GPI

Engineering | Design | Planning | Construction Management

NOTICE OF INTENT APPLICATION

Replacement of Brandy Brow Culvert Over East Meadow River

Haverhill, Massachusetts

November 2025

Prepared By:
Greenman-Pedersen, Inc.
181 Ballardvale Street,
Suite 202,
Wilmington, MA 01887
(978) 570-2999

Submitted To:
The City of Haverhill
Conservation Commission
City Hall – Room 300
4 Summer Street
Haverhill, MA 01830-5885

Prepared For:
The City of Haverhill
Engineering Department
City Hall – Room 300
4 Summer Street
Haverhill, MA 01830-5885

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Notice of Intent Application

Replacement of Brandy Brow Road Culvert Over East Meadow River

Haverhill, MA

REF: NEX-2300100.00

November 7, 2025

Ms. Harmony Wilson, Chair
Haverhill Conservation Commission
City Hall Room 300
4 Summer Street
Haverhill, MA 01830

SUBJECT: Notice of Intent Application
Proposed Replacement of Brandy Brow Road Culvert over East Meadow River
Haverhill, MA

Dear Ms. Wilson and Members of the Commission:

On Behalf of the City of Haverhill – Engineering Department, Greenman-Pedersen, Inc. (GPI) is submitting for your review a Notice of Intent (NOI) application under the Massachusetts Wetlands Protection Act, (M.G.L. Chapter 131 Section 40) for the proposed Replacement of Brandy Brow Culvert over East Meadow River in the City of Haverhill, Massachusetts (the Project).

The Project is located at the East Meadow River culvert crossing along Brandy Brow Road in the City of Haverhill, Massachusetts. The culvert is located approximately 0.25 miles west of the intersection of East Meadow Drive and Brandy Brow Road, adjacent to the residential property at 288 Brandy Brow Road. The Project includes the replacement of the existing culvert and the reconstruction of both the east and west roadway approaches to a point approximately 50 feet beyond the existing culvert structure. The project also includes narrowing the travel lanes over the existing structure to a width of 6-feet to allow for pedestrian and emergency response vehicle access over the culvert.

The Massachusetts Division of Ecological Restoration (DER) Stream Continuity Program provides state-wide assistance to communities interested in replacing degraded and/or undersized road-stream crossings with better designed culverts or bridges that meet improved environmental and flood resiliency criteria. The purpose of the Culvert Replacement Municipal Assistance Grant Program funding is to encourage municipalities to replace culverts with structures that meet these criteria as defined in the Massachusetts Stream Crossing Standards. This project has been selected to receive funding from the DER Culvert Replacement Municipal Assistant Grant Program.

The purpose of the Project is to replace the existing, failing culvert with a structure that can accommodate larger storm flows, provide better protection against erosion and scour, reduce resident vulnerability to changing climatic conditions, and improve access across the East Meadow River for pedestrians and emergency personnel. The proposed horizontal and vertical alignment of Brandy Brow Road will essentially remain the same as the existing conditions with minor variations. Proposed replacement of the culvert will improve natural stream processes along East Meadow River and will allow aquatic species to access critical habitat upstream and downstream of the culvert. The new crossing will also benefit public safety, improve climate resiliency, and reduce the risk of infrastructure damage by accommodating larger storm flows. The Project will also accommodate recreational activities and improve access to the various hiking and wilderness paths to the west of the culvert.

This Notice of Intent (NOI) has been submitted under the Massachusetts Wetlands Protection Act, M.G.L. Chapter 131, Section 40 (the Act); work is proposed within areas Subject to Protection under the Act. Wetland resource area delineations were conducted within the project limits on January 26, 2024 by LEC Environmental Consultants, Inc., (LEC). Jurisdictional wetland resource areas within and adjacent to the project limits have been survey located and are depicted on the attached Notice of Intent Plans. Jurisdictional wetland resource areas within the project limits include Bordering Vegetated Wetlands (BVW), Bank to Perennial Stream, Land Under Water Bodies and Waterways (LUWW), 200-foot Riverfront Area, and Bordering Land Subject to Flooding (BLSF). The project will also result in work within the 100-foot Buffer Zone and the City of Haverhill's 25-foot No Build No Disturbance Zone and 50-foot No Build Zone.

Should you have any questions, or require additional information, please contact me directly by phone (978) 570-2559 or email amarquis@gpinet.com.

Sincerely,

GREENMAN-PEDERSEN, INC.

Alexa Marquis
Environmental Analyst

enclosure(s) Notice of Intent Application and supporting documents

c. John Pettis III, City of Haverhill – City Engineer
Samuel Campbell, GPI – Environmental Department Head
Chris Stairs, GPI – Director of Transportation Engineering
Ryan Melchionno, GPI – Project Manager Structural Engineer
Sid Kashi, GPI – Senior Project Manager
Girish Patel, GPI – Senior Designer

WPA Form 3 – Notice of Intent

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 3 – Notice of Intent

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

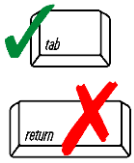
Provided by MassDEP:

MassDEP File Number

Document Transaction Number

Haverhill
City/Town

Important:
When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



Note:
Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

A. General Information

1. Project Location (**Note:** electronic filers will click on button to locate project site):

Brandy Brow Road (a. Street Address) | Haverhill (b. City/Town) | 01830 (c. Zip Code)

Latitude and Longitude: 42.826656 (d. Latitude) | -71.040303 (e. Longitude)

Brandy Brow Roadway Layout / NA (f. Assessors Map/Plat Number) | NA (g. Parcel /Lot Number)

2. Applicant:

John H. (a. First Name) | Pettis III (b. Last Name)

The City of Haverhill - Engineering Department (c. Organization)

City Hall 4 Summer Street, Room 300 (d. Street Address)

Haverhill (e. City/Town) | MA (f. State) | 01830 (g. Zip Code)

978-374-2335 (h. Phone Number) | 978-373-8475 (i. Fax Number) | JPettis@HaverhillMA.gov (j. Email Address)

3. Property owner (required if different from applicant): ☒ Check if more than one owner

(a. First Name) | (b. Last Name)

The City of Haverhill (c. Organization)

City Hall 4 Summer Street (d. Street Address)

Haverhill (e. City/Town) | MA (f. State) | 01830 (g. Zip Code)

(h. Phone Number) | (i. Fax Number) | (j. Email address)

4. Representative (if any):

Alexa (a. First Name) | Marquis (b. Last Name)

Greenman-Pedersen Inc., (GPI) (c. Company)

181 Ballardvale Street, Suite 202 (d. Street Address)

Wilmington (e. City/Town) | MA (f. State) | 01887 (g. Zip Code)

978-570-2559 (h. Phone Number) | (i. Fax Number) | amarquis@gpinet.com (j. Email address)

5. Total WPA Fee Paid (from NOI Wetland Fee Transmittal Form):

Fee Exempt (a. Total Fee Paid) | (b. State Fee Paid) | (c. City/Town Fee Paid)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

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A. General Information (continued)

6. General Project Description:

The project proposes to replace the Brandy Brow Road Culvert over East Meadow River and reconstruct the culvert's respective approaches to approximately 50 linear feet on either side. The existing open bottom concrete culvert is in poor condition and does not meet current Massachusetts Stream Crossing Standards.

7a. Project Type Checklist: (Limited Project Types see Section A. 7b.)

1. ☐ Single Family Home
2. ☐ Residential Subdivision
3. ☐ Commercial/Industrial
4. ☐ Dock/Pier
5. ☐ Utilities
6. ☐ Coastal engineering Structure
7. ☐ Agriculture (e.g., cranberries, forestry)
8. ☒ Transportation
9. ☐ Other

7b. Is any portion of the proposed activity eligible to be treated as a limited project (including Ecological Restoration Limited Project) subject to 310 CMR 10.24 (coastal) or 310 CMR 10.53 (inland)?

1. ☒ Yes ☐ No

If yes, describe which limited project applies to this project. (See 310 CMR 10.24 and 10.53 for a complete list and description of limited project types)

310 CMR 10.53(i)
2. Limited Project Type

If the proposed activity is eligible to be treated as an Ecological Restoration Limited Project (310 CMR10.24(8), 310 CMR 10.53(4)), complete and attach Appendix A: Ecological Restoration Limited Project Checklist and Signed Certification.

8. Property recorded at the Registry of Deeds for:

Essex
a. County

b. Certificate # (if registered land)

2408
c. Book

380
d. Page Number

B. Buffer Zone & Resource Area Impacts (temporary & permanent)

1. ☐ Buffer Zone Only – Check if the project is located only in the Buffer Zone of a Bordering Vegetated Wetland, Inland Bank, or Coastal Resource Area.
2. ☒ Inland Resource Areas (see 310 CMR 10.54-10.58; if not applicable, go to Section B.3, Coastal Resource Areas).

Check all that apply below. Attach narrative and any supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

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B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

For all projects affecting other Resource Areas, please attach a narrative explaining how the resource area was delineated.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☒ Bank	98 lf perm / 0 lf temp 1. linear feet	2. linear feet
b. ☒ Bordering Vegetated Wetland	0 sf perm / 30 sf temp 1. square feet	2. square feet
c. ☒ Land Under Waterbodies and Waterways	0 sf perm / 1,412 sf temp 1. square feet 3. cubic yards dredged	2. square feet

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
d. ☒ Bordering Land Subject to Flooding	1,436 sf perm / 2,434 sf temp 1. square feet 0 3. cubic feet of flood storage lost	2. square feet 4. cubic feet replaced
e. ☐ Isolated Land Subject to Flooding	1. square feet 2. cubic feet of flood storage lost	3. cubic feet replaced
f. ☒ Riverfront Area	East Meadow River 1. Name of Waterway (if available) - **specify coastal or inland**	

2. Width of Riverfront Area (check one):

☐ 25 ft. - Designated Densely Developed Areas only

☐ 100 ft. - New agricultural projects only

☒ 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project: 8,138 square feet

4. Proposed alteration of the Riverfront Area:

a. total square feet	b. square feet within 100 ft.	c. square feet between 100 ft. and 200 ft.
1,436 perm / 2,434 temp	1,436 perm / 2,434 temp	0

5. Has an alternatives analysis been done and is it attached to this NOI? ☒ Yes ☐ No

6. Was the lot where the activity is proposed created prior to August 1, 1996? ☒ Yes ☐ No

3. ☐ Coastal Resource Areas: (See 310 CMR 10.25-10.35)

Note: for coastal riverfront areas, please complete **Section B.2.f**. above.

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B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

Check all that apply below. Attach narrative and supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below	
b. ☐ Land Under the Ocean	1. square feet 2. cubic yards dredged	
c. ☐ Barrier Beach	Indicate size under Coastal Beaches and/or Coastal Dunes below	
d. ☐ Coastal Beaches	1. square feet	2. cubic yards beach nourishment
e. ☐ Coastal Dunes	1. square feet	2. cubic yards dune nourishment

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
f. ☐ Coastal Banks	1. linear feet	
g. ☐ Rocky Intertidal Shores	1. square feet	
h. ☐ Salt Marshes	1. square feet	2. sq ft restoration, rehab., creation
i. ☐ Land Under Salt Ponds	1. square feet 2. cubic yards dredged	
j. ☐ Land Containing Shellfish	1. square feet	
k. ☐ Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above 1. cubic yards dredged	
l. ☐ Land Subject to Coastal Storm Flowage	1. square feet	

4. ☐ Restoration/Enhancement

If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.2.b or B.3.h above, please enter the additional amount here.

a. square feet of BVW

b. square feet of Salt Marsh

5. ☒ Project Involves Stream Crossings

0
a. number of new stream crossings

1
b. number of replacement stream crossings

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C. Other Applicable Standards and Requirements

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section C and complete Appendix A: Ecological Restoration Limited Project Checklists – Required Actions (310 CMR 10.11).

Streamlined Massachusetts Endangered Species Act/Wetlands Protection Act Review

1. Is any portion of the proposed project located in **Estimated Habitat of Rare Wildlife** as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP)? To view habitat maps, see the *Massachusetts Natural Heritage Atlas* or go to http://maps.massgis.state.ma.us/PRI_EST_HAB/viewer.htm.

a. ☒ Yes ☐ No

If yes, include proof of mailing or hand delivery of NOI to:

Natural Heritage and Endangered Species Program
Division of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581

August 1, 2021
b. Date of map

If *yes*, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18). To qualify for a streamlined, 30-day, MESA/Wetlands Protection Act review, please complete Section C.1.c, and include requested materials with this Notice of Intent (NOI); *OR* complete Section C.2.f, if applicable. *If MESA supplemental information is not included with the NOI, by completing Section 1 of this form, the NHESP will require a separate MESA filing which may take up to 90 days to review (unless noted exceptions in Section 2 apply, see below).*

c. Submit Supplemental Information for Endangered Species Review*

1. ☒ Percentage/acreage of property to be altered:

(a) within wetland Resource Area: 0.05 acres (percentage/acreage)

(b) outside Resource Area: _____ (percentage/acreage)

2. ☒ Assessor's Map or right-of-way plan of site

2. ☒ Project plans for entire project site, including wetland resource areas and areas outside of wetlands jurisdiction, showing existing and proposed conditions, existing and proposed tree/vegetation clearing line, and clearly demarcated limits of work **

(a) ☒ Project description (including description of impacts outside of wetland resource area & buffer zone)

(b) ☒ Photographs representative of the site

* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review (see https://www.mass.gov/ma-endangered-species-act-mesa-regulatory-review).
Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.
** MESA projects may not be segmented (321 CMR 10.16). The applicant must disclose full development plans even if such plans are not required as part of the Notice of Intent process.

C. Other Applicable Standards and Requirements (cont'd)

(c) ☒ MESA filing fee (fee information available at https://www.mass.gov/how-to/how-to-file-for-a-mesa-project-review).
Make check payable to "Commonwealth of Massachusetts - NHESP" and ***mail to NHESP*** at above address

*Projects altering **10 or more acres** of land, also submit:*

(d) ☐ Vegetation cover type map of site

(e) ☐ Project plans showing Priority & Estimated Habitat boundaries

(f) OR Check One of the Following

1. ☐ Project is exempt from MESA review.
Attach applicant letter indicating which MESA exemption applies. (See 321 CMR 10.14, https://www.mass.gov/service-details/exemptions-from-review-for-projectsactivities-in-priority-habitat; the NOI must still be sent to NHESP if the project is within estimated habitat pursuant to 310 CMR 10.37 and 10.59.)

2. ☐ Separate MESA review ongoing. a. NHESP Tracking # b. Date submitted to NHESP

3. ☐ Separate MESA review completed.
Include copy of NHESP "no Take" determination or valid Conservation & Management Permit with approved plan.

3. For coastal projects only, is any portion of the proposed project located below the mean high water line or in a fish run?

a. ☒ Not applicable – project is in inland resource area only b. ☐ Yes ☐ No

If yes, include proof of mailing, hand delivery, or electronic delivery of NOI to either:

South Shore - Bourne to Rhode Island border, and the Cape & Islands:

Division of Marine Fisheries -
Southeast Marine Fisheries Station
Attn: Environmental Reviewer
836 South Rodney French Blvd.
New Bedford, MA 02744
Email: dmf.envreview-south@mass.gov

North Shore - Plymouth to New Hampshire border:

Division of Marine Fisheries -
North Shore Office
Attn: Environmental Reviewer
30 Emerson Avenue
Gloucester, MA 01930
Email: dmf.envreview-north@mass.gov

Also if yes, the project may require a Chapter 91 license. For coastal towns in the Northeast Region, please contact MassDEP's Boston Office. For coastal towns in the Southeast Region, please contact MassDEP's Southeast Regional Office.

c. ☐ Is this an aquaculture project? d. ☐ Yes ☒ No

If yes, include a copy of the Division of Marine Fisheries Certification Letter (M.G.L. c. 130, § 57).

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C. Other Applicable Standards and Requirements (cont'd)

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

4. Is any portion of the proposed project within an Area of Critical Environmental Concern (ACEC)?

   a. ☐ Yes ☒ No If yes, provide name of ACEC (see instructions to WPA Form 3 or MassDEP Website for ACEC locations). **Note:** electronic filers click on Website.

   b. ACEC

5. Is any portion of the proposed project within an area designated as an Outstanding Resource Water (ORW) as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00?

   a. ☒ Yes ☐ No

6. Is any portion of the site subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L. c. 131, § 40A) or the Coastal Wetlands Restriction Act (M.G.L. c. 130, § 105)?

   a. ☐ Yes ☒ No

7. Is this project subject to provisions of the MassDEP Stormwater Management Standards?

   a. ☒ Yes. Attach a copy of the Stormwater Report as required by the Stormwater Management Standards per 310 CMR 10.05(6)(k)-(q) and check if:

      1. ☐ Applying for Low Impact Development (LID) site design credits (as described in Stormwater Management Handbook Vol. 2, Chapter 3)

      2. ☒ A portion of the site constitutes redevelopment

      3. ☐ Proprietary BMPs are included in the Stormwater Management System.

   b. ☐ No. Check why the project is exempt:

      1. ☐ Single-family house

      2. ☐ Emergency road repair

      3. ☐ Small Residential Subdivision (less than or equal to 4 single-family houses or less than or equal to 4 units in multi-family housing project) with no discharge to Critical Areas.

D. Additional Information

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section D and complete Appendix A: Ecological Restoration Notice of Intent – Minimum Required Documents (310 CMR 10.12).

Applicants must include the following with this Notice of Intent (NOI). See instructions for details.

Online Users: Attach the document transaction number (provided on your receipt page) for any of the following information you submit to the Department.

1. ☒ USGS or other map of the area (along with a narrative description, if necessary) containing sufficient information for the Conservation Commission and the Department to locate the site. (Electronic filers may omit this item.)

2. ☒ Plans identifying the location of proposed activities (including activities proposed to serve as a Bordering Vegetated Wetland [BVW] replication area or other mitigating measure) relative to the boundaries of each affected resource area.

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D. Additional Information (cont'd)

3. ☒ Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s), Determination of Applicability, Order of Resource Area Delineation, etc.), and attach documentation of the methodology.

4. ☒ List the titles and dates for all plans and other materials submitted with this NOI.

WPA Notice of Intent Plans
a. Plan Title

GPI
b. Prepared By

Timothy Letton
c. Signed and Stamped by

11/6/2025
d. Final Revision Date

1" = 20'
e. Scale

f. Additional Plan or Document Title

g. Date

5. ☐ If there is more than one property owner, please attach a list of these property owners not listed on this form.

6. ☒ Attach proof of mailing for Natural Heritage and Endangered Species Program, if needed.

7. ☐ Attach proof of mailing for Massachusetts Division of Marine Fisheries, if needed.

8. ☒ Attach NOI Wetland Fee Transmittal Form

9. ☒ Attach Stormwater Report, if needed.

E. Fees

1. ☒ Fee Exempt: No filing fee shall be assessed for projects of any city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority, municipal housing authority, or the Massachusetts Bay Transportation Authority.

Applicants must submit the following information (in addition to pages 1 and 2 of the NOI Wetland Fee Transmittal Form) to confirm fee payment:

2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payor name on check: First Name

7. Payor name on check: Last Name

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F. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

1. Signature of Applicant	2. Date
3. Signature of Property Owner (if different)	4. Date
5. Signature of Representative (if any)	6. Date

For Conservation Commission:
Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

For MassDEP:
One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a **copy** of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

Other:
If the applicant has checked the “yes” box in any part of Section C, Item 3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.

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NOI Wetland Fee Transmittal Form

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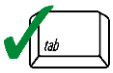


A. Applicant Information

1. Location of Project:

Brandy Brow Road	Haverhill
a. Street Address	b. City/Town
c. Check number	d. Fee amount

2. Applicant Mailing Address:

John H.	Pettis III
a. First Name	b. Last Name

The City of Haverhill - Engineering Department
c. Organization

City Hall 4 Summer Street, Room 300
d. Mailing Address

Haverhill	MA	01830
e. City/Town	f. State	g. Zip Code

978-374-2335	978-373-8475	JPettis@HaverhillMA.gov
h. Phone Number	i. Fax Number	j. Email Address

3. Property Owner (if different):

a. First Name	b. Last Name

City of Haverhill
c. Organization

City Hall 4 Summer Street
d. Mailing Address

Haverhill	MA	01830
e. City/Town	f. State	g. Zip Code

h. Phone Number	i. Fax Number	j. Email Address

B. Fees

To calculate filing fees, refer to the category fee list and examples in the instructions for filling out WPA Form 3 (Notice of Intent).

Fee should be calculated using the following process & worksheet. ***Please see Instructions before filling out worksheet.***

Step 1/Type of Activity: Describe each type of activity that will occur in wetland resource area and buffer zone.

Step 2/Number of Activities: Identify the number of each type of activity.

Step 3/Individual Activity Fee: Identify each activity fee from the six project categories listed in the instructions.

Step 4/Subtotal Activity Fee: Multiply the number of activities (identified in Step 2) times the fee per category (identified in Step 3) to reach a subtotal fee amount. Note: If any of these activities are in a Riverfront Area in addition to another Resource Area or the Buffer Zone, the fee per activity should be multiplied by 1.5 and then added to the subtotal amount.

Step 5/Total Project Fee: Determine the total project fee by adding the subtotal amounts from Step 4.

Step 6/Fee Payments: To calculate the state share of the fee, divide the total fee in half and subtract $12.50. To calculate the city/town share of the fee, divide the total fee in half and add $12.50.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

NOI Wetland Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

B. Fees (continued)

Step 1/Type of Activity	Step 2/Number of Activities	Step 3/Individual Activity Fee	Step 4/Subtotal Activity Fee
NA Municipal Project / Fee Exempt			

Step 5/Total Project Fee: _____

Step 6/Fee Payments:

Total Project Fee: _____ a. Total Fee from Step 5

State share of filing Fee: _____ b. 1/2 Total Fee **less $**12.50

City/Town share of filling Fee: _____ c. 1/2 Total Fee **plus** $12.50

C. Submittal Requirements

a.) Complete pages 1 and 2 and send with a check or money order for the state share of the fee, payable to the Commonwealth of Massachusetts.

Department of Environmental Protection
Box 4062
Boston, MA 02211

b.) **To the Conservation Commission:** Send the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and the city/town fee payment.

To MassDEP Regional Office (see Instructions): Send a copy of the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and a **copy** of the state fee payment. (E-filers of Notices of Intent may submit these electronically.)

Property Owner Information

NOTICE OF INTENT – PROPERTY OWNER INFORMATION

Brandy Brow Road Culvert Replacement

Haverhill, MA

First / Last Name: N/A

Organization: City of Haverhill

Street Address: N/A (Brandy Brow Road Public Right of Way)

City / Town: Haverhill

State: MA

Zip Code: 01830

Assessors Map / Plat Number: N/A

Parcel / Lot Number: N/A

First / Last Name: N/A

Organization: City of Haverhill

Street Address: 0 Brandy Brow Road

City / Town: Haverhill

State: MA

Zip Code: 01830

Assessors Map / Plat Number: 462

Parcel / Lot Number: 203-1

First / Last Name: Michael F. McCarthy

Organization: N/A

Street Address: 288 Brandy Brow Road

City / Town: Haverhill

State: MA

Zip Code: 01830

Assessors Map / Plat Number: 462

Parcel / Lot Number: 201-4

First / Last Name: Michael J. Navaria & Jennifer L. Navaria

Organization: N/A

Street Address: 284 Brandy Brow Road

City / Town: Haverhill

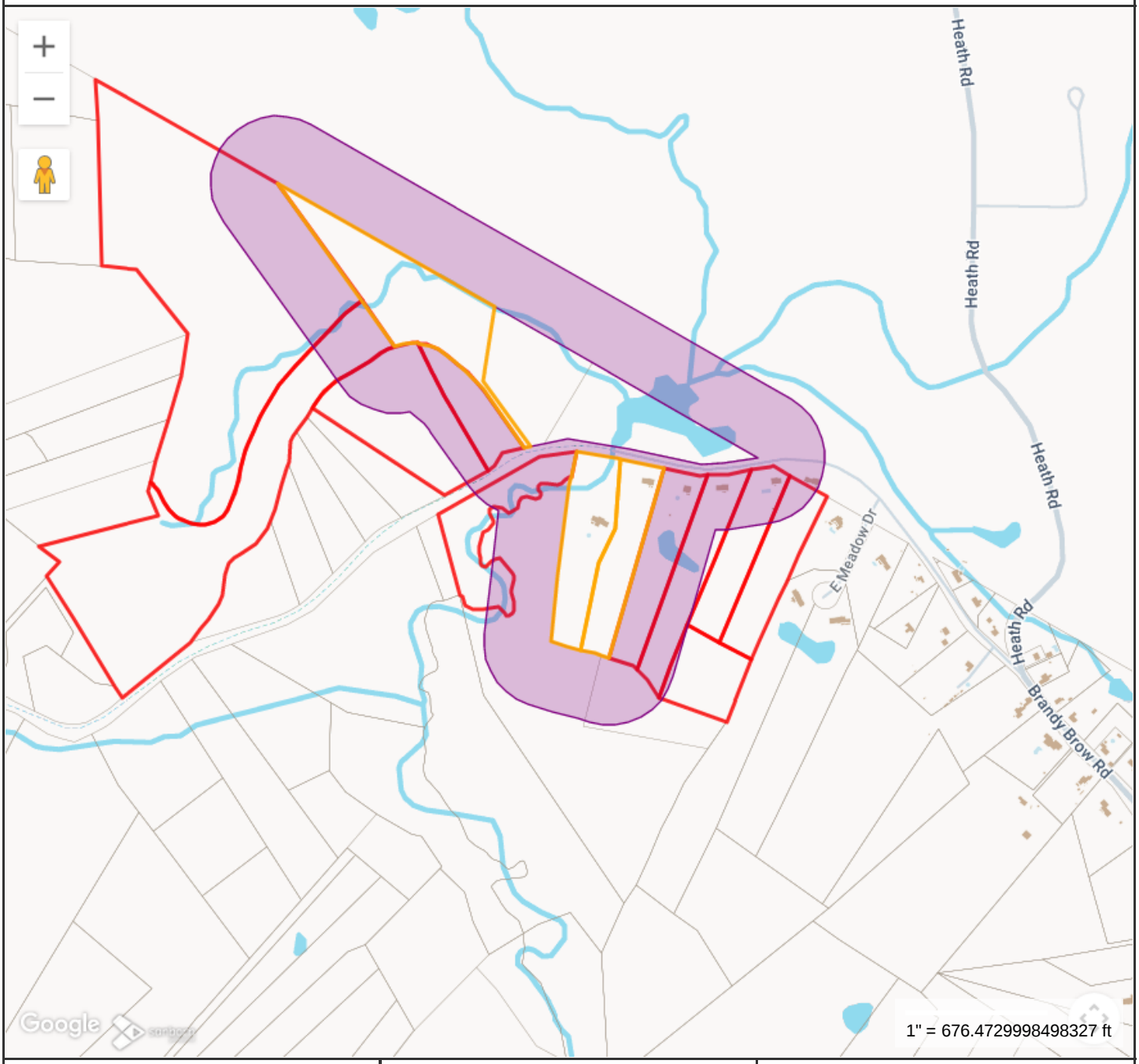
State: MA

Zip Code: 01830

Assessors Map / Plat Number: 462

Parcel / Lot Number: 201-3

Abutters Within 300-feet of Project Limits



MAP FOR REFERENCE ONLY
NOT A LEGAL DOCUMENT

City of Haverhill, MA makes no claims and no warranties, expressed or implied, concerning the validity or accuracy of the GIS data presented on this map.

Geometry updated June 25, 2025
Data updated June 25, 2025

Print map scale is approximate. Critical layout or measurement activities should not be done using this resource.

FITZGERALD JUSTIN K
276 BRANDY BROW RD

ROY JACK A ETUX JOAN F HATEM-ROY
280 BRANDY BROW RD

CITY OF HAVERHILL WATER WORKS DEPT
4 SUMMER ST

CITY OF HAVERHILL WATER WORKS DEPT
4 SUMMER ST

CITY OF HAVERHILL
4 SUMMER ST ROOM #114

CITY OF HAVERHILL PUBLIC WORK DEPT
4 SUMMER ST

CITY OF HAVERHILL TAX LIEN
4 SUMMER ST

CITY OF HAVERHILL
4 SUMMER ST

GILFORD THEODORE
268 BRANDY BROW RD

GILFUS DENNIS
272 BRANDY BROW RD

Notice of Intent Project Narrative

WPA FORM 3 – NOTICE OF INTENT

PROJECT NARRATIVE

1.0 Introduction

On behalf of the City of Haverhill – Engineering Department, Greenman-Pedersen, Inc., (GPI) proposes the Replacement of Brandy Brow Road Culvert over East Meadow River in the City of Haverhill, Massachusetts (the Project). USGS and aerial locus maps of the Project limits are included in **Figure 1** and **Figure 2**, respectively.

The Project is located at the East Meadow River culvert crossing along Brandy Brow Road in the City of Haverhill, Massachusetts. The culvert is located approximately 0.25 miles west of the intersection of East Meadow Drive and Brandy Brow Road, adjacent to the residential property at 288 Brandy Brow Road. The Project includes the replacement of the existing culvert and the reconstruction of both the east and west roadway approaches to a point approximately 50 feet beyond the existing culvert structure. The project also includes narrowing the travel lanes over the existing structure to a width of 6 feet to allow for pedestrian access over the culvert and emergency response vehicles.

The Massachusetts Division of Ecological Restoration (DER) Stream Continuity Program provides state-wide assistance to communities interested in replacing degraded and/or undersized road-stream crossings with better designed culverts or bridges that meet improved environmental and flood resiliency criteria. The purpose of the Culvert Replacement Municipal Assistance Grant Program funding is to encourage municipalities to replace culverts with structures that meet these criteria as defined in the Massachusetts Stream Crossing Standards. This project has been selected to receive funding from the DER Culvert Replacement Municipal Assistant Grant Program.

This Notice of Intent (NOI) has been submitted under the Massachusetts Wetlands Protection Act, M.G.L. Chapter 131, Section 40 (the Act); work is proposed within areas Subject to Protection under the Act. Wetland resource area delineations were conducted within the project limits on January 26, 2024 by LEC Environmental Consultants, Inc., (LEC). Jurisdictional wetland resource areas within and adjacent to the project limits have been survey located and are depicted in **Attachment D**, Notice of Intent Plans. Jurisdictional wetland resource areas within the project limits include Bordering Vegetated Wetlands (BVW), Bank to perennial stream, Land Under Water Bodies and Waterways (LUWW), 200-foot Riverfront Area (RA), and Bordering Land Subject to Flooding (BLSF). The project will also result in work within the 100-foot Buffer Zone and the City of Haverhill's 25-foot No Build No Disturbance Zone and 50-foot No Build Zone.

1.1 Purpose and Need

The purpose of the Project is to replace the existing, failing culvert with a structure that can accommodate larger storm flows, provides better protection against erosion and scour, reduces resident vulnerability to changing climatic conditions, and improves access across the East Meadow River for pedestrians and emergency personnel over the culvert. The proposed horizontal and vertical alignment of Brandy Brow Road will largely match the existing conditions with minor variations. Proposed replacement of the culvert will improve natural stream processes along East Meadow River and will allow aquatic species to access critical habitat upstream and downstream of the culvert. The new crossing will also benefit public safety, improve climate resiliency, and reduce the risk of infrastructure damage by accommodating larger storm flows. The Project will also accommodate recreational activities and improve access to the various hiking

and wilderness paths to the west of the culvert. A detailed description of the improvements proposed by this project is provided in **Section 3.0**.

Within the project limits, existing operational and safety deficiencies include severe erosion of the culvert walls, putting the culvert at risk of structural failure. Failure of the culvert would eliminate access for residents and emergency services. In its existing condition, the culvert does not meet the Massachusetts Stream Crossing Standards. Please see **Appendix B** for Site Photographs.

1.2 Wetland Resource Areas and Work Subject to Filing

All jurisdictional wetland resource areas within the project limits are associated with East Meadow River. The project will result in work within BVW, Bank to perennial stream, LUWW, 200-foot RA, and BLSF. A description of the classification and location of jurisdictional wetland resource areas within the project limits is described in **Section 2.2**.

1.3 City of Haverhill Wetland Protection Ordinance

The City of Haverhill Conservation Commission generally maintains the same jurisdictional wetland resource area definitions as the Act and establishes a 25-foot No Build-No Disturbance Zone and 50-foot No Build Zone per the City of Haverhill Wetland Protection Ordinance (the Ordinance). The project will result in impacts to the 25-foot No Build-No Disturbance Zone and 50-foot No Build Zone.

The Ordinance defines the 25-foot No Build-No Disturbance Zone as:

> *"An area set aside from development to allow for a buffer area between wetlands and buildings, zero to 25 feet from the flagged wetlands on the site where no disturbance or building is allowed…"*

The Ordinance defines the 50-foot No Build Zone as:

> *"Twenty-five to 50 feet from the flagged wetlands on the site where no building is allowed."*

1.4 Other Permits Required

The work proposed by this project includes the replacement of Brandy Brow Road culvert, an activity which requires authorization under Massachusetts General Law Chapter 91, the waterway licensing program. A Chapter 91 WW04 Request for Determination of Applicability will be submitted concurrently with the NOI application to MassDEP to determine if the work will require a Chapter 91 License.

It is anticipated that the project will require a combined 401 Water Quality Certification (WQC) Dredge and 401 WQC Fill / Excavation Application (Form WW26) under 314 CMR 9.00 Section 401 of the Clean Water Act, for work proposed within an Outstanding Resource Water.

2.0 Existing Conditions

2.1 Existing Site Conditions

Brandy Brow Road in Haverhill is a local roadway within the existing city layout. The existing culvert conveys Brandy Brow Road over East Meadow River, a tributary to the Merrimack River that receives flow from the Neal Pond Water Supply Land and Haverhill Well Fields. Brandy Brow Road transitions to an unpaved roadway to the west of the culvert and provides access to hiking and wilderness trails. These trails extend from the area adjacent to the Brandy Brow Road culvert north and west to the New Hampshire border in Plaistow, New Hampshire.

Four unnamed, perennial tributaries, depicted on the most recent USGS Topographic Map, originate approximately 7,000 feet north of the Project and flow through undeveloped forested uplands and wetlands, residential development, agricultural fields, and under paved roadways prior to discharging into Neal Pond. A beaver dam exists approximately 130 feet north of the Project where East Meadow River discharges from Neal Pond and flows beneath Brandy Brow Road via the existing culvert. The beaver dam creates a significant impoundment upstream of the existing culvert. The project does not propose any activities to or along the existing beaver dam. The East Meadow River continues flowing in a southerly direction for approximately 3.5 miles, discharging into and flowing from the Millvale Reservoir, and ultimately discharging into the Merrimack River.

The existing culvert consists of a single span concrete deck with encased steel stringers. The barrel of the existing culvert has an 8-foot open span with each abutment wall varying in width; the east abutment wall measures 5.7 feet and the west abutment wall measures 3.1 feet. The roadway varies in width but measures approximately 20 feet wide over the culvert. The total length of the culvert structure measures 36 feet. The abutments consist of dry stacked field stones which exhibit severe deterioration. The upstream ends of both abutments have been reconstructed with cast-in-place concrete. The northeast and northwest wingwalls consist of mortared cut granite blocks. The southeast and southwest wingwalls are reinforced concrete. The southwest wingwall has a mortared cut granite block retaining wall that extends 3 feet. All observed elements of the bridge are in extremely poor condition. Brandy Brow Road is closed to traffic over the culvert. The water level inside the culvert channel was observed to be approximately 20 inches deep on February 9, 2024.

In its existing condition, there are numerous deficiencies along this segment of Brandy Brow Road and Brandy Brow Road culvert including a lack of shoulders, a lack of railings and guardrails along the culvert, and structural deficiencies of bridge elements mentioned above. The existing culvert also fails to meet the Massachusetts Stream Crossing Standards.

Land uses adjacent to the project limits include residential single-family neighborhoods and wetlands / waterways located directly adjacent to the project limits associated with East Meadow River and Neal Pond. The project limits primarily consist of impervious area associated with the existing culvert structure.

2.2 Wetland Resource Areas

Wetland resource area delineations were conducted within the project limits on January 26, 2024 by LEC. Jurisdictional wetland resource areas within and adjacent to the project limits have been survey located and are depicted on the attached Notice of Intent Plans as **Attachment D**. Jurisdictional wetland resource areas within the project limits include BVW, Bank to perennial stream, LUWW, 200-foot Riverfront Area, and BLSF. The project will also result in work within the 100-foot Buffer Zone and the Ordinance's 25-foot No Build-No Disturbance Zone and 50-foot No Build Zone. An Environmental Constraints Map is provided as **Figure 3**. The Wetland Delineation Sketch is provided as **Appendix A**.

2.2-1 Bank to Intermittent Stream

Bank was delineated in one location proximate to the project limits and is associated with East Meadow River, a perennial stream. The stream crosses beneath Brandy Brow Road via single barrel concrete frame culvert with an open bottom. **Table 2.2-1A** provides a description of the delineated banks within the project limits.

Table 2.2-1A

Flag Series	Waterbody Name	Description / Notes
WF#B-100 To WF#B-112 And WF#B-200 To WF#B-212	East Meadow River Perennial Stream	The Bank along East Meadow River varies throughout the Site and is comprised of cobbles, rocks, mucky/mineral substrate, and wetland vegetation. Stone foundations occur along the Bank in proximity to the Brandy Brow Road culvert crossing. Generally, bank undercuts and scouring are common throughout the Bank downstream of the culvert, and exposed roots and scouring are present throughout, as well. The MAHW line is coincident with top of Bank, and the MAHW/Bank is generally coincident with OHW. Bank to the north of the culvert crossing is generally located within steep embankments, with exception to the western Bank between flags B-204 through B-208. Bank to the south of the culvert is situated within gently to moderately sloping embankments to the west, and steep embankments to the east. All Banks are generally vegetated and well defined, ranging from 2 to 24 inches high.

2.2-2 Bordering Vegetated Wetlands

BVW was delineated in one location proximate to the Project limits as described in **Table 2.2-2A**. Work is proposed within the associated 100-foot Buffer Zone to BVW as well as the Ordinance's 25-foot No Build-No Disturbance Zone and 50-foot No Build Zone. Please see **Appendix A** for more information regarding the BVW Flag Series.

Table 2.2-2A

Flag Series	Location	Description / Notes
WF#-1-1 to WF#1-12	Located north of Brandy Brow Road associated with the WF#B-200 bank of East Meadow River	One scrub-shrub BVW occurs within a topographic depression and fringes along the western Bank of East Meadow River north (upstream) of the culvert in proximity to the Site. Surface water was observed flowing from the upland meadow to the west into the BVW between wetland flags 1-9 and 1-10; however, no upgradient protectable Wetland Resource Areas were observed. The depression held approximately 2 inches of standing water at the time of LEC's site evaluation, and surface water continued flowing into the river downgradient of wetland flags 1-4/1-5 and 1-11/1-12.

		Vegetation within the scrub-shrub BVW includes individuals of mature red maple (Acer rubrum). The sparse shrub layer includes individuals of European buckthorn (Rhamnus cathartica) and silky dogwood (Cornus amomum). The groundcover layer includes seedlings from the overstory. Due to site observations outside the growing season, additional groundcover may be present.

2.2-3 Land Under Water Bodies and Waterways

LUWW was identified in one location between the delineated Bank boundaries and below the mean annual low water levels of East Meadow River. Portions of the perennial stream immediately downgradient of the beaver dam and culvert contain deeper pools, likely as a result of the high velocity discharges.

2.2-4 Bordering Land Subject to Flooding (BLSF)

According to the July 3, 2012 FEMA Flood Insurance Rate Map (FIRM) Map Number 25009C0083F, East Meadow River has an associated Zone A Flood Hazard Area throughout the project limits. Zone A is classified as an area subject to the 1% annual chance flood (100-year flood), where base flood elevations have not been determined. Please refer to **Figure 5** for the FEMA FIRMette.

2.2-5 200-foot Riverfront Area

East Meadow River is a perennial stream with an associated 200-foot RA from the MAHW boundary. The MAHW boundaries within the project limits are generally coincident with the delineated Bank boundaries. Therefore, the limits of the RA have been measured 200 feet horizontally from the Bank flags. The limits of the 200-foot Riverfront Area are depicted on the Notice of Intent Plans.

2.2-6 100-foot Buffer Zone

Due to the linear nature of the project and its location adjacent to several wetland resource areas, including Bank and BVW, work within the 100-foot Buffer Zone is essentially unavoidable. The 100-foot Buffer Zone within the project limits can generally be considered previously developed or degraded by the existing transportation infrastructure and adjacent residential and commercial developments. Undisturbed portions of the 100-foot Buffer Zone will be left unaltered to the maximum extent practicable. Erosion control and sedimentation control measures and construction techniques will be employed and maintained to protect adjacent wetland resource areas. The limits of all jurisdictional wetland resource areas are depicted on the Project Plans provided in **Attachment D**.

2.3 Jurisdictional Wetland Resource Areas – City of Haverhill

As mentioned previously, the Ordinance generally maintains the same jurisdictional wetland resource area definitions as the Act and establishes a 25-foot No Build-No Disturbance Zone and a 50-foot No Build Zone. Due to the linear nature of the project and its location adjacent to several wetland resource areas, including Bank and BVW, work within the 25-foot No Build-No Disturbance Zone and 50-foot No Build Zone is essentially unavoidable.

2.4 Other Sensitive Environmental Areas

The project is located within an Outstanding Resource Water (ORW) classified as a Public Water Supply Watershed and a MassDEP Zone A Wellhead Protection Area which are associated with the Millvale Reservoir. Please see **Figure 4** for the Stormwater Critical Areas Locus Map.

The project is located within land subject to Article 97 protection associated with Neal Pond Water Supply Land. However, the Project does not propose a disposition or change in land use of Article 97 land.

A review of the current MassGIS data layer for the Massachusetts Natural Heritage Atlas (effective August 1, 2021) under the Natural Heritage and Endangered Species Program (NHESP) indicates that the project limits are located within Priority Habitat of Rare Species identified as PH 2148. MassDEP and NHESP have developed a Streamlined NOI process for projects that must be reviewed under both the Massachusetts Endangered Species Act (MESA) and the Wetland Protection Act (WPA). A copy of the NOI application and supporting documents have been sent to MassWildlife for review.

No Certified Vernal Pools under the jurisdiction of the Wetlands Protection Act Regulations (310 CMR 10.00 et seq.) or the Massachusetts Endangered Species Act (321 CMR 10.00 et seq.) occur within or adjacent to the Project limits.

East Meadow River is identified as a cold-water fishery by the Massachusetts Division of Fisheries & Wildlife according to the MassGIS data layer.

3.0 Proposed Conditions

The Project generally proposes the replacement of the existing culvert to meet current Massachusetts Stream Crossing standards. The majority of the work proposed for this project will occur within previously disturbed / developed areas of Bank, LUWW, BVW, and 200-foot RA associated with existing culvert and roadway infrastructure. The improvements proposed to address existing deficiencies within the project limits include the replacement of the existing culvert, roadway narrowing to a 6-foot-wide single travel lane to allow for emergency services to cross the East Meadow River, and provide access to pedestrians and bicyclists to nearby recreation areas.

3.1 Proposed Improvements

The improvements proposed as part of this Project include:

- Installation of erosion and sedimentation control measures, anticipated to consist of compost filter tubes and silt fencing where necessary, around the limit of work.
- Conduct clearing and grubbing of vegetation and tree removal to facilitate construction phase site access.
- Implementation of water controls including sheet piles or sandbags for dewatering and a bypass pipe to maintain stream flow during construction. The water control system will ultimately be designed by the Contractor prior to construction.
- Demolition and removal of the existing bridge deck.

- Demolition and removal of the existing reinforced concrete / stone masonry abutments and stone masonry wingwalls.

- Removal of an existing check dam within the East Meadow River channel approximately 12 feet upstream of the existing culvert.

- Excavation within and adjacent to the channel to install cast in place (CIP) concrete footings and riprap with gravel packed voids for scour protection.

- Installation of a three-sided, precast concrete box culvert supported by CIP concrete footings. The proposed three-sided culvert will have a width of 34 feet, a height of 7 feet 8 inches, and a length of 8 feet. The proposed culvert will be embedded to a depth of 6 feet 9 inches including 5 feet 9 inches of riprap with gravel packed voids and a minimum 12 inches of natural streambed material.

- Construction of CIP concrete wingwalls at the culvert inlet and outlet.

- Installation of riprap with gravel packed voids above the banks to protect against erosion and scour during high flow events. Loam and seed will be applied over riprap within upland areas to provide vegetated surface cover.

- Installation of natural streambed material and grading of a low flow channel within the stream channel and through the culvert to maintain natural water depths and velocities during a variety of flow conditions.

- Installation of timber rail fences over the culvert and along the roadway approaches for pedestrian safety.

- Full depth construction of a 6-foot Hot Mix Asphalt (HMA) shared use path over the culvert.

- Removal of portions of the existing roadway pavement to tie the shared use path into the existing conditions at the east and west ends of the culvert crossing.

- Conduct site grading to tie into existing conditions.

- Application of loam and seed to all disturbed vegetated areas.

3.2 Construction Staging and Sequencing

The anticipated construction sequence for this project includes the following steps:

- Mobilize equipment, work force, and necessary materials to site.

- Install erosion and sedimentation control measures and conduct clearing and grubbing of vegetation and tree trimming / removal to facilitate site access.

- Conduct any necessary grading to facilitate access to East Meadow River.

- Structural elements to be demolished and removed.

- Install water control structure and bypass pipe.

- Demolish and remove existing bridge elements from the site.
- Conduct necessary excavation to construct cast in place concrete footings, wingwalls, and installation of rip rap.
- Install new three-sided culvert within stream channel.
- Embed three-sided culvert with riprap and natural streambed material; install additional riprap upgradient of the banks.
- Place natural streambed material over riprap within the stream channel and grade low flow channel; install loam and seed over riprap in upland areas.
- Upon stabilization of channel and completion of natural stream bed installation, remove the water control system and bypass pump and restore natural flow within the East Meadow River.
- Construct shared use path and timber rail fencing over the proposed three-sided culvert.
- Apply loam and seed to all disturbed areas of vegetation.
- Apply native wetland seed mix to temporarily impacted wetland areas.
- Remove erosion and sedimentation control measures.
- Demobilize equipment and remove any excess construction materials or waste generated from construction activities.

3.3 Scour Protection and Streambed Restoration

In areas outside of the reconstructed stream channel, scour protection will consist of riprap with gravel packed voids. Loam and seed will be spread on top of the riprap and gravel to fill voids and establish a vegetative layer. It is important to note that not all stone surfaces will be covered.

In areas within the reconstructed stream channel, scour protection will consist of riprap with gravel packed voids below a 12-inch minimum natural streambed material. Excavated stones including cobbles and boulders shall be salvaged and stockpiled on site and shall be reused in the reconstructed stream channel to simulate the natural downstream reach conditions. Any excavated material that is man-made or does not match the downstream reach condition shall be removed and discarded from the project limits.

The project also proposes a low flow channel within the reconstructed stream channel as well as native or imported stone and/or boulders clustered near the thalweg. The low flow channel and stone and boulders will provide suitable habitat and cover for aquatic life during low flow.

4.0 Wetland Resource Area Impacts

The project proposes work along Bank to perennial stream, within LUWW, BVW, 200-foot RA, and BLSF. The project also proposes work within the 100-foot Buffer Zone and the Ordinance's 25-foot No Build-No Disturbance Zone and the 50-foot No Build Zone associated with BVW. The majority of this work will occur within areas considered previously developed / degraded by existing impervious surface areas.

4.1 Proposed Activities in Jurisdictional Wetland Resource Areas

4.1-1 Bank to Perennial Stream

The project will result in 98 linear feet (98 linear feet permanent) of new alteration along the Bank. Permanent impacts along the Bank are associated with the replacement of the existing culvert, widening of the bankfull width to meet current Massachusetts Stream Crossing Standards, grading, and construction phase site access.

A summary of the impacts to Bank proposed by the Project is included in **Table 4.1-1**.

Table 4.1-1

Flag Series	Station	Permanent (lf)	Temporary (lf)	Total (lf)	Notes
WF#B-105 to WF#B-112	100+75	49	0	49	Replacement of existing culvert, stream channel widening, and construction phase site access.
WF#B-206 to WF#B-212	100+50	49	0	49	Replacement of existing culvert, stream channel widening, and construction phase site access.
Total		98	0	98	

Proposed work along the Bank is eligible to be treated as a limited project pursuant to:

- 310 CMR 10.53(3)(i) – *"The maintenance, repair (but not substantial enlargement except when necessary to meet the Massachusetts Stream Crossing Standards) of structures, including dams and reservoirs, and appurtenant works to dams and reservoirs, buildings, piers, towers, headwalls, bridges, and culverts which existed on the effective date 310 CMR 10.51 through 10.60 (April 1, 1983)."*

A summary of the project's compliance with the Performance Standards is provided in **8.0 Regulatory Compliance**.

4.1-2 Land Under Water Bodies and Waterways (LUWW)

The project will result in 1,412 square feet (1,412 square feet temporary) of new alteration within the LUWW. The project proposes to replace the failing culvert with one that will meet Massachusetts Stream Crossing Standards and enhance the streambed and bank with DER approved natural streambed material. Work proposed within LUWW includes temporary dewatering, grading, and construction phase site access. All of the temporary impacts within LUWW will be restored.

A summary of the total impacts to LUWW proposed by the Project is included in **Table 4.1-2**.

Table 4.1-2

	Land Under Water Bodies and Waterways Impacts
Permanent (sf)	0
Temporary (sf)	1,412
Total (sf)	1,412

Proposed work within LUWW is eligible to be treated as a limited project pursuant to:

- 310 CMR 10.53(3)(i) – *"The maintenance, repair (but not substantial enlargement except when necessary to meet the Massachusetts Stream Crossing Standards) of structures, including dams and reservoirs, and appurtenant works to dams and reservoirs, buildings, piers, towers, headwalls, bridges, and culverts which existed on the effective date 310 CMR 10.51 through 10.60 (April 1, 1983)."*

A summary of the project's compliance with the Performance Standards is provided in **8.0 Regulatory Compliance**.

4.1-3 Bordering Vegetated Wetlands

The project will result in 30 square feet of temporary new alteration within BVW. Temporary impacts within the BVW are associated with grading, installation of erosion and sedimentation control measures, and construction phase site access. All temporarily disturbed areas within the BVW will be restored upon completion of the project through the application of native wetland seed mix.

A summary of the total impacts to BVW proposed by the Project is included in **Table 4.1-3.**

Table 4.1-3

	Bordering Vegetated Wetland Impacts
Permanent (sf)	0
Temporary (sf)	30
Total (sf)	30

All of the proposed work within BVW is eligible to be treated as a limited project pursuant to:

- 310 CMR 10.53(3)(i) – *"The maintenance, repair (but not substantial enlargement except when necessary to meet the Massachusetts Stream Crossing Standards) of structures, including dams and reservoirs, and appurtenant works to dams and reservoirs, buildings, piers, towers, headwalls, bridges, and culverts which existed on the effective date 310 CMR 10.51 through 10.60 (April 1, 1983)."*

These impacts are associated with the replacement of the culvert and restoration of the stream that it spans. A summary of the project's compliance with the Performance Standards is provided in **8.0 Regulatory Compliance**.

4.1-4 Bordering Land Subject to Flooding

According to the Hydraulic Report included as **Attachment C**, and the FEMA FIRMette included as **Figure 5**, the entirety of the project is located within the 100-year Floodplain.

The area of new alteration within the BLSF is coincident with the new alteration within the 200-foot RA and results in 3,870 square feet of impacts (2,434 square feet temporary / 1,436 square feet permanent). Please see the following section for a description of impacts within the 200-foot RA. A summary of the project's compliance with BLSF Performance Standards is provided in **8.0 Regulatory Compliance**.

The compensatory flood storage calculations are included as **Figure 6**.

4.1-5 200-foot Riverfront Area

The Project proposes alteration within the 200-foot RA totaling 8,138 square feet. Of the 8,138 square feet, 2,237 square feet is previously developed by the existing roadway infrastructure and 2,032 square feet is associated with temporary easements for the project that will not be altered. The project will result in 3,870 square feet (2,434 square feet temporary / 1,436 square feet permanent) of new alteration within 200-foot RA. Proposed permanent impacts within RA are a result of culvert replacement and frame unit construction, as well as scour pad construction. Temporary impacts within RA are associated with grading, installation of erosion and sediment control measures, streambed restoration and enhancement, and construction phase site access. All temporarily disturbed areas outside of the streambed restoration area within RA will be restored upon completion of the project through the application of loam and native seed mix. The stone scour apron will receive a layer of loam and seed to fill voids and promote native plant growth within the 200-foot RA.

All of the work proposed by the Project within the 200-foot RA is located within the Inner Riparian Area. A summary of the total impacts to RA proposed by the Project is included in **Table 4.1-5**.

Table 4.1-5

	200-foot Riverfront Area Impacts		
	Inner Riparian	**Outer Riparian**	**Total**
Permanent (sf)	1,436	0	1,436
Temporary (sf)	2,434	0	2,434
Total (sf)	3,870	0	3,870

Proposed work within 200-foot RA is eligible to be treated as a limited project pursuant to:

- 310 CMR 10.53(3)(i) – *"The maintenance, repair (but not substantial enlargement except when necessary to meet the Massachusetts Stream Crossing Standards) of structures, including dams and reservoirs, and appurtenant works to dams and reservoirs, buildings, piers, towers, headwalls, bridges, and culverts which existed on the effective date 310 CMR 10.51 through 10.60 (April 1, 1983)."*

The proposed replacement of the existing culvert at Brandy Brow Road spanning East Meadow River is eligible to be treated as a limited project per 310 CMR 10.53(3)(i) as the work proposed includes the replacement of the existing failing structure.

The entirety of the project is located within the inner riparian zone of the 200-foot RA. All impacts within the 100-foot Buffer Zone, 50-foot No Build Zone, and 25-foot No Build-No Disturbance Zone are coincident to the impacts within the inner riparian zone. The impacts within the 100-foot Buffer Zone, 50-foot No Build Zone, and 25-foot No Build-No Disturbance Zone sum the total impact to the inner riparian zone, 3,870 square feet (2,434 square feet temporary / 1,436 square feet permanent) of new alteration.

4.1-6 100-foot Buffer Zone

The project will result in 1,890 square feet (1,261 square feet temporary / 629 square feet permanent) of alteration within the 100-foot Buffer Zone. All of the proposed alteration within the 100-foot Buffer Zone is coincident with the 200-foot RA. Proposed permanent impacts within the 100-foot Buffer Zone are a result of the construction of the culvert frame units and construction of the stone scour apron. Temporary impacts are associated with grading, installation of erosion and sediment control measures, streambed restoration, and construction phase site access. All temporarily disturbed areas within the 100-foot Buffer Zone will be restored upon completion of the project through the application of loam and native seed mix. **Table 4.1-6** below provides a summary of the proposed 100-foot Buffer Zone impacts.

Table 4.1-6

	100-foot Buffer Zone Impacts
Permanent (sf)	629
Temporary (sf)	1,261
Total (sf)	1,890

4.2 Work in Jurisdictional Wetland Resource Areas – City of Haverhill

4.2-1 50-foot No Build Zone

The project will result in 1,227 square feet (750 square feet temporary / 477 square feet permanent) of alteration within the 50-foot No Build Zone. All of the proposed alteration within the 50-foot No Build Zone is coincident with the 200-foot RA. Proposed permanent impacts within the 50-foot No Build Zone are a result of the construction of the culvert frame units and the stone scour apron. Temporary impacts are associated with grading, installation of erosion and sediment control measures, streambed restoration, and construction phase site access. All temporarily disturbed areas within the 50-foot No Build Zone will be restored upon completion of the project through the application of loam and native seed mix. **Table 4.2-1** below provides a summary of the proposed 50-foot No Build Zone impacts.

Table 4.2-1

	50-foot No Build Zone Impacts
Permanent (sf)	477
Temporary (sf)	750
Total (sf)	1,227

4.2-2 25-foot No Build-No Disturbance Zone

The project will result in 753 square feet (423 square feet temporary / 330 square feet permanent) of new alteration within the 25-foot No Build-No Disturbance Zone. All of the

proposed alteration within the 25-foot No Build-No Disturbance Zone is coincident with the 200-foot RA. Proposed permanent impacts within the 25-foot No Build-No Disturbance Zone are a result of the construction of the proposed culvert frame units and the stone scour apron. Temporary impacts are associated with grading, installation of erosion and sediment control measures, construction of streambed restoration, and construction phase site access. All temporarily disturbed areas within the 25-foot No Build-No Disturbance Zone will be restored upon completion of the project through the application of loam and native seed mix. **Table 4.2-2** below provides a summary of the proposed 25-foot No Build-No Disturbance Zone impacts.

Table 4.2-2

	25-foot No Build-No Disturbance Zone Impacts
Permanent	330
Temporary	423
Total	753

5.0 Avoidance, Minimization, and Mitigation Measures

The Project was designed with an interest to avoid, minimize, and mitigate impacts to wetland resource areas to the maximum extent practicable. Mitigation measures provided for unavoidable impacts allow the project to be conditioned to comply with the General Performance Standards in the Wetland Regulations and contribute to the interests found in the Massachusetts Wetland Protection Act. Impacts to resource areas Subject to Protection under the Act have been adequately compensated. Temporarily impacted areas will be restored in place using a native seed mix.

5.1 Avoidance

Due to the proposed improvements along Brandy Brow Road, specifically the proposed culvert replacement, the project is unable to completely avoid impacts to jurisdictional wetland resource areas. Though it is not possible to completely avoid impacting all jurisdictional wetland resource areas, the applicant has altered the design to avoid impacts where practicable and feasible.

5.2 Minimization

The work areas within the upstream and downstream reaches of the East Meadow River have been minimized to the maximum extent practicable while still providing adequate space to facilitate demolition and construction activities. The limits of the scour protection have been minimized to the maximum extent practicable while also ensuring that the culvert is adequately armored for high flow events. Please see **Section 7.0 Alternatives Analysis**.

5.3 Mitigation

Mitigation measures provided for unavoidable impacts allow the project to be conditioned to comply with the General Performance Standards in the Wetlands Regulations and contribute to the interests found in the Massachusetts Wetland Protection Act. The Project proposes 30 square feet of temporary new alteration within BVW. The project proposes to restore temporarily impacted areas within BVW with a native wetland seed mix.

5.3.1 Stream Crossing Replacement

The project proposes to replace the existing culvert that conveys East Meadow River beneath Brandy Brow Road with a new precast, open box, concrete culvert that meets the

Massachusetts Stream Crossing Standards and provides a significant improvement over the existing conditions. The proposed crossing structure will provide a more open crossing that spans bankfull width, thus improving wildlife passage while also not changing the hydrology of East Meadow River during low flow or flooding events. Please refer to **8.3 Massachusetts River and Stream Crossing Standards** for a summary of the proposed structures' compliance with the Massachusetts Stream Crossing Standards.

5.4 Erosion and Sedimentation Control

Erosion and sedimentation controls will be installed and maintained where activities are proposed within 100 feet of wetland resource areas. The proposed erosion and sedimentation control measures will provide a limit of work barrier while also preventing sediments and suspended solids from migrating into or towards downgradient wetland resource areas.

Erosion controls shall consist of compost filter tubes and silt fences. No hay bales shall be used at any time on this project. The erosion and sedimentation control measures will be constructed in accordance with the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban areas, March 1997 and the USDA SCS's Erosion and Sediment control in the Site Development, Massachusetts Conservation Guide, September – 1983. Best management practices for erosion and sedimentation control will be adhered to for all phases of construction to minimize potential impacts to wetland resource areas and wildlife habitat.

The contractor will be responsible for obtaining the National Pollution Discharge Elimination System (NPDES) Construction General Permit. A Stormwater Pollution Prevention Plan (SWPPP) will be submitted prior to any land disturbance.

6.0 Stormwater

The Project is subject to the Massachusetts Stormwater Standards which are incorporated into the Wetlands Protection Regulations, 310 CMR 10.05 (6)(b) and defined at 310 CMR 10.05 (6)(k) through (q). The proposed improvements along Brandy Brow Road include upgrades to the existing transportation infrastructure and therefore can be classified as a redevelopment project which is defined as the maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage, and repaving. The project will result in a net reduction in impervious area by 944 square feet by narrowing the Brandy Brow Road travel way over the East Meadow River from approximately 20 feet to 6 feet.

The Project has been designed to meet the stormwater standards to the maximum extent practicable. A Stormwater Checklist and Report have been completed and submitted with this NOI, as required.

7.0 Alternatives Analysis

7.1 Alternative 1

Alternative 1 consisted of: precast concrete arch units (Not Skewed), precast or cast-in-place concrete headwalls (approximately 2 feet tall), U-Shaped modular or cast-in-place concrete cantilever wingwalls, cast-in-place concrete rafted footings on micro-piles (piles added later in concept development), 29 foot 6 inch exposed clear span having a 7-foot vertical clearance to the intrados, and embankment armoring (added later in concept development).

Alternative 1 is based on an average downstream full bank width of 23.5 feet and a corresponding minimum DER channel width goal of 1.2 x full bank width = 28.2 feet. The clear span of 29 feet 6 inches is the result of selecting a widely available off-the-shelf precast arch unit that vertically fits the site. A 7-foot vertical clearance to the arch intrados was achieved which satisfies DER's minimum 6-foot height requirement. Hydraulic analysis of this arch alternative resulted in a significantly undersized opening that overtopped during a 100-year flood event. Alternative 1 was determined to be inadequate and removed from further consideration.

7.2 Alternative 2 (Selected)

Alternative 2 consists of; precast concrete 3-sided rigid frame units (skewed), flared cast-in-place concrete cantilever walls, cast-in-place spread footings, a 34-foot clear span and approximate 7.66 foot vertical clearance, and riprap scour protection below natural streambed.

Alternative 2 provides a larger opening to avoid overtopping during the100-year flood event. A 3-sided frame was selected as it provides a significantly more efficient opening relative to an arch. The clear span was increased to 34 feet, and the vertical clearance was increased to 7.66 feet which satisfies DER's minimum 6-foot height requirement and nearly achieves DER's optimum 8-foot height goal. Headwalls were omitted for this alternative as a result of increasing the vertical opening. The frame units are skewed to match the channel to better accommodate the significant flood volumes reflected in the H&H analysis. Alternative 2 was selected.

7.3 Off Site Alternative

There are no feasible off-site alternatives that would be less environmentally impactful than the proposed improvements. Any new culvert construction intended to bypass Brandy Brow Road Culvert over East Meadow River would have major impacts on private property, environmentally sensitive areas, and safety concerns that would significantly outweigh any potential benefits.

7.4 No Build Alternative

The No Build Alternative would result in the existing culvert remaining deficient and would provide no improvements to the existing culvert or transportation infrastructure. The No Build Alternative was not considered.

8.0 Regulatory Compliance

8.1 General Performance Standards

The project will meet the General Performance Standards at 310 CMR 10.54(4), 10.56(4)(a), 10.57(4)(a), and 10.58(4) for the portions of the project that do not qualify as Limited Projects.

8.2-1 10.54(4) General Performance Standards for Bank

(a) Where the presumption set forth in 310 CMR 10.54(3) is not overcome, any proposed work on a Bank shall not impair the following:

1. *the physical stability of the Bank;*
2. *the water carrying capacity of the existing channel within the Bank;*
3. *ground water and surface water quality;*
4. *the capacity of the Bank to provide breeding habitat, escape cover and food for fisheries;*
5. *the capacity of the Bank to provide important wildlife habitat functions. A project or projects on a single lot, for which Notice(s) of Intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 50 feet (whichever is less) of the length of the bank found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. In the case of a bank of*

a river or an intermittent stream, the impact shall be measured on each side of the stream or river. Additional alterations beyond the above threshold may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures contained in 310 CMR 10.60.

6. *Work on a stream crossing shall be presumed to meet the performance standard set forth in 310 CMR 10.54(4)(a) provided the work is performed in compliance with the Massachusetts Stream Crossing Standards by consisting of a span or embedded culvert in which, at a minimum, the bottom of a span structure or the upper surface of an embedded culvert is above the elevation of the top of the bank, and the structure spans the channel width by a minimum of 1.2 times the bankfull width. This presumption is rebuttable and may be overcome by the submittal of credible evidence from a competent source. Notwithstanding the requirement of 310 CMR 10.54(4)(a)5., the impact on bank caused by the installation of a stream crossing is exempt from the requirement to perform a habitat evaluation in accordance with the procedures contained in 310 CMR 10.60.*

   (b) Notwithstanding the provisions of 310 CMR 10.54(4)(a), structures may be permitted in or on a Bank when required to prevent flood damage to facilities, buildings and roads constructed prior to the effective date of 310 CMR 10.51 through 10.60 or constructed pursuant to a Notice of Intent filed prior to the effective date of 310 CMR 10.51 through 10.60 (April 1, 1983), including the renovation or reconstruction (but not substantial enlargement) of such facilities, buildings and roads, provided that the following requirements are met:

   1. *The proposed protective structure, renovation, or reconstruction is designed and constructed using best practical measures so as to minimize adverse effects on the characteristics and functions of the resource area;*
   2. *The applicant demonstrates that there is no reasonable method of protecting, renovating, or rebuilding the facility in question other than the one proposed.*

   (c) Notwithstanding the provisions of 310 CMR 10.54(4)(a) or (b), no project may be permitted which will have any adverse effect on the specified habitat sites of Rare Species, as identified by procedures established under 310 CMR 10.59.

The Project proposes the replacement of Brandy Brow Road Culvert that conveys flow from East Meadow River and meets the General Performance Standards for Bank at 310 CMR 10.54(4). In accordance with 310 CMR 10.54(4)(a), the proposed improvements will not impair:

1. the physical stability of the Bank; the construction of the proposed wingwalls and the stone scour apron will protect against erosion and scour on the slopes adjacent to the existing Banks, contributing to the stability of the Banks.
2. the water carrying capacity within the Bank; the project will not result in any fill within the existing channel and changes to the channel's width and depth are a direct result of channel widening and streambed restoration to meet the Massachusetts Stream Crossing Standards. The existing culvert is undersized and has restricted the channel width. Please see **Attachment C** for the Hydraulic Report which demonstrates a "No Rise" in elevations for the various modelled storm events.
3. the groundwater and surface water quality; the project proposes to replace the existing culvert that spans East Meadow River. There are no existing storm drains within proximity of the culvert. The proposed culvert and approaches will utilize "country drainage." The new culvert will include a 6-inch reveal at both curbs to direct runoff from draining directly to the river below.

4. the capacity of the Bank to provide breeding habitat, escape cover, and food for fisheries; the proposed East Meadow Brook culvert streambed will consist of native material approved by DER to ensure appropriate habitat for naturally occurring aquatic species. The structure will not result in any adverse effects on the Bank's ability to support fisheries and wildlife habitat functions.
5. the capacity of the Bank to provide important wildlife habitat functions; the project will temporarily alter 98 linear feet of Banks to East Meadow River and will not have any adverse effects on the Banks' ability to provide important wildlife habitat functions.
6. compliance with the Massachusetts Stream Crossing Standards; the project proposes to replace the Brandy Brow Road culvert over East Meadow River. The project is in compliance with the Massachusetts Stream Crossing Standards as demonstrated in **Section 8.3**

310 CMR 10.54(4)(b) is not applicable as none of the improvements proposed along Brandy Brow Road are related to the construction of structures intended to prevent flood damage to facilities, buildings, or roads constructed prior to the effective date.

All of the proposed work within the project limits is located within NHESP Priority Habitat (PH 2148). Coordination with MassWildlife is ongoing to determine if the project will result in a "take" of rare species located within PH 2148. It is not anticipated that the project will result in any adverse impacts to designated rare species habitat, rare upland, wetland vertebrate, or invertebrate species. There are no NHESP Certified or potential vernal pools within the project limits. The project anticipates compliance with 310 CMR 10.54(4)(c).

The proposed work complies with all of the applicable performance standards for Bank at 310 CMR 10.54.

8.2-2 10.55(4) General Performance Standards for Bordering Vegetated Wetlands

(a) Where the presumption set forth in 310 CMR 10.55(3) is not overcome, any proposed work in a Bordering Vegetated Wetland shall not destroy or otherwise impair any portion of said area.

(b) Notwithstanding the provisions of 310 CMR 10.55(4)(a), the issuing authority may issue an Order of Conditions permitting work which results in the loss of up to 5000 square feet of Bordering Vegetated Wetland when said area is replaced in accordance with the following general conditions and any additional, specific conditions the issuing authority deems necessary to ensure that the replacement area will function in a manner similar to the area that will be lost:

1. *the surface of the replacement area to be created ("the replacement area") shall be equal to that of the area that will be lost ("the lost area");*
2. *the ground water and surface elevation of the replacement area shall be approximately equal to that of the lost area;*
3. *The overall horizontal configuration and location of the replacement area with respect to the bank shall be similar to that of the lost area;*
4. *the replacement area shall have an unrestricted hydraulic connection to the same water body or waterway associated with the lost area;*
5. *the replacement area shall be located within the same general area of the water body or reach of the waterway as the lost area;*
6. *at least 75% of the surface of the replacement area shall be reestablished with indigenous wetland plant species within two growing seasons, and prior to said vegetative reestablishment any exposed soil in the replacement area shall be temporarily stabilized*

to prevent erosion in accordance with standard U.S. Soil Conservation Service methods; and

7. *the replacement area shall be provided in a manner which is consistent with all other General Performance Standards for each resource area in Part III of 310 CMR 10.00. In the exercise of this discretion, the issuing authority shall consider the magnitude of the alteration and the significance of the project site to the interests identified in M.G.L. c. 131, § 40, the extent to which adverse impacts can be avoided, the extent to which adverse impacts are minimized, and the extent to which mitigation measures, including replication or restoration, are provided to contribute to the protection of the interests identified in M.G.L. c. 131, § 40.*

(c) Notwithstanding the provisions of 310 CMR 10.55(4)(a), the issuing authority may issue an Order of Conditions permitting work which results in the loss of a portion of Bordering Vegetated Wetland when;

1. *said portion has a surface area less than 500 square feet;*
2. *said portion extends in a distinct linear configuration ("finger-like") into adjacent uplands; and*
3. *in the judgment of the issuing authority it is not reasonable to scale down, redesign or otherwise change the proposed work so that it could be completed without loss of said wetland.*

(d) Notwithstanding the provisions of 310 CMR 10.55(4)(a),(b) and (c), no project may be permitted which will have any adverse effect on specified habitat sites of rare vertebrate or invertebrate species, as identified by procedures established under 310 CMR 10.59.

(e) Any proposed work shall not destroy or otherwise impair any portion of a Bordering Vegetated Wetland that is within an Area of Critical Environmental Concern designated by the Secretary of Energy and Environmental Affairs under M.G.L. c. 21A, § 2(7) and 301 CMR 12.00: Areas of Critical Environmental Concern. 310 CMR 10.55(4)(e):

1. *supersedes the provisions of 310 CMR 10.55(4)(b) and (c);*
2. *shall not apply if the presumption set forth at 310 CMR 10.55(3) is overcome;*
3. *shall not apply to work proposed under 310 CMR 10.53(3)(l); and*
4. *shall not apply to maintenance of stormwater detention, retention, or sedimentation ponds, or to maintenance of stormwater energy dissipating structures, that have been constructed in accordance with a valid order of conditions.*

The project results in 30 square feet of total alteration within BVW. The project does not propose permanent impacts to BVW, resulting in no “lost area.” The project has been adjusted to avoid BVW alteration where practicable and feasible. In order to adequately restore the streambed and stream banks, a portion of BVW is proposed to be graded and temporarily impacted. The project proposes to adequately restore temporarily impacted areas with a native wetland seed mix.

8.2-3 10.56(4)(a) General Performance Standards for Land Under Water Bodies and Waterways (LUWW)

(a) Where the presumption set forth in 310 CMR 10.56(3) is not overcome, any proposed work within Land under Water Bodies and Waterways shall not impair the following:

1. *The water carrying capacity within the defined channel, which is provided by said land in conjunction with the banks;*
2. *Ground and surface water quality;*

3. *The capacity of said land to provide breeding habitat, escape cover and food for fisheries; and*
4. *The capacity of said land to provide important wildlife habitat functions. A project or projects on a single lot, for which Notice(s) of intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 5,000 square feet (whichever is less) of land in this resource area found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. Additional alterations beyond the above threshold may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures established under 310 CMR 10.60.*
5. *Work on a stream crossing shall be presumed to meet the performance standard set forth in 310 CMR 10.56(4)(a) provided the work is performed in compliance with the Massachusetts Stream Crossing Standards by consisting of a span or embedded culvert in which, at a minimum, the bottom of a span structure or the upper surface of an embedded culvert is above the elevation of the top of the bank, and the structure spans the channel width by a minimum of 1.2 times the bankfull width. This presumption is rebuttable and may be overcome by the submittal of credible evidence from a competent source. Notwithstanding the requirements of 310 CMR 10.56(4)(a)4., the impact on Land under Water Bodies and Waterways caused by the installation of a stream crossing is exempt from the requirement to perform a habitat evaluation in accordance with the procedures established under 310 CMR 10.60.*

Work within LUWW will meet the performance standards at 310 CMR 10.56(4) as work will not impair the water carrying capacity within the defined channels, impair ground or surface water quality, or permanently exceed thresholds for wildlife habitat impairment at the proposed East Meadow River stream crossing replacement.

8.2-4 10.57(4)(a) General Performance Standards for Bordering Land Subject to Flooding

(1) Compensatory Flood Storage shall be provided for all flood storage volume that will be lost as the result of a proposed project within Bordering Land Subject to Flooding, when in the judgment of the issuing authority said loss will cause an increase or will contribute incrementally to an increase in the horizontal extent and level of flood waters during peak flows. Compensatory storage shall mean a volume not previously used for flood storage and shall be incrementally equal to the theoretical volume of flood water at each elevation, up to and including the 100-year flood elevation, which would be displaced by the proposed project. Such compensatory volume shall have an unrestricted hydraulic connection to the same waterway or water body. Further, with respect to waterways, such compensatory volume shall be provided within the same reach of the river, stream, or creek.

The Project proposes cut and fill volumes below Base Flood Elevation. The project will not result in any loss of flood storage resulting in a change in the horizontal extents or level of flood waters during peak flows and as such no compensatory flood storage is required or proposed. The compensatory flood storage calculations are included as **Figure 6**.

(2) Work within Bordering Land Subject to Flooding, including that work required to provide the above specified compensatory storage, shall not restrict flows so as to cause an increase in flood stage or velocity.

The proposed work within BLSF is temporary in nature or proposes the redevelopment of existing roadway infrastructure and will not result in any restriction of flow so as to cause an increase in flood storage or velocity. The project proposes to demolish the existing culvert that restricts the flow of East Meadow River and replace the culvert with one that meets the Massachusetts Stream Crossing Standards.

> *(3) Work in those portions of bordering lands subject to flooding found to be significant to the protection of wildlife habitat shall not impair its capacity to provide important wildlife habitat functions. Except for work which would adversely affect vernal pool habitat, a project or projects on a single lot, for which Notice(s) of Intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 5,000 square feet (whichever is less) of land in this resource area found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. Additional alterations beyond the above threshold, or altering vernal pool habitat, may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures contained in 310 CMR 10.60.*

The BLSF within the project limits at Brandy Brow Road is previously developed / degraded by the existing roadway infrastructure. This area of BLSF is significant to the protection of wildlife habitat. The proposed improvements within BLSF will not impair, and instead enhance, the area's ability to provide wildlife habitat functions via streambed restoration by meeting the Massachusetts Stream Crossing Standards.

8.2-5 10.58(4) General Performance Standards for Riverfront Area

> (a) *Protection of Other Resource Areas. The work shall meet the performance standards for all other resource areas within the riverfront area, as identified in 310 CMR 10.30 (Coastal Bank), 10.32 (Salt Marsh), 10.55 (Bordering Vegetated Wetland), and 10.57 (Land Subject to Flooding). When work in the riverfront area is also within the buffer zone to another resource area, the performance standards for the riverfront area shall contribute to the protection of the interests of M.G.L. c. 131, § 40 in lieu of any additional requirements that might otherwise be imposed on work in the buffer zone within the riverfront area.*

The project proposes work that will result in the alteration of other jurisdictional wetland resource areas, specifically LUWW, BVW, Bank, and BLSF, however, the project complies with the General Performance Standards for these resource areas and therefore complies with 10.58(4)(a).

> *(b) Protection of Rare Species. No project may be permitted within the Riverfront Area which will have any adverse effect on specified habitat sites of rare wetland or upland, vertebrate or invertebrate species, as identified by the procedures established under 310 CMR 10.59 or 10.37, or which will have any adverse effect on vernal pool habitat certified prior to the filing of the Notice of Intent.*

All of the proposed work within the project limits is located within NHESP Priority Habitat (PH 2148). Coordination with MassWildlife is ongoing to determine if the project will result in a "take" of rare species located within PH 2148. It is not anticipated that the project will result in any adverse impacts to designated rare species habitat, rare upland, wetland vertebrate, or invertebrate species. There are no NHESP Certified or potential vernal pools within the project limits. The project complies with 10.58(4)(b).

(c) Practicable and Substantially Equivalent Economic Alternatives. There must be no practicable and substantially equivalent economic alternative to the proposed project with less adverse effects on the interests identified in M.G.L. c. 131 § 40.

There are no practicable and sustainable equivalent economic alternatives to the proposed project that would have less adverse effects on the interests identified in M.G.L. c. 131 § 40. Please refer to **Appendix C** for the Riverfront Area Alternatives Analysis.

(d) No Significant Adverse Effect. The work, including proposed mitigation measures, must have no significant adverse impact on the riverfront area to protect the interests identified in M.G.L. c. 131, § 40.

The project will result in permanent alteration of undeveloped / undisturbed 200-foot Riverfront Area totaling 3,870 square feet (1,436 square feet permanent, or 17.6% of total permanent new alteration within 8,138 square feet of 200-foot RA). The project does not anticipate significant adverse effects to the 200-foot RA.

8.3 Massachusetts River and Stream Crossing Standards

As described in **5.3.2 Stream Crossing Replacement**, the project proposes to replace the existing culvert that conveys East Meadow River beneath Brandy Brow Road with a new precast, 3-sided open bottom, concrete culvert. The clear span was increased to 34 feet and the vertical clearance was increased to 7.66 feet which nearly achieves DER's optimum 8-foot height goal. Headwalls were omitted for this alternative as a result of increasing the vertical opening. The frame units are skewed to match the channel to better accommodate the significant flood volumes reflected in the H&H analysis. Within the culvert, the streambed will be embedded with a base of modified rock fill and gravel filled voids and topped with an additional 1-foot of DER approved pebbles and/or a native streambed material. The proposed crossing structure meets the Massachusetts Stream Crossing Standards and provides an improvement over the existing conditions. Dewatering measures and turbidity controls will be implemented during the removal of the existing culvert and installation of the new culvert to ensure there are no increases in total suspended solids or turbidity during construction. A summary of the existing and proposed structures' compliance with the Massachusetts Stream Crossing Standards is provided below.

Standard 1 – Type of Crossing: *Spans (bridges, 3-sided box culverts, open-bottom culverts or arches) are strongly preferred.*

Existing Structure: The existing culvert consists of a single span concrete deck with encased steel stringers. The culvert has an 8-foot clear span with each wall varying in width and a vertical clearance of 6.33 feet. The abutments consist of stacked field stones. The upstream ends of both abutments have been reconstructed with cast-in-place concrete. The northeast and northwest wingwalls consist of mortared cut granite blocks. The southeast and southwest wingwalls are reinforced concrete. The southwest wingwall has a mortared cut granite block retaining wall that extends 3 feet. The existing culvert does not meet Standard 1.

Proposed Structure: The proposed structure is an open bottom, 3-sided, concrete box culvert which will be embedded with a natural streambed material. The proposed structure provides an improvement over the existing conditions. **The proposed structure meets Standard 1.**

Standard 2 – Embedment: *All culverts should be embedded (sunk into stream) a minimum of 2 feet, and round pipe culverts at least 25%. If pipe culverts cannot be embedded this deep, then*

they should not be used. When embedment materials include elements > 15 inches in diameter, embedment depths should be at least twice the D_{84} (particle width larger than 84% of particles) of particles of the embedment materials.

Existing Structure: The existing culvert is embedded to a depth less than 1-foot. The existing structure does not meet Standard 2.

Proposed Structure: The proposed structure will be embedded to a depth of 5 feet below the existing bottom of streambed elevation; 4 feet modified rock fill with gravel filled voids, topped with a minimum 1-foot of natural streambed material. **The proposed structure meets Standard 2.**

Standard 3 – Crossing Span: *Spans channel width (a minimum of 1.2 times the bankfull width of the stream).*

Existing Structure: Within the vicinity of the existing crossing structure, East Meadow River has an average bankfull width of approximately 23.47 feet. A structure spanning the channel a minimum of 1.2 times bankfull width would have a width of 28.1 feet. The existing structure has an open span of 8 feet. The existing culvert does not span the channel 1.2 times bankfull width, therefore the existing culvert does not meet Standard 3.

Proposed Structure: The proposed crossing structure has an open span of 34 feet. The proposed structure spans the channel greater than 1.2 times bankfull width and provides an improvement over the existing conditions. **The proposed structure meets Standard 3**.

Standard 4 – Openness: *Openness ratio (cross-sectional area / crossing length) of at least 0.82 feet (0.25 meters). The crossing should be wide and high relative to its length.*

Existing Structure: The existing structure has a cross-sectional area of 50.64 square feet. The existing structure is 36 feet long. The existing structure has an openness ratio of 1.4 and meets Standard 4.

Openness Ratio = (cross-sectional area / crossing length)
Openness Ratio = (8 x 6.33) / 36
Openness Ratio = (50.64) / 36
Openness Ratio = 1.40

Proposed Structure: The proposed structure has a cross-sectional area of 260.44 square feet and a crossing length of 8 feet. The openness ratio of the proposed structure is 32.55, well above the minimum openness ration of 0.82. **The proposed structure meets Standard 4.**

Openness Ratio = (cross-sectional area / crossing length)
Openness Ratio = (34 x 7.66) / 8
Openness Ratio = (260.44) / 8
Openness Ratio = 32.55

Standard 5 – Substrate: *Natural bottom substrate should be used within the crossing, and it should match the upstream and downstream substrates. The substrate and design should resist displacement during floods and maintain an appropriate bottom during normal flows.*

Existing Structure: The existing structure is embedded into the streambed, but it is unclear whether substrate formed over time or whether the culvert was embedded with natural streambed material intentionally. The existing structure appears to meet Standard 5.

Proposed Structure: The proposed structure will be embedded into the streambed with a minimum 1-foot of natural streambed material on top of 4 feet of modified rock fill and gravel filled voids. The project proposes to remove natural streambed materials within the project limits to regrade the stream channel and replace it during the streambed restoration process. Natural streambed material will tie into the existing upstream and downstream substrates, be constructed with appropriate bottom forms, and resist displacement during floods. **The proposed structure meets Standard 5.**

Standard 6 – Water Depth and Velocity: *Water depths and velocities are comparable to those found in the natural channel at a variety of flows.*

Existing Structure: In the existing condition, a well-established beaver dam exists at the outlet of Neal Pond. The upstream portion of East Meadow River between the culvert and the beaver dam is a lagoon (pool) with a significantly wider channel width compared with the downstream channel. A stone boulder check dam is located approximately 12 feet upstream of the culvert.

Proposed Structure: A hydraulic analysis has been conducted to ensure that water surface elevations, channel depths, and flow velocities will not significantly deviate from those found in the existing conditions. The beaver dam and established lagoon will not be altered as part of this project. **The proposed structure meets Standard 6.**

9.0 Conclusion

The proposed Brandy Brow Road Culvert Replacement Project crossing East Meadow River in Haverhill, Massachusetts has been designed to avoid work within and alteration of jurisdictional wetland resource areas where possible. Where impacts are unavoidable, they have been minimized and appropriately mitigated. The proposed mitigation measures allow the project to comply with the Performance Standards outlined in the Wetlands Protection Act. The applicant respectfully requests that the Haverhill Conservation Commission find the proposed improvements and mitigation measures described in this NOI adequately protective of the interests identified within the WPA and issue an Order of Conditions approving the work described in this NOI and shown on the accompanying plans.

Figure 1 – USGS Topographic Locus Map

GPI
Engineering
Design
Planning
Construction Management
978.570.2999 GPINET.COM

Greenman-Pedersen, Inc.
181 Ballardvale Street
Suite 202
Wilmington, MA 01887

0 250 500 750 1000
SCALE: 1" = 250'

REPLACMENT OF BRANDY BROW ROAD CULVERT OVER EAST MEADOW RIVER HAVERHILL, MA

Figure 2 – Aerial Locus Map

Aerial Locus Map

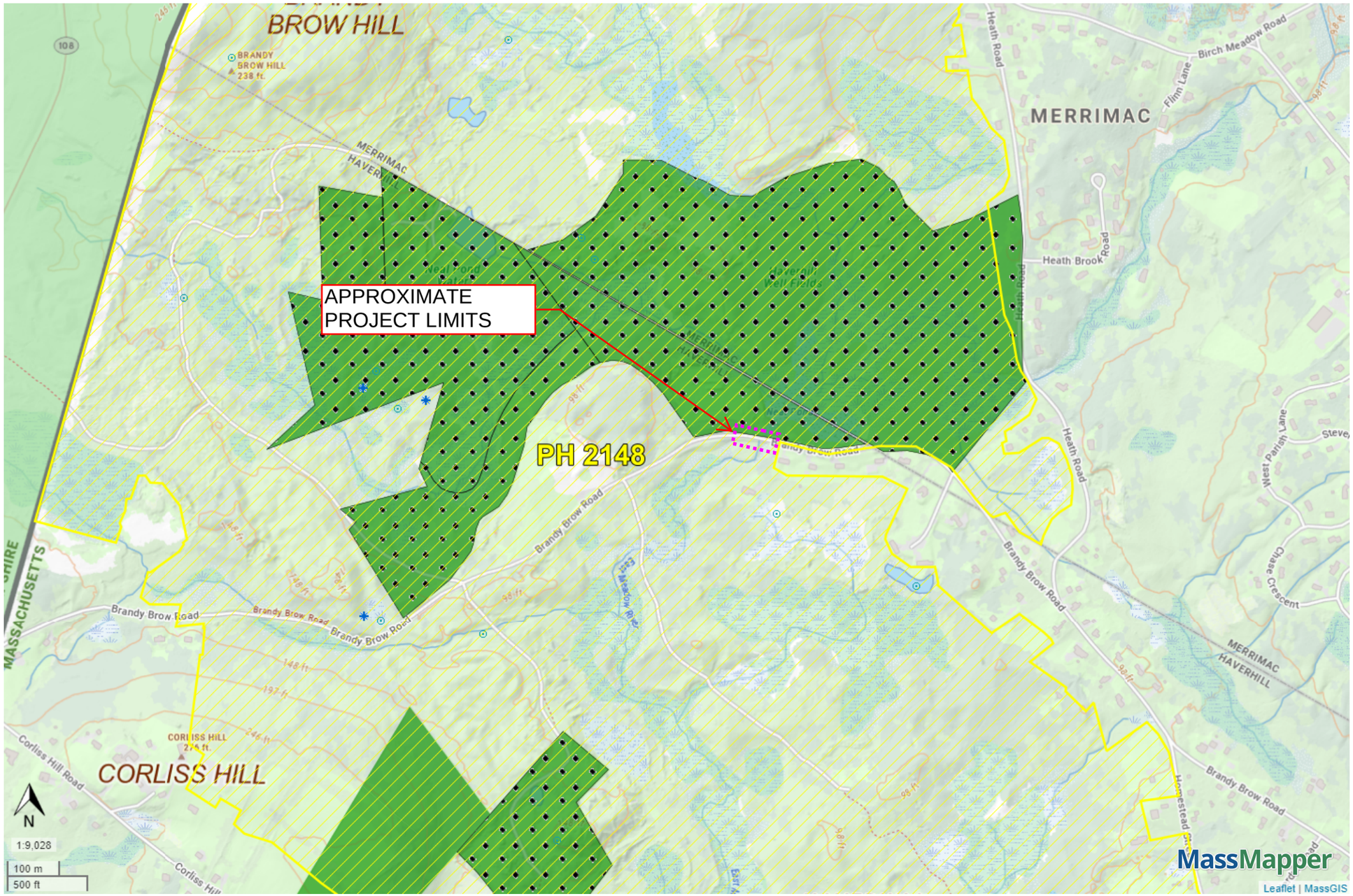
Replacement of Brandy Brow Road Culvert Over East Meadow River

Approximate Project Limits

Replacement of Brandy Brow Road Culvert Over East Meadow River
Haverhill, MA

Figure 3 – Environmental Constraints Map

Environmental Constraints Map



Potential Vernal Pools

NHESP Certified Vernal Pools

NHESP Priority Habitats of Rare Species

NHESP Estimated Habitats of Rare Wildlife

Openspace Article 97

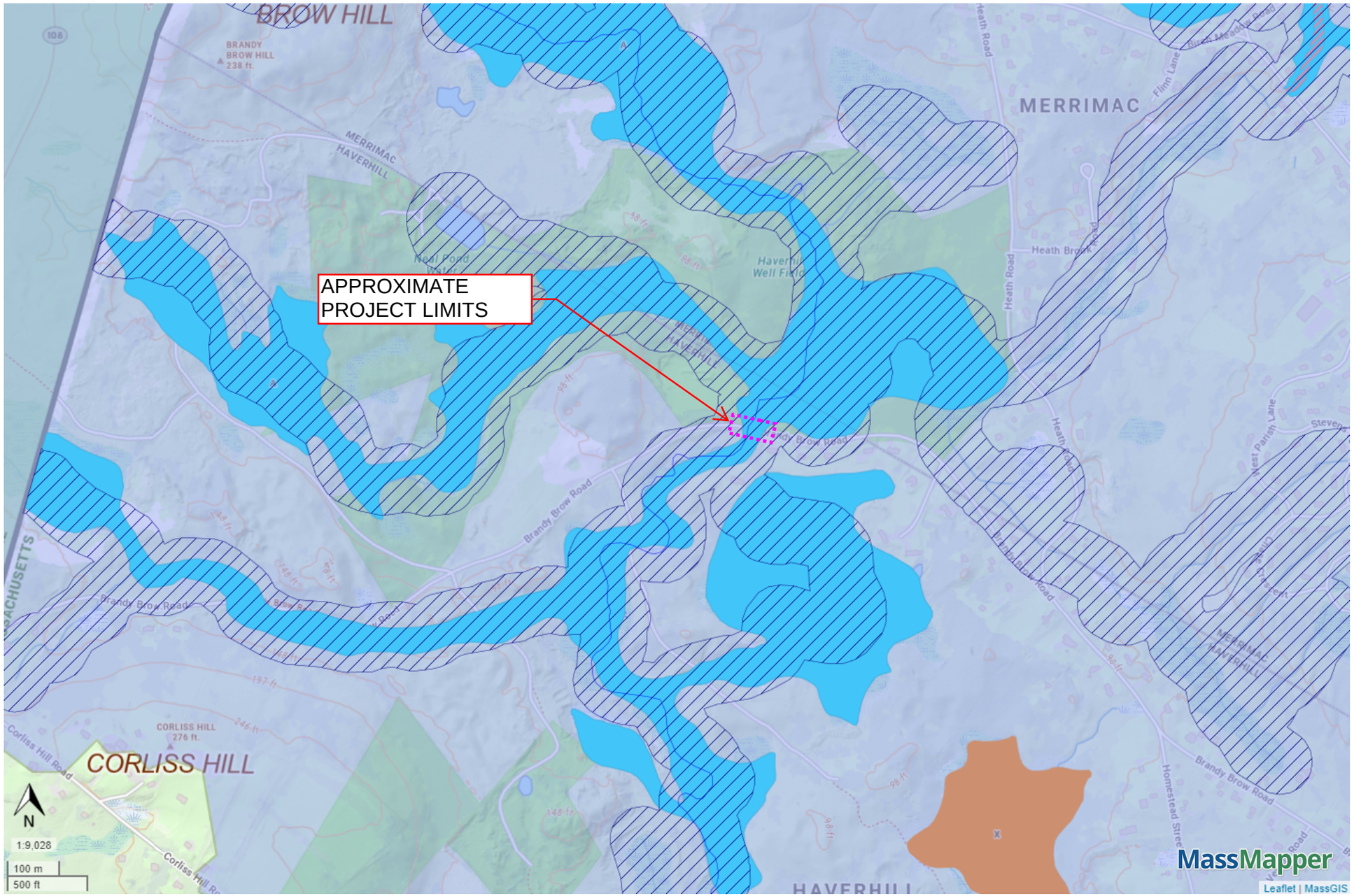
Openspace by Level of Protection

- IN PERPETUITY
- LIMITED
- TERM LIMITED
- NONE
- UNKNOWN

Replacement of Brandy Brow Road Culvert Over East Meadow River
Haverhill, MA

Figure 4 – Stormwater Critical Areas Map

Stormwater Critical Areas



IWPAs

Zone A

Zone Is

Zone IIs

Shellfish Growing Areas
- APPROVED
- CONDITIONALLY APPROVED
- RESTRICTED
- CONDITIONALLY RESTRICTED
- PROHIBITED

Public Water Supplies
- Communtiy Groundwater Well
- Non-Communtiy Groundwater Well
- Surface Water Intake
- Emergency Surface Water Intake
- Community Labels
- Non-Community Labels

Marine Beaches Lines
- Public
- Semi-Public

DFW Coldwater Fisheries Resources

Outstanding Resource Waters
- ACEC
- Cape Cod National Seashore
- Protected Shoreline
- Public Water Supply Watershed
- Retired Public Water Supply
- Scenic/Protected River
- Wildlife Refuge

FEMA National Flood Hazard Layer

Replacement of Brandy Brow Road Culvert Over East Meadow River
Haverhill, MA

Figure 5 – FEMA FIRMette

National Flood Hazard Layer FIRMette

FEMA

71°2'44"W 42°49'49"N

71°2'7"W 42°49'23"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/18/2024 at 3:37 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Figure 6 – Compensatory Flood Storage Calculations

GPI Calculations **Greenman-Pedersen, Inc.**

Location Haverhill, MA **Job Number** NEX-2300100.00
Title Replacement of Brandy Brow Road Culvert over East Meadow River
Calculated By GBP **Checked By**

Flood Plain Summary
Below El. 19.00

Elevation	Proposed CUT Volume (CY)	Proposed FILL Volume (CY)	Net Volume (CY)
71 - 70	3	0	3
70 - 69	55	0	55
69 - 68	48	0	48
68 -67	38	1	37
67 - 66	52	0	52
66 - 65	71	0	71
65 - 64	98	0	98
64 - 63	105	0	105
63 - 62	108	0	108
62 - 61	82	0	82
61 - 60	42	1	41
60 - 59	13	0	13
Totals	714	2	712 ←

OVERALL NET INCREASE IN FLOODPLAIN STORAGE

* **FLOODPLAIN STORAGE REQUIREMENT NOT MET AT THE FOLLOWING ELEVATION INTERVALS:**

Appendix A – Wetland Delineation Report

June 28, 2024

Email (rmelchionno@gpinet.com)

Mr. Ryan Melchionno, P.E.
Greenman-Pedersen, Inc.
181 Ballardvale Street, Suite 202
Wilmington, MA 01887

Re: Wetland Resource Area Analysis [LEC File #: GPI\23-499.04]
Culvert Replacement Feasibility Study
Brandy Brow Road over East Meadow River
Haverhill, Massachusetts

Dear Mr. Melchionno:

Pursuant to your request, LEC Environmental Consultants, Inc., (LEC) conducted a site evaluation and Wetland Resource Area Analysis along East Meadow River in the vicinity of Brandy Brow Road in Haverhill, Massachusetts. The purpose of the evaluation was to determine Wetland Resource Area boundaries associated with East Meadow River extending 100 feet upgradient and downgradient from the culvert crossing beneath Brandy Brow Road ("the Site"). LEC also collected field data to determine average bankfull width, stream bed substrate characteristics, and to identify stream profile features of East Meadow River.

Our site evaluation was conducted on January 26, 2024 in accordance with the *Massachusetts Wetlands Protection Act* (M.G.L. c. 131, s. 40, the *Act*) and its implementing Regulations (310 CMR 10.00, the *Act Regulations*), the *Federal Clean Water Act* (33 U.S.C. 1344, s.404, the *CWA*) and its *Regulations* (33 CFR and 40 CFR, the *CWA Regulations*), and the *City of Haverhill Wetlands Protection Ordinance* (City Code Chapter 253, the *Ordinance*). LEC also employed the criteria provided in *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act* (September 2022) and the *Field Indicators for Identifying Hydric Soils in New England* (Version 4, June 2020). The following report provides a general site description, wetland delineation methodology, and a description of the Wetland Resource Areas.

General Site Description

The Site is located west of the intersection of Brandy Brow Road and East Meadow Drive in the vicinity of 288 Brandy Brow Road within the northern residential section of Haverhill (Attachment A, Figures 1 and 2). Residential development associated with Brandy Brow Road occurs to the east and south of the Site, and undeveloped areas containing forested uplands, wetlands, and meadow habitat occur to the north and west. Neal Pond occurs immediately north of a beaver dam located approximately 130 feet north of the Site, and East Meadow River discharges from the pond, flowing in a southerly direction beneath Brandy Brow Road and continuing in a southwest direction.

Brandy Brow Road is an approximately 24-foot-wide paved asphalt roadway located within an approximately 50-foot-wide right-of-way (ROW), extending in an east/west direction consisting of two travel lanes. The paved roadway narrows to approximately 18 feet wide within the ROW west of the driveway associated with 288 Brandy Brow Road, and continues for approximately 200 feet prior to transitioning to a dirt road. Topography generally slopes downgradient from the paved portions of the roadway in a north and south direction towards East Meadow River and adjacent forested areas.

Four unnamed, perennial tributaries depicted on the most recent USGS Topographic Map (Attachment A, Figure 1) originate approximately 7,000 feet north of the Site and flow through undeveloped forested uplands and wetlands, residential development, agricultural fields, and paved roadways prior to discharging into Neal Pond. As previously noted, a beaver dam occurs approximately 130 feet north of the Site where East Meadow River discharges from Neal Pond, and flows beneath Brandy Brow Road via an 11-foot-wide open-bottom-stone culvert. East Meadow River continues flowing in a southerly direction for approximately 3.5 miles, discharging into and flowing from the Millvale Reservoir, and ultimately discharging into the Merrimack River.

Generally, within proximity to the Site, East Meadow River can be characterized as a linear stream channel with gently to steeply sloping embankments and is confined within a uniform channel defined by adjacent land development to the east, vegetated embankments, and/or abrupt Bank undercuts. The river contains key features (i.e., woody debris, large cobbles, sediment/leaf litter deposits), pools, riffles, point bars, and runs.

The main hydrologic features associated with the Site include East Meadow River, Neal Pond, and associated BVW. Depicted as perennial on the most recent USGS Topographic Map (Attachment A, Figure 1), the segment of East Meadow River at the Site is determined as a Third Order Stream (Strahler method, 1957). As depicted on the USGS Topographic Map, a series of intermittent tributaries originate approximately 7,000 feet to the north (upgradient) of Neal Pond and intersect to create three Second Order Streams; two of which converge into a Third Order Stream prior to discharging into Neal Pond. Conversely, a review of aerial imagery, MassDEP Wetland Datalayers, and 1-foot contours on MassMapper indicates that East Meadow River is a Fourth Order Stream. Additional tributaries are identified contributing to two perennial stream complexes and appear to create two Third Order Streams entering Neal Pond. In the absence of field evaluations to confirm upstream contributions to East Meadow River, LEC presumes that East Meadow River is a Third or Fourth Order Stream.

Undeveloped upland areas surrounding the Site contain maintained meadow and forested uplands. The forested uplands include a canopy of northern red oak (*Quercus rubra*), red maple (*Acer rubrum*), American elm (*Ulmus americana*), and eastern white pine (*Pinus strobus*). The understory contains eastern hemlock (*Tsuga canadensis*), Tartarian honeysuckle (*Lonicera tatarica*), European buckthorn (*Rhamnus cathartica*), sweet pepperbush (*Clethra alnifolia*), and saplings from the canopy. The groundcover contains specimens from the overstory, cinnamon fern (*Osmunda cinnamomea*), garlic mustard (*Alliaria petiolata*), raspberry (*Rubus* sp.), and maintained lawn. Entanglements of Asiatic bittersweet (*Celastrus orbiculatus*) are common throughout.

According to the Natural Resource Conservation Service (NRCS) Soil Survey (Web Soil Survey and Essex County, Massachusetts, Version 19, September 10, 2023), Neal Pond is mapped as Freetown muck (0-1% slopes). East Meadow River, associated BVW, and adjacent upland areas are primarily mapped as Windsor loamy sand (8-15% slopes) and Pits, gravel. A gravel pit inclusion is depicted to the northwest of the culvert crossing. According to NRCS, the Freetown Series is described as very deep, very poorly drained organic soils commonly found in depressions or on level uplands and alluvial plains; the Windsor Series as very deep, excessively drained soils formed in sandy outwash or eolian deposits; and Pits, gravel as irregularly shaped areas from which gravel has been removed for construction purposes.

LEC inspected soil conditions within the forested uplands using a hand-held, Dutch-style soil auger and generally observed a very coarse sand topsoil layer (A-Horizon) measuring 5 inches thick with a soil matrix color of 10YR 2/2. The A-Horizon is directly underlain by an 11-inch thick very gravelly sand subsoil (B-Horizon) with a soil matrix color of 2.5Y 4/4. Stony refusal was encountered approximately 16 inches below the mineral soil surface. Redoximorphic features were not observed within the soil profile and no other indicators of hydrology were observed within the upper soil profile. As a result, the observed soil profile does not qualify as 'hydric' in accordance with the *Field Indicators Guide*. A DEP *BVW Determination Form* for a representative upland transect upgradient of LEC flagging station 1-6 is included in Attachment C.

Floodplain Designation

According to the July 3, 2012 *Federal Emergency Management Agency* (FEMA) *Flood Insurance Rate Maps* (FIRM) for the City of Haverhill, Massachusetts (Community Panel 25009C0083F, Attachment A, Figure 3), East Meadow River, Neal Pond, and adjacent land in proximity to the Brandy Brow Road culvert crossing are mapped within a Zone A – *Special Flood Hazard Areas*.

Natural Heritage and Endangered Species Program (NHESP) Designation

According to the 15th Edition (August 1, 2021) of the Natural Heritage Endangered Species Program (NHESP) *Massachusetts Natural Heritage Atlas* and MassGIS MassMapper, the Site is located within *Estimated Habitat of Rare Wildlife* (EH 1358) and *Priority Habitat of Rare Species* (2148). In addition, there are no mapped certified or potential vernal pools on or in close proximity to the Site (Attachment A, Figure 4).

Division of Fisheries & Wildlife (DFW) Coldwater Fishery Designation

According to the Coldwater Fish Resources (CFR) Mapping program (https://www.mass.gov/info-details/coldwater-fish-resources), East Meadow River is mapped as a Coldwater Fishery within the Merrimack River Watershed (SARIS ID: 8450525; Attachment A, Figure 4). The stream is mapped through almost its entire stretch from an upstream tributary approximately 1,500 feet west of the Massachusetts/New Hampshire state border to its confluence with the Merrimack River.

Area of Critical Environmental Concern (ACEC)

According to MassGIS MassMapper (https://maps.massgis.digital.mass.gov/MassMapper/MassMapper), East Meadow River, Neal Pond, and surrounding areas are not mapped within an Area of Critical Environmental Concern (ACEC).

Outstanding Resource Water (ORW)

According to MassGIS MassMapper and 314 CMR 4.06, East Meadow River, Neal Pond, and surrounding areas are mapped within the Millvale Reservoir Outstanding Resource Water (ORW, Attachment A, Figure 5). The Millvale Reservoir ORW type is Public Water Supply Watershed, and the ORW boundary is defined as the entire reservoir to outlet in Haverhill and those tributaries thereto.

Impaired Waters Designation

According to MassGIS, MassDEP 2022 Integrated List of Waters, the segment of East Meadow River within the Site is mapped as a Category 5 Impaired Water – "Waters requiring a TMDL" (Assessment Unit ID: MA84A-39, Attachment A, Figure 6). The extent of mapping includes "headwaters, outlet Neal Pond, Haverhill to inlet Millvale Reservoir, Haverhill." The listed impairment is *Escherichia coli* (E. coli).

Surface Water Protection Areas

According to MassGIS MassMapper, the Site is located within a Surface Water Supply Protection Area (Zone A) associated with the Millvale Reservoir (PWS ID: 3128000-05S) (Attachment A, Figure 5).

Wetland Boundary Determination

LEC conducted a site evaluation on January 26, 2024 to identify, delineate, and characterize protectable Wetland Resource Areas within 100 feet of the culvert in the survey area proximate to the Brandy Brow Road crossing over East Meadow River in Haverhill. Based on our observations, LEC determined that the Site contains BVW, Bank-Mean Annual High Water (MAHW), Land Under Water Bodies and Waterways (LUW), and Riverfront Area. Wetland Resource Area boundaries were not delineated on private property south of Brandy Brow Road, as site access was not authorized by the landowner.

The extent of Wetland Resource Areas was determined through observations of existing plant communities, hydrologic indicators, and bankfull indicators in accordance with the *Act*, the *Act Regulations*, the *CWA*, the *CWA Regulations*, and the *Ordinance*. LEC delineated the BVW boundary with sequentially-numbered, blaze-orange surveyor's tape with the words "LEC Resource Area" printed in black. LEC flagging stations 1-1 through 1-12 demarcate the BVW boundary.

LEC delineated the Bank and MAHW boundaries with sequentially-numbered blue surveyor's tape. LEC flagging stations B-100 through B-112 and B-200 through B-212 demarcate the boundary associated with East Meadow River.

The 100-foot Buffer Zone extends from the outermost boundary of BVW or Bank.

Bordering Vegetated Wetland (BVW)

BVW is defined in 310 CMR 10.55(2) as *freshwater wetlands which border on creeks, rivers, streams, ponds, and lakes. In these areas soils are saturated and/or inundated such that they support a predominance of wetland indicator plants. The boundary of BVW is the line within which 50% or more of the vegetational community consists of wetland indicator plants and saturated or inundated conditions exist.*

According to the *Ordinance* (Chapter 553-8 Definitions), Vegetated Wetland is defined as: *areas where the topography is low and flat and where the soils are annually saturated. The boundary of vegetated wetlands is the line within which the vegetational community is substantially characterized by species identified in the Wetlands Protection Act or this chapter, or, when vegetation appears to have been altered, within which hydric soils are present. The types of vegetated wetlands are: wet meadows, marshes, swamps and bogs. The Commission may find, based on substantial evidence in a particular case, that additional species are characteristic of wetlands.*

One scrub-shrub BVW occurs within a topographic depression and fringes along the western Bank of East Meadow River north (upstream) of the culvert in proximity to the Site (Attachment B, Photos 3 and 5). Surface water was observed flowing from the upland meadow to the west into the BVW between wetland flags 1-9 and 1-10; however, no upgradient protectable Wetland Resource Areas were observed. The depression held approximately 2 inches of standing water at the time of LEC's site evaluation, and surface water continued flowing into the river downgradient of wetland flags 1-4/1-5 and 1-11/1-12.

Vegetation within the scrub-shrub BVW includes individuals of mature red maple (*Acer rubrum*). The sparse shrub layer includes individuals of European buckthorn (*Rhamnus cathartica*) and silky dogwood (*Cornus amomum*). The groundcover layer includes seedlings from the overstory. Due to site observations outside the growing season, additional groundcover may be present.

LEC inspected soil conditions using a hand-held, Dutch-style soil auger within wetland areas and observed a 13-inch thick, sandy loam topsoil (A-Horizon) with a soil matrix color of 10YR 4/1 with 5% redoximorphic depletions between 10 and 13 inches below the mineral soil surface. The subsurface soil is underlain by a coarse sand subsoil (B Horizon) with a soil matrix color of 10 YR 3/2. The soil profile within the BVW is considered 'hydric' in accordance with the *Field Indicators Guide.*

A DEP *BVW Determination Form* for a representative wetland transect downgradient of LEC flagging station 1-6 are included in Attachment C.

Bank, Mean Annual High Water and Ordinary High Water

According to 310 CMR 10.54(2): *Bank is defined as the portion of the land surface which normally abuts and confines a water body. It occurs between a water body and a vegetated bordering wetland and adjacent flood plain, or, in the absence of these, it occurs between a water body and an upland… The upper boundary of a Bank is the first observable break in the slope or the mean annual flood level, whichever is lower. The lower boundary of a Bank is the mean annual low flow level.*

Mean Annual High Water (MAHW) is defined at 310 CMR 10.58 (2)(a)(2) as *the line that is apparent from visible markings or changes in the character of soils or vegetation due to the prolonged presence of water and that distinguishes between predominantly aquatic and predominantly terrestrial land. Field indicators of bankfull conditions shall be used to determine the mean annual high-water line. Bankfull field indicators include but are not limited to; changes in slope, changes in vegetation, stain lines, top of pointbars, changes in bank materials, or bank undercuts.*

The term Ordinary High Water (OHW) mark is defined at 33 CFR 328.3(e) as the *line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.*

The Ordinance (§253-8) defines Bank as *the land area which normally abuts and confines a water body, the lower boundary being the mean annual low flow level and the upper boundary being the first observable break in slope or the mean annual flood level, whichever is higher.*

The *Ordinance* does not define MAHW, so the above-definition prevails.

The Bank along East Meadow River varies throughout the Site and is comprised of cobbles, rocks, mucky/mineral substrate, and wetland vegetation. Stone foundations occur along the Bank in proximity to the Brandy Brow Road culvert crossing. Generally, bank undercuts and scouring are common throughout the Bank downstream of the culvert, and exposed roots and scouring are present throughout, as well. The MAHW line is coincident with top of Bank, and the MAHW/Bank is generally coincident with OHW.

Bank to the north of the culvert crossing is generally located within steep embankments, with exception to the western Bank between flags B-204 through B-208. Bank to the south of the culvert is situated within gently to moderately sloping embankments to the west, and steep embankments to the east. All Banks are generally vegetated and well defined, ranging from 2 to 24 inches high.

Land Under Waterbodies and Waterways (LUW)

According to 310 CMR 10.56(2): *LUW is the land beneath any creek, river, stream, pond or lake. Said land may be composed of organic muck or peat, fine sediments, rocks or bedrock...The boundary of Land under Water Bodies and Waterways is the mean annual low water level.*

The *Ordinance* does not define LUW, so the above definition prevails.

LUW is associated with the land area beneath East Meadow River. The 18 to 55-foot-wide stream channel is comprised predominantly of sands and very fine gravel, with a variety of leaf litter, muck, and cobbles. Portions of the perennial stream immediately downgradient of the beaver dam and culvert contain deeper pools, likely as a result of the high velocity discharges.

Bordering Land Subject to Flooding

According to the *Act Regulations* [310 CMR 10.57 2 (a)], BLSF is defined as *an area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds or lakes. It extends from the banks of these waterways and water bodies; where a bordering vegetated wetland occurs, it extends from said wetland.*

The *Ordinance* does not define BLSF, so the above definition prevails.

According to the July 3, 2012 *Federal Emergency Management Agency* (FEMA) *Flood Insurance Rate Maps* (FIRM) for the City of Haverhill, Massachusetts (Community Panel 25009C0083F, Attachment A, Figure 4), East Meadow River, Neal Pond, and adjacent land in proximity to the Brandy Brow Road culvert crossing are mapped within a Zone A - *Special Flood Hazard Areas.*

As such, areas located beyond the Bank and/or BVW boundaries are protectable as Bordering Land Subject to Flooding (BLSF).

Riverfront Area

A River is defined as *any natural flowing body of water that empties to any ocean, lake, pond or other river and which flows throughout the year. Rivers include streams that are perennial because surface water flows within them throughout the year. Intermittent streams are not rivers as defined herein because surface water does not flow within them throughout the year* [310 CMR 10.58(2)(a)(1)].

According to 310 CMR 10.58 2(a), *Riverfront Area is defined as the area of land between a river's mean annual high water line and a parallel line measured horizontally 200 feet away.*

The Ordinance (§253-8) defines a River as a naturally flowing body of water that empties to any lake, ocean or other river and which flows throughout the year.

According to the latest USGS Topographic Map, East Meadow River is mapped as a perennial waterway. Land within 200 feet of the Bank-MAHW Line of East Meadow River is designated as Riverfront Area. The 200-foot Riverfront Area includes the adjacent BVW, forested uplands, upland meadow, and previously disturbed and developed areas associated with Brandy Brow Road, including the paved roadway, maintained vegetated shoulders, and other site appurtenances.

East Meadow River Morphological Features Analysis

The following provides a detailed analysis of the morphological features associated with the portion of East Meadow River within 100 feet of the Brandy Brow Road culvert crossing.

Bankfull Width Measurements

According to the Massachusetts River & Stream Crossing Standards, dated March 1, 2006 (revised 3/1/2011 and corrected 3/8/2012), determining the average bankfull width is required for designing the replacement stream crossings. LEC focused on measuring multiple locations downgradient of the Brandy Brow Road culvert crossing within East Meadow River, as the upstream beaver dam creates unnatural

characteristics within the stream. Based on these measurements, the average bankfull width is 23.47 feet, as noted in Table 1.

Table 1. Bankfull Width Measurements (East Meadow River downstream of culvert)

Location	Corresponding Flag Number	Bankfull Width (feet)
1	BWF 1	21’
2	BWF 2	29’
3	BWF 3 (Reference Reach)	24’
4	BWF 4	18’
5	BWF 5	21.5’ 22.5’ (including Bank undercut)
6	BWF 6	24.5’
7	BWF 7/B212	19.6’ 25.3’ (edge of scouring)
	Average Bankfull Width:	**23.47’**

LEC utilized the USGS Water Resources Web Application, StreamStats, to calculate the bankfull widths associated with the perennial stream. Considering the surrounding developed conditions, the upstream beaver dam, and undersized culvert, LEC produced two StreamStats reports, each one located immediately upstream and downstream of the culvert crossing. As noted in the StreamStats Reports (Attachment E), the calculated bankfull width identified in both reports is 24.4 feet. The StreamStats results are generally similar to downstream existing conditions; however, upstream existing conditions are almost twice as wide likely due to the undersized culvert and presence of the upstream beaver dam.

Reference Reach

The reference reach of a stream channel provides a design template of the existing stream channel to facilitate the design of the proposed new stream bed. According to Section 5.5 of the *USDA Forest Service document Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings*, dated August, 2008, “*the ideal reference reach represents the physical, hydrologic, and hydraulic characteristics of the channel that would be at the culvert site if the road did not exist.*”

Primarily, the upstream extent of East Meadow River is obstructed by the undersized open-bottom-stone culvert beneath Brandy Brow Road, and the natural morphological development has likely been altered as a result of the upstream beaver dam. Downstream of the culvert crossing, East Meadow River exhibits

more naturally meandering features within a confined channel in undeveloped forested uplands and wetlands (beyond the survey area).

LEC collected bankfull width data at one reference reach within East Meadow River approximately 175 feet downstream of the Brandy Brow Road culvert crossing. The stream bed substrate analysis provided below occurred within the reference reach location at the flag labeled "BF 3" (Attachment B, Photo 14).

Stream Bed Substrate Analysis

LEC conducted a riverbed substrate analysis (i.e., pebble count) utilizing the *Step-Toe Procedure* outlined in the *USDA Forest Service publication (GTR RM-245) Stream Channel Reference Sites: An Illustrated Guide to Field Technique*, dated April 1994, in order to facilitate the design of the proposed new stream bed at the culvert replacement. LEC conducted the pebble count at the reference reach location approximately 175 feet downstream of the Brandy Brow Road culvert crossing. The width of 100 samples were measured and the data tabulated by size class and frequency (absolute number, %, and cumulative %), as noted in Attachment E. The pebble count locations, largely representative of general stream bed conditions, contained a range from sand to coarse gravel. A high density of sand (44%) is prevalent in the reference reach.

Stream Profile Features

As previously noted, the stream profile of East Meadow River contains key features (i.e., woody debris, sediment/leaf litter deposits), pools, riffles, point bars, and runs (Attachment F). The upstream segment prior to flowing beneath Brandy Brow Road exhibits a relatively linear stream channel with a deep pool, likely formed as a result of the upstream beaver dam and row of large cobbles upstream of the culvert crossing. Riffles occur immediately prior to the river approaching the open-bottom-stone culvert (Attachment B, Photo 6). Tree throws are present within immediate proximity of the Banks, and key features such as small to medium boulders occur in close proximity to the open-bottom-stone culvert.

The downstream segment of East Meadow River exhibits a uniform, relatively linear channel with moderate to abrupt turns occurring approximately 140 feet and 300 feet downstream of the culvert crossing. The substrate includes sand and very fine to coarse gravel, and medium to large cobbles occur sporadically. The downstream segment is almost entirely comprised of high velocity riffles. A fine sediment point bar is present between the two aforementioned turns in the channel, and a pool occurs immediately downstream and slightly alongside the point bar. A submerged tree throw was observed extending roughly parallel to the direction of flow, thereby creating a pool immediately downstream of the key feature. Additional key features include branches along the Banks. Pockets of leaf litter caught on the tree throw and small branches occur sporadically within the channel.

Summary

LEC conducted a site evaluation and wetland delineation on January 26, 2024 to determine the extent of Wetland Resource Areas subject to jurisdiction under the *Act* and *Act Regulations*, the *CWA* and the *CWA Regulations*, and the *Ordinance*, and to delineate the BVW and Bank-MAHW Line associated with East Meadow River. Based on our site evaluation and review of pertinent maps, LEC determined that the

Wetland Resource Areas associated with the Site include BVW, Bank, LUW, BLSF, and Riverfront Area. LEC also collected field data to determine average bankfull width and stream bed substrate characteristics of the perennial stream in order to support the design of the culvert replacement. Activities associated with the culvert replacement project will impact Wetland Resource Areas and the associated 100-foot Buffer Zone, and will require filing necessary permit applications with the Haverhill Conservation Commission (Notice of Intent Application), the Massachusetts Department of Environmental Protection (401 Water Quality Certification for dredging in or discharge of dredge or fill material to an ORW), and/or the US Army Corps of Engineers (Self-Verification Notification or Pre-Construction Notification).

Thank you for the opportunity to provide these services. Should you have any questions or require additional information, do not hesitate to contact me in our Worcester office at 508-753-3077 or at akendall@lecenvironmental.com.

Sincerely,

LEC Environmental Consultants, Inc.

Andrea Kendall, PWS
Senior Environmental Scientist

Claire A. Hoogeboom
Wetland Scientist

alk: projects\23-499.04\Wetland Resource Area Analysis.doc

Attachment A

Locus Maps

Figure 1: USGS Topographic Map

Figure 2: USGS Color Ortho Imagery Map

Figure 3: FEMA Flood Insurance Rate Map

Figure 4: NHESP Estimated & Priority Habitats & Coldwater Fishery Map

Figure 5: Area of Critical Environmental Concern, Outstanding Resource Waters & Surface Water Protection Area Map

Figure 6: Impaired Waters Map

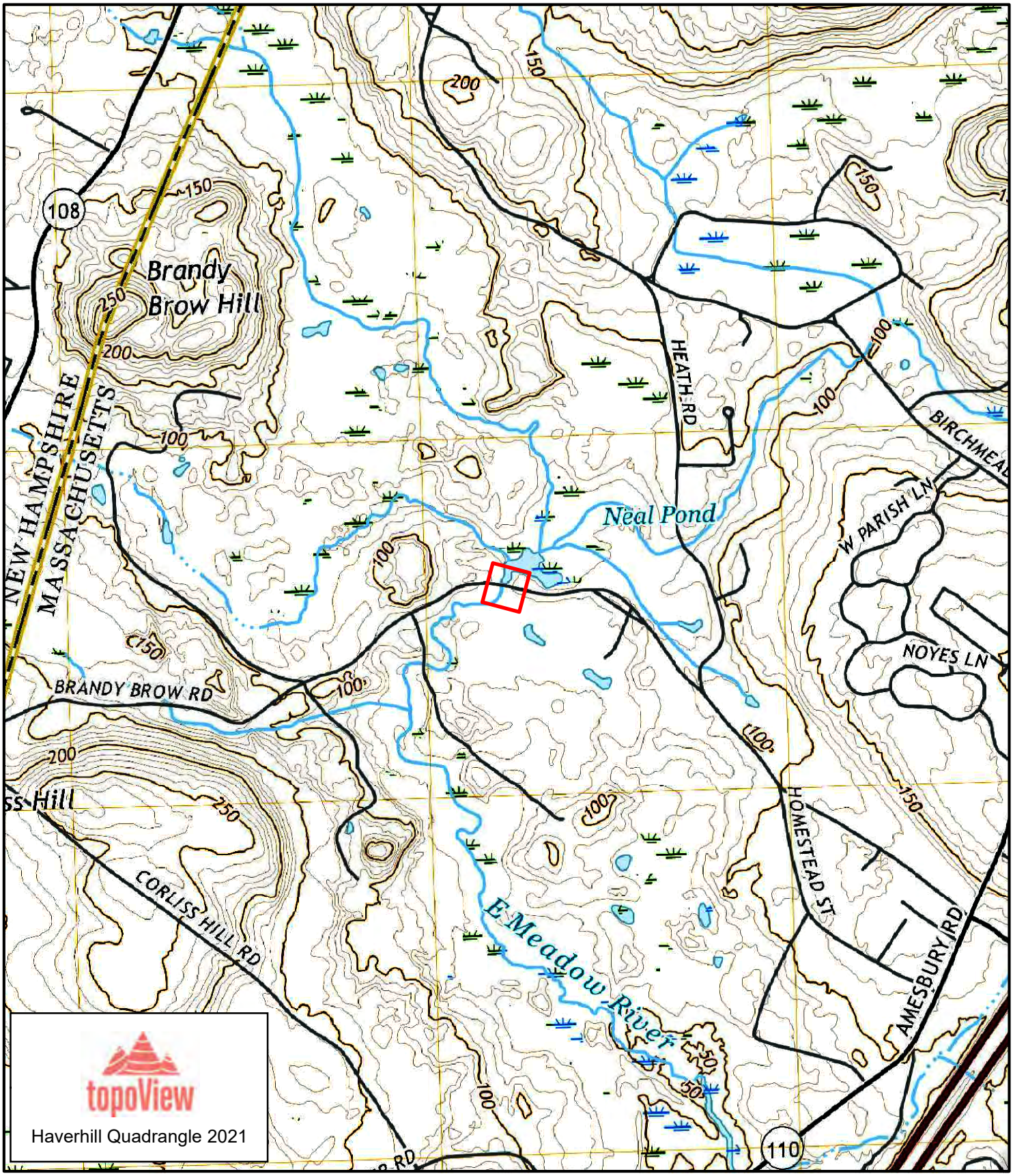


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Figure 1: USGS Topographic Map
Brandy Brow Road Culvert Replacement
Haverhill, MA

March 21, 2024

N

0 600 1,200 Feet

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Figure 2: USGS Color Ortho Imagery Map
Brandy Brow Road Culvert Replacement
Haverhill, MA

March 21, 2024

N

0 100 200 Feet

National Flood Hazard Layer FIRMette

71°2'43"W 42°49'50"N

Figure 3: FEMA FIRMette

71°2'5"W 42°49'23"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/22/2024 at 9:37 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

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Figure 4: NHESP Estimated & Priority Habitats and Coldwater Fishery Map
Brandy Brow Road Culvert Replacement
Haverhill, MA

March 21, 2024

N

0 100 200 Feet

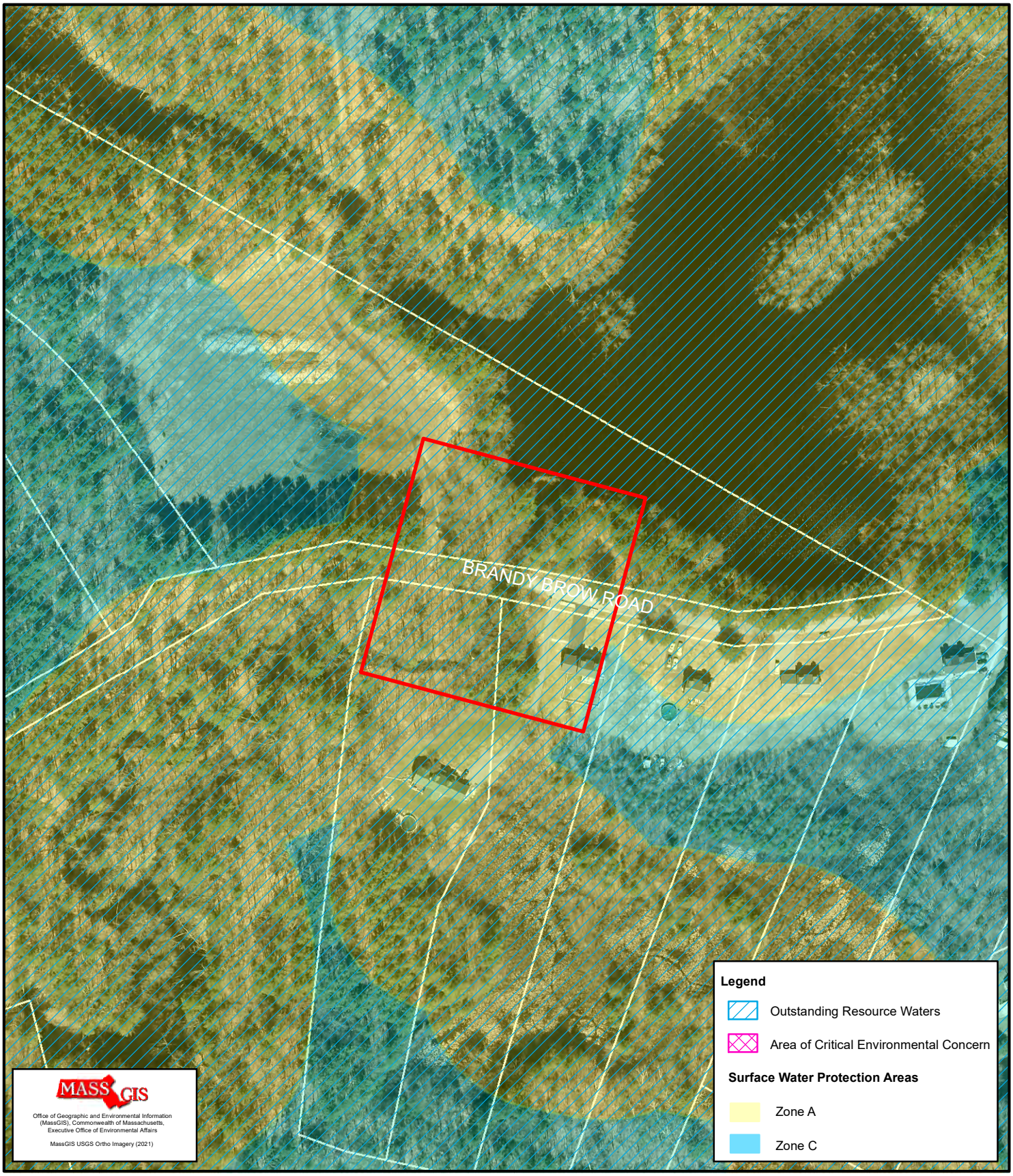

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Figure 5: ACEC, ORW & Surface Water Protection Map
Brandy Brow Road Culvert Replacement
Haverhill, MA

March 21, 2024

N

0 100 200 Feet

4.06: continued

TABLE 15 MERRIMACK RIVER BASIN (continued)*				
Surface Water Name†	**Surface Water or Segment Boundary**	**Mile Point‡**	**Class**	**Qualifiers**
Plumbush Creek			SA, B[2]	ORW
Lake Attitash	Entire lake to outlet in Amesbury and those tributaries thereto		A	PWS ORW
Tuxbury Pond	Entire pond to outlet in Amesbury and those tributaries thereto		A	PWS ORW
Millvale Reservoir	Entire reservoir to outlet in Haverhill and those tributaries thereto		A	PWS ORW
Kenoza Lake	Entire lake to outlet in Haverhill and those tributaries thereto		A	PWS ORW
Crystal Lake	Entire lake to outlet in Haverhill and those tributaries thereto		A	PWS ORW
Haggets Pond	Entire pond to outlet in Andover and those tributaries thereto		A	PWS ORW
Fish Brook	Entire length and those tributaries thereto	4.0 - 0.0	A	PWS ORW
Lake Cochichewick	Entire lake to outlet in North Andover and those tributaries thereto		A	PWS ORW
Artichoke Reservoir (Upper and Lower Artichoke Reservoir)	Entire reservoir to outlet in West Newbury and those tributaries thereto		A	PWS ORW
Unnamed Reservoir (Indian Hill Reservoir)	Entire reservoir to outlet in West Newbury and those tributaries thereto		A	PWS ORW
Chadwick Pond (Little Pond)	Entire pond to outlet in Haverhill and those tributaries thereto		A	PWS ORW
Hoveys Pond (Mitchell Pond, Johnson Pond)	Entire pond to outlet in Boxford and those tributaries thereto		A	PWS ORW
Johnsons Pond	Entire pond to outlet in Groveland and those tributaries thereto		A	PWS ORW
Round Pond (Lake Pentucket)	Entire lake to outlet in Haverhill and those tributaries thereto		A	PWS ORW
Crooked Springs Brook	Source in Chelmsford to confluence with Stony Brook, Chelmsford		B	Cold Water

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Figure 6: Impaired Waters Map
Brandy Brow Road Culvert Replacement
Haverhill, MA

March 21, 2024

N

0 100 200 Feet

Attachment B

Site Photographs

East Meadow River on North (Upstream) Side of Brandy Brow Road Culvert

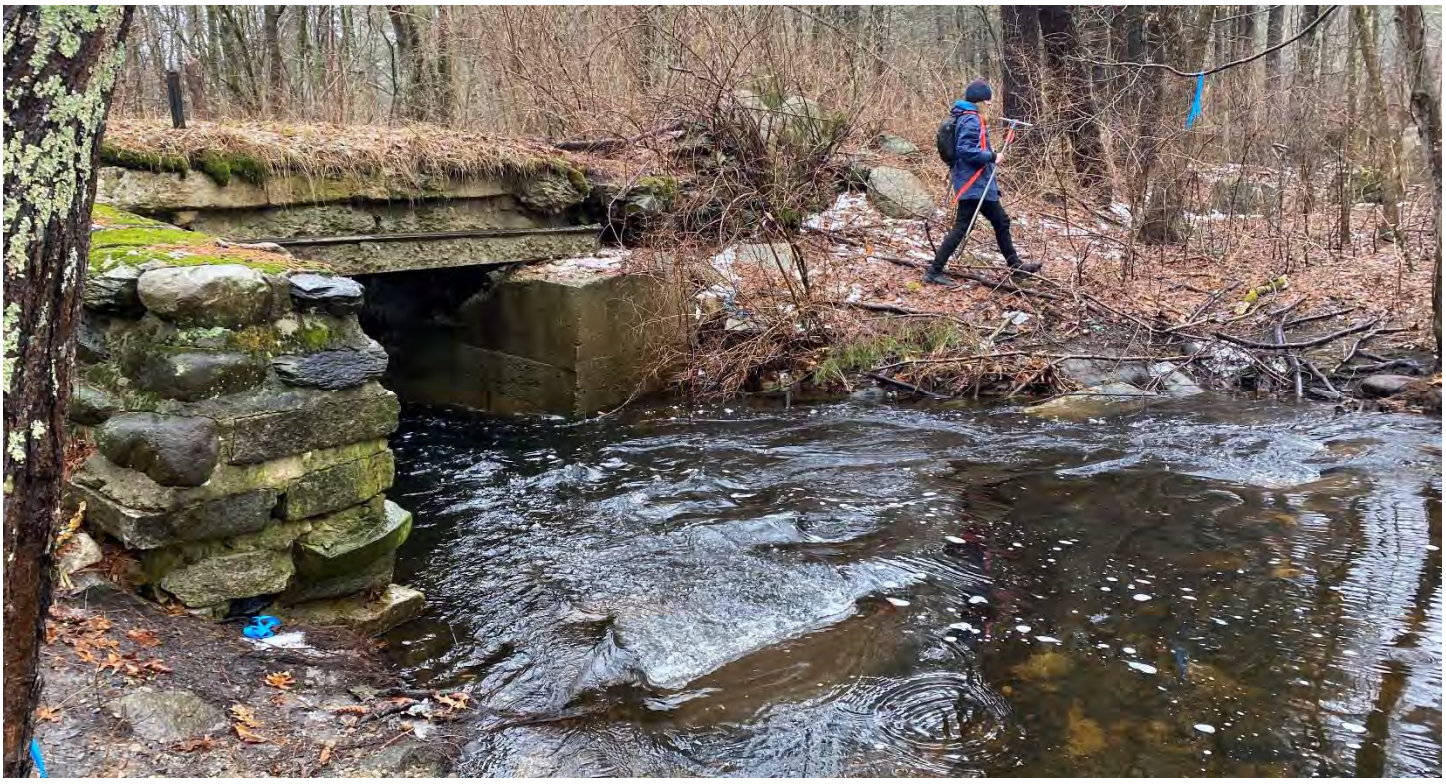
Photograph 1: Northeast view of river discharging from beaver dam from flag B-202.

Photograph 2: East view of River from flag B-203.

Photograph 3: Southeast view of river and 1-series BVW from flag B-204.

Photograph 4: Northeast view of eastern Bank from flag B-106.

Photograph 5: Northeast view of 1-series BVW and forested upland from Brandy Brow Road.



Photograph 6: Southwest view of Brandy Brow Road culvert from flag B-108.

Photograph 6: North view of East Meadow River from Brandy Brow Road.

East Meadow River on South (Downstream) Side of Brandy Brow Road Culvert

Photograph 7: South view of East Meadow River from Brandy Brow Road.

Photograph 8: North view of open-bottom-stone culvert beneath Brandy Brow Road.

Photograph 9: Northeast view of East Meadow River and open-bottom-stone culvert from flag B-212.

Photograph 10: South view of East Meadow River from flag B-212.

Photograph 11: South view of East Meadow River approximately 60 feet south of Brandy Brow Road culvert (Bankfull Width Flag (BWF) 6).

Photograph 12: East view of East Meadow River from BWF 4.

Photograph 13: Southwest view of East Meadow River from BWF 4.

Photograph 14: Southeast view of East Meadow River at BWF 3/Reference Reach.

Attachment C

MassDEP BVW Determination Data Forms

BORDERING VEGETATED WETLAND DETERMINATION FORM

Project/Site: Brandy Brow Road over East Meadow River City/Town: Haverhill Sampling Date: 1/26/2024

Applicant/Owner: City of Haverhill Sampling Point or Zone: 1-6 (UPL)

Investigator(s): Claire Hoogeboom, LEC Environmental Consultants, Inc. Latitude / Longitude: 42.82689 / -71.04041

Soil Map Unit Name: Windsor loamy sand (8-15% slopes) NWI or DEP Classification: N/A

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ☐ No ☑ (If no, explain in Remarks)

Are Vegetation ☐, Soil ☐ , or Hydrology ☐ significantly disturbed? (If yes, explain in Remarks)

Are Vegetation ☐, Soil ☐ , or Hydrology ☐ naturally problematic? (If yes, explain in Remarks)

SUMMARY OF FINDINGS – Attach site map and photograph log showing sampling locations, transects, etc.

Wetland vegetation criterion met?	Yes ☐	No ☑	**Is the Sampled Area within a Wetland?** Yes ☐ No ☑
Hydric Soils criterion met?	Yes ☐	No ☑	
Wetlands hydrology present?	Yes ☐	No ☑	

Remarks, Photo Details, Flagging, etc.:

- Test Pit located approximately 5-feet upgradient of wetland flag 1-6.
- Data collected outside the growing season. Higher levels of precipitation occurred during 2023 prior to site evaluation.

HYDROLOGY

Field Observations:			
Surface Water Present?	Yes ☐	No ☑	Depth (inches)_____
Water Table Present?	Yes ☐	No ☑	Depth (inches)_____
Saturation Present (including capillary fringe)?	Yes ☐	No ☑	Depth (inches)_____

Wetland Hydrology Indicators

Reliable Indicators of Wetlands Hydrology	Indicators that can be Reliable with Proper Interpretation	Indicators of the Influence of Water
☐ Water-stained leaves	☐ Hydrological records	☐ Direct observation of inundation
☐ Evidence of aquatic fauna	☐ Free water in a soil test hole	☐ Drainage patterns
☐ Iron deposits	☐ Saturated soil	☐ Drift lines
☐ Algal mats or crusts	☐ Water marks	☐ Scoured areas
☐ Oxidized rhizospheres/pore linings	☐ Moss trim lines	☐ Sediment deposits
☐ Thin muck surfaces	☐ Presence of reduced iron	☐ Surface soil cracks
☐ Plants with air-filled tissue (aerenchyma)	☐ Woody plants with adventitious roots	☐ Sparsely vegetated concave surface
☐ Plants with polymorphic leaves	☐ Trees with shallow root systems	☐ Microtopographic relief
☐ Plants with floating leaves	☐ Woody plants with enlarged lenticels	☐ Geographic position (depression, toe of slope, fringing lowland
☐ Hydrogen sulfide odor		

Remarks (describe recorded data from stream gauge, monitoring well, aerial photos, previous inspections, if available):

This form is only for BVW delineations. Other wetland resource areas may be present and should be delineated according to the applicable regulatory provisions.

Form Revised July 2023

VEGETATION – Use both common and scientific names of plants.

Tree Stratum Plot size 30'

Common name	Scientific name	Indicator Status	Absolute % Cover	Dominant? (yes/no)	Wetland Indictor? (yes/no)
1. red maple	Acer rubrum	FAC	63.0	Yes	Yes
2. northern red oak	Quercus rubra	FACU	20.5	Yes	No
3. american elm	Ulmus americana	FACW	10.5	No	Yes
4.					
5.					
6.					
7.					
8.					
9.					

94.0 = Total Cover

Shrub/Sapling Stratum Plot size 15'

Common name	Scientific name	Indicator Status	Absolute % Cover	Dominant? (yes/no)	Wetland Indictor? (yes/no)
1. Tartarian honeysuckle	Lonicera tatarica	FACU	63.0	Yes	No
2. European buckthorn	Rhamnus cathartica	FAC	10.5	No	Yes
3.					
4.					
5.					
6.					
7.					
8.					
9.					

73.5 = Total Cover

Herb Stratum Plot size 5'

Common name	Scientific name	Indicator Status	Absolute % Cover	Dominant? (yes/no)	Wetland Indictor? (yes/no)
1. dewberry	Rubus flagellaris	FACU	3.0	Yes	No
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					

3.0 = Total Cover

VEGETATION – continued.

Woody Vine Stratum Plot size 30'

Common name	Scientific name	Indicator Status	Absolute % Cover	Dominant? (yes/no)	Wetland Indictor? (yes/no)
1. Asiatic bittersweet	Celastrus orbiculatus	FACU	20.5	Yes	No
2.					
3.					
4.					
		20.5 = Total Cover			

Rapid Test: Do all dominant species have an indicator status of OBL or FACW? Yes ☐ No ☑

Dominance Test:	Number of dominant species	Number of dominant species that are wetland indicator plants	Do wetland indicator plants make up ≥ 50% of dominant plant species?
	5	1	Yes ☐ No ☑

Prevalence Index:		Total % Cover (all strata)	Multiply by:	Result
	OBL species		X 1	= 0.00
	FACW species	11	X 2	= 21.00
	FAC species	74	X 3	= 220.50
	FACU species	108	X 4	= 430.00
	UPL species		X 5	= 0.00
	Column Totals	(A) 191.5		(B) 671.5
Prevalence Index		B/A = 3.51		Is the Prevalence Index ≤ 3.0? Yes ☐ No ☑

Wetland vegetation criterion met? Yes ☐ No ☑

Definitions of Vegetation Strata

Tree - Woody plants 3 in. (7.62 cm) or more in diameter at breast height (DBH), regardless of height

Shrub / Sapling - Woody plants less than 3 in. (7.62 cm) DBH and greater than or equal to 3.3 ft. (1 m) tall

Herb - All herbaceous (non-woody plants, regardless of size, and woody plants less than 3.3 ft. (1 m) tall

Woody vines - All woody vines greater than 3.3 ft. (1 m) in height

Cover Ranges	
Range	Midpoint
1-5 %	3.0 %
6-15 %	10.5 %
15-25 %	20.5 %
26-50 %	38.0 %
51-75 %	63.0 %
76-95 %	85.5 %
96-100 %	98.0 %

Sampling Point 1-6 (UPL)

SOIL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Location[2]		
0-5	10YR 2/2	100.00					VCS	
5-16	2.5Y 4/4	100.00					VGS	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators (Check all that apply)		**Indicators for Problematic Hydric Soils**
☐ Histosol (A1)	☐ Polyvalue Below Surface (S8)	☐ 2 cm Muck (A10)
☐ Histic Epipedon (A2)	☐ Thin Dark Surface (S9)	☐ 5 cm Mucky Peat or Peat (S3)
☐ Black Histic (A3)	☐ Loamy Gleyed Matrix (F2)	☐ Iron-Manganese Masses (F12)
☐ Hydrogen Sulfide (A4)	☐ Depleted Matrix (F3)	☐ Mesic Spodic (A17)
☐ Stratified Layers (A5)	☐ Redox Dark Surface (F6)	☐ Red Parent Material (F21)
☐ Depleted Below Dark Surface (A11)	☐ Depleted Dark Surface (F7)	☐ Very Shallow Dark Surface (F22)
☐ Thick Dark Surface (A12)	☐ Redox Depressions (F8)	
☐ Sandy Mucky Mineral (S1)		
☐ Sandy Gleyed Matrix (S4)		
☐ Sandy Redox (S5)		☐ Other (Include Explanation in Remarks)
☐ Stripped Matrix (S6)		
☐ Dark Surface (S7)		

Restrictive Layer (if observed) Type: Stony Depth (inches): 16.00

Remarks:

Hydric Soils criterion met? **Yes** ☐ **No** ☑

BORDERING VEGETATED WETLAND DETERMINATION FORM

Project/Site: Brandy Brow Road over East Meadow River City/Town: Haverhill Sampling Date: 1/26/2024

Applicant/Owner: City of Haverhill Sampling Point or Zone: 1-6 (WET)

Investigator(s): Claire Hoogeboom, LEC Environmental Consultants, Inc. Latitude / Longitude: 42.82689 / -71.04041

Soil Map Unit Name: Windsor loamy sand (8-15% slopes) NWI or DEP Classification: Deep Marsh

Are climatic/hydrologic conditions on the site typical for this time of year? Yes [ ] No [✓] (If no, explain in Remarks)

Are Vegetation [ ], Soil [ ], or Hydrology [ ] significantly disturbed? (If yes, explain in Remarks)

Are Vegetation [ ], Soil [ ], or Hydrology [ ] naturally problematic? (If yes, explain in Remarks)

SUMMARY OF FINDINGS – Attach site map and photograph log showing sampling locations, transects, etc.

Wetland vegetation criterion met?	Yes [✓]	No [ ]	**Is the Sampled Area within a Wetland?** Yes [✓] No [ ]
Hydric Soils criterion met?	Yes [✓]	No [ ]	
Wetlands hydrology present?	Yes [✓]	No [ ]	

Remarks, Photo Details, Flagging, etc.:

- Test Pit located approximately 2-feet downgradient of wetland flag 1-6.
- Data collected outside the growing season. Higher levels of precipitation occurred during 2023 prior to site evaluation.

HYDROLOGY

Field Observations:			
Surface Water Present?	Yes [✓]	No [ ]	Depth (inches) 2.00
Water Table Present?	Yes [✓]	No [ ]	Depth (inches) 0.00
Saturation Present (including capillary fringe)?	Yes [✓]	No [ ]	Depth (inches) 0.00

Wetland Hydrology Indicators

Reliable Indicators of Wetlands Hydrology	Indicators that can be Reliable with Proper Interpretation	Indicators of the Influence of Water
[✓] Water-stained leaves	[ ] Hydrological records	[✓] Direct observation of inundation
[ ] Evidence of aquatic fauna	[✓] Free water in a soil test hole	[✓] Drainage patterns
[ ] Iron deposits	[✓] Saturated soil	[ ] Drift lines
[ ] Algal mats or crusts	[✓] Water marks	[ ] Scoured areas
[ ] Oxidized rhizospheres/pore linings	[ ] Moss trim lines	[ ] Sediment deposits
[ ] Thin muck surfaces	[ ] Presence of reduced iron	[ ] Surface soil cracks
[ ] Plants with air-filled tissue (aerenchyma)	[✓] Woody plants with adventitious roots	[✓] Sparsely vegetated concave surface
[ ] Plants with polymorphic leaves	[ ] Trees with shallow root systems	[✓] Microtopographic relief
[ ] Plants with floating leaves	[ ] Woody plants with enlarged lenticels	[✓] Geographic position (depression, toe of slope, fringing lowland
[ ] Hydrogen sulfide odor		

Remarks (describe recorded data from stream gauge, monitoring well, aerial photos, previous inspections, if available):

Snow melt coupled with precipitation within 1 week prior to site evaluation likely contributed to high groundwater and saturated conditions. Observations also occur outside the growing season. As such, standing water, free water in a soil test hole, and saturated soil alone are not reliable indicators of wetland hydrology; however, site conditions generally support the wetland determination.

This form is only for BVW delineations. Other wetland resource areas may be present and should be delineated according to the applicable regulatory provisions.

Form Revised July 2023

VEGETATION – Use both common and scientific names of plants.

Tree Stratum Plot size 30'

Common name	Scientific name	Indicator Status	Absolute % Cover	Dominant? (yes/no)	Wetland Indictor? (yes/no)
1. red maple	Acer rubrum	FAC	38.0	Yes	Yes
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

38.0 = Total Cover

Shrub/Sapling Stratum Plot size 15'

Common name	Scientific name	Indicator Status	Absolute % Cover	Dominant? (yes/no)	Wetland Indictor? (yes/no)
1. silky dogwood	Cornus amomum	FACW	20.5	Yes	Yes
2. European buckthorn	Rhamnus cathartica	FAC	10.5	Yes	Yes
3.					
4.					
5.					
6.					
7.					
8.					
9.					

31.0 = Total Cover

Herb Stratum Plot size 5'

Common name	Scientific name	Indicator Status	Absolute % Cover	Dominant? (yes/no)	Wetland Indictor? (yes/no)
1. silky dogwood	Cornus amomum	FACW	10.5	Yes	Yes
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					

10.5 = Total Cover

VEGETATION – continued.

Woody Vine Stratum	Plot size 30'				
Common name	Scientific name	Indicator Status	Absolute % Cover	Dominant? (yes/no)	Wetland Indictor? (yes/no)
1.					
2.					
3.					
4.					
			0.0 = Total Cover		

Rapid Test: Do all dominant species have an indicator status of OBL or FACW?				Yes ☐ No ☑
Dominance Test:	Number of dominant species	Number of dominant species that are wetland indicator plants		Do wetland indicator plants make up ≥ 50% of dominant plant species? Yes ☑ No ☐
	4	4		
Prevalence Index:		Total % Cover (all strata)	Multiply by:	Result
	OBL species		X 1	= 0.00
	FACW species	31	X 2	= 62.00
	FAC species	49	X 3	= 145.50
	FACU species		X 4	= 0.00
	UPL species		X 5	= 0.00
	Column Totals	(A) 79.5		(B) 207.5
Prevalence Index		B/A = 2.61		Is the Prevalence Index ≤ 3.0? Yes ☑ No ☐
Wetland vegetation criterion met?		**Yes** ☑	**No** ☐	

Definitions of Vegetation Strata

Tree - Woody plants 3 in. (7.62 cm) or more in diameter at breast height (DBH), regardless of height

Shrub / Sapling - Woody plants less than 3 in. (7.62 cm) DBH and greater than or equal to 3.3 ft. (1 m) tall

Herb - All herbaceous (non-woody plants, regardless of size, and woody plants less than 3.3 ft. (1 m) tall

Woody vines - All woody vines greater than 3.3 ft. (1 m) in height

Cover Ranges	
Range	Midpoint
1-5 %	3.0 %
6-15 %	10.5 %
15-25 %	20.5 %
26-50 %	38.0 %
51-75 %	63.0 %
76-95 %	85.5 %
96-100 %	98.0 %

Sampling Point 1-6 (WET)

SOIL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Location[2]		
0-13	10YR 2/1	95.00	10YR 5/2	5.00	D	PL	SL	
13-24	10YR 3/2	100.00					CS	<25% gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators (Check all that apply)		**Indicators for Problematic Hydric Soils**
☐ Histosol (A1)	☐ Polyvalue Below Surface (S8)	☐ 2 cm Muck (A10)
☐ Histic Epipedon (A2)	☐ Thin Dark Surface (S9)	☐ 5 cm Mucky Peat or Peat (S3)
☐ Black Histic (A3)	☐ Loamy Gleyed Matrix (F2)	☐ Iron-Manganese Masses (F12)
☐ Hydrogen Sulfide (A4)	☐ Depleted Matrix (F3)	☐ Mesic Spodic (A17)
☐ Stratified Layers (A5)	☑ Redox Dark Surface (F6)	☐ Red Parent Material (F21)
☐ Depleted Below Dark Surface (A11)	☐ Depleted Dark Surface (F7)	☐ Very Shallow Dark Surface (F22)
☐ Thick Dark Surface (A12)	☐ Redox Depressions (F8)	
☐ Sandy Mucky Mineral (S1)		
☐ Sandy Gleyed Matrix (S4)		
☐ Sandy Redox (S5)		☐ Other (Include Explanation in Remarks)
☐ Stripped Matrix (S6)		
☐ Dark Surface (S7)		

Restrictive Layer (if observed) Type: N/A Depth (inches): _____

Remarks:

Hydric Soils criterion met? **Yes** ☑ **No** ☐

Attachment D

Riverbed Substrate Analysis

Pebble Count at Bankfull Width (BWF3)
East Meadow River Downstream from Brandy Brow Road Culvert

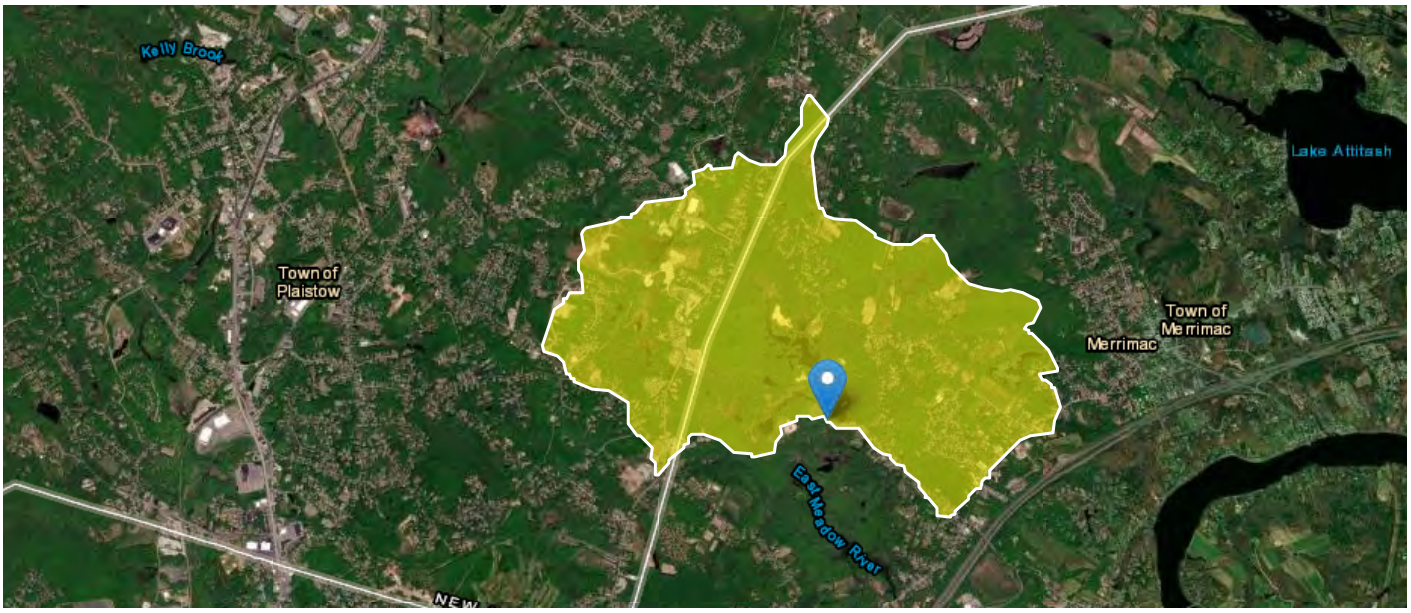
Class	Particle Size (mm)	Frequency	Percent	Cumulative Percent
Sand	<2	44	44%	44%
Very Fine Gravel	2-4	19	19%	63%
Fine Gravel	4-6	16	16%	79%
Fine Gravel	6-8	7	7%	86%
Medium Gravel	8-11	11	11%	97%
Medium Gravel	11-16	2	2%	99%
Coarse Gravel	16-22	1	1%	100%
Coarse Gravel	22-32	0	0%	100%
Very Coarse Gravel	32-45	0	0%	100%
Very Coarse Gravel	45-64	0	0%	100%
Small Cobble	64-90	0	0%	100%
Medium Cobble	90-128	0	0%	100%
Large Cobble	128-180	0	0%	100%
Very Large Cobble	180-256	0	0%	100%
Small Boulder	256-512	0	0%	100%
Medium Boulder	512-1024	0	0%	100%
Large Boulder	1024-2048	0	0%	100%
Very Large Boulder	2048-4096	0	0%	100%
	Total	100	100%	100%

Attachment E

USGS StreamStats Reports
(2 total)

StreamStats Report: Upstream of Brandy Brow Road Crossing

Region ID: MA
Workspace ID: MA20240319155824766000
Clicked Point (Latitude, Longitude): 42.82679, -71.04034
Time: 2024-03-19 11:58:46 -0400



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	6.148	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	2.674	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0.23	square mile per mile
DRNAREA	Area that drains to a point on a stream	3.64	square miles
ELEV	Mean Basin Elevation	136	feet
FOREST	Percentage of area covered by forest	72.16	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	12.04	percent
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	35.46	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	0.16	512
ELEV	Mean Basin Elevation	136	feet	80.6	1948

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
LC06STOR	Percent Storage from NLCD2006	12.04	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	92.9	ft^3/s	47.5	182	42.3
20-percent AEP flood	153	ft^3/s	77.1	304	43.4
10-percent AEP flood	200	ft^3/s	98.4	406	44.7
4-percent AEP flood	267	ft^3/s	127	561	47.1
2-percent AEP flood	323	ft^3/s	149	701	49.4
1-percent AEP flood	382	ft^3/s	171	855	51.8
0.5-percent AEP flood	446	ft^3/s	193	1030	54.1
0.2-percent AEP flood	537	ft^3/s	222	1300	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.674	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.23	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
7 Day 2 Year Low Flow	0.376	ft^3/s	0.13	1.05	49.5	49.5
7 Day 10 Year Low Flow	0.163	ft^3/s	0.0444	0.558	70.8	70.8

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.23	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	2.674	percent	0.32	24.6

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
50 Percent Duration	3.57	ft^3/s	1.63	7.77	17.6	17.6
60 Percent Duration	2.58	ft^3/s	1.11	5.95	19.8	19.8
70 Percent Duration	1.63	ft^3/s	0.747	3.52	23.5	23.5
75 Percent Duration	1.27	ft^3/s	0.583	2.74	25.8	25.8
80 Percent Duration	1.12	ft^3/s	0.503	2.46	28.4	28.4
85 Percent Duration	0.828	ft^3/s	0.353	1.91	31.9	31.9
90 Percent Duration	0.658	ft^3/s	0.273	1.55	36.6	36.6
95 Percent Duration	0.376	ft^3/s	0.134	1.02	45.6	45.6
98 Percent Duration	0.239	ft^3/s	0.0739	0.731	60.3	60.3
99 Percent Duration	0.174	ft^3/s	0.0504	0.565	65.1	65.1

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.674	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.23	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
August 50 Percent Duration	0.877	ft^3/s	0.365	2.07	33.2	33.2

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	6.148	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	24.4	ft	21.3
Bankfull Depth	1.35	ft	19.8
Bankfull Area	32.6	ft^2	29
Bankfull Streamflow	87.9	ft^3/s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	26	ft
Bieger_D_channel_depth	1.62	ft
Bieger_D_channel_cross_sectional_area	42.8	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	36.3	ft
Bieger_P_channel_depth	1.83	ft
Bieger_P_channel_cross_sectional_area	66.9	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	19.5	ft
Bieger_USA_channel_depth	1.59	ft
Bieger_USA_channel_cross_sectional_area	34.3	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	24.4	ft	21.3
Bankfull Depth	1.35	ft	19.8
Bankfull Area	32.6	ft^2	29
Bankfull Streamflow	87.9	ft^3/s	55
Bieger_D_channel_width	26	ft	
Bieger_D_channel_depth	1.62	ft	
Bieger_D_channel_cross_sectional_area	42.8	ft^2	
Bieger_P_channel_width	36.3	ft	
Bieger_P_channel_depth	1.83	ft	
Bieger_P_channel_cross_sectional_area	66.9	ft^2	
Bieger_USA_channel_width	19.5	ft	
Bieger_USA_channel_depth	1.59	ft	
Bieger_USA_channel_cross_sectional_area	34.3	ft^2	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverPages)

Probability Statistics

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	0.01	1.99

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PCTSNDGRV	Percent Underlain By Sand And Gravel	35.46	percent	0	100
FOREST	Percent Forest	72.16	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.943	dim

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [Crippen Bue Region 2]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.64	square miles	0.1	3000

Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 2]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	13400	ft^3/s

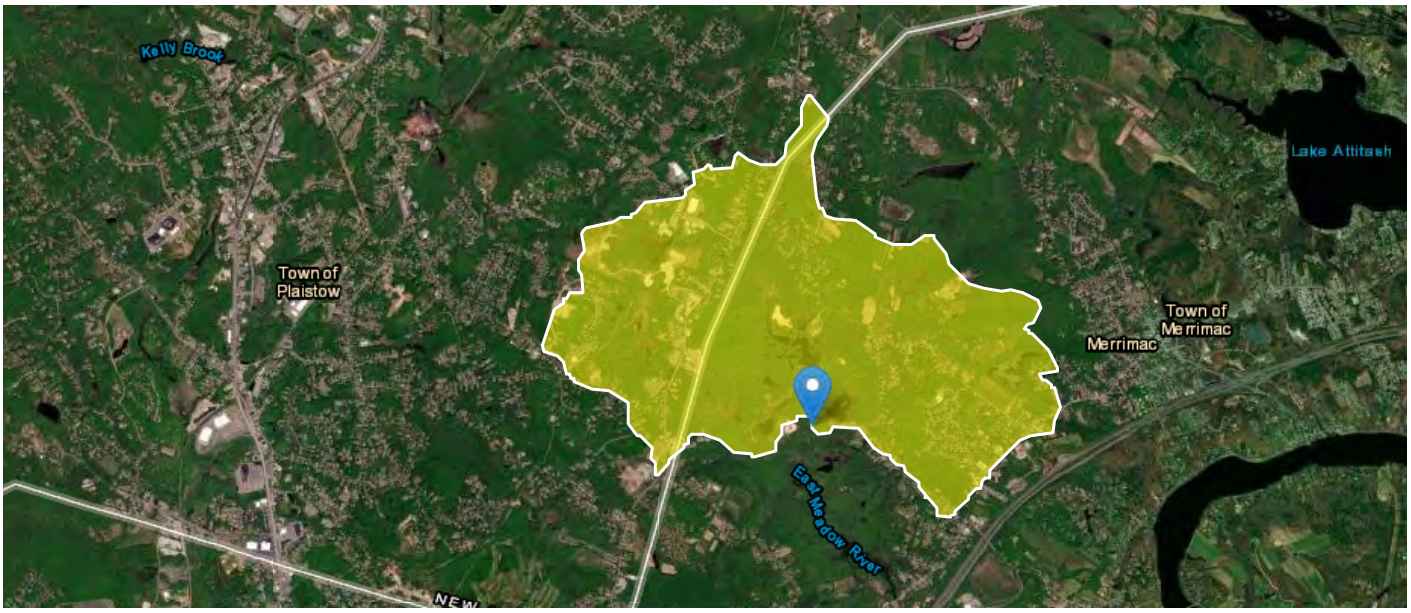
Maximum Probable Flood Statistics Citations

Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (https://pubs.usgs.gov/wsp/1887/report.pdf)

Application Version: 4.19.4
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

StreamStats Report: Downstream of Brandy Brow Road Crossing

Region ID: MA
Workspace ID: MA20240319160155938000
Clicked Point (Latitude, Longitude): 42.82622, -71.04219
Time: 2024-03-19 12:02:17 -0400



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	6.143	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	2.67	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0.23	square mile per mile
DRNAREA	Area that drains to a point on a stream	3.65	square miles
ELEV	Mean Basin Elevation	136	feet
FOREST	Percentage of area covered by forest	72.16	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	12.01	percent
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	35.63	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	0.16	512
ELEV	Mean Basin Elevation	136	feet	80.6	1948

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
LC06STOR	Percent Storage from NLCD2006	12.01	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	93.2	ft^3/s	47.6	182	42.3
20-percent AEP flood	153	ft^3/s	77.1	304	43.4
10-percent AEP flood	200	ft^3/s	98.4	406	44.7
4-percent AEP flood	268	ft^3/s	127	564	47.1
2-percent AEP flood	324	ft^3/s	149	703	49.4
1-percent AEP flood	383	ft^3/s	171	858	51.8
0.5-percent AEP flood	447	ft^3/s	194	1030	54.1
0.2-percent AEP flood	539	ft^3/s	223	1300	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.67	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.23	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
7 Day 2 Year Low Flow	0.377	ft^3/s	0.13	1.05	49.5	49.5
7 Day 10 Year Low Flow	0.163	ft^3/s	0.0444	0.558	70.8	70.8

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.23	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	2.67	percent	0.32	24.6

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
50 Percent Duration	3.58	ft^3/s	1.64	7.78	17.6	17.6
60 Percent Duration	2.59	ft^3/s	1.12	5.97	19.8	19.8
70 Percent Duration	1.63	ft^3/s	0.748	3.52	23.5	23.5
75 Percent Duration	1.28	ft^3/s	0.588	2.76	25.8	25.8
80 Percent Duration	1.12	ft^3/s	0.503	2.46	28.4	28.4
85 Percent Duration	0.83	ft^3/s	0.354	1.91	31.9	31.9
90 Percent Duration	0.659	ft^3/s	0.274	1.55	36.6	36.6
95 Percent Duration	0.377	ft^3/s	0.134	1.02	45.6	45.6
98 Percent Duration	0.24	ft^3/s	0.0743	0.734	60.3	60.3
99 Percent Duration	0.175	ft^3/s	0.0508	0.568	65.1	65.1

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.67	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.23	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
August 50 Percent Duration	0.88	ft^3/s	0.367	2.07	33.2	33.2

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	6.143	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	24.4	ft	21.3
Bankfull Depth	1.35	ft	19.8
Bankfull Area	32.7	ft^2	29
Bankfull Streamflow	88	ft^3/s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	26	ft
Bieger_D_channel_depth	1.63	ft
Bieger_D_channel_cross_sectional_area	42.9	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	36.3	ft
Bieger_P_channel_depth	1.83	ft
Bieger_P_channel_cross_sectional_area	67	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	19.5	ft
Bieger_USA_channel_depth	1.59	ft
Bieger_USA_channel_cross_sectional_area	34.4	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	24.4	ft	21.3
Bankfull Depth	1.35	ft	19.8
Bankfull Area	32.7	ft^2	29
Bankfull Streamflow	88	ft^3/s	55
Bieger_D_channel_width	26	ft	
Bieger_D_channel_depth	1.63	ft	
Bieger_D_channel_cross_sectional_area	42.9	ft^2	
Bieger_P_channel_width	36.3	ft	
Bieger_P_channel_depth	1.83	ft	
Bieger_P_channel_cross_sectional_area	67	ft^2	
Bieger_USA_channel_width	19.5	ft	
Bieger_USA_channel_depth	1.59	ft	
Bieger_USA_channel_cross_sectional_area	34.4	ft^2	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverPages)

Probability Statistics

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	0.01	1.99

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PCTSNDGRV	Percent Underlain By Sand And Gravel	35.63	percent	0	100
FOREST	Percent Forest	72.16	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.943	dim

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [Crippen Bue Region 2]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.65	square miles	0.1	3000

Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 2]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	13400	ft^3/s

Maximum Probable Flood Statistics Citations

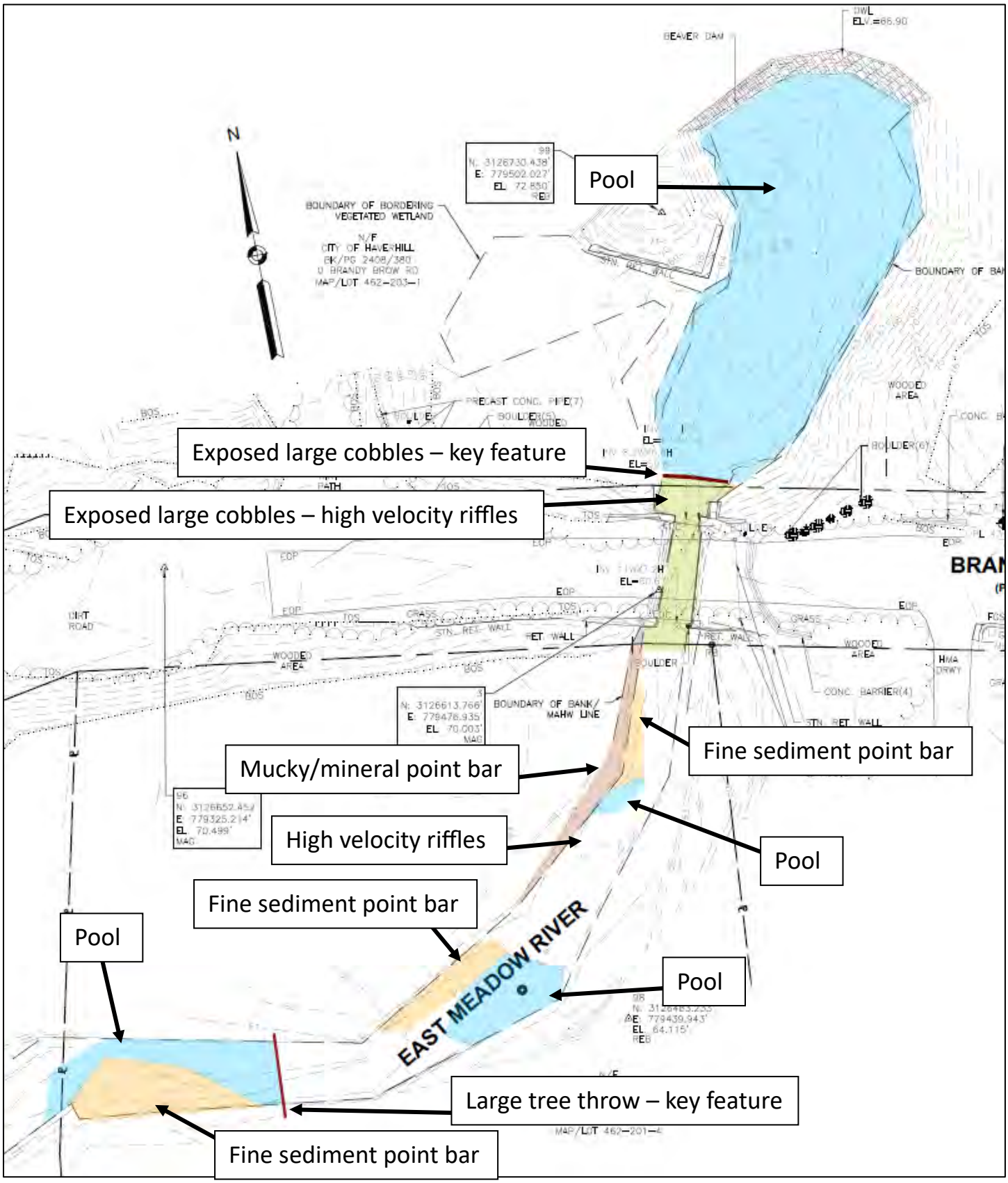
Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (https://pubs.usgs.gov/wsp/1887/report.pdf)

Application Version: 4.19.4
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Attachment F

Stream Profile Features

Stream Profile Features



Appendix B – Site Photographs

Photo 1: View of Brandy Brow Road over East Meadow River culvert on the upstream side, facing south.

Photo 2: View of Brandy Brow Road over East Meadow River culvert on the upstream side, facing south west.

Photo 3: View of East Meadow River on the upstream side facing Neal Pond to the north.

Photo 4: View of the top of the Brandy Brow culvert on the upstream side facing west.

Photo 5: View of East Meadow River facing south atop the Brandy Brow culvert.

Photo 6: View of the Brandy Brow culvert from the downstream side facing north east.

Appendix C – Riverfront Area Alternatives Analysis

Evaluation of Alternatives

Replacement of Brandy Brow Road Culvert over East Meadow River

Haverhill, MA

As required by the General Performance Standards for Riverfront Area at 310 CMR 10.58(4)(c)(1-3), there must be no practicable and substantially equivalent economic alternative to the proposed project with less adverse effects on the interests identified in M.G.L. c. 131 § 40. An alternative is practicable and substantially equivalent economically if it is available and capable of being constructed after taking into consideration costs, existing technology, proposed use, and logistics in light of overall project purposes. Available and capable of being done means the alternative is obtainable and feasible.

Based on the Evaluation of Alternatives presented herein, it has been determined that no practicable and substantially equivalent economic alternative to the current design of the project exists with less adverse effects on the interests identified in M.G.L. c. 131 § 40.

Overall Project Purpose

The overall purpose of this project is to replace the existing, failing culvert with a structure that can accommodate larger storm flows, provides better protection against erosion and scour, reduces resident vulnerability to changing climatic conditions, and improves access across the East Meadow River for pedestrians and emergency personnel. Proposed replacement of the culvert will improve natural stream processes along East Meadow River and will allow aquatic species to access critical habitat upstream and downstream of the culvert.

Project Description

The City of Haverhill – Engineering Department proposes the Replacement of Brandy Brow Road Culvert over East Meadow River in the City of Haverhill, Massachusetts (the Project).

The Project is located at the East Meadow River culvert crossing along Brandy Brow Road in the City of Haverhill, Massachusetts. The culvert is located approximately 0.25 miles west of the intersection of East Meadow Drive and Brandy Brow Road, adjacent to the residential property at 288 Brandy Brow Road.

The existing culvert consists of single span concrete deck with encased steel stringers. The barrel of the existing culvert has an 8-foot open span with each abutment wall varying in width; the east abutment wall measures 5.7 feet and the west abutment wall measures 3.1 feet. The roadway varies in width but measures approximately 20 feet wide over the culvert. The total length of the culvert structure measures 36 feet. The abutments consist of dry stacked field stones which exhibit severe deterioration. The upstream ends of both abutments have been reconstructed with cast-in-place concrete. The northeast and northwest wingwalls consist of mortared cut granite blocks. The southeast and southwest wingwalls are reinforced concrete. The southwest wingwall has a mortared cut granite

block retaining wall that extends 3 feet. All observed elements of the bridge are in extremely poor condition. Brandy Brow Road is closed to traffic over the culvert. The water level inside the culvert channel was observed to be approximately 20 inches deep on February 9, 2024.

In its existing condition, there are numerous deficiencies along this segment of Brandy Brow Road and Brandy Brow Road Culvert including a lack of shoulders, a lack of railings and guardrails along the culvert, and deficiencies in structural elements of the culvert stated previously.

The Project generally proposes the replacement of the existing culvert to meet current Massachusetts Stream Crossing standards. The majority of the work proposed as part of this project will occur within previously disturbed / developed areas associated with existing roadway infrastructure. The improvements proposed to address existing deficiencies within the project limits include the replacement of the existing culvert and roadway narrowing to a 6-foot wide single travel lane to allow for emergency services to cross the East Meadow River and provide access to pedestrians and bicyclists to nearby recreation areas.

The work proposed to address existing deficiencies within the project limits include:

- Installation of erosion and sedimentation control measures, anticipated to consist of compost filter tubes and silt fencing where necessary, around the limit of work.

- Conduct clearing and grubbing of vegetation and tree removal to facilitate construction phase site access.

- Implementation of water controls including sheet piles or sandbags for dewatering and a bypass pipe to maintain stream flow during construction. The water control system will ultimately be designed by the Contractor prior to construction.

- Demolition and removal of the existing bridge deck.

- Demolition and removal of the existing reinforced concrete / stone masonry abutments and stone masonry wingwalls.

- Removal of an existing check dam within the East Meadow River channel approximately 12 feet upstream of the existing culvert.

- Excavation within and adjacent to the channel to install cast in place (CIP) concrete footings and riprap with gravel packed voids for scour protection.

- Installation of a three-sided, precast concrete box culvert supported by CIP concrete footings. The proposed three-sided culvert will have a width of 34 feet, a height of 7 feet 8 inches, and a length of 8 feet. The proposed culvert will be embedded to a depth of 6 feet 9 inches including 5 feet 9 inches of riprap with gravel packed voids and a minimum 12 inches of natural streambed material.

- Construction of CIP concrete wingwalls at the culvert inlet and outlet.

- Installation of riprap with gravel packed voids above the banks to protect against erosion and scour during high flow events. Loam and seed will be applied over riprap within upland areas to provide vegetated surface cover.

- Installation of natural streambed material and grading of a low flow channel within the stream channel and through the culvert to maintain natural water depths and velocities during a variety of flow conditions.

- Installation of timber rail fences over the culvert and along the roadway approaches for pedestrian safety.

- Full depth construction of a 6-foot Hot Mix Asphalt (HMA) shared use path over the culvert.

- Removal of portions of the existing roadway pavement to tie the shared use path into the existing conditions at the east and west ends of the culvert crossing.

- Conduct site grading to tie into existing conditions.

- Application of loam and seed to all disturbed vegetated areas.

These proposed improvements represent a context sensitive design that meets the need for operation, safety, and accessibility improvements while also avoiding significant impacts to environmentally sensitive areas within and adjacent to the project limits.

Scope of Alternatives

According to 310 CMR 10.58(4)(c)(2), the scope of alternatives to consider shall be commensurate with the type and scope of the project. The issuing authority shall presume that alternatives beyond the scope are not practicable and therefore need not be considered.

The various alternatives for a culvert replacement project are primarily related to the culvert structure and dimensions, the structures intended use, and its ability to meet the Massachusetts Stream Crossing Standards.

Evaluation of Alternatives

The applicant is required to submit information to describe sites and the work both for a proposed location and alternative site locations and configuration sufficient for a “No Significant Adverse Impact” determination by the issuing authority. The level of detail of information shall be commensurate with the scope of the project and practicability of alternatives.

The applicant has evaluated four (4) alternatives for the proposed improvements along Brandy Brow Road Culvert including:

1) Culvert Dimension Alternative
2) Crossing Length Alternative
3) Off Site Alternative
4) No Build Alternative

These Alternatives and their potential impacts to 200-foot Riverfront Area are described below.

Alternative 1) – Culvert Dimension Alternative:

The project proposes a precast concrete 3-sided rigid frame units (skewed), flared cast-in-place concrete cantilever walls, cast-in-place spread footings, a 34-foot clear span and approximate 7.66-foot vertical clearance, and riprap scour protection below natural streambed.

This culvert provides a larger opening to avoid overtopping during the100-year flood event. A 3-sided frame was selected as it provides a significantly more efficient opening relative to an arch. The clear span was increased to 34 feet and the vertical clearance was increased to 7.66 feet which achieves DER's minimum 6-foot height requirement and nearly achieves DER's optimum 8-foot height goal. Headwalls were omitted for this alternative as a result of increasing the vertical opening. The frame units are skewed to match the channel to better accommodate the significant flood volumes reflected in the H&H analysis.

Alternative 2) – Crossing Length Alternative:

The project proposes to replace the existing culvert that spans East Meadow River. The proposed design complies with the Massachusetts Stream Crossing Standards by narrowing the travel way from 20 feet to 6 feet and therefore reducing the total crossing length from 36 feet to 8 feet.

The construction of the proposed culvert and travel way represents the best alternative for accommodating pedestrian and bicycle traffic while also minimizing impacts to 200-foot Riverfront Area.

Alternative 3) – Off Site Alternative:

There is no feasible off-site alternatives to the proposed improvements that would be less environmentally impactful. Any new culvert construction intended to bypass Brandy Brow Road Culvert over East Meadow River would have major impacts on private property, environmentally sensitive areas, and safety concerns that would significantly outweigh any potential benefits.

Alternative 4) – No Build Alternative:

In the No Build Alternative, the Brandy Brow Road Culvert within the project limits would remain deficient and further degrade over time. This alternative was not considered.

Findings

The analysis of alternatives concluded the selected alternative best met the needs of the proposed project. The selected alternative balances the need for safety improvements along the Brandy Brow Road Culvert with the minimization of impacts to the adjacent wetland resource areas, cultural resources, and commercial / residential developments.

Attachment A – Stormwater Checklist and Report

(Bound Separately)

Attachment B – Boring Logs

(Bound Separately)

Attachment C – Hydraulic Report

(Bound Separately)

Attachment D – Notice of Intent Plans

(Bound Separately)