed Longevity	Typically 1-year, possibly 2
Seed Germination Rate	95%
Seedling Density	
Other Propagules	root suckering
Dispersal Vectors	Birds, small mammals, humans

Sources

Boelk, D. (2007) *Lepidium latifolium* L. Encycloweedia, California Department of Food and Agriculture, APWG: WEED US. http://www.texasinvasives.org/invasives_database/detail.php?symbol=LELA2

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Multiflora rose

Rosa multiflora

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Multiflora rose**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)

Latin Name: ***Rosa multiflora***
Native to: **Japan & Korea**


Compound leaves (spring)


Multiflora rose – Concord, NH

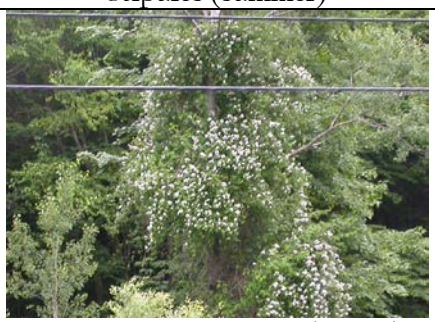

Compound leaf (Late summer)


Flowers (spring)


Stipules (summer)


Thorns (summer)


Terminal Bud (spring)


Vining up a native tree (spring)


Rose hips (fall)

Description: Hardy shrub / climber reaching up to 15' or more in height and 10' in width. **Stems:** Long and arching, forming dense clumps, thorns may or may not be present. **Leaves:** Alternately arranged, compound with 7-9 leaflets and having feather margins at base. **Flowers:** Clusters of white or pink, June to July. **Fruit:** Rose hips turn red in fall. **Zone:** 3-8. **Habitat:** Prefers moist, well drained soils, full sun. **Spread**: Fruits with seeds are dispersed by birds. **Comments:** Very aggressive, leading to competition and displacement of native species. **Controls:** Hand or mechanical removal, cutting, or herbicide application.

General Considerations

Multiflora rose is a large perennial shrub that forms dense stands of impenetrable thickets that can grow to 30 ft in diameter by 6-10 ft tall, which displaces native vegetation. It can also grow as a climbing vine reaching heights of 25-30 ft. It has alternately arranged, pinnately compound leaves with 7-9 leaflets. Canes grow to 13 ft long and are armed with stout woody thorns. It forms large clusters of fragrant white or pink flowers that bloom from June to July. Like other roses, it forms small red pulpy fruits called hips, which may be eaten by birds. It reproduces from seeds or by rooting at the tip of arching stems that touch the ground. It can be distinguished from native roses by its long arching stems and

numerous small white flowers or hips depending on the season. To verify identification of this plant contact a natural resources professional.

Multiflora rose is highly aggressive and readily colonizes old fields, pastures, roadsides, open woodlands, and forest edge habitats. It can also establish itself in forested sites where open gaps occur. It is most productive in sunny areas with well-drained soils.

Multiflora rose is used for cover during all times of year by cottontail rabbits, white-tailed deer, pheasants, and mice. It is a preferred nesting site species for gray catbirds.

Control Options

See the following control guides: **Integrated Pest Management (IPM) for Woody Plants**; or the **Control of Invasive Species by Numbers**

Multiflora rose Rosa multiflora	
Plant Type	Shrub
Habitat Type	Forests, field, roadsides, wetlands
USDA Hardiness Zone	3-8
Rooting Structure	Fibrous shallow
Environmental Impacts	The presence of prickles on stems and leaves are most likely a deterrent for grazing livestock. It is still used as a rootstock for certain cultivated roses and apparently resistant to certain diseases such as black spot. However, it is a host to some viral diseases which can be vectored to cultivated roses.
Wildlife Impacts	Loss of valuable habitat
Leaf arrangement	Alternate and odd-pinnate with 7 to 9 leaflets.
NWI Ranking	UPL, FACU
Soil Type	Well drained
Soil pH Range	5-7
Light Requirements	Prefers partial to full sun, shade
Growing Season	
Growth Rate	1-ft per year
Mature Height	15 ft. (5 m)
Life Span	?
Reproductive Age	1 year
Flowering Period	May to June
Flower Type	Monoecious
Pollination	Insects
Seed Set	September
Seed Per Plant	500,000 per plant
Scarification Required	Yes
Cold Stratification	3-4 °C for 90-120 days
Seed Longevity	10-20 years
Seed Germination Rate	60%
Seedling Density	?
Other Propagules	Seed, suckering, layering
Dispersal Vectors	Birds, mammals & water

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, *Alliaria petiolata:* http://www.eddmaps.org/ipane/ipanespecies/trees/ailanthus_altissima.htm

USDA Forest Service invasive species website: http://www.fs.fed.us/database/feis/plants/tree/ailalt/all.html

Invasives.org: http://www.invasive.org/browse/subinfo.cfm?sub=3003

Honeysuckle shrubs

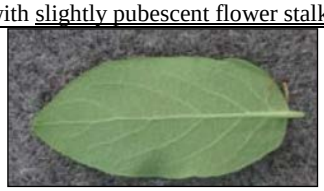
Lonicera spp.

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Honeysuckles**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)

Latin Name: ***Lonicera spp.***
Native to: **Eurasia**

Bell's honeysuckle *Lonicera x bella*	Morrow's honeysuckle *Lonicera morrowii*	Tatarian honeysuckle *Lonicera tatarica*
 Flowering –whitish to pink fading to yellow with slightly pubescent flower stalks	 Flowering –whitish to pink with long pubescent flower stalks	 Flowering – pink to almost red with long glabrous flower stalks
 Leaves are bluish green, slightly pubescent beneath	 Leaves elliptic to ovate, soft pubescent beneath, petiole $^{1}/_{12}$ to $^{1}/_{8}$" long	 Leaves bluish-green, petiole $^{1}/_{12}$ to ¼" long, hairless on underside
 Stem/bark, sparsely pubescent	 Stem light brown turning gray	 Stems green turning brown, glabrous
 Buds & leaf scar	 Leaf buds	 Leaf buds-flattened, glabrous
 Hollow stem	 Hollow stem	 Hollow stem
 Fruits are red or yellow ¼" diameter on short peduncles that are longer than the petioles	 Ripe fruit is blood red, ¼" diameter on long peduncles, which are very hairy	 ¼" red to orange berry

Bell's honeysuckle *Lonicera x bella*	Morrow's honeysuckle *Lonicera morrowii*	Tatarian honeysuckle *Lonicera tatarica*
Description: Shrub reaching 20' in height and width. **Stems:** Greenish to tan with corky wings. **Leaves:** Oppositely arranged, simple and elliptic, 1-3" long by half as wide, light green. **Flowers:** Yellow, white or pink, May to early June. **Fruit:** Fleshy red, forming in pairs in leaf axis. **Zone:** 4-8. **Habitat:** Prefers dry upland soils, full sun to heavy shade, pH adaptable. **Spread:** Seeds are dispersed by birds. **Comments:** *L. x bella* is a cross between *L. tatarica* & *L. morrowii*. Spreads into natural areas forming dense stands, which displace native species. **Controls**: Hand or mechanical removal, continuous cutting, girdling, and herbicide treatment.	**Description:** Shrub reaching 6-8' tall. **Stems:** Smooth, glabrous, Tannish, hollow. **Leaves:** Ovate, simple, entire, opposite, pubescent beneath, 1-2$^1/_2$" long. **Flowers:** Tubular, white, turning yellow with age, May to June. **Fruits:** Berry turning red. **Zone:** 3-8 . **Habitat:** Moist to wet shaded floodplains, forests, roadsides, fields, waste places. **Spread:** Seeds are dispersed by wildlife and humans. **Comments:** Rapidly invades sites, forming a dense vegetative layer that outcompetes native flora and fauna species. **Controls:** Hand control is effective for small plants, while mechanical removal and repetitive cutting also work well. Herbicide treatment is better for areas with greater infestations.	**Description:** Upright deciduous shrub reaching 6-15' tall. **Stems:** Smooth, glabrous, tan, hollow. **Leaves:** Ovate, smooth, bluish-green, opposite, 1-2$^1/_2$" long. **Flowers:** Tubular, pink or white, April to May. **Fruit:** Berry with two seeds, turning red in fall. **Zone:** 3-8. **Habitat:** Under story species in woodland sites, also invades open spaces. Thrives in moist soils. **Spread:** Seeds dispersed by wildlife and humans. **Comments:** Rapidly invades forests, fields, roadsides and floodplains. Outcompetes native species. **Controls:** Hand control is effective for small plants while mechanical removal, cutting and chemical applications are better for larger stands.

Lonicera spp. Shrub honeysuckles	
Plant Type	Shrub
Habitat Type	Forests, fields, roadsides, wetlands
USDA Hardiness Zone	3-8
Rooting Structure	Fibrous shallow
Environmental Impacts	Dense shade outcompetes and displaces native understory plants thus reducing the availability of food for wildlife. These plants are also allelopathic lending to their ability to create monotypic shrub layers.
Wildlife Impacts	Loss of valuable habitat
Leaf arrangement	Opposite
NWI Ranking	FACU
Soil Type	
Soil pH Range	6.5-8
Light Requirements	Prefers partial to full sun, shade
Growing Season	
Growth Rate	1-ft per year
Mature Height	7-10 ft. (2.13 -3 m)
Life Span	20 -35 years
Reproductive Age	3 years
Flowering Period	April to June
Flower Type	Monoecious
Pollination	Insects
Seed Set	September
Seed Per Plant	>20,000
Scarification Required	Yes
Cold Stratification	3-4 °C for 90-120 days
Seed Longevity	2 or more years
Seed Germination Rate	80%
Seedling Density	459,000 plants/acre
Other Propagules	Suckering, layering
Dispersal Vectors	Birds and mammals

General Considerations

Bush honeysuckles are large deciduous shrubs originating from Eurasia. Bell's honeysuckle grows to an average height of 9', Morrow's is generally less than 7' tall and Tatarian rarely exceeds 10'. Stems of all of these are hollow, whereas native honeysuckles have solid pith. Flowers are tubular and occur from April to June. Birds widely disseminate seeds after eating the fleshy fruits. Seedlings emerge throughout the growing season. It is also one of the earliest plants to leaf out in the spring and one of the latest to drop its leaves in the fall. Their early development and dense canopy allows them to displace native plants. This effectively leaves the forest floor barren and subject to erosion as well as diminishing the availability of food for wildlife. These invasive honeysuckles have also been shown to be allelopathic, which prevents and/or inhibits native species regeneration.

Control Options

See the following control guides: Integrated Pest Management (IPM) for Woody Plants; or the **Control of Invasive Species by Numbers**

Berries may be mildly poisonous if eaten. Sensitivity to a toxin varies with a person's age, weight, physical condition, and individual susceptibility. Children are most vulnerable because of their curiosity and small size. Toxicity can vary in a plant according to season, the plant's different parts, and its stage of growth

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England: http://www.eddmaps.org/ipane/ipanespecies/shrubs/Lonicera_tatarica.htm

Ohio State University: http://www.oardc.ohio-state.edu/weedguide/singlerecord.asp?id=840

Illinois Dept of Natural Resources: http://dnr.state.il.us/inpc/pdf/VMG%20Bush%20honeysuckle%20revised%202007.pdf

Norway maple

Acer platanoides

Fact Sheet

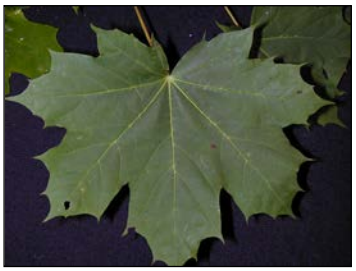
NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Norway maple**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)

Latin Name: ***Acer platanoides***
Native to: **Europe and western Asia**







Description: Large deciduous tree 60' high by 40' wide. **Bark**: Grayish and somewhat furrowed. **Twigs**: Smooth, olive-brown. **Buds**: Terminal, imbricate, rounded, smooth, greenish-red. **Leaves**: Opposite, 4-7'' wide, 5-lobed, dark green to dark red above, lustrous below. **Flowers**: Greenish-yellow, April. **Fruit**: Horizontal samara. **Zone**: 3-7. Habitat: Moist, well drained soils, full sun to partial shade. **Spread**: Seeds spread by wind and water. **Comments**: Leaf stalks exude milky white sap. Fast growing, buds break earlier than most native species. Naturalizes in woodlands where it can outcompete native species. **Controls**: Pull or dig seedlings/saplings. Cut large trees and prune suckers when they sprout. Herbicide: foliar spray, cut-stem, bark banding, or slash bark with ax and apply to wounds.

General Considerations

Within the past 30 years or so, Norway maple has spread widely in urban woodlots and forest edge habitats throughout the Northeast and providences of Canada. It prefers the same mesic (moist) soils where sugar maple (*Acer saccharum*) is often found. For this reason, Norway maple is recognized as invasive species in over 20 states in the Northeast and providences of Canada.

The ecological impacts, loss of natural habitat and reduction of species diversity, is a result of Norway maple's ability to create dense shade from its overlapping broad leaves/canopy. They also negatively affect the natural successional changes of forest habitat by the release of allelopathic chemicals from their shallow rooting system. These chemicals inhibit or prevent the establishment of other plants within the root-zone thus eliminating competition for water, nutrients, and light. These impacts to native vegetation are also amplified by its ability to uptake large amounts of water from the soil. The lack of adequate groundcovers can promote erosion and loss of soil, which has the potential to cause water quality and turbidity impacts to surface waters and wetlands. Furthermore, Norway maple has fewer diseases and pest insects that than our native sugar maple, which gives it a competitive edge over sugar maple.

Norway maple is sometimes confused with our native sugar maple (*Acer saccharum*) and so here are a few distinguishing characteristics that can be used to tell the two apart. Norway maple leaves are usually broader than they are long, while sugar maple leaves are generally longer than wide. Norway maple leaves when broken off at the petiole exude milky white sp where sugar maple has clear watery sap. Norway maple seeds (winged samaras) form in oppositely arranged pairs with a wide spread (180°); sugar maple seeds, and other native maple seeds, are horseshoe shaped where the wings droop at a 45° to 90° angle. Norway maple terminal buds are large, rounded, and blunt, with only 2–3 pairs of scales; sugar maple has long, sharply pointed buds with many scales. Bark of mature Norway maples has tight, furrowed grooves, similar to our native ash, while sugar maple bark is both flattish and smooth when young or platy when older. Norway maple leaves are very distinguishable in the fall since they persist after most native plants have dropped their leaves and because they turn a pale to orange- yellow, in contrast to sugar maple's brilliant oranges and reds.

Control Options

See the following control guides: Integrated Pest Management (IPM) for Woody Plants; or the Control of Invasive Species by Numbers

Acer platanoides Norway maple	
Plant Type	Tree
Habitat Type	Forests, field edges
USDA Hardiness Zone	3-7
Rooting Structure	Fibrous shallow
Environmental Impacts	Phytotoxin interrupts mycorrhizal activity. Foliage produces water-soluble antifungal chemicals which may alter the soil-borne mycorrhizae, pathogenic fungi, and decomposer fungi. Diminishes the quantity of light in the understory.
Wildlife Impacts	Loss of valuable habitat
Leaf arrangement	Alternate
NWI Ranking	UPL
Soil Type	
Soil pH Range	5.2-7.2
Light Requirements	Prefers partial to full sun, shade
Growing Season	
Growth Rate	1-ft per year
Mature Height	90 ft. (30 m)
Life Span	250 years
Reproductive Age	5 years
Flowering Period	April
Flower Type	Monoecious
Pollination	Insects
Seed Set	September
Seed Per Plant	>2,000 per plant
Scarification Required	Yes at 3°C
Cold Stratification	3-4 °C for 90-120 days
Seed Longevity	Typically 1-year, possibly 2
Seed Germination Rate	76%
Seedling Density	170–700/acre
Other Propagules	Suckering
Dispersal Vectors	Wind & water

Sources

Swearingen, J., B. Slattery, K. Reshetiloff, and S. Zwicker. 2010. Plant Invaders of Mid-Atlantic Natural Areas, 4th ed. National Park Service and U.S. Fish and Wildlife Service. Washington, DC. 168pp. Retrieved on September 15, 2011 from http://www.nps.gov/plants/alien/pubs/midatlantic/acpl.htm

Canadian Botanical Conservation Network, 2003. Invasive Tree Species, *Acer platanoides.* *www.rbg.ca/cbcn/en/invasives/i_tree2.html*

Dirr, M.A., 1997. Dirr's Hardy Trees and Shrubs, An Illustrated Encyclopedia. Published by the Timber Press, Portland, Oregon

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, *Acer platanoides.* http://www.eddmaps.org/ipane/ipanespecies/trees/Acer_platanoides.htm

Autumn olive

Elaeagnus umbellata

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Autumn olive** Latin Name: ***Elaeagnus umbellata***
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*) Native to: **Asia**


Eliptical leaves (summer)


Autumn olive – Concord, NH


Silvery underside of leaf (summer)


Flowers (spring)


Fleshy fruit (late summer)


Fruit clusters (fall)


Bark (summer)


Single thorn (summer)


Fall foliage (autumn)

Description: Weedy deciduous shrub measuring 20' by 20'. **Bark**: Silvery-gray and smooth with whitish lenticels. **Stems**: Cinnamon-brown. **Leaves**: Elliptical, 2-3'' long, glossy, green above and silvery below. **Flowers**: Solitary, whitish, 4-petaled, mid-June. **Fruit**: Drupe. **Zone**: 3-8. **Habitat**: Naturalizes in open spaces exposed to full sun. **Spread**: Seeds dispersed by birds and wildlife. **Comments**: Very aggressive. Outcompetes and displaces native species. **Controls**: Remove seedlings and saplings by hand. Larger shrubs can be mechanically removed, or cut and apply herbicide to stump.

General Considerations

Fruits are bourn in great numbers on ¼ inch stalks starting off as silvery with brown scales turning red as they ripen (September to November) containing a single seed. Fleshy fruits are consumed by birds and wildlife thus spreading the seeds over long distances. Cold stratification improves germination. Seeds that pass through the digestive tract of birds and wildlife scarify the hard seedcoat, which will help with germination in the spring. Persistent seed bank is possible. Fruits are also collected and cooked to turn into jelly.

Cutting plants can promote sucker sprouting and a stronger rooting system if not chemically treated thereafter.

Tolerant of a wide variety of growing conditions from wet to dry and basic to acidic soils. Persists in shade with rapid growth in full sun to produce seed as early as year 3. Wide spreading with many sprouts, leafing out early in spring and retaining foliage late in fall leading to the exclusion of other forest plants. Abundant seed spread by birds, with seedlings able to establish in shade. Invades forest edges and understories.

Autumn-olive forms root nodules induced by symbiosis with actinomycetes in the soil. This symbiosis permits the fixation and subsequent utilization of atmospheric nitrogen

Mature plants can produce about 30 pounds of fruit annually. Thirty pounds of fruit is generally equivalent to about 3 pounds of seed, or about 66,000 seeds. Under favorable conditions, autumn-olive can produce fruit by 3 to 5 years of age, usually at about 4 to 8 feet in height. Fruit production is reduced by shading.

Control Options

See the following control guides: **Integrated Pest Management (IPM) for Woody Plants**; or the **Control of Invasive Species by Numbers**

Elaeagnus umbellata Autumn olive	
Plant Type	Shrub
Habitat Type	Forests, fields, roadsides, wetlands
USDA Hardiness Zone	3-8
Rooting Structure	Fibrous
Environmental Impacts	Nitrogen fixing disrupts natural soil processes required by many native species. Displacing native plants
Wildlife Impacts	Loss of valuable habitat
Leaf arrangement	Alternate, simple
NWI Ranking	FACU
Soil Type	Sand, loam or clay-based soils
Soil pH Range	5-7
Light Requirements	Prefers full sun, but grows in light shade.
Growing Season	
Growth Rate	1-ft per year
Mature Height	20 ft. (7 m)
Life Span	
Reproductive Age	3-5 years
Flowering Period	April - May
Flower Type	Monoecious or Dioecious
Pollination	Open-pollinated - insects
Seed Set	September
Seed Per Plant	66,000 seeds
Scarification Required	Yes
Cold Stratification	3-4 °C for 90-120 days
Seed Longevity	Typically 3-years possibly 4
Seed Germination Rate	90%
Seedling Density	125,000 plants hectare
Other Propagules	Suckering
Dispersal Vectors	Bird, small mammals, fruit dropping

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, *Alliaria petiolata:* http://www.eddmaps.org/ipane/ipanespecies/trees/ailanthus_altissima.htm

USDA Forest Service invasive species website: http://www.fs.fed.us/database/feis/plants/tree/ailalt/all.html

Invasives.org: http://www.invasive.org/browse/subinfo.cfm?sub=3003

Burning bush

Euonymus alatus

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Burning bush**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)

Latin Name: ***Euonymus alatus***
Native to: **Asia**


Leaves-opposite (summer)


Burning bush – Boscawen, NH


Branching habit (summer)


Flowers (spring)


Berries (summer)


Berries (fall)


Terminal buds (spring)


Corky bark (summer)


Fall foliage (Autumn)

Description: Deciduous shrub reaching 20' in height and width. **Stems**: Greenish with corky wings. **Leaves**: Oppositely arranged, simple and elliptic, 1-3" long by half as wide, light green. **Flowers**: Inconspicuous greenish-yellow, May to June. **Fruit**: Fleshy green capsule turning red in fall. **Zone**: 3 to 8. **Habitat**: Prefers dry upland soils, full sun to heavy shade, pH adaptable. **Spread**: Seeds are dispersed by birds and wildlife. **Comments**: Outcompetes and displaces native species. **Controls**: Hand remove seedlings and saplings. Use a spade or shovel to dig out larger plants. Large populations may be controlled with herbicide use.

General Considerations

Burning bush, also known as winged Euonymus, is often a multi-stemmed deciduous shrub that grows to 6-12' tall. It develops a dense branching habit and often is wider than it is tall. The bark of older stems is gray or brownish gray with small fissures/furrows. Younger stems are green having lateral tan corky wing appendages. Leaves are arranged oppositely along the stems and grow outward in a horizontal fashion (in the fall when the leaves turn color they droop). Leaves are 1-2½" long and ½-1¼" across; they are elliptic to broadly elliptic and finely serrated along their margins. Upper leaf surfaces are medium to dark green, while their lower surfaces are a lighter shade of green.

Flowers are somewhat inconspicuous and form in the axils of the leaves between May and June. Flowers are about 1/3" across, consisting of 4 yellowish green petals, 4 green sepals, 4 short stamens, and a central green disk, from which a multi-lobed stigma develops. The petals are well-rounded and widely spreading when a flower is fully open. The blooming period occurs during early summer and lasts about 3 weeks. During the summer, fertile flowers develop into 4-lobed seed capsules with smooth sides. At maturity during the fall, the seed capsules are up to ½" long and their exteriors become dark red or purple. Each capsule splits open along the margins of its lobes to reveal 1-4 orange-red arils. The fleshy exterior of each aril contains a single ellipsoid seed up to 1/3" long. The deciduous leaves become bright red during the autumn before they fall to the ground.

Burning bush tolerates full sun to medium shade, moist to dry-mesic conditions, and many soil types allowing it to become established in natural woodland areas. Typical habitats include disturbed woodlands, woodland borders, thickets, vacant lots, roadsides, and fence rows. This shrub is often cultivated in lawns and along highways; it usually naturalizes near urban and suburban areas.

Seeds are dispersed by frugivorous birds that eat the fleshy arils and spread their seeds to new locations. White-Tailed Deer avoid the foliage of Winged Euonymus. As a result, this shrub has a tendency to increase in wooded areas.

Control Options

See the following control guides: **Integrated Pest Management (IPM) for Woody Plants** or the **Control of Invasive Species by Numbers**

Euonymus alatus Burning bush	
Plant Type	Shrub
Habitat Type	Forests, field edges, roadsides
USDA Hardiness Zone	3-8
Rooting Structure	Deep and fibrous
Environmental Impacts	Outcompetes native understory vegetation by diminishes the availability of light. Foliage is not palatable to deer and so they avoid it and over brows other species.
Wildlife Impacts	Degradation of habitat
Leaf arrangement	Opposite
NWI Ranking	UPL
Soil Type	Adaptable to a variety of site conditions
Soil pH Range	6-6.5
Light Requirements	Very shade tolerant
Growing Season	
Growth Rate	1-ft per year
Mature Height	8.2 feet (2.5 m) tall
Life Span	250 years
Reproductive Age	5 years
Flowering Period	May to June
Flower Type	Dioecious
Pollination	Insects - bees
Seed Set	September and October
Seed Per Plant	Prodigious
Scarification Required	Not required
Cold Stratification	Yes
Seed Longevity	Unknown
Seed Germination Rate	~90%
Seedling Density	170–700/acre
Other Propagules	Suckering and layering
Dispersal Vectors	Frugivorous birds

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, *Alliaria petiolata:* http://www.eddmaps.org/ipane/ipanespecies/shrubs/Euonymus_alata.htm

USDA Forest Service invasive species website: http://www.fs.fed.us/database/feis/plants/shrub/euoala/all.html#Palatability%20and/or%20nutritional%20value

Invasives.org: http://www.invasive.org/browse/subinfo.cfm?sub=3023

Japanese barberry

Berberis thunbergii

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Japanese barberry**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)

Latin Name: ***Berberis thunbergii***
Native to: **Japan**


leaves (spring)


Japanese barberry – Antrim, NH


Old truck with barberry (summer)


Flowers (spring)


Single thorn (spring)


Seeds & fleshy fruit (fall)


Naturalized cultivar (Summer)


Fall foliage (Autumn)


Late fall (fall)

Description: Deciduous shrub, 2-41/2' tall. **Leaves**: Ovate, simple, entire. Color varies depending on variety. **Flowers**: Small yellowish, bloom in May in clusters of 2-4. **Fruit**: Drupe, turning red in summer. **Zone**: 4-8. Habitat: Prefers well drained soils in semi shade and often occurring in forests, roadsides, and open fields. **Spread**: Seeds are dispersed by wildlife. **Comments**: Forms dense thickets in natural environments where it becomes established, resulting in impacts to native flora and fauna. **Controls**: Remove small immature plants by hand. Dig larger plants with a garden spade or remove mechanically. Cut stems at base or control with herbicide treatment.

General Considerations

Japanese barberry reproduces from prolific seeds, rhizomes, or layering. Seeds have a germination rate as high as 90%, and are distributed by birds including ruffed grouse, bobwhite, pheasant, and wild turkey. Because barberry is shade tolerant, an extensive population can become established in a short time under a closed forest canopy. Severe drought or extreme winters have little effect on overall mortality or seed production. Deer avoid barberry while often browsing surrounding vegetation, which may effectively increase barberry's competitive advantage

Forested/woodland sites invaded by Japanese barberry tend to have higher occurrences of ticks than those habitats not yet invaded. Abundance of black-legged tick (*Ixodes scapularis*), which is a vector for lyme disease, was greater in the presence of Japanese barberry due to its high evapotranspiration rate.

Information regarding Japanese barberry impacts in invaded communities includes evidence that Japanese barberry invasion displaces native shrubs and causes changes in soil properties. Japanese barberry persistence in invaded stands may also alter successional patterns.
Japanese barberry invasion can alter soil microbial composition and increase nitrate concentrations. High nitrate concentrations may result in higher nitrogen losses due to leaching or might make these sites more susceptible to invasion by other weedy plants. The researchers suggest that even if Japanese barberry is removed, it is very likely that differences in the soils will persist for a prolonged period after that, which might significantly impede the restoration of native flora in the cleared sites.

One study also provides evidence that invaded sites support more biomass in the shrub layer than uninvaded sites. There is concern that additional biomass in invaded stands may increase the likelihood of fire in those stands, although this did not seem to be the case during the growing season on sites studied in Massachusetts.

Control Options

See the following control guides: Integrated Pest Management (IPM) for Woody Plants or the Control of Invasive Species by Numbers

Japanese barberry Berberis thunbergii	
Plant Type	Shrub
Habitat Type	Forests, fallow fields, open spaces
USDA Hardiness Zone	4-8
Rooting Structure	Fibrous shallow
Environmental Impacts	Can raise soil pH and affect nitrogen levels. Maintains ground level humidity to ~80% which is optimum tick habitat.
Wildlife Impacts	Foliage toxic to deer, loss of habitat
Leaf arrangement	Alternate
NWI Ranking	UPL, FCU
Soil Type	
Soil pH Range	3.7 to 7.0
Light Requirements	Prefers partial to full sun, shade
Growing Season	
Growth Rate	2 to 4 feet (0.6-1.2 m) per year
Mature Height	6 ft. (1.8 m)
Life Span	Moderate
Reproductive Age	2 years
Flowering Period	April-May
Flower Type	Monoecious
Pollination	Insects
Seed Set	August - October
Seed Per Plant	>1,000
Scarification Required	Yes
Cold Stratification	90 days
Seed Longevity	1-2 years
Seed Germination Rate	94%
Seedling Density	?
Other Propagules	Layering, suckering
Dispersal Vectors	Wildlife, wind & water

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, http://www.eddmaps.org/ipane/ipanespecies/shrubs/Berberis_thunbergii.htm

USDA Forest Service invasive species website: http://www.fs.fed.us/database/feis/plants/shrub/berthu/all.html

Invasives.org: http://www.invasive.org/browse/subinfo.cfm?sub=3010

Bugwood: http://wiki.bugwood.org/Archive:SEEPPC/Japanese_Barberry_-_Berberis_thunbergii_DC.

European barberry

Berberis vulgaris

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **European or Common barberry**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)
Latin Name: ***Berberis vulgaris***
Native to: **Europe**


leaves (spring)


European barberry – Hanover, NH


Flower (spring)


Flowers (spring)


Thorns in threes


Seeds & fleshy fruit (fall)


Stem/bark (Summer)


Fall foliage (Autumn)


Fall foliage (Autumn)

Description: Shrub 3-8' in height by 3-6' in width. **Stems**: Tan bark with 3 long spines at each leaf axis. **Leaves**: Alternate, simple, 1/2"-11/2" long, bright green above, dull below. **Flowers**: Perfect, yellow, 1/2" long, mid-April to May. **Fruit**: Oblong drupe turning pale red in fall. **Zone**: 4-8. **Habitat**: Prefers full sun to partial shade and open spaces to wooded areas. **Spread**: Seeds are dispersed by birds and wildlife. **Comments**: Highly adaptable to most environments and is pollution tolerant. **Controls**: Hand pull young plants. Cut or mechanically remove older larger plants or apply approved herbicides for large populations.

General Considerations

Berberis vulgaris is an upright and arching shrub that can reach 10' in height producing a mass of erect, arching stems. The branches are grooved, gray and glabrous, and usually have groupings of three long clustered 1" spines. The foliage is dull green, about 1-2" long and ovate to oblong with finely serrate margins and arranged alternately in bundles (fascicled). Flowers are yellow and borne on pendulous racemes. These flowers appear from late May into June. The fruit are ellipsoid in shape, red in color and are around ½" long each containing 1-3 seeds. Early-fruiting plants typically produced fewer seeds/fruit than late-fruiting plants.

Though *Berberis vulgaris* is not very common on the landscape in most places, there is a risk that it could once again become a serious pest. The fact that it is an alternate host for wheat rust

Birds and livestock are the most common dispersers of common barberry seed. However, small mammals, including small rodents, can often be a mechanism for seed dispersal. In riparian habitats seeds can easily drop into the watercourse and readily float downstream to other locations. Seeds separated from their fruit often germinate in the 1st year , while seeds contained in their fruits often have a delayed germination and sprout the 2nd year. Germination rates tend to be higher under shady conditions compared to those sees found in full sun.

Common barberry acts as an alternate host for cereal stem rust (*Puccinia graminis*), which can severely reduce cereal crop yields. In the early 1900's crop failure was common due to cereal stem rusts outbreaks so in 1918 the United States created a barberry eradication program to remove them from the landscape.

Control Options

See the following control guides: Integrated Pest Management (IPM) for Woody Plants or the Control of Invasive Species by Numbers

European barberry Berberis vulgaris	
Plant Type	Shrub
Habitat Type	Forests, fields, roadsides, wetlands, coastal areas
USDA Hardiness Zone	4-8
Rooting Structure	Fibrous, rhizomatous, shallow to deep
Environmental Impacts	Alternate host for cereal stem rust (*Puccinia graminis*), which can severely reduce cereal crop yields
Wildlife Impacts	Loss of habitat
Leaf arrangement	Alternate
NWI Ranking	UPL, FCU
Soil Type	Dry to moist soils
Soil pH Range	3.7 to 7.0
Light Requirements	Prefers partial to full sun, shade
Growing Season	
Growth Rate	2 to 4 feet (0.6-1.2 m) per year
Mature Height	10 ft. (3 m)
Life Span	Moderate
Reproductive Age	2-7 years
Flowering Period	April-May
Flower Type	Monoecious
Pollination	Insects
Seed Set	August - September
Seed Per Plant	2,000 - 4,000
Scarification Required	Yes
Cold Stratification	Yes
Seed Longevity	9 years
Seed Germination Rate	72-88%
Seedling Density	?
Other Propagules	Layering, suckering
Dispersal Vectors	Wildlife & water

Sources

Mehrhoff, L., 2001. Invasive Plant Atlas of New England, Catalog of Species, http://www.eddmaps.org/ipane/ipanespecies/shrubs/Berberis_vulgaris.htm

USDA Forest Service invasive species website: http://www.fs.fed.us/database/feis/plants/shrub/bervul/all.html

USDA: http://www.ars.usda.gov/main/docs.htm?docid=10755

Invasives.org: http://www.invasive.org/browse/subinfo.cfm?sub=5181

Bugwood: http://wiki.bugwood.org/Berberis_vulgaris

Blunt-Leaved / Boarder Privet

Ligustrum obtusifolium

Fact Sheet

NH Department of Agriculture, Markets & Food, Division of Plant Industry, 29 Hazen Dr, Concord, NH 03301
(603) 271-3488

Common Name: **Blunt-leaved privet / Boarder privet**
New Hampshire Invasive Species Status: **Prohibited** (*Agr 3800*)
Latin Name: ***Ligustrum obtusifolium***
Native to: **Asia**

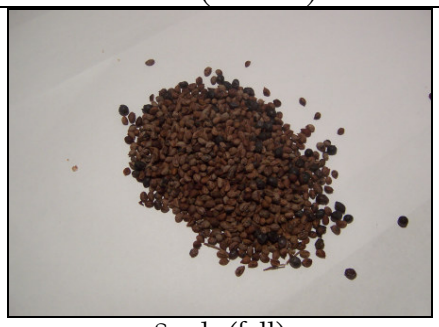

Eliptical leaves (summer)


Blunt-leaved privet – Rye, NH


leaves (summer)

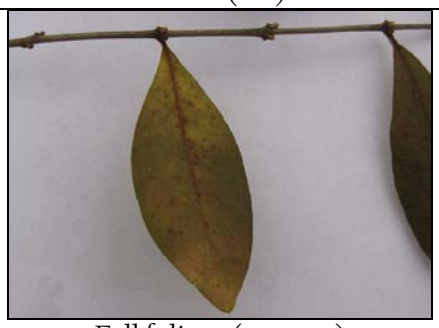

Flowers (spring)


Fleshy fruits-Drupes (late summer)


Seeds (fall)


Form (summer)


Branching and leaf habit (summer)


Fall foliage (autumn)

Description: Shrub reaching 12' tall by 10-12' wide. **Stems:** Greenish, smooth. **Leaves:** Opposite, simple and elliptic, 1-3" long by half as wide, blunt tipped, light green. **Flowers:** Small white panicles, May to early June. **Fruit:** Small blackish drupe. **Zone:** 4-7. **Habitat:** Prefers dry upland soils, full sun to heavy shade, pH adaptable. **Spread:** Seeds dispersed by birds. **Comments**: Becomes established in natural areas leading to competition and displacement of native species. **Controls:** Hand or mechanical removal, cutting, herbicide applications such as foliar or cut-stem.

General Considerations

Ligustrum obtusifolium, referred to as either Blunt-leaved privet or Boarder privet, is a medium sized deciduous shrub in the olive (Oleaceae) family. Its leaves are opposite, simple, oblong, 1 to 2 inches long, dark green above and lighter below with a rounded or blunt tip and base. It has short white flowers in nodding panicles, which are very fragrant, but unpleasant appearing in early summer. The fruit is dull blackish-purple drupe about ¼" in diameter that ripens in the fall and often persists into the following spring. Each fruit contains 1-4 seeds. The bark is grayish brown, somewhat smooth and covered with short, light colored lenticels. Distinguished from other privets by its minutely fuzzy twigs, by its hairy leaf midrib, and by its flower clusters which are about 1 to 2 inches in length

It is tolerates a wide variety of growing conditions from wet to dry sites, mineral to organic soils, high pH to basic and partial shade to full sun. However it does best in full sun, which allows it to produce seed when it's 3-years old. The typical shape or habit is wide spreading with numerous sprouts. Like most invasive plants it too leafs out early in the spring and retains its foliage late in the fall. The longer growing season allows it to outcompete and suppress many native plants. Seed dispersal is mainly from frugivorous birds feeding on the fruits, flying away and excreting the seeds. Ligustrum obtusifolium grows readily from seed or from root and stump sprouts.

The foliage can be toxic to herbivorous mammals while both the foliage and berries are toxic to humans.

Control Options

See the following control guides: **Integrated Pest Management (IPM) for Woody Plants**; or the **Control of Invasive Species by Numbers**

Ligustrum obtusifolium Blunt-Leaved / Boarder Privet	
Plant Type	Shrub
Habitat Type	Forests, fields, roadsides, floodplains
USDA Hardiness Zone	4-7
Rooting Structure	Fibrous
Environmental Impacts	Displacing native plants
Wildlife Impacts	Toxic to mammals, loss of valuable habitat
Leaf arrangement	Alternate, simple
NWI Ranking	?
Soil Type	Sandy or loamy based soils
Soil pH Range	5.5-8
Light Requirements	Full sun to part shade
Growing Season	
Growth Rate	Medium
Mature Height	12 ft. (4 m)
Life Span	?
Reproductive Age	3-5 years
Flowering Period	June
Flower Type	Dioecious
Pollination	Open-pollinated - insects
Seed Set	September
Seed Per Plant	?
Scarification Required	No
Cold Stratification	Yes
Seed Longevity	?
Seed Germination Rate	57%-92%
Seedling Density	?
Other Propagules	Suckering
Dispersal Vectors	Bird, small mammals, fruit dropping

Sources

Illinois Wildflowers:
http://www.illinoiswildflowers.info/trees/plants/border_privet.html

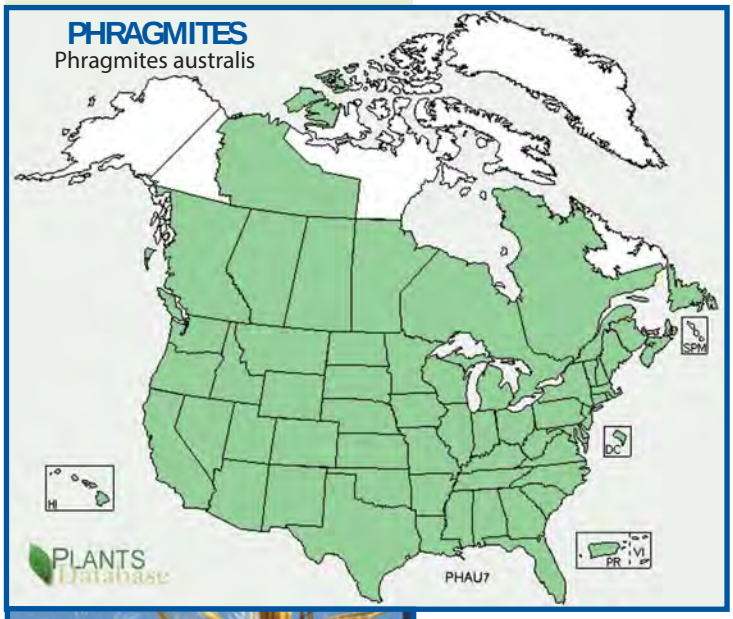
Invasives.org:
http://www.invasive.org/browse/subinfo.cfm?sub=10087

Missouri Botanical garden:
http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=c322

Sea Grant
Pennsylvania
www.paseagrant.org

Phragmites
Phragmites australis

Phragmites, also called the common reed, is a long-lived, perennial grass that grows in tall stands that can exclude almost all other vegetation. While some strains of the species are native to North America, aggressive non-native strains have expanded throughout the United States, replacing much of the native reed.



Map courtesy of USDA Plants Database.

Species Description

Phragmites forms dense stands that can reach up to 15 feet high. Leaves are broad and pointed and reach 20-61 cm (8-24 in) long. Flowers form bushy clusters that look "fluffy" due to fine hairs that grow on the seeds as they mature. Below ground, *Phragmites* forms a dense network of roots and rhizomes several feet deep. Rhizomes can grow 10 ft (3m) or more in a single season. Differentiating between native and invasive forms of *Phragmites* can be very difficult so DNA analysis is the most reliable method for identifying strains.

Native & Introduced Ranges

Although the species name '*australis*' suggests that *Phragmites* is native to Australia, it is believed to have originated from the Middle East. Genetic research has shown three separate lineages occurring in North America: a native strain, a European strain, and one whose lineage is currently unclear. The invasive European strain was introduced in the 1800s, most likely in ballast material from trans-oceanic ships. It is now widespread throughout the lower 48 states and southern Canada.

Photo courtesy of Ken Chamberlain, The Ohio State University, Bugwood.org.

Biology & Spread

Phragmites reproduces and spreads both by seed production and through vegetative fragmentation of rhizomes. Hundreds to thousands of seeds are produced each year which can spread to new locations by wind and water; although, seed viability can be highly variable. In addition, the extensive root and rhizome network allows this species to reproduce vegetatively as rhizomes break off and float downstream to new locations. Heavy machinery and equipment may also transport this species along roadsides between sites.

Habitat

Phragmites is unusual among grasses in that it is able to colonize a wide range of habitats, including fresh and brackish waters. It is abundant along the borders of lakes, ponds, rivers, marsh communities, roadsides and disturbed areas.

Photo courtesy of Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

PHRAGMITES

Photo courtesy of Richard Old, XID Services, Inc., Bugwood.org.

Impacts

Threat to Biodiversity

Introduced *Phragmites* is aggressive and quickly develops dense stands that take over wetland ecosystems, alter wetland hydrology, increase fire potential, and reduce wetland wildlife habitat. *Phragmites* consumes available growing space and pushes out other plants, including native strains of the species, quickly turning once biologically diverse wetlands into monocultures.

Economic Costs

Marsh restoration efforts to remove *Phragmites* can be very expensive and are often ineffective since this species can be quick to return after burning and chemical treatments.

Illustration courtesy of USDA NRCS PLANTS Database, Bugwood.org.

Prevention & Control

While there are several treatments available for *Phragmites*, the effectiveness of a particular treatment depends on the area and extent of infestation. Areas with large, established populations are best restored using herbicide treatments. Prescribed burning after the plant has flowered, either alone or in combination with herbicide treatment, may also be effective; however, plants should not be burned in the spring or summer before flowering because this may stimulate growth. Cutting can help manage the size of the population, but timing is critical, and shoots must be properly disposed of to prevent sprouting in treated areas. A combination of the above techniques is probably the most effective tool for eradication; however, frequent monitoring is needed to help prevent reinvasions.

Photo courtesy of Bernd Blossey, Cornell University, Bugwood.org.

References:

Faulds, A. and Wakefield, K. *Phragmites*: A tale of two strains. Fact Sheet. <http://seagrant.psu.edu/publications/fs/Phragmites.pdf>.

Saltonstall, K. 2005. Fact Sheet: Giant Reed. Plant Conservation Alliance's Alien Plant Working Group, Weeds Gone Wild. <http://www.nps.gov/plants/alien/fact/pdf/phaul.pdf>.

Swearingen, J. and Saltonstall, K. 2010. *Phragmites* Field Guide: Distinguishing native and exotic forms of Common Reed (*Phragmites australis*) in the United States. Plant Conservation Alliance, Weeds Gone Wild. <http://www.nps.gov/plants/alien/pubs/index.htm>.

Sea Grant Pennsylvania
www.paseagrant.org

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COASTAL RESOURCES MANAGEMENT PROGRAM

U.S. FISH & WILDLIFE SERVICE
Great Lakes RESTORATION

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ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

WD-BB-45 2019

Purple Loosestrife

Species Description

Purple loosestrife is an erect perennial herb standing three to ten feet tall. Its average height is five feet. The plant blossoms every July through September with purple flowers that are located in long spikes at the tip of its branches. Its leaves are opposite or whorled on a square, sometimes woody stem. One purple loosestrife plant may grow as an individual stalk or as several stalks clumped together. As beautiful as this plant may appear, its beauty is deceptive, as purple loosestrife is gradually altering our nation's wetlands. Native look-alikes of this plant are swamp loosestrife and blue vervain.

Purple Loosestrife
(Lythrum salicaria)

Species Range and Distribution

Purple loosestrife is a problem in New Hampshire and throughout North America and Canada. The northeastern United States and southern Canada are the areas experiencing the greatest impact of purple loosestrife. The distribution of purple loosestrife ranges from being common to abundant, and many areas have been found to support dense stands of this plant.

How Was Purple Loosestrife Introduced?

Purple loosestrife is native to Eurasia. It was originally introduced to eastern North America in the early to mid-1800s. This invasive plant was either accidentally introduced via ship ballasts, deliberately brought over as an ornamental plant or its seeds were transported by imported raw wool and sheep.

Where Does Purple Loosestrife Invade?

Optimum habitats for purple loosestrife include freshwater marshes, open stream margins and alluvial floodplains. Purple loosestrife also invades wet meadows, pasture wetlands, cattail marshes, stream and river banks, lake shores, irrigation ditches, drainage ditches and stormwater retention basins. Purple loosestrife is often associated with cattail, reed canary grass and other moist soil plants.

What Makes Purple Loosestrife a Good Invader?

Purple loosestrife prefers moist organic soils, fluctuating water levels and full sunlight; which are conditions that can stress many native plants. However, this plant can survive in many conditions associated with disturbed sites, such as construction sites. It can tolerate a wide range of environmental conditions (temperature, sunlight, pH, nutrient levels) and can establish itself on a variety of substrates (gravel, sand, clay, and organic soil). Purple loosestrife has no natural predators, such as disease or insects on this continent; therefore, it has an incredible ability to out-compete native vegetation and to form dense stands.

How Does Purple Loosestrife Spread?

Purple loosestrife's ability to spread contributes to its success as an invader. One adult purple loosestrife plant can produce 2.5 million to 2.7 million seeds annually. Seeds are roughly the size of ground pepper grains, and are viable for many years. They may remain dormant in the soil until conditions are right for germination. These seeds are easily dispersed and transported by water, wind, bird feathers, animal fur, footwear, boats, boat trailers and car tires. Purple loosestrife is also capable of resprouting from broken stems, underground roots and plant fragments. If mowed, the cut stem pieces will send out new roots and form new plants. The once commercial sale of purple loosestrife also increased the spread of this plant by introducing it to various wetlands and home gardens. It has been illegal to sell, purchase, propagate, import, distribute and transport *Lythrum* species in New Hampshire since 1999.

Why Is Purple Loosestrife a Problem?

Purple loosestrife negatively affects both wildlife and agriculture. It displaces and replaces native flora and fauna, eliminating food, nesting and shelter for wildlife. Purple loosestrife forms a single-species stand that no bird, mammal, or fish depends upon, and germinates faster than many native wetland species. If wildlife species are displaced, those that cannot move into new areas may be lost. By reducing habitat size, purple loosestrife has a negative impact of fish spawning and waterfowl habitat. The plant also diminishes wetland recreational values such as boating, fishing and hunting. This, in turn, may hurt local economies. Purple loosestrife affects agriculture by blocking flow in drainage and irrigation ditches and decreasing crop yield and quality.

What Are Some Solutions to the Purple Loosestrife Problem?

Three possible control methods exist for purple loosestrife. These include physical, biological and chemical means. None of these methods will completely eliminate purple loosestrife, but they will control the populations within ecologically acceptable limits.

Physical Control of purple loosestrife is possible for smaller stands of plants (fewer than about 100 plants). It involves physically removing the plant from the soil. Removal should ensure that all root and plant pieces are dug out of the soil. The best time to remove purple loosestrife from the soil is prior to seeding time (August/September). Removal after this time will not eliminate the seeds that have

already been produced by the plant. Once the plants are removed they should be burned or tightly bagged to prevent the spread of seeds or resprouting. Composting is not an alternative as the plants may regenerate in the compost pile. Many local conservation commissions, garden clubs and other specialty groups throughout New Hampshire are initiating their own purple loosestrife monitoring programs involving mapping, hand-pulling and disposal of this nuisance plant. If hand-pulling during flowering time, cut off the flower stalk and bag it before removing the plant and roots to minimize seed dispersal.

Biological Control is a method of control involving the release of predators to attack the pest species. Three different species have been used in North America to attempt to control purple loosestrife: two species of beetles and one weevil. These three species are common in Europe where they combine to act on the leaves and roots, thereby controlling its populations. The insects were proven "safe" to our natural environment as a result of extensive research conducted at Cornell University.

In the late 1990s, the New Hampshire Departments of Agriculture and Transportation initiated a joint project to introduce beetles into areas infested with purple loosestrife. The beetles feed on the plants, curbing their growth within a five-year period, depending on the size of the infestation. There are now over 20 such sites in New Hampshire, with each showing signs of success with thinning purple loosestrife populations. The beetles appear to be migrating to nearby purple loosestrife sites, controlling growth there. Their population is regulated by the purple loosestrife growth, and the beetles have been making good headway at reducing populations of this particular invasive plant in the state.

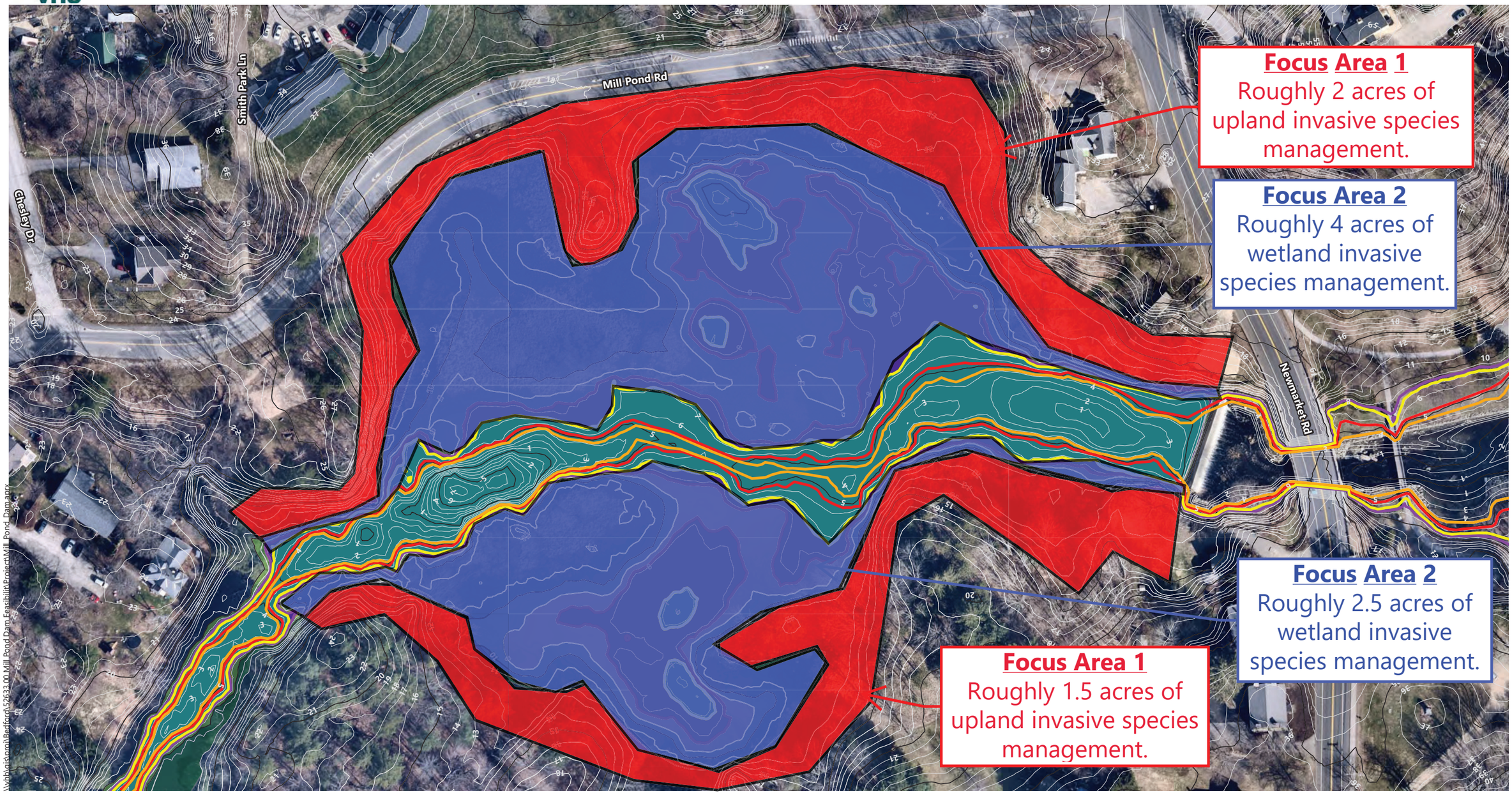
Chemical Control: In dry areas, Round-Up can be used for control. In wetlands or areas with standing water, only a licensed applicator working under a special permit can conduct an herbicide treatment.

What Can I Do to Help?

There are many things you can do to help prevent the spread of purple loosestrife. The first step is to ***recognize it***. Purple loosestrife is most easily identified when in bloom (July and August), before it goes to seed. The second step is to ***report it***. If a large infestation is identified, you can contact the departments of Agriculture, Transportation or Environmental Services. Mapping the infestation is helpful as well. The third step is to ***remove it***. Check with authorities prior to removal to determine what permits may be needed and how best to proceed.

For more information about exotic aquatic plants, please contact the Exotic Species Program at (603) 271-2248, or go to https://www.des.nh.gov/ and search "Exotic Species."

Attachment B: Invasive Species Management Focus Areas Figure



\\vhb\ais\nan\Bedford\52633.00 Mill Pond Dam Feasibility Project\Mill_Pond_Dam.aprx

0 50 100 200 Feet

Anticipated Vegetation Transition Zones
- < 5' Open Water
- 5'-6' Emergent Wetland
- 6'-8' Freshwater Emergent Marsh/Shrub
- 9'-10' Marsh/Shrub/Forested Wetland
- >10' Shrub/Forested Wetland/Upland Transition

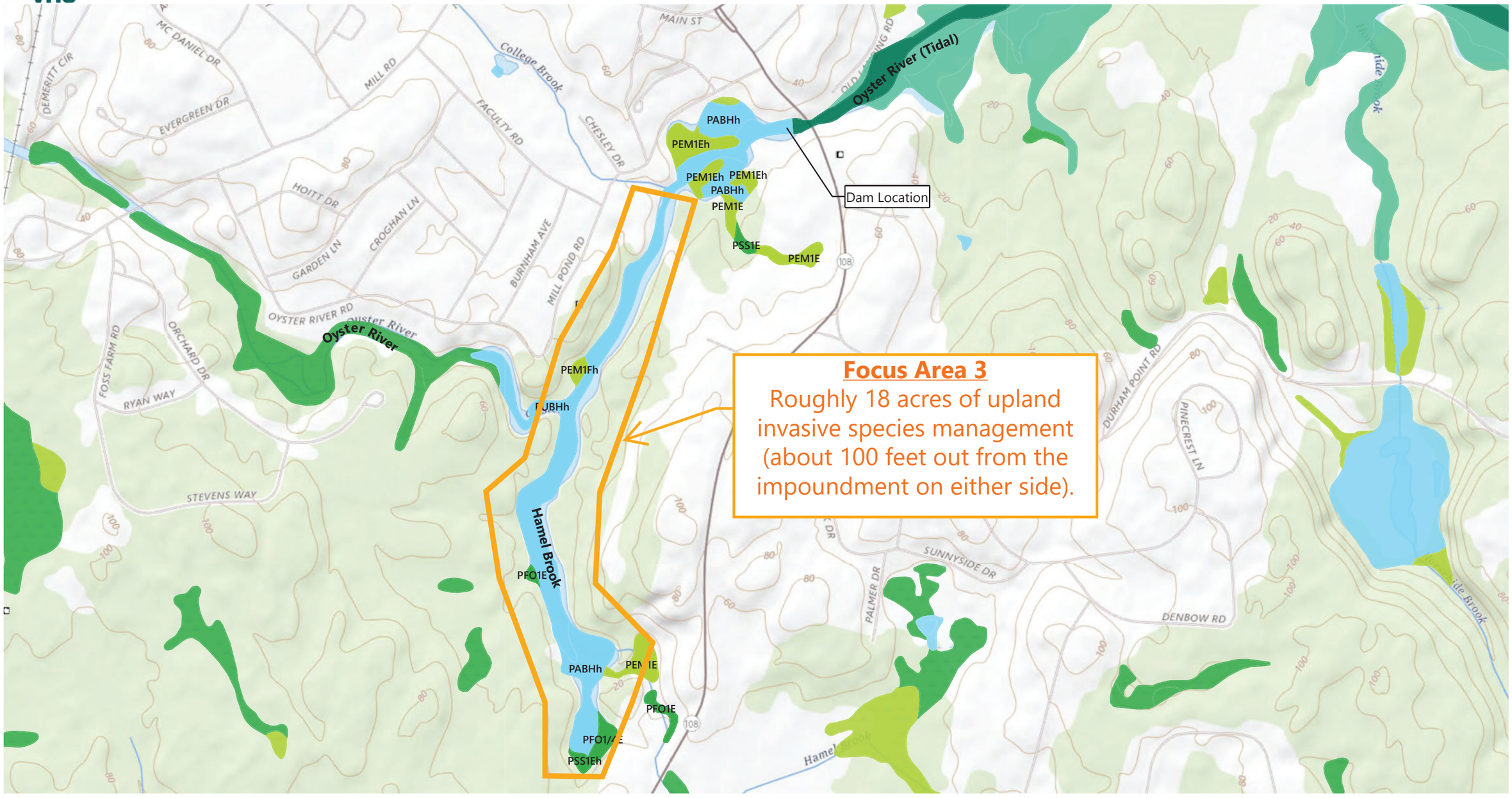
Anticipated High Water Lines
- Mean Higher High Water - 4.4' - Higher Low Marsh
- Head of Tide Limit - 5.4' - High Marsh
- Mean Higher High Water + 2.9' RSLR (Likely Range)
- Mean Higher High Water + 3.8' RSLR (5% Chance)

- Index Contour (5 ft)
- 1' Contour Intervals

Oyster River Dam Removal at Mill Pond | Durham, New Hampshire

Source : NHDES, VHB, ArcGIS Online

Invasive Species Management Focus Areas



0 325 650 1300 Feet

NWI Wetland

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

Oyster River Dam Removal at Mill Pond | Durham, New Hampshire

Source : NHDES, VHB, ArcGIS Online

Invasive Species Management Focus Areas

Attachment C: IVMP Matrix

Integrated Vegetation Management Plan

Oyster River Dam Removal at Mill Pond

Prior/Post Dam Removal	Item	Activities	Primary Responsible Parties	Other Involved Parties	Ideal Start Time	Target Deadline	Notes
Prior to Dam Removal	Map Existing Invasive Plant Populations	Utilize existing data and solicit public involved via EDDMapS.	Town	-	ASAP	June/July 2024	Would require landowner permission to enter private properties within the focus areas around the impoundment.
		Drone flight over the focus areas.	VHB	Town	Mill Pond Complete, Fall 2023	June/July 2024	This should occur in the early fall since many invasive species leaves are first to turn yellow.
	Assess Seed Viability	Partial pond draw down to observe natural germination within exposed substrates along the perimeter.	VHB/Town	-	Early 2024, pre-construction	Construction/ dam removal	Coordination with NHF&G would be required to avoid and minimize impacts to aquatic species. This option is not favored due to anticipated public opposition to the poor aesthetics.
		Potential UNH student research project to germinate pond sediment seed bank in controlled lab setting.	UNH volunteers	-	TBD	June/July 2024	Optional Task. Dependent on UNH resources
	Continue and Expand Invasive Plant Control Efforts	Continue the Town's existing invasive species control efforts within and around Mill Pond.	Contractor/Licensed Herbicide Applicator	Durham Land Stewardship Coordinator	ASAP	June/July 2024	Coordinate further with Doug Cygan on this. Avoid herbicide application within the Milne Sanctuary.
		Promptly following drawndown, apply herbicides to the surrounding invasive species.	Contractor/Licensed Herbicide Applicator	Durham Land Stewardship Coordinator	Promptly post-draw down; July 2024?	mid-2024, 1-3 weeks after implementation	This would remove the seed sources to reduce invasive species colonization of the exposed areas. The licensed applicator will be responsible for obtaining necessary pesticide application permits and complying with applicable pesticide regulations.
		Engage volunteers in the cutting and removal of dead invasive plants after herbicide has been applied.	Durham Land Stewardship Coordinator	Local Volunteers	Promptly post-herbicide application; July 2024?	June/July 2024	Using volunteers to hand pull invasive plant species over large areas is inefficient, but can be effective with a limited scope and good for public relations.
		Host workshops to teach interested landowners invasive plant identification and different management techniques they could implement on their land.	Durham Land Stewardship Coordinator	Private landowners	Early/mid 2024	June/July 2024	Engage private landowners in the focus areas to assist in reducing seed sources on their propreties by pulling, digging, or smothering invasive plants. Herbicide can only be applied by licensed professionals.
Post Dam Removal	Invasive Species Monitoring	Spread wetland seed mix on newly exposed sediment to suppress invasive plant growth.	Contractor	Town	Promptly following dam removal	Promptly following dam removal	There is the potential to begin native planting immediately following drawdown, pre-dam removal to quickly establish native vegetation (i.e., a combination of cattail plugs and New England Wetland Seed Mix, to avoid cattail monoculture).
		Monitor for flush of invasive plant seedlings in the newly exposed sediments and hand pull as feasible.	Durham Land Stewardship Coordinator	Local Volunteers	Beginning of first year	End of first year	This will likely require visits once a month from late April to September (six visits total).
		Continue to monitor for flush of invasive plant seedlings and hand pull or cut as feasible.	Durham Land Stewardship Coordinator	Local Volunteers	Beginning of second year	End of fifth year	This will likely require three visits per year during the growing season (April/May, June/July, and August/September).
	Develop and implement a 5-year invasive species control plan within all focus areas	Woody invasive plants killed the previous year along the shoreline should be removed by mechanically clipping and removing the dead plant material.	Contractor	Durham Land Stewardship Coordinator / Local Volunteers	Beginning of first year	End of fifth year	This would allow native vegetation to recolonize the space and improve the site aesthetics. Town volunteers could assist with this effort to increase public involvement with the project and improve aesthetics.
		Apply cut-stem or low volume foliar spray herbicide to invasive plants in focus areas.	Contractor/Licensed Herbicide Applicator	VHB	Within the first year post dam removal	The fifth year post dam removal	A recent study by UNH provides guidance on percent solution of Glyphosate and Garlon that results in mortality of glossy buckthorn after one treatment using cut-stem (Glyphosate 5% solution) and surface application to the lower 1.5 feet of bark stem (Garlon 5% solution) (Lee, 2020).

Appendix G: Conceptual Cost Estimates

Computations

Project:	Mill Pond Dam Removal	Project #	52633.02
Location:	Durham, NH	Sheet	1
Calculated by:	AHF	Date:	1/4/2024
Checked by:	DWC	Date:	1/5/2024

CONCEPTUAL COST ESTIMATE - Additional Oyster River Sediment Excavation

Item	Quantity	Unit	Unit Price	Total	Source / Notes
Erosion & Sediment Control					
Timber Mat Access Roadway	1,636	SY	$ 111.00	$ 181,547.00	China Lake Fishway 2021 Bids, 7% inflation
Dewatering and Erosion Control	1	LS	$ 20,000.00	$ 20,000.00	Sawyer Mill 2019 Bids, 10% inflation
Subtotal				**$ 201,547.00**	
Control of Water					
Cofferdam, Turbidity Barriers, and Water Diversion	1	LS	$ 66,000.00	$ 66,000.00	Sawyer Mill 2019 Bids, 10% inflation
Subtotal				**$ 66,000.00**	
Sediment Dredging					
Sediment removal	3,852	CY	$ 44.00	$ 169,481.48	Sawyer Mill 2019 Bids, 10% inflation
Sediment Transport & Disposal	6,279	TON	$ 150.00	$ 941,777.78	CES 2024 Disposal estimate, assume 1.63 tons per CY
Subtotal				**$ 1,111,259.26**	
CONSTRUCTION COST SUBTOTAL				**$ 1,379,000.00**	
Mobilization & Demolition					
Mobilization and Demobilization	1	LS	$ 68,950.00	$ 68,950.00	5% of Construction Subtotal
Subtotal				**$ 68,950.00**	
Construction Contingency					
Contract Bonds	1	LS	$ 13,790.00	$ 13,790.00	1% of Construction Subtotal
Contingency	1	LS	$ 275,800.00	$ 275,800.00	20% of Construction Subtotal
Subtotal				**$ 289,590.00**	
Design Costs					
Supplemental Sediment Analysis, pre-characterization	1	LS	$ 27,580.00	$ 27,580.00	2% of Construction Subtotal
Construction Phase Services and Erosion Control Monitoring	1	LS	$ 137,900.00	$ 137,900.00	10% of Construction Subtotal
Subtotal				**$ 165,480.00**	
CONSTRUCTION COST SUBTOTAL				**$ 525,000.00**	
Total				**$ 1,904,000.00**	

Computations

Project:	Mill Pond Dam Removal	Project #	52633.02
Location:	Durham, NH	Sheet	2
Calculated by:	AHF	Date:	1/4/2024
Checked by:	DWC	Date:	1/5/2024

CONCEPTUAL COST ESTIMATE - Additional Oyster River Grade Controls

Item	Quantity	Unit	Unit Price	Total	Source / Notes
Erosion & Sediment Control					
Timber Mat Access Roadway	1,636	SY	$ 111.00	$ 181,547.00	China Lake Fishway 2021 Bids, 7% inflation
Dewatering and Erosion Control	1	LS	$ 20,000.00	$ 20,000.00	Sawyer Mill 2019 Bids, 10% inflation
Subtotal				**$ 201,547.00**	
Control of Water					
Cofferdam, Turbidity Barriers, and Water Diversion	1	LS	$ 66,000.00	$ 66,000.00	Sawyer Mill 2019 Bids, 10% inflation
Subtotal				**$ 66,000.00**	
Riffle Crest Construction					
Excavation and site preparation	785	CY	$ 28.00	$ 21,980.00	NHDOT weighted bid prices
Riffle Crest Stones	785	CY	$ 110.00	$ 86,350.00	Sawyer Mill 2019 Bids, 10% inflation
Subtotal				**$ 108,330.00**	
CONSTRUCTION COST SUBTOTAL				**$ 376,000.00**	
Mobilization & Demolition					
Mobilization and Demobilization	1	LS	$ 18,800.00	$ 18,800.00	5% of Construction Subtotal
Subtotal				**$ 18,800.00**	
Construction Contingency					
Contract Bonds	1	LS	$ 3,760.00	$ 3,760.00	1% of Construction Subtotal
Contingency	1	LS	$ 75,200.00	$ 75,200.00	20% of Construction Subtotal
Subtotal				**$ 78,960.00**	
Design Costs					
Riffle Crest engineering and design	1	LS	$ 22,560.00	$ 22,560.00	6% of Construction Subtotal
Construction Phase Services and Erosion Control Monitoring	1	LS	$ 37,600.00	$ 37,600.00	10% of Construction Subtotal
Subtotal				**$ 60,160.00**	
CONSTRUCTION COST SUBTOTAL				**$ 158,000.00**	
Total				**$ 534,000.00**	

Appendix H: Turbidity Sampling and Control Plan

Turbidity Sampling and Control Plan
Removal of the Oyster River Dam at Mill Pond
Durham, NH

Turbidity in the river during all in-water work shall be monitored and controlled as follows:

1. **General Items:**
    a. All proposed monitoring for turbidity in the river during all in-water work shall be completed by a qualified Contractor approved by the Town and shall be conducted in accordance with the specifications below.
    b. Visual monitoring shall be the primary form of turbidity monitoring. However, when turbidity is visible downstream of the work area during an outgoing or slack tide, field measurements of turbidity using turbidity meters shall be conducted. Visible turbidity is assumed to be visually detectable at approximately 30 nephelometric turbidity units (NTUs) or greater.
    c. Turbidity monitoring shall only be required during the conduct of in-stream work such as the dam breach and demolition, installation or removal of a cofferdam or stream diversion feature, or other work that has the potential to create downstream turbidity.
    d. Turbidity monitoring may require the use of a floating raft/dock or small boat to access the center of the channel.
    e. With Town approval, turbidity measurements using turbidity meters or probes do not need to be made if the Contractor believes that it would be unsafe for personnel to collect in stream measurements due to conditions such as high water velocity and/or ice conditions.

2. **Monitoring Stations and Monitoring Frequency:** Monitoring locations marked by GPS coordinates (supplemented by a buoy or a similar marker if possible) should be set up in the river at the location of four monitoring stations as described below:
    a. **Upstream - Background (UP-1):** A background station will be established in the main river channel (thalweg) at the upstream limit of the existing Mill Pond impoundment (approximately 250 feet upstream of the westernmost limit of work) in an area not disturbed by the construction activity. The purpose of this station is to provide baseline turbidity information. During construction activities that could potentially cause increased in-stream turbidity (i.e., construction activities), monitoring should occur each day at the following intervals:
        i. Prior to the commitment of in-water work,
        ii. Midday while in-water is being performed, and
        iii. At the conclusion of in-water work.
        iv. If there is visible turbidity within the mixing zone, visual monitoring and turbidity measurements should be taken hourly.
    b. **Downstream 1 (DS-1):** A downstream station will be placed approximately 200 feet downstream from the dam in the middle of the channel at the pedestrian bridge crossing. This station would represent the upper portion of the assumed mixing zone where the potential for increased turbidity may occur but is expected to be limited to extend only across ½ channel width allowing aquatic passage for

the remaining channel width. During construction activities, monitoring for turbidity should be conducted as follows:

i. Visual Monitoring should take place every hour and
ii. Measurements should be taken hourly if there is visible turbidity.

c. **Downstream 2 (DS-2):** A farther downstream station should be placed in the middle of the channel approximately 850 feet downstream from the dam and would represent the downstream end of the mixing zone. The existing pier at the Durham Landing boat launch represents a convenient landmark or access point for this station. It is assumed that the turbidity will have fully dissipated or would be no more than 30 NTUs above background across the entire channel at this location. During construction activities that could potentially result in increased in-stream turbidity, monitoring for turbidity should be conducted as follows:

i. Visual Monitoring should take place every hour and
ii. Measurements should be taken hourly if there is visible turbidity.

Tidal Background (TB-1): For incoming tides, another background station will be established approximately 1,350 feet downstream from the dam at the western most point of the Durham Landing parking area. The purpose of this station will be to allow turbidity monitoring of background conditions during an incoming tide to detect any turbidity being contributed from tidal inflow prior to entering the upstream mixing zone that is closer to the project site. During construction activities that could potentially result in increased in-stream turbidity, monitoring for turbidity should be conducted as follows:

i. Visual Monitoring should take place every hour and
ii. Measurements should be taken hourly if there is visible turbidity.

3. **Required Actions to Control Turbidity**:
   a. **DS-1:** If turbidity is visible in more than 1/2 of the channel at this station, work should stop and should not resume until there is no visible turbidity in more than 1/2 of the channel. It is assumed that if turbidity is visible in more than 1/2 of the channel, the turbid discharge is impacting aquatic organism passage.
   b. **DS-2:** If turbidity is visible in any part of the channel at this station a sample will be taken and if turbidity is greater than 30 NTUs, work should stop until visible turbidity measures no more than 30 NTUs across any part of the channel.
   c. **TB-1:** If turbidity is visible at this station during incoming tide under background conditions at the same time that turbidity is visible in the upstream mixing zone, measurements should be taken to determine if the turbidity in the upstream mixing zone is 10 NTUs above background levels in the tidal inflow.

4. **Meter Monitoring Protocols:** Field measurements of turbidity using turbidity meters shall comply with the following:
   a. Monitoring frequency at each location shall comply with item 2 above.
   b. Results for in stream measurements, calibration, and QA/QC shall be recorded on field data sheets, as well as the date, time, location, and the names of those conducting the monitoring.

c. Sampling Procedures for Hand-held Meters
    1) Rinse the sampling container three times with water from the waterbody.
    2) Submerge the sampling container a minimum of an arm's length upstream and allow the container to fill. Collect samples approximately one foot below the surface or at mid-depth (whichever is less) by placing a finger or thumb over the container opening, submersing the container to the appropriate depth, and then removing your finger or thumb from the container opening and allowing the container to fill.
    3) Do not collect any water immediately adjacent to legs or boots.
    4) Ensure that any introduced air bubbles are removed prior to analysis.
    5) Immediately cap the sample container, measure in the field using a turbidity meter and record results on the field data sheet.

d. Sampling Procedures Using Dataloggers (Optional):
    i. Dataloggers can be used instead of hand-held meters to automatically collect the majority of near-continuous (i.e., every 15 minutes) turbidity measurements.
    ii. Dataloggers shall be calibrated according to the manufacturer's instructions, with results recorded on the field data sheet.
    iii. On the same day that dataloggers are deployed as well as prior to and on the same day that dataloggers are retrieved, hand-held turbidity measurements shall be made instream next to the datalogger for comparison to datalogger results.
    iv. Dataloggers shall be retrieved, data downloaded, recalibrated, and redeployed at least once every 2 weeks.
    v. If dataloggers are used, hand-held turbidity meter measurements shall also be taken at least twice per day as a back-up in case the datalogger malfunctions and/or the data (which is downloaded at least once every 2 weeks) is later found to be invalid.

e. Quality Assurance and Quality Control (QA/QC)
    1) Turbidity meters shall have an accuracy of + 2% for readings below 100 NTUs and + 3% for readings above 100 NTUs, and a resolution of $\pm$ 0.1 NTU. Prior to monitoring, meter specifications shall be provided to the Town for approval.
    2) Hand-held meters shall be recalibrated daily with results recorded on the field data sheet.
    3) Duplicate samples shall be taken for every 10th sample with results and identification of the duplicate sample clearly identified and recorded on the field data sheet. If the relative difference[1] between the duplicate measurement and the original measurement exceeds 10%, recalibrate the turbidity meter and re-measure turbidity.

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[1] $RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100\%$

The relative percent difference (RPD) is equal to the following:

where x_1 is the original sample concentration and x_2 is the replicate sample concentration.

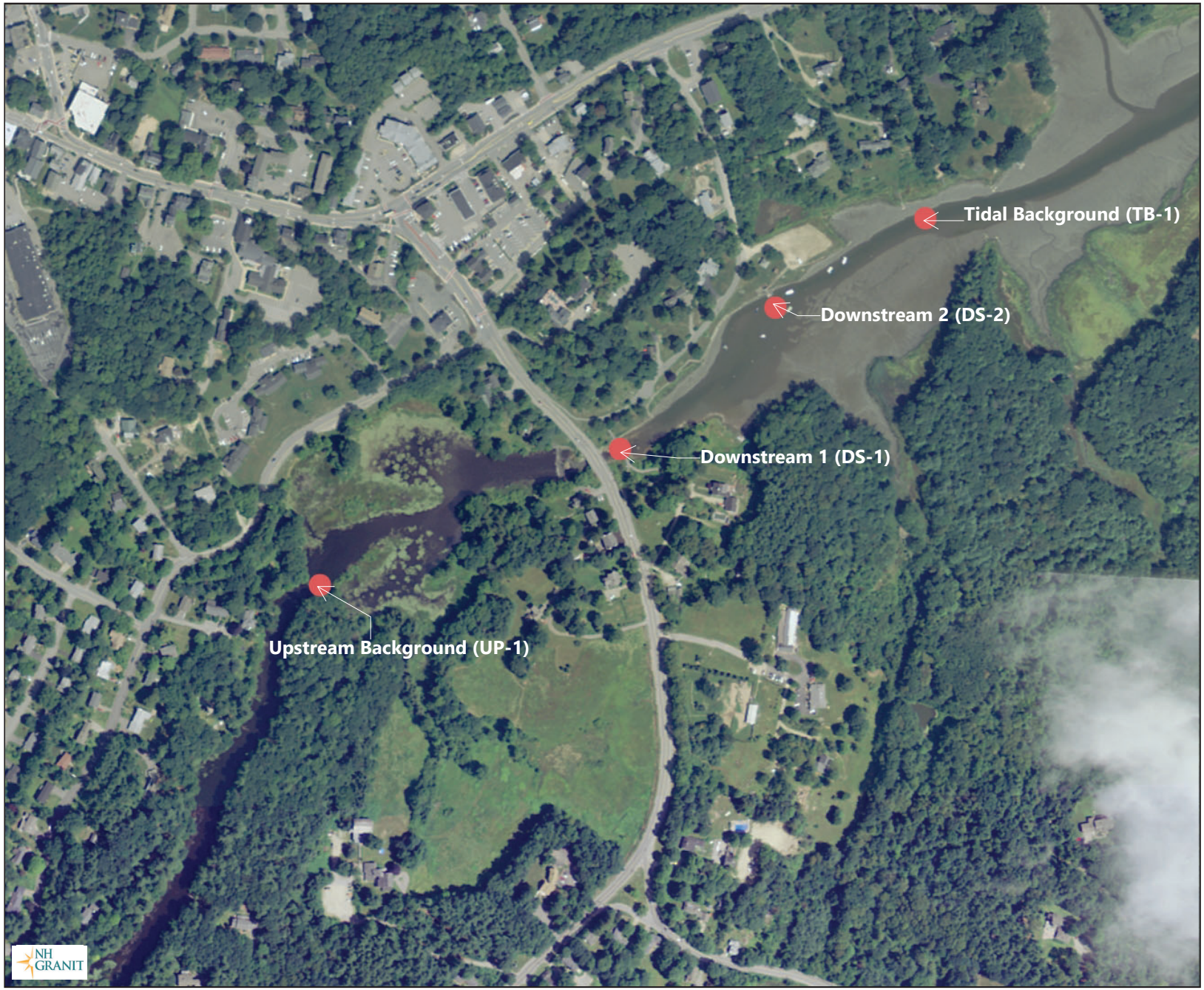
4) Blank samples shall be taken every 10th sample and recorded on the field data sheet. Blank samples shall be taken by filling a sample container with deionized water and measuring the turbidity immediately following measurement of the 10th sample.

5. **Visual Monitoring with Photo Documentation Protocols:** Visual Monitoring for turbidity and photo documentation shall comply with the following:
    a. Visual Monitoring results shall be recorded on field data sheets. Field Data sheets for Visual Monitoring shall include the names of those conducting the observations, the date, time, location, and result (i.e., visual turbidity or no visual turbidity) of each observation, and the date/time when work was ordered to be stopped and the date/time when work was allowed to resume.
    b. Photos of each station shall be taken during each observation in which there is visible turbidity. Each photo shall include the date, time, and location.
    c. Photos must be taken from a location and angle that will clearly show visible turbidity should it occur. Use of drones for this purpose is recommended. Prior to construction, the Contractor shall provide photos of each monitoring location to the Town for approval proving that the proposed method to photograph conditions in-stream will clearly show visible turbidity should it occur.

6. **Documentation, Notification, and Reporting:**
    a. The Contractor shall maintain electronic copies of all field data sheets, datalogger data in MS Excel format (if dataloggers are used), and photos (with date, time, and location) and submit them to the Town and/or NHDES within 48 hours of receiving a request.
    b. Reports that include the results from the previous week shall be transmitted to the Town by Tuesday of the following week. The weekly reports shall include the following:
        i. If turbidity data was not collected, an explanation as to why and when it wasn't collected with supporting information (i.e., gauge information showing high flows, photos showing ice build-up, etc.).
        ii. A summary of any data that was collected that did not meet the QA/QC requirements.
        iii. Turbidity meter results including the date, time, and location.
        iv. The dates, times, locations, and associated photos.
        v. The dates and times when work was stopped due to exceedances of any of the criteria above.
        vi. The dates, times, associated photos at each location, and turbidity meter results, when work was allowed to resume.
        vii. If dataloggers are used and retrieved the previous week, an MS Excel plot showing all datalogger results with NTUs on the y-axis and time/date on the x-axis.

7. **Notification:** The Town shall be notified immediately when turbidity results indicate that exceedances outside the mixing zone have occurred.

Proposed Turbidity Monitoring Locations



Legend

- State
- County
- City/Town

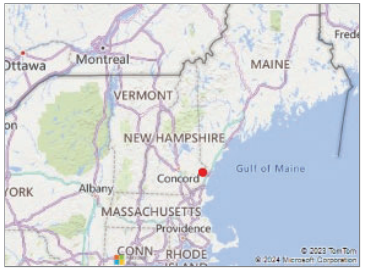
Map Scale

1: 5,000

Map Generated: 2/1/2024

Notes

Note that the depicted proposed turbidity monitoring locations are approximate.



Appendix I: NHB DataCheck Results Letter and Correspondence

NHB DataCheck Results Letter
NH Natural Heritage Bureau
Please note: maps and NHB record pages are **confidential** and shall be redacted from public documents.

To: Lauren Frank
30 Nathan Lord Rd
Amherst, NH 03031
lfrank@vhb.com

From: NHB Review
NH Natural Heritage Bureau
Main Contact: Ashley Litwinenko - nhbreview@dncr.nh.gov

cc: NHFG Review, Anthony Tur

Date: 07/21/2023 (valid until 07/21/2024)
Re: DataCheck Review by NH Natural Heritage Bureau and NH Fish & Game
Permits: NHDES - Shoreland Standard Permit, NHDES - Wetland Standard Dredge & Fill - Minimum, USACE - General Permit, USEPA - Stormwater Pollution Prevention

NHB ID: NHB23-2114

Town: Durham
Location: Mill Pond, Durham

Project Description: The Town proposes to remove the Oyster River Dam at Mill Pond due to concerns regarding its structural integrity/stability. The goals are to recreate the natural river channel and improve habitat quality, as eutrophication has degraded the impoundment. Integrated veg management will be employed within the drained impoundment to manage invasive species. NHB20-2530 was requested during the feasibility study phase. Amy Lamb's comments (dated 11/16/20) and other project documents are available on the Town's website. Coordination with NHF&G is ongoing (including topics such as fish passage and drawdown timeframes) and further coordination with NHB is planned.

Next Steps for Applicant:

NHB's database has been searched for records of rare species and exemplary natural communities. Please carefully read the comments and consultation requirements below.

NHB Comments: Based on our records it does not appear that the surveys Amy Lamb requested in a memo on November 16th, 2020 were ever conducted. If these surveys did occur please contact NHB with the results. If these surveys did not occur, please survey for all species as Amy Lamb noted in her memo and as seen below:

Recommended survey time frames:
Beck's water-marigold – when in flower: early August to early September
great bur-reed – when in flower (early July) or with mature achenes (mid-July to mid-September)
ivy-leaved duckweed - July to August
lake quillwort – mature megaspores required for identification: July to September

marsh horsetail – when in fruit June to July
arctic bur-reed – when flowering (beginning in mid-July) through fruiting (mid-September)

NHFG Comments: Please refer to NHFG consultation requirements below.

NHB Consultation

If this NHB DataCheck letter includes records of rare plants and/or natural communities/systems, please contact NHB and provide any requested supplementary materials by emailing nhbreview@dncr.nh.gov.

If this NHB DataCheck letter DOES NOT include any records of rare plants and/or natural communities/systems, no further consultation with NHB is required.

NH Fish and Game Department Consultation

If this NHB DataCheck letter DOES NOT include ANY wildlife species records, then, based on the information submitted, no further consultation with the NH Fish and Game Department pursuant to Fis 1004 is required.

If this NHB DataCheck letter includes a record for a threatened (T) or endangered (E) wildlife species, consultation with the New Hampshire Fish and Game Department under Fis 1004 may be required. To review the Fis 1000 rules (effective February 3, 2022), please go to https://wildlife.state.nh.us/wildlife/environmental-review.html. All requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent by mail, and **must include the NHB DataCheck results letter number and "Fis 1004 consultation request" in the subject line**.

If the NHB DataCheck response letter does not include a threatened or endangered wildlife species but includes other wildlife species (e.g., Species of Special Concern), consultation under Fis 1004 is not required; however, some species are protected under other state laws or rules, so coordination with NH Fish & Game is highly recommended or may be required for certain permits. While some permitting processes are exempt from required consultation under Fis 1004 (e.g., *statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule*), coordination with NH Fish & Game may still be required under the rules governing those specific permitting processes, and it is recommended you contact the applicable permitting agency. For projects not requiring consultation under Fis 1004, but where additional coordination with NH Fish and Game is requested, please email NHFGreview@wildlife.nh.gov, and include the NHB DataCheck results letter number and "review request" in the email subject line.
Contact NH Fish & Game at (603) 271-0467 with questions.

NHB Database Records:
The following record(s) have been documented in the vicinity of the proposed project.
Please see the map and detailed information about the record(s) on the following pages.

Natural Community	**State[1]**	**Federal**	**Notes**
Sparsely vegetated intertidal system	--	--	Threats to these communities are primarily alterations to the hydrology of the wetland (such as alterations that might affect the sheet flow of tidal waters across the intertidal flat) and increased input of nutrients and pollutants in storm runoff.

Plant species	**State[1]**	**Federal**	**Notes**
arctic bur-reed (*Sparganium natans*)*	T	--	
Beck's water-marigold (*Bidens beckii*)*	T	--	Threats to aquatic species include changes in water quality, e.g., due to pollution and stormwater runoff, and significant changes in water level.
great bur-reed (*Sparganium eurycarpum*)*	T	--	Threats to aquatic species include changes in water quality, e.g., due to pollution and stormwater runoff, and significant changes in water level.
ivy-leaved duckweed (*Lemna trisulca*)*	E	--	Threats to aquatic species include changes in water quality, e.g., due to pollution and stormwater runoff, and significant changes in water level.
lake quillwort (*Isoetes lacustris*)*	E	--	
marsh horsetail (*Equisetum palustre*)*	E	--	This wetland species, which occurs in marshes and wet meadows, would be threatened by changes to local hydrology, including increased nutrient input from stormwater runoff, and sedimentation from nearby disturbance. It also occurs on river and streambanks, where the primary threats would be direct destruction of plants or their habitat.

Vertebrate species	**State[1]**	**Federal**	**Notes**
American Brook Lamprey (*Lethenteron appendix*)*	E	--	Contact the NH Fish & Game Dept (see above).
American Eel (*Anguilla rostrata*)*	SC	--	Contact the NH Fish & Game Dept (see above).
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)	T	T	Contact the NH Fish & Game Dept (see above) and the US Fish & Wildlife Service (see below).
Banded Sunfish (*Enneacanthus obesus*)	SC	--	Contact the NH Fish & Game Dept (see above).

Blanding's Turtle (*Emydoidea blandingii*)*	E	--	Contact the NH Fish & Game Dept (see below).
New England Cottontail (*Sylvilagus transitionalis*)	E	--	Contact the NH Fish & Game Dept (see above).
Shortnose Sturgeon (*Acipenser brevirostrum*)	E	E	Contact the NH Fish & Game Dept (see above) and the US Fish & Wildlife Service (see below).
Sora (*Porzana carolina*)	SC	--	Contact the NH Fish & Game Dept (see above).
Spotted Turtle (*Clemmys guttata*)*	T	--	Contact the NH Fish & Game Dept (see below).
Swamp Darter (*Etheostoma fusiforme*)	SC	--	Contact the NH Fish & Game Dept (see above).

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list.

An asterisk (*) indicates that the most recent report for that occurrence was 20 or more years ago.

For all animal reviews, refer to 'IMPORTANT: NHFG Consultation' section above. Contact for federally-listed animals: Anthony Tur, US FWS, at (603) 223-2541.

Disclaimer: NHB's database can only tell you of known occurrences that have been reported to NHFG/NHB. Known occurrences are based on information gathered by qualified biologists or members of the public, reported to our offices, and verified by NHB/NHFG.

However, many areas have never been surveyed, or have only been surveyed for certain species.

NHB recommends surveys to determine what species/natural communities are present onsite.

From:	Dionne, Michael
To:	Nicole Martin
Cc:	Peter Walker; Winters, Melissa
Subject:	[External] FIS 1004 Consultation Request-NHB23-2114 - Oyster River Dam Removal at Mill Pond
Date:	Thursday, October 26, 2023 8:51:36 AM

Hi Nicole,
Based on the information submitted for NHB DataCheck review, NHFGD determined that, although there are NHB records for several fish and wildlife species present in the vicinity of the Mill Pond Dam Removal Project, we do not expect that they will be impacted significantly by the proposed project.

Many of the species listed such as the Atlantic and shortnose sturgeon, swamp darter, and American brook lamprey exist outside of the existing Mill Pond impoundment and should not be directly impacted by the dam removal. American eel exist throughout the Oyster River and will benefit from the removal of a barrier to their movement. Sora and New England cottontail may also benefit from the conversion of Mill Pond to a riverine system with increased shrub habitat and marshy river edge. However, amphibians and reptiles such as Blanding's turtle and spotted turtle may need some time to adapt to the change in their environment. It is our recommendation that the lowering of the impoundment be conducted during summer flow or sometime between late spring and early fall in general.

No further consultation with NHFGD is required.

Mike Dionne
Environmental Review Coordinator

NH Fish & Game Department
11 Hazen Drive
Concord, NH 03301
(603) 271-1136, michael.dionne@wildlife.nh.gov

New Hampshire Natural Heritage Bureau

Division of Forests & Lands - DNCR
172 Pembroke Road, Concord, NH 03301
(603) 271-2214 https://www.nh.gov/nhdfl/

November 16, 2020

Peter J. Walker
VHB
2 Bedford Farms Drive, Suite 200
Bedford, NH 03110
pwalker@vhb.com

RE: Oyster River Dam at Mill Pond, Durham: Draft Feasibility Study Comments

Dear Mr. Walker:

Thank you for providing NHB the opportunity to review and comment on the draft feasibility study for the Oyster River Dam at Mill Pond (NHDES Dam #071.03).

The NH Natural Heritage Bureau (NHB), under the Rare Plant Protection Act of 1987 (RSA 217-A), works to study, protect, and provide information on native plant species and natural communities in New Hampshire. NHB develops the list of State Threatened and Endangered plants in New Hampshire, and maintains a comprehensive statewide database of known occurrences of these species, as well as exemplary natural communities and natural community systems. In cooperation with the NH Fish & Game Department's Nongame and Endangered Wildlife Program, NHB also maintains the statewide database of threatened, endangered and special concern wildlife species. NHB databases are used for environmental review of projects permitted by State, Federal, and municipal organizations; NHB provides "DataChecks" with rare species and exemplary natural community information for this purpose.

NHB provided a DataCheck for the Oyster River Dam feasibility study, with information about known populations of State Listed plant species, Special Concern and State & Federally Listed wildlife species, and exemplary natural communities and systems that could be impacted by the various scenarios explored under the study (NHB20-2530). The DataCheck scope included the area of interest provided by VHB, consisting of Mill Pond and its impoundment, and surrounding areas. The DataCheck included one exemplary natural community, six (6) State Threatened or Endangered plant species, and six (6) tracked wildlife species. (*Note: this memo will not address wildlife species, as wildlife is under the jurisdiction of the NH Fish & Game Department*.)

The following four State Listed aquatic and wetland plant species have historically been documented within the impoundment of Mill Pond. Surveys have not been conducted since 1998, according to NHB database information; the current status of these populations is unknown. These species have the potential to be impacted by both dredging and significant changes in water level, as well as changes in salinity. They also have the potential to occur elsewhere in the study area.

Beck's water-marigold (*Bidens beckii*), T – while NHB database mapping only shows this plant as occurring at one location within Mill Pond, data for the occurrence indicate it is also present upstream. This species was documented in very shallow water, but it generally occurs in aquatic bed habitat. Portions of the population have been previously impacted by dredging activities. Last observed in 1995.

great bur-reed (*Sparganium eurycarpum*), T – this species can occur in a variety of wetland habitats, including emergent marshes, beaver-influenced wetlands, pondshores, wet meadows, ponds, rivershores,

forested swamps, shrub swamps, and brackish tidal marshes. This species occurs in the most varied habitats and may be the most likely to persist following a dam removal scenario. Last observed in 1995.

ivy-leaved duckweed (*Lemna trisulca*), E - This is a floating aquatic bed species that is unlikle to persist under a dam removal scenario. Last observed in 1998.

lake quillwort (*Isoetes lacustris*), E – This species occurs in lakes and slow-moving rivers, sometimes submerged but sometimes emergent in shallower waters. NHB records indicate that the placement of "Aquascreen panels" may have extirpated the population in the past. Last observed in 1978.

Two additional species have been observed in the vicinity, and could be present in areas of appropriate habitat:

marsh horsetail (*Equisetum palustre*), E – While documented along a nearby roadside, this species typically also occurs along rivershores and in/along edges of various wetland types.
arctic bur-reed (*Sparganium natans*), T – This species inhabits slow-moving rivers, ponds, fens, and other aquatic bed habitats.

Downstream of the dam, within the tidal portion of the Oyster River, is a mapped exemplary natural community. The **sparsely vegetated intertidal system** could be impacted by sediment release associated with dam removal, or dredging, to a lesser extent.

NHB recommends that surveys for all of the rare plant species listed above occur throughout the study area. Surveys throughout impact areas and the greater study area are crucial to assess the current status of the populations, and the potential impacts of drawdowns or dredging on plant communities. Additionally, establishing a complete picture of the vegetation communities throughout the study area will provide further information for possible restoration and mitigation activities. For example, surveys could identify appropriate transplant sites for impacted plants or previously undocumented rare species populations.

Recommended survey time frames:

Beck's water-marigold – when in flower: early August to early September
great bur-reed – when in flower (early July) or with mature achenes (mid-July to mid-September)
ivy-leaved duckweed - July to August
lake quillwort – mature megaspores required for identification: July to September
marsh horsetail – when in fruit June to July
arctic bur-reed – when flowering (beginning in mid-July) through fruiting (mid-September)

As discussed in the study, dam removal (Alternative 5) would reduce the amount of aquatic bed habitat as well as impact the hydrology of existing emergent wetlands, but convert several acres of existing aquatic bed to new emergent wetlands. A total of 10.8 acres would be affected, according to the study, resulting in additional habitat for some rare plant species while also resulting in a reduction of habitat for others. Some species may be able to persist under the change in conditions, while others would likely be unlikely to persist due to an intolerance for hydrological changes and salinity increases. Modeled sea level rise may eventually mitigate some of the anticipated drawdown conditions, but increases and salinity and the timescale of such sea level increases may not result in an overall benefit to rare plant species.

Under the restoration dredge scenario (Option 1), 2.4 acres of freshwater emergent and aquatic bed wetlands would be directly impacted, potentially impacting rare plant populations. While there may be a greater acreage of hydrologically-impacted wetlands under the dam removal scenario, NHB concurs that the overall

effect of restoring several hundred to thousands of feet of tidal connection with the Oyster River takes precendence over the maintenance of an artificial impoundment, even if the work results in impacts to the rare plant species documented in Mill Pond.

Please provide survey results to NHB as soon as surveys are complete. Depending on survey results, NHB will work with the consultant and/or the Town of Durham to develop mitigation options. Potential mitigation scenarios depend on the life history of the species, the range of conditions they tolerate, and the size and location(s) of any populations found, but may include seed collection, seed redistribution to appropriate habitat, transplanting, and monitoring of documented rare plant populations.

Should you have any questions or need additional information, please contact NHB.

Lastly, NHB requests that detailed rare plant species information (e.g., maps, detailed directions to populations) be redacted from publicly available documents.

Thank you for the opportunity to review and comment.

Sincerely,

Amy Lamb, Ecological Information Specialist, Natural Heritage Bureau

cc: Sabrina Stanwood, Administrator, Natural Heritage Bureau
NH Department of Natural and Cultural Resources Sabrina.stanwood@dncr.nh.gov

Phenology and habitat information sources:

Seymour, Frank C. 1982. The Flora of New England: A Manual for the Identification of All Vascular Plants Including Ferns and Fern Allies Growing Without Cultivation in New England. Harold N. Moldenke and Alma L. Moldenke, NJ.

Go Botany. 2020. https://gobotany.nativeplanttrust.org Native Plant Trust, MA.

NORM Phenology Information. 2020. Unpublished document. Native Plant Trust, MA.

NHB Database. 2020. Natural Heritage Bureau, NH.

Nicole Martin

From: Peter Walker
Sent: Thursday, January 25, 2024 11:58 AM
To: Stanwood, Sabrina
Cc: DNCR: NHB Review; Nicole Martin; April Talon; Gregg Moore (Gregg.Moore@unh.edu)
Subject: RE: [External] RE: Mill Pond Dam Removal (NHB23-2114) - Rare Plant Impacts and Mitigation
Attachments: 2024-01-25 Mill Pond Dam Removal NHB Coordination Letter.pdf

Hi Sabrina –

See the attached letter regarding the Mill Pond Dam project. I'll give you a call soon to check in on the status of the project. Thanks for your help!

Pete

Peter Walker
Principal
Environmental Services

P 603.391.3942

www.vhb.com

From: Stanwood, Sabrina <Sabrina.Stanwood@dncr.nh.gov>
Sent: Thursday, December 21, 2023 3:15 PM
To: Peter Walker <PWalker@VHB.com>
Cc: DNCR: NHB Review <nhbreview@dncr.nh.gov>; Nicole Martin <nmartin@vhb.com>
Subject: [External] RE: Mill Pond Dam Removal (NHB23-2114) - Rare Plant Impacts and Mitigation

Hi Peter,
Thank you for the meeting the other day, it was good to see visuals of the proposed project.
I wanted to follow up about NHB's comments on the Datacheck Letter. In a memo dated Nov. 16, 2020, Amy Lamb requested surveys for the species listed below. What are the status of the surveys? If they did occur, would you please contact NHB with the results?

Recommended survey time frames:
Beck's water-marigold – when in flower: early August to early September
great bur-reed – when in flower (early July) or with mature achenes (mid-July to mid-September)
ivy-leaved duckweed - July to August
lake quillwort – mature megaspores required for identification: July to September
marsh horsetail – when in fruit June to July
arctic bur-reed – when flowering (beginning in mid-July) through fruiting (mid-September)

Thank you,
Sabrina

Sabrina Stanwood, Administrator (she/her)
Natural Heritage Bureau (NHB)

Division of Forests & Lands - DNCR
172 Pembroke Rd., Concord, NH 03301
(mobile) 603-892-8824
https://www.mooseplate.com/
https://www.nh.gov/nhdfl/about-us/natural-heritage-bureau.htm
https://www4.des.state.nh.us/NHB-DataCheck/

From: Nicole Martin <nmartin@vhb.com>
Sent: Tuesday, December 19, 2023 2:33 PM
To: Stanwood, Sabrina <Sabrina.Stanwood@dncr.nh.gov>; Severance, Madeline <Madeline.P.Severance@dncr.nh.gov>
Cc: Peter Walker <PWalker@VHB.com>; Bouchard, Jessica <Jessica.R.Bouchard@dncr.nh.gov>
Subject: RE: Mill Pond Dam Removal (NHB23-2114) - Rare Plant Impacts and Mitigation

---

Hello Sabrina and Maddie,

We appreciate your time today to review the Mill Pond Dam Removal Project. Please refer to the attached slides, as requested. We will work on finalizing our meeting notes and composing the letter we discussed to share with you within the next week or two.

Thank you,

Nicole Martin, CWS
Environmental Scientist

P 603.391.3889

www.vhb.com

-----Original Appointment-----
From: Peter Walker <PWalker@VHB.com>
Sent: Tuesday, December 12, 2023 1:41 PM
To: Peter Walker
Cc: Nicole Martin
Subject: Mill Pond Dam Removal (NHB23-2114) - Rare Plant Impacts and Mitigation
When: Tuesday, December 19, 2023 1:00 PM-2:15 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Microsoft Teams Meeting

About 60-75 minutes to review the proposed Mill Pond Dam removal project on the Oyster River in Durham (NHB23-2114) including the status of updated rare plant field studies, and discussion of likely impacts, and plans to help mitigate the probable effects.

Gregg – Please join us if you are available.

Hopefully next Tuesday afternoon still works for others!

Microsoft Teams meeting

Join on your computer, mobile app or room device
Click here to join the meeting

Meeting ID: 267 450 221 925
Passcode: 28aGEV
Download Teams | Join on the web

Or call in (audio only)
+1 508-556-4407,,777135249# United States, Worcester
Phone Conference ID: 777 135 249#
Find a local number | Reset PIN

Learn More | Meeting options | Legal

January 25, 2024

Ref: 52633.03

Sabrina Stanwood
Natural Heritage Bureau Administrator
172 Pembroke Road
Concord, NH 03301

Re: Oyster River Dam Removal at Mill Pond - Durham, NH
NHB23-2114 Coordination

Dear Ms. Stanwood:

We appreciated your time reviewing this project during our meeting on December 19, 2023. The notes and presentation materials for that meeting are attached. Please let us know if you have any comments or corrections.

As we move forward with the project, we intend to continue to work with Dr. Gregg Moore to obtain updated information on the presence or likely absence of the listed plant species for Mill Pond based on his field research and use of Mill Pond as a laboratory for his undergraduate classes. As discussed during our meeting, Dr. Moore verified that *Lemna trisulca* and both *Sparganium* species were present in Mill Pond in Fall 2023. If required, we can continue field work in the spring and summer of 2024 to finalize information on the current distribution of the species listed in the Natural Heritage Bureau's (NHB) DataCheck Report (NHB23-2114). Alternatively, as NHB suggested during our recent meeting, we may simply assume species presence as we develop project-specific conservation measures in collaboration with your office.

There will likely be effects on many of the identified species in the NHB database. Refer to **Table 1** below and the attached **Meeting Notes** for more information.

Table 1: Abbreviated Impact Assessment by Plant Species

NHB23-2114 Species		State Listing Status	Comments
arctic bur-reed	*Sparganium natans*	T	Verified to occur in Mill Pond, Fall 2023. These species will be impacted but may eventually benefit from the dam removal through the expected increase in emergent habitat within the drained impoundment.
great bur-reed	*Sparganium eurycarpum*	T	
ivy-leaved duckweed	*Lemna trisulca*	E	*Lemna trisulca* is present within Mill Pond based on observations by Dr. Gregg Moore, Fall 2023. *L. trisulca* and other species of *Lemna* present within the pond would be significantly affected by dam removal and may

			not persist post-dam removal due to the loss of stagnant open water habitat.
Beck's water-marigolds	*Bidens beckii*	T	We are unsure of current species status within Mill Pond. If present, this aquatic species would be affected and may not persist following removal due to the loss of shallow open water and aquatic bed habitat.
lake quillwort	*Isoetes lacustris*	E	This species may no longer be present within Mill Pond. Last recorded sighting was in 1978. This species prefers habitats with good water quality and the Mill Pond water quality has significantly declined (i.e., eutrophication) since this plant was observed.
marsh horsetail	*Equisetum palustre*	E	Occurrence of this species in the impoundment is currently unknown. However, dam removal may lead to an increase in marsh habitat, particularly within the Hamel Brook reach, which might eventually benefit the species.

To help mitigate impacts on these species, VHB intends to require the salvage and reuse of some portion of excavated topsoil within the proposed active channel restoration area and the temporarily impact areas as that soil may contain seeds from the identified species. Additionally, there may be an opportunity to collaboratively develop one or more plant rescue plans whereby rootstock or reproductive material could be collected from one or more of the affected populations prior to construction and relocated within the impoundment or to an offsite area of suitable habitat (approved by NHB).

Despite the proposed project impacts, we believe the project will yield an overall environmental benefit by allowing the site to transition back to a native and sustainable ecosystem which should resemble in many ways its pre-impoundment conditions. We also emphasize that this project has applied principals of natural channel design and incorporates an integrated vegetation management plan to prevent colonization by invasive species.

We welcome NHB feedback as we finalize best management practices prior to, during, and post-construction to manage impacts to the listed plant species within Mill Pond. Please don't hesitate to contact me or Nicole Martin if you have any comments or need additional information.

Sincerely,

VHB

Peter J. Walker
Principal, Environmental Services

cc: April Talon, Town of Durham
Gregg Moore, UNH

Attachments
NHB23-2114 DataCheck Results Letter
12/19/23 Meeting Notes
12/19/23 Meeting Slides

Meeting Notes

Date:	12/19/2023	Notes Taken By:	VHB
Place:	Virtual, Microsoft Teams 1:00 PM – 2:00 PM	Re:	NHB Coordination Meeting Mill Pond Dam Removal, Durham, NH
Project No.:	52633.03		

NHB ATTENDEES: Sabrina Stanwood and Maddie Severance
VHB ATTENDEES: Peter Walker and Nicole Martin

Meeting Intent

The intent of this meeting was to initiate coordination with NHB on this project and determine the best approach to minimize impacts to the listed species while maintaining the project schedule. We wanted to engage NHB proactively given the complexity of this project.

Action items are noted in **dark teal bold** font.

Presentation and Embedded Discussion Notes

- Project Timeline: Submit the wetlands permit application to NHDES in January 2024 and remove the dam during low flow in 2024 (after July 1st due to the anadromous fish run).

- Project Background Summary:
  - This project has many public funds, including a grant from NOAA.
  - The dam is located at the head of tide. Dam removal will allow some tidal flows into the current impounded area. The drained impoundment area will mostly be freshwater emergent/scrub-shrub habitat that will transition to more brackish/tidal conditions over time, especially accounting for climate change (~2.9 feet of relative sea level rise in this area). Without sea level rise, tidal action would be limited to the restored river channel within the Mill Pond impoundment.
  - The pond isn't functioning as an open water system. During the growing season, it is essentially aquatic bed and emergent marsh habitat.
  - Limits of the existing impoundment extend upstream beyond Mill Pond into the Middle Impoundment and Hamel Brook. The slides (*already provided to the meeting attendings via email*) show figures demonstrating the existing versus post-dam removal water levels within the impoundment.
  - Feasibility Study (Nov 2020) and Supplemental Analysis (July 2021) available online.
    - The Feasibility Study can be accessed at: oyster_river_dam_at_mill_pond_feasibility_study_-_final.pdf (durham.nh.us)
    - The Supplemental Analysis can be accessed at: oyster_river_dam_at_mill_pond_-_supplemental_analysis_final.pdf (durham.nh.us)
  - The Town proposes to remove most of the dam infrastructure but retain some dam and mill foundation remnants to the south for historic preservation purposes.

- Active channel restoration is proposed upstream of the existing dam location with natural design techniques (i.e., stone cross vanes, j hooks, log vanes, bounder clusters, root wads, etc.) to make the restored channel look natural. No angular riprap is proposed within the river channel.
- Approximately ~4,500 cubic yards of sediment will be excavated to restore the upstream channel.
- An integrated vegetation management plan is being developed that will be implemented within the drained impoundment area to prevent colonization by invasive species, in collaboration with Ellen Snyder (Ibis Wildlife Consulting), Dr. Tom Lee (UNH Professor), and Doug Cygan (NH Department of Agriculture Invasive Species Coordinator).
- Dr. Gregg Moore (UNH Professor) teaches aquatic biology and has been taking his students to Mill Pond for years. He has mapped plant populations within Mill Pond and has been using this site as an outdoor lab for many years. We are actively coordinating with him to update and share his data.
- Alternatively, in lieu of updated surveys, NHB noted that we could just assume species presence and implement best management practices (BMPs) accordingly.

› NHB DataCheck Report (NHB23-2114) identified the following species:
- **arctic bur-reed** (*Sparganium natans*) and **great bur-reed** (*Sparganium eurycarpum*) – both state threatened
  - Dr. Moore has verified the presence of *Sparganium* species within Mill Pond. The post-dam removal emergent habitat increase may benefit these species.
- **ivy-leaved duckweed** (*Lemna trisulca*) - state endangered
  - Dr. Moore has verified the presence of numerous species of duckweed within Mill Pond, including some common species. Duckweed likely would not persist within the site post-dam removal due to the loss of stagnant open water habitat.
- **Beck's water-marigolds** (*Bidens beckii*) - state threatened
  - We have no new information about this species beyond what is contained in the NHB report.
- **lake quillwort** (*Isoetes lacustris*) - state endangered
  - This genus can be cryptic and can be very difficult to locate in the field since it is quite small. However, plants in this genus tend to prefer habitats with good water quality and the last recorded sighting was in 1978. Therefore, it is possible this species is no longer present within Mill Pond.
- **marsh horsetail** (*Equisetum palustre*) - state endangered
  - We are not too concerned about project impacts to this species, as it is mapped far upstream from the site and because it's preferred habitat will likely become more abundant following dam removal.

- NHF&G had many vertebrate species records on the NHB DataCheck Report, and we completed consultation with NHF&G/Mike Dionne. Ultimately, the project benefits outweigh the short-term impacts and many of the identified animal species would be benefited and could adapt to the habitat changes.

Discussion Notes

› NHB Project Impression: NHB recognizes that this project will yield environmental benefits despite some initial adverse impacts to plant populations within the Mill Pond impoundment.

- Plant Preservation Approach: One option could be to take the first 2-4 inches of topsoil and redistribute in an appropriate suitable habitat (such as Hamel Brook) with some post-construction monitoring, assuming that soil might have some seeds from the identified listed species.
    - Contamination: In light of the soil contamination identified within the site, it may be prudent to remove and stockpile excavated topsoil from the area of proposed active channel restoration that can be used to restore temporary impacts within the Mill Pond impoundment (such as over the compacted soil beneath the temporary access road post-construction), as opposed to spreading contaminated soil elsewhere outside of the site.
    - Success Criteria: It was determined that this project would be a best effort learning exercise as opposed to having strict success/survivorship criteria.
    - Plant Species Status: We are currently considering all listed species equally, but NHB noted that preservation of the endangered species would take priority over the threatened species.

- Record: To document this meeting and update the digital project record, VHB will compose a letter and transmit via email. That way, NHB can easily review and respond via email to confirm the conclusions reached during this meeting and documented in these notes. This will provide documentation for the wetlands permit application with a commitment to continue to work closely with NHB to develop best management practices prior to, during, and post-construction to manage impacts to the listed plant species in Mill Pond that NHDES could incorporate as a permit condition.

Mill Pond Dam on the Oyster River

NHB Coordination Meeting

December 19, 2023

1

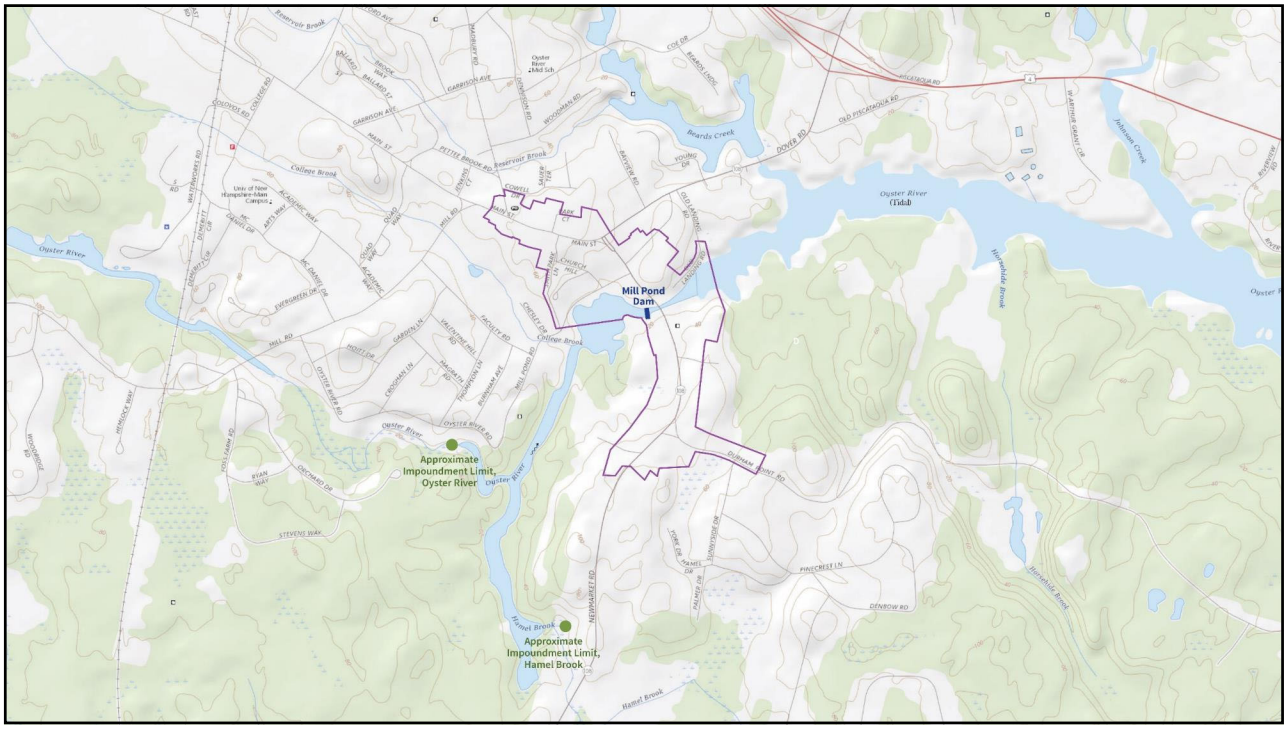
Parameter	Measure
Age	Built in 1913 (Listed on NH Register)
Size	140 ft X 13 ft
50-year Flow (Spillway Design Flow)	3,352 cfs
Existing Spillway Capacity	1,015 cfs
Existing Spillway Capacity, with Freeboard	352 cfs

A view of the Oyster River Dam, looking upstream from the NH 108 Bridge.

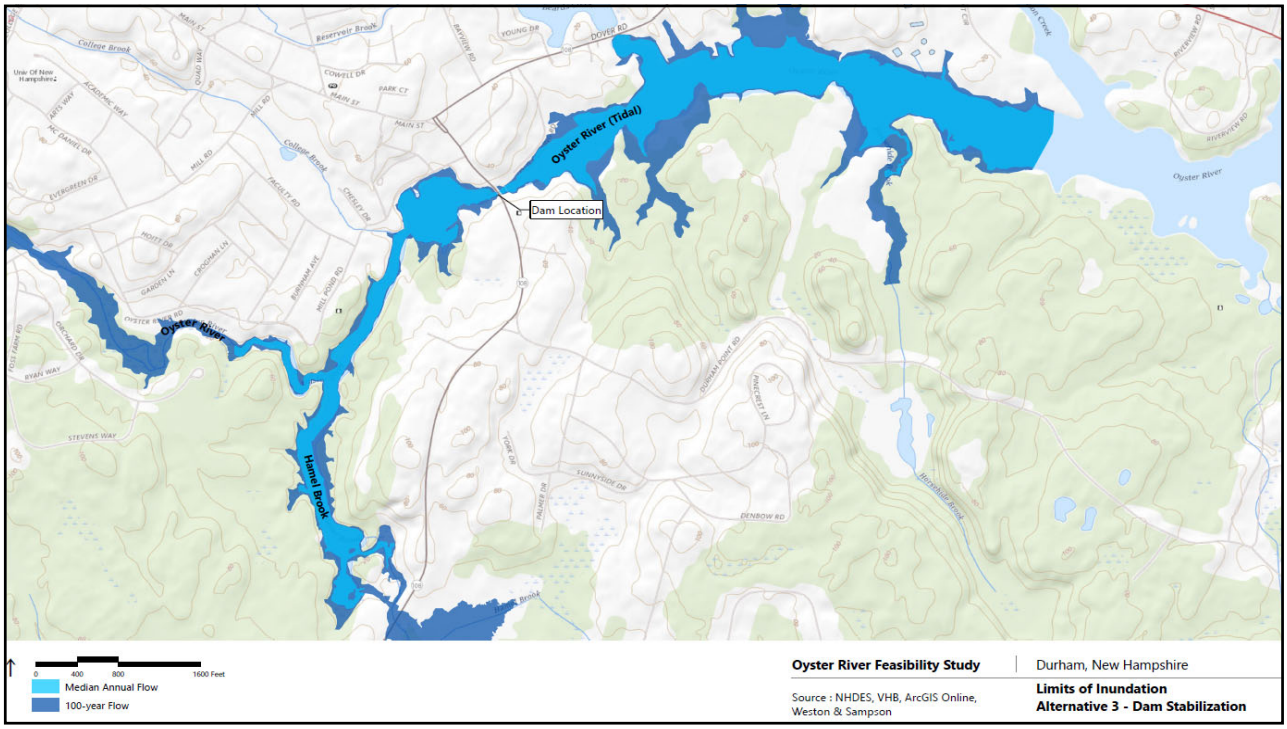
2


Oyster River Dam
at Mill Pond
Mill Pond
Oyster River (Tidal)
September 29, 2021

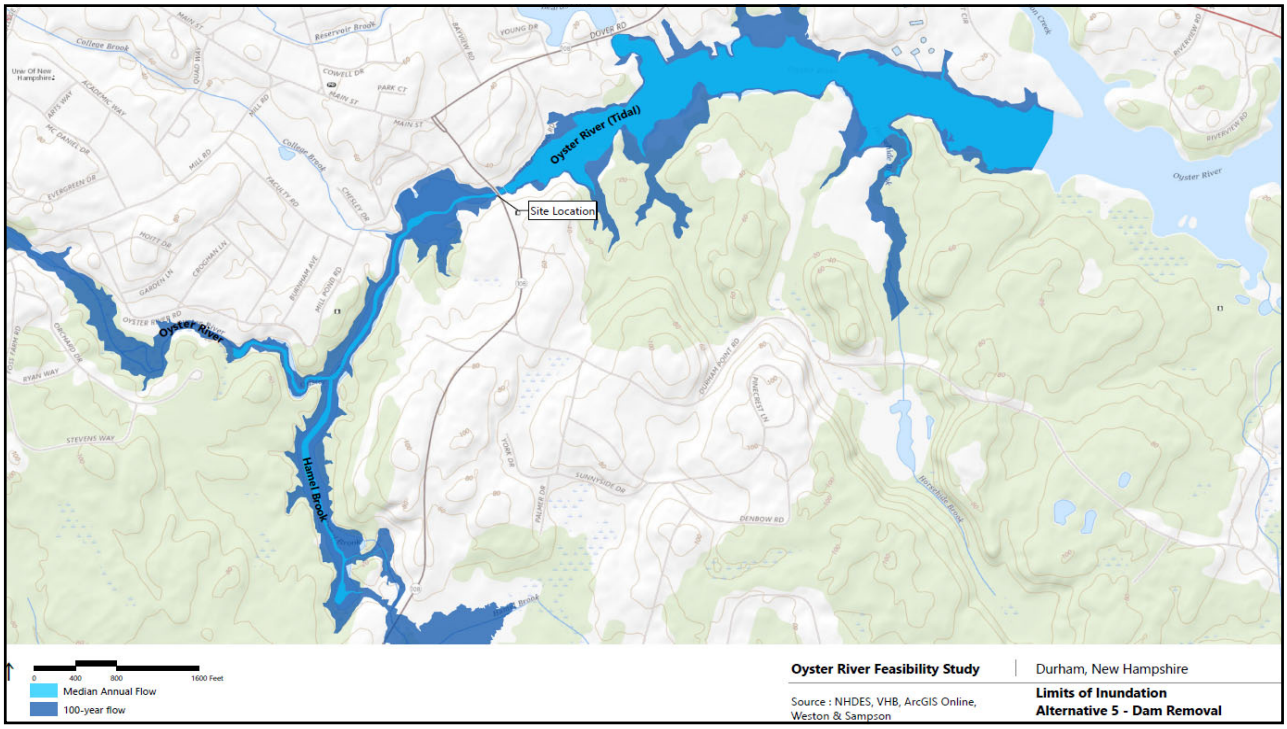
3


Mill Pond
Dam
Approximate
Impoundment Limit,
Oyster River
Approximate
Impoundment Limit,
Hamel Brook
Oyster River
(Tidal)
Beards Creek
College Brook
Reservoir Brook
Hamel Brook

4

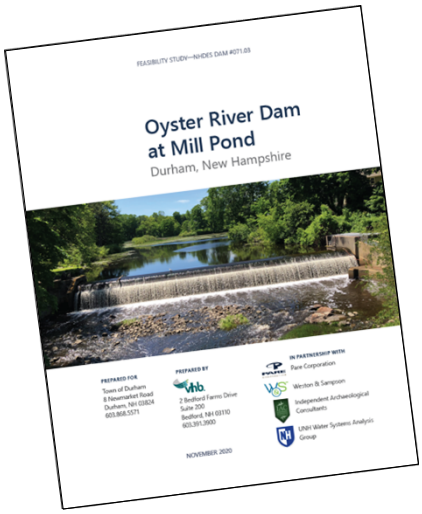

Oyster River (Tidal)
Dam Location
Oyster River
Hamel Brook
0 400 800 1600 Feet
Median Annual Flow
100-year Flow
Oyster River Feasibility Study
Durham, New Hampshire
Source : NHDES, VHB, ArcGIS Online, Weston & Sampson
Limits of Inundation
Alternative 3 - Dam Stabilization

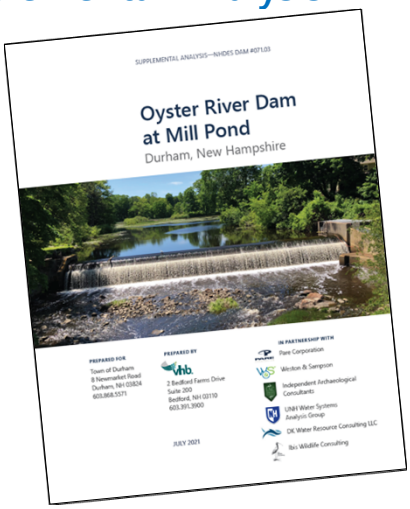
5


Oyster River (Tidal)
Site Location
Oyster River
Hamel Brook
0 400 800 1600 Feet
Median Annual Flow
100-year flow
Oyster River Feasibility Study
Durham, New Hampshire
Source : NHDES, VHB, ArcGIS Online, Weston & Sampson
Limits of Inundation
Alternative 5 - Dam Removal

6

Feasibility Study and Supplemental Analysis



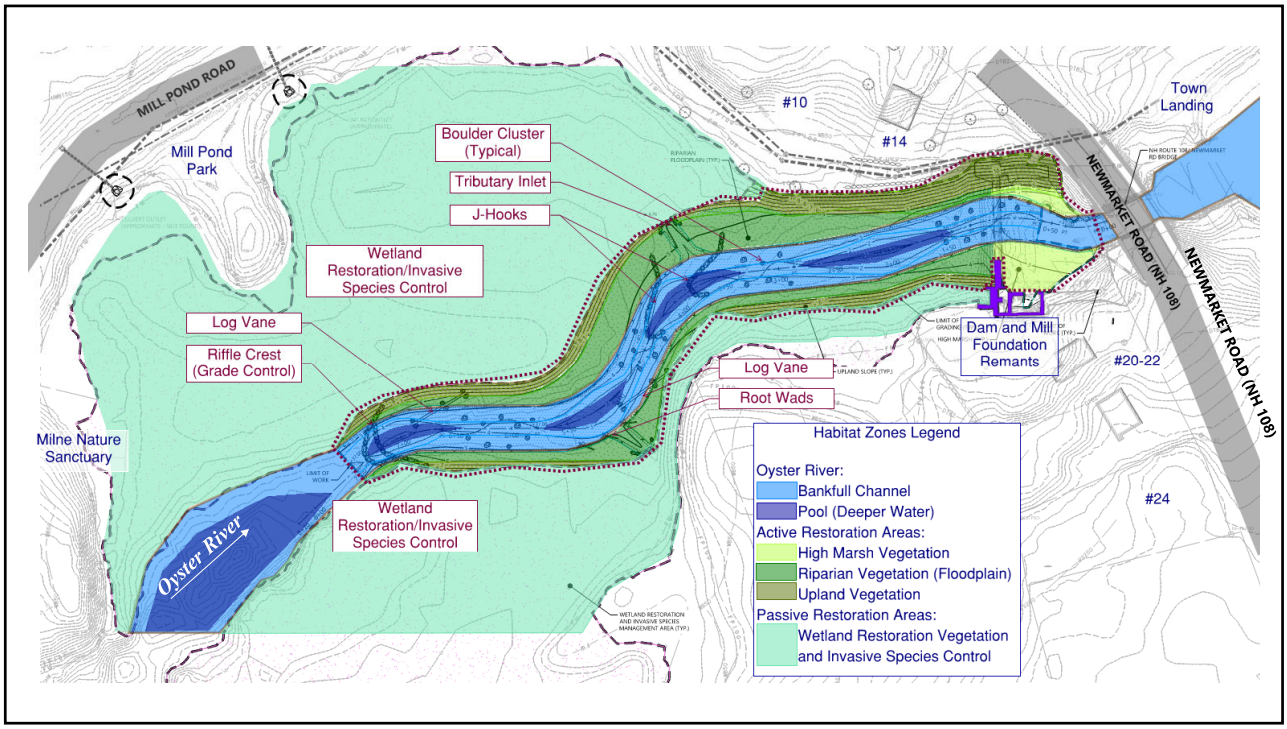


Oyster River Dam at Mill Pond Current Information and Feasibility Study | The Town of Durham New Hampshire
https://www.ci.durham.nh.us/publicworks/oyster-river-dam-mill-pond-current-information-and-feasibility-study

7

Dam Removal and Active Channel Restoration

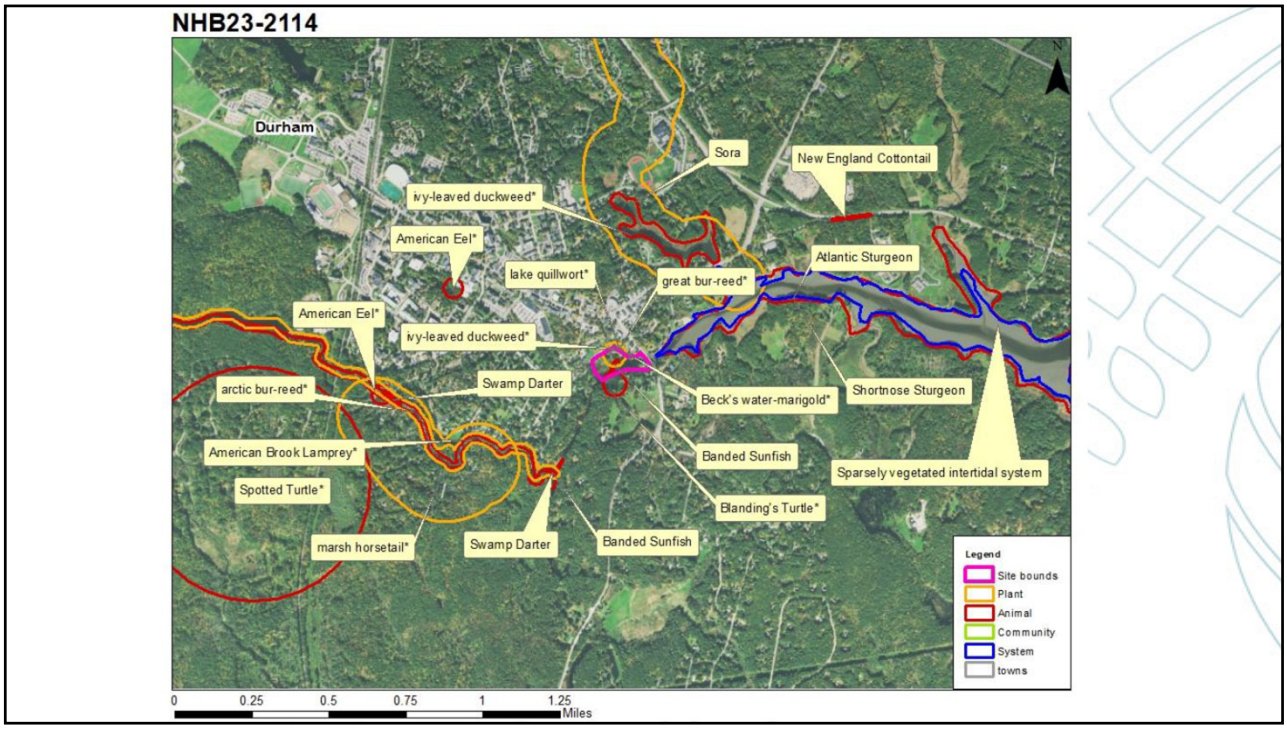
8



9

Riffle Crest/Stone Cross-Vane

10



11

NHB DataCheck Report (NHB23-2114)
Natural Community and Plant Records

Natural Community	State[1]
Sparsely vegetated intertidal system	--

Plant species	State[1]
arctic bur-reed (*Sparganium natans*)*	T
Beck's water-marigold (*Bidens beckii*)*	T
great bur-reed (*Sparganium eurycarpum*)*	T
ivy-leaved duckweed (*Lemna trisulca*)*	E
lake quillwort (*Isoetes lacustris*)*	E
marsh horsetail (*Equisetum palustre*)*	E

NHB Comments: Based on our records it does not appear that the surveys Amy Lamb requested in a memo on November 16th, 2020 were ever conducted. If these surveys did occur please contact NHB with the results. If these surveys did not occur, please survey for all species as Amy Lamb noted in her memo and as seen below:

Recommended survey time frames:
Beck's water-marigold – when in flower: early August to early September
great bur-reed – when in flower (early July) or with mature achenes (mid-July to mid-September)
ivy-leaved duckweed - July to August
lake quillwort – mature megaspores required for identification: July to September
marsh horsetail – when in fruit June to July
arctic bur-reed – when flowering (beginning in mid-July) through fruiting (mid-September)

12

NHB DataCheck Report (NHB23-2114) Animal Records

Vertebrate species	State[1]	Federal
American Brook Lamprey (*Lethenteron appendix*)*	E	--
American Eel (*Anguilla rostrata*)*	SC	--
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)	T	T
Banded Sunfish (*Enneacanthus obesus*)	SC	--
Blanding's Turtle (*Emydoidea blandingii*)*	E	--
New England Cottontail (*Sylvilagus transitionalis*)	E	--
Shortnose Sturgeon (*Acipenser brevirostrum*)	E	E
Sora (*Porzana carolina*)	SC	--
Spotted Turtle (*Clemmys guttata*)*	T	--
Swamp Darter (*Etheostoma fusiforme*)	SC	--

- Coordination with NHF&G was completed in October 2023 outside of the formal Fis 1004 process. **NHF&G does not expect that the listed vertebrate species will be impacted significantly by the proposed project.**
  - Recommended lowering the impoundment in summer (between late spring and early fall).
- Some species are present outside the impoundment and wouldn't be directly impacted. Others would benefit from removal of the barrier to upstream fish passage.
- Cottontail may benefit from conversion of the impoundment to a shrub habitat and marshy river edge.
- Turtles and amphibians may take some time to adapt to the changes.

13

Photos of Plants in Impoundment

Photo 7: Representative view south of the western portion of Mill Pond, taken from near Mill Pond Park. 07/12/2023.

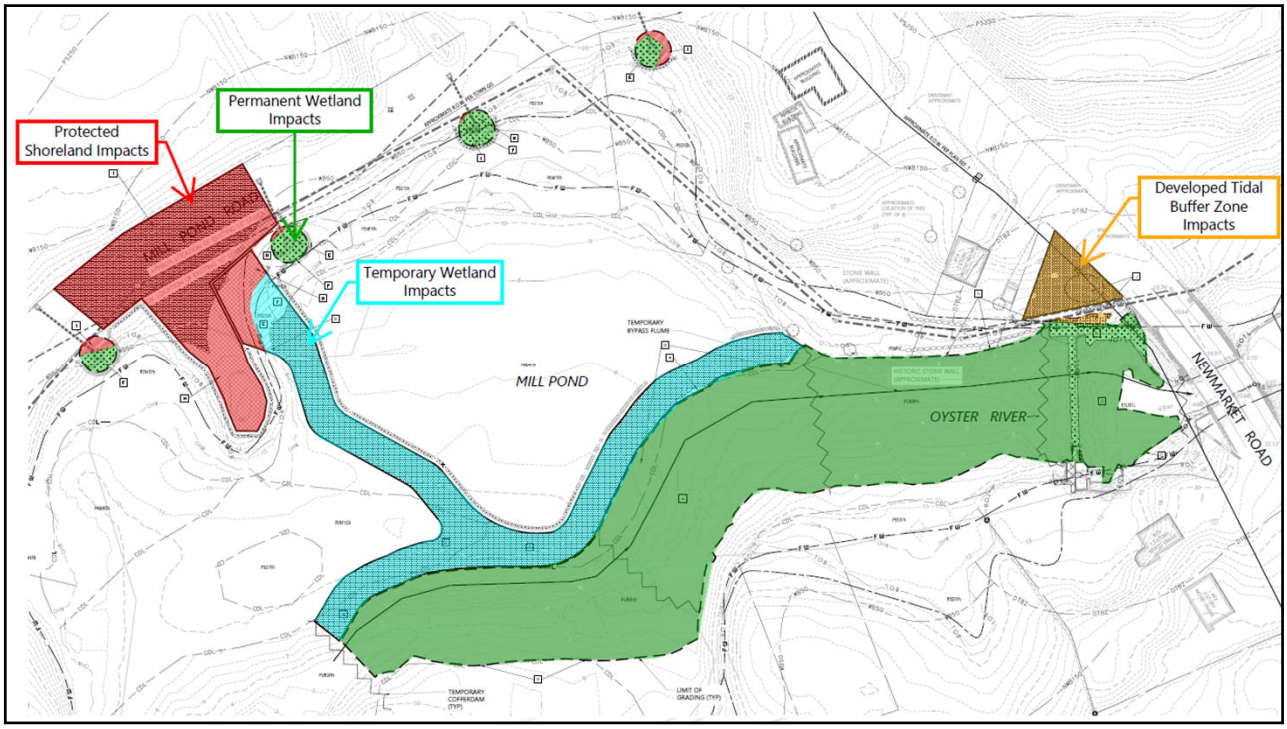
Photo 8: Representative view northeast of Mill Pond taken from Mill Pond Park. Note the prevalence of algae and floating vascular plants covering the water surface. 07/12/2023.

14

Oyster River Dam at Mill Pond – Projected Timeline

Projected Date	Task/Milestone
Summer/Fall 2022	• Grant Writing • Final Surveys • Section 106 Consultation
Winter 2022/Spring 2023	• Preliminary Plans (10%) • Section 106 Consultation • Natural Resource Surveys
Summer 2023	• 50% Design • Section 106 Consultation
Winter 2023/2024	• **Permit Applications** • **Section 106 Consultation – Mitigation** • **Advertise for Contractor Bids**
Winter/Spring 2024	• Section 106 – Execute MOA • Final Plans (100% Construction)
Spring 2024	• **Permit Decisions**
Summer/Fall 2024	• **Dam Removal (Pending Permitting)**

15



20

Appendix J: USFWS IPaC Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: January 19, 2024
Project Code: 2023-0103980
Project Name: Oyster River Dam Removal at Mill Pond

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through IPaC by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see Migratory Bird Permit | What We Do | U.S. Fish & Wildlife Service (fws.gov).

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

PROJECT SUMMARY

Project Code: 2023-0103980
Project Name: Oyster River Dam Removal at Mill Pond
Project Type: Dam - Removal
Project Description: The Town of Durham proposes to remove the Oyster River Dam at Mill Pond due to concerns regarding its structural integrity/stability. The goals are to recreate the natural river channel upstream of the dam and improve habitat quality, as eutrophication has degraded the impoundment. Integrated vegetation management will be employed within the drained impoundment to manage invasive species. Limited tree clearing may be required along the pond bank near Mill Pond Road to facilitate construction access. All work will occur under dry conditions (e.g., behind cofferdams with water diversion). Detailed project information is available on the Town's website at https://www.ci.durham.nh.us/publicworks/oyster-river-dam-mill-pond-current-information-and-feasibility-study.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@43.13074745,-70.92030598374492,14z

Counties: Strafford County, New Hampshire

ENDANGERED SPECIES ACT SPECIES

There is a total of 3 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Endangered

BIRDS

NAME	STATUS
Roseate Tern *Sterna dougallii dougallii* Population: Northeast U.S. nesting population No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2083	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: VHB, Inc.
Name: Nicole Martin
Address: 2 Bedford Farms Drive
Address Line 2: Suite 200
City: Bedford
State: NH
Zip: 03110
Email nmartin@vhb.com
Phone: 6033913900

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Army Corps of Engineers

Appendix K: EFH Mapper Reports

Upstream of the dam, west of Newmarket Road.

EFH Mapper Report

EFH Data Notice

Essential Fish Habitat (EFH) is defined by textual descriptions contained in the fishery management plans developed by the regional fishery management councils. In most cases mapping data can not fully represent the complexity of the habitats that make up EFH. This report should be used for general interest queries only and should not be interpreted as a definitive evaluation of EFH at this location. A location-specific evaluation of EFH for any official purposes must be performed by a regional expert. Please refer to the following links for the appropriate regional resources.

Greater Atlantic Regional Office
Atlantic Highly Migratory Species Management Division

Query Results

Degrees, Minutes, Seconds: Latitude = 43° 7' 52" N, Longitude = 71° 4' 52" W
Decimal Degrees: Latitude = 43.131, Longitude = -70.919

The query location intersects with spatial data representing EFH and/or HAPCs for the following species/management units.

*** W A R N I N G ***

Please note under "Life Stage(s) Found at Location" the category "ALL" indicates that all life stages of that species share the same map and are designated at the queried location.

EFH

Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
		Atlantic Butterfish	Adult	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
		Atlantic Cod	Eggs, Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
		Atlantic Herring	Adult, Juvenile, Larvae	New England	Amendment 3 to the Atlantic Herring FMP
		Atlantic Mackerel	Eggs, Juvenile, Larvae	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
		Atlantic Sea Scallop	ALL	New England	Amendment 14 to the Atlantic Sea Scallop FMP
		Atlantic Wolffish	ALL	New England	Amendment 14 to the Northeast Multispecies FMP

Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
		Bluefish	Adult, Juvenile	Mid-Atlantic	Bluefish
		Little Skate	Adult, Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		Pollock	Eggs, Juvenile, Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
		Red Hake	Adult, Eggs/Larvae/Juvenile	New England	Amendment 14 to the Northeast Multispecies FMP
		Smooth Skate	Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		Thorny Skate	Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		White Hake	Adult, Eggs, Juvenile	New England	Amendment 14 to the Northeast Multispecies FMP
		Windowpane Flounder	Adult, Eggs, Juvenile, Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
		Winter Flounder	Eggs, Juvenile, Larvae/Adult	New England	Amendment 14 to the Northeast Multispecies FMP
		Winter Skate	Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP

Pacific Salmon EFH

No Pacific Salmon Essential Fish Habitat (EFH) were identified at the report location.

Atlantic Salmon

No Atlantic Salmon were identified at the report location.

HAPCs

No Habitat Areas of Particular Concern (HAPC) were identified at the report location.

EFH Areas Protected from Fishing

No EFH Areas Protected from Fishing (EFHA) were identified at the report location.

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data.
****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data. ****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**
All EFH species have been mapped for the Greater Atlantic region, **Atlantic Highly Migratory Species EFH**, Bigeye Sand Tiger Shark, Bigeye Sixgill Shark, Caribbean Sharpnose Shark, Galapagos Shark, Narrowtooth Shark, Sevengill Shark, Sixgill Shark, Smooth Hammerhead Shark, Smalltail Shark

Downstream of the dam, east of Newmarket Road.

EFH Mapper Report

EFH Data Notice

Essential Fish Habitat (EFH) is defined by textual descriptions contained in the fishery management plans developed by the regional fishery management councils. In most cases mapping data can not fully represent the complexity of the habitats that make up EFH. This report should be used for general interest queries only and should not be interpreted as a definitive evaluation of EFH at this location. A location-specific evaluation of EFH for any official purposes must be performed by a regional expert. Please refer to the following links for the appropriate regional resources.

Greater Atlantic Regional Office
Atlantic Highly Migratory Species Management Division

Query Results

Degrees, Minutes, Seconds: Latitude = 43° 7' 56" N, Longitude = 71° 5' 4" W
Decimal Degrees: Latitude = 43.132, Longitude = -70.915

The query location intersects with spatial data representing EFH and/or HAPCs for the following species/management units.

*** W A R N I N G ***

Please note under "Life Stage(s) Found at Location" the category "ALL" indicates that all life stages of that species share the same map and are designated at the queried location.

EFH

Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
		Atlantic Butterfish	Adult	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
		Atlantic Cod	Eggs, Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
		Atlantic Herring	Adult, Juvenile, Larvae	New England	Amendment 3 to the Atlantic Herring FMP
		Atlantic Mackerel	Eggs, Juvenile, Larvae	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
		Atlantic Sea Scallop	ALL	New England	Amendment 14 to the Atlantic Sea Scallop FMP
		Atlantic Wolffish	ALL	New England	Amendment 14 to the Northeast Multispecies FMP

Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
		Bluefin Tuna	Adult	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
		Bluefish	Adult, Juvenile	Mid-Atlantic	Bluefish
		Little Skate	Adult, Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		Pollock	Eggs, Juvenile, Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
		Red Hake	Adult, Eggs/Larvae/Juvenile	New England	Amendment 14 to the Northeast Multispecies FMP
		Smooth Skate	Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		Thorny Skate	Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		White Hake	Adult, Eggs, Juvenile	New England	Amendment 14 to the Northeast Multispecies FMP
		Windowpane Flounder	Adult, Eggs, Juvenile, Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
		Winter Flounder	Eggs, Juvenile, Larvae/Adult	New England	Amendment 14 to the Northeast Multispecies FMP
		Winter Skate	Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP

Pacific Salmon EFH

No Pacific Salmon Essential Fish Habitat (EFH) were identified at the report location.

Atlantic Salmon EFH / HAPC

Link	Data Caveat	Name	Designation	Lifestage	Management Council	FMP
		Coastal Areas	EFH	All	New England	Amendment 3 to the Atlantic Salmon FMP

HAPCs

No Habitat Areas of Particular Concern (HAPC) were identified at the report location.

EFH Areas Protected from Fishing

No EFH Areas Protected from Fishing (EFHA) were identified at the report location.

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data. ****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**
All EFH species have been mapped for the Greater Atlantic region, **Atlantic Highly Migratory Species EFH**, Bigeye Sand Tiger Shark, Bigeye Sixgill Shark, Caribbean Sharpnose Shark, Galapagos Shark, Narrowtooth Shark, Sevengill Shark, Sixgill Shark, Smooth Hammerhead Shark, Smalltail Shark

Appendix L: Cultural Resource Documentation

Please mail the completed form and required material to:

New Hampshire Division of Historical Resources
State Historic Preservation Office
Attention: Review & Compliance
19 Pillsbury Street, Concord, NH 03301-3570

RECEIVED
NOV 06 2020

DHR Use Only	
R&C #	12197
Log In Date	11/6/20
Response Date	___/___/___
Sent Date	___/___/___

Request for Project Review by the New Hampshire Division of Historical Resources

☒ This is a new submittal
☐ This is additional information relating to DHR Review & Compliance (R&C) #:

GENERAL PROJECT INFORMATION

Project Title Oyster River Dam at Mill Pond, Durham, NH Feasibility Study

Project Location Oyster River west of Newmarket Road/NH Route 108

City/Town Durham Tax Map 3-3, 6-6, 9-3, 11-0 Lot # 3-3, 6-6, 9-3, 11-0

NH State Plane - Feet Geographic Coordinates: Easting 1184004 Northing 230837
(See RPR Instructions and R&C FAQs for guidance.)

Lead Federal Agency and Contact *(if applicable)*
(Agency providing funds, licenses, or permits)
Permit Type and Permit or Job Reference #

State Agency and Contact *(if applicable)* NH Department of Environmental Services

Permit Type and Permit or Job Reference #

APPLICANT INFORMATION

Applicant Name Town of Durham, c/o April Talon, PE

Mailing Address 8 Newmarket Road Phone Number (603) 868-5578

City Durham State NH Zip 03824 Email atalon@ci.durham.nh.us

CONTACT PERSON TO RECEIVE RESPONSE

Name/Company Peter Walker, VHB

Mailing Address 200 Bedford Farms Road, #200 Phone Number 603-391-3900

City Bedford State NH Zip 03110 Email pwalker@vhb.com

This form is updated periodically. Please download the current form at www.nh.gov/nhdhr/review. *Please refer to the Request for Project Review Instructions for direction on completing this form.* Submit one copy of this project review form for each project for which review is requested. Include a self-addressed stamped envelope to expedite review response. Project submissions will not be accepted via facsimile or e-mail. This form is required. Review request form must be complete for review to begin. Incomplete forms will be sent back to the applicant without comment. Please be aware that this form may only initiate consultation. For some projects, additional information will be needed to complete the Section 106 review. All items and supporting documentation submitted with a review request, including photographs and publications, will be retained by the DHR as part of its review records. Items to be kept confidential should be clearly identified. For questions regarding the DHR review process and the DHR's role in it, please visit our website at: www.nh.gov/nhdhr/review or contact the R&C Specialist at marika.labash@dncr.nh.gov or 603.271.3558.

PROJECTS CANNOT BE PROCESSED WITHOUT THIS INFORMATION

Project Boundaries and Description

- ☒ Attach the Project Mapping ***using EMMIT or relevant portion of a 7.5' USGS Map.*** *(See RPR Instructions and R&C FAQs for guidance.)*
- ☒ Attach a detailed narrative description of the proposed project.
- ☒ Attach a site plan. The site plan should include the project boundaries and areas of proposed excavation.
- ☒ Attach photos of the project area (overview of project location and area adjacent to project location, and specific areas of proposed impacts and disturbances.) *(Informative photo captions are requested.)*
- ☒ A DHR records search must be conducted to identify properties within or adjacent to the project area. Provide records search results via EMMIT or in **Table 1**. *(Blank table forms are available on the DHR website.)*
  EMMIT or in-house records search conducted on 10/23/2019.

Architecture

Are there any buildings, structures (bridges, walls, culverts, etc.) objects, districts or landscapes within the project area? ☒ Yes ☐ No
If no, skip to Archaeology section. If yes, submit all of the following information:

Approximate age(s): 18th-20th century

- ☒ Photographs of ***each*** resource or streetscape located within the project area, with captions, along with a mapped photo key. (Digital photographs are accepted. All photographs must be clear, crisp and focused.)
- ☒ If the project involves rehabilitation, demolition, additions, or alterations to existing buildings or structures, provide additional photographs showing detailed project work locations. (i.e. Detail photo of windows if window replacement is proposed.)

Archaeology

Does the proposed undertaking involve ground-disturbing activity? ☒ Yes ☐ No
If yes, submit all of the following information:

- ☒ Description of current and previous land use and disturbances.
- ☒ Available information concerning known or suspected archaeological resources within the project area (such as cellar holes, wells, foundations, dams, etc.)

Please note that for many projects an architectural and/or archaeological survey or other additional information may be needed to complete the Section 106 process.

DHR Comment/Finding Recommendation *This Space for Division of Historical Resources Use Only*

☐ Insufficient information to initiate review. ☑ Additional information is needed in order to complete review.

☐ No Potential to cause Effects ☐ No Historic Properties Affected ☐ No Adverse Effect ☐ Adverse Effect

Comments: CONCUR WITH RESULTS OF PHASE IA ARCHAEOLOGICAL SENSITIVITY ASSESSMENT. ADDITIONAL STUDY MAY BE NECESSARY DEPENDENT ON SELECTED ALTERNATIVE.

The DHR encourages alternatives that preserve the character-defining features of the dam and its setting. Please contact the DHR to discuss survey requirements for above-ground resources. We also encourage close coordination with the Durham HDC/HC.

If plans change or resources are discovered in the course of this project, you must contact the Division of Historical Resources as required by federal law and regulation.

Authorized Signature: Nadine Miller, DSHPO Date: 11/25/2020

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD MA 01742-2751

March 6, 2023

Regulatory Division
File No. NAE-2022-02045

Peter Walker, VHB
2 Bedford Farms Drive, Suite 200
Bedford, NH 03110

Dear Peter Walker,

This letter concerns the US Army Corps of Engineers permit review of the Mill Pond Dam Removal Project, located on Newmarket Road, Durham, New Hampshire 03824. Department of the Army regulated impacts associated with this project include grading and fill associated with temporary construction access and staging areas, river floodplain restoration along with dam and fishway removal.

We have consulted with the State Historic Preservation Officer (SHPO) regarding the permit determination area. This decision has been finalized and is attached. The appropriate Tribal Historic Preservation Officers (THPOs) still has yet to participate in consultation. Now that the permit area has been finalized, next steps are to determine if any historic properties may be affected by the work to be authorized by the Corps. At that time, we may need to make an effect determination and coordinate this with the SHPO and the appropriate THPOs as part of our Section 106 coordination process.

If you have any questions, please contact Stephanie Morrison of my staff at (978) 318-8003 or stephanieann.prokopmorrison@usace.army.mil.

Sincerely,

Frank J Del Giudice
Digitally signed by Frank J Del Giudice
Date: 2023.03.09 09:23:50 -05'00'

Frank J. DelGiudice
Chief, NH & VT Section
Regulatory Division

Nadine Miller, Deputy State Historic Preservation; nadine.m.miller@dncr.nh.gov
Peter Walker, VHB; pwalker@vhb.com

MILL POND ROAD

NEWMARKET ROAD

TEMPORARY CONSTRUCTION ACCESS/STAGING AREA

TEMPORARY CONSTRUCTION ACCESS

CONSTRUCTION ACCESS FOR CHANNEL RESTORATION - AFTER CONSTRUCTION, CONVERT TO PEDESTRIAN TRAIL

UPSTREAM LIMIT OF PROPOSED RIVER CHANNEL RESTORATION

OYSTER RIVER CHANNEL THALWEG ALIGNMENT

8+00

9+00

10+00

11+00

12+00

13+00

14+00

15+00

16+00

17+00

18+00

19+00

20+00

21+00

LIMITS OF PROPOSED RIVER FLOODPLAIN RESTORATION GRADING

LIMITS OF PROPOSED RIVER CHANNEL RESTORATION GRADING

APPROXIMATE PROPERTY LINE (TYP)

TEMPORARY CONSTRUCTION ACCESS/STAGING AREA

EXISTING MILL POND DAM AND FISHWAY TO BE REMOVED

DOWNSTREAM LIMIT OF PROPOSED RIVER CHANNEL RESTORATION

NH ROUTE 108/ NEWMARKET RD BRIDGE

EXISTING DAM REMNANT TO REMAIN IN PLACE

0 50 100 200 FEET

\\vhbgbl\pro\Bedford\52633.00 Mill Pond Dam Feasibilit\cad\ev\planmisc\FIG_X-52633-CHANNEL-GRADING_REV2023-01.dwg

Mill Pond Dam Removal | **Durham, New Hampshire**

Proposed Limits of Work

Appendix M: USACE Appendix B Checklist and Supporting Notes

US Army Corps of Engineers ®
New England District

Appendix B
New Hampshire General Permits
Required Information and USACE Section 404Checklist

USACE Section 404 Checklist

1. Attach any explanations to this checklist. Lack of information could delay a USACE permit determination.
2. All references to "work" include all work associated with the project construction and operation. Work includes filling, clearing, flooding, draining, excavation, dozing, stumping, etc.
3. See GC 3 for information on single and complete projects.
4. Contact USACE at (978) 318-8832 with any questions.
5. The information requested below is generally required in the NHDES Wetland Application. See page 61 for NHDES references and Admin Rules as they relate to the information below.

1. Impaired Waters	Yes	No
1.1 Will any work occur within 1 mile upstream in the watershed of an impaired water? See the following to determine if there is an impaired water in the vicinity of your work area. * https://nhdes-surface-water-quality-assessment-site-nhdes.hub.arcgis.com/ https://www.des.nh.gov/water/rivers-and-lakes/water-quality-assessment https://www4.des.state.nh.us/onestopdatamapper/onestopmapper.aspx	X	
2. Wetlands	Yes	No
2.1 Are there are streams, brooks, rivers, ponds, or lakes within 200 feet of any proposed work?	X	
2.2 Are there proposed impacts to tidal SAS, prime wetlands, or priority resource areas? Applicants may obtain information from the NH Department of Resources and Economic Development Natural Heritage Bureau (NHB) DataCheck Tool for information about resources located on the property at https://www4.des.state.nh.us/NHB-DataCheck/.	X	
2.3 If wetland crossings are proposed, are they adequately designed to maintain hydrology, sediment transport & wildlife passage?		N/A
2.4 Would the project remove part or all of a riparian buffer? (Riparian buffers are lands adjacent to streams where vegetation is strongly influenced by the presence of water. They are often thin lines of vegetation containing native grasses, flowers, shrubs and/or trees that line the stream banks. They are also called vegetated buffer zones.)	X	
2.5 The overall project site is more than 40 acres?		X
2.6 What is the area of the previously filled wetlands?	Unknown	
2.7 What is the area of the proposed fill in wetlands?	~1.53 AC	
2.8 What % of the overall project sire will be previously and proposed filled wetlands?	N/A	
3. Wildlife	Yes	No
3.1 Has the NHB & USFWS determined that there are known occurrences of rare species, exemplary natural communities, Federal and State threatened and endangered species and habitat, in the vicinity of the proposed project? (All projects require an NHB ID number & a USFWS IPAC determination.) NHB DataCheck Tool: https://www4.des.state.nh.us/NHB-DataCheck/. USFWS IPAC website: https://ipac.ecosphere.fws.gov/	X	

3.2 Would work occur in any area identified as either "Highest Ranked Habitat in N.H." or "Highest Ranked Habitat in Ecological Region"? (These areas are colored magenta and green, respectively, on NH Fish and Game's map, "2010 Highest Ranked Wildlife Habitat by Ecological Condition.") Map information can be found at: • PDF: https://wildlife.state.nh.us/wildlife/wap-high-rank.html. • Data Mapper: www.granit.unh.edu. • GIS: www.granit.unh.edu/data/downloadfreedata/category/databycategory.html.	X	
3.3 Would the project impact more than 20 acres of an undeveloped land block (upland, wetland/waterway) on the entire project site and/or on an adjoining property(s)?		X
3.4 Does the project propose more than a 10-lot residential subdivision, or a commercial or industrial development?		X
3.5 Are stream crossings designed in accordance with the GC 31?		N/A
4. Flooding/Floodplain Values	Yes	No
4.1 Is the proposed project within the 100-year floodplain of an adjacent river or stream?	X	
4.2 If 4.1 is yes, will compensatory flood storage be provided if the project results in a loss of flood storage?		N/A
5. Historic/Archaeological Resources		
For a minimum, minor or major impact project - a copy of the RPR Form (www.nh.gov/nhdhr/review) with your DES file number shall be sent to the NH Division of Historical Resources as required on Page 37 GC 14(d) of the GP document**	X	
6. Minimal Impact Determination (for projects that exceed 1 acre of permanent impact)	Yes	No
Projects with greater than 1 acre of permanent impact must include the following: • Functional assessment for aquatic resources in the project area. • On and off-site alternative analysis. • Provide additional information and description for how the below criteria are met.	X	
6.1 Will there be complete loss of aquatic resources on site?		X
6.2 Have the impacts to the aquatic resources been avoided and minimized to the greatest extent practicable?	X	
6.3 Will all aquatic resource function be lost?		X
6.4 Does the aquatic resource (s) have regional significance (watershed or ecoregion)?	X	
6.5 Is there an on-site alternative with less impact?	X	
6.6 Is there an off-site alternative with less impact?		X
6.7 Will there be a loss to a resource dependent species?		X
6.8 Are indirect impacts greater than 1 acre within and adjacent to the project area?	X	
6.9 Does the proposed mitigation replace aquatic resource function for direct, indirect, and cumulative impacts?		X

*Although this checklist utilizes state information, its submittal to USACE is a federal requirement.

** If your project is not within Federal jurisdiction, coordination with NH DHR is not required under Federal law.

1.1 According to the NHDES Wetlands Permit Planning Tool, the Project area is located within the vicinity of a watershed that has a listed impairment for chloride (NHRIV600030902-09). The Project area also falls within the quarter mile buffer of the Upper Oyster River and Oyster River–Mill Pond Dam water bodies. The Oyster River-Mill Pond Dam water body has listed impairments for Chlorophyll-a, Dissolved Oxygen Saturation, Escherichia coli, and Dissolved Oxygen Concentrations (NHIMP600030902-04). The Upper Oyster River water body has listed impairments for Chlorophyll-a, Dissolved Oxygen Saturation, Enterococcus, Estuarine Bioassessments, Light Attenuation Coefficient, Total Nitrogen, and Dissolved Oxygen Concentration (NHEST600030902-01-03). The proposed activities are expected to improve water quality and reduce these impairments.

2.1-2.4 This Project is centered around the Oyster River Dam at Mill Pond due to identified deficiencies and safety concerns. The Oyster River (including Mill Pond) is mapped as a Floodplain Wetland Adjacent to a Tier 3 Stream PRA. Additionally, tidal waters and wetlands (i.e., mudflats, open water, and low marsh) which are also classified as PRAs are mapped downstream of the Newmarket Road/NH 108 bridge crossing. PRAs include bogs/peatlands, floodplain wetlands contiguous to tier 3 or higher watercourses, prime wetlands, 100-foot prime wetland buffers, sand dunes, tidal waters or tidal wetlands, and areas that have documented occurrences of protected species or habitat in accordance with Env-Wt 103.66. Refer to the response to **Item 3.1** below for more information regarding rare, threatened, and endangered species both within and in the vicinity of the Project area. No wetland or stream crossings are proposed to be constructed. In terms of riparian vegetation clearing, this Project only proposes very minimal tree clearing/trimming for construction access off Mill Pond Road. Invasive species along the pond perimeter will also be treated and managed in accordance with the Integrated Vegetation Management Plan (IVMP) provided in ***Appendix F***. Post-construction, native vegetation will be allowed to establish within the drained impoundment area, along with proposed plants along the restored upstream river channel.

3.1 The NHB DataCheck Results Letter (NHB23-2114) dated July 21, 2023, identified the potential presence of one natural community, six plant species, and ten vertebrate species within the vicinity of the Project area. Consultation with NHB is underway and consultation with NHF&G is complete. The USFWS IPaC Species List, dated January 19, 2024, identified the potential presence of the endangered northern long-eared bat (*Myotis septentrionalis,* NLEB), endangered roseate tern (*Sterna dougallii dougallii*), and candidate species monarch butterfly (*Danaus plexippus*). Consultation for the NLEB and the roseate tern using the applicable IPaC Determination Keys is still pending feedback from the USACE (as the lead federal agency) to complete. Refer to **Section 6** of the **Application Narrative** for a more detailed discussion.

3.2 Downstream of the Oyster River Dam and beyond the proposed limits of work, the Oyster River is classified as the Highest Ranked Habitat in NH. Two small sections of the impounded Mill Pond upstream of the Oyster River Dam are classified as the Highest Ranked Habitat in the Biological Region and Supporting Landscape. Refer to **Section 6.3** of the **Application Narrative** for more information. However, one of the goals of this dam removal Project is to restore the Oyster River to its natural free flowing state and improve the surrounding habitat area. The current pond is overwhelmed with plant matter and will see post-construction water quality improvements. Overall, this Project is expected to benefit and improve wildlife habitat.

4.1 The Project area is overlapped by Federal Emergency Management Agency (FEMA) Special Flood Hazard Areas (SFHAs) including the Zone AE regulatory floodway which occupies most of the Mill Pond impoundment and Zone AE 100-year floodplain which borders the floodway in low topographic areas within the Project area. Nevertheless, the proposed dam removal will improve the flood resilience of the surrounding community

and increase flood storage within the drained Mill Pond impoundment. Refer to **Section 5.1** of the **Application Narrative** for more detailed information.

5.0 A Request for Project Review (RPR) was submitted to the NH Department of Historical Resources (NHDHR) on November 5, 2020. This Project has undergone extensive Section 106 consultation, which is still underway. Since the Oyster River Dam is a historic resource, mitigation options are being investigated. This includes the retention of the old mill remnants and southern dam abutment for example. Refer to **Section 8** of the **Application Narrative** for more information regarding the Section 106 consultation for this Project.

6.0 According to the attached plans, this Project proposes approximately 66,570 sq ft (1.53 acres) of permanent impacts and 21,340 sq ft (0.49 acres) of temporary impacts to palustrine wetlands (within USACE jurisdiction, excluding the banks and developed tidal buffer zone) to remove the Oyster River Dam, reconstruct the upstream Oyster River channel, and stabilize the outlets of existing stormwater outfalls along the perimeter of the impoundment.

6.1-6.9 There will not be a complete loss of aquatic resources within the Project area. Although the artificial Mill Pond impoundment will be drained, the Oyster River will remain, and the upstream channel will be restored through removal of the excess accumulated sediment and stabilization. The drained Mill Pond impoundment is expected to transition into emergent and scrub-shrub wetland habitat. Despite the large area of permanent impact proposed, the outcome of this Project will be environmentally beneficial in many ways (i.e., fish passage, water quality, habitat diversity, river function, etc.). Given the existing low quality of the Mill Pond impoundment (i.e., excessive plant biomass and water quality impairments), the implementation of this Project may increase the functions and values of the Oyster River and the surrounding drained impoundment wetland area. Refer to **Section 4.3** of the **Application Narrative** for more information on the existing conditions functional assessment. All impacts have been avoided and minimized to the extent feasible while ensuring the Project outcome is both ecologically sustainable and aesthetically pleasing.

Other less impactful on-site alternatives were considered during the Feasibility Study phase (including dam repair or stabilization) but not pursued as they did not address the main objectives of environmental restoration and were too expensive. Refer to **Section 7.3** of the **Application Narrative** for more information regarding the alternatives analysis. And since this Project is centered around this specific deficient dam, off-site alternatives were not an option.

This Project is a restoration/enhancement project that seeks to reverse historic human alteration of the landscape and restore the natural Oyster River functions and values within the Project area.