Bureau of Resource Protection – Wetlands and Waterways
Form 3 – Notice of Intent
Massachusetts Wetlands Protection Act (M.G.L. c.131 s.40)
City of Haverhill Wetlands Protection Ordinance

Closure of Northern Mound and Lot 26 Ash Area

Submitted to:
The Massachusetts Department of Environmental Protection
Division of Wetlands and Waterways
MassDEP Northeast Regional Office - Wilmington
205B Lowell Street,
Wilmington, MA 01887

Submitted by:
City of Haverhill
40 South Porter Street
Haverhill, MA 01835
and
Holcim – Northeast Region, Inc.
35 Village Road
Middleton, MA 01949

Prepared by:
Epsilon Associates, Inc.
3 Mill & Main Place, Suite 250
Maynard, MA 01754

In Association with:
Langdon Environmental LLC
McClure Engineering, Inc.

Epsilon ASSOCIATES INC.

November 3, 2022

Projects:\4514 Haverhill Landfill Closure\Env. Permitting\Notice of Intent

November 1, 2022

Haverhill Conservation Commission
City Hall Room 300
4 Summer Street
Haverhill, MA 01830

Subject: Notice of Intent | Closure of Northern Mound and Lot 26 Ash Area
Old Groveland Road, Haverhill, Massachusetts.

Dear Commissioners:

On behalf of City of Haverhill and Holcim-Northeast Region Inc. (the "Applicants"), Epsilon Associates, Inc. ("Epsilon") is pleased to submit this Notice of Intent ("NOI") to the Haverhill Conservation Commission for the required Closure of Northern Mound and Lot 26 Ash Area (the "Project") pursuant to the Massachusetts Solid Waste Management regulations (310 CMR 19.000). Portions of the proposed work will alter state resource areas of Bordering Vegetated Wetlands, Inland Bank, 100-yeasr flood plain (regulated as Land Subject to Coastal Storm Flowage), Riverfront Area and 100-foot buffer zone, as well as the municipal resource are of isolated vegetated wetland. The project was designed to restore altered areas in-place to yield no loss of state and municipal resource areas.

The enclosed NOI was prepared in accordance with the Massachusetts Wetlands Protection Act ("WPA") (MGL c.131 §40) and regulations (310 CMR 10.00) and the Haverhill Wetlands Ordinance Chapter 253. We sent a copy of this NOI to the Natural Heritage and Endangered Species Program ("NHESP"). A Conservation and Management Permit application (a.k.a. a "Take" Permit) is being submitted separately to the NHESP. The Take Permit is not expected to be issued before the Order of Conditions ("OOC"). We respectfully request that the OOC include by reference the conditions included in the Take Permit, as applicable to wetland resource areas.

Because the City is the Applicant the project is exempt from the WPA and Ordinance NOI filing fee. Enclosed is the $45 local notification fee.

This NOI is being submitted for the Commission's review at the November 17, 2022 public hearing. If the Commission would like to conduct a site walk prior to that date or has any questions regarding this NOI, please do not hesitate to contact me at (978) 461-6226 or via email at ddunk@epsilonassociates.com.

Sincerely,
EPSILON ASSOCIATES, INC.

Dwight R. Dunk, LPD, PWS, BCES
Principal

cc: MassDEP Northeast Region
NHESP
R. Ward, City of Haverhill
J. Temple, Holcim Northeast Region Inc.
B. Haskell, Langdon Environmental

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LIST OF ATTACHMENTS

LIST OF TABLES

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

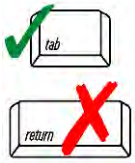
Provided by MassDEP:

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):

Old Groveland Road — a. Street Address
Haverhill — b. City/Town
01835 — c. Zip Code

Latitude and Longitude:
42° 45' 21" North — d. Latitude
71° 02' 43" West — e. Longitude

Map 776, Block 788 — f. Assessors Map/Plat Number
Lots 24, 26, 27 and 1AA — g. Parcel /Lot Number

2. Applicant:

See page 1a of 9 — a. First Name
b. Last Name
c. Organization
d. Street Address
e. City/Town
f. State
g. Zip Code
h. Phone Number
i. Fax Number
j. Email Address

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

See page 1a of 9 — a. First Name
b. Last Name
c. Organization
d. Street Address
e. City/Town
f. State
g. Zip Code
h. Phone Number
i. Fax Number
j. Email address

4. Representative (if any):

Dwight — a. First Name
Dunk — b. Last Name
EpsilonAssociates, Inc. — c. Company
3 Mill & Main Place, Suite 250 — d. Street Address
Maynard — e. City/Town
MA — f. State
01754 — g. Zip Code
978.897.7100 — h. Phone Number
i. Fax Number
ddunk@epsilonassociates.com — j. Email address

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

City is Applicant - Fee Exempt — a. Total Fee Paid
b. State Fee Paid
c. City/Town Fee Paid

WPA Form 3 -Notice of Intent

A. General Information 2. & 3. Applicant / Owner

1. City of Haverhill
   40 South Porter Street
   Haverhill, MA 01835
   Contact: Mr. Robert Ward | (978) 374-2328 | rward@haverhillwater.com

2. Holcim – Northeast Region
   35 Village Road
   Middleton, MA 01949
   Contact: Mr. Jarrett Temple | (339) 206-7719 | j.temple@holcim.com

Massachusetts Department of Environmental Protection
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A. General Information (continued)

6. General Project Description:

Final Capping of the Northern Mound of the Haverhill Municipal Landfill and Lot 26 Ash Area pursuant to the Adminstrative Consent Order and Solid Waste Regulations (310 CMR 19.000)l

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)

Landfill Capping - 301 CMR 10.53 (3)(p)
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:

Southern Essex	
a. County	b. Certificate # (if registered land)
36490	485
c. Book	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	1,720 Temporary 1. linear feet	1,415 restored in place 2. linear feet
b. ☒ Bordering Vegetated Wetland	1,185 Temporary 1. square feet	 2. square feet
c. ☐ Land Under Waterbodies and Waterways	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	86,250 1. square feet 2,349 cy 3. cubic feet of flood storage lost	86,250 2. square feet 3,073 cy 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	Merrimack River & Johnson Creek 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: 419,050 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.
419,050	209,525	209,525

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

a. number of new stream crossings

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

   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 _____ 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.

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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. 99-5547 (a. NHESP Tracking #) TBD (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 - Cohasset 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 - Hull 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).

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

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

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City/Town

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.

a. Plan Title

b. Prepared By

c. Signed and Stamped by

d. Final Revision Date

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

Massachusetts Department of Environmental Protection
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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 10/20/2022

3. S ner (if different) Dwight R. Duncan

4. Date 10/27/2022

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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Rt 3 N-1
1. Signature of Applicant

10/20/22
2. Date

3. Signature of Co-Applicant (if different)

4. Date

Dwight R. Duncan
5. Signature of Representative (if any)

10/27/2022
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.

HAVERHILL CONSERVATION COMMISSION Notice of Intent

City of Haverhill Conservation Commission

HCC Local Application Form 3
Notice of Intent

A. STATUTE APPLICABILITY

This application is being filed with the Commission in accordance with the following (check all that apply):

X Massachusetts Wetlands Protection Act, M.G.L. Chapter 131, Section 40
X Haverhill Municipal Ordinance Chapter 253

B. GENERAL INFORMATION

Applicant **City of Haverhill (Mr. Robert Ward) & Holcim – Northeast Region (Mr. Jarrett Temple)**
Property Owner **Holcim – Northeast Region**
Representative **Dwight Dunk, Epsilon Associates, Inc.**
Location (Street Address) **Old Groveland Road, Haverhill, MA 01835**
Assessor's Parcel Identification **Map 776, Block 788**

C. APPLICATION CHECKLIST

The Commission requires the submittal of this original, completed Form; one (1) paper copy of site plans; and one (1) paper copy of all other materials. Additionally, the Commission requires the submittal of individual PDFs of this Form and all listed application materials. If practical, related items may be combined into a single PDF. PDFs should not mix larger format sheets (e.g. site plans) with smaller sheets (e.g. letters). These submittal requirements also apply to supplemental information provided during the public hearing. The following materials shall be submitted with this form:

- ☒ Completed, current WPA Form 3, 3A, or 4 and NOI Wetland Fee Transmittal Form
- ☒ Project Narrative with description of resource areas & delineation methodology and demonstration of compliance with pertinent Performance Standards
- ☒ Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan
- ☒ Site Plans clearly describing the location and nature of the work, including such information as site boundaries, wetlands, topography, existing and proposed conditions, vegetation cover, soils, erosion & sedimentation controls, Title 5 compliance, flood storage calculations…(24" x 36" max. sheet size)
- ☐ MassDEP Bordering Vegetated Wetland Delineation Field Data Forms, as appropriate
- ☐ Wetland Resource Area Impact Mitigation Plan prepared in accordance with MA Inland Wetland Replication Guidelines, if applicable
- ☐ Demonstration of compliance with MA River & Stream Crossing Standards, if applicable (The HCC applies the General Standards to all resource area crossings for wildlife passage.)
- ☐ Simplified or Detailed Wildlife Habitat Evaluation (Appendix A or B), if applicable (See "MA Wildlife Habitat Protection Guidance for Inland Wetlands")
- ☒ Demonstration of compliance with MA Stormwater Management Standards, including but not limited to
  - ☒ Stormwater Report with pertinent calculations based on NOAA Atlas 14 rainfall data
  - ☒ Checklist for Stormwater Report
  - ☒ Long-Term Pollution Prevention Plan
  - ☒ Operation and Maintenance Plan
  - ☒ Illicit Discharge Compliance Statement

- [X] 8½" x 11" sections of the following maps with project location clearly identified
  - [X] USGS Quadrangle
  - [X] MassGIS Orthophoto
  - [X] City of Haverhill Parcel ID Map, also identifying properties within 300' of subject property
  - [X] NRCS Soils Map and Resource Report
  - [X] FEMA Flood Insurance Rate Map, if applicable
  - [X] MA NHESP Estimated Habitats of Rare Wildlife and Priority Habitats of Rare Species, if applicable
  - [ ] MassDEP/UMass-Amherst Habitat of Potential Regional or Statewide Importance, if applicable
- [X] Proof of NOI filing with the MA Natural Heritage & Endangered Species Program, if applicable
- [ ] Appropriate Filing Fees, payable to the City of Haverhill, under the Act and Ordinance
- [X] Other: **ORAD confirming wetland boundaries - Attachment H**

D. LOCAL PERMIT DOCUMENTATION

In accordance with 310 CMR 10.05(4)(e), list all obtainable permits, variances, and approvals required by local ordinance with respect to the proposed activity and status of same:

Order of Conditions (NOI to be submitted 11/3/22)

E. APPLICATION CERTIFICATION

I have read the Department of Environmental Protection's "Instructions for Completing Application" and the City's Municipal Ordinance under Chapter 253, with all applicable regulations and policies, for the filing of this application with the Haverhill Conservation Commission and agree to its terms and conditions, as amended. I understand the submitted NOI, its plans, and all its supporting materials are public records and may be uploaded to the City's website for public review. As required by the Commission, the wetland resource area(s) are flagged, the corners of proposed structures are staked, and the centerline of proposed roadway(s) and/or driveway(s) are marked, as appropriate, to facilitate site inspections by Commissioners and Conservation Staff.

Signed: Jarrett Temple (APPLICANT) **11/1/2022** (DATE)

F. SITE ACCESS ACKNOWLEDGEMENT

I hereby grant the Haverhill Conservation Commission and its officials permission to enter upon my property at **Old Groveland Road, Haverhill, MA 01835, Map 776, Block 788** to review the filed
(STREET ADDRESS AND ASSESSOR'S PARCEL ID)
Notice of Intent and future site conditions for compliance with the issued Order of Conditions. The sole purpose of this acknowledgement is to allow the Commission and its officials to perform their duties under the Massachusetts Wetlands Protection Act and the City's wetlands protection ordinance.

Signed: Jarrett Temple (PROPERTY OWNER) **11/1/2022** (DATE)

- [X] 8½" x 11" sections of the following maps with project location clearly identified
  - [X] USGS Quadrangle
  - [X] MassGIS Orthophoto
  - [X] City of Haverhill Parcel ID Map, also identifying properties within 300' of subject property
  - [X] NRCS Soils Map and Resource Report
  - [X] FEMA Flood Insurance Rate Map, if applicable
  - [X] MA NHESP Estimated Habitats of Rare Wildlife and Priority Habitats of Rare Species, if applicable
  - [ ] MassDEP/UMass-Amherst Habitat of Potential Regional or Statewide Importance, if applicable
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Signed: _____ **11/1/2022**
(APPLICANT) (DATE)

F. SITE ACCESS ACKNOWLEDGEMENT

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(STREET ADDRESS AND ASSESSOR'S PARCEL ID)
Notice of Intent and future site conditions for compliance with the issued Order of Conditions. The sole purpose of this acknowledgement is to allow the Commission and its officials to perform their duties under the Massachusetts Wetlands Protection Act and the City's wetlands protection ordinance.

Signed: _____ **11/1/2022**
(PROPERTY OWNER) (DATE)

G. AFFIDAVIT OF SERVICE FOR ABUTTER NOTIFICATION

I, **Dwight Dunk**, hereby certify under the pains and penalties of perjury that on **11/2/2022** I gave
(NAME OF PERSON MAKING AFFIDAVIT) (DATE)
notification to all abutters pursuant to the requirements of the second paragraph of Massachusetts General Laws Chapter 131, Section 40, the DEP Guide to Abutter Notification dated April 8, 1994, and Haverhill Municipal Ordinance Chapter 253, Section 5 in connection with the following matter:

A Notice of Intent filed under the Massachusetts Wetlands Protection Act and said ordinance by **City of Haverhill & Holcim-Northeast Region** with the Haverhill Conservation Commission on
(NAME OF APPLICANT)
11/3/2022 for property located at **Old Groveland Road, Haverhill, MA 01835**
(DATE) (STREET ADDRESS AND ASSESSOR'S PARCEL ID)

The list of the abutters to whom the Abutter Notification Form sent, with their addresses and Assessor's parcel identification information that corresponds with the submitted map section, are attached to this application.

Signed: Dwight R. Dunk **11/1/2022**
(NAME OF PERSON MAKING AFFIDAVIT) (DATE)

H. ABUTTER NOTIFICATION FORM

In accordance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40 (the Wetlands Protection Act) and Haverhill Municipal Ordinance Chapter 253, Section 5, you are hereby notified of the following:

1. The name of the applicant is **City of Haverhill (Mr. Robert Ward) & Holcim – Northeast Region (Mr. Jarrett Temple)**
2. Brief Project Description: **Final Capping of the Northern Mound of the Haverhill Municipal Landfill and Lot 26 Ash Area pursuant to the Administrative Consent Order and Solid Waste Regulations (310 CMR 19.000)**
3. The applicant has filed a Notice of Intent ("NOI") with the Haverhill Conservation Commission seeking permission to remove, fill, dredge or alter an Area Subject to Protection Under the Wetlands Protection Act and/or Haverhill Municipal Ordinance Chapter 253 and/or to perform work within the buffer zone of such an Area.
4. The address of the lot where the activity is proposed is **Old Groveland Road, Haverhill, MA 01835**
   (INCLUDE ASSESSOR'S MAP/BLOCK/LOT)
5. Copies of the NOI may be examined at *the Haverhill Conservation Department Office* between the hours of *8am and 4pm* from *Monday through Friday*. Contact information is below. You may also find helpful application materials on the "Projects Under Review" section of the Commission's website.
6. Copies of the NOI may be obtained from either (check one) the applicant _____, or the applicant's representative **Dwight Dunk**, by calling this telephone number **(978) 897-7100** between the hours of **8 AM** and **5 PM** on the following days of the week **Monday to Friday**
7. Information regarding the *date, time, and place* of the public hearing may be obtained from the *Haverhill Conservation Department Office* between the hours of *8am and 4pm* from *Monday through Friday*. Contact information is below. You may also consult the "Agenda" section of the Commission's website.

NOTE: Notice of the public hearing, including its date, time and place, will be published at least five (5) days in advance in the *Haverhill Gazette newspaper*.

NOTE: Notice of the public hearing, including its date, time, and place, will be posted in Haverhill City Hall not less than forty-eight (48) hours in advance.

NOTE: You may contact the Haverhill Conservation Department for more information about this application, the Wetlands Protection Act, and Haverhill Municipal Ordinance Chapter 253. Please note the Department has only one staff person; every effort will be made to assist you in a timely manner.

Website: http://www.cityofhaverhill.org/departments/conservation_commission/index.php.
Email: conservation@cityofhaverhill.com
Phone: 978.374.2334

NOTE: For additional information about this application and the Act, you may contact the MA Department of Environmental Protection Northeast Regional Office Service Center.

Website: http://www.mass.gov/eea/agencies/massdep/about/contacts/northeast-region.html
Phone: 978.694.3200

City of Haverhill Conservation Commission

HCC Local Application Form 3
Notice of Intent

I. LOCAL ORDINANCE FEE CALCULATION FORM

ACTIVITY	LOCAL ORDINANCE FEE	# of Activities or Measurement	Subtotal
***Abbrev. Notice of Resource Area Delineation (ANRAD)**			
Single Family House Project	$1/linear foot, first 100'; $0.50/lf, second 100'; $0.10/lf, each additional foot		
All Other Projects	***$1/linear foot, first 1000'; $0.50/lf, second 1000'; $0.10/lf, each additional foot		
%*Notices of Intent (NOI)			
Category 1 Activity	$100		
Category 2 Activity	$250		
Category 3 Activity	$525		
Category 4 Activity	$725		
Category 5 Activity	$2/foot		
Category 6 Activity - If no ANRAD was filed for the project site, then a local Cat. 6 fee must be paid in accordance with the ANRAD fee schedule	See ANRAD fee schedule		
Resource Area Alterations			
Buffer Zone, 75'-100' from resource area boundary	$0.05 / square foot		
Buffer Zone, 35'-75' from resource area boundary	$0.10 / square foot		
Buffer Zone, 0'-35' from resource area boundary	$0.25 / square foot		
Bordering Vegetated Wetland	$0.50 / square foot		
Bank	$5 / linear foot		
Land Under Water	$0.50 / square foot		
Land Subject to Flooding	$0.05 / square foot		
Riverfront Area	$0.05 / square foot		
Riverfront Area with the watershed of a potable water supply	$0.50 / square foot		
Land within 100' of a Certified Vernal Pool	$0.25 / square foot		
Local-only Jurisdictional Resource Area	$0.25 / square foot		
Land within 200' of a potable water supply	$0.50 / square foot		
		ADVERTISING FEE*	$45
		LOCAL ORDINANCE FEE TOTAL	Fee Exempt
		For filings resulting from enforcement action, double the Local Ordinance Fee Total	$45

NOTES:

*Application is subject to an additional $45 Local Advertising Fee payable to the City of Haverhill prior to **EACH** advertising

***Local Ordinance Fee maximum of $100 for applications exceeding 1000'. Commission requires review by outside consultant under M.G.L. Ch. 44, sec. 53G for projects exceeding 1000'. Applicant shall post escrow in accordance with HCC Rules for Hiring Outside Consultants. Cap passed by a 5-0 vote of the Commission on March 7, 2019.

%Local Ordinance Fees for RDA, NOI, & RMOC increase 50% when project is also proposed within a Riverfront Area

Local Ordinance Fees passed by a 7 – 0 vote of the Commission on October 28, 2010, effective January 1, 2011

Proof of Filing with NHESP

Invoice: Date : 02Nov22 Shipping : 21.51
Customer : 4514 Weight : 3 LBS Special : 4.30
Phon: NATURAL HERITAG COD : Handling : 0.00
Dept : NHESP DV : 0.00 Total : 25.81

Svcs: PRIORITY OVERNIGHT
TRCK: 5637 2983 1475

ORIGIN ID:AYEA (978) 897-7100
DWIGHT DUNK
EPSILON ASSOCIATES
3 CLOCK TOWER PLACE
SUITE 250
MAYNARD, MA 01754
UNITED STATES US

SHIP DATE: 02NOV22
ACTWGT: 3.00 LB MAN
CAD: 0804148/CAFE3616

BILL SENDER

TO **NHESP**
NATURAL HERITAGE & ENDANGERED SPEC
1 RABBIT HILL ROAD
DIVISION OF FISHERIES & WILDLIFE
WESTBOROUGH MA 01581

577C4/07FS/4328

REF: 4514

FedEx Express

J22202203280l uv

TRK# 0201 **5637 2983 1475**

THU – 03 NOV 10:30A
PRIORITY OVERNIGHT

01 BBFA

01581
MA-US **BOS**

Part # 156148-434 RIT EXP 02/21

Attachment A

Project Narrative

ATTACHMENT A PROJECT NARRATIVE

1.0 Introduction

The City of Haverhill, Massachusetts ("City" or "Haverhill") and Holcim-NER, Inc. ("Holcim"), together, the "Applicants", propose to construct a final cap over the Northern Mound of the inactive Haverhill Landfill ("Landfill" or "Northern Mound") and over the Lot 26 Ash Area in Haverhill, Massachusetts. Together, these activities and improvements constitute the "Project".

The purpose and need of the Project are to cap the Northern Mound and the Lot 26 Ash Area in accordance with the MassDEP's Solid Waste Management Regulations (310 CMR 19.000). Since the Haverhill Landfill is listed on the National Priorities List ("NPL") established by the United States Environmental Protection Agency (EPA), the final cap and associated remedial or corrective actions at the Landfill also have to comply with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA" or Superfund) as administered by EPA.

The final cap will isolate historically landfilled waste from the environment and prevent direct exposure to landfilled waste by both human and ecological receptors; significantly decrease the future production and release of leachate generated from landfilled waste to groundwater and surface water; and control emissions of landfill gas in a manner that prevents lateral off-site migration towards structures and utilities.

On behalf of the Applicants, Epsilon Associates, Inc. ("Epsilon") submits this Notice of Intent ("NOI") which was prepared in accordance with the Massachusetts Wetlands Protection Act (MGL c.131 s.40) ("Act" or "WPA") and implementing Regulations (310 CMR 10.00) (the "Regulations") and the Haverhill Wetlands Protection Ordinance, Chapter 253 ("Ordinance").

State jurisdictional wetland resource areas, within and proximate to the Project include:

- Land Under Water,
- Inland Bank,
- Bordering Vegetated Wetlands,
- Bordering Land Subject to Flooding, and
- Riverfront Area

Haverhill By-Law jurisdictional wetland resource areas, or portions thereof, identified within the Project area include the state resource areas listed above, plus Isolated Vegetated Wetland ("IVW").

The state and municipal jurisdictional wetland resource areas within and proximate to the Northern Mound were previously reviewed and approved through the issuance of an Order of Resource Area Delineation ("ORAD") [DEP File number 33-1434]. A copy of the ORAD is provided

in Attachment H. This Project has also completed Massachusetts Environmental Policy Act ("MEPA") review [EOEA No. 12626] and the Certificate on the Final Environmental Impact Report required no further review MEPA was issued on November 15, 2021.

2.0 Existing Conditions

The Project site comprises two parcels — Lot 26 and 27 — in Haverhill, MA. Lot 27 encompasses the Northern Mound of the Haverhill Landfill, located on the southerly bank of the Merrimack River, and the adjacent Lot 26 accommodates the Lot 26 Ash Area (see Attachment B, Figure 1 - USGS Locus Map and Figure 2 - Aerial Locus Map). Attachment C contains site photographs. Limited waste excavation and relocation will be performed on Lot 1A owned by National Grid.

The municipal Landfill includes two parts, the Northern and Southern Mounds, which are divided by National Grid property. The Southern Mound is capped and therefore not part of this NOI. The Project limits for this NOI is limited to the Northern Mound and adjacent Lot 26 Ash Area. For purposes of this NOI, the "Project Area" includes the Northern Mound and the Lot 26 Ash Area and any area on the National Grid parcel where landfilled waste was historically placed.

The Northern Mound property is approximately 20 acres of land: bounded to the north by the Merrimack River; to the east by Johnson Creek, a perennial watercourse, and a tributary to the Merrimack River; to the south by the property owned by National Grid and used for electrical transmission and access; and to the west by a National Grid substation. Wooded areas occur along the western, northern, and eastern edges of the Northern Mound. The Northern Mound also includes remnant drainage and stormwater management facilities related to historic landfill and National Grid activities. The National Grid property also includes a Town of Groveland sanitary sewer easement and was originally a railroad corridor. Landfilled waste is present in approximately 17.3 acres of the Northern Mound.

The approximately 2.1-acre Lot 26 Ash Area refers to the MassDEP-approved delineated limits of buried ash located on a parcel east of the Southern Mound and southeast of the Northern Mound. Lot 26 Ash Area also includes the existing stormwater retention basin utilized for the closure of the Southern Mound and the southern portion of the Northern Mound. A Quonset hut building that was formerly utilized as part of asphalt batch plant operations on Lot 26 Ash Area will be demolished and removed. A roadway utilized by National Grid to access their substation located to the west of the Northern Mound also crosses the Lot 26 Ash Area. This roadway is the permitted alignment of the utility poles that connect the solar photovoltaic system installed on the Southern Mound plateau and the associated battery storage facility located on Lot 26 south of the Lot 26 Ash Area to its interconnection point on the National Grid (formerly Mass Electric) property. Installation of the poles in the Lot 26 Ash Area was approved by MassDEP.

Project construction trailers and contractor staging will be located on Lot 26 in Haverhill, south of the lot 26 Ash Area.

The topography within the Project site is dominated by the Northern Mound which extends to approximately elevation 52 feet North American Vertical Datum 1988 ("NAVD 88"), with side slopes of historically landfilled solid waste of the landfill immediately adjacent to the Merrimack River to the north at approximately elevation 2 feet NAVD 88, and the ROW to the south at approximately elevation 30 feet NAVD 88. Low lying areas surround the landfill mounds and include forested/scrub-shrub uplands and wetlands (see Attachment B, Figure 3 – MassDEP Wetlands). An existing conditions plan is presented as Sheet C-1, Existing Conditions Plan in Attachment D, Project Plans.

The Federal Emergency Management Agency ("FEMA") Flood Insurance Rate Map ("FIRM") for this area identifies Zone AE (elevation 21 feet NAVD 88 along the Merrimack River and Johnson Creek) and Zone X, Other Flood Areas (0.2% annual chance of flooding) floodplain to undefined elevations in portions of the Study Area (see Attachment B, Figure 4 – FEMA FIRM).

2.1 Soils

As mapped by the USDA Natural Resources Conservation Service ("NRCS") Web Soil Survey, dominant Soil Map Units (i.e., Soil Units occupying greater than 5% of the area of interest) found within the Study Area include the following:

- Saco variant silt loam, 0 to 3 percent slopes
- Udorthents, refuse substratum
- Pits, gravel
- Deerfield loamy fine sand, 0 to 3 percent slopes
- Hinckley loamy sand, 8 to 15 percent slopes
- Windsor loamy sand, 3 to 8 percent slopes

Of these, Saco variant silt loam is classified as poorly drained or wetter, with water tables at less than 6 inches below the ground surface and is considered to be a hydric (wetland) soil. See Attachment B, Figure 5 – SSURGO Soils.

2.2 Threatened and Endangered Species

The northern portion of the Project Area is located within mapped Priority Habitat for State-Protected Rare Species and Estimated Habitat for Rare Wildlife by the Massachusetts Natural Heritage and Endangered Species Program ("NHESP") (Natural Heritage Atlas, 2021). One potential vernal pool is located outside of the Study Area, mapped to the east of Yemma Road, near Johnson Creek. No certified vernal pools are mapped in or proximate to the Study Area (see Attachment B, Figure 6 – NHESP Habitat). The following species are associated with this mapped habitat:

- Bald Eagle (*Haliaeetus leucocephalus*),

- Wood Turtle (*Glyptemys insculpta*),
- Atlantic Sturgeon (*Acipenser oxyrinchus*), and
- Shortnose Sturgeon (*Acipenser brevirostrum*).

A separate Conservation and Management Permit application will be filed in accordance with guidance received from NHESP during the MEPA review process.

3.0 Wetland Resource Areas

The on-site and adjacent wetland resources areas were previously approved by the Haverhill Conservation Commission in January of 2018 through an Order of Resource Area Delineation ("ORAD") DEP File No. 33-1434, and the Groveland Conservation Commission via an ORAD DEP File No. 030-0445. Both ORADs have since been extended. The Haverhill ORAD until January 2024 and the Groveland ORAD until January 2023. Copies of the ORADs and the extensions are attached as Attachment H.

The Abbreviated Notices of Resource Area Delineation ("ANRAD") described the onsite and adjacent state and municipal resources and is incorporated into the NOI by reference. A summary of wetland resource areas is presented in Table 3-1 below.

The City of Haverhill Wetlands Protection Ordinance, Chapter 253 (Ordinance) exerts jurisdiction over additional resource areas. The additional wetland resource area on or proximate to the Study Area regulated by the Haverhill Ordinance observed in the Study Area including a single Isolated Vegetated Wetland ("IVW").

Table 3-1 Resource Areas Present within Northern Mound and Lot 26 Ash Area

Wetland Area	State Resource Areas					Ordinance Resource Areas	Description
	Bank	BVW	LUW	BLSF	RFA		
Series A Flags A-44 to A-136	✓		✓		✓		Top of Bank - Johnson Creek & Merrimack River. Dominant bank vegetation included river birch (*Betula nigra*), glossy buckthorn (*Frangula alnus*), bittersweet (*Celastrus orbiculatus*), & silver maple (*Acer saccharinum*).
Series B Flags B-1 to B-9		✓					Forested wetland bordering on Johnson Creek. Dominant vegetation included false nettle (*Boehmeria cylindrica*), sensitive fern (*Onoclea sensibilis*), arrow arum (*Peltandra virginica*), red maple (*Acer rubrum*), & river birch.
Series C Flags C-1 to C-9		✓					Forested/emergent wetland located along the bank of the Merrimack River. Dominant vegetation included stinging nettle (*Urtica dioica*), goldenrod, jewelweed (*Impatiens capensis*), poison ivy (*Toxicodendron radicans*), & dogwood (*Cornus* sp.).
Series D Flags D-1 to D-8						✓	Forested IVW located north of the National Grid Mass Electric Property and west of intermittent stream Series E, described below. Sparse herbaceous vegetation included American sycamore (*Platanus occidentalis*), silver maple, poison ivy, & goldenrod (*Solidago* sp.).
Series E Flags E-1 to E7 E-1A to E- 7A & E-8 to E-12	✓						Top of Bank - intermittent stream channel that runs south to north within the western portion of the Study Area. The channel extends from a culvert located underneath the Mass Electric Property and connects to BVW Series F. The channel contained no water during the time of the delineation. Dominant vegetation along the southern end of the channel included garlic mustard (*Allaria petiolata*) & sugar maple (*Acer saccharum*).
Series F Flags F-1 to F4 & F-1A to F- 4A	✓						Emergent wetland located south of the Mass Electric Property. Dominant vegetation included speckled alder (*Alnus incana*), broad-leaf cattail (*Typha latifolia*), soft-stem club-rush (*Schoenoplectus tabernaemontani*), arrow arum, & blue vervain (*Verbena hastata*).

4.0 Description of Proposed Work

4.1 Introduction

The purpose and need of the Project are to close and cap the unlined Northern Mound and the Lot 26 Ash Area as mandated by the Massachusetts Solid Waste Management Regulations (310 CMR 19.000). The purpose of a final cap is to minimize stormwater infiltration to reduce leachate generation, prevent erosion of the landfill surface, provide controls for stormwater runoff, control the migration of landfill gases, and isolate wastes from the environment thereby eliminating direct contact of waste with human and ecological receptors. The Project Plans depicting the proposed design are provided in Attachment D.

Much of the Northern Mound and Lot 26 Ash Area is located in Riverfront Area, floodplain (regulated as Bordering Land Subject to Flooding or "BLSF"), and the Project Area includes Inland Bank, BVW, IVW and associated 100-foot buffer zones. Capping requires work in uplands, resource areas and buffer zone. Capping will require removing approximately 6.2 acres of existing tree cover on the Northern Mound that is above landfilled waste. Trees located outside the limit of landfilled waste in the Northern Mound including, below the mean high water ("MHW") elevation will remain, which yields approximately 3.9 acres of trees and understory vegetation to remain along the river. There is no loss of BVW proposed because altered BVW will be restore in situ.

The closure design includes planting a new wooded plateau within the riparian zone to mitigate for lost woodland habitat and to retain Bald Eagle habitat in the riparian zone. Additionally, a single telephone pole with crossbars will be installed on the plateau to prove Bald Eagle perching habitat. The pole will be driven into the underlying landfilled waste and the cap will be booted around the pole.

A turtle nesting habitat as described below will be constructed approximately within the footprint of the existing Quonset hut structure on the Lot 26 Ash Area.

Construction staging will occur on Lot 26 south of the Lot 26 Ash Area in the approximate location utilized during the Southern Mound cap construction. The staging area will consist of office trailer(s) and stockpile areas and be surrounded with silt fence and haybales for the duration of construction.

The stormwater management system is design to meet the Solid Waste Management Regulations requirements, as well as the Massachusetts Stormwater Management Regulations, to the extent practicable for a landfill capping project.

The proposed design does not require any work below the existing MHW elevation to install the final cap. Existing trees and vegetation, including any trees that have fallen into the river, will be left in-place if they do not interfere with cap construction. See Project Plans in Attachment D for the approximate limit of the existing and proposed cap systems.

4.2 Standard Landfill Cap Design

The principal functions of a landfill cap are to minimize stormwater infiltration so as to reduce the potential for leachate generation, prevent erosion of the landfill surface, provide controls for stormwater runoff, control off-site migration of landfill gas, and isolate wastes from the environment to break potential exposure pathways.

The Northern Mound of the Haverhill Landfill abuts the Merrimack River and the confluence with Johnson's Creek as such the river facing side of the landfill may be inundated during extreme flooding events. Therefore, rip rap slope protection up to the 10-year flood elevation is provided.

Capping activities on the Lot 26 Ash Area will not be below the 100-year flood elevation and a standard edge of cap anchor trench detail will be implemented.

The MassDEP solid waste cap designed for this Landfill complies with Solid Waste Regulations and the MassDEP Landfill Technical Guidance Manual, Revised May 1997 ("LTGM"). This same cap has been installed on numerous solid waste landfills in the Commonwealth over the past 25 years.

Design details for a standard cap cross-section are described below and are depicted on the attached Project Plans. The Lot 26 Ash Area will be capped using the standard cap design. The Northern Mound cap will use both the standard design plus Project-specific modifications.

The cap cross-sections are based on the Solid Waste Regulations and the LTGM. Descriptions of the cap and materials proposed are described below. The Project is required to obtain a Corrective Action Design ("CAD") permit from the MassDEP in accordance with the Solid Waste Regulations. The CAD Permit Application has been submitted to MassDEP and is currently under review.

As part of the capping of the Northern Mound, existing landfilled waste along the existing steep slopes immediately adjacent to the river and creek will be excavated and relocate to within the limits of the area to be final capped. There will also be waste relocation in the wetland area to the west of the Northern Mound and in areas along and on the Mass Electric property. Relocated waste will be covered with a minimum six-inch-thick layer of daily cover soils in accordance with MassDEP's Solid Waste Regulations at the end of each operating day.

All work required to cap the Northern Mound and Lot 26 Ash Area will be implemented from uphill locations. The construction contractor will not be permitted to work in standing water along the river and creek.

Subgrade Bedding Layer

A subgrade layer is typically required above the landfilled waste of sufficient thickness and structural strength to support construction activities and provide for long-term final cover system integrity. Typically, a minimum 6-inch-thick subgrade layer is required. For both the Northern Mound and Lot 26 Ash Area, the subgrade below the gas venting layer will be relocated solid waste, daily cover and contouring soils permitted in accordance with the Solid Waste Regulations.

For the Northern Mound, the subgrade will be overlain by six-inch thick coarse sand bedding/gas venting layer. This layer will direct landfill gas towards the onsite passive venting system and provide a bedding layer to protect the overlying capping layer.

The coarse sand layer is not required for the Lot 26 Ash Area because the landfilled ash in this area is inert and does not generate landfill gas.

Low-Permeability Capping Layer

The low-permeability capping layer minimizes infiltration of water into and through the waste mass, thereby reducing the volume of landfill leachate generated and minimizing the migration of landfill contaminants into the groundwater. The proposed low-permeability capping layer is a synthetic 40-mil textured high density polyethylene ("HDPE") flexible membrane layer ("FML"). This material was selected for its low-permeability characteristics, flexibility, strength, chemical-resistance, general industry wide acceptance, and its friction angle with respect to the overlying drainage layer. Textured HDPE will be installed across the entire area to be capped.

Drainage/Vegetative Support Layer

The drainage/vegetative support layer consists of a 12-inch-thick sand drainage layer and an 8-inch topsoil layer, consistent with the MassDEP regulations and associate guidance documents.

The drainage layer, which lies directly above the FML, allows subsurface water to drain laterally off the cap, thereby helping to minimize the potential for water to pass through the low-permeability layer. As a secondary function, the drainage layer serves to protect the underlying low permeability layer during construction and future uses. For the areas to receive a standard final cap, the drainage layer will consist of a 12-inch-thick layer of coarse sand.

It is necessary to provide a discharge point for the water conveyed in the drainage layer to reduce pressure on the low-permeability liner. At the bottom of slopes, a stone rip-rap slope and stone anchor trench will be constructed to allow the water in the drainage layer to be discharged without damaging the vegetative support layer. The slope bottom detail is shown on the attached Project Plans. A drainage geocomposite has been added to the final cap slopes immediately adjacent to the river and creek to enhance drainage during flood events and maintain improved stability.

The river-facing side of the Landfill that may be inundated during extreme flooding events, therefore the stone rip-rap slope will extend up to the 10-year flood elevation along the river and creek. The area between the 10- and 100-year flood elevations will be constructed with a GeoCell grid material that will provide enhanced stability of the vegetated area during extreme flood events.

The vegetative cover provides surficial stability of the closure system. The vegetative cover minimizes erosion of the underlying soils, and it retains moisture and promotes evapotranspiration. The vegetation's root system must not interfere with the drainage and low

permeability layers (no trees or other deep-rooted vegetation will be used) and all plant species will be capable of self-propagation. The seed mixture will contain drought resistant plant species and will be applied in a manner that ensures quick growth after construction.

The topsoil portion of the vegetative cover layer will be a minimum of 8-inches thick. The specified topsoil will require a higher organic content than natural topsoil and loam. The topsoil will require the use of an organic amendment such as compost. The higher organic content will help retain moisture for vegetative support.

All seeded slopes 4 horizontal to 1 vertical (4H: 1V) or steeper will also be covered with an erosion control mat. The erosion control blanket will minimize erosion and enhance moisture retention during the establishment of the vegetative cover.

The Merrimack River riparian zone is mapped habitat for Bald Eagles. Therefore, as depicted on the Project Plans, an approximately 60-foot-wide tree planting plateau is proposed to mitigate for the loss of trees in the riparian zone. The tree planting plateau will include a deeper vegetative support soil layer to accommodate the deeper rooting trees. The planting palette for the wooded plateau is comprised of native species in compliance with RFA standards and as requested by the NHWESP.

4.3 Modification to Standard Cap

Closure plans for the Northern Mound are provided in Appendix D. The standard MassDEP cap will be modified in the following two ways for the Northern Mound:

- In areas where trees and shrubs will be planted for mitigation, the cap will be augmented by adding between 3 and 5 feet of common fill and a filter fabric. The additional layer will provide space to sustain the root system of the trees and shrubs to be planted as mitigation.

- Along the edge of the Landfill in the River and Creek, the slope of relocated waste is proposed to be steepened to 2H:1V, instead of the standard 3:1. A geocomposite drainage net will be placed over the FML and covered with appropriately sized rip rap stone. The recommended bank stabilization cross-section will be extended to the 10-year floodplain (elevation 14-feet NAVD88) and is intended to protect the cap from more frequent storm events. The bottom of the slope will be an anchor trench as is required to anchor the FML and protect the cap. The recommended bank stabilization cross-section is shown in Attachment D.

  The area above the 10-year floodplain will be graded at a 3H:1V slope and be the standard MassDEP final cap augmented with a GeoCell grid product in the topsoil layer. The areas that are sloped at 3H:1V will not be planted with any trees or shrubby vegetation and will be periodically mowed. Larger vegetation in this area is susceptible to being dislodged

and uprooted during flood events, exposing the underlying cap layers, and causing significant damage. The grassed vegetation will continue to and above the 100-year floodplain elevation established by FEMA at el. 21 feet NAVD88.

The final cap over the Lot 26 Ash Area will also be a low-permeability FML over all final areas of landfilled ash. Many of the components and approaches to the corrective actions on the Lot 26 Ash Area are similar to those to be implemented on the Northern Mound. The plans for the capping of the Lot 26 Ash Area are included in Attachment D. The standard cap over the Lot 26 Ash Area will be modified in the following three areas:

- The existing stormwater retention basin will be reconstructed and expanded to meet the requirements for stormwater controls from the capped Southern and Northern Mounds. The basin overlies landfilled ash. The capping layer under the basin will be augmented with a bentonite clay geotextile to provide additional protection against infiltration of stormwater in the basin into the underlying landfilled ash.

- The existing roadway to the National Grid property will be maintained and reconstructed on top of the cap. In this area, the topsoil layer of the final cap will be replaced with a filter fabric overlain a gravel layer.

- In the turtle nesting area, the high-organic topsoil will be replaced with a sandy loam and a habitat-specific planting and landscaping plan will be implemented.

All of these alternative cross-sections for the Lot 26 Ash Area as shown on the attached plans and similar approaches have been approved at other solid waste landfills in Massachusetts capped in accordance with MassDEP's solid waste regulations.

4.4 Landfill Gas Management System Design

A passive landfill gas control system is proposed for the Northern Mound. The passive venting system will include deep vents to be installed throughout the Landfill. MassDEP's Solid Waste Regulations require that landfill gas controls be implemented during closure and that the controls be effective to keep landfill gas in subsurface soils at the designated compliance boundary, typically the property line, to below 25% of the lower explosive limit ("LEL"). There has been extensive sampling of subsurface landfill gas around the Landfill that has not recently shown migration of landfill gas above 25% of the LEL in any monitored location.

No gas venting is needed for the Lot 26 Ash Area because the landfilled ash is inert and does not generate landfill gases.

Monitoring for landfill gas migration continue during the minimum 30-year direction post-closure period that commences after the Northern Mound closure is approved by MassDEP.

Details of the Landfill gas control system components are depicted in the attached Project Plans.

4.5 Stormwater System

Consistent with the Solid Waste Regulations and the Regulations, a stormwater control system is required to prevent erosion of the capped Landfill and protect receiving water quality from stormwater discharges, and to control post-closure runoff rates to match (or be lower than) the existing runoff rates. The proposed stormwater design incorporates BMPs including: 1) lined swales and channels to convey runoff off the Landfill and to prevent erosion of the capping system, and 2) a detention basin with sediment forebays to settle solids out of stormwater before discharge to down gradient receiving waters. See the attached Project Plans which depict the stormwater system and Attachment G, Stormwater Report which presents the stormwater analysis to support the design and that documents compliance with the MassDEP Stormwater Management Standards to the extent practicable for landfill capping project.

Final design of the stormwater controls will be sufficient for the 100-year frequency, 24-hour duration design storm event and will mitigate peak and total flows from both the 25-year and 100-year design storms in accordance with MassDEP's Solid Waste Regulations and other regulations and policies.

The stormwater basin where drainage from the southern part of the Northern Mound is currently and will continue to be directed, is located on the Lot 26 Ash Area. This basin also accepts stormwater drainage from the eastern and northern sides of the Southern Mound.

Stormwater from the southern portion of the Northern Mound will be directed towards a swale system adjacent to the Mass Electric property to the swale constructed as part of the Southern Mound closure through a series of culverts. This swale will discharge into the stormwater basin located on Lot 26 Ash Area. This basin was designed to accommodate the flows from this portion of the Northern Mound.

4.6 Wood Turtle Habitat Improvements

Establishing suitable Wood Turtle nesting habitat adjacent to Johnson Creek, in the vicinity of the Lot 26 Ash Area was identified by NHESP, during the MEPA review process, as a measure to support the local resident Wood Turtle population. Therefore, finish grading, soil type (loamy sand) and warm season grasses is proposed in an approximately 10,000 s.f. area on Lot 26 Ash Area to provide suitable nesting habitat. Greater detail is provided below in the mitigation section.

5.0 Project Alternatives

Consideration of alternatives is a requirement under the general provisions of the Wetland Protection Regulations Limited Project provisions for the closure of landfills when undertaken to comply with the requirements of the MassDEP Solid Waste Regulations. The Regulations at 310 CMR 10.53(3), read in part:

"… In determining whether to exercise its discretion to approve the limited projects listed in 310 CMR 10.53(3), the Issuing Authority shall consider the following factors: the magnitude of the alteration and the significance of the Project site to the interests identified in M.G.L. c. 131, § 40, the availability of reasonable alternatives to the proposed activity, 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."

The following is a summary of Project and on-site alternatives considered during the planning and development phases of the Project. The goal in this process was to ensure that the alternative selected is consistent with the Project's objectives while avoiding and minimizing environmental impacts to the extent practicable at a reasonable cost. Please note, an alternatives analysis for this Project was reviewed by MEPA and MassDEP through the Environmental Impact Review ("EIR") process, in which the proposed Project was identified and selected as the preferred alternative. The Secretary of Energy and Environmental Affairs issued a Certificate on the Final EIR (EEA No. 12626) indicating the proposed Project did not need further MEPA review and could proceed to state permitting.

Alternatives evaluated below focus on bank stabilization measures for the Northern Mound because as the extent of the final cap to be installed would be the same for all the capping alternatives. Four alternatives were evaluated for the capped bank based on the following four criteria:

- **Criteria 1:** Meet regulatory requirements, including MassDEP's Solid Waste Regulations and CERCLA, for the capping landfilled solid waste; and other permits to be issued by MassDEP and the Haverhill Conservation Commission.

- **Criteria 2:** Minimize the use of hard structures such as rip rap stone and revetments along the lower bank of the final cap.

- **Criteria 3:** Minimize impacts to wetland resource areas and identified rare and endangered species habitat including the ability to accommodate mitigation measures.

- **Criteria 4:** Implementation considerations including constructability, short-term impacts such as truck traffic during construction, post-closure maintenance requirements, and comparative costs.

Each alternative was qualitatively evaluated for each of the criteria and assigned a ranking (Low, Medium, or High) based on its comparison to the other alternatives.

The following four alternatives for the bank stabilization were evaluated:

- **Alternative 1:** No Action. Cap not constructed and slope remains in current conditions.

- **Alternative 2:** Cap landfilled waste on slopes with rip rap toe extending up to the elevation of 100-year floodplain.

- **Alternative 3:** Cap landfilled waste on slopes with rip rap toe extending up to the elevation of 10-year floodplain. Trees and plantings along the plateau above the slopes.

- **Alternative 4:** Cap landfilled waste on slopes without rip rap at toe. Trees and plantings along most of the plateau above the slopes.

5.1 Alternative 1 - No Action Alternative

For this alternative, the final cap over the Lot 26 Ash Area and Northern Mound are not constructed and the existing slopes remain in their current unstable condition. There is no work in filled or flowed tidelands, and there are no direct impacts to wetland resource areas with this alternative because no construction would occur. The existing tree cover would remain as long as the trees are not undermined by the continuing erosion of landfilled waste into the Merrimack River and Johnson Creek. The No Action alternative is ranked as Low for criteria 1 because it does not include a final cap and is not compliant with MassDEP's Solid Waste Regulations. If no cap is installed, contaminants from landfilled waste in the Lot 26 Ash Area and the Northern Mound will continue to leach into groundwater and adversely affect surface water quality in the creek and river, and landfilled waste will continue to erode into the river. Therefore, Alternative 1 – No Action is not retained for further evaluation.

5.2 Alternative 2 – Alternative Armoring Bank to BLSF Elevation

This alternative proposes the installation of rip rap on top of the standard cap to the elevation of the 100-year floodplain (el. 21-feet NAVD88). This alternative provides for a stable final cap meeting the standard requirements of MassDEP's Solid Waste Regulations that can be constructed with standard procedures and does not require any variances. Because the alternative extends the rip rap stone to the 100-year floodplain elevation (elevation 21-feet NAVD88), it creates a hardened surface along the sloped edge of the river and the creek of approximately 50-feet wide (e.g., approximately from elevation 5 feet NAVD88 to elevation 21 at a three horizontal to one vertical slope).

This alternative removes all trees and vegetation from the lower half of the landfill slope and converts a soil bank to hardened rip rap slope. It meets criterion 1 but does not meet criteria 2 and 3, and therefore was not retained for further consideration.

5.3 Alternative 3 – Final Cap with Rip Rap to 10-Year Floodplain (Preferred Alternative)

In this alternative, the rip rap stone is extended from the bottom of the final cap to the 10-year floodplain elevation (elevation 14-feet NAVD88). A vegetated cap augmented with a geocomposite drainage layer will be installed above this elevation to augment the free draining sand drainage layer when flood elevations on the creek and river extend above the 10-year flood

elevation. This alternative only requires that the hardened rip rap surface be extended approximately 20-feet up the final slope because it drops the height of the rip rap to the 10-year flood elevation and establishes a steeper base slope. However, the extent of the geocomposite will be determined during final design.

This alternative is the same as Alternative 2 except the rip rap is installed to the elevation of the 10-year floodplain elevation and a drainage geocomposite is added. This alternative provides for a stable final cap meeting the requirements of MassDEP's Solid Waste. A drainage geocomposite and GeoCell grid system will be added to create a stable condition that MassDEP can permit and approve.

Based on the comparative evaluation of alternatives described in this section, this alternative is the preferred alternative. It can be designed and constructed to meet all regulatory requirements, minimizes the extent of hardened surfaces along the river and creek to that required for the construction of a stable final cap that isolates landfilled waste and minimizes the continued leaching of contaminants into groundwater; can accommodate various mitigation measures described in section 4; and has similar implementation impacts as the other alternatives.

The mitigation measures discussed for rare species, wetlands and landfill gas emissions can all be implemented for this Alternative.

5.4 Alternative 4 – No Rip Rap at Toe of Final Cap

This alternative is the similar to Alternative 3; however, no rip rap is proposed to the 10-year floodplain elevation. The slope above the anchor trench would be stabilized with a vegetated cap.

Alternative 4 has no hard structures on the final cap, which will provide for a final cap meeting MassDEP's requirements. However, the layers above the capping layer will slough and fail during significant precipitation and flooding events exposing the flexible membrane liner because there is no rip rap to allow the pore water in the sand drainage layer to discharge. Therefore, this alternative is ranked as Low for criteria 1 as well as criteria 4 (Implementation) and is eliminated from further consideration.

Mitigation measures discussed for rare species, wetlands and landfill gas emissions can all be implemented for this Alternative.

5.5 Alternative Impacts

The impacts on construction traffic and wetland resource areas for the three capping alternatives are the same since the limit of the final cap and associated waste excavation remain the same and the final cap is installed to approximately the same grades. The costs to implement and construct Alternatives 2, 3, and 4 are similar but Alternative 4 (No Rip Rap Along Slope) would require regular inspection and ongoing maintenance of eroded and failed slopes that would require future construction along the lower elevations of the final cap.

The construction related impacts are similar for Alternatives 2, 3, and 4 including similar truck trips to deliver capping soils and materials and duration of construction. The implementation cost for Alternatives 2, 3, and 4 are also similar.

Table 5-1 Alternatives Impact Analysis

Alternative	Alternative One: No Action	Alternative Two: Alternative Armoring Bank to BLSF Elevation	Alternative Three: Preferred Alternative Armoring Bank to 10-Year Floodplain	Alternative Four: No Rip Rap at Toe of Final Cap
Land Alteration Entire Landfill (Acres)	0	19.8 Acres	19.8 Acres	19.8 Acres
Area Along Bank with Armoring (ft^2)[1]	0	2,831 LF; 51 FT assumed length = 144,381 ft^2 (3.3 acres)	2,831 LF, 30 FT assumed length = 84,930 ft^2 (1.9 acres)	0
Wetland Resource Areas – Permanent Impacts				
BVW (ft^2)	0	3,400 ft^2 (temporary)	1,185 ft^2 (temporary)	3,400 ft^2 (temporary)
Inland Bank – Merrimack R. & Johnson C.	0	1,1415 LF (Temporary)	1,415 LF (Temporary)	1,415 LF (Temporary)
Inland Bank – Intermittent Stream	0	305 LF (Restored in situ)	305 LF (Restored in situ)	305 LF (Restored in situ)
BLSF (ft^3)	0	+45,000 ft^3 (increase)	+19,548 ft^3 (increase)[2]	+18,950 ft^3 (increase)
Riverfront Area (ft^2)	0	9.6 acres	9.6 acres	9.6 acres
Restoration of Trees (acres)	None	1.0 acres	2.8 acres	2.8 acres
Estimated Construction Truck Trips – Entire Project (round trips)	None	4,970	4,970	4,970

Notes:

1. Armoring area estimate does not include anchor trench area**.**
3. Decrease in created flood storage in recommended alternative based on decreased waste excavation along River for 2:1 base slope and to maintain current slopes.

6.0 Potential Alterations and Proposed Mitigation Measures During Construction

At both the Northern Mound and Lot 26 Ash Area, construction work in wetland resources is unavoidable because it is required to construct the mandated final cap pursuant to the Solid Waste Regulations in Riverfront area and BLSF. Site grading was designed to avoid and minimize work in BVW and Bank to the extent practicable. However, the existing limit of landfilled waste and the need to either, cap it in place or relocate and consolidate waste within the areas to be final capped results in some unavoidable work in BVW and Bank.

The extent of the 200-foot RFA and BLSF (the 100-year floodplain) onto areas that were historically landfilled makes working in those overlay resource areas unavoidable. An alternatives analysis for the bank stabilization measures, demonstrates that the proposed Project is the least environmentally damaging practicable alternative that concomitantly meets the Project purpose and complies with the Solid Waste Regulations.

6.1 Description of Work and Resource Areas

Capping the Landfill will involve earthwork within the 200-foot Riverfront Area as depicted on the Project Plans. Alteration in the 200-RFA is approximately 9.62 acres. 1.98 acres of disturbance will occur in the 100-year floodplain, 1,185 s.f. in BVW, 305 linear feet in Inland Bank of the intermittent stream and 1,415 linear feet of Inland Bank of the Merrimack River and Johnson Creek. There will also be 950 s.f. of temporary disturbance in IVW.

Table 6-1 Summary of Wetland Impacts

State Wetland Resource Area	Proposed Alteration	Comments	Series Associated with Resource Areas
Inland Bank (Merrimack River & Johnson Creek)	1,415 linear feet (Top margin of Bank)	Temporary along top of Bank – in several discrete segments along the Merrimack River and Johnson Creek	Series A
Inland Bank (Int. Stream)	305 linear feet	Intermittent Stream Channel to be restored in-situ	Series E
BVW	1,185 square feet (southern margin of BVW)	Temporary - Restore in-situ	Series B Series C
IVW	950 square feet (temporary)	Temporary - Restore in-situ	Series D
Riverfront Area	9.62 acres	Associated with Merrimack River. & Johnson Creek	Series A
BLSF (100-yr Floodplain)	1.98 acres	Associated with Merrimack River. & Johnson Creek	

6.2 Propose Work in Resource Areas

The overall approach to cap the Northern Mound and Lot 26 Ash Area is to construct a final cap that meets MassDEP's requirements as outlined in the Solid Waste Regulations and associated guidance documents. The cap must also meet the requirements of CERCLA for closure of municipal solid waste landfills that are on the NPL.

In summary the following elements are proposed for this Project including:

Standard MassDEP Cap. A final cap is proposed on all historically landfilled areas remaining after waste consolidation is completed. The proposed cap meets the standard requirements of MassDEP's Solid Waste Regulations.

Edge of Cap along the Merrimack River and Johnson Creek. The existing edge of landfilled waste along the Merrimack River extends down the slope and nearly to the top of Bank and BVW where present. The design includes a rip rap slope extending from the toe of slope up to el. 14 feet NAVD88, i.e., the 10-year flood elevation. See Cross-Section A-A through G-G on the Northern Mound and Lot 26 Ash Area capping plans included in Attachment D. The rip rap slope is needed to protect the cap from erosion up to the 10-year flood elevation and addresses the design requirement to allow the sand drainage layer to have a discharge point.

The extent of Bank alteration is based on the need to excavate the toe of slope up to five feet beyond the final limit of landfilled waste to install the anchor trench. This additional temporary area is needed to excavate incidental waste observed beyond the estimated limit of landfilled waste and to excavate a trench in which the required anchor trench will be installed. The temporary workspace will be restored to final grade with clean soil and seeded to stabilize the exposed soils resulting in no permanent loss of Inland Bank.

Intermittent Stream Channel. The intermittent stream channel, in the western portion of the Northern Mound (wetland flag series E), is located over landfilled waste to varying depths. This intermittent channel is regulated as Bank. The existing landfilled waste in this area will be excavated and consolidated under the final capped area on the Northern Mound. The channel and surrounding area will be re-graded to approximately pre-closure conditions. The channel will be re-established to convey storm drainage from the south, northward to the Merrimack River. Reconstructing this channel in situ results in no loss of Bank associated with the intermittent stream channel.

Isolated Vegetated Wetland. The IVW (Wetland Flag series D) is partially located over landfilled waste. Waste will be removed from this area and consolidated under the cap to the east or the IVW area will be capped and replicated at another on-site location off the cap. The altered IVW will be re-established by backfilling the excavated area with common fill to one foot below finish grades, and then establishing finish grades with organic rich loam and planting the area with a wetland plant community to restore the IVW in situ. Reconstructing this IVW in place results in no loss of IVW.

Bordering Vegetated Wetland. Like Inland Bank, along flag series C (BVW) waste extends to the BVW boundary. A five-foot-wide temporary workspace from the limit of final grading to account for any waste excavation, excavation to key in the cap anchor trench and to backfill the BVW to pre-construction grades. See Cross-Section C-C' in the plans in Attachment D for the work in this BVW. Temporarily disturbed portion of this BVW will be restored with organic rich loam and seeded with a wetland seed mix to stabilize exposed soils. This in place restoration will result in no loss to BVW.

Bordering Land Subject to Flooding. For the Northern Mound, work in BLSF, involves all capping construction that extends from the top of Bank landward to elevation 21 feet NAVD88. To avoid the loss of flood storage capacity, the plan involves excavating waste from the lower elevations of the floodplain and consolidating it under the cap at higher elevations above 21-feet NAVD. This is depicted on most cross-sections but is most pronounced on Section B-B' and G-G' on the plans in Attachment D. By consolidating waste in this manner there is no loss in flood storage capacity. For the Lot 26 Ash Area, the regrading of the currently steep slope along Johnson Creek will also create additional storage within the BLSF.

The Landfill capping requires filling approximately 2,349 cy of BLSF and includes the construction of approximately 3,073 cy of compensatory flood storage, resulting in a net increase of approximately 724 cy of flood storage on the site. See Table 6-2 below for a summary of the filling and compensatory flood storage by 2-foot increments – the survey contour.

Table 6-2 Summary of Compensatory Flood Storage Volume – Northern Mound

Elevation Interval	Fill volume (cy)	Compensatory Volume (cy)	Change (cy)
El. 6 – 8 feet	256	326	+ 70
El 8 – 10 feet	57	229	+172
El 10 – 12 feet	175	309	+134
El 12 – 14 feet	143	204	+61
El 14 – 16 feet	256	326	+70
El 16 – 18 feet	220	337	+117
El 18 – 20 feet	672	802	+130
El 20 – 22 feet*	570	540	-30
Total	**2,349**	**3,073**	**+724**

* BLSF extends to el. 21 feet NAVD 88. There is no construction within BLSF for Lot 26 Ash Area.

Riverfront Area. For the Northern Mound and Lot 26 Ash Area, work in RFA, which extends 200-feet horizontally from the MHW, and involves excavation and relocation of historically landfilled waste and construction of the final cap. Capping pursuant to the Solid Waste Regulations will improve the existing conditions and meet the definition of redevelopment of a previously developed RFA (310 CMR 10.58(5)). Capping the landfilled waste within the RFA will not adversely

impact the ability of this resource area to protect the interests of the Wetlands Protection Act, and the capping project is specifically designed to improve the interest to prevention of pollution, by preventing future discharge of contaminants into the groundwater and potentially to nearby surface waters.

6.3 Construction Period Mitigation Measures

The following summary presents the mitigation measures that will be implemented to avoid and minimize impacts to the wetland resource areas, the Merrimack River and Jonson Creek during construction. Please refer to Project Plans for typical details of measures to protect wetlands and waterways during and after construction.

Construction Period

- Install straw wattles and/or sediment fence at the limits of work as shown on the Project Plans to prevent erosion or sedimentation into resource areas. The sediment barrier will be inspected weekly and after all storm events of ½ -inch or greater and repaired as needed. The barrier will be left in place until the area is permanently stabilized. Straw wattles and sediment fence will be replaced as necessary due to sediment build-up and degradation.

- Erosion control blanket will be installed on all vegetated exposed slopes of 4:1 (horizontal : vertical) or steeper during construction to minimize soil erosion.

- Where construction is occurring within the 200-Foot Riverfront Area, disturbed areas will be seeded and mulched to stabilize soils and prevent erosion as soon as possible after construction is complete, when no further alteration is anticipated for 30 or more days. In the event that this work is to take place outside of the growing season, erosion control blankets or mulch and tackifier will be placed over these areas to minimize erosion.

- For work that will disturb soils, and additional disturbances that are anticipated within 7 to 30 days, the area will be temporarily stabilized with mulch and tackifier or erosion control blankets, or other equivalent measures, as required to maintain the disturbed areas.

- Runoff will be directed into temporary detention/sedimentation basins, where practical, via temporary swales or berms. Swales and berms will be seeded and covered with erosion control blankets to stabilize the soils until the grass roots have developed sufficiently to stabilize the soil. The existing permanent basin will be re-constructed on-site as part of the Project.

- Rock or haybale check dams will be installed in swales to reduce flow velocities and minimize erosion.

- All equipment refueling and any required minor maintenance will occur outside of wetland resource areas including the 200-foot Riverfront Area and BLSF. Operators will be required to maintain a supply of SPEEDY DRY or other suitable oil absorbent material with the equipment for the clean-up of any accidental spills during refueling or maintenance operations.

- Periodic inspections will occur during construction by the engineer to ensure compliance with the Order of Conditions.

Post-Construction Measures

- All areas disturbed by these activities will be stabilized upon completion of the work.

- The silt fence/hay bale barrier and other erosion controls will not be removed until the work area is stabilized.

- The landfill cap vegetation and drainage system will be regularly inspected in accordance with the Solid Waste Regulations and the MassDEP Solid Waste Approval issued to cap this landfill.

6.4 Compliance with Stormwater Management Regulations

The Massachusetts Stormwater Management Standards ("Standards") were developed to address issues relating to water quality and water quantity (flooding, low base flow and recharge). These Standards are incorporated into the Regulations at 310 CMR 10.05(6)(k), and were developed to be protective of the environment, especially receiving waters. See Attachment G Stormwater Report for the completed Stormwater Checklist and a review of the Stormwater Standards.

7.0 Compliance with Wetland Protection Regulation and Limited Project Performance Standards

The Project is mandated to close the Northern Mound and Lot 26 Ash Area in compliance with the Solid Waste Regulations and was designed to protect the interests of the Wetlands Protection Act. As described above, work is proposed along the top of Inland Bank, the edge of BVW, within BLSF, in 200-foot Riverfront Area, and the municipal resource area of IVW. Whereas this project is eligible for review as a Landfill Limited Project per 10.53(3)(p), below is a review of the how the Project complies with the Limited Project performance standards (the Limited Project standard is shown in italics and bold and the response is shown in plain text).

310 CMR 10.53(3)(p)1. – Alternatives) A project design alternative analysis shall be prepared in accordance with 310 CMR 19.150: Landfill Assessment Requirements.

As presented in this NOI, an alternatives analysis that included a No Build alternative and other design alternatives was developed. Based on the analysis it was determined that there are no practicable alternatives to the Project with less adverse environmental effects than Preferred Alternative.

310 CMR 10.53(3)(p)2.a. through f - Such projects shall be designed, constructed, implemented, operated, and maintained to avoid or, where avoidance is not practicable, to minimize impacts to resource areas, and to meet the standards … 10.53(3)(p)2. a. through f.

310 CMR 10.53(3)(p)2.a. – Hydrological Change Minimization.

The proposed stormwater system will be designed to prevent an increase in peak rate of runoff for the post-construction condition, see Attachment D, Stormwater Report. Because this is a landfill closure project, stormwater infiltration is not appropriate or proposed.

310 CMR 10.53(3)(p)2.b. – Best Management Practices.

Vegetation removal, grading, waste relocation and restoration, installation of and construction of the final cap is required within resource areas and the 100-foot buffer zone to Bank and BVW, RFA and BLSF. These activities are required to install the final cap and comply with the Solid Waste Regulations. The majority of the capping work is located outside of resource areas and greater than 100 feet from the Merrimack River and Johnson Creek.

During construction, a suite of best management practices ("BMPs") will be implemented including sediment and erosion controls; temporary and permanent soil stabilization measures; temporary and permanent stormwater controls; and designated refueling areas. A description of BMPs is depicted in Attachment D, Project Plans. These BMPs have proven effective at other landfill closure projects located in close proximity to resource areas.

310 CMR 10.53(3)(p)2.c. – Mitigating Measures.

A suite of construction period BMPs will be implemented to avoid and minimize impacts to adjacent resource areas during construction. Permanent alteration in BLSF and RFA associated with the landfill capping project will be mitigated through the restoration of a woodland community in the proposed tree planting area as depicted on the Project Plans. Included in the planting plateau is a single roosting mast to integrate Bald Eagle perching sites in the restored areas.

The slope design along the river and creek incorporates a rip rap slope between the top of Bank and elevation 14 feet NAVD88 (10-year flood plain). This design avoids the need to work on the Bank below the immediate top of Bank and establishes a stabilized slope to protect the landfill cap to avoid the potential for damage to the cap and release of waste to the environment. This design also reduces the fill in BLSF as compared to earlier designs and allows the construction of compensatory flood storage.

310 CMR 10.53(3)(p)2.d. – Compensatory Storage.

The construction of the final cap requires filling approximately 2,349 cubic yards (cy) of BLSF and includes the construction of approximately 3,073 cy of compensatory flood storage, resulting in a net increase of approximately 724 cy of flood storage. See Table 6-2 above that presents the incremental changes in BLSF and documents the increase in flood storage. This meets the performance standard found 310 CMR 10.27(4)(a) for BLSF, because it provides greater than a 1:1 ratio of compensatory flood storage volume to filled flood plain volume within the same elevation range.

310 CMR 10.53(3)(p)2.e. – Restricted Flows

Grading to consolidate the landfill footprint will maintain proper elevations to avoid restricted flows. The proposed grading plan is presented in Attachment D, Project Plans.

310 CMR 10.53(3)(p)2.f. – Resource Area Restoration

The Project requires landfill capping in the BLSF and 200-foot RFA, and will temporarily alter portions of Bank, BVW and IVW (municipal resource area) because landfilled waste is found in BLSF and RFA, and extends to Bank, BVW and IVW. Temporarily altered Bank, BVW and IVW will be restored in-situ and yield no net loss of these resource areas as a result of the Project. The tree planting plateau is proposed to restore woodland habitat in the riparian zone to mitigate for tree cutting necessary to install the final cap in mapped Bald Eagle habitat.

8.0 Wildlife Habitat

8.1 Introduction

This section describes the proposed alterations in and proximate to the Estimated Habitat and Priority Habitats, potential effects on habitat of state-listed species, and measures proposed to mitigate for work in state-listed species habitats.

This section focusses on Bald Eagle and Wood Turtle habitat, because the proposed Project avoids any planned work below the MHW line of the Merrimack River, i.e., no in-water work is proposed in Shortnose Sturgeon habitat. Although no in-water work is proposed, proactive mitigation measures are outlined if, during construction, it is determined that in-water work is required.

The project Site lies partially within mapped Priority Habitat (PH 2122) and Estimated Habitat (EH 1393) associated with the Merrimack River which forms the northerly landfill boundary. These polygons are associated with occurrences for Bald Eagle (*Haliaeetus leucocephalus*) which are identified as "Threatened" by the Massachusetts Division of Fisheries and Wildlife ("MDFW"), and Shortnose Sturgeon (*Acipenser brevirostrum*) are found in the river and are identified as

"Endangered" by MDFW. Mapped habitat polygons associated with Johnson Creek in Groveland PH 2087 and EH 1371) are mapped for Wood Turtle (*Glyptemys insculpta*) rated as a "Species of Special Concern" by MDFW.[1]

The following sections address each of these three state-listed species, addressing habitat, potential effects, and proposed mitigation.

8.2 Bald Eagle Habitat, Potential Effects and Proposed Mitigation

Bald Eagles are regularly observed flying or hunting over and perching along the Merrimack River from Manchester, NH to Newburyport, MA. Additionally, Eagles with more northerly breeding territories will overwinter in the Merrimack Valley taking advantage of more persistent open water and generally milder winter conditions as compared to their breeding territories.

8.2.1 Bald Eagle Habitat

For nesting, eagles typically select large, prominent trees adjacent to, or within ready flight distance to their preferred feeding territory, in this case the Merrimack River. Occasionally, nests are established in less prominent trees. Most nests become large structures because nests are re-used year-to-year and expanded annually, often weighing up to several hundred pounds or more. Most typically, nests are located away from significant human activity or other ongoing human disturbances. The tree canopy long the river is dominated by eastern cottonwood, river birch and silver maples, with no stately examples of these trees along the river's edge. A number of mature trees along the water's edge have tipped into the river. The species composition and condition of trees diminishes the availability of outstanding perching or nesting sites on the landfill property. To date no nests have been observed on the Landfill property nor any observed for a considerable distance up- or down-river. The on-site habitat is most likely is limited to occasional perching sites in trees along the river.

Hales Island, an approximately 65-acre island is located northwest of the Landfill, and it is predominantly forested. Because it is in a relatively natural state after having been utilized as a golf course and other functions in the past, Hale's Island – being uninhabited and forested – provides better nearby habitat for Bald Eagles, presuming a mated pair found a suitably mature

[1] **Endangered** - any species of plant or animal in danger of extinction throughout all or a significant portion of its range and species of plants or animals in danger of extirpation as documented by biological research and inventory

Threatened - any species of plant or animal likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and any species declining or rare as determined by biological research and inventory and likely to become endangered in the foreseeable future

Species of Special Concern - any species of plant or animal which has been documented by biological research and inventory to have suffered a decline that could threaten the species if allowed to continue unchecked or that occurs in such small numbers or with such a restricted distribution or specialized habitat requirements that it could easily become threatened within Massachusetts

and robust tree. The remaining nearby river reaches upstream and downstream, both in Haverhill and Groveland, are all variously developed. The developed landscape of the nearby river corridor is not conducive to Eagle nesting.

In summary, suitable perches for resting, feeding, and hunting are found along the Merrimack River in eastern Massachusetts, and those features arguably provide habitat for the species. Within the narrow band of riverside forest on the Landfill there are relatively mature trees of eastern cottonwood, river birch and silver maple. Eagles fly along virtually all of the Merrimack River in eastern Massachusetts and occasionally they may utilize any available perching site on the Landfill because it is unoccupied. The current or future use of the Northern Mound for nesting is unlikely due to the limited nesting sites. However, the adjacent Hales Island is preferable habitat for perching and nesting because it is more isolated.

8.2.2 Potential Effects

The work close to the Northern Mound is described above the typical landfill cross-section is presented in the Project Plans. Although this plan minimizes tree clearing in Bald Eagle habitat, unavoidable clearing is still required to cap the Northern Mound in accordance with 310 CMR 19.00. As shown on the Project Plans 2-4 approximately 6.2 acres of trees will be cleared and approximately 3.9 acres of trees will be retained on the shelf along the river.

8.2.3 Mitigation Measures

Mitigation involves minimizing tree removal, replanting a woodland habitat atop the Northern Mound, and installing one eagle nesting mast. See Sheets L-1 and L-2 which present the proposed planting plan.

Trees along the lower elevations are being retained to minimize tree removal to only those needed to cap the Northern Mound. The Northern Mound will be inspected (tree sweep) for existing eagle nests or nests being constructed in the late fall to early winter prior to cutting trees on the landfill mound. Tree cutting will only proceed after the tree sweep is completed and no nests are confirmed.

The revised closure plans include an approximately 55- to 60-foot-wide woodland on a nearly level plateau established on the landfill between elevation 36 feet and 40 feet NAVD88. The woodland zone will be established by importing soils to provide an 8- to 10-foot-deep planting bed above the cap. The woodland will be planted with a mix of trees and shrubs to re-establish approximately 2.8 acre of woodland along the river. See Table 8-1 below that presents the proposed planting palette. After trees and shrubs are planted the woodland area will be seeded to stabilize the soils.

Table 8-1 Proposed Woodland Zone Planting Palette

Symbol	Quantity	Common Name	Latin Binomial	Size	Root
Trees					
AR	136	Red Maple	*Acer rubrum*	2- to 2.5-in caliper	BB
QR	102	Red Oak	*Quercus rubra*	2- to 2.5-in caliper	BB
QA	68	White oak	*Quercus alba*	2- to 2.5-in caliper	BB
TC	85	Canadian Hemlock	*Tsuga canadensis*	5- to 6-ft tall	BB
BN	119	River Birch	*Betula nigra*	1.5- to 2-in caliper	BB
FP	85	Green Ash	*Fraxinus pennsylvanica*	2- to 2.5-in caliper	BB
Shrubs					
IV	68	Common Winterberry	*Ilex verticillata*	#7 pot	20% male
KL	85	Mountain Laurel	*Kalmia latifolia*	3- to 4-ft tall	Collected
VC	96	Highbush Blueberry	*Vaccinium corymbosum*	3- to 4-ft tall	
VD	90	Arrowood Viburnum	*Viburnum dentatum*	#7 pot	
SC	30	American Elder	*Sambucus canadensis*	#7 pot	

The Applicants will also install one eagle nesting mast on the Northern Mound to provide nest habitat until the planted trees mature to provide nesting habitat. The final location of the single pole will be determined in consultation with NHESP staff.

The woodland zone includes a gravel access road along the top of the slope (parallel to the river) to provide access to maintenance crews to inspect for soil erosion, plant growth and stability of the eagle nesting mast. Should trees or shrubs die in the first-year post-installation (transplant mortality) they will be replaced to achieve the count presented in Table 8-1. Capped landfills are required to be periodically inspected for the minimum 30-year post closure period. The purpose is to inspect and confirm the drainage system is functioning and the final cap is stable. Should deficiencies be noted repairs are made to correct those deficiencies. On the Northern Mound, these inspections will also include documenting growth and condition of the planted trees the eagle nesting mast. Should trees topple during the 30-year inspection period the trees will be cut up, trunks and slash retained on-site following prudent forestry techniques. A new tree of the same species may be re-planted in its place. Exposed soils will be raked smooth and seeded to stabilize the exposed soils.

8.3 Wood Turtle Habitat, Potential Effects and Proposed Mitigation

Wood Turtles can be found throughout New England, north to Nova Scotia, west to eastern Minnesota, and south to northern Virginia. They appear to be widespread in Massachusetts, though most towns have fewer than 5 known occurrences. With little known about the status of local populations they are listed as a Species of Special Concern.

8.3.1. Wood Turtle Habitat

The preferred Wood Turtle habitat is riparian areas associated with slower moving mid-sized streams with sandy bottoms and heavily vegetated stream banks. The stream bottom and muddy banks provide hibernating sites for overwintering while open areas with sand or gravel substrate near the stream's edge are used for nesting[2].

Wood turtle is associated with portions of Johnson Creek based on mapping of Priority and Estimated Habitats by the MDFW. Additionally, this species is also associated with Argilla Brook that forms a confluence with Johnson Creek approximately 700 feet south-southeast of the Quonset hut building (Lot 26).

The conditions of Johnson Creek adjacent to the Northern Mound north of the former railroad alignment largely preclude its value as habitat for wood turtles. This part of the brook has a significant mean tidal range, estimated at five or more feet, essentially equal to that of the adjacent Merrimack River. The banks of the creek in this area are sculpted smooth with no protective cover objects, and the annual ice breaking and scour along this creek reach make this zone of the creek unsuitable for wood turtles.

The tidal influence extends southward beyond the former railroad crossing; however, it is attenuated by the constriction formed by the former railroad bridge abutments. There are boulders within the creek bed by the railroad crossing that cause riffles during lower tidal stages and, in part limit the influence of the tide flux. The qualitative value of the creek for wood turtles increases with progress upstream from (or south of) the former railroad crossing up to the confluence with Argilla Brook where a floodplain plant community provides para-emergent habitat for wood turtles presumably overwintering in the streams.

Historically, wood turtles inhabiting Johnson Creek and Argilla Brook could meander across what was likely considerably more open canopy habitat. The greater than half century of activities in the vicinity provided a mixture of soil disturbance (generally positive) along with a significant mortality risk to adults and egg stage animals (generally negative) due to vehicular mortality, earth moving activities, and manipulation in areas that might be suitable for nesting habitat. The recent period of relative inactivity at the closed landfill and inactive asphalt batch plant may have provided a relative improvement of conditions for wood turtles.

Nesting habitat, within normal migratory distances of approximately 600 feet is a critical habitat feature for wood turtles. There is, and has been, open canopy habitat associated with the landfill and asphalt batch plant to the west of Johnson Creek. With the exception of the recent Southern

[2] NHESP – 2015. Wood Turtle – Factsheet. 3 pp.

Mound Capping Project and the electrical interconnection for the solar photovoltaic installation on the Southern Mound, activity on and around the Northern Mound and Lot 26 Ash Area has been and is currently *de minimus*.

Current probable nesting habitat in the Project vicinity is likely associated with an electrical substation in Groveland, east of Johnson Creek and north of Argilla Brook, and the low-lying sandy substrates east of the Southern Mound off of Yemma Road extension. Neither area provides preferable conditions due to distance to an overwintering area (brook), or due to limitations in available nesting substrate.

8.3.2 Potential Effects

Closing the Lot 26 Ash Area is described above and will involve excavation, grading, installing an FML capping layer and soils above the FML. These construction activities plus construction vehicle traffic will occur in mapped habitat of Wood Turtle and have the potential of harming animals and disturbing habitat. The work includes open grassy areas with sandy soils as well as woodland habitat. In the current condition, Wood Turtles probably experience an uncertain long-term fate local to Johnson Creek. The capping of the Northern Mound and the Lot 26 Ash Area, with the mitigation described below have the potential to improve local conditions.

8.3.3 Mitigation

To lessen potential adverse effects on Wood Turtles and their habitat measures are proposed during construction and the for the long-term to avoid a Take and to improve habitat quality post-construction.

During construction measures to avoid harming any turtle specimens on Lot 26 Ash Area include the following:

- Adhere to conditions established by NHESP in their Conservation and Management Permit;
- In early May, inspecting the work area for turtles and if none found encircling the work area with exclusion fencing (a well-installed siltation fence barrier) to prevent migration of wood turtles into and through the work area;
- Install exclusion fencing along Yemma Road on the project site to prevent turtles from crossing the road or entering the work zone from the south;
- Not placing, stockpiling, or storing sandy soils, i.e., soils that may be conducive for nesting, in the work area during the nesting season;
- Conduct a turtle sweep for hatchlings in September; and
- Develop a working training program to inform construction workers of turtle identification, migration seasons and the established protocols should they find a Wood Turtle in the work zone during construction.

Long-term mitigation involves constructing suitable Wood Turtle nesting habitat in the vicinity of the existing Quonset hut. An approximately 10,000 ft^2 area of Wood Turtle nesting habitat is proposed. The constructed Wood Turtle nesting habitat will be established by augmenting the proposed soil cap for the Lot 26 Ash Area near the top of the bank to Johnson's Creek by replacing the typical loamy topsoil with a sandy soil to a depth of one foot. Wood Turtles prefer open areas with sand or gravel substrate near the stream edge for nesting. Therefore, the nesting habitat will be seeded with a warm season grass mix to establish a sparse old-field community. The cap and grass maintenance will be maintained only when the Turtles have finished nesting and their eggs have hatched, which means annual maintenance in this area will only be performed between October 1 and May 1 to avoid nesting, eggs, and hatching.

8.4 Short-Nose Sturgeon Habitat, Potential Effects and Proposed Mitigation

Shortnose Sturgeon is listed as both a federally and state listed Endangered Species and they are found in large tidal rivers along the Atlantic Coast of North America from Canada to Florida. Shortnose Sturgeon are anadromous to amphidromous (i.e., spawn in freshwater but spend portions of life cycle in saltwater).

In Massachusetts, most Shortnose Sturgeon populations are riverine, predominantly in the Connecticut and Merrimack Rivers. Spawning generally occurs in April to May, at freshwater sites upstream but within tidal influence in deep water areas with a gravel, rubble, and cobble substrate. Fertile eggs are demersal and become adhesive shortly after fertilization, suggesting eggs remain relatively close to spawning sites. Juveniles are reported to remain in freshwater for the first 2 to 8 years of life. Sturgeons are bottom feeders and feed in vegetated areas on a variety of prey items; juveniles feed on insects and crustaceans while adults feed on small mollusks, insect larvae and crustaceans. Seasonal migrations may vary on life stage, season, and latitude; however, there is a general pattern of migration movements between feeding, wintering, and spawning habitats. Threats to Shortnose Sturgeon include habitat loss and degradation (construction of dams, bridges, dredging) and mortality (impingement on intake screens and pollution). Habitat loss and mortality cause a heavy toll due to late spawning age and large migrations between critical habitats[3,4].

No work was conducted to determine the presence / absence of Shortnose Sturgeon in the Merrimack River near the Landfill. However, literature[5,6] documents that the Shortnose Sturgeon

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[3] Crance, J.H. 1986 – Habitat Suitability Index Models and Instream Flow Suitability Curves: Shortnose Sturgeon. U.S. F.W.S. Biol. Rep. 82 (10.129). 31pp.

[4] NHESP – 2008. Shortnose Sturgeon – Factsheet. 1 pp.

[5] Kieffer, Mc. & K. Kynard. 1993. Annual Movements of Shortnose and Atlantic Sturgeons in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society. 122: 1088 – 1103

[6] Kieffer, Mc. & K. Kynard. 1996. Spawning of Shortnose Sturgeon in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society. 125: 179 - 186

range in the Merrimack River extends up-river to and past Haverhill. Due to documentation presented in the literature and based on written comments from the NHESP, the Project Applicants concur with the NHESP mapping documenting Shortnose Sturgeon presence in the Merrimack River at Haverhill.

Potential Effects and Proposed Mitigation

As described above, Cross-Section A-A' through F-F' on the project plans for the Northern Mound, no in-water work is proposed, i.e., no work below MHW. In places where work is required immediately adjacent to the MHW limit, that work is limited to removing landfilled waste where present and back filling the excavation with clean soil and seeding. In certain locations, such as conditions at Cross-Section G-G' the rip rap stone drainage layer will be close to the MHW line. Where construction will extend close to the MHW, work will be timed to occur during the falling mid-tide through low tide and cease at the rising mid-tide elevation to ensure there is no in-water work. This work plan avoids any direct activities in Shortnose Sturgeon habitat.

Once in construction, should actual field conditions differ from what is expected based on test pit data and monitoring well data and it is determined that some work is required riverward of mean high water the following measures will be implemented to avoid effects to Shortnose Sturgeon and their habitat:

- No work will occur during the TOY established by NOAA, DMF and the NHESP, expected to be March 15th to June 15th;
- Work will occur in the dry to the greatest extent possible;
- A sediment barrier to also serve as a fish exclusion barrier will be installed at the mean low water line; and
- Any tree felling will be done so that trees fall toward land and not into the water.

No in-water long term mitigation measures are needed because no structures are proposed below MHW. However, the lower slope of the capped landfill will be a stabilized rip rap slope from elevation 6- to 8-feet NAVD88 up to the 10-year flood elevation at el. 14-feet NAVD88. This is needed to ensure the slope remains stable and does not become damaged and release capped waste to the environment. Although not confining regular river flows the following measures are proposed for the rip rap slope to mitigate effects that can occur from smooth rock slopes on a riverbank:

- The rip rap and slope will follow bank meanders along the slope to avoid a "straight line" riverbank;
- When placing the rock, it will be placed to create variability in the slope along the riverbank;

- Range of stone sizes will be used (e.g., from a small diameter to 8-inches to an upper range of 30-inches) and placed, or dumped, randomly to ensure there is a roughened rock face with voids of various sizes on the rock slope.

8.5 Conclusion

Work in and proximate to NHESP mapped habitat is required to construct the mandated final cap over the Northern Mound and the Lot 26 Ash Area pursuant to MassDEP and EPA requirements under provisions of the ACO as well as the MassDEP's Regulations and CERCLA, respectively. The Northern Mound and Lot 26 Ash Area closure project will be designed to avoid wildlife impacts by following measures to be established in consultation with the NHESP, and work in habitat is avoided to the extent practicable. To mitigate for unavoidable work in mapped habitats, primary mitigation measures included in the Northern Mound project are:

- Re-establishing approximately 2.9 acres of woodland for Bald Eagle roosting in the riparian zone;
- Installing and maintaining one bald eagle nesting mast, location to be determined in consultation with NHESP; and
- Establishing approximately 10,000 ft^2 of Wood Turtle nesting habitat along the edge of the Lot 26 Ash Area.

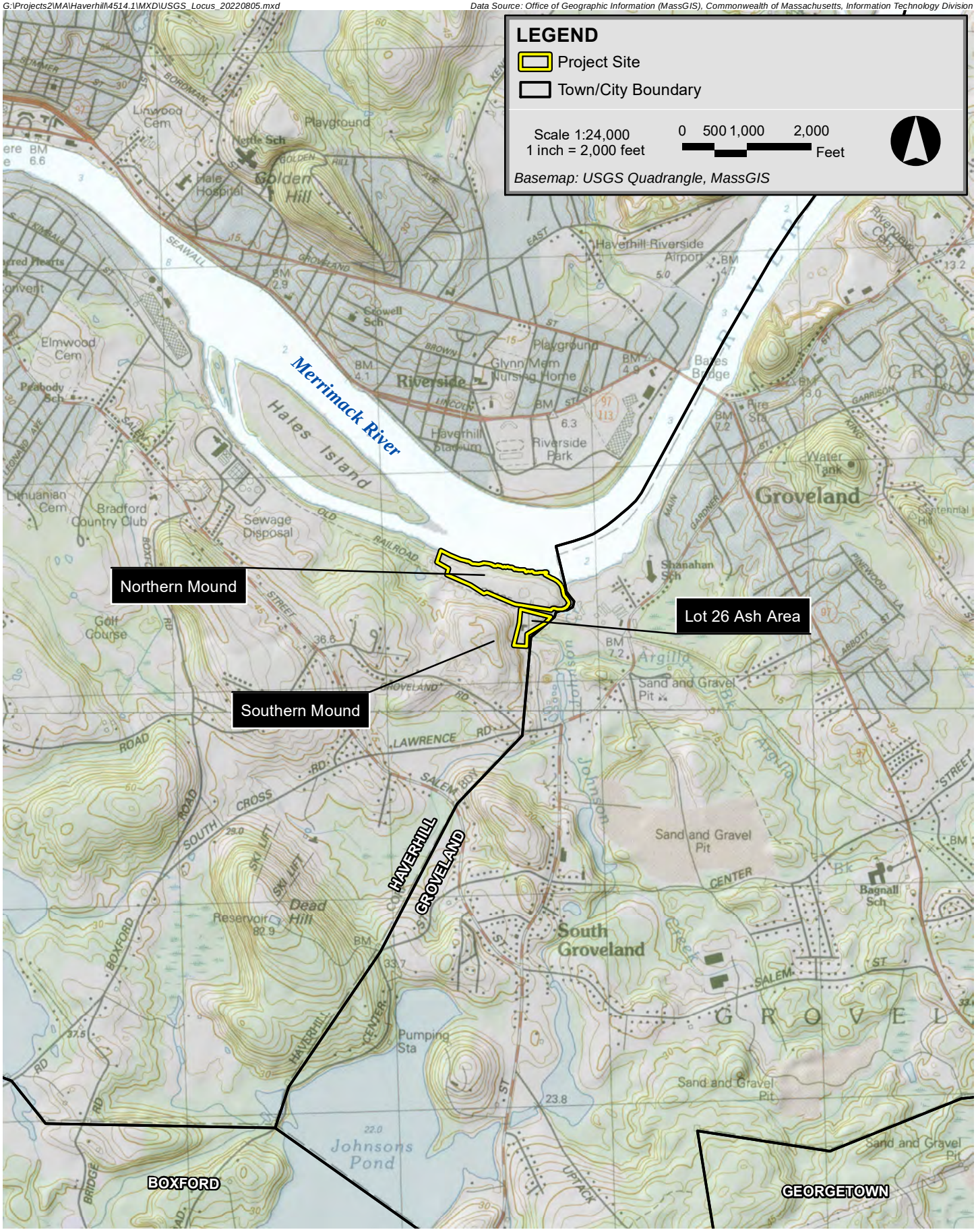
As the Northern Mound and Lot 26 Ash Area closure projects advance to final design, the Applicant will coordinate with the NHESP to advance the mitigation plans from the current preliminary phase to final design.

9.0 Conclusion

The information contained in this NOI, attachments, and depicted on the accompanying Project Plans describes the site, proposed work, mitigation measures and compliance with performance standards. The purpose of this project is to cap the Northern Mound and Lot 26 Ash Area to bring it into compliance with the Solid Waste Regulations and to protect human health and the environment. The BMPs described herein are proposed to protect the proximate resource areas associated with the Merrimack River and Johnson Creek during construction, and the capped Landfill will provide long-term protection by minimizing leachate production and the potential for transport of leachate down gradient to receiving waters, and to the ground water. Whereas this Project will remedy an environmental liability and includes BMPs to protect the environment during construction, the applicant respectfully requests that the Haverhill Conservation Commission issue an Order of Conditions approving the Project with pragmatic conditions to protect the relevant interests identified in Act [M.G.L. c. 131 §40] and the Haverhill Bylaw.

Attachment B

Project Figures

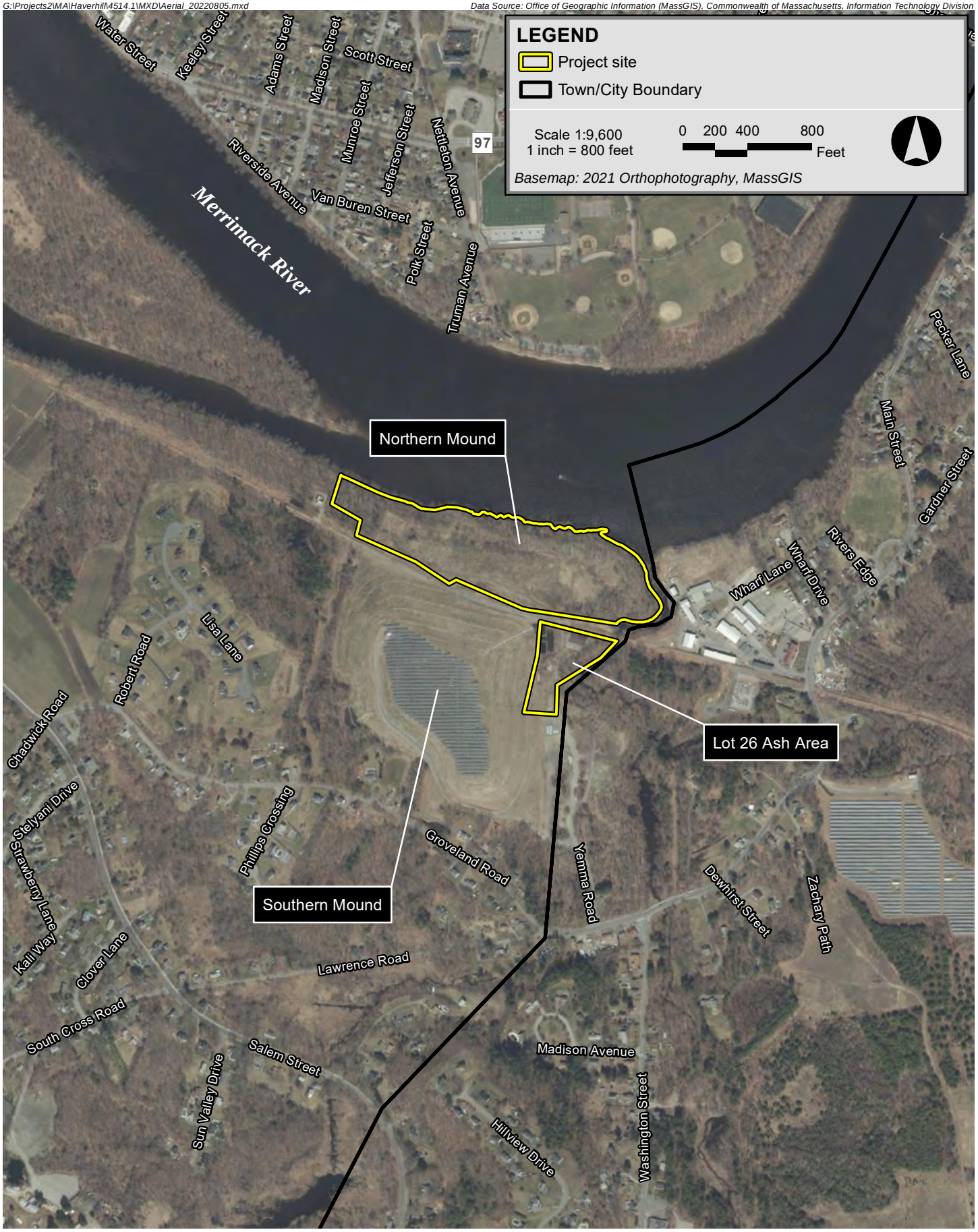


Haverhill Municipal Landfill Notice of Intent Haverhill, Massachusetts

Epsilon Associates Inc.

Figure 1

USGS Locus Map

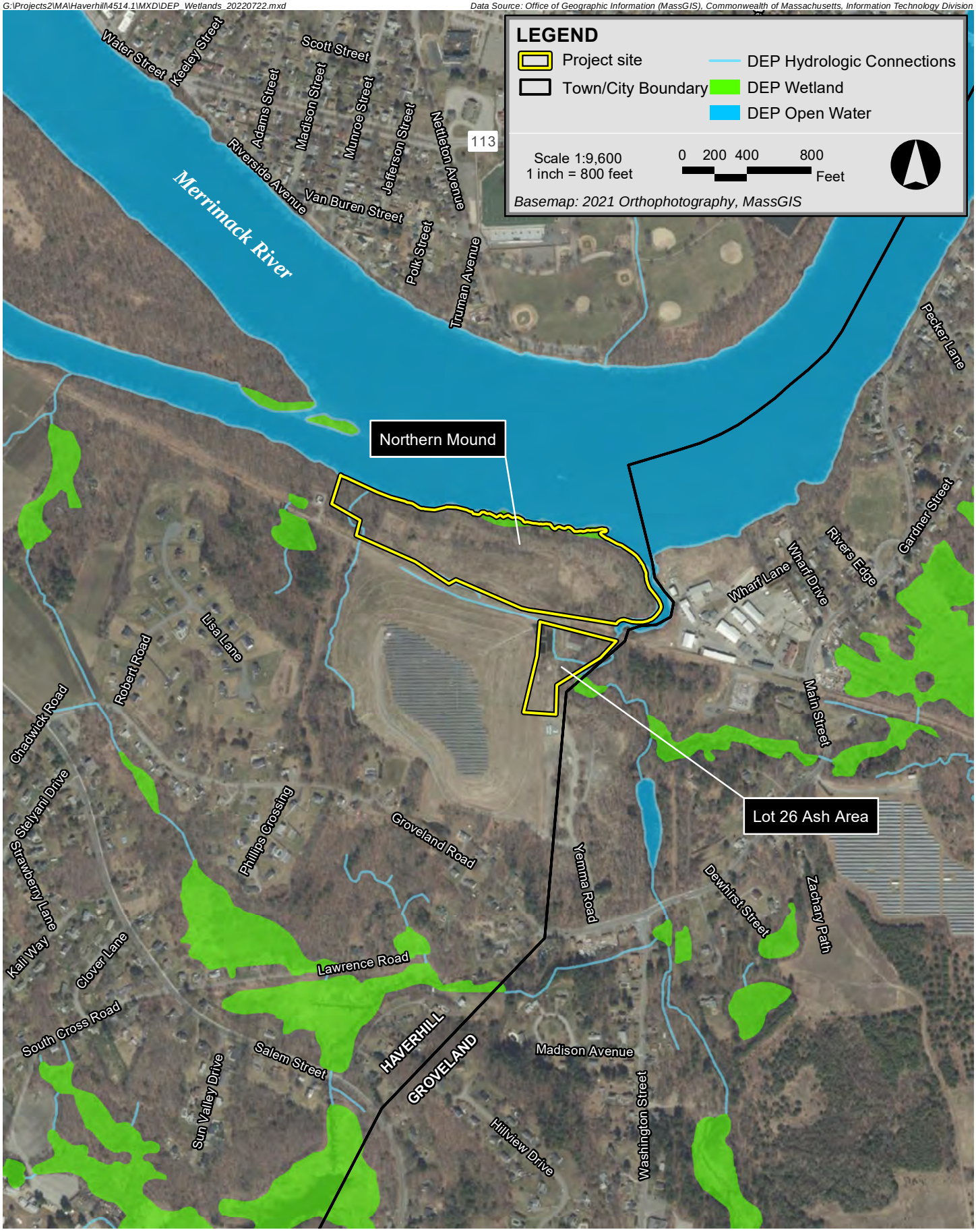


Haverhill Municipal Landfill Notice of Intent Haverhill, Massachusetts

Epsilon Associates Inc.

Figure 2

Aerial Locus Map



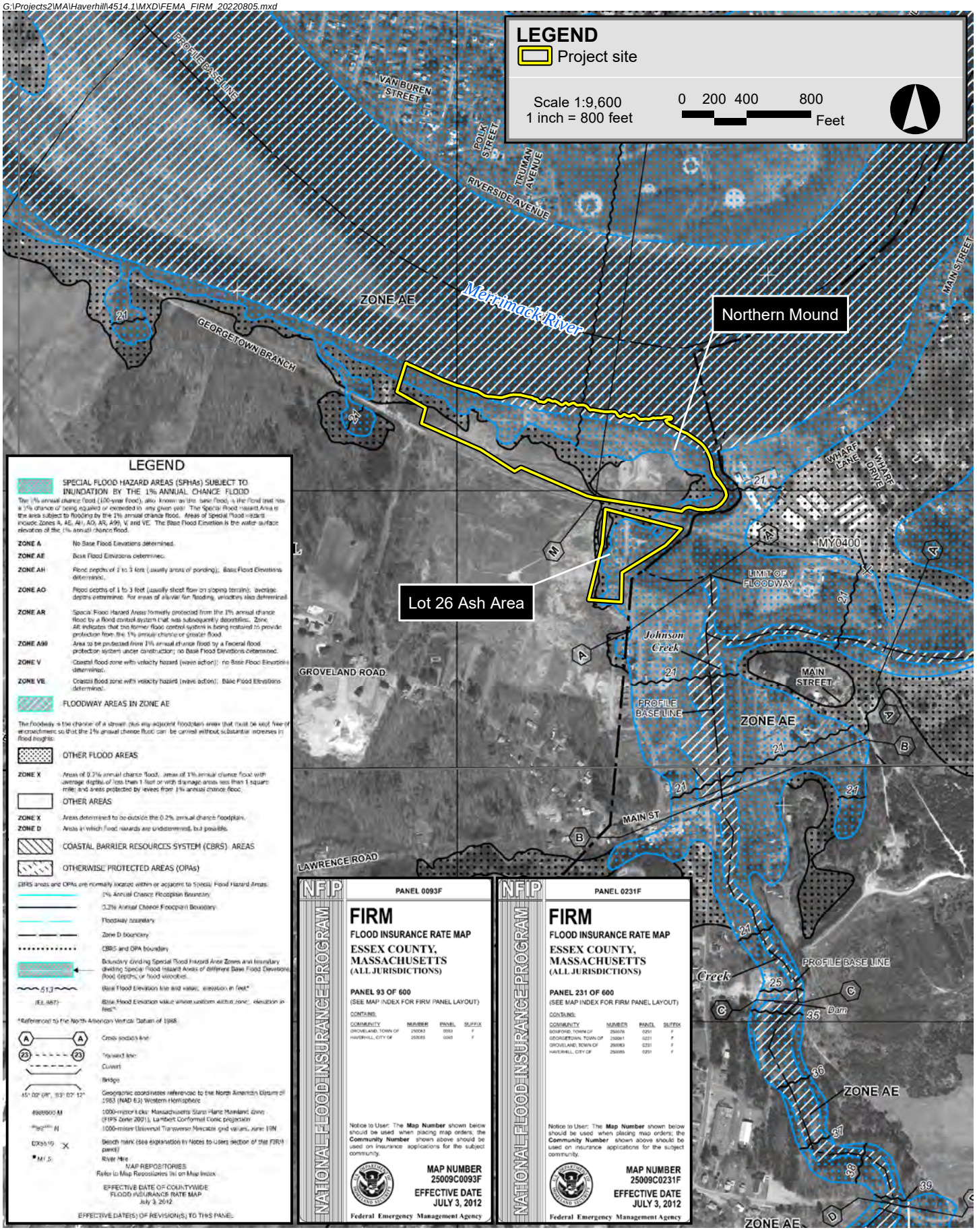
Haverhill Municipal Landfill Notice of Intent Haverhill, Massachusetts

Epsilon Associates Inc.

Figure 3

MassDEP Wetlands

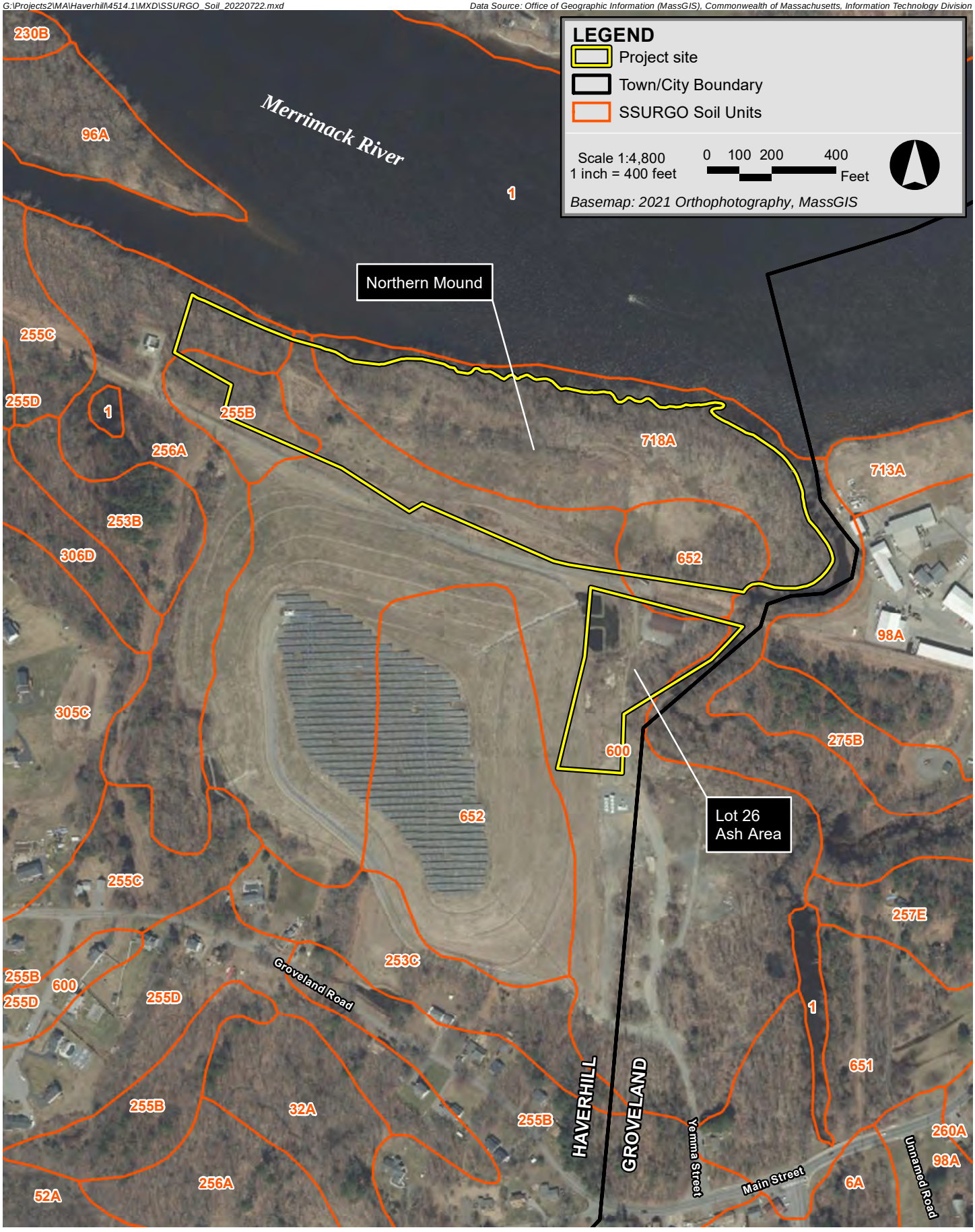
G:\Projects2\MA\Haverhill\4514.1\MXD\FEMA_FIRM_20220805.mxd



Haverhill Municipal Landfill Notice of Intent Haverhill, Massachusetts

Epsilon Associates Inc.

Figure 4
FEMA FIRM



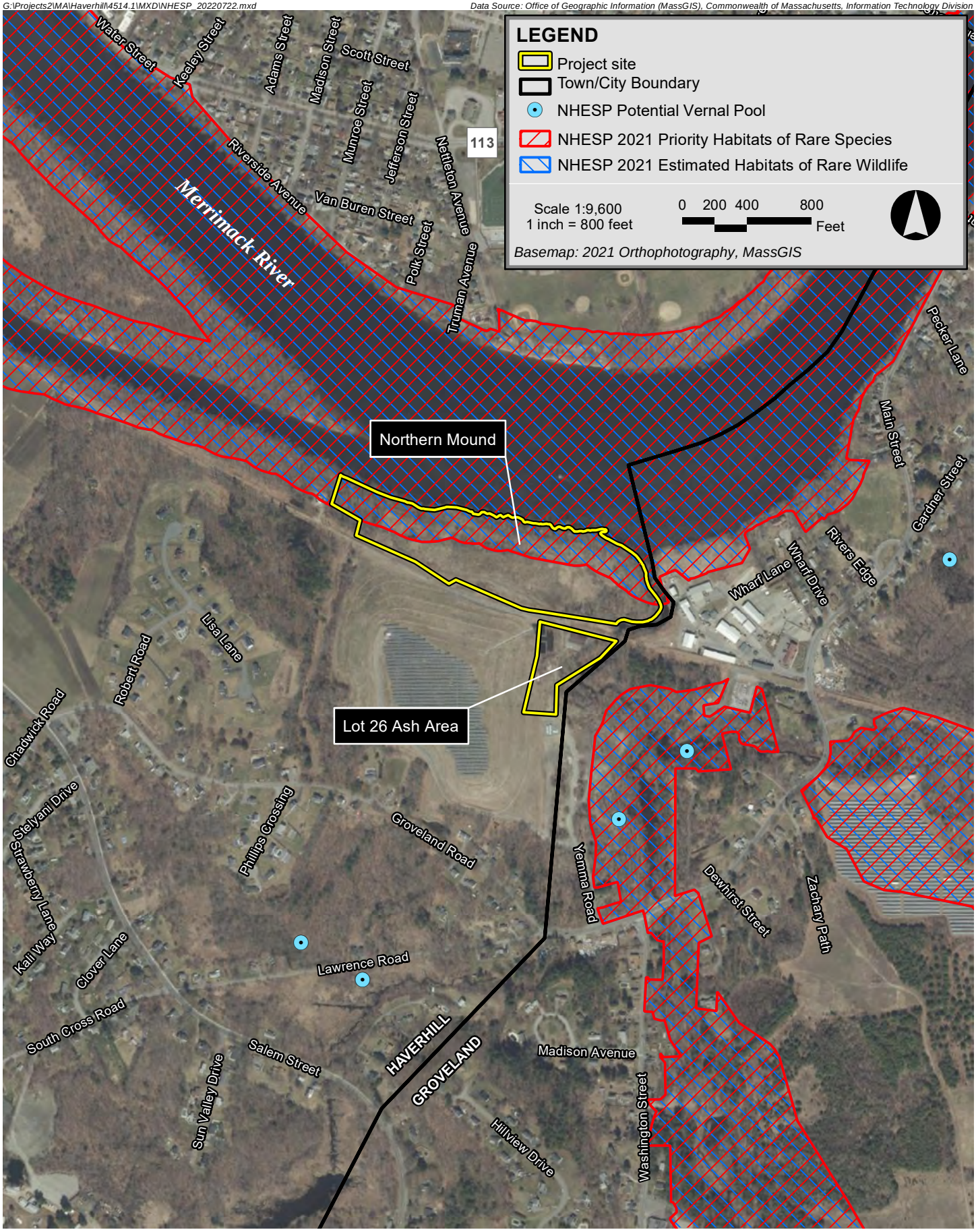
Haverhill Municipal Landfill Notice of Intent Haverhill, Massachusetts

Epsilon Associates Inc.

Figure 5

SSURGO Soils

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Haverhill Municipal Landfill Notice of Intent Haverhill, Massachusetts

Epsilon Associates Inc.

Figure 6

NHESP Habitat

Attachment C

Site Photographs

The Bank of a former wash water pond, located at the southern end of Bank Series A, which continues to Johnson Creek.

Looking south along the bank of Johnson Creek.

Looking north along Johnson Creek near BVW Series B.

A view of BVW Series B, located along the western bank of Johnson Creek.

Looking north from Johnson Creek at its confluence with the Merrimack River.

Looking south along the intermittent stream channel identified as Bank Series E.

The southern portion of Series E.

Looking west along the bank of the Merrimack River (Bank Series A).

Looking north towards the right-of-way at BVW Series F.

The culvert that BVW Series F connects to, located on the southern side of the National Grid ROW.

A view of IVW Series D.

BVW Series C, located south of the bank of the Merrimack River.

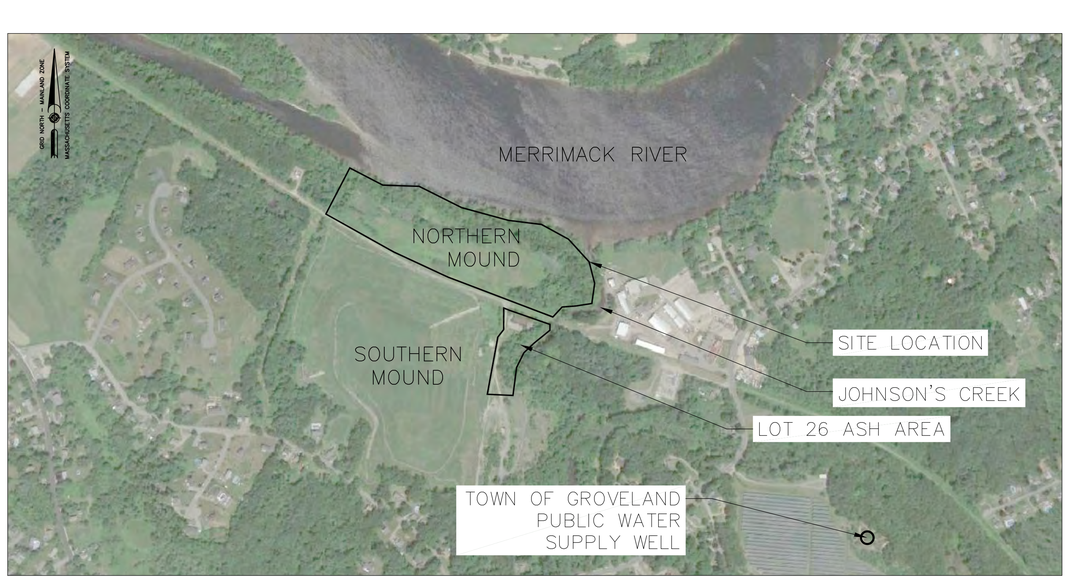
Attachment D

Project Plans

HAVERHILL LANDFILL

CORRECTIVE ACTION DESIGN-NORTHERN MOUND
CWSRF # 6970

OLD GROVELAND ROAD
HAVERHILL, MA



PREPARED FOR:

CITY OF HAVERHILL MASSACHUSETTS

MAYOR: JAMES J. FIORENTINI
INTERIM DIRECTOR OF PUBLIC WORKS: ROBERT E. WARD

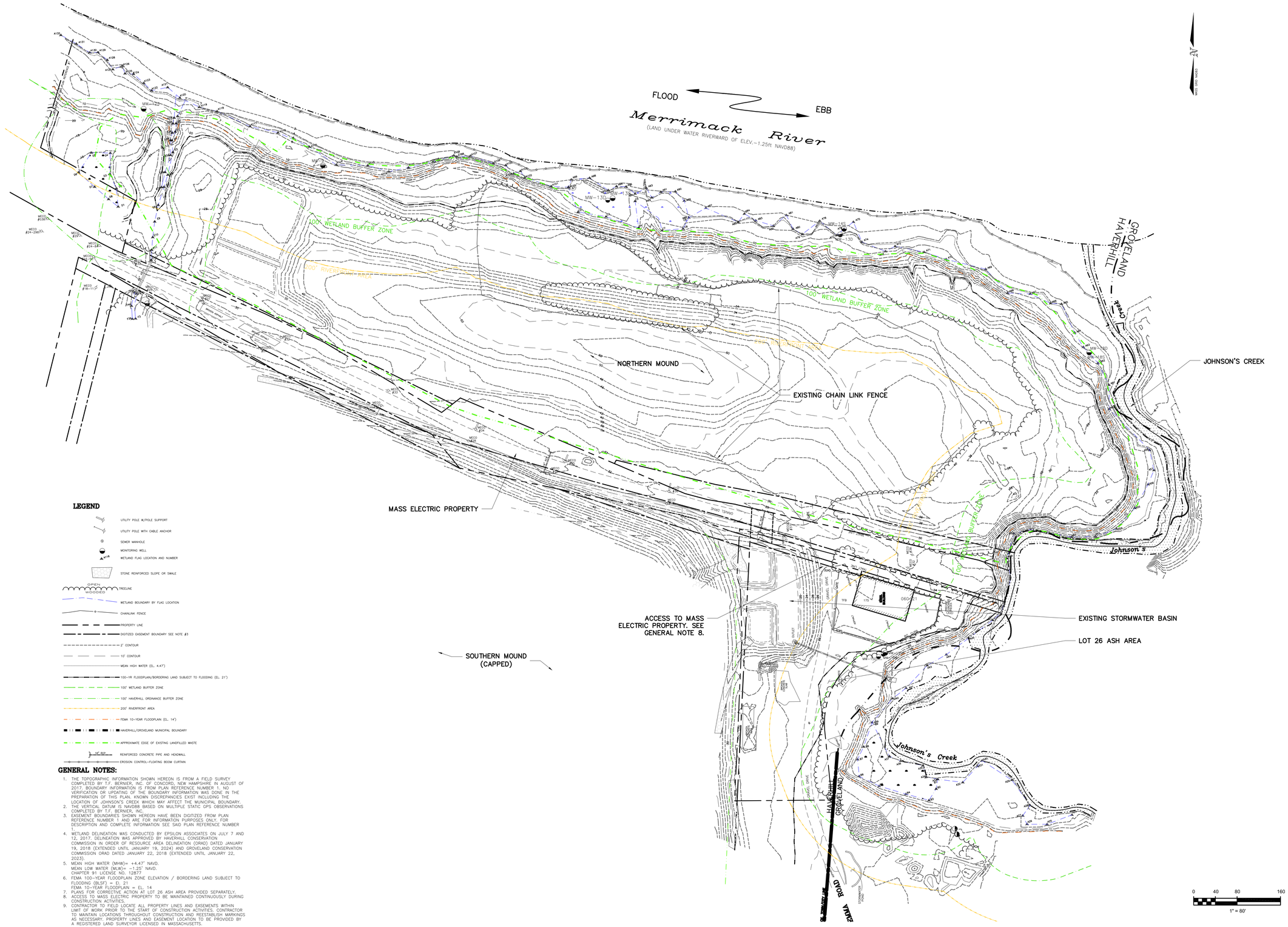
HOLCIM–NER, INC.
REGIONAL MANAGER, LAND AND ENVIRONMENT: JARRETT TEMPLE

LIST OF DRAWINGS

OCTOBER 2022

Langdon Environmental LLC

75 CONGRESS ST. SUITE 214, PO BOX 511
PORTSMOUTH, NH 03802
(617) 875–3693



LEGEND

- UTILITY POLE W/POLE SUPPORT
- UTILITY POLE WITH CABLE ANCHOR
- SEWER MANHOLE
- MONITORING WELL
- WETLAND FLAG LOCATION AND NUMBER
- STONE REINFORCED SLOPE OR SWALE
- TREELINE
- WETLAND BOUNDARY BY FLAG LOCATION
- CHAINLINK FENCE
- PROPERTY LINE
- DIGITIZED EASEMENT BOUNDARY SEE NOTE #3
- 2' CONTOUR
- 10' CONTOUR
- MEAN HIGH WATER (EL. 4.47')
- 100-YR FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING (EL. 21')
- 100' WETLAND BUFFER ZONE
- 100' HAVERHILL ORDINANCE BUFFER ZONE
- 200' RIVERFRONT AREA
- FEMA 10-YEAR FLOODPLAIN (EL. 14')
- HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
- APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE
- REINFORCED CONCRETE PIPE AND HEADWALL
- EROSION CONTROL-FLOATING BOOM CURTAIN

GENERAL NOTES:

1. THE TOPOGRAPHIC INFORMATION SHOWN HEREON IS FROM A FIELD SURVEY COMPLETED BY T.F. BERNIER, INC. OF CONCORD, NEW HAMPSHIRE IN AUGUST OF 2017. BOUNDARY INFORMATION IS FROM PLAN REFERENCE NUMBER 1. NO VERIFICATION OR UPDATING OF THE BOUNDARY INFORMATION WAS DONE IN THE PREPARATION OF THIS PLAN. KNOWN DISCREPANCIES EXIST INCLUDING THE LOCATION OF JOHNSON'S CREEK WHICH MAY AFFECT THE MUNICIPAL BOUNDARY.
2. THE VERTICAL DATUM IS NAVD88 BASED ON MULTIPLE STATIC GPS OBSERVATIONS COMPLETED BY T.F. BERNIER, INC.
3. EASEMENT BOUNDARIES SHOWN HEREON HAVE BEEN DIGITIZED FROM PLAN REFERENCE NUMBER 1 AND ARE FOR INFORMATION PURPOSES ONLY. FOR DESCRIPTION AND COMPLETE INFORMATION SEE SAID PLAN REFERENCE NUMBER 1.
4. WETLAND DELINEATION WAS CONDUCTED BY EPSILON ASSOCIATES ON JULY 7 AND 12, 2017. DELINEATION WAS APPROVED BY HAVERHILL CONSERVATION COMMISSION IN ORDER OF RESOURCE AREA DELINEATION (ORAD) DATED JANUARY 19, 2018 (EXTENDED UNTIL JANUARY 19, 2024) AND GROVELAND CONSERVATION COMMISSION ORAD DATED JANUARY 22, 2018 (EXTENDED UNTIL JANUARY 22, 2023).
5. MEAN HIGH WATER (MHW)= +4.47' NAVD.
   MEAN LOW WATER (MLW)= -1.25' NAVD.
   CHAPTER 91 LICENSE NO. 12877
6. FEMA 100-YEAR FLOODPLAIN ZONE ELEVATION / BORDERING LAND SUBJECT TO FLOODING (BLSF) = EL. 21
   FEMA 10-YEAR FLOODPLAIN = EL. 14
7. PLANS FOR CORRECTIVE ACTION AT LOT 26 ASH AREA PROVIDED SEPARATELY.
8. ACCESS TO MASS ELECTRIC PROPERTY TO BE MAINTAINED CONTINUOUSLY DURING CONSTRUCTION ACTIVITIES.
9. CONTRACTOR TO FIELD LOCATE ALL PROPERTY LINES AND EASEMENTS WITHIN LIMIT OF WORK PRIOR TO THE START OF CONSTRUCTION ACTIVITIES. CONTRACTOR TO MAINTAIN LOCATIONS THROUGHOUT CONSTRUCTION AND REESTABLISH MARKINGS AS NECESSARY. PROPERTY LINES AND EASEMENT LOCATION TO BE PROVIDED BY A REGISTERED LAND SURVEYOR LICENSED IN MASSACHUSETTS.

PLAN REFERENCES

1. PLAN OF LAND LOCATED IN HAVERHILL AND GROVELAND MASSACHUSETTS PREPARED FOR CDM, CITY OF HAVERHILL AND AGGREGATE INDUSTRIES SCALE: 1"=120' [DATED] FEBRUARY 3, 2006 PREPARED BY SCOTT L. GILES P.L.S. #13972.

REVISIONS

Bruce W. Haley, P.E. 6.14.22

Langdon Environmental LLC
75 CONGRESS STREET SUITE 214, PO BOX 511
PORTSMOUTH, NH 03802
(617) 875-3693

Proj. Mgr: BWH
Designed : JEC
Drawn : JEC
Checked : BWH
Scale : AS NOTED
Date : OCT. 2022

EXISTING CONDITIONS PLAN

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

C-1

5 D-3 INSTALL AND MAINTAIN FLOATING BOOM CURTAIN OR PORTADAM AT ELEVATION OF MEAN LOW WATER (MLW)

FLOOD

EBB

Merrimack River

(LAND UNDER WATER RIVERWARD OF ELEV.-1.25ft NAVD88)

REMOVE AND ABANDON EXISTING GROUNDWATER MONITORING WELLS (TYP.)

100' WETLAND BUFFER ZONE

200' RIVERFRONT AREA

GROVELAND

HAVERHILL

Creek

JOHNSON'S CREEK

NORTHERN MOUND

REMOVE EXISTING CHAIN LINK FENCE

CLEAR AND GRUB EXISTING TREES AND VEGETATION WITHIN LIMITS REQUIRED TO INSTALL FINAL CAP (SEE NOTES).

MASS ELECTRIC PROPERTY

ACCESS TO MASS ELECTRIC PROPERTY. SEE GENERAL NOTE 8.

SOUTHERN MOUND (CAPPED)

EXISTING STORMWATER BASIN

LOT 26 ASH AREA

Johnson's Creek

Johnson's

100' WETLAND BUFFER ZONE

100' HAVERHILL ORDINANCE BUFFER ZONE

HAVERHILL

GROVELAND

MUNICIPAL BOUNDARY

BAILEY ROAD

STORMWATER POND

N

0 40 80 160

1" = 80'

LEGEND

- UTILITY POLE W/POLE SUPPORT
- UTILITY POLE WITH CABLE ANCHOR
- SEWER MANHOLE
- MONITORING WELL
- WETLAND FLAG LOCATION AND NUMBER
- STONE REINFORCED SLOPE OR SWALE
- TREELINE (OPEN / WOODED)
- WETLAND BOUNDARY BY FLAG LOCATION
- CHAINLINK FENCE
- PROPERTY LINE
- DIGITIZED EASEMENT BOUNDARY SEE NOTE #3
- 2' CONTOUR
- 10' CONTOUR
- MEAN HIGH WATER (EL. 4.47')
- 100-YR FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING (EL. 21')
- 100' WETLAND BUFFER ZONE
- 100' HAVERHILL ORDINANCE BUFFER ZONE
- 200' RIVERFRONT AREA
- FEMA 10-YEAR FLOODPLAIN (EL. 14')
- HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
- APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE
- REINFORCED CONCRETE PIPE AND HEADWALL
- EROSION CONTROL-FLOATING BOOM CURTAIN

REVISIONS

Langdon Environmental LLC

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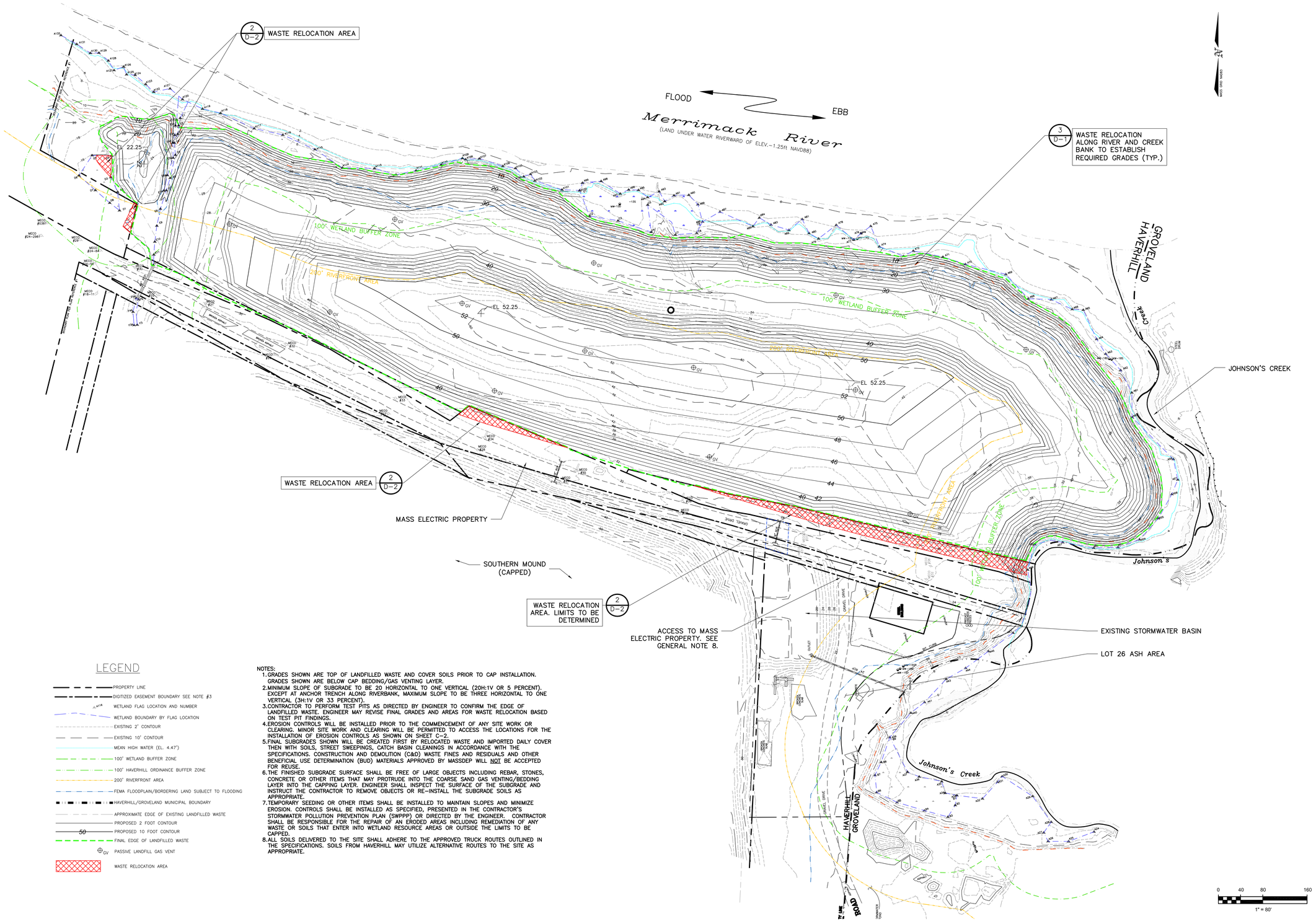
SITE PREPARATION AND EROSION CONTROLS PLAN

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

C-2



LEGEND

- PROPERTY LINE
- DIGITIZED EASEMENT BOUNDARY SEE NOTE #3
- WETLAND FLAG LOCATION AND NUMBER
- WETLAND BOUNDARY BY FLAG LOCATION
- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- MEAN HIGH WATER (EL. 4.47')
- 100' WETLAND BUFFER ZONE
- 100' HAVERHILL ORDINANCE BUFFER ZONE
- 200' RIVERFRONT AREA
- FEMA FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING
- HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
- APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE
- PROPOSED 2 FOOT CONTOUR
- PROPOSED 10 FOOT CONTOUR
- FINAL EDGE OF LANDFILLED WASTE
- PASSIVE LANDFILL GAS VENT
- WASTE RELOCATION AREA

NOTES:
1. GRADES SHOWN ARE TOP OF LANDFILLED WASTE AND COVER SOILS PRIOR TO CAP INSTALLATION. GRADES SHOWN ARE BELOW CAP BEDDING/GAS VENTING LAYER.
2. MINIMUM SLOPE OF SUBGRADE TO BE 20 HORIZONTAL TO ONE VERTICAL (20H:1V OR 5 PERCENT), EXCEPT AT ANCHOR TRENCH ALONG RIVERBANK, MAXIMUM SLOPE TO BE THREE HORIZONTAL TO ONE VERTICAL (3H:1V OR 33 PERCENT).
3. CONTRACTOR TO PERFORM TEST PITS AS DIRECTED BY ENGINEER TO CONFIRM THE EDGE OF LANDFILLED WASTE. ENGINEER MAY REVISE FINAL GRADES AND AREAS FOR WASTE RELOCATION BASED ON TEST PIT FINDINGS.
4. EROSION CONTROLS WILL BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY SITE WORK OR CLEARING. MINOR SITE WORK AND CLEARING WILL BE PERMITTED TO ACCESS THE LOCATIONS FOR THE INSTALLATION OF EROSION CONTROLS AS SHOWN ON SHEET C-2.
5. FINAL SUBGRADES SHOWN WILL BE CREATED FIRST BY RELOCATED WASTE AND IMPORTED DAILY COVER THEN WITH SOILS, STREET SWEEPINGS, CATCH BASIN CLEANINGS IN ACCORDANCE WITH THE SPECIFICATIONS. CONSTRUCTION AND DEMOLITION (C&D) WASTE FINES AND RESIDUALS AND OTHER BENEFICIAL USE DETERMINATION (BUD) MATERIALS APPROVED BY MASSDEP WILL NOT BE ACCEPTED FOR REUSE.
6. THE FINISHED SUBGRADE SURFACE SHALL BE FREE OF LARGE OBJECTS INCLUDING REBAR, STONES, CONCRETE OR OTHER ITEMS THAT MAY PROTRUDE INTO THE COARSE SAND GAS VENTING/BEDDING LAYER INTO THE CAPPING LAYER. ENGINEER SHALL INSPECT THE SURFACE OF THE SUBGRADE AND INSTRUCT THE CONTRACTOR TO REMOVE OBJECTS OR RE-INSTALL THE SUBGRADE SOILS AS APPROPRIATE.
7. TEMPORARY SEEDING OR OTHER ITEMS SHALL BE INSTALLED TO MAINTAIN SLOPES AND MINIMIZE EROSION. CONTROLS SHALL BE INSTALLED AS SPECIFIED, PRESENTED IN THE CONTRACTOR'S STORMWATER POLLUTION PREVENTION PLAN (SWPPP) OR DIRECTED BY THE ENGINEER. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REPAIR OF AN ERODED AREAS INCLUDING REMEDIATION OF ANY WASTE OR SOILS THAT ENTER INTO WETLAND RESOURCE AREAS OR OUTSIDE THE LIMITS TO BE CAPPED.
8. ALL SOILS DELIVERED TO THE SITE SHALL ADHERE TO THE APPROVED TRUCK ROUTES OUTLINED IN THE SPECIFICATIONS. SOILS FROM HAVERHILL MAY UTILIZE ALTERNATIVE ROUTES TO THE SITE AS APPROPRIATE.

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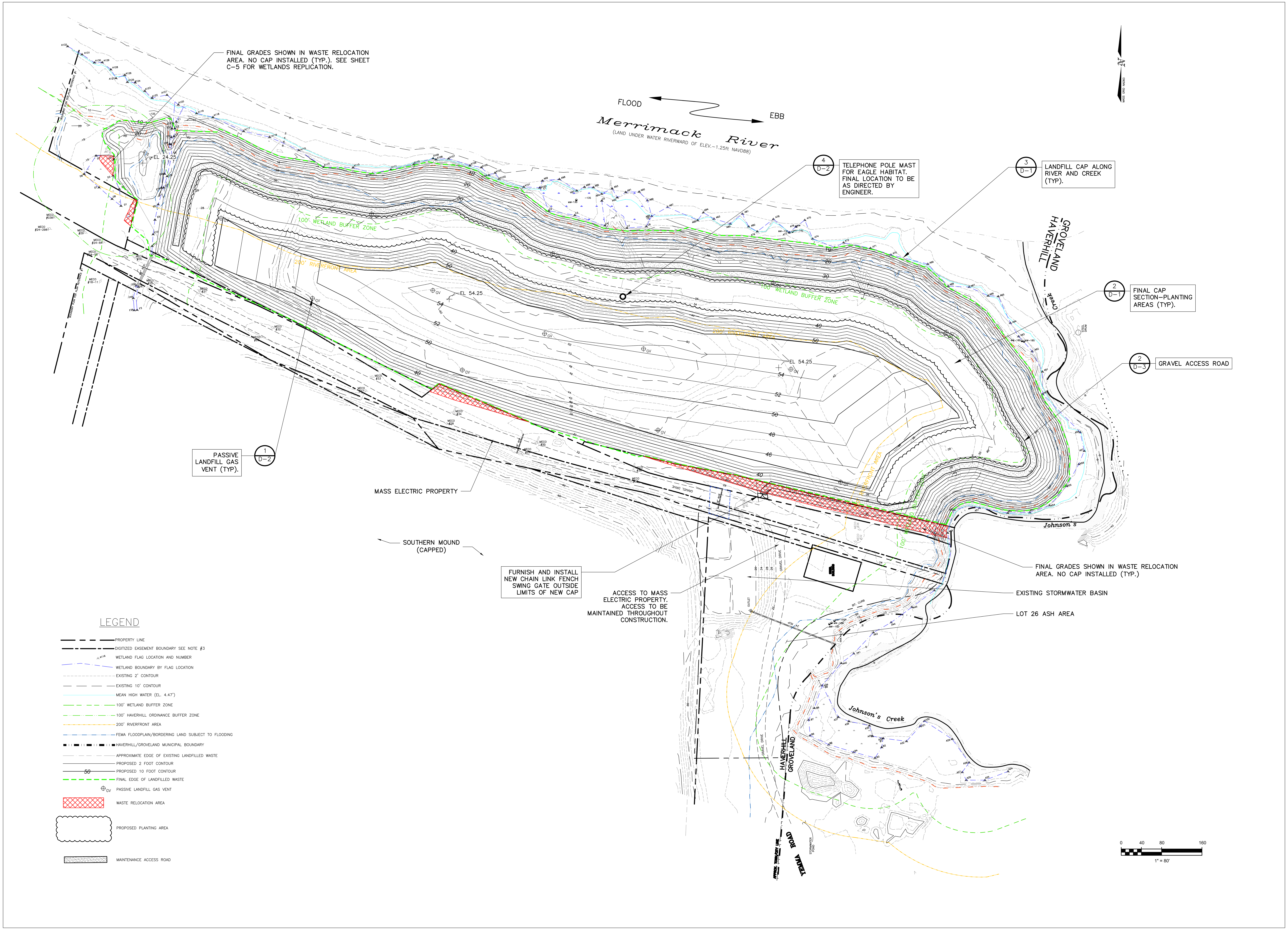
WASTE RELOCATION/CAP SUBGRADE PLAN

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

C-3



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FINAL CAPPING AND GRADING PLAN

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

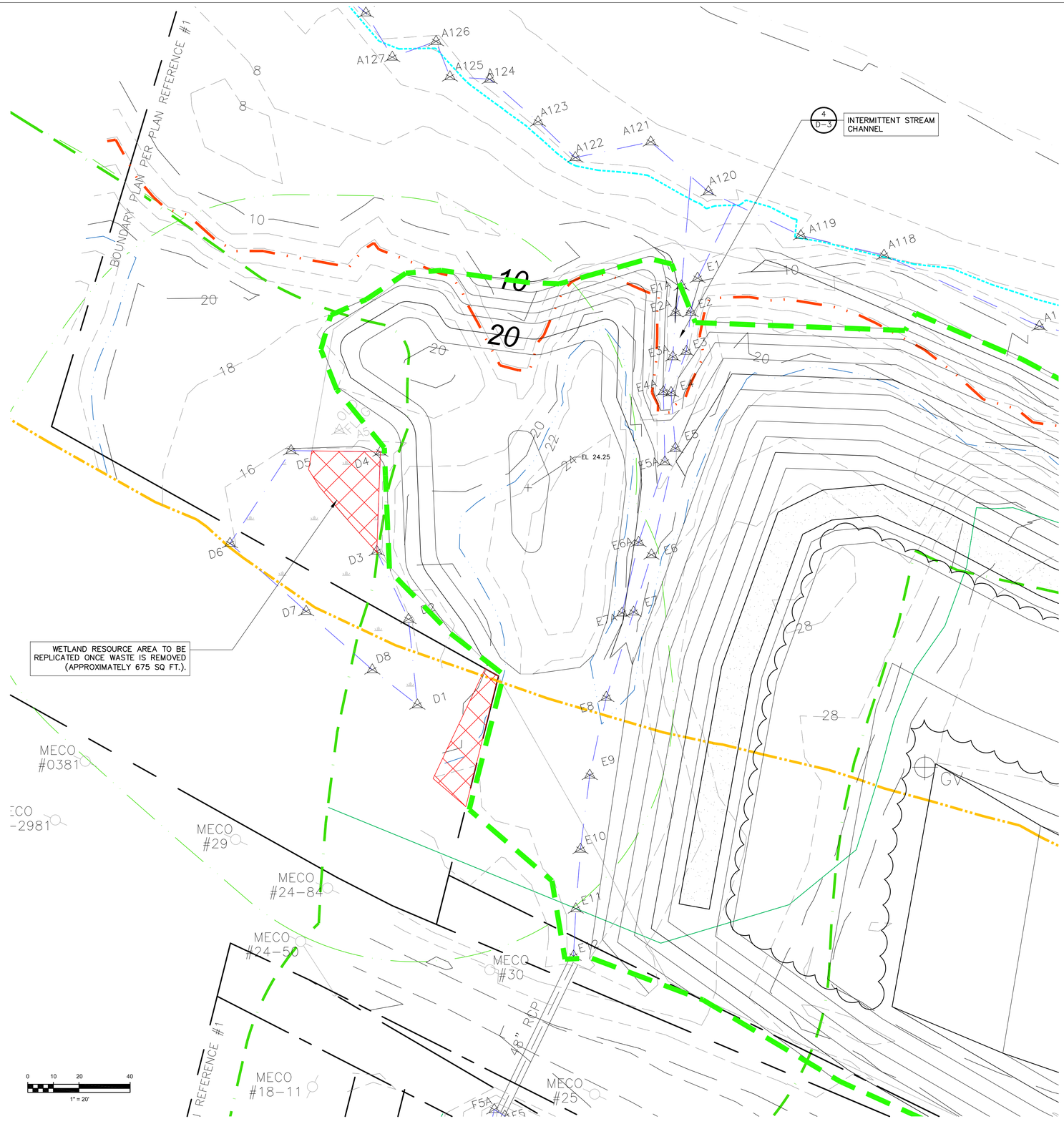
Proj. No.

Dwg. No.

C-4

LEGEND

- PROPERTY LINE
- DIGITIZED EASEMENT BOUNDARY SEE NOTE #3
- A116 WETLAND FLAG LOCATION AND NUMBER
- WETLAND BOUNDARY BY FLAG LOCATION
- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- MEAN HIGH WATER (EL. 4.47')
- 100' WETLAND BUFFER ZONE
- 100' HAVERHILL ORDINANCE BUFFER ZONE
- 200' RIVERFRONT AREA
- FEMA FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING
- APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE
- PROPOSED 2 FOOT CONTOUR
- 50 PROPOSED 10 FOOT CONTOUR
- FINAL EDGE OF LANDFILLED WASTE
- GV PASSIVE LANDFILL GAS VENT
- WASTE RELOCATION AREA



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WETLAND RESOURCE AREA RESTORATION PLAN

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

C-5

FLOOD

EBB

Merrimack River

(LAND UNDER WATER RIVERWARD OF ELEV.–1.25ft NAVD88)

EL 24.25

100' WETLAND BUFFER ZONE

200' RIVERFRONT AREA

EL 54.25

NORTHERN MOUND

GROVELAND

HAVERHILL

Creek

JOHNSON'S CREEK

MASS ELECTRIC PROPERTY

SOUTHERN MOUND
(CAPPED)

ACCESS TO MASS
ELECTRIC PROPERTY. SEE
GENERAL NOTE 8.

EXISTING STORMWATER BASIN

LOT 26 ASH AREA

Johnson's Creek

Johnson's

Top of Bank

HAVERHILL
GROVELAND

YANKEE ROAD

STORMWATER POND

LEGEND

- PROPERTY LINE
- DIGITIZED EASEMENT BOUNDARY SEE NOTE #3
- WETLAND FLAG LOCATION AND NUMBER
- WETLAND BOUNDARY BY FLAG LOCATION
- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- MEAN HIGH WATER (EL. 4.47')
- 100' WETLAND BUFFER ZONE
- 100' HAVERHILL ORDINANCE BUFFER ZONE
- 200' RIVERFRONT AREA
- FEMA FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING
- HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
- APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE
- PROPOSED 2 FOOT CONTOUR
- 50 PROPOSED 10 FOOT CONTOUR
- FINAL EDGE OF LANDFILLED WASTE
- GV PASSIVE LANDFILL GAS VENT
- PROPOSED PLANTING AREA
- MAINTENANCE ACCESS ROAD

0 40 80 160

1" = 80'

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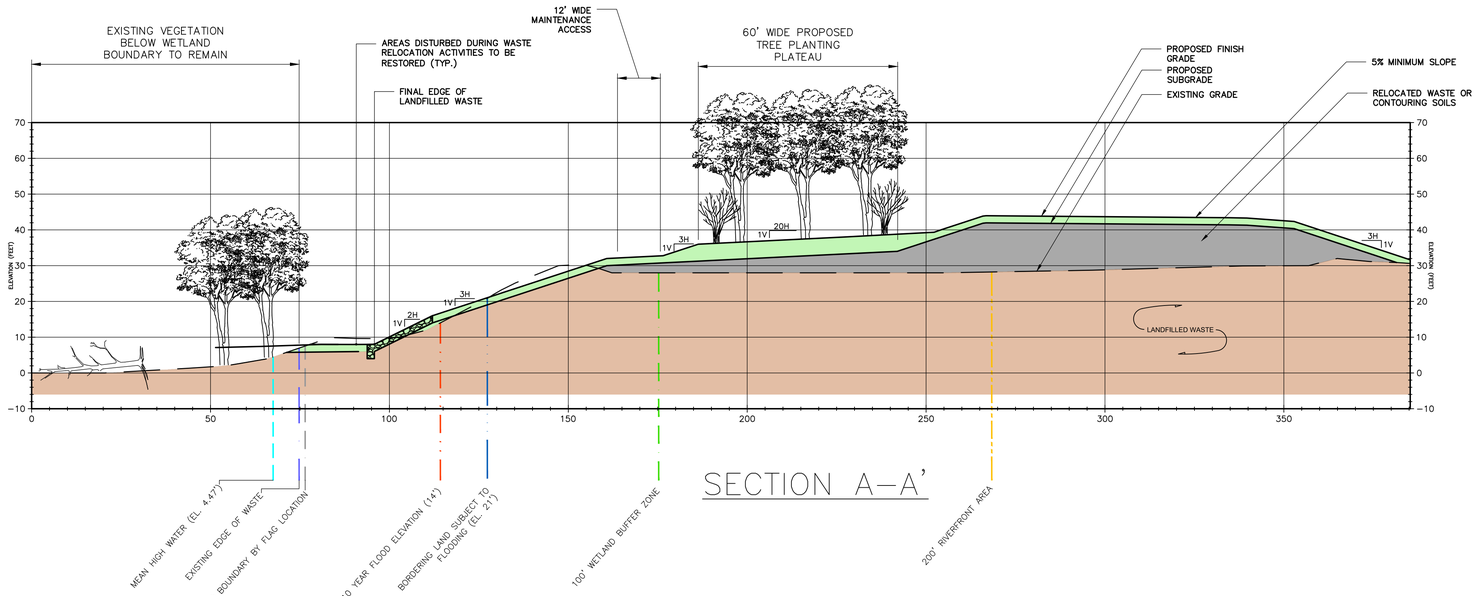
SECTION KEY PLAN

HAVERHILL LANDFILL–NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

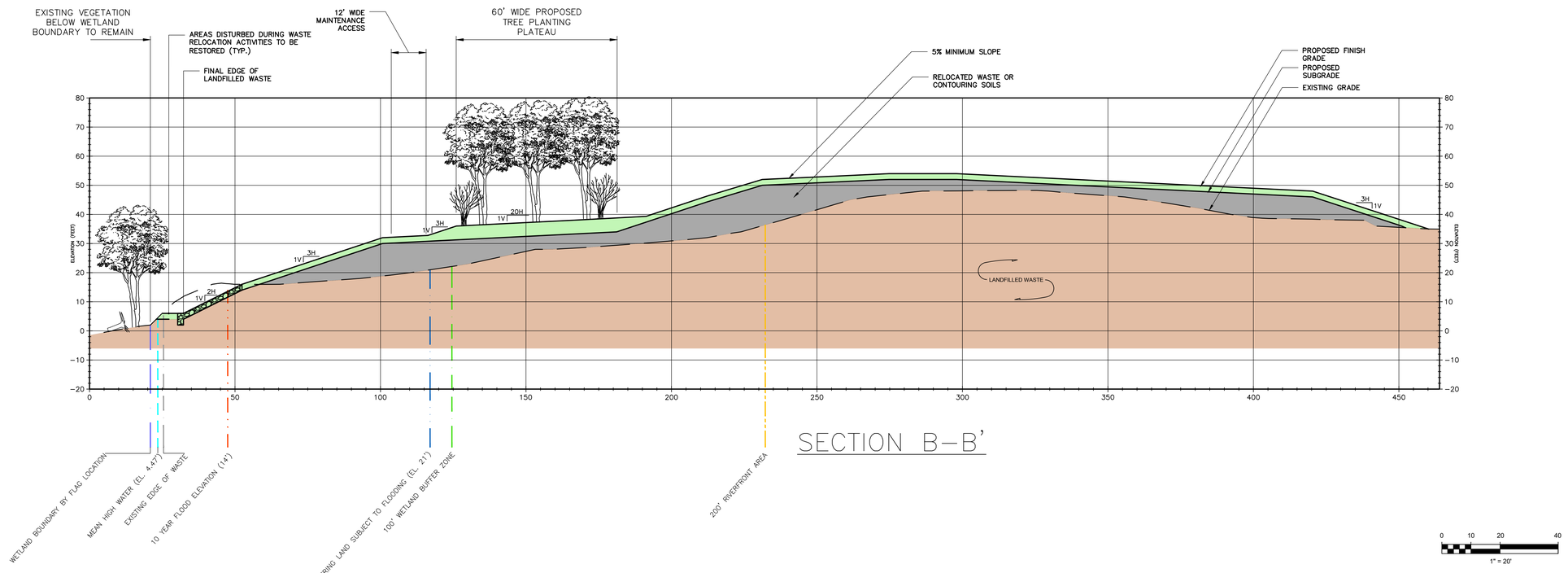
Proj. No.

Dwg. No.

C-6



SECTION A–A'



SECTION B–B'

0 10 20 40
1" = 20'

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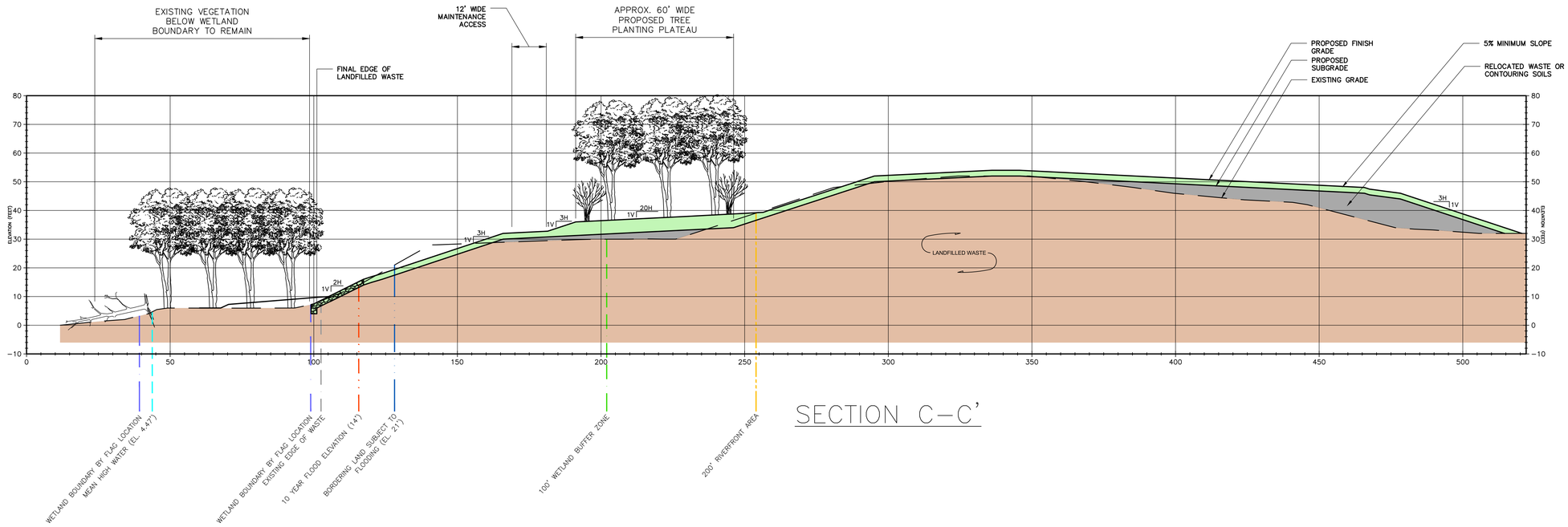
SECTIONS I

HAVERHILL LANDFILL–NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

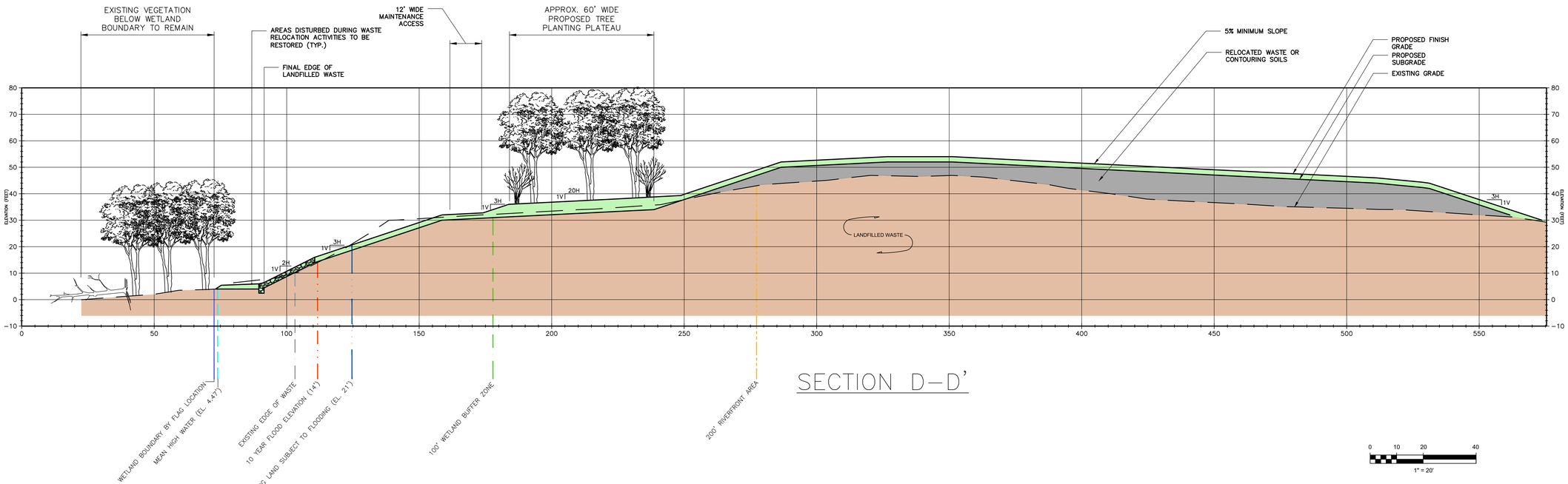
Proj. No.

Dwg. No.

C-7



SECTION C–C'



SECTION D–D'

0 10 20 40
1" = 20'

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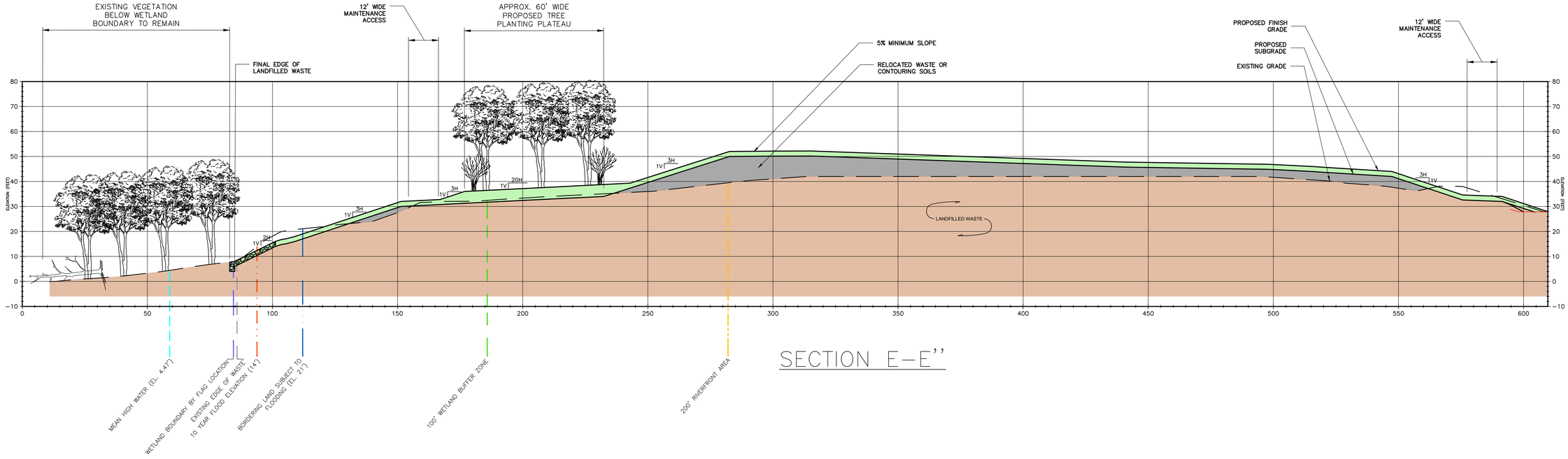
SECTIONS II

HAVERHILL LANDFILL–NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

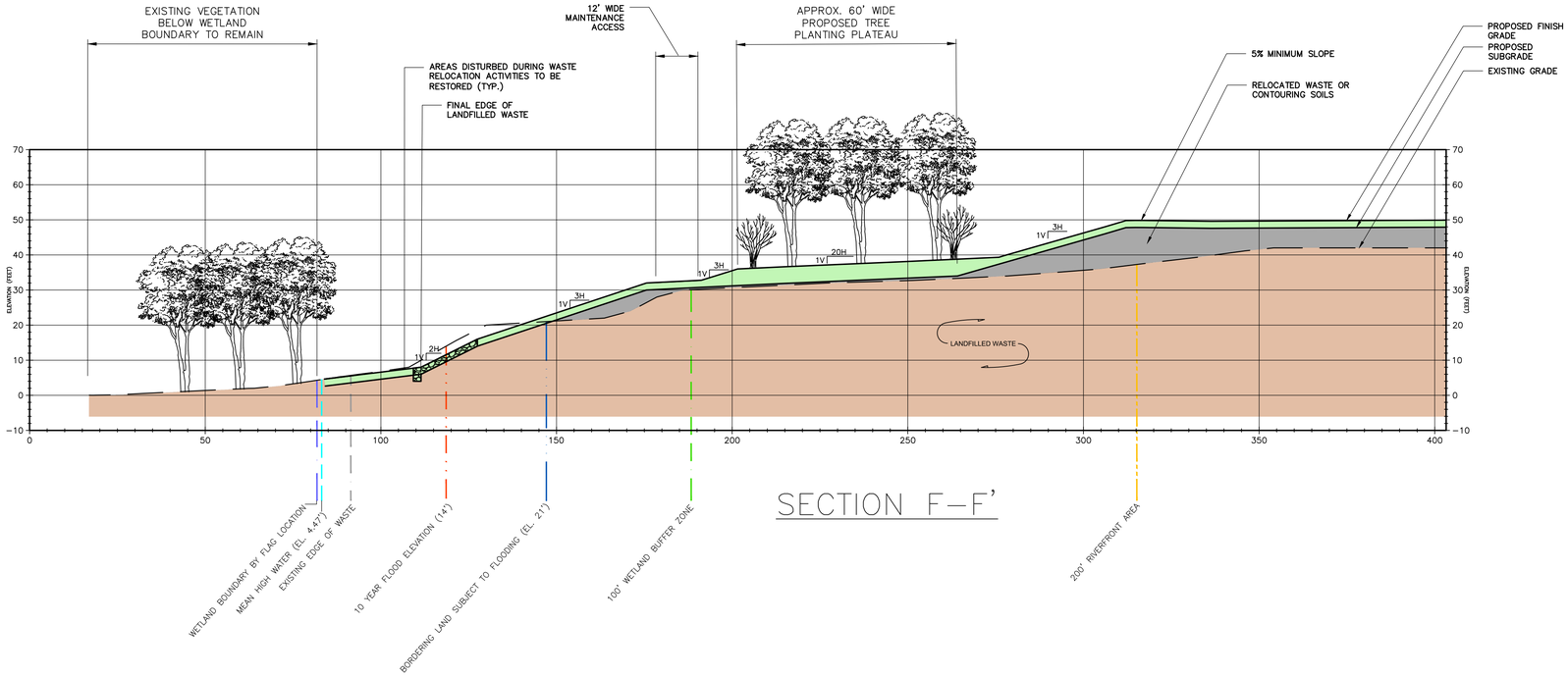
Proj. No.

Dwg. No.

C-8



SECTION E–E''



SECTION F–F'

0 10 20 40
1" = 20'

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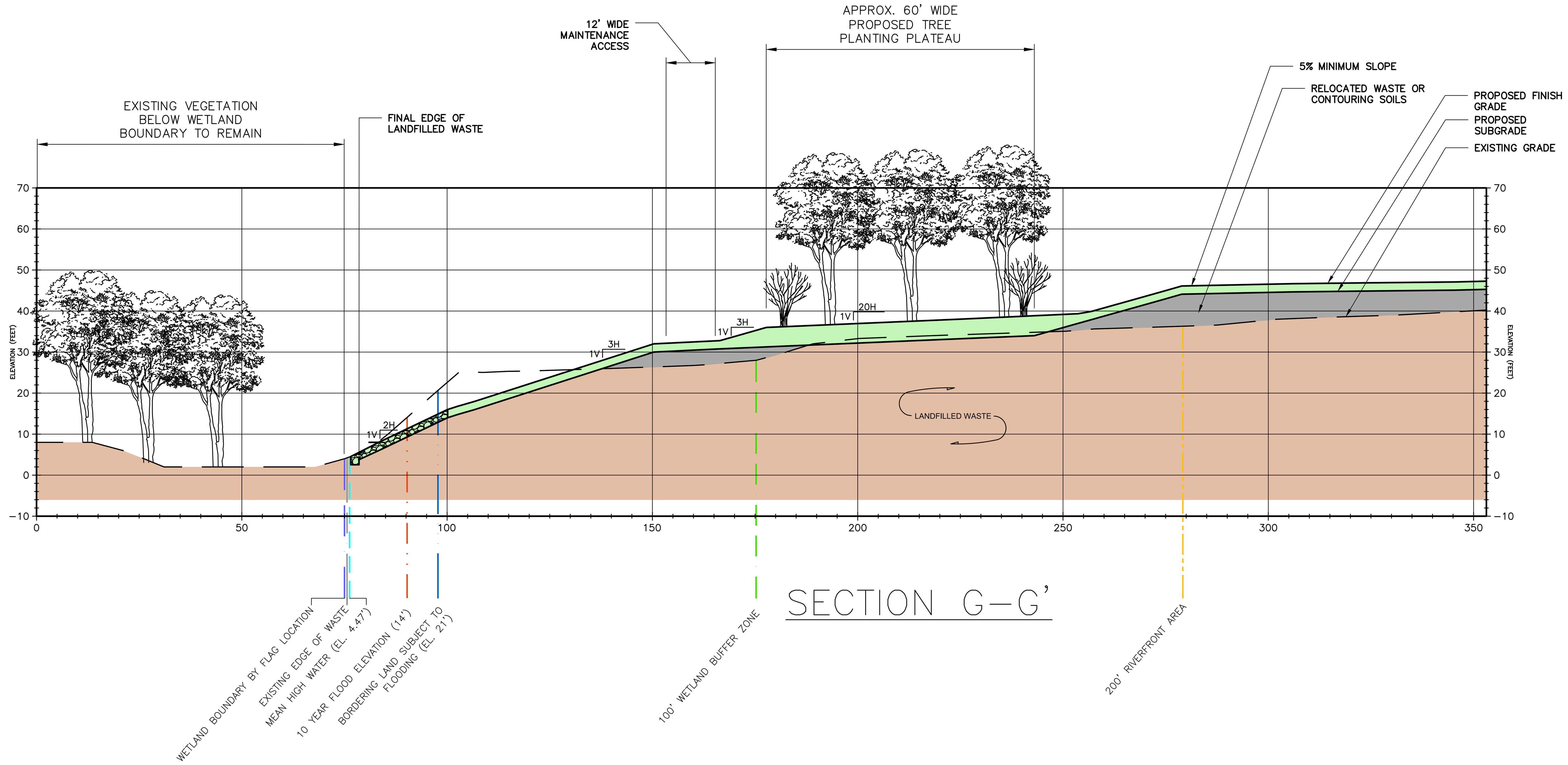
SECTIONS III

HAVERHILL LANDFILL–NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

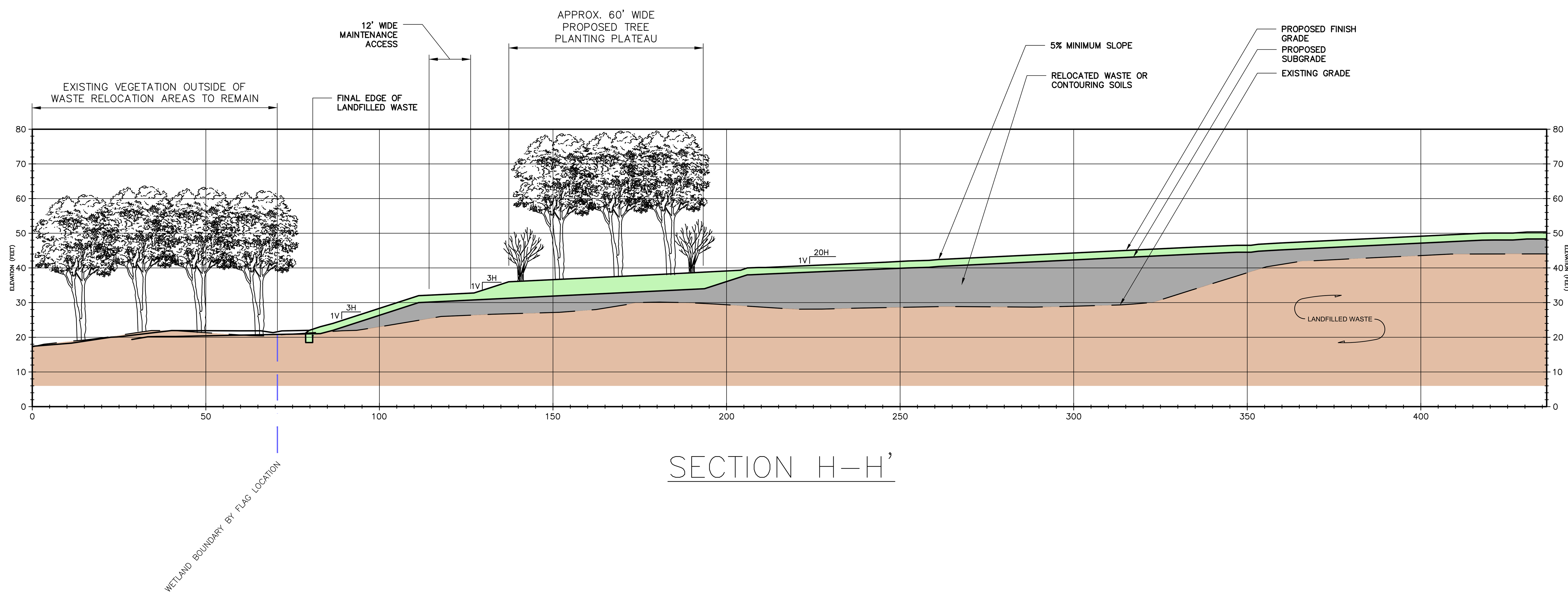
Proj. No.

Dwg. No.

C-9



SECTION G–G'



SECTION H–H'

0 10 20 40
1" = 20'

REVISIONS

10-14-22

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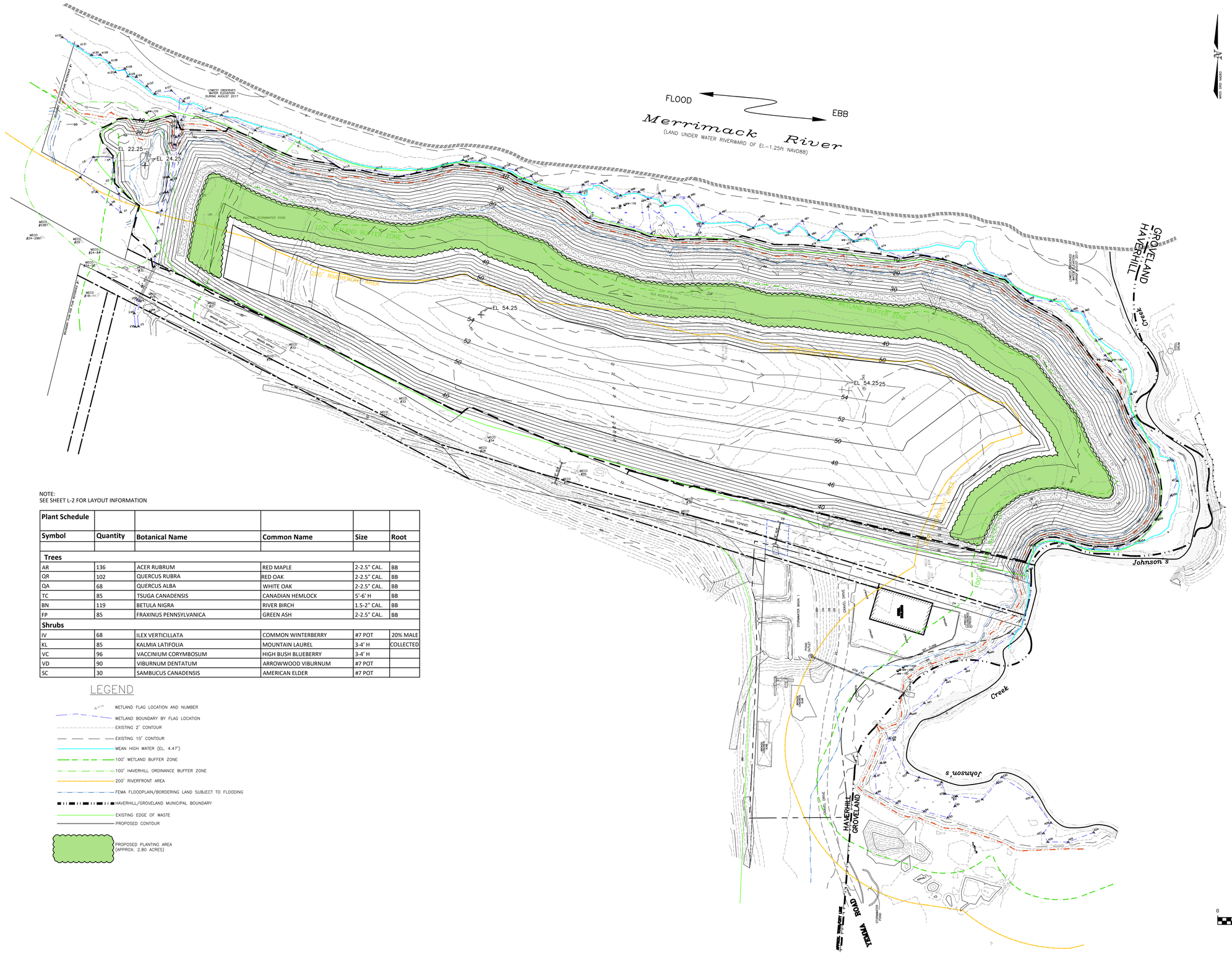
SECTIONS IV

HAVERHILL LANDFILL–NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

C–10



NOTE:
SEE SHEET L-2 FOR LAYOUT INFORMATION

Plant Schedule					
Symbol	**Quantity**	**Botanical Name**	**Common Name**	**Size**	**Root**
Trees					
AR	136	ACER RUBRUM	RED MAPLE	2-2.5" CAL.	BB
QR	102	QUERCUS RUBRA	RED OAK	2-2.5" CAL.	BB
QA	68	QUERCUS ALBA	WHITE OAK	2-2.5" CAL.	BB
TC	85	TSUGA CANADENSIS	CANADIAN HEMLOCK	5'-6' H	BB
BN	119	BETULA NIGRA	RIVER BIRCH	1.5-2" CAL.	BB
FP	85	FRAXINUS PENNSYLVANICA	GREEN ASH	2-2.5" CAL.	BB
Shrubs					
IV	68	ILEX VERTICILLATA	COMMON WINTERBERRY	#7 POT	20% MALE
KL	85	KALMIA LATIFOLIA	MOUNTAIN LAUREL	3-4' H	COLLECTED
VC	96	VACCINIUM CORYMBOSUM	HIGH BUSH BLUEBERRY	3-4' H	
VD	90	VIBURNUM DENTATUM	ARROWWOOD VIBURNUM	#7 POT	
SC	30	SAMBUCUS CANADENSIS	AMERICAN ELDER	#7 POT	

LEGEND

- WETLAND FLAG LOCATION AND NUMBER
- WETLAND BOUNDARY BY FLAG LOCATION
- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- MEAN HIGH WATER (EL. 4.47')
- 100' WETLAND BUFFER ZONE
- 100' HAVERHILL ORDINANCE BUFFER ZONE
- 200' RIVERFRONT AREA
- FEMA FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING
- HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
- EXISTING EDGE OF WASTE
- PROPOSED CONTOUR
- PROPOSED PLANTING AREA (APPROX. 2.80 ACRES)

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Scale : 1"=80'NOTED
Date : OCT. 2022

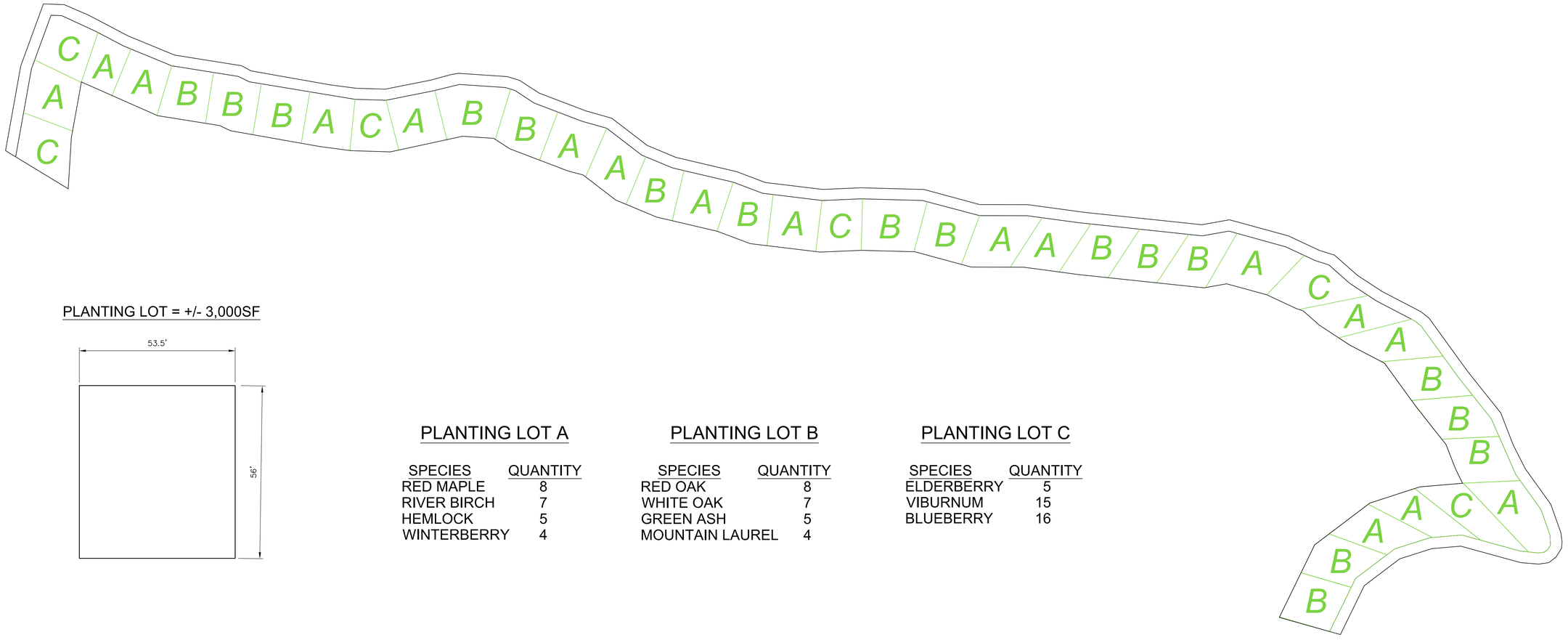
LANDSCAPE PLAN

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

L-1



PLANTING LOT = +/- 3,000SF

PLANTING LOT A

SPECIES	QUANTITY
RED MAPLE	8
RIVER BIRCH	7
HEMLOCK	5
WINTERBERRY	4

PLANTING LOT B

SPECIES	QUANTITY
RED OAK	8
WHITE OAK	7
GREEN ASH	5
MOUNTAIN LAUREL	4

PLANTING LOT C

SPECIES	QUANTITY
ELDERBERRY	5
VIBURNUM	15
BLUEBERRY	16

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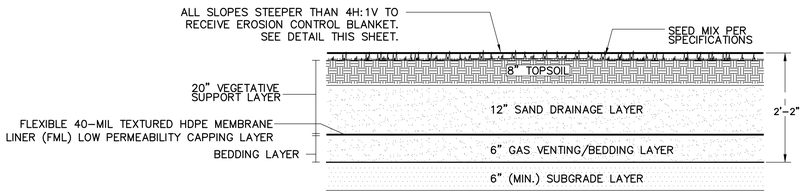
LANDSCAPE LAYOUT PLAN

HAVERHILL LANDFILL–NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

L-2



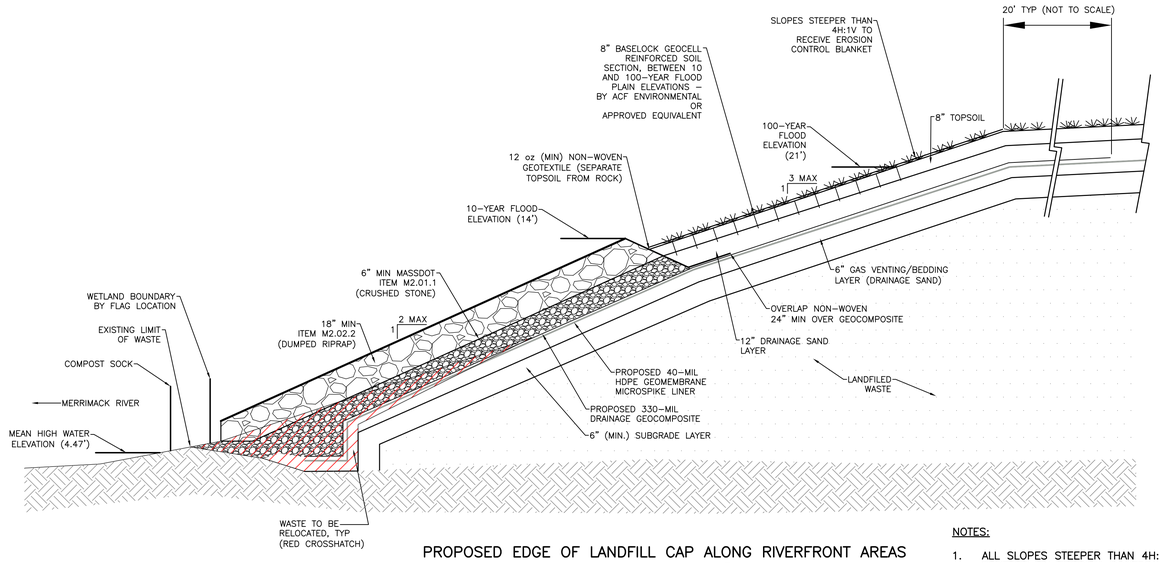
NOTE:

1. SOIL SUBGRADE LAYER TO BE INSTALLED OVER ALL AREAS OF RELOCATED WASTE PER SPECIFICATIONS.

TYPICAL FINAL CAP SECTION

DETAIL 1 / D-1

N.T.S.



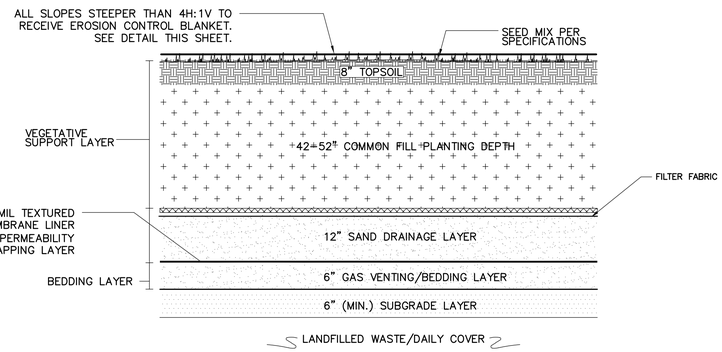
PROPOSED EDGE OF LANDFILL CAP ALONG RIVERFRONT AREAS

DETAIL 3 / D-1

N.T.S.

NOTES:

1. ALL SLOPES STEEPER THAN 4H:1V SHALL BE COVERED BY EROSION CONTROL BLANKET. SEE DETAIL THIS SHEET
2. SEE APPROXIMATE LIMITS OF DETAIL ON SHEET C-4.



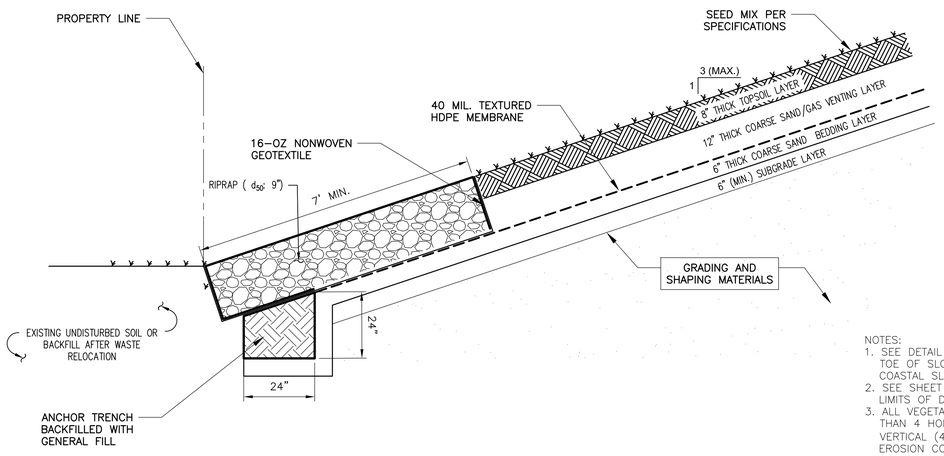
NOTE:

1. SOIL SUBGRADE LAYER TO BE INSTALLED OVER ALL AREAS OF RELOCATED WASTE PER SPECIFICATIONS.

TYPICAL FINAL CAP SECTION-PLANTING AREAS

DETAIL 2 / D-1

N.T.S.



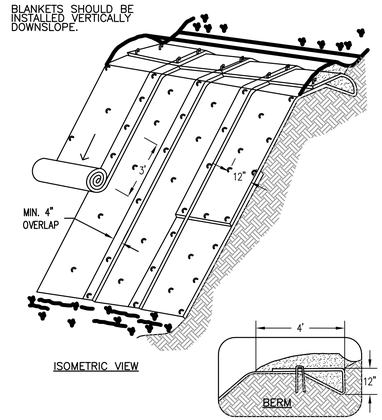
NOTES:

1. SEE DETAIL THREE THIS SHEET FOR TOE OF SLOPE AT LOCATIONS WITH COASTAL SLOPE PROTECTION.
2. SEE SHEET C-5 FOR APPROXIMATE LIMITS OF DETAIL INSTALLATION.
3. ALL VEGETATED SLOPES STEEPER THAN 4 HORIZONTAL TO ONE VERTICAL (4H:1V) TO RECEIVE EROSION CONTROL FABRIC.

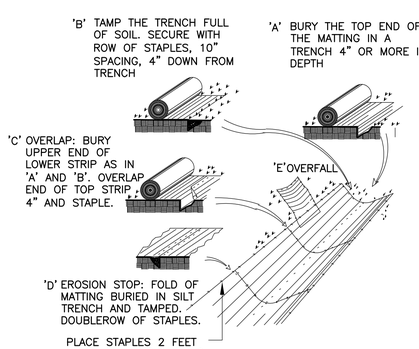
TYPICAL FINAL CAP SYSTEM TOE OF SLOPE ANCHORING-NON-RIVERFRONT AREAS

DETAIL 4 / D-1

SCALE: NTS



SLOPE CONDITION



SWALE CONDITION

NOTES:

1. ALL SLOPES STEEPER THAN 4H:1V SHALL BE COVERED BY EROSION CONTROL BLANKET.
2. STAPLE DIMENSIONS AND SIZE PER MANUFACTURER'S SPECIFICATIONS. STAPLES SHALL NOT BE LONGER THAN 12" AND SHAL NOT DAMAGE THE 40-MIL. HDPE FML.

EROSION CONTROL BLANKET

DETAIL 5 / D-1

N.T.S.

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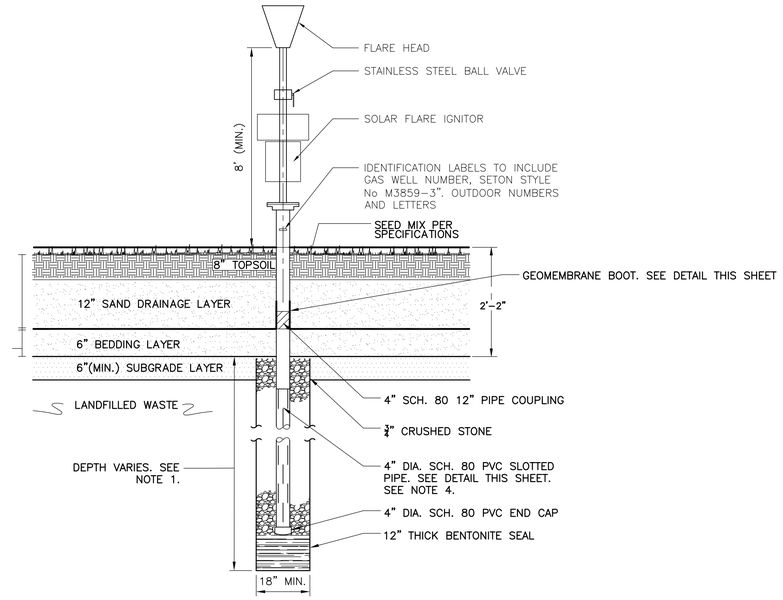
DETAILS I

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

D-1

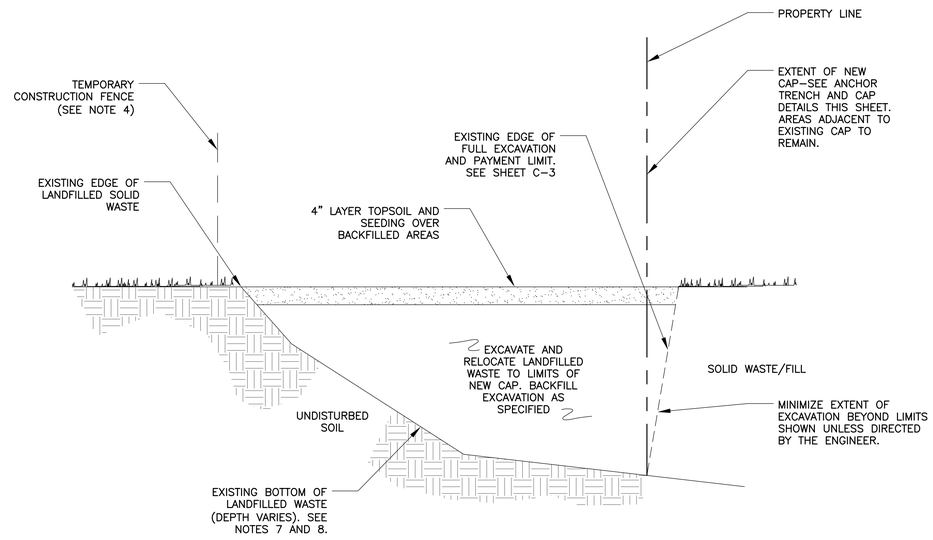


NOTES:
1. GAS VENT BOREHOLE TO BE ADVANCED 2' BELOW THE BOTTOM OF WASTE OR 2' BELOW THE TOP OF GROUNDWATER, WHICHEVER IS ENCOUNTERED FIRST. DEPTH TO BE CONFIRMED BY THE ENGINEER.
2. PLACE 12" THICK BENTONITE SEAL AT THE BOTTOM OF BOREHOLE PRIOR TO THE PLACEMENT OF VENT.
3. SOLVENT WELD COUPLING TO FULL CONTACT AREA OF BOTH PIPES.
4. INSTALL SOLAR VENT FLARE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

LANDFILL GAS VENT-SOLAR VENT FLARE

DETAIL 1 / D-2

N.T.S.

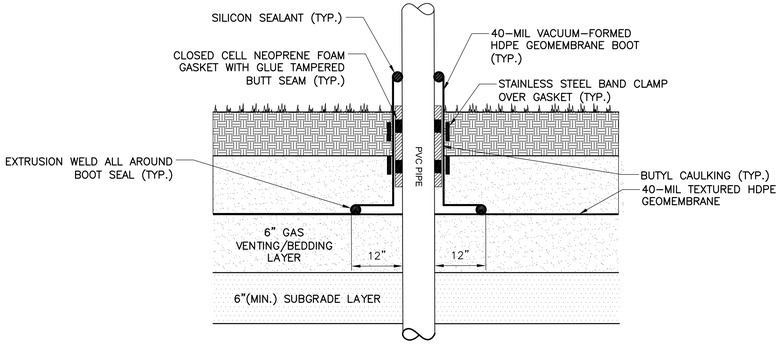


NOTES:
1. DURING WASTE EXCAVATION, A 6-INCH CLEAN SOIL DAILY COVER LAYER TO BE PLACED OVER EXPOSED WASTE AT THE END OF EACH DAY. CONTRACTOR MAY USE A TARP THAT IS PROPERLY WEIGHTED AS AN ALTERNATIVE TO SOIL WITH APPROVAL BY ENGINEER.
2. CONTRACTOR TO CONTROL STORMWATER TO NOT RUN INTO OPEN EXCAVATION AREAS.
3. CONTRACTOR TO MINIMIZE EXTENT OF OPEN EXCAVATIONS AT THE END OF EACH DAY.
4. FOR WASTE EXCAVATION ADJACENT TO AND ON MASS ELECTRIC PROPERTY, CONTRACTOR TO MAINTAIN TEMPORARY FENCING AND TAKE ALL NECESSARY MEASURES TO CONTROL PUBLIC ACCESS TO EXCAVATIONS AND ACTIVE CONSTRUCTION AREAS.
5. EXCAVATED AREAS OUTSIDE OF CAP TO BE BACKFILLED WITH SOIL TYPES AS SPECIFIED.
6. FINISH BACKFILL GRADES TO BE EXISTING ELEVATIONS.
7. BOTTOM LIMIT OF EXCAVATION TO BE DETERMINED BY ENGINEER BASED ON REMOVAL OF ALL SOLID WASTE AND VISUALLY IMPACTED SOILS.
8. CONTRACTOR TO PROVIDE SURVEYED ELEVATION AND LIMITS OF BOTTOM OF WASTE EXCAVATION AREAS.

SCHEMATIC CROSS-SECTION OF WASTE EXCAVATION AND RELOCATION AREAS

DETAIL 2 / D-2

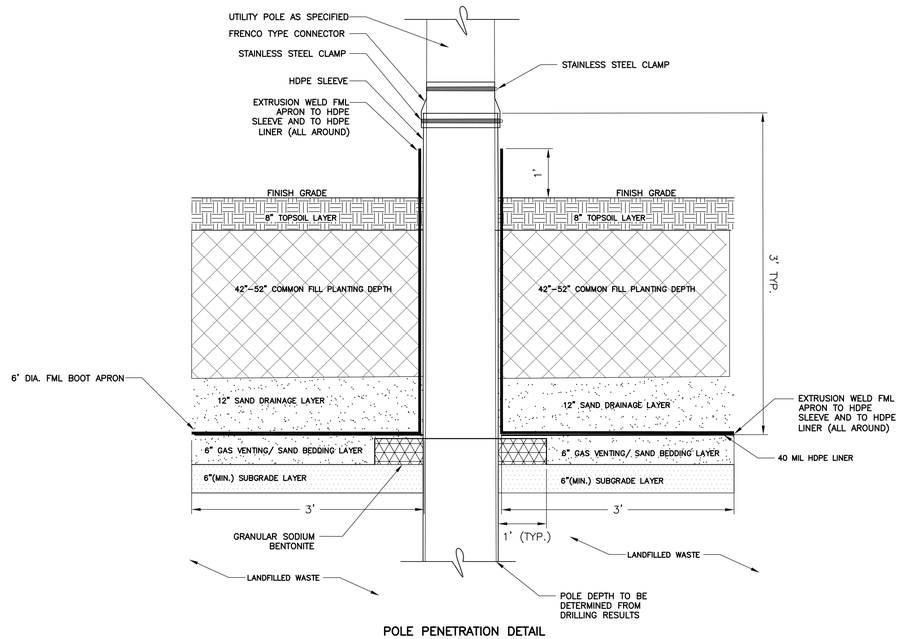
N.T.S.



GEOMEMBRANE BOOT

DETAIL 3 / D-2

N.T.S.



POLE PENETRATION DETAIL

DETAIL 4 / D-2

SCALE: NTS

REVISIONS

Langdon Environmental LLC
75 CONGRESS STREET SUITE 214, PO BOX 511
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Date : OCT. 2022

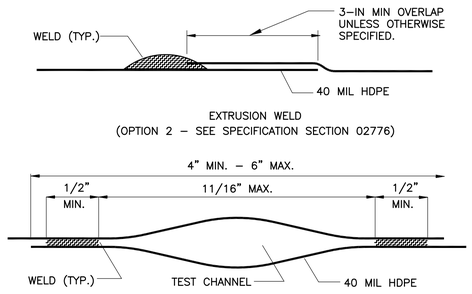
DETAILS II

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

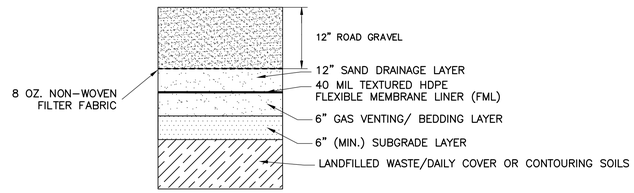
D-2



HDPE WELD DETAIL

DETAIL 1 / D-3

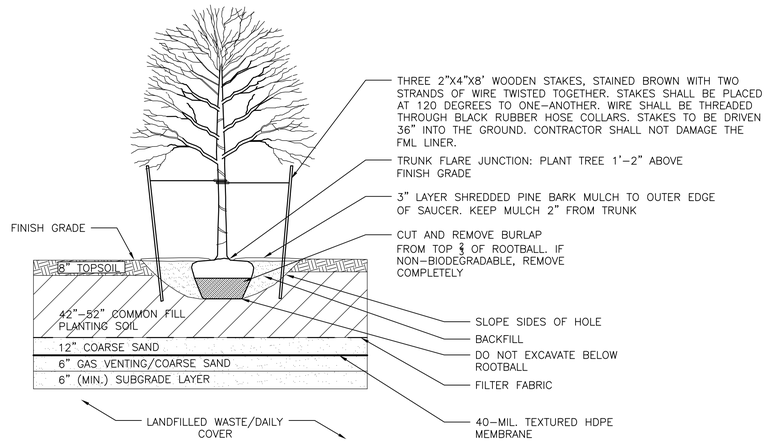
SCALE: NTS



GRAVEL ACCESS ROAD CAP SECTION

DETAIL 2 / D-3

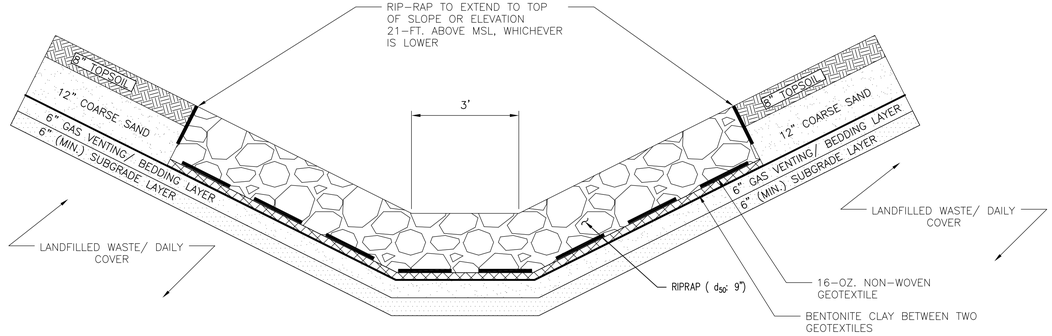
N.T.S.



TREE PLANTING

DETAIL 3 / D-3

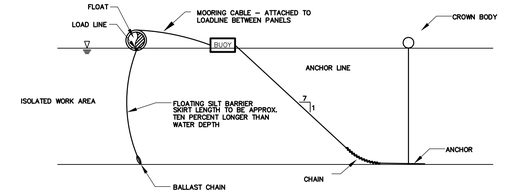
NOT TO SCALE



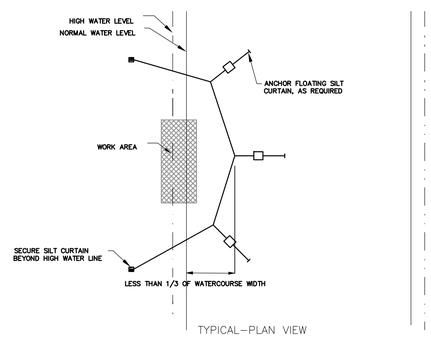
INTERMITTENT STREAM CHANNEL

DETAIL 4 / D-3

N.T.S.



TYPICAL COMPONENTS / ANCHORAGE SYSTEM



TYPICAL-PLAN VIEW

Maximum flow for waterbody shall be less than 5fps.
Isolated work area shall not exceed more than 1/3 stream width.
Silt curtain shall be placed parallel to stream flow.

FLOATING BOOM CURTAIN

DETAIL 5 / D-3

N.T.S.

REVISIONS

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DETAILS III

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

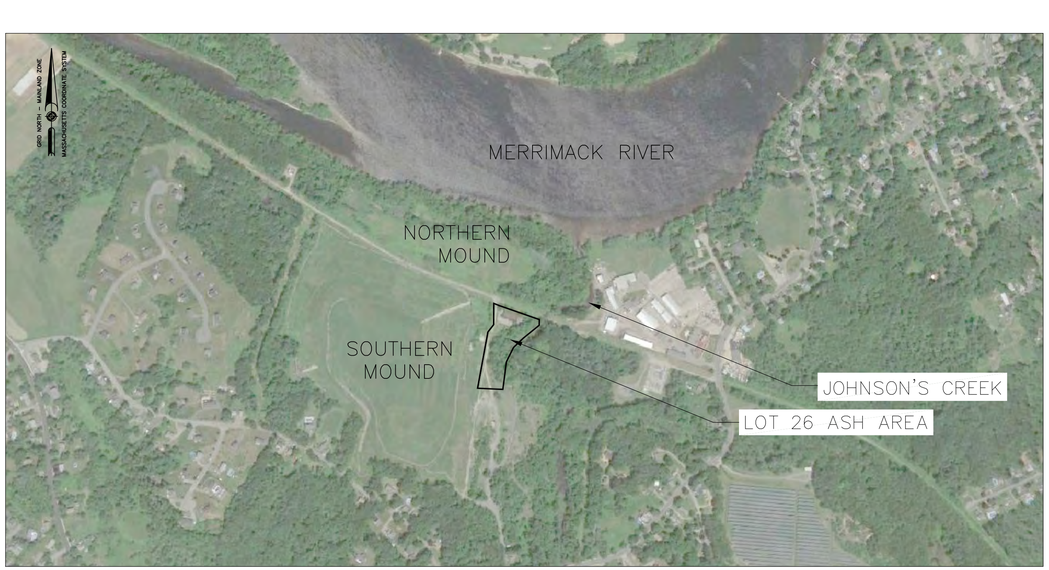
Proj. No.

Dwg. No.

D-3

LOT 26 ASH AREA
CLEAN WATER SRF No. 6970
CORRECTIVE ACTION DESIGN
PERMIT APPLICATION

OLD GROVELAND ROAD
HAVERHILL, MA



PREPARED FOR:

CITY OF HAVERHILL MASSACHUSETTS

MAYOR: JAMES J. FIORENTINI
INTERIM DIRECTOR OF PUBLIC WORKS: ROBERT E. WARD

HOLCIM–NER, INC.
REGIONAL MANAGER, LAND AND ENVIRONMENT: JARRETT TEMPLE

LIST OF DRAWINGS

OCTOBER 2022

FOR PERMITTING PURPOSES ONLY

COMMONWEALTH OF MASSACHUSETTS
BRUCE W HASKELL
No. 37467
REGISTERED PROFESSIONAL ENGINEER
10-14-22

Langdon Environmental LLC
75 CONGRESS ST. SUITE 214, PO BOX 511
PORTSMOUTH, NH 03802
(617) 875–3693

GENERAL NOTES:

1. THE TOPOGRAPHIC INFORMATION SHOWN HEREON IS FROM A FIELD SURVEY COMPLETED BY T.F. BERNIER, INC. OF CONCORD, NEW HAMPSHIRE IN AUGUST OF 2017. BOUNDARY INFORMATION IS FROM PLAN REFERENCE NUMBER 1. NO VERIFICATION OR UPDATING OF THE BOUNDARY INFORMATION WAS DONE IN THE PREPARATION OF THIS PLAN. KNOWN DISCREPANCIES EXIST INCLUDING THE LOCATION OF JOHNSON'S CREEK WHICH MAY AFFECT THE MUNICIPAL BOUNDARY.
2. THE VERTICAL DATUM IS NAVD88 BASED ON MULTIPLE STATIC GPS OBSERVATIONS COMPLETED BY T.F. BERNIER, INC.
3. EASEMENT BOUNDARIES SHOWN HEREON HAVE BEEN DIGITIZED FROM PLAN REFERENCE NUMBER 1 AND ARE FOR INFORMATION PURPOSES ONLY. FOR DESCRIPTION AND COMPLETE INFORMATION SEE SAID PLAN REFERENCE NUMBER 1.
4. WETLAND DELINEATION WAS CONDUCTED BY EPSILON ASSOCIATES ON JULY 7 AND 12, 2017. DELINEATION WAS APPROVED BY HAVERHILL CONSERVATION COMMISSION IN ORDER OF RESOURCE AREA DELINEATION (ORAD) DATED JANUARY 19, 2018 (EXTENDED UNTIL JANUARY 19, 2024) AND GROVELAND CONSERVATION COMMISSION ORAD DATED JANUARY 22, 2018 (EXTENDED UNTIL JANUARY 22, 2023).
5. MEAN HIGH WATER (MHW)= +4.47' NAVD.
   MEAN LOW WATER (MLW)= −1.25' NAVD.
   CHAPTER 91 LICENSE NO. 12877
6. FEMA 100−YEAR FLOODPLAIN ZONE ELEVATION / BORDERING LAND SUBJECT TO FLOODING (BLSF) = El. 21
   FEMA 10−YEAR FLOODPLAIN = EL. 14
7. PLANS FOR CORRECTIVE ACTION AT NORTHERN MOUND PROVIDED SEPARATELY.
8. ACCESS TO MASS ELECTRIC PROPERTY TO BE MAINTAINED CONTINUOUSLY DURING CONSTRUCTION ACTIVITIES. DURING CONSTRUCTION ACTIVITIES, CONTRACTOR MAY RELOCATE EXISTING GRAVEL ROAD TO PROTECT EXISTING POWER LINE POLES AS APPROVED BY ENGINEER.
9. CONTRACTOR TO FIELD LOCATE ALL PROPERTY LINES AND EASEMENTS WITHIN LIMIT OF WORK PRIOR TO THE START OF CONSTRUCTION ACTIVITIES. CONTRACTOR TO MAINTAIN LOCATIONS THROUGHOUT CONSTRUCTION AND REESTABLISH MARKINGS AS NECESSARY. PROPERTY LINES AND EASEMENT LOCATION TO BE PROVIDED BY A REGISTERED LAND SURVEYOR LICENSED IN MASSACHUSETTS.

PLAN REFERENCES

1. PLAN OF LAND LOCATED IN HAVERHILL AND GROVELAND MASSACHUSETTS PREPARED FOR CDM, CITY OF HAVERHILL AND AGGREGATE INDUSTRIES SCALE: 1"=120' [DATED] FEBRUARY 3, 2006 PREPARED BY SCOTT L. GILES P.L.S. #13972.

PERMIT PLAN−NOT FOR CONSTRUCTION

NUMBER	DATE	MADE BY	CHECKED BY	DESCRIPTION

REVISIONS

COMMONWEALTH OF MASSACHUSETTS — BRIAN W. HAMEL — REGISTERED PROFESSIONAL ENGINEER — 10-11-22

Langdon Environmental LLC
75 CONGRESS STREET SUITE 214, PO BOX 511
PORTSMOUTH, NH 03802
(617) 875-3693

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Date : OCT. 2022

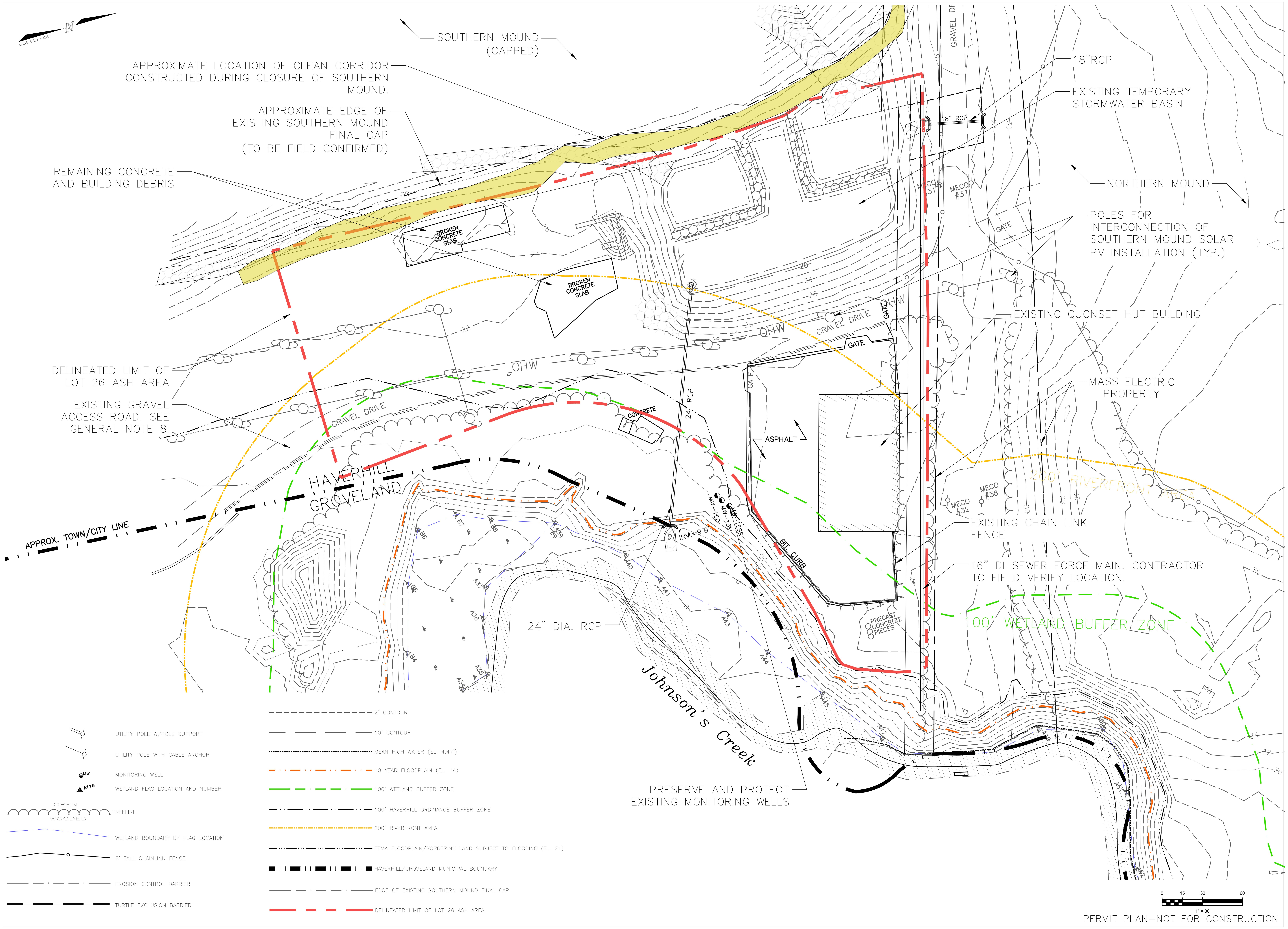
GENERAL NOTES

LOT 26 ASH AREA
CORRECTIVE ACTION DESIGN

Proj. No.

Dwg. No.

G−1


SOUTHERN MOUND (CAPPED)
APPROXIMATE LOCATION OF CLEAN CORRIDOR CONSTRUCTED DURING CLOSURE OF SOUTHERN MOUND.
APPROXIMATE EDGE OF EXISTING SOUTHERN MOUND FINAL CAP (TO BE FIELD CONFIRMED)
REMAINING CONCRETE AND BUILDING DEBRIS
BROKEN CONCRETE SLAB
DELINEATED LIMIT OF LOT 26 ASH AREA
EXISTING GRAVEL ACCESS ROAD. SEE GENERAL NOTE 8.
GRAVEL DRIVE
OHW
HAVERHILL
GROVELAND
APPROX. TOWN/CITY LINE
CONCRETE
24" RCP
INV.=9.0
MW-15D
MW-15M
MW-15SR
BIT. CURB
ASPHALT
GATE
24" DIA. RCP
Johnson's Creek
PRESERVE AND PROTECT EXISTING MONITORING WELLS
PRECAST CONCRETE PIECES
18"RCP
8" RCP
EXISTING TEMPORARY STORMWATER BASIN
NORTHERN MOUND
MECO #31
MECO #37
POLES FOR INTERCONNECTION OF SOUTHERN MOUND SOLAR PV INSTALLATION (TYP.)
EXISTING QUONSET HUT BUILDING
MASS ELECTRIC PROPERTY
MECO #32
MECO #38
EXISTING CHAIN LINK FENCE
16" DI SEWER FORCE MAIN. CONTRACTOR TO FIELD VERIFY LOCATION.
100' WETLAND BUFFER ZONE
200' RIVERFRONT AREA
GRAVEL DRIVE
UTILITY POLE W/POLE SUPPORT
UTILITY POLE WITH CABLE ANCHOR
MONITORING WELL
WETLAND FLAG LOCATION AND NUMBER
OPEN
WOODED
TREELINE
WETLAND BOUNDARY BY FLAG LOCATION
6' TALL CHAINLINK FENCE
EROSION CONTROL BARRIER
TURTLE EXCLUSION BARRIER
2' CONTOUR
10' CONTOUR
MEAN HIGH WATER (EL. 4.47')
10 YEAR FLOODPLAIN (EL. 14)
100' WETLAND BUFFER ZONE
100' HAVERHILL ORDINANCE BUFFER ZONE
200' RIVERFRONT AREA
FEMA FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING (EL. 21)
HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
EDGE OF EXISTING SOUTHERN MOUND FINAL CAP
DELINEATED LIMIT OF LOT 26 ASH AREA
0 15 30 60
1" = 30'

PERMIT PLAN–NOT FOR CONSTRUCTION

REVISIONS

Langdon Environmental LLC

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Date : OCT. 2022

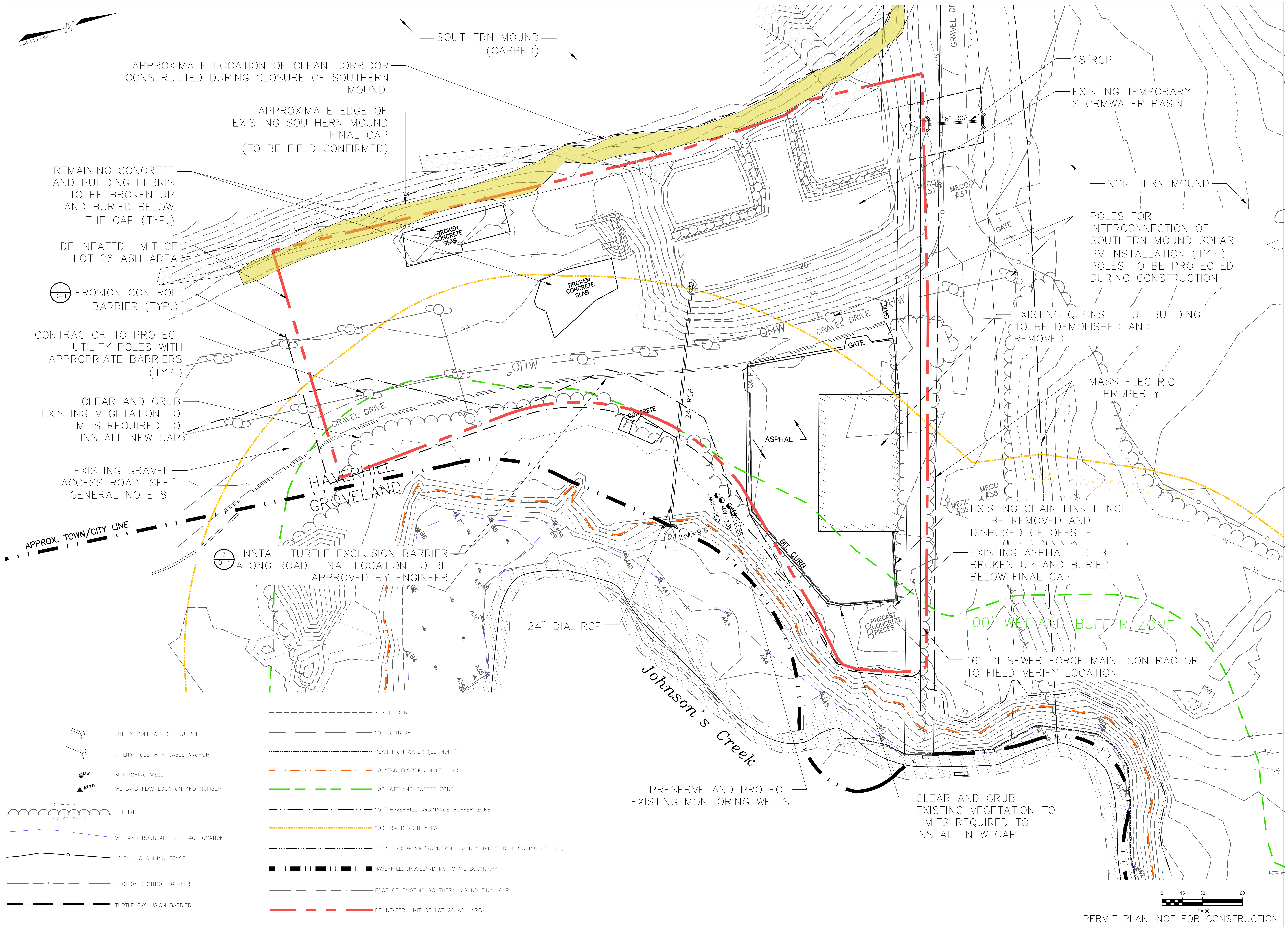
EXISTING CONDITIONS PLAN

LOT 26 ASH AREA CORRECTIVE ACTION DESIGN

Proj. No.

Dwg. No.

C-1



SOUTHERN MOUND (CAPPED)
APPROXIMATE LOCATION OF CLEAN CORRIDOR CONSTRUCTED DURING CLOSURE OF SOUTHERN MOUND.
APPROXIMATE EDGE OF EXISTING SOUTHERN MOUND FINAL CAP (TO BE FIELD CONFIRMED)
REMAINING CONCRETE AND BUILDING DEBRIS TO BE BROKEN UP AND BURIED BELOW THE CAP (TYP.)
DELINEATED LIMIT OF LOT 26 ASH AREA
1 D-1 EROSION CONTROL BARRIER (TYP.)
CONTRACTOR TO PROTECT UTILITY POLES WITH APPROPRIATE BARRIERS (TYP.)
CLEAR AND GRUB EXISTING VEGETATION TO LIMITS REQUIRED TO INSTALL NEW CAP
EXISTING GRAVEL ACCESS ROAD. SEE GENERAL NOTE 8.
APPROX. TOWN/CITY LINE
HAVERHILL
GROVELAND
3 D-1 INSTALL TURTLE EXCLUSION BARRIER ALONG ROAD. FINAL LOCATION TO BE APPROVED BY ENGINEER
24" DIA. RCP
Johnson's Creek
PRESERVE AND PROTECT EXISTING MONITORING WELLS
CLEAR AND GRUB EXISTING VEGETATION TO LIMITS REQUIRED TO INSTALL NEW CAP
16" DI SEWER FORCE MAIN. CONTRACTOR TO FIELD VERIFY LOCATION.
100' WETLAND BUFFER ZONE
EXISTING ASPHALT TO BE BROKEN UP AND BURIED BELOW FINAL CAP
EXISTING CHAIN LINK FENCE TO BE REMOVED AND DISPOSED OF OFFSITE
MASS ELECTRIC PROPERTY
EXISTING QUONSET HUT BUILDING TO BE DEMOLISHED AND REMOVED
POLES FOR INTERCONNECTION OF SOUTHERN MOUND SOLAR PV INSTALLATION (TYP.). POLES TO BE PROTECTED DURING CONSTRUCTION
NORTHERN MOUND
EXISTING TEMPORARY STORMWATER BASIN
18"RCP
GRAVEL DRIVE
BROKEN CONCRETE SLAB
BROKEN CONCRETE SLAB
GRAVEL DRIVE
GRAVEL DRIVE
OHW
GATE
ASPHALT
BIT. CURB
CONCRETE
24" RCP
PRECAST CONCRETE PIECES
MECO #31
MECO #37
MECO #38
INV.=9.0
MW-15D
MW-15M
MW-15SR
200' RIVERFRONT AREA
UTILITY POLE W/POLE SUPPORT
UTILITY POLE WITH CABLE ANCHOR
MONITORING WELL
WETLAND FLAG LOCATION AND NUMBER
OPEN
WOODED
TREELINE
WETLAND BOUNDARY BY FLAG LOCATION
6' TALL CHAINLINK FENCE
EROSION CONTROL BARRIER
TURTLE EXCLUSION BARRIER
2' CONTOUR
10' CONTOUR
MEAN HIGH WATER (EL. 4.47')
10 YEAR FLOODPLAIN (EL. 14)
100' WETLAND BUFFER ZONE
100' HAVERHILL ORDINANCE BUFFER ZONE
200' RIVERFRONT AREA
FEMA FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING (EL. 21)
HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
EDGE OF EXISTING SOUTHERN MOUND FINAL CAP
DELINEATED LIMIT OF LOT 26 ASH AREA
0 15 30 60
1" = 30'

PERMIT PLAN–NOT FOR CONSTRUCTION

REVISIONS

COMMONWEALTH OF MASSACHUSETTS BRUCE W. HASKELL CIVIL No. 37467 REGISTERED PROFESSIONAL ENGINEER 10-14-22

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SITE PREPARATION PLAN

LOT 26 ASH AREA CORRECTIVE ACTION DESIGN

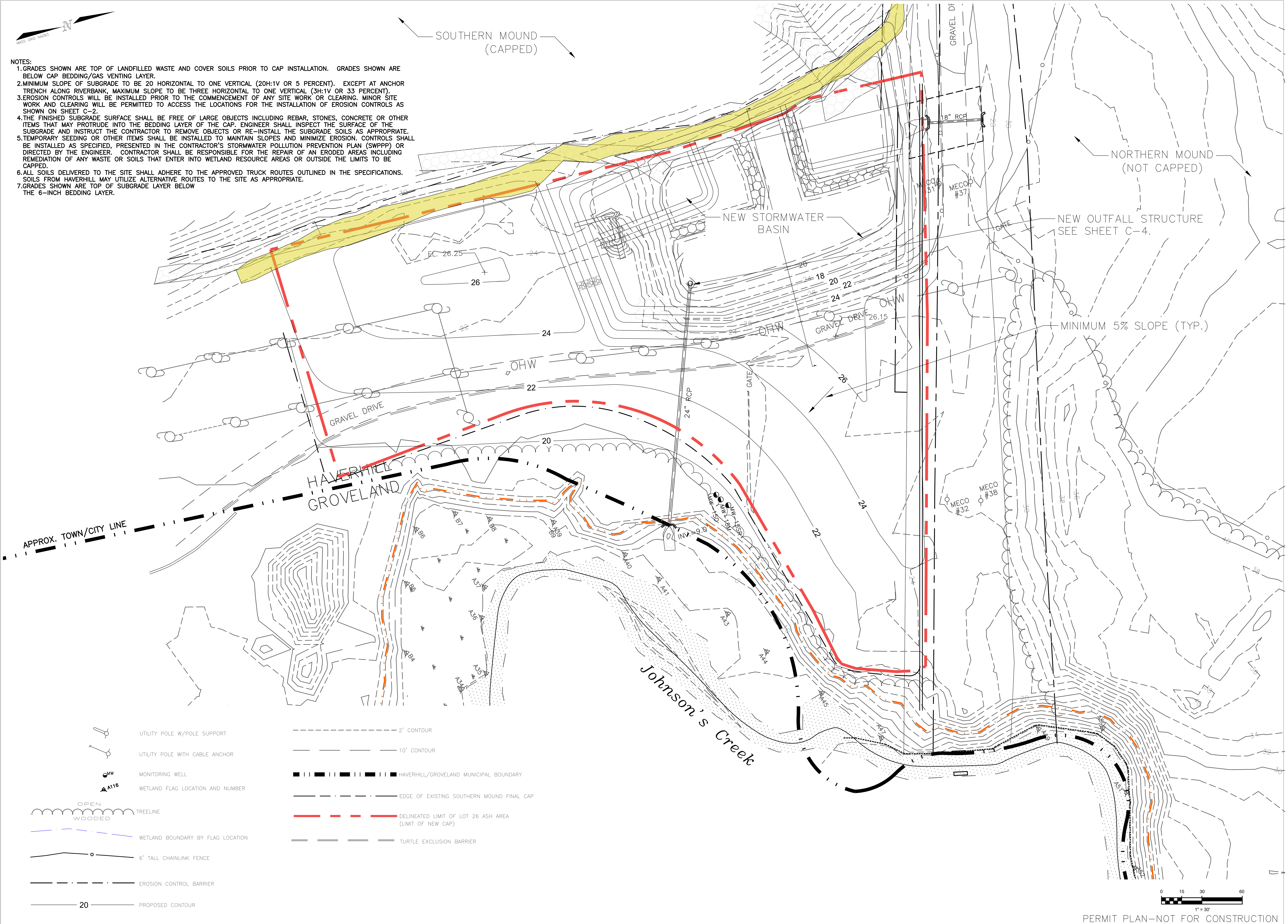
Proj. No.

Dwg. No.

C-2

NOTES:

1. GRADES SHOWN ARE TOP OF LANDFILLED WASTE AND COVER SOILS PRIOR TO CAP INSTALLATION. GRADES SHOWN ARE BELOW CAP BEDDING/GAS VENTING LAYER.
2. MINIMUM SLOPE OF SUBGRADE TO BE 20 HORIZONTAL TO ONE VERTICAL (20H:1V OR 5 PERCENT). EXCEPT AT ANCHOR TRENCH ALONG RIVERBANK, MAXIMUM SLOPE TO BE THREE HORIZONTAL TO ONE VERTICAL (3H:1V OR 33 PERCENT).
3. EROSION CONTROLS WILL BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY SITE WORK OR CLEARING. MINOR SITE WORK AND CLEARING WILL BE PERMITTED TO ACCESS THE LOCATIONS FOR THE INSTALLATION OF EROSION CONTROLS AS SHOWN ON SHEET C-2.
4. THE FINISHED SUBGRADE SURFACE SHALL BE FREE OF LARGE OBJECTS INCLUDING REBAR, STONES, CONCRETE OR OTHER ITEMS THAT MAY PROTRUDE INTO THE BEDDING LAYER OF THE CAP. ENGINEER SHALL INSPECT THE SURFACE OF THE SUBGRADE AND INSTRUCT THE CONTRACTOR TO REMOVE OBJECTS OR RE-INSTALL THE SUBGRADE SOILS AS APPROPRIATE.
5. TEMPORARY SEEDING OR OTHER ITEMS SHALL BE INSTALLED TO MAINTAIN SLOPES AND MINIMIZE EROSION. CONTROLS SHALL BE INSTALLED AS SPECIFIED, PRESENTED IN THE CONTRACTOR'S STORMWATER POLLUTION PREVENTION PLAN (SWPPP) OR DIRECTED BY THE ENGINEER. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REPAIR OF AN ERODED AREAS INCLUDING REMEDIATION OF ANY WASTE OR SOILS THAT ENTER INTO WETLAND RESOURCE AREAS OR OUTSIDE THE LIMITS TO BE CAPPED.
6. ALL SOILS DELIVERED TO THE SITE SHALL ADHERE TO THE APPROVED TRUCK ROUTES OUTLINED IN THE SPECIFICATIONS. SOILS FROM HAVERHILL MAY UTILIZE ALTERNATIVE ROUTES TO THE SITE AS APPROPRIATE.
7. GRADES SHOWN ARE TOP OF SUBGRADE LAYER BELOW THE 6-INCH BEDDING LAYER.



PERMIT PLAN—NOT FOR CONSTRUCTION

REVISIONS

COMMONWEALTH OF MASSACHUSETTS BRUCE W. HASKELL No. 37467 REGISTERED PROFESSIONAL ENGINEER 10-14-22

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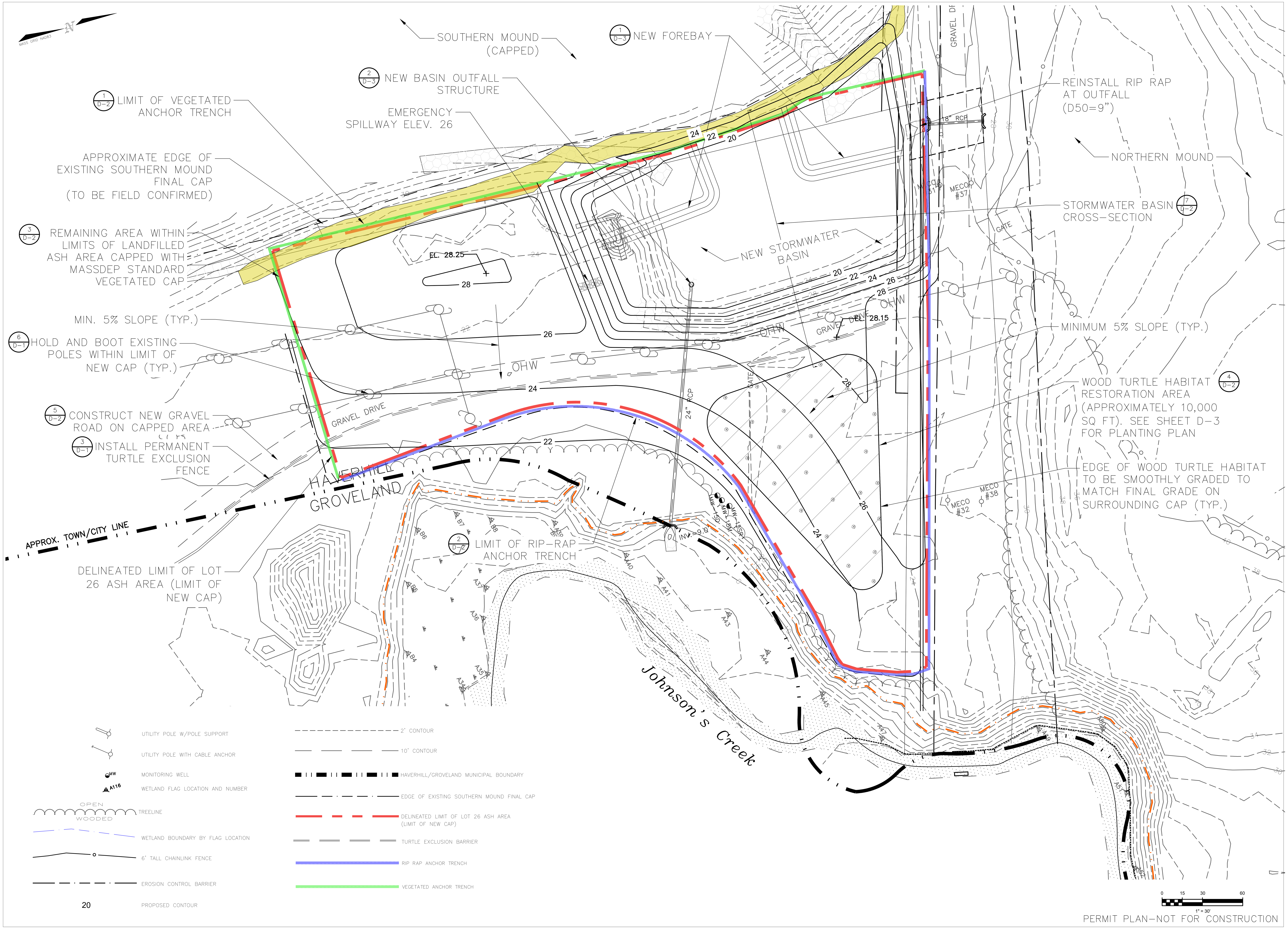
SUBGRADE PLAN

LOT 26 ASH AREA
CORRECTIVE ACTION DESIGN

Proj. No.

Dwg. No.

C-3


MASS GRID NAD83
N
SOUTHERN MOUND (CAPPED)
1 D-3 NEW FOREBAY
2 D-3 NEW BASIN OUTFALL STRUCTURE
1 D-2 LIMIT OF VEGETATED ANCHOR TRENCH
EMERGENCY SPILLWAY ELEV. 26
APPROXIMATE EDGE OF EXISTING SOUTHERN MOUND FINAL CAP (TO BE FIELD CONFIRMED)
3 D-2 REMAINING AREA WITHIN LIMITS OF LANDFILLED ASH AREA CAPPED WITH MASSDEP STANDARD VEGETATED CAP
MIN. 5% SLOPE (TYP.)
6 D-1 HOLD AND BOOT EXISTING POLES WITHIN LIMIT OF NEW CAP (TYP.)
5 D-2 CONSTRUCT NEW GRAVEL ROAD ON CAPPED AREA
3 D-1 INSTALL PERMANENT TURTLE EXCLUSION FENCE
APPROX. TOWN/CITY LINE
HAVERHILL
GROVELAND
DELINEATED LIMIT OF LOT 26 ASH AREA (LIMIT OF NEW CAP)
2 D-2 LIMIT OF RIP-RAP ANCHOR TRENCH
EL. 28.25
EL. 28.15
NEW STORMWATER BASIN
GRAVEL DRIVE
OHW
24" RCP
18" RCP
GATE
REINSTALL RIP RAP AT OUTFALL (D50=9")
NORTHERN MOUND
STORMWATER BASIN CROSS-SECTION 7 D-2
MINIMUM 5% SLOPE (TYP.)
WOOD TURTLE HABITAT RESTORATION AREA (APPROXIMATELY 10,000 SQ FT). SEE SHEET D-3 FOR PLANTING PLAN 4 D-2
EDGE OF WOOD TURTLE HABITAT TO BE SMOOTHLY GRADED TO MATCH FINAL GRADE ON SURROUNDING CAP (TYP.)
MECO #37
MECO #32
MECO #38
Johnson's Creek
UTILITY POLE W/POLE SUPPORT
UTILITY POLE WITH CABLE ANCHOR
MONITORING WELL
WETLAND FLAG LOCATION AND NUMBER
OPEN
WOODED
TREELINE
WETLAND BOUNDARY BY FLAG LOCATION
6' TALL CHAINLINK FENCE
EROSION CONTROL BARRIER
20 PROPOSED CONTOUR
2' CONTOUR
10' CONTOUR
HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
EDGE OF EXISTING SOUTHERN MOUND FINAL CAP
DELINEATED LIMIT OF LOT 26 ASH AREA (LIMIT OF NEW CAP)
TURTLE EXCLUSION BARRIER
RIP RAP ANCHOR TRENCH
VEGETATED ANCHOR TRENCH
0 15 30 60
1" = 30'
PERMIT PLAN–NOT FOR CONSTRUCTION

REVISIONS

COMMONWEALTH OF MASSACHUSETTS BRUCE W. HASKELL CIVIL No. 37467 REGISTERED PROFESSIONAL ENGINEER 10-14-22

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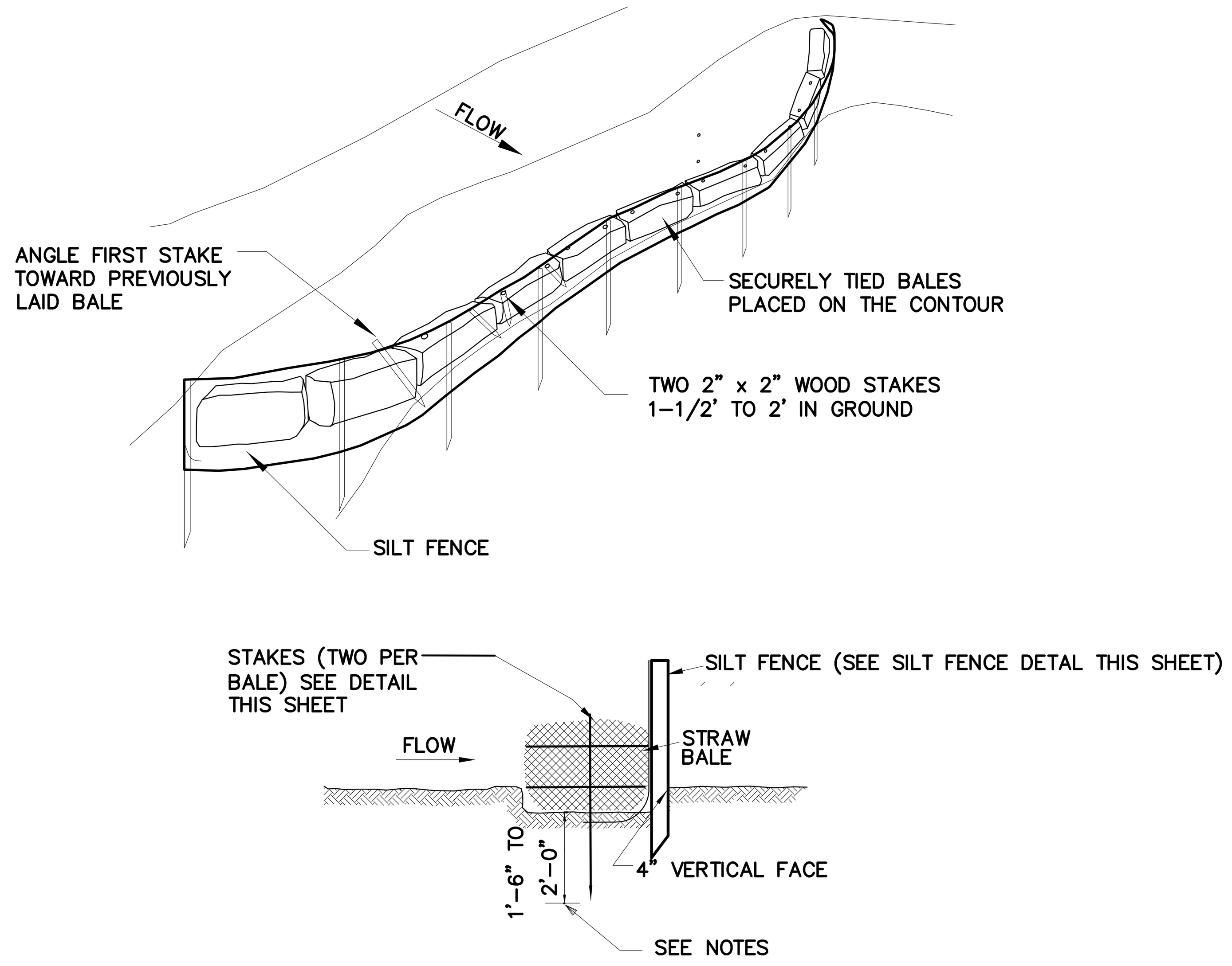
FINAL GRADING PLAN

LOT 26 ASH AREA
CORRECTIVE ACTION DESIGN

Proj. No.

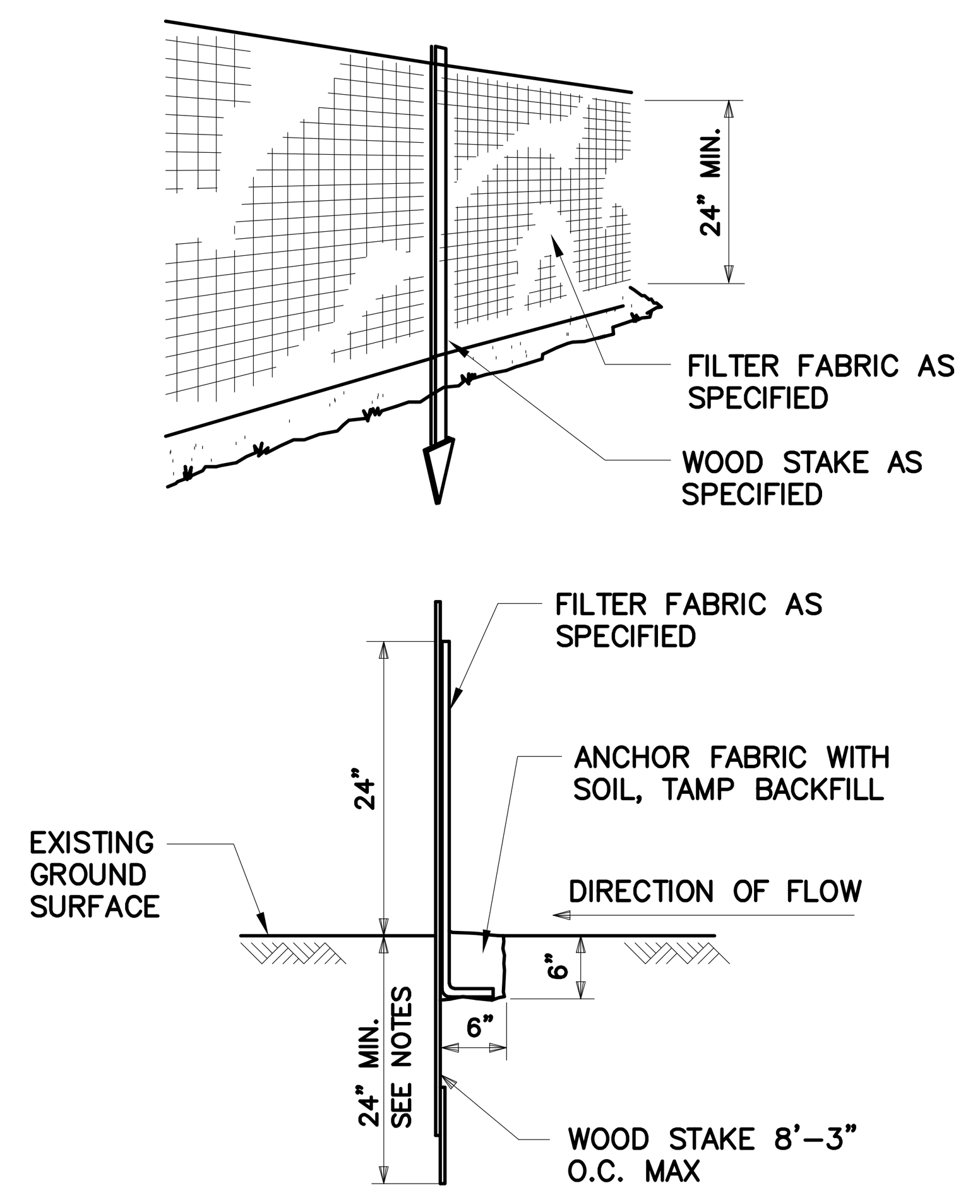
Dwg. No.

C-4



ERORSION CONTROLS

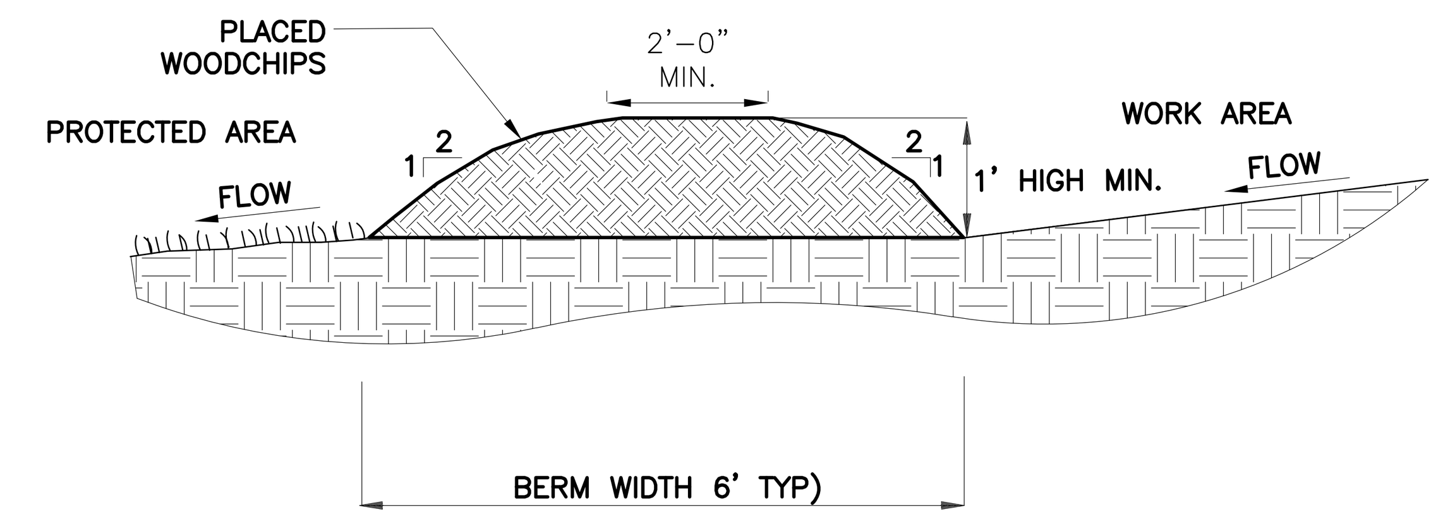
DETAIL 1
N.T.S. D-1



SILT FENCE DETAIL

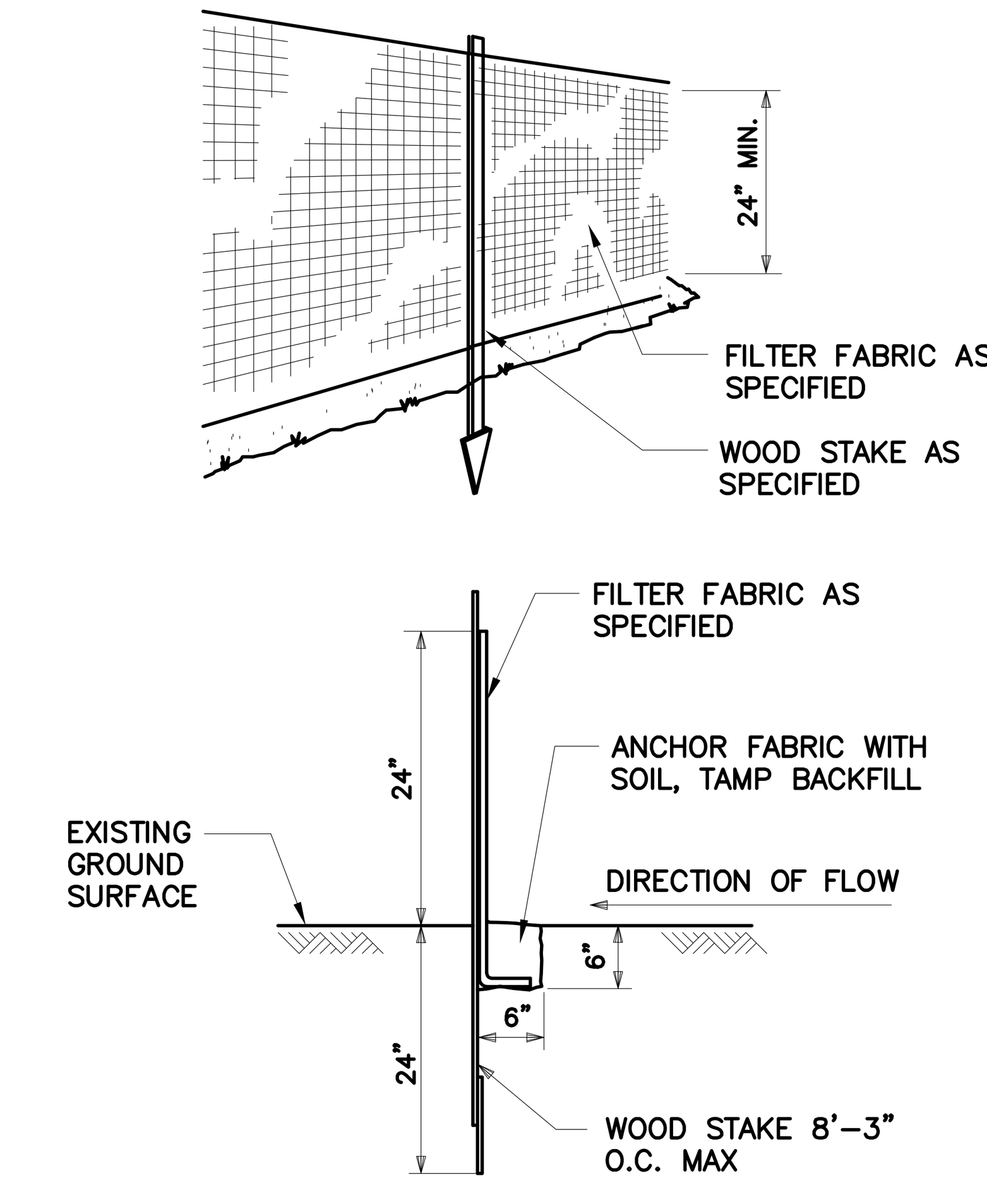
N.T.S.

NOTE:
1. EROSION CONTROLS TO BE MAINTAINED BY CONTRACTOR FOR THE DURATION OF CONSTRUCTION. EROSION CONTROLS TO BE REPAIRED OR REPLACED AS REQUIRED OR AS DIRECTED BY THE ENGINEER.
2. AT LOCATIONS WHERE EROSION CONTROLS ARE REQUIRED ON EXISTING SOIL CAP, CONTRACTOR WILL USE CLEAN WOOD CHIP BERM (SEE DETAIL 2 THIS SHEET).



WOOD CHIP EROSION CONTROL BERM

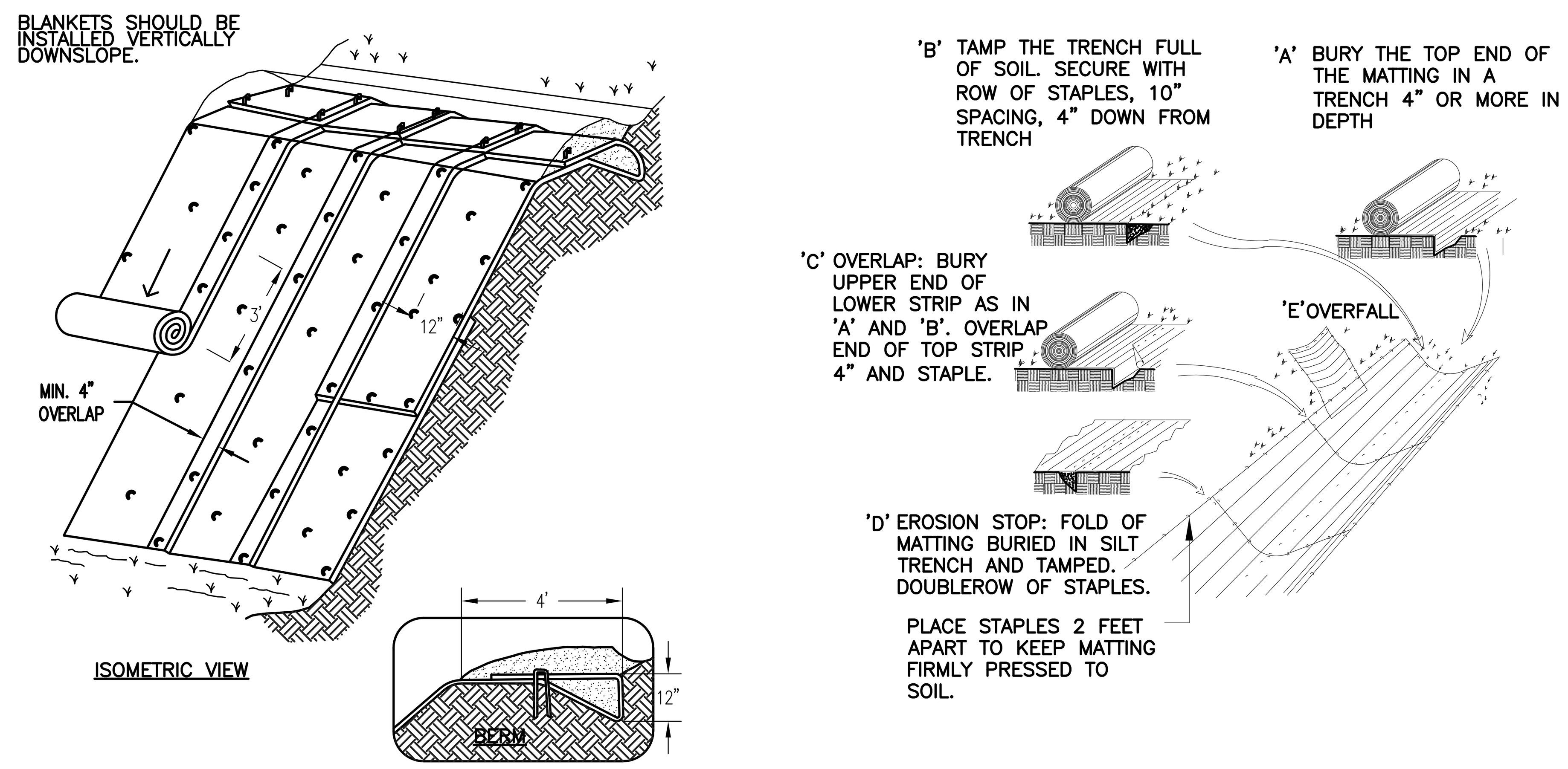
DETAIL 2
NOT TO SCALE D-1



NOTES:
1. CONTRACTOR TO MAINTAIN TURTLE EXCLUSION FENCE OUTSIDE OF EROSION CONTROLS FOR THE DURATION OF CONSTRUCTION.

TURTLE EXCLUSION FENCE

DETAIL 3
N.T.S. D-1



SLOPE CONDITION

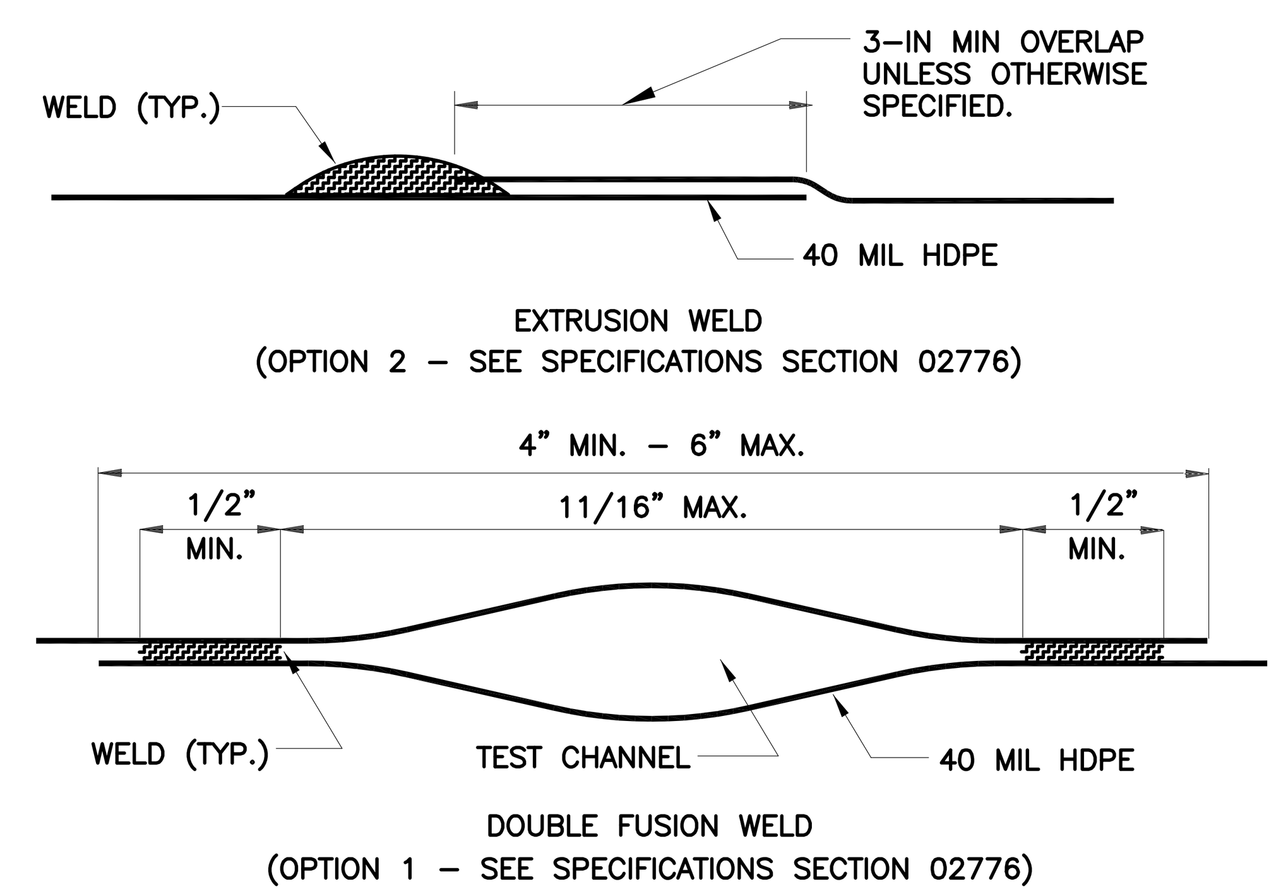
SWALE CONDITION

NOTES:

1. ALL SLOPES STEEPER THAN 4H:1V SHALL BE COVERED BY EROSION CONTROL BLANKET.
2. DIMENSIONS GIVEN IN THE DRAWINGS ARE EXAMPLES; DEVICE SHALL BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS.
3. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS, AND GRASS. MATS/BLANKETS SHALL HAVE DIRECT SOIL CONTACT.
4. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
5. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.
6. STAPLE DIMENSIONS AND SIZE PER MANUFACTURER'S SPECIFICATIONS. STAPLES SHALL NOT BE LONGER THAN 12" AND SHALL NOT DAMAGE THE 40-MIL. HDPE FML.

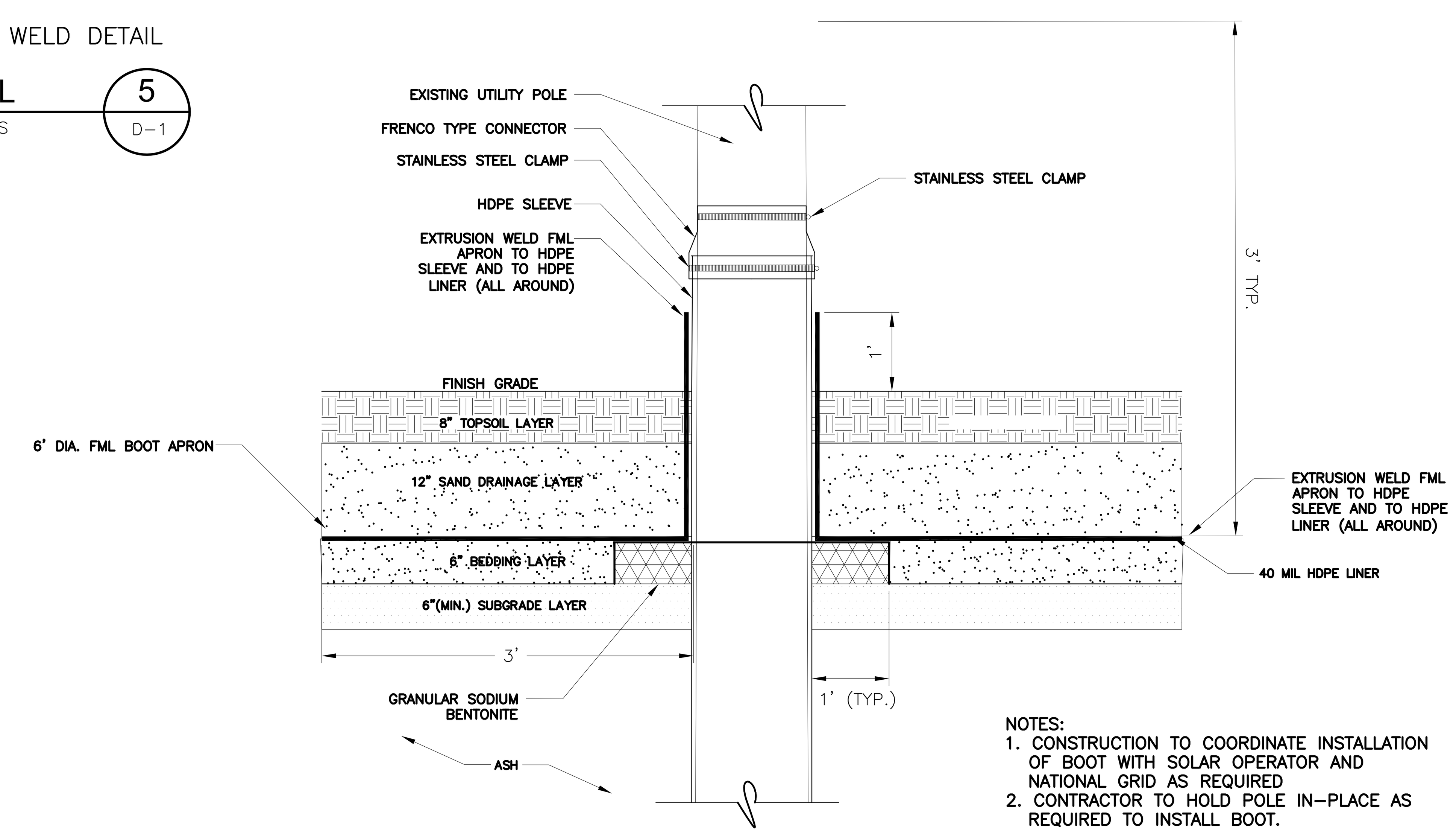
EROSION CONTROL BLANKET

DETAIL 4
N.T.S. D-1



HDPE WELD DETAIL

DETAIL 5
SCALE: NTS D-1



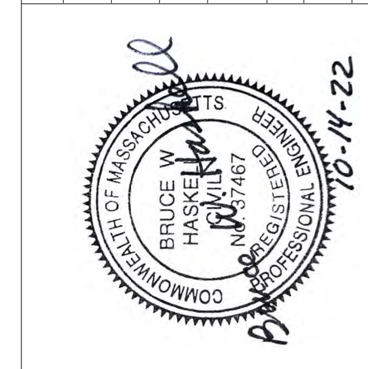
NOTES:
1. CONSTRUCTION TO COORDINATE INSTALLATION OF BOOT WITH SOLAR OPERATOR AND NATIONAL GRID AS REQUIRED
2. CONTRACTOR TO HOLD POLE IN-PLACE AS REQUIRED TO INSTALL BOOT.

POLE PENETRATION BOOT DETAIL

DETAIL 6
SCALE: NTS D-1

PERMIT PLAN-NOT FOR CONSTRUCTION

REVISIONS



Langdon Environmental LLC
75 CONGRESS STREET SUITE 214, PO BOX 511
PORTSMOUTH, NH 03802

Proj. Mgr: BWH
Designed : JEC
Drawn : JEC
Checked : BWH
Scale : AS NOTED
Date : OCT. 2022

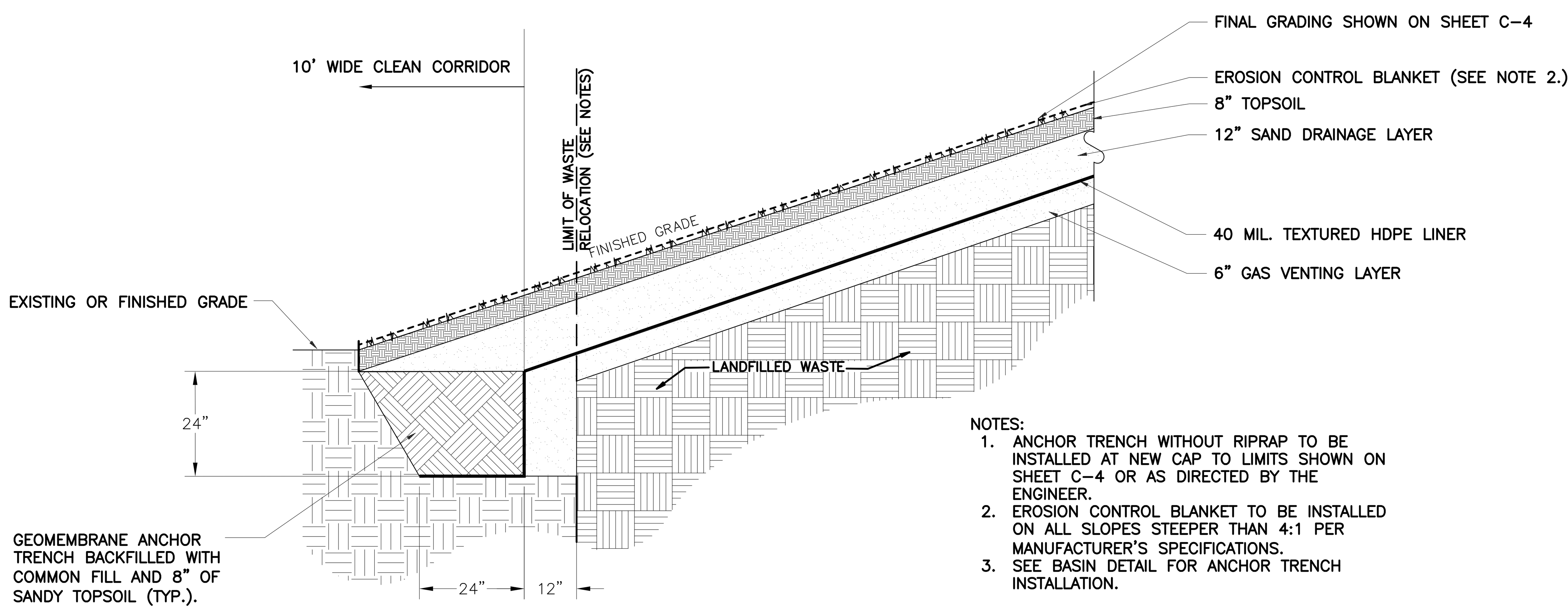
DETAILS I

LOT 26 ASH AREA
CORRECTIVE ACTION DESIGN

Proj. No.

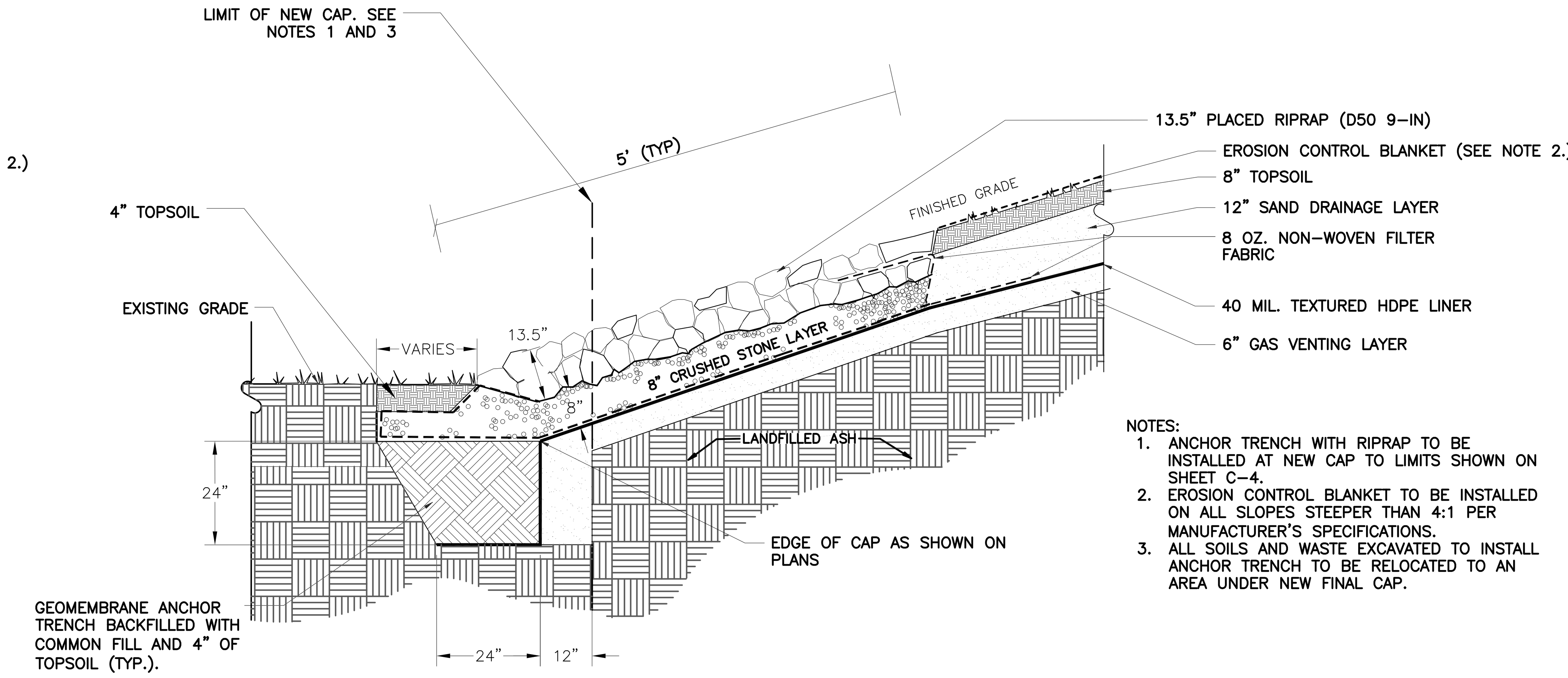
Dwg. No.

D-1



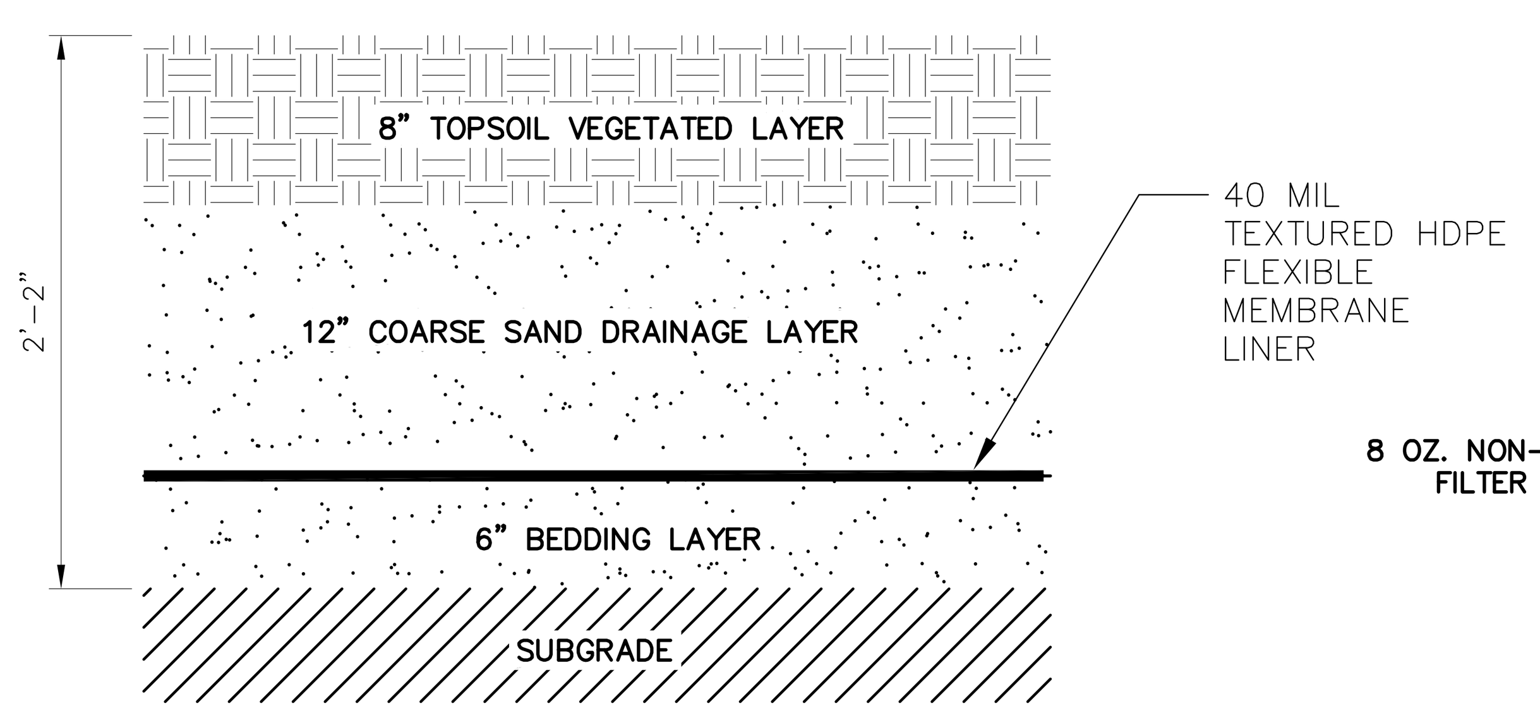
ANCHOR TRENCH WITHOUT RIPRAP

DETAIL 1 (D-2)
N.T.S.



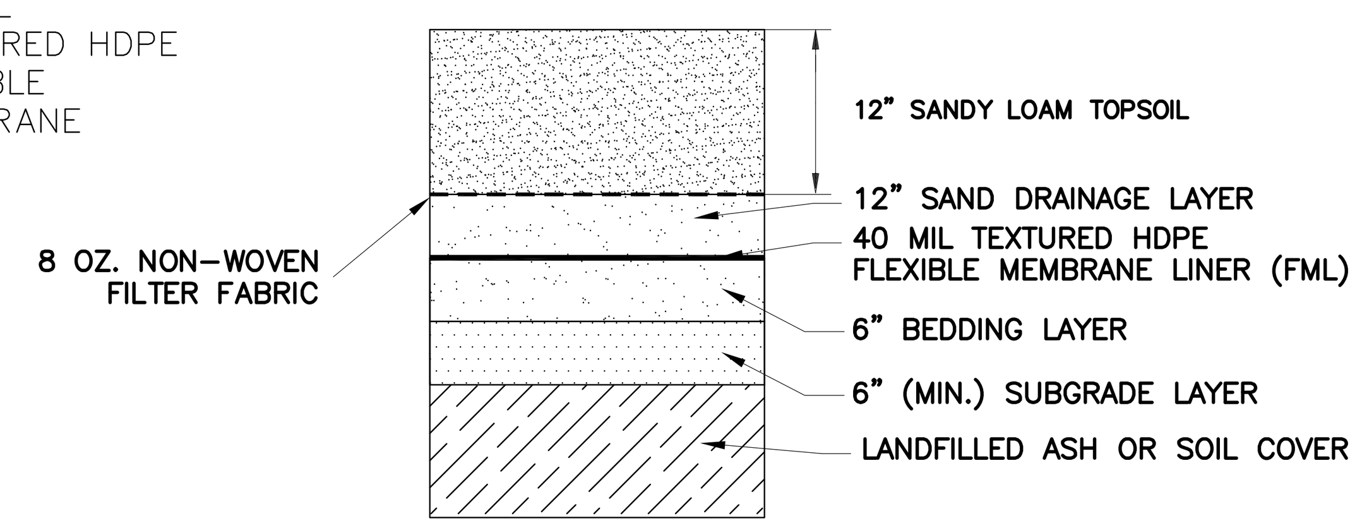
RIPRAP TOE OF SLOPE & ANCHOR TRENCH

DETAIL 2 (D-2)
N.T.S.



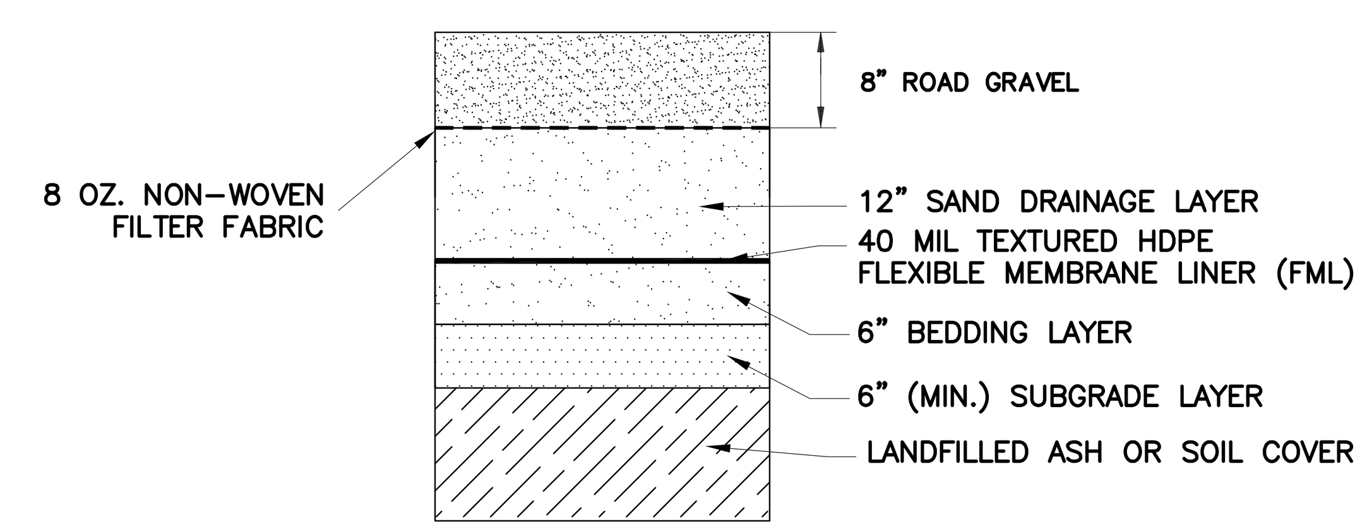
MASSDEP STANDARD SOLID WASTE CAP
CAP SECTION

DETAIL 3 (D-2)
N.T.S.



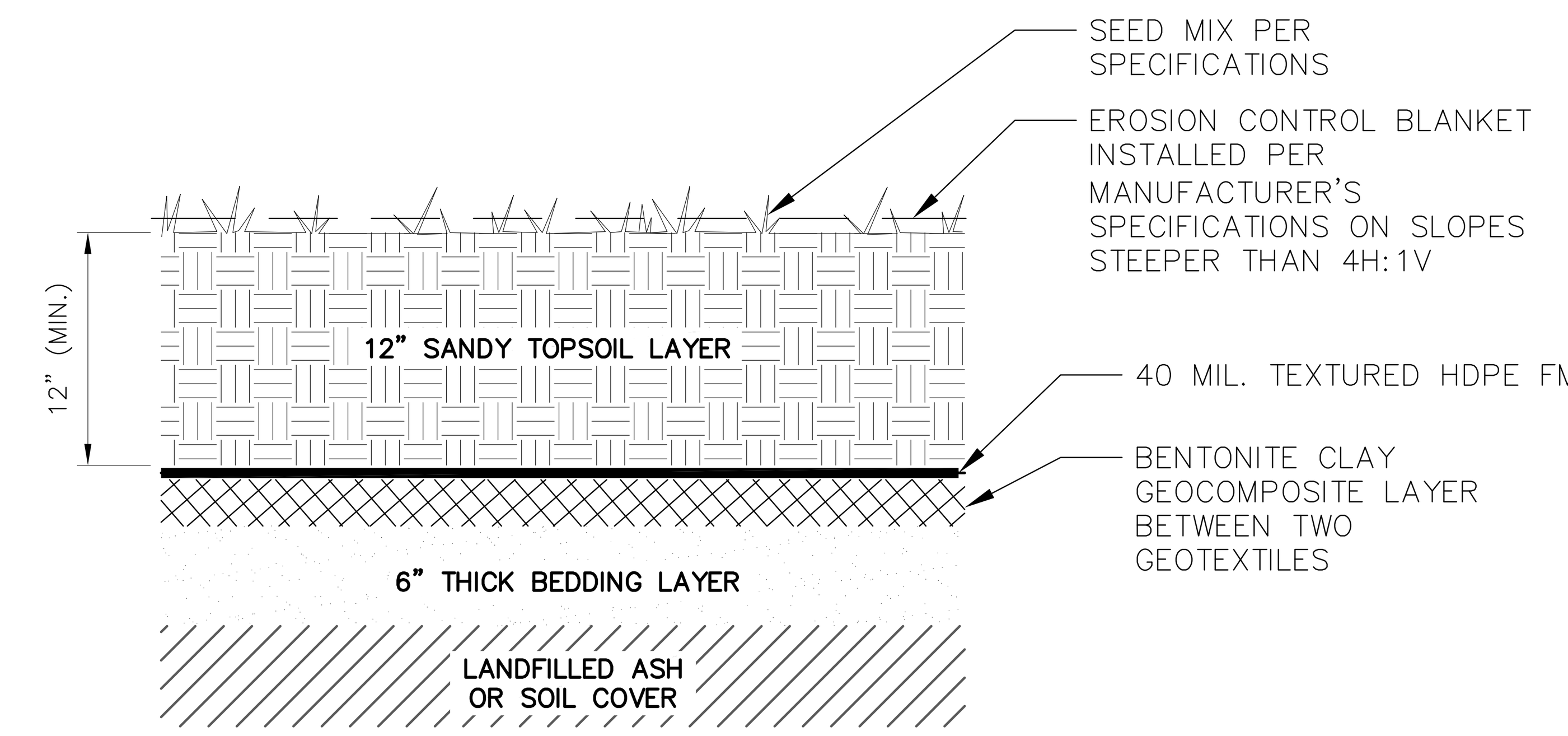
TURTLE HABITAT AREA CAP CROSS SECTION
CAP SECTION

DETAIL 4 (D-2)
N.T.S.



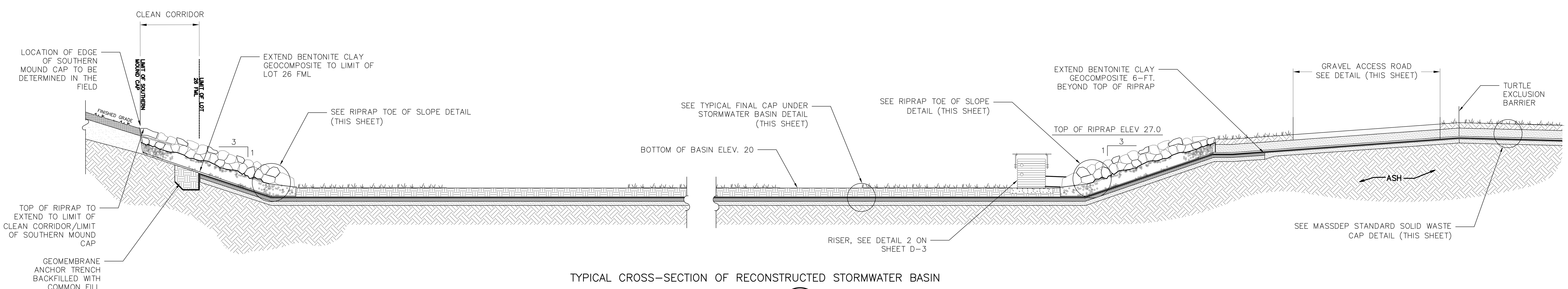
GRAVEL ACCESS ROAD
CAP SECTION

DETAIL 5 (D-2)
N.T.S.



TYPICAL FINAL CAP UNDER STORMWATER BASIN

DETAIL 6 (D-2)
N.T.S.



TYPICAL CROSS-SECTION OF RECONSTRUCTED STORMWATER BASIN

DETAIL 7 (D-2)
N.T.S.

PERMIT PLAN-NOT FOR CONSTRUCTION

REVISIONS

COMMONWEALTH OF MASSACHUSETTS
BRUCE W. HASKELL
CIVIL
No. 37467
REGISTERED PROFESSIONAL ENGINEER
10-14-22

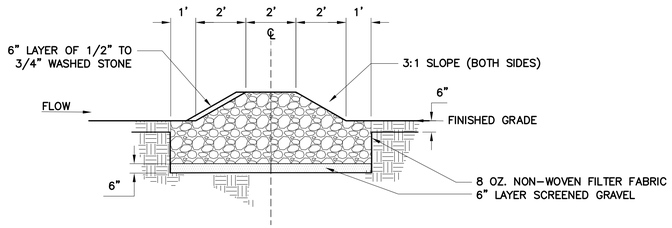
Langdon Environmental LLC
75 CONGRESS STREET SUITE 214, PO BOX 511
PORTSMOUTH, NH 03802
(617) 875-3693

Proj. Mgr.: BWH
Designed : JEC
Drawn : JEC
Checked : BWH
Scale : AS NOTED
Date : OCT. 2022

DETAILS II

LOT 26 ASH AREA
CORRECTIVE ACTION DESIGN

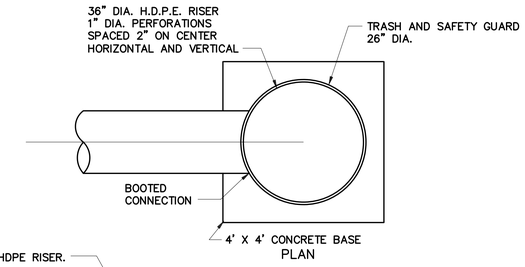
Proj. No.
Dwg. No.
D-2



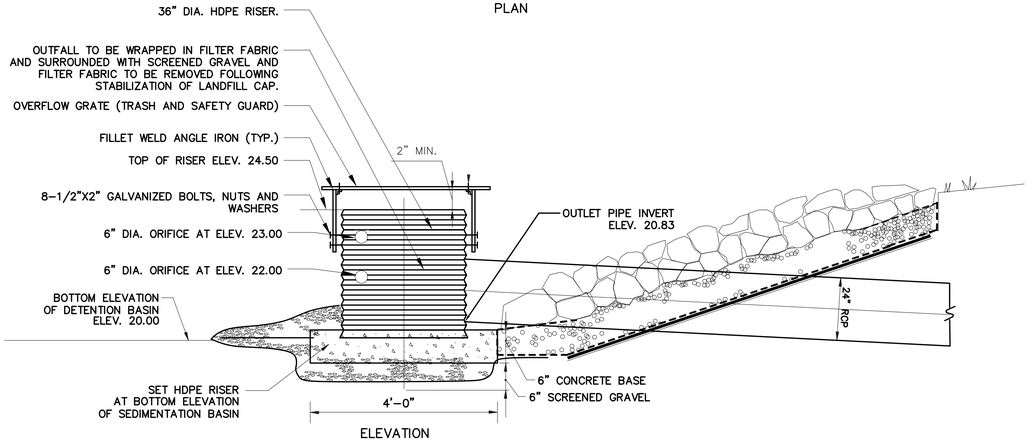
FOREBAY BERM

DETAIL 1 / D-3

SCALE: NTS



PLAN

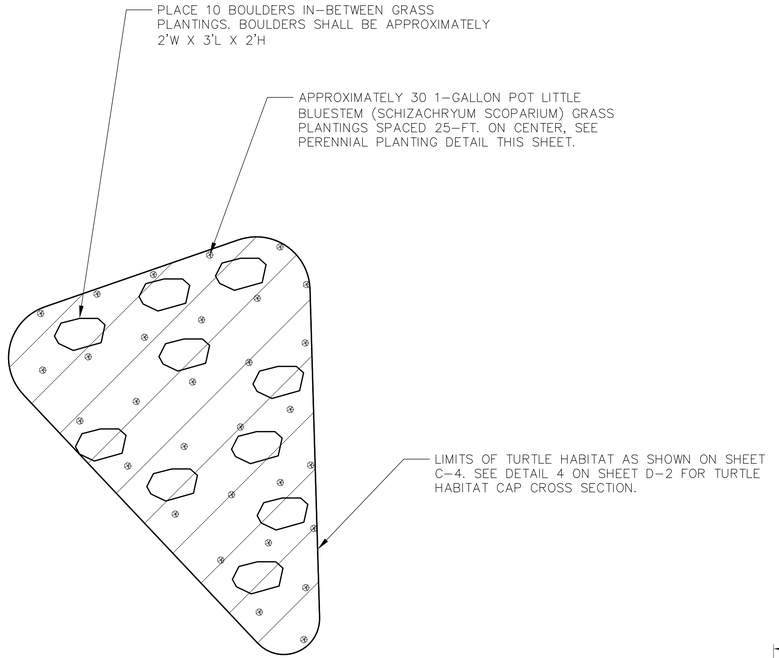


ELEVATION

BASIN OUTLET RISER PIPE SECTION

DETAIL 2 / D-2

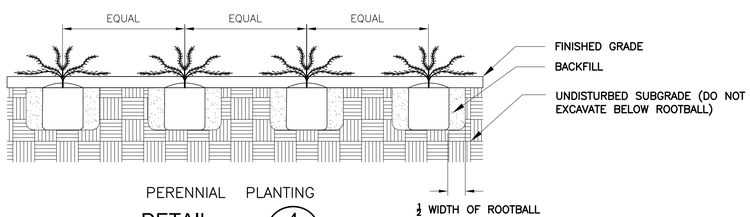
NOT TO SCALE



TURTLE HABITAT PLANTING PLAN

DETAIL 3 / D-3

SCALE: NTS



PERENNIAL PLANTING

DETAIL 4 / D-3

NOT TO SCALE

PERMIT PLAN-NOT FOR CONSTRUCTION

REVISIONS

COMMONWEALTH OF MASSACHUSETTS
BRUCE W. HASKELL
No. 49018
REGISTERED PROFESSIONAL ENGINEER
10-Nov-22

Langdon Environmental LLC
75 CONGRESS STREET SUITE 214 PO BOX 511
PORTSMOUTH, NH 03802
(617) 875-3693

Proj. Mgr: BWH
Designed : JEC
Drawn : JEC
Checked : BWH
Scale : AS NOTED
Date : OCT. 2022

DETAILS III

LOT 26 ASH AREA
CORRECTIVE ACTION DESIGN

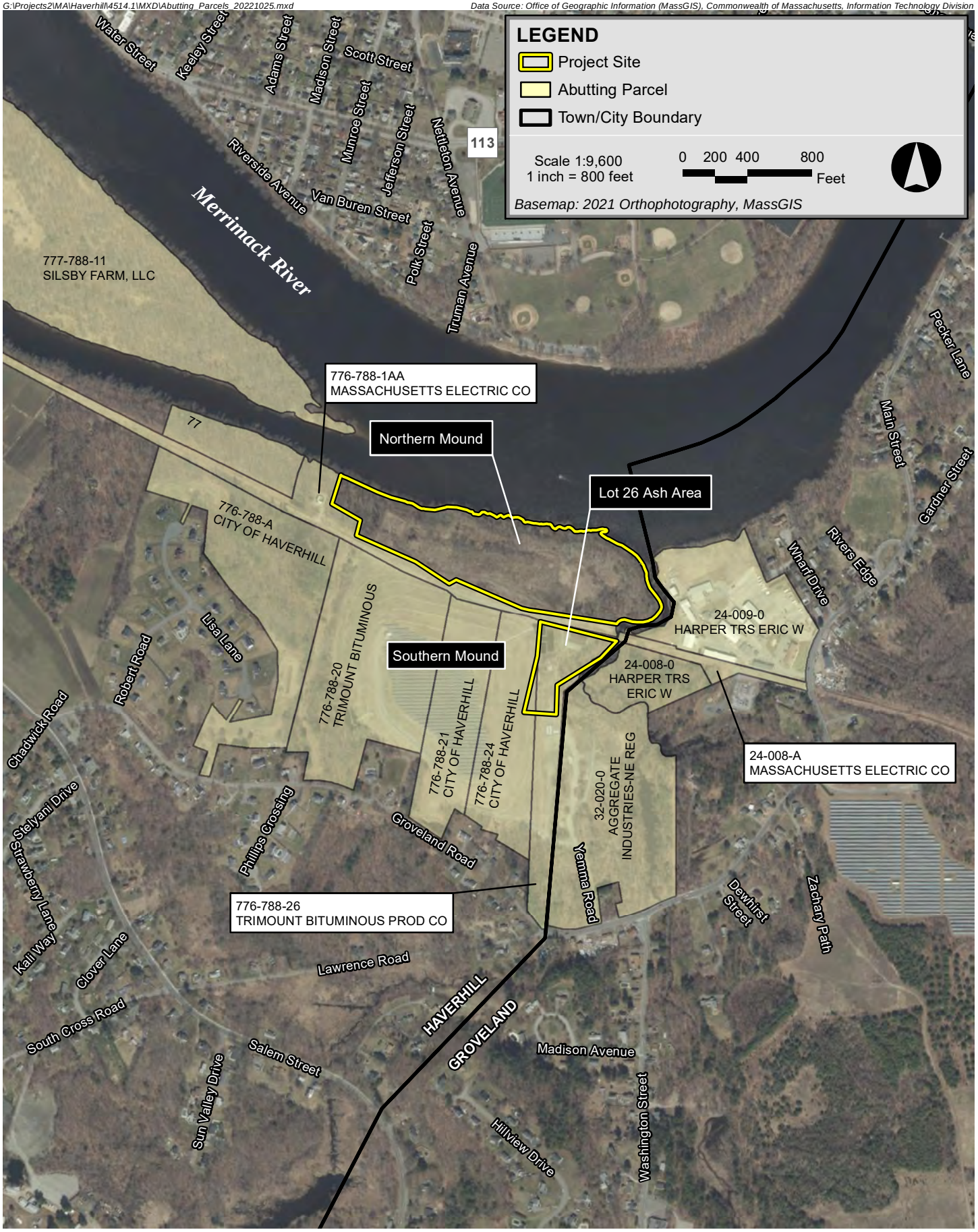
Proj. No.

Dwg. No.

D-3

Attachment E

Abutter Information



Abutting Parcels

LIST OF ABUTTERS			
Assessor Parcel ID Number	**Address**	**Current Owner (per Assessor Records)**	**Owner Address**
776-788-1AA	124 GROVELAND RD HAVERHILL, MA 01835	NATIONAL GRID (formerly MASS ELECTRIC)	40 SYLVAN RD WALTHAM, MA 02451-2286
776-788-24	GROVELAND RD HAVERHILL, MA 01835	THE CITY OF HAVERHILL	4 SUMMER ST HAVERHILL, MA 1830
776-788-26	GROVELAND RD HAVERHILL, MA 01835	TRIMOUNT BITUMINOUS PROD CO	1715 BROADWAY SAUGUS, MA 1906
776-788-20	GROVELAND RD HAVERHILL, MA 01835	TRIMOUNT BITUMINOUS PROD CO	1715 BROADWAY SAUGUS, MA 1906
776-788-21	GROVELAND RD HAVERHILL, MA 01835	THE CITY OF HAVERHILL	4 SUMMER ST HAVERHILL, MA 1830
776-788-A	LISA LN HAVERHILL, MA 01835	THE CITY OF HAVERHILL	4 SUMMER ST HAVERHILL, MA 1830
776-788-B	LISA LN HAVERHILL, MA 01835	THE CITY OF HAVERHILL	4 SUMMER ST HAVERHILL, MA 1830
777-788-11	SALEM ST HAVERHILL, MA 01835	SILSBY FARM, LLC	P.O. BOX 5421 SALISBURY, MA 1952
32-020-0 (Groveland)	5 YEMMA RD GROVELAND, MA 01834	AGGREGATE INDUSTRIES NE REG	6211 N ANN ARBOR RD DUNDEE, MI 48131
24-008-0 (Groveland)	0 MAIN ST GROVELAND, MA 01834	HARPER TRS ERIC W	8 FEDERAL WY GROVELAND, MA 01834
24-009-0 (Groveland)	441, MAIN ST GROVELAND, MA 01834	HARPER TRS ERIC W	8 FEDERAL WY GROVELAND, MA 01834
24-008-A	0 MAIN ST GROVELAND, MA 01834	NATIONAL GRID (formerly MASS ELECTRIC)	40 SYLVAN RD WALTHAM, MA 02451-2286

City of Haverhill Conservation Commission

HCC Local Application Form 3
Notice of Intent

H. ABUTTER NOTIFICATION FORM

In accordance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40 (the Wetlands Protection Act) and Haverhill Municipal Ordinance Chapter 253, Section 5, you are hereby notified of the following:

1. The name of the applicant is **City of Haverhill (Mr. Robert Ward) & Holcim – Northeast Region (Mr. Jarrett Temple)**
2. Brief Project Description: **Final Capping of the Northern Mound of the Haverhill Municipal Landfill and Lot 26 Ash Area pursuant to the Administrative Consent Order and Solid Waste Regulations (310 CMR 19.000)**
3. The applicant has filed a Notice of Intent ("NOI") with the Haverhill Conservation Commission seeking permission to remove, fill, dredge or alter an Area Subject to Protection Under the Wetlands Protection Act and/or Haverhill Municipal Ordinance Chapter 253 and/or to perform work within the buffer zone of such an Area.
4. The address of the lot where the activity is proposed is **Old Groveland Road, Haverhill, MA 01835**
   (INCLUDE ASSESSOR'S MAP/BLOCK/LOT)
5. Copies of the NOI may be examined at *the Haverhill Conservation Department Office* between the hours of *8am and 4pm* from *Monday through Friday*. Contact information is below. You may also find helpful application materials on the "Projects Under Review" section of the Commission's website.
6. Copies of the NOI may be obtained from either (check one) the applicant _____, or the applicant's representative **Dwight Dunk**, by calling this telephone number **(978) 897-7100** between the hours of **8 AM** and **5 PM** on the following days of the week **Monday to Friday**
7. Information regarding the *date, time, and place* of the public hearing may be obtained from the *Haverhill Conservation Department Office* between the hours of *8am and 4pm* from *Monday through Friday*. Contact information is below. You may also consult the "Agenda" section of the Commission's website.

NOTE: Notice of the public hearing, including its date, time and place, will be published at least five (5) days in advance in the *Haverhill Gazette newspaper*.

NOTE: Notice of the public hearing, including its date, time, and place, will be posted in Haverhill City Hall not less than forty-eight (48) hours in advance.

NOTE: You may contact the Haverhill Conservation Department for more information about this application, the Wetlands Protection Act, and Haverhill Municipal Ordinance Chapter 253. Please note the Department has only one staff person; every effort will be made to assist you in a timely manner.

Website: http://www.cityofhaverhill.org/departments/conservation_commission/index.php.
Email: conservation@cityofhaverhill.com
Phone: 978.374.2334

NOTE: For additional information about this application and the Act, you may contact the MA Department of Environmental Protection Northeast Regional Office Service Center.

Website: http://www.mass.gov/eea/agencies/massdep/about/contacts/northeast-region.html
Phone: 978.694.3200

Attachment F

Filing Fee Information

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

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

A. Applicant Information

1. Location of Project:

Old Groveland Road	Haverhill
a. Street Address	b. City/Town
Fee Exemp - City is Applicant	$0
c. Check number	d. Fee amount

2. Applicant Mailing Address:

See page 1a of 2	
a. First Name	b. Last Name

c. Organization

d. Mailing Address

e. City/Town | f. State | g. Zip Code

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

3. Property Owner (if different):

See page 1a of 2	
a. First Name	b. Last Name

c. Organization

d. Mailing Address

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.

WPA Wetland Fee Transmittal Form

A. Applicant Information | Applicant / Owner

1. City of Haverhill
   40 South Porter Street
   Haverhill, MA 01835
   Contact: Mr. Robert Ward | (978) 374-2328 | rward@haverhillwater.com

2. Holcim – Northeast Region
   35 Village Road
   Middleton, MA 01949
   Contact: Mr. Jarrett Temple | (339) 206-7719 | j.temple@holcim.com

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

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.)

Attachment G

Stormwater Report

STORMWATER MANAGEMENT REPORT

Northern Mound
Haverhill Landfill
Old Groveland Road
Haverhill, MA

Prepared for:
Langdon Environmental LLC
40 Pleasant Street, Suite 302
PO Box 511
Portsmouth, NH 03802

9.28.22

McCLURE
ENGINEERING, INC

119 Worcester Road. – Charlton, Massachusetts 01507 – T: 508.248.2005

Table of Contents

List of Sections

List of Tables

List of Appendices

Section I - Introduction

A. Scope of Analysis

McClure Engineering, Inc. (McClure) was retained to prepare this engineering analysis of pre and post-development drainage runoff conditions for the proposed landfill capping for the Northern Mound of the Haverhill Landfill located on Old Groveland Road, Haverhill, MA (Site).

This Stormwater Management Report provides the required analysis of the proposed stormwater system for compliance with the Massachusetts 310 CMR 10.00 Wetland Protection Regulations as promulgated by the Commissioner of the Massachusetts Department of Environmental Protection (MassDEP) pursuant to the authority granted under the Wetland Protection Act, M.G.L. c. 131 sec. 40 (WPA). The analysis includes pre- and post- conditions hydrologic modeling, and hydraulic sizing of the conveyance systems, sizing and analysis of Stormwater Best Management Practices (BMPs) of structural or non-structural techniques for managing stormwater to prevent or reduce non-point source pollutants from entering surface waters or ground waters. This report will demonstrate that the stormwater management system as designed and laid out complies with the referenced regulations.

A copy of the "MA-DEP Checklist for Stormwater Report" is included as **Appendix A**.

B. Site Description

The project is located on the north side of Old Groveland Road. The Site is home to the Haverhill Landfill and is known as the "Northern Mound". The parcel is identified as Assessor's parcels 776-788-27, containing approximately 13.7 acres of land. The site is located along the southern side of the Merrimack River and the western side of Johnson Creek. There are also wetlands associated with an intermittent stream along the western side of the property.

According to the Massachusetts Geographic Information System, the area along the Merrimack River is a Priority Habitat area and work in this area will be conducted through approval of the NHESP. The Site falls outside of any surface water protection areas and wellhead protection areas. The section of the Merrimack River in which the site sits is considered a Class SB water.

There are on-site FEMA Flood Hazard areas per Flood Insurance Rate Map (FIRM) Number 25009C0093F, Effective on 07/03/2012 (see **Appendix C**).

C. Proposed Construction

The project proposes to complete the corrective actions required by the Solid Waste Management Regulations (310 CMR 19.000) promulgated by MassDEP at the Haverhill Landfill (Landfill). The activities include capping of an existing landfill known as the Northern Mound. The proposed project can be considered a redevelopment project. Reconstruction of the existing stormwater detention basin is proposed, which includes the enlarging of the basin itself, the construction of an emergency spillway, and the replacement of the outlet control structure..

Stormwater management controls are incorporated into landfill closure design to minimize impacts on the surrounding environment and to protect the landfill cap from damage caused by erosion. Stormwater controls provide the following critical functions:
• Maintain the integrity of the landfill cap by preventing erosion of the soil layers above the membrane cap;
• Minimize the potential production of leachate by diverting stormwater runoff away from the landfill surface and preventing water ponding on the capped landfill; and
• Minimize the transport of stormwater sediment from the capped landfill surface into adjacent receiving waters.

The integrity of the cap is maintained by the grass, topsoil, and drainage layer above the cap. Existing drainage swales are being maintained and utilized to convey stormwater to pipes on the southern side of the mound. The western, northern, and eastern sides of the mound will sheet flow from the site over the stabilized cap.

Section II - Hydrologic Analysis

A. Purpose

The purpose of this analysis is to determine the peak rate of stormwater runoff leaving the site and to design a stormwater management system that will prevent offsite flooding impacts. MassDEP Stormwater Management Policy, Standard No. 2, requires that post-development peak stormwater discharge rates shall not exceed pre-development levels.

B. Methodology

The pre- and post-development stormwater runoff has been analyzed using HydroCAD, a stormwater modeling computer program. HydroCAD is a collection of techniques for the generation and routing of hydrographs, including Soil Conservation Service (SCS) Technical Release No. 20 (TR-20) and SCS Technical Release 55 (TR-55), Urban Hydrology for Small Watersheds. The analysis routes completely through one node at a time determining each outflow hydrograph before considering the next node.

The subcatchments have been modeled using SCS methods. Curve numbers, which are based upon the type of development and soil classifications, coupled with the time of concentration have been used to generate the peak storm flow for each area. The detailed information and results are provided in this report.

Hydrology

Computer Model:	HydroCAD 10.0 © 2013 Applied Microcomputer Systems, drainage modeling software;
Hydrologic Methodology:	TR-55 Methodology is used for analysis of peak flow and infiltration basin sizing.
Watershed Areas:	Watershed areas are calculated using AutoCAD software based on the subcatchment areas delineated on topographic mapping included as “Pre-Development Drainage” and “Post-Development Drainage”. The areas shown, times of concentration and runoff coefficients are all consistent with the TR-55 drainage calculation method.

C. Selection of Storm Events

The intensity for each storm event was determined from the National Oceanic and Atmospheric Administration National Weather Service Atlas 14 Point Precipitation Frequency Estimates (See **Appendix C**). Evaluations were based upon a Type III, 24-hour storm. Rainfall frequency and intensity used in this analysis are as follows:

Design Storm Event	Rainfall Intensity
2 year	3.19 inches
10 year	5.05 inches
25 year	6.21 inches
100 year	8.00 inches

D. Soils Classification

Site soils classifications were obtained from the following sources:

1.) Advanced soil mapping performed by the U.S. Department of Agriculture’s Natural Resources Conservation Service (NRCS), “Soil Survey of Essex County, Massachusetts.” (See **Appendix C** for detailed soil information).

The soils descriptions are mapped as follows:

718A – Saco Silt Loam
652 – Udorthents, refuse substratum
600 – Pits. Gravel
255B – Windsor Loamy Sand

As the site is an existing landfill, all soils are assumed to be HSG "C".

E. Pre-Development Model Summary

For stormwater management system design purposes, the pre-development condition is based on the existing site conditions. Stormwater runoff from the Project area has been broadly divided into six (6) major drainage sub-catchments with five (5) point of analysis – the Merrimack River, Wetlands to the West, (2) 18" Cross Culverts to the South, and Johnson Creek.

In the Pre-Development condition, the surface cover is based upon recent aerial ortho imagery and survey information provided.

The graphical presentation of the pre-development model is shown in **Appendix D**.

F. Post-Development Model Summary

For the required corrective actions, landfilled waste will be relocated and covered with soils, additional contouring soils will be imported and placed and the final cap will be constructed. Stormwater runoff from the Post-Development Project area has been broadly divided into six (6) major drainage sub-catchments with five (5) point of analysis – the Merrimack River, Wetlands to the West, (2) 18" Cross Culverts to the South, and Johnson Creek.

The graphical presentation of the post development model is shown in **Appendix E**.

G. Summary of Peak Stormwater Discharge Rates

The Pre- and Post-Analyses HydroCAD Report of the 2, 10, 25 and 100 year frequency storms is provided in **Appendix D** and **E** respectively. The following summary tables present results for the pre- and post-development analysis for the 2, 10, 25 and 100 year, 24-hr storm events at the analysis points as previously described.

The tables show that post peak rate of runoff is less than or equal to that of pre-existing peak rate of runoff for all the storms as studied for all analysis points. There is a very slight increase of 0.02 cfs during a 100 year storm event to one of the roadway cross culverts which should be considered de minimis. This flow is directed towards the existing detention basin. The outlet control structure of the basin is proposed to be slightly modified to attenuate flows as necessary for discharge to Johnson Creek, AP5. All flows and analysis points are also subject to coastal storm flowage, however the analysis does indicate no impact to downstream flood elevations.

Table No. 1
Analysis Point 1: Merrimack River

	Pre-Development (cfs)	Post-Development (cfs)
2 Year Storm	12.10	9.52
10 Year Storm	27.56	23.37
25 Year Storm	37.88	32.83
100 Year Storm	54.19	47.97

Table No. 2
Analysis Point 2: Western Wetlands

	Pre-Development (cfs)	Post-Development (cfs)
2 Year Storm	1.90	1.66
10 Year Storm	4.33	4.09
25 Year Storm	5.96	5.77
100 Year Storm	8.53	8.44

Table No. 3
Analysis Point 3: Outlet Southwestern 18” Cross Culvert

	Pre-Development (cfs)	Post-Development (cfs)
2 Year Storm	1.58	1.38
10 Year Storm	3.60	3.40
25 Year Storm	4.95	4.78
100 Year Storm	7.09	6.99

Table No. 4
Analysis Point 4: Outlet Southeastern 18” Cross Culvert

	Pre-Development (cfs)	Post-Development (cfs)
2 Year Storm	1.84	1.65
10 Year Storm	4.09	3.98
25 Year Storm	5.48	5.48
100 Year Storm	6.45	6.47*

Table No. 5
Analysis Point 5: Johnson Creek

	Pre-Development (cfs)	Post-Development (cfs)
2 Year Storm	4.46	4.07
10 Year Storm	10.17	10.03
25 Year Storm	18.94	14.75
100 Year Storm	40.05	29.27

Section III – Stormwater Standards

A. Standard 1 – Computations to Show That Discharge Does Not Cause Scour or Erosion

No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

Proposed Full Compliance:

The Project is designed with no new stormwater conveyances, therefore there will be no discharge of untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth of Massachusetts.

B. Standard 2 – Peak Rate Attenuation

Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage.

Proposed Full Compliance:

The peak rate attenuation analyses and summaries have been reported in hydrologic analysis provided in Section 2.G of this report documenting there is no increase to off-site peak flow rates*. The proposed stormwater conveyances will control the post-development peak discharge rates less than the predevelopment peak discharge rates for the 2-year, 10-year, 25-year, and 100-year 24-hour storm events. A review of FEMA Flood Insurance Rate Map was reviewed for this site. The mapping does show a flood hazard area mapped on this site. The analysis as submitted indicates that there will be no increase in rate of runoff that would cause an increase of the flood elevation downstream.

*There is a very slight increase of 0.02 cfs during a 100 year storm event out of one of the roadway cross culverts which should be considered de minimis. Inflow to the culvert is actually lower during this storm, however outflow is increased by 0.02 cfs due to a slight increase in overall volume to the culvert. This flow is then directed towards the detention basin. The basin is proposed to be reconstructed including expanding of the basin and replacement of the outlet control structure, which will attenuate flows as necessary for discharge to Johnson Creek, AP5. Analysis points 1, 2, and 5 are also subject to coastal storm flowage, however the analysis does indicate no impact to downstream flood elevations.

C. Standard 3 – Recharge

Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post- development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Proposed Maximum Extent Practicable Compliance:

Per the Massachusetts Stormwater Handbook Volume 1: Overview of the Massachusetts Stormwater Standards, Chapter 1: MassDEP recognizes that it may be difficult to infiltrate the required recharge volume on certain sites because of soil conditions. For sites comprised solely of C and D soils and bedrock at the land surface, proponents are required to infiltrate the required recharge volume only to the maximum extent practicable. MassDEP also recognizes that on some sites, there is a risk that infiltrating the required recharge volume may cause or contribute to groundwater contamination. Consequently, MassDEP requires infiltration only to the maximum extent practicable on the following sites: sites where recharge is proposed at or adjacent to an area

classified as contaminated, sites where contamination has been capped in place; sites that have an Activity and Use Limitation (AUL) that precludes inducing runoff to the groundwater, pursuant to MGL Chapter 21E and the Massachusetts Contingency Plan 310 CMR 40.0000; sites that are the location of a solid waste landfill as defined in 310 CMR 19.000; and sites where groundwater from the recharge location flows directly toward a solid waste landfill or 21E site.

Additionally, the Solid Waste Regulations (310 CMR 19.115) state: Stormwater controls shall prevent erosion, discharge of pollutants, protect the physical integrity of the landfill and be managed according to applicable standards established by the Department, including but not limited to, wetlands protection regulations at 310 CMR 10.05(6)(b), and the Department's Stormwater Policy. For purposes of meeting stormwater standards established by the Department, recharge shall be permitted at the landfill only where the recharge will not adversely impact the quality of groundwater leaving the site.

Therefore, because the project is the proposed closure of a solid waste landfill, groundwater recharge for the site is not proposed in accordance with the above cited guidance and regulations. The function of the landfill closure is to minimize recharge and contamination to groundwater.

D. Standard 4 – Water Quality

Stormwater management systems must be designed to remove 80% of the average annual post construction load of Total Suspended Solids (TSS). This standard is met when:

a. *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter implemented and maintained;*
b. *Stormwater BMPs are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and*
c. *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

Proposed Maximum Extent Practicable Compliance:

The proposed Project will provide source reduction of potential TSS through the use of a vegetated cap paired with stone lined swales and check dams. These proposed stormwater BMPs will provide for an improvement of TSS removal beyond what is currently existing on site. The Project site is proposed to be fully stabilized at the completion of construction to eliminate the potential of TSS. The proposed stormwater improvements meet the TSS removal requirement as there is no proposed impervious areas and no TSS production associated with the vegetated capping system. Standard 4 also requires the development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long-term pollution prevention plan. As further described in the response to Standard #9, the Post- Closure Maintenance Plan required by MassDEP includes a long-term inspection and maintenance program.

A "Long Term Operation and Maintenance Plan" for stormwater controls is being provided as **Appendix H**.

E. Standard 5 – Land Uses with Higher Potential Pollutant Loads

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, or stormwater runoff, the proponent shall use the specific stormwater BMP's determined by the Department to be suitable for such use as provided in the Massachusetts Stormwater Handbook.

Proposed Full Compliance:

The site is considered a Land Use with Higher Potential Pollutant Loads (LUHPPL), as it is a solid waste landfill facility. The Project includes excavation and relocation of waste as well as placement of contouring materials and landscaping and installation of a final cap meeting the requirements of MassDEP's Solid Waste Management Regulations (310 CMR 19.000).

F. Standard 6 – Critical Areas

Stormwater discharges to a Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or any other critical area require the use of the specific stormwater best management practices determined by the Department to be suitable for managing discharges to such area as provided in the Massachusetts Stormwater Handbook.

Proposed Full Compliance:

- The site does discharge to Outstanding Resource Waters (Class SB – Merrimack River and bordering wetlands). No groundwater recharge is proposed as the project is the proposed capping of a landfill therefore 44% pretreatment of runoff prior to infiltration is not necessary. The project also does not include any proposed impervious areas, therefore TSS removal is not necessary and a WQv associated with a 1" WQ depth is achieved.

G. Standard 7 - Redevelopment

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable; Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

Proposed Full Compliance:

The Site is considered a redevelopment. The proposed Site is proposed to fully meet Standards 1, 2, 4, 5, 6, 7, 8, 9, and 10. Standard 3 is proposed to be met to the maximum extent practicable as the project is the capping of an existing landfill.

H. Standard 8 – Construction Period Controls

A plan to control construction related impacts including erosion sedimentation and other pollution prevention sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) must be implemented.

Proposed Full Compliance:

Projects that disturb one acre of land or more are required to obtain coverage under the NPDES Construction General Permit issued by EPA and prepare a Construction SWPPP. A Construction SWPPP for the Project will be prepared by the contractor prior to the start of construction. The Construction SWPPP will identify the potential sources of pollution reasonably expected to affect stormwater quality and documents the selection, design, installation, and implementation of BMPs for erosion and sediment control and pollutant reduction during construction.

- Draft - Weekly Construction Period Inspection Report is provided as **Appendix F**.

- Project will disturb > 1 Acre, therefore an EPA–NPDES Stormwater General Permit is required. A request for permit coverage will be submitted to USEPA in an electronic Notice of Intent (NOI) for the closure project. A copy of the completed NOI form and applicable USEPA authorization documentation will be included in the Construction SWPPP upon completion.

I. Standard 9 – Operation and Maintenance Plan

A long term operation and maintenance plan must be developed and implemented to ensure that stormwater management systems function as designed.

Proposed Full Compliance:

- Long Term Operation and Maintenance Plan for stormwater controls is included in the Stormwater Management Report, **Appendix G**.

J. Standard 10 – Illicit Discharges to Drainage System

All illicit discharges to the stormwater management system are prohibited.

Proposed Full Compliance:

- The Long Term Operation and Maintenance Plan provided in **Appendix G** addresses illicit discharges to drainage system.

- An illicit discharge compliance statement, signed by the owner and/or operator, shall be submitted prior to the discharge of stormwater runoff to the post-construction stormwater best management practices.

Appendix A includes a copy of the "MA-DEP Checklist for Stormwater Report".

Appendix B includes a USGS Topo Map.

Appendix C includes a FEMA FIRM Map, USDA NRCS Site Soil Maps, and NOAA Atlas 14 Precipitation Data.

Appendix D & E includes the complete Pre-Development and Post-Development drainage calculation reports.

Appendix F provides a DRAFT "Weekly Construction Period Inspection Report"

Appendix G provides a DRAFT "Long Term Stormwater Operation & Maintenance Plan"

APPENDIX A

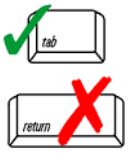
MA-DEP STORMWATER CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

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



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

9.28.22

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☒ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☒ Solid Waste Landfill pursuant to 310 CMR 19.000

☒ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☒ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☒ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☒ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☒ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☒ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☒ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☒ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☒ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

APPENDIX B

USGS Map

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

HAVERHILL QUADRANGLE
MASSACHUSETTS - NEW HAMPSHIRE
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid:Universal Transverse Mercator, Zone 19T

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, July 2016 - October 2016
Roads.....U.S. Census Bureau, 2016 - 2017
Names.....GNIS, 1974 - 2018
Hydrography.....National Hydrography Dataset, 2004 - 2017
Contours.....National Elevation Dataset, 2012
Boundaries.....Multiple sources; see metadata file 2016 - 2017
Wetlands.....FWS National Wetlands Inventory 1985 - 2012

MN
GN
14°34´
259 MILS
1°24´
25 MILS
UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000 - m Square ID
CH
Grid Zone Designation 19T

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

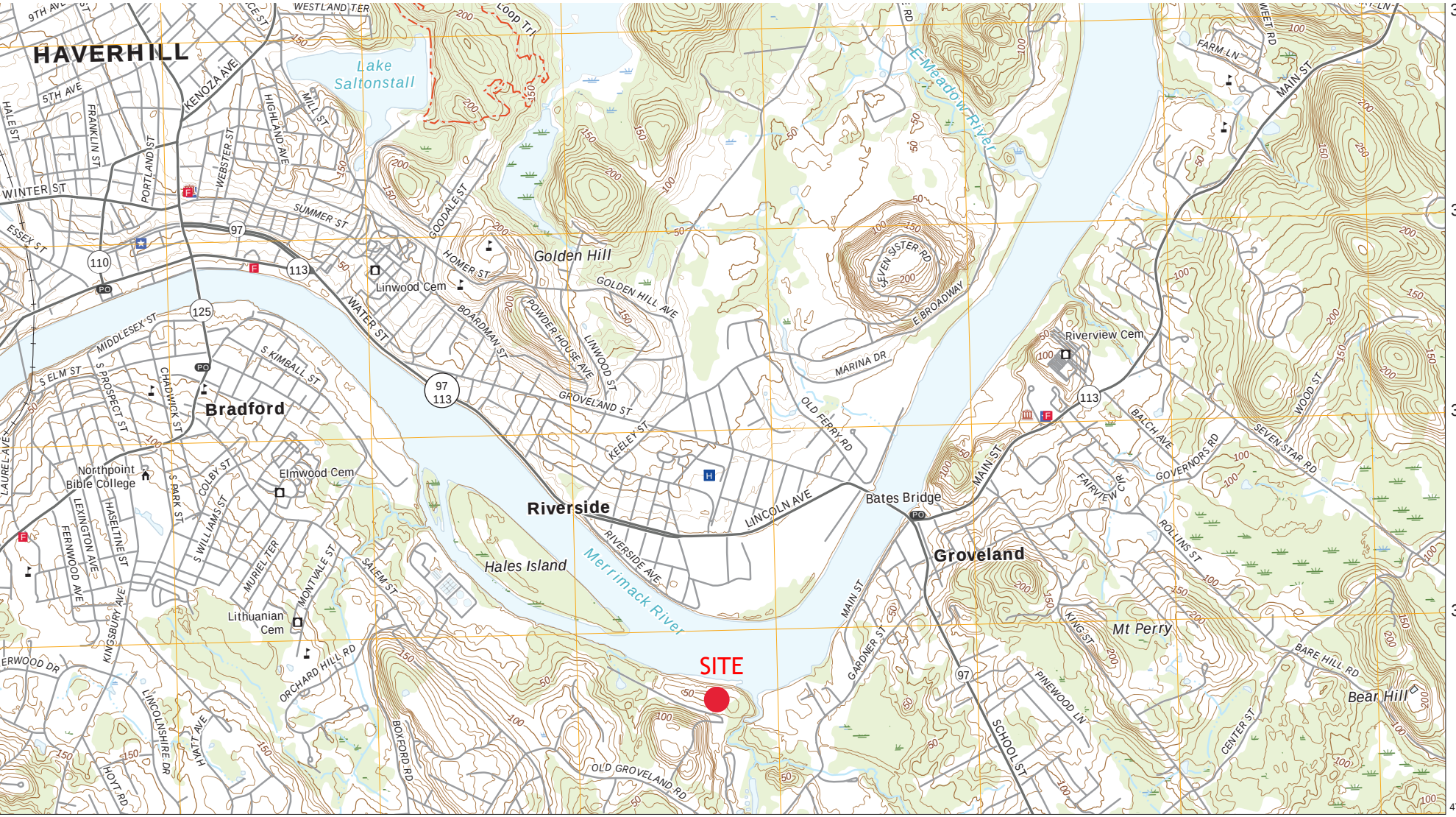
MASSACHUSETTS
QUADRANGLE LOCATION

1 Sandown
2 Kingston
3 Exeter
4 Salem Depot
5 Newburyport West
6 Lawrence
7 South Groveland
8 Georgetown

ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

HAVERHILL, MA, NH
2021


HAVERHILL
Lake Saltonstall
Golden Hill
Linwood Cem
Bradford
Riverside
Hales Island
Merrimack River
Meadow River
Riverview Cem
Bates Bridge
Groveland
Mt Perry
Bear Hill
Elmwood Cem
Lithuanian Cem
Northpoint Bible College
SITE
WESTLAND TER
5TH AVE
KENOZA AVE
WINTER ST
SUMMER ST
ESSEX ST
MILL ST
HIGHLAND AVE
WEBSTER ST
PORTLAND ST
FRANKLIN ST
GOODALE ST
HOMER ST
GOLDEN HILL AVE
BOARDMAN ST
POWDER HOUSE AVE
LINWOOD ST
WATER ST
MIDDLESEX ST
S ELM ST
S PROSPECT ST
CHADWICK ST
S KIMBALL ST
GROVELAND ST
KEELEY ST
OLD FERRY RD
MARINA DR
E BROADWAY
SEVEN SISTER RD
FARM LN
MAIN ST
WOOD ST
BALCH AVE
SEVEN STAR RD
GOVERNORS RD
FAIRVIEW CIR
ROLLINS ST
LINCOLN AVE
RIVERSIDE AVE
COLBY ST
S PARK ST
S WILLIAMS ST
LEXINGTON AVE
HASELTINE ST
FERNWOOD AVE
MUIRIEL TER
MONTVALE ST
SALEM ST
ORCHARD HILL RD
KINGSBURY AVE
LINCOLNSHIRE DR
HYATT AVE
HOYT RD
BOXFORD RD
OLD GROVELAND RD
GARDNER ST
KING ST
PINEWOOD LN
SCHOOL ST
CENTER ST
BARE HILL RD
LAUREL AVE
ERWOOD DR
97
110
113
125
39
38
37
36
30
31
32
33
34
35
47 35000m N
3 36000m E
42.7500°
-71.0000°

APPENDIX C

FEMA - FLOOD PLAIN MAPPING

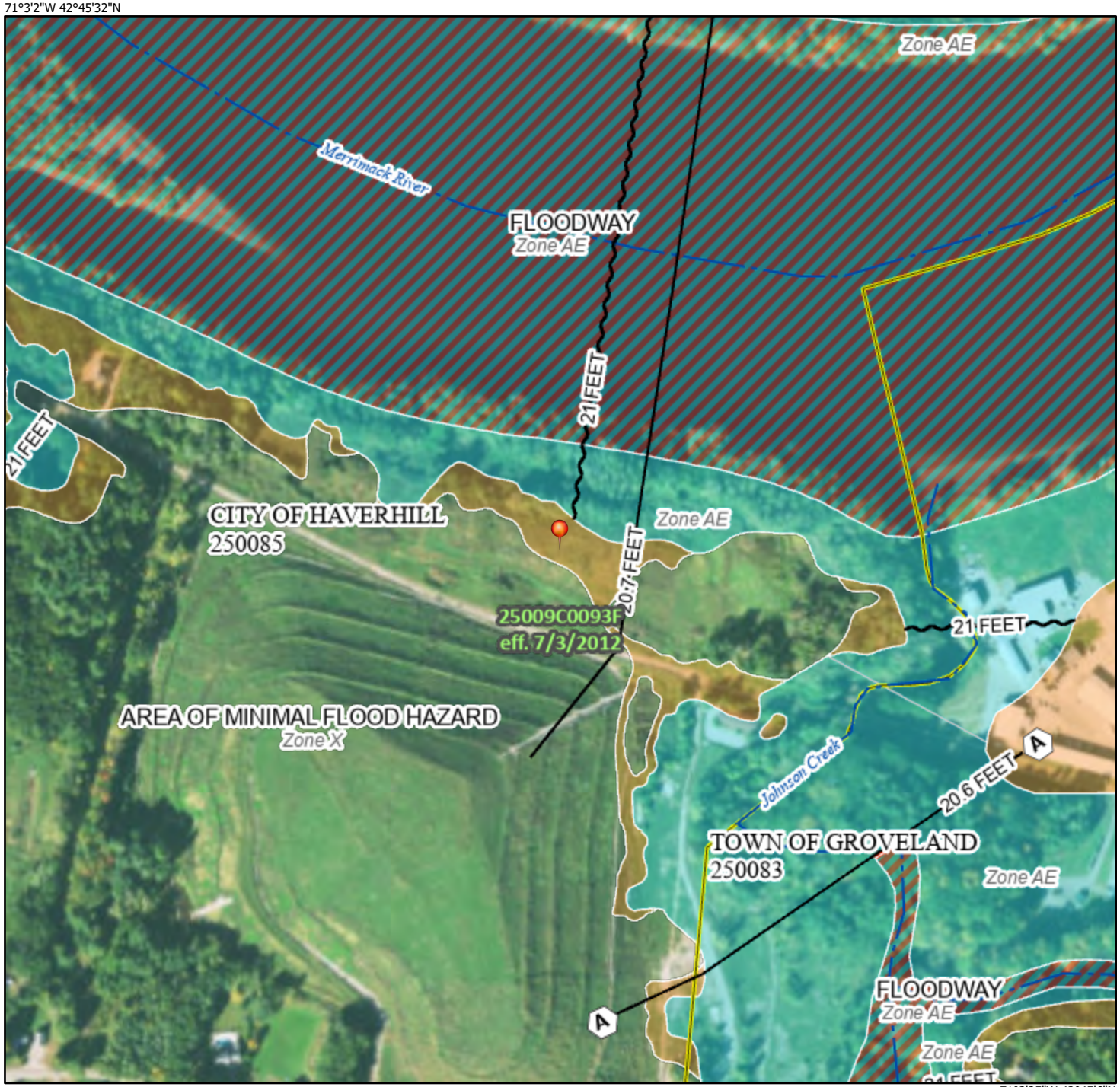
NCRS SOIL MAPPING

NOAA PRECIPITATION FREQUENCY ESTIMATES

National Flood Hazard Layer FIRMette

FEMA

71°3'2"W 42°45'32"N



71°2'25"W 42°45'6"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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

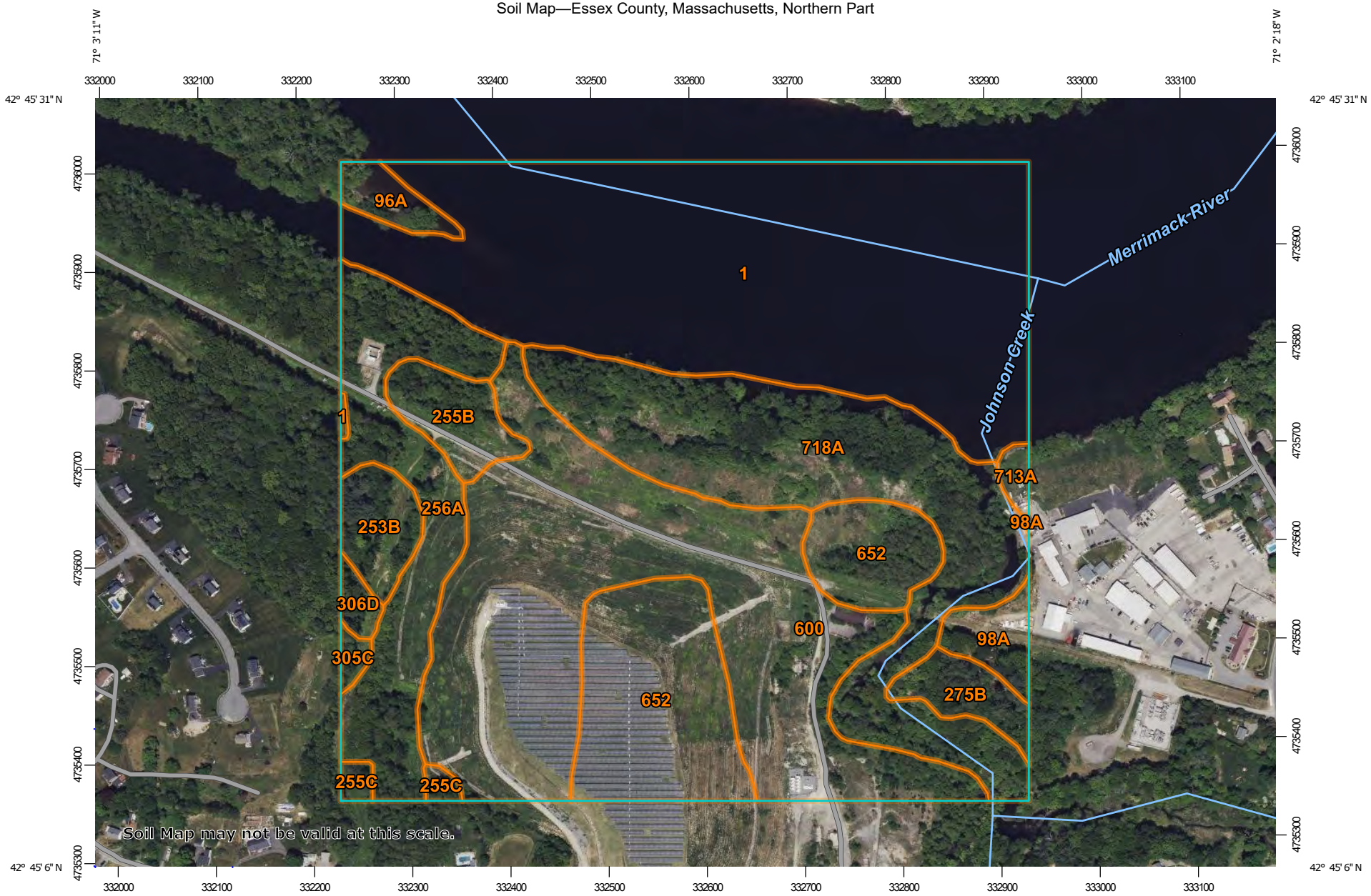
N

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 9/28/2022 at 11:51 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.



Map Scale: 1:5,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 17, Sep 2, 2021

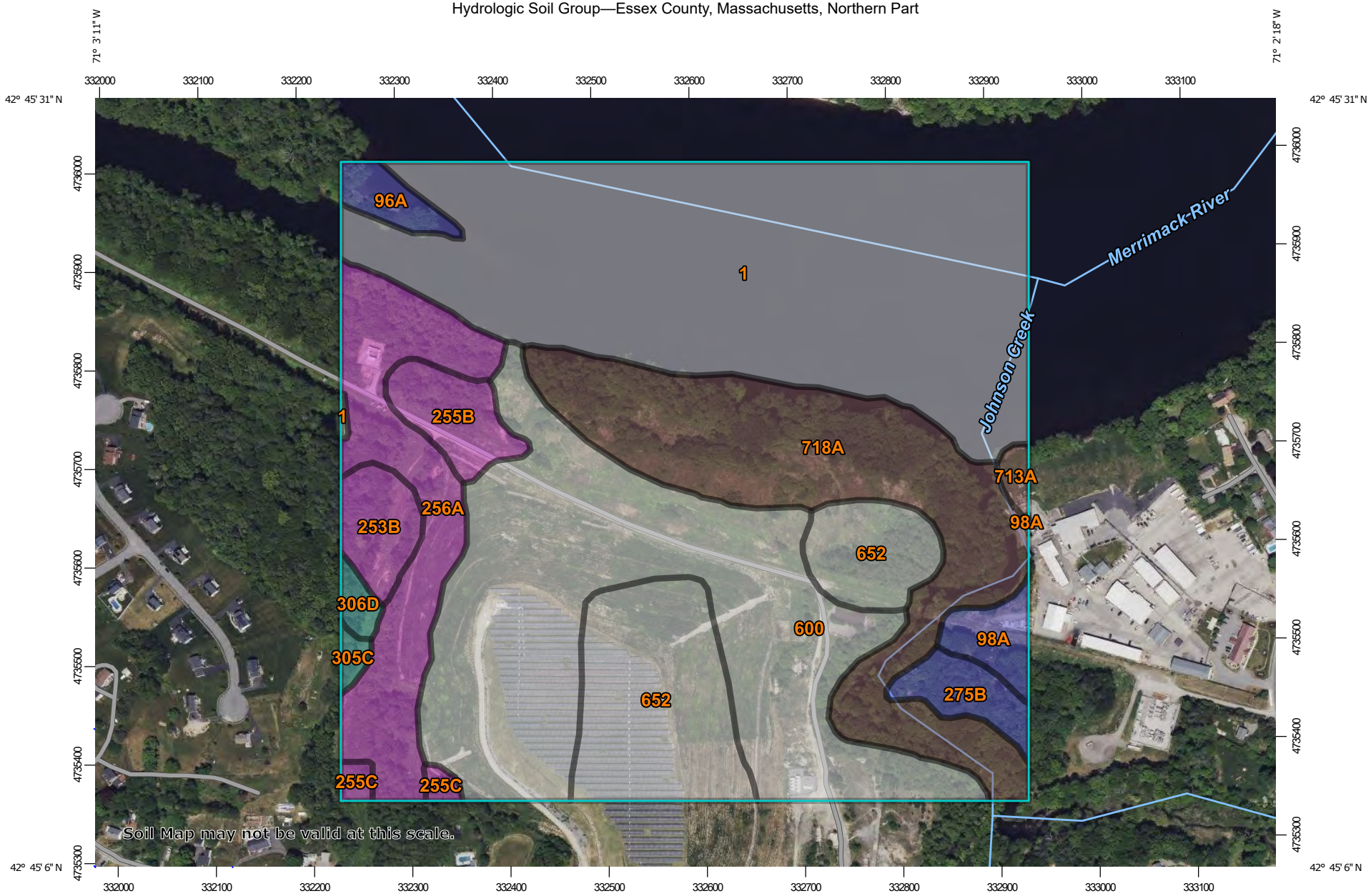
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	35.1	31.1%
96A	Hadley very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	1.2	1.1%
98A	Winooski very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	1.5	1.4%
253B	Hinckley loamy sand, 3 to 8 percent slopes	2.1	1.9%
255B	Windsor loamy sand, 3 to 8 percent slopes	2.4	2.2%
255C	Windsor loamy sand, 8 to 15 percent slopes	0.6	0.5%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	9.7	8.6%
275B	Agawam fine sandy loam, 3 to 8 percent slopes	1.8	1.6%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	0.4	0.3%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	0.6	0.5%
600	Pits, gravel	27.2	24.1%
652	Udorthents, refuse substratum	11.5	10.2%
713A	Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded	0.4	0.4%
718A	Saco variant silt loam, frequently ponded, 0 to 1 percent slopes, frequently flooded	18.2	16.1%
Totals for Area of Interest		**112.8**	**100.0%**



Map Scale: 1:5,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 17, Sep 2, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		35.1	31.1%
96A	Hadley very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	B	1.2	1.1%
98A	Winooski very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	B	1.5	1.4%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	2.1	1.9%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	2.4	2.2%
255C	Windsor loamy sand, 8 to 15 percent slopes	A	0.6	0.5%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	9.7	8.6%
275B	Agawam fine sandy loam, 3 to 8 percent slopes	B	1.8	1.6%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	0.4	0.3%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	C	0.6	0.5%
600	Pits, gravel		27.2	24.1%
652	Udorthents, refuse substratum		11.5	10.2%
713A	Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded	B/D	0.4	0.4%
718A	Saco variant silt loam, frequently ponded, 0 to 1 percent slopes, frequently flooded	B/D	18.2	16.1%
Totals for Area of Interest			**112.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOAA Atlas 14, Volume 10, Version 3
Location name: Haverhill, Massachusetts, USA*
Latitude: 42.7552°, Longitude: -71.0455°
Elevation: 51.98 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.308** (0.243-0.383)	**0.368** (0.290-0.458)	**0.466** (0.367-0.582)	**0.547** (0.428-0.687)	**0.658** (0.496-0.861)	**0.742** (0.547-0.992)	**0.829** (0.592-1.15)	**0.926** (0.626-1.31)	**1.06** (0.690-1.56)	**1.17** (0.743-1.76)
10-min	**0.437** (0.345-0.543)	**0.521** (0.411-0.649)	**0.659** (0.518-0.823)	**0.774** (0.604-0.972)	**0.932** (0.703-1.22)	**1.05** (0.776-1.41)	**1.18** (0.839-1.63)	**1.31** (0.887-1.86)	**1.51** (0.977-2.21)	**1.66** (1.05-2.49)
15-min	**0.514** (0.406-0.639)	**0.613** (0.484-0.763)	**0.775** (0.609-0.967)	**0.910** (0.711-1.14)	**1.10** (0.827-1.44)	**1.24** (0.912-1.65)	**1.38** (0.987-1.92)	**1.54** (1.04-2.19)	**1.77** (1.15-2.60)	**1.96** (1.24-2.93)
30-min	**0.707** (0.559-0.879)	**0.844** (0.666-1.05)	**1.07** (0.839-1.33)	**1.25** (0.979-1.58)	**1.51** (1.14-1.98)	**1.70** (1.25-2.27)	**1.90** (1.36-2.64)	**2.12** (1.44-3.02)	**2.44** (1.58-3.58)	**2.69** (1.70-4.04)
60-min	**0.901** (0.711-1.12)	**1.08** (0.848-1.34)	**1.36** (1.07-1.70)	**1.60** (1.25-2.00)	**1.92** (1.45-2.52)	**2.17** (1.60-2.90)	**2.42** (1.73-3.36)	**2.71** (1.83-3.84)	**3.11** (2.02-4.56)	**3.43** (2.17-5.14)
2-hr	**1.16** (0.926-1.44)	**1.40** (1.11-1.73)	**1.78** (1.41-2.21)	**2.10** (1.65-2.61)	**2.53** (1.93-3.31)	**2.86** (2.13-3.82)	**3.20** (2.32-4.46)	**3.62** (2.46-5.11)	**4.24** (2.76-6.20)	**4.77** (3.03-7.11)
3-hr	**1.35** (1.08-1.66)	**1.62** (1.30-2.00)	**2.08** (1.65-2.56)	**2.45** (1.94-3.04)	**2.97** (2.27-3.87)	**3.35** (2.51-4.47)	**3.76** (2.75-5.24)	**4.27** (2.91-6.01)	**5.05** (3.29-7.35)	**5.72** (3.64-8.49)
6-hr	**1.72** (1.39-2.11)	**2.09** (1.69-2.56)	**2.69** (2.16-3.30)	**3.19** (2.55-3.93)	**3.87** (2.99-5.02)	**4.37** (3.31-5.81)	**4.92** (3.62-6.83)	**5.61** (3.83-7.84)	**6.67** (4.36-9.65)	**7.59** (4.84-11.2)
12-hr	**2.17** (1.77-2.64)	**2.65** (2.16-3.22)	**3.43** (2.79-4.19)	**4.08** (3.29-5.01)	**4.98** (3.87-6.41)	**5.64** (4.29-7.44)	**6.36** (4.70-8.76)	**7.24** (4.97-10.1)	**8.61** (5.66-12.4)	**9.79** (6.27-14.3)
24-hr	**2.57** (2.12-3.10)	**3.20** (2.63-3.86)	**4.21** (3.45-5.10)	**5.06** (4.11-6.16)	**6.22** (4.88-7.97)	**7.07** (5.43-9.29)	**8.00** (5.98-11.0)	**9.18** (6.33-12.7)	**11.0** (7.26-15.7)	**12.6** (8.11-18.4)
2-day	**2.90** (2.40-3.47)	**3.67** (3.05-4.40)	**4.94** (4.08-5.95)	**6.00** (4.92-7.26)	**7.45** (5.91-9.53)	**8.50** (6.60-11.2)	**9.68** (7.32-13.3)	**11.2** (7.76-15.4)	**13.7** (9.06-19.4)	**15.9** (10.2-23.0)
3-day	**3.18** (2.65-3.79)	**4.01** (3.35-4.79)	**5.38** (4.47-6.45)	**6.51** (5.37-7.85)	**8.07** (6.43-10.3)	**9.21** (7.18-12.0)	**10.5** (7.96-14.4)	**12.1** (8.42-16.6)	**14.9** (9.84-21.0)	**17.3** (11.1-24.9)
4-day	**3.45** (2.89-4.10)	**4.31** (3.61-5.13)	**5.72** (4.77-6.83)	**6.89** (5.70-8.28)	**8.49** (6.79-10.8)	**9.66** (7.56-12.6)	**11.0** (8.35-15.0)	**12.7** (8.82-17.3)	**15.5** (10.3-21.8)	**18.0** (11.6-25.8)
7-day	**4.21** (3.56-4.98)	**5.10** (4.30-6.04)	**6.56** (5.51-7.80)	**7.77** (6.48-9.29)	**9.43** (7.59-11.9)	**10.6** (8.37-13.8)	**12.0** (9.16-16.3)	**13.8** (9.61-18.6)	**16.6** (11.1-23.3)	**19.2** (12.4-27.4)
10-day	**4.89** (4.15-5.77)	**5.81** (4.92-6.86)	**7.31** (6.17-8.65)	**8.55** (7.16-10.2)	**10.3** (8.28-12.9)	**11.5** (9.07-14.8)	**12.9** (9.84-17.3)	**14.7** (10.3-19.8)	**17.5** (11.7-24.4)	**20.0** (12.9-28.4)
20-day	**6.83** (5.85-8.00)	**7.84** (6.71-9.19)	**9.49** (8.09-11.2)	**10.9** (9.19-12.9)	**12.8** (10.3-15.7)	**14.2** (11.2-17.9)	**15.7** (11.9-20.5)	**17.4** (12.3-23.3)	**19.9** (13.4-27.6)	**22.0** (14.3-31.1)
30-day	**8.43** (7.26-9.83)	**9.52** (8.19-11.1)	**11.3** (9.68-13.2)	**12.8** (10.9-15.1)	**14.8** (12.0-18.1)	**16.4** (12.9-20.4)	**18.0** (13.6-23.2)	**19.7** (13.9-26.1)	**22.0** (14.8-30.3)	**23.8** (15.5-33.5)
45-day	**10.5** (9.07-12.1)	**11.6** (10.1-13.5)	**13.6** (11.7-15.8)	**15.2** (13.0-17.8)	**17.4** (14.2-21.1)	**19.1** (15.1-23.6)	**20.8** (15.6-26.5)	**22.4** (16.0-29.7)	**24.6** (16.6-33.7)	**26.2** (17.1-36.7)
60-day	**12.2** (10.6-14.1)	**13.4** (11.7-15.6)	**15.5** (13.4-18.0)	**17.2** (14.7-20.1)	**19.5** (15.9-23.6)	**21.3** (16.9-26.2)	**23.1** (17.4-29.2)	**24.7** (17.7-32.6)	**26.8** (18.2-36.6)	**28.3** (18.5-39.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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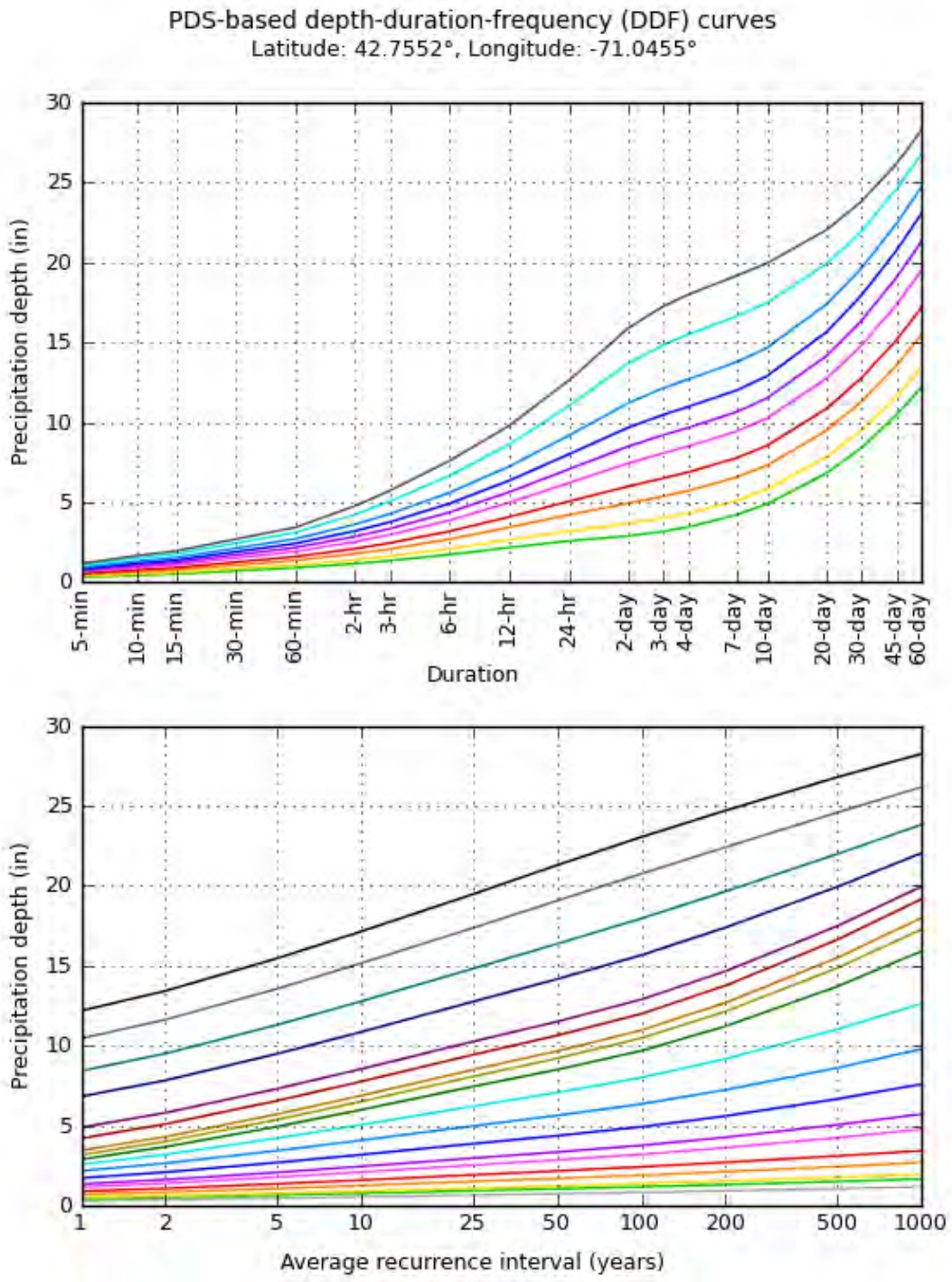
PF graphical



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Mon Aug 1 16:49:47 2022

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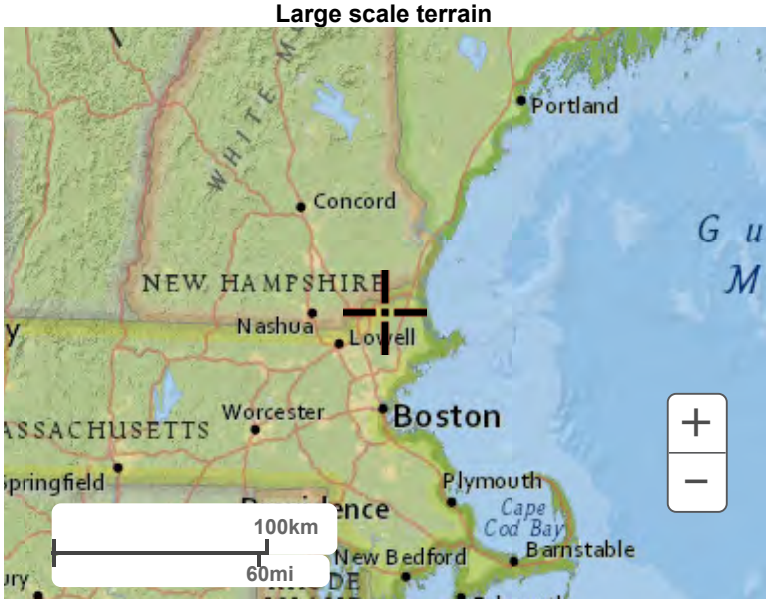
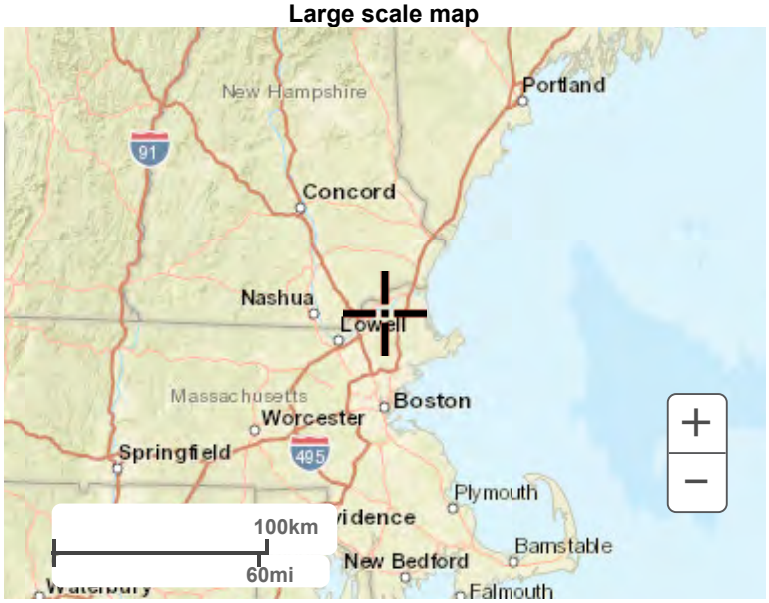
Maps & aerials

Small scale terrain

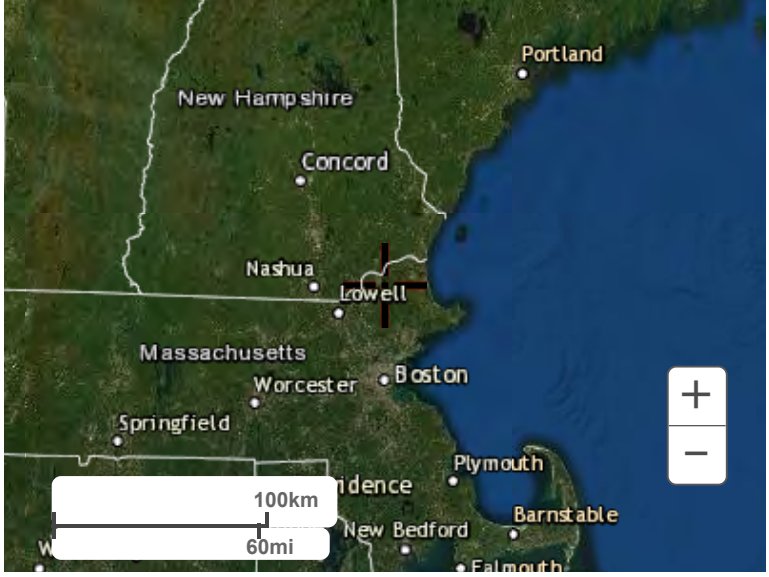
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX D

PRE-DEVELOPMENT
HYDROCAD DRAINAGE CALCULATIONS

FLOOD

EBB

Merrimack River

(LAND UNDER WATER RIVERWARD OF El.-1.25ft NAVD88)

GROVELAND

HAVERHILL

100' WETLAND BUFFER ZONE

INACTIVE STORMWATER POND

E1

E2

E3

E4

E5

E6
AREA FROM
2018 TIGHE &
BOND REPORT

NORTHERN MOUND

SOUTHERN MOUND
(CAPPED)

JOHNSON'S CREEK

MASS ELECTRIC PROPERTY

EXISTING STORMWATER BASIN

LOT 26 ASH AREA

Johnson's Creek

HAVERHILL
GROVELAND

ROAD

0 40 80 160

1" = 80'

LEGEND

- UTILITY POLE W/POLE SUPPORT
- UTILITY POLE WITH CABLE ANCHOR
- SEWER MANHOLE
- MONITORING WELL
- WETLAND FLAG LOCATION AND NUMBER
- STONE REINFORCED SLOPE OR SWALE
- TREELINE
- WETLAND BOUNDARY BY FLAG LOCATION
- 6' TALL CHAINLINK FENCE
- EDGE OF OBSERVED SURFACE WATER
- DIGITIZED EASEMENT BOUNDARY SEE NOTE #5
- 2' CONTOUR
- 10' CONTOUR
- MEAN HIGH WATER (EL. 4.47')
- 100' WETLAND BUFFER ZONE
- 100' HAVERHILL ORDINANCE BUFFER ZONE
- 200' RIVERFRONT AREA
- FEMA FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING
- HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
- EDGE OF EXISTING WASTE

NOTES:

1. THE TOPOGRAPHIC INFORMATION SHOWN HEREON IS FROM A FIELD SURVEY COMPLETED BY T.F. BERNIER, INC. OF CONCORD, NEW HAMPSHIRE IN AUGUST OF 2017. BOUNDARY INFORMATION IS FROM PLAN REFERENCE NUMBER 1. FOR A COMPLETE HISTORY OF THE BOUNDARY INFORMATION WAS DONE IN THE PREPARATION OF THIS PLAN, KNOWN DISCREPANCIES EXIST INCLUDING THE LOCATION OF JOHNSON'S CREEK WHICH MAY AFFECT THE MUNICIPAL BOUNDARY.
2. THE VERTICAL DATUM IS NAVD88 BASED ON MULTIPLE STATIC GPS OBSERVATIONS COMPLETED BY T.F. BERNIER, INC.
3. EASEMENT BOUNDARIES SHOWN HEREON HAVE BEEN DIGITIZED FROM PLAN REFERENCE NUMBER 3, AND ARE APPROXIMATE AND PROVIDED ONLY. FOR DESCRIPTION AND COMPLETE INFORMATION SEE SAID PLAN REFERENCE NUMBER 3.
4. WETLAND DELINEATION WAS CONDUCTED BY EPSILON ASSOCIATES ON JULY 7 AND 12, 2017.
5. MEAN HIGH WATER (MHW)= +4.47' NAVD.
MEAN LOW WATER (MLW)= +1.25' NAVD.
PER CH.91 LICENSE NO. 12877
6. FEMA 100-YEAR FLOODPLAIN ZONE ELEVATION / BORDERING LAND SUBJECT TO FLOODING (BLSF) = El. 21

NOT FOR CONSTRUCTION

REVISIONS

Langdon Environmental LLC

79 CONGRESS STREET, SUITE 214 PO BOX 511
PORTSMOUTH, NH 03802
(617) 875-3693

Proj. Mgr: BWH
Designed : JEC
Drawn : JEC
Checked : BWH
Scale : 1"=80'
Date : AUG 2021

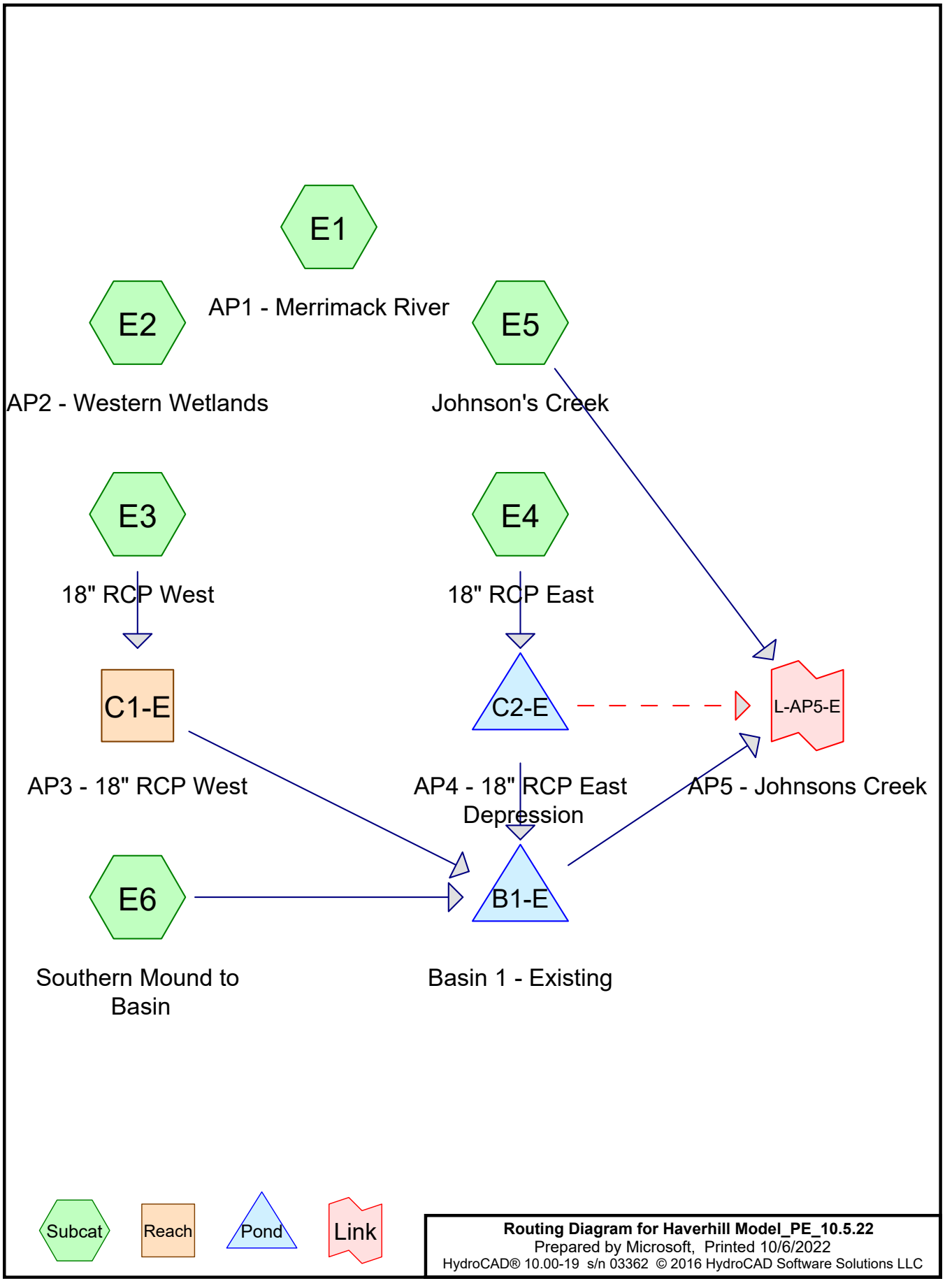
EXISTING CONDITIONS

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

C-1



Routing Diagram for Haverhill Model_PE_10.5.22
Prepared by Microsoft, Printed 10/6/2022

Summary for Subcatchment E1: AP1 - Merrimack River

Runoff = 12.10 cfs @ 12.13 hrs, Volume= 42,210 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
420,465	77	Brush, Poor, HSG C
420,465		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.2	350	0.1500	2.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.6	400	Total			

Summary for Subcatchment E2: AP2 - Western Wetlands

Runoff = 1.90 cfs @ 12.19 hrs, Volume= 7,643 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
76,130	77	Brush, Poor, HSG C
76,130		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
6.8	640	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.2	690	Total			

Summary for Subcatchment E3: 18" RCP West

Runoff = 1.58 cfs @ 12.12 hrs, Volume= 5,446 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
54,250	77	Brush, Poor, HSG C
54,250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.7	280	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.2	330	Total			

Summary for Subcatchment E4: 18" RCP East

Runoff = 1.98 cfs @ 12.14 hrs, Volume= 7,145 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
71,175	77	Brush, Poor, HSG C
71,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
4.1	425	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.6	475	Total			

Summary for Subcatchment E5: Johnson's Creek

Runoff = 4.46 cfs @ 12.14 hrs, Volume= 15,842 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
157,810	77	Brush, Poor, HSG C
157,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.7	360	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.1	410	Total			

Summary for Subcatchment E6: Southern Mound to Basin

Runoff = 19.09 cfs @ 12.12 hrs, Volume= 67,069 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					**Direct Entry,**

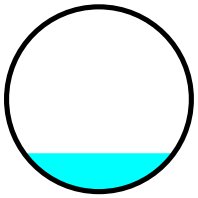
Summary for Reach C1-E: AP3 - 18" RCP West

Inflow Area = 54,250 sf, 0.00% Impervious, Inflow Depth = 1.20" for 2YearMass event
Inflow = 1.58 cfs @ 12.12 hrs, Volume= 5,446 cf
Outflow = 1.58 cfs @ 12.12 hrs, Volume= 5,446 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.99 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.30 fps, Avg. Travel Time= 0.3 min

Peak Storage= 11 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-E: Basin 1 - Existing

Inflow Area = 906,083 sf, 0.00% Impervious, Inflow Depth = 1.06" for 2YearMass event
Inflow = 22.28 cfs @ 12.13 hrs, Volume= 79,661 cf
Outflow = 0.52 cfs @ 21.05 hrs, Volume= 25,727 cf, Atten= 98%, Lag= 535.2 min
Primary = 0.52 cfs @ 21.05 hrs, Volume= 25,727 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 22.99' @ 21.05 hrs Surf.Area= 25,779 sf Storage= 65,436 cf

Plug-Flow detention time= 742.3 min calculated for 25,722 cf (32% of inflow)
Center-of-Mass det. time= 602.1 min (1,465.2 - 863.2)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	189,410 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	17,641	531.0	0	0	17,641
22.00	23,569	638.0	41,067	41,067	27,663
24.00	28,145	736.0	51,646	92,714	38,466
26.00	33,611	910.0	61,675	154,389	61,317
27.00	36,450	982.0	35,021	189,410	72,198

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 13.00' S= 0.0442 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.50'	**1.0" Vert. Orifice/Grate X 13.00 columns** X 11 rows with 2.0" cc spacing C= 0.600
#3	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.52 cfs @ 21.05 hrs HW=22.99' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.52 cfs of 16.28 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.52 cfs @ 2.46 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond C2-E: AP4 - 18" RCP East Depression

Inflow Area = 71,175 sf, 0.00% Impervious, Inflow Depth = 1.20" for 2YearMass event
Inflow = 1.98 cfs @ 12.14 hrs, Volume= 7,145 cf
Outflow = 1.84 cfs @ 12.18 hrs, Volume= 7,145 cf, Atten= 7%, Lag= 2.5 min
Primary = 1.84 cfs @ 12.18 hrs, Volume= 7,145 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 27.80' @ 12.18 hrs Surf.Area= 715 sf Storage= 312 cf

Plug-Flow detention time= 4.7 min calculated for 7,144 cf (100% of inflow)
Center-of-Mass det. time= 4.7 min (860.6 - 855.9)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.94' S= 0.0015 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.84 cfs @ 12.18 hrs HW=27.80' TW=21.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.84 cfs @ 2.79 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link L-AP5-E: AP5 - Johnsons Creek

Inflow Area = 1,063,893 sf, 0.00% Impervious, Inflow Depth > 0.47" for 2YearMass event
Inflow = 4.46 cfs @ 12.14 hrs, Volume= 41,569 cf
Primary = 4.46 cfs @ 12.14 hrs, Volume= 41,569 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1: AP1 - Merrimack River

Runoff = 27.56 cfs @ 12.12 hrs, Volume= 93,374 cf, Depth= 2.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
420,465	77	Brush, Poor, HSG C
420,465		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.2	350	0.1500	2.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.6	400	Total			

Summary for Subcatchment E2: AP2 - Western Wetlands

Runoff = 4.33 cfs @ 12.19 hrs, Volume= 16,906 cf, Depth= 2.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
76,130	77	Brush, Poor, HSG C
76,130		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
6.8	640	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.2	690	Total			

Summary for Subcatchment E3: 18" RCP West

Runoff = 3.60 cfs @ 12.12 hrs, Volume= 12,047 cf, Depth= 2.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
54,250	77	Brush, Poor, HSG C
54,250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.7	280	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.2	330	Total			

Summary for Subcatchment E4: 18" RCP East

Runoff = 4.52 cfs @ 12.13 hrs, Volume= 15,806 cf, Depth= 2.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
71,175	77	Brush, Poor, HSG C
71,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
4.1	425	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.6	475	Total			

Summary for Subcatchment E5: Johnson's Creek

Runoff = 10.17 cfs @ 12.13 hrs, Volume= 35,045 cf, Depth= 2.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
157,810	77	Brush, Poor, HSG C
157,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.7	360	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.1	410	Total			

Summary for Subcatchment E6: Southern Mound to Basin

Runoff = 46.90 cfs @ 12.12 hrs, Volume= 156,405 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					**Direct Entry,**

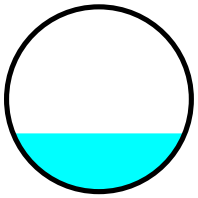
Summary for Reach C1-E: AP3 - 18" RCP West

Inflow Area = 54,250 sf, 0.00% Impervious, Inflow Depth = 2.66" for 10YearMass event
Inflow = 3.60 cfs @ 12.12 hrs, Volume= 12,047 cf
Outflow = 3.60 cfs @ 12.12 hrs, Volume= 12,047 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.60 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.75 fps, Avg. Travel Time= 0.2 min

Peak Storage= 19 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-E: Basin 1 - Existing

Inflow Area = 906,083 sf, 0.00% Impervious, Inflow Depth = 2.44" for 10YearMass event
Inflow = 54.05 cfs @ 12.12 hrs, Volume= 184,258 cf
Outflow = 3.79 cfs @ 14.24 hrs, Volume= 130,025 cf, Atten= 93%, Lag= 127.1 min
Primary = 3.79 cfs @ 14.24 hrs, Volume= 130,025 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 24.47' @ 14.24 hrs Surf.Area= 29,385 sf Storage= 106,219 cf

Plug-Flow detention time= 413.9 min calculated for 130,025 cf (71% of inflow)
Center-of-Mass det. time= 316.3 min (1,154.5 - 838.1)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	189,410 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	17,641	531.0	0	0	17,641
22.00	23,569	638.0	41,067	41,067	27,663
24.00	28,145	736.0	51,646	92,714	38,466
26.00	33,611	910.0	61,675	154,389	61,317
27.00	36,450	982.0	35,021	189,410	72,198

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 13.00' S= 0.0442 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.50'	**1.0" Vert. Orifice/Grate X 13.00 columns** X 11 rows with 2.0" cc spacing C= 0.600
#3	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.79 cfs @ 14.24 hrs HW=24.47' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.79 cfs of 24.58 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.79 cfs @ 4.87 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond C2-E: AP4 - 18" RCP East Depression

Inflow Area = 71,175 sf, 0.00% Impervious, Inflow Depth = 2.66" for 10YearMass event
Inflow = 4.52 cfs @ 12.13 hrs, Volume= 15,806 cf
Outflow = 4.09 cfs @ 12.19 hrs, Volume= 15,806 cf, Atten= 10%, Lag= 3.0 min
Primary = 4.09 cfs @ 12.19 hrs, Volume= 15,806 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.25' @ 12.19 hrs Surf.Area= 1,222 sf Storage= 746 cf

Plug-Flow detention time= 4.0 min calculated for 15,806 cf (100% of inflow)
Center-of-Mass det. time= 3.9 min (836.5 - 832.6)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.94' S= 0.0015 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.08 cfs @ 12.19 hrs HW=28.25' TW=22.76' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 4.08 cfs @ 3.51 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link L-AP5-E: AP5 - Johnsons Creek

Inflow Area = 1,063,893 sf, 0.00% Impervious, Inflow Depth > 1.86" for 10YearMass event
Inflow = 10.17 cfs @ 12.13 hrs, Volume= 165,070 cf
Primary = 10.17 cfs @ 12.13 hrs, Volume= 165,070 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1: AP1 - Merrimack River

Runoff = 37.88 cfs @ 12.12 hrs, Volume= 128,351 cf, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
420,465	77	Brush, Poor, HSG C
420,465		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.2	350	0.1500	2.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.6	400	Total			

Summary for Subcatchment E2: AP2 - Western Wetlands

Runoff = 5.96 cfs @ 12.18 hrs, Volume= 23,239 cf, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
76,130	77	Brush, Poor, HSG C
76,130		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
6.8	640	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.2	690	Total			

Summary for Subcatchment E3: 18" RCP West

Runoff = 4.95 cfs @ 12.12 hrs, Volume= 16,560 cf, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
54,250	77	Brush, Poor, HSG C
54,250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.7	280	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.2	330	Total			

Summary for Subcatchment E4: 18" RCP East

Runoff = 6.21 cfs @ 12.13 hrs, Volume= 21,727 cf, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
71,175	77	Brush, Poor, HSG C
71,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
4.1	425	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.6	475	Total			

Summary for Subcatchment E5: Johnson's Creek

Runoff = 13.98 cfs @ 12.13 hrs, Volume= 48,173 cf, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
157,810	77	Brush, Poor, HSG C
157,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.7	360	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.1	410	Total			

Summary for Subcatchment E6: Southern Mound to Basin

Runoff = 65.92 cfs @ 12.12 hrs, Volume= 218,731 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					**Direct Entry,**

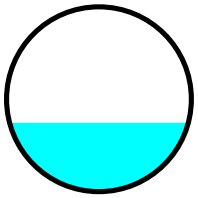
Summary for Reach C1-E: AP3 - 18" RCP West

Inflow Area = 54,250 sf, 0.00% Impervious, Inflow Depth = 3.66" for 25YearMass event
Inflow = 4.95 cfs @ 12.12 hrs, Volume= 16,560 cf
Outflow = 4.95 cfs @ 12.12 hrs, Volume= 16,560 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.30 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.96 fps, Avg. Travel Time= 0.2 min

Peak Storage= 24 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.56'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-E: Basin 1 - Existing

Inflow Area = 906,083 sf, 0.00% Impervious, Inflow Depth = 3.40" for 25YearMass event
Inflow = 75.59 cfs @ 12.12 hrs, Volume= 257,018 cf
Outflow = 15.52 cfs @ 12.60 hrs, Volume= 202,700 cf, Atten= 79%, Lag= 28.6 min
Primary = 15.52 cfs @ 12.60 hrs, Volume= 202,700 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 25.14' @ 12.60 hrs Surf.Area= 31,208 sf Storage= 126,604 cf

Plug-Flow detention time= 318.5 min calculated for 202,700 cf (79% of inflow)
Center-of-Mass det. time= 238.2 min (1,066.7 - 828.5)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	189,410 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	17,641	531.0	0	0	17,641
22.00	23,569	638.0	41,067	41,067	27,663
24.00	28,145	736.0	51,646	92,714	38,466
26.00	33,611	910.0	61,675	154,389	61,317
27.00	36,450	982.0	35,021	189,410	72,198

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 13.00' S= 0.0442 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.50'	**1.0" Vert. Orifice/Grate X 13.00 columns** X 11 rows with 2.0" cc spacing C= 0.600
#3	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=15.51 cfs @ 12.60 hrs HW=25.14' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 15.51 cfs of 27.53 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 4.93 cfs @ 6.33 fps)
  └─**3=Orifice/Grate** (Weir Controls 10.58 cfs @ 2.62 fps)

Summary for Pond C2-E: AP4 - 18" RCP East Depression

Inflow Area = 71,175 sf, 0.00% Impervious, Inflow Depth = 3.66" for 25YearMass event
Inflow = 6.21 cfs @ 12.13 hrs, Volume= 21,727 cf
Outflow = 5.49 cfs @ 12.19 hrs, Volume= 21,727 cf, Atten= 12%, Lag= 3.4 min
Primary = 5.48 cfs @ 12.19 hrs, Volume= 21,726 cf
Secondary = 0.01 cfs @ 12.19 hrs, Volume= 1 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.51' @ 12.19 hrs Surf.Area= 1,559 sf Storage= 1,099 cf

Plug-Flow detention time= 3.8 min calculated for 21,727 cf (100% of inflow)
Center-of-Mass det. time= 3.7 min (827.2 - 823.5)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.94' S= 0.0015 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.48 cfs @ 12.19 hrs HW=28.51' TW=23.95' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 5.48 cfs @ 3.84 fps)

Secondary OutFlow Max=0.01 cfs @ 12.19 hrs HW=28.51' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.19 fps)

Summary for Link L-AP5-E: AP5 - Johnsons Creek

Inflow Area = 1,063,893 sf, 0.00% Impervious, Inflow Depth > 2.83" for 25YearMass event
Inflow = 18.94 cfs @ 12.53 hrs, Volume= 250,873 cf
Primary = 18.94 cfs @ 12.53 hrs, Volume= 250,873 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1: AP1 - Merrimack River

Runoff = 54.19 cfs @ 12.12 hrs, Volume= 184,807 cf, Depth= 5.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
420,465	77	Brush, Poor, HSG C
420,465		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.2	350	0.1500	2.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.6	400	Total			

Summary for Subcatchment E2: AP2 - Western Wetlands

Runoff = 8.53 cfs @ 12.18 hrs, Volume= 33,461 cf, Depth= 5.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
76,130	77	Brush, Poor, HSG C
76,130		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
6.8	640	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.2	690	Total			

Summary for Subcatchment E3: 18" RCP West

Runoff = 7.09 cfs @ 12.11 hrs, Volume= 23,844 cf, Depth= 5.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
54,250	77	Brush, Poor, HSG C
54,250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.7	280	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.2	330	Total			

Summary for Subcatchment E4: 18" RCP East

Runoff = 8.89 cfs @ 12.13 hrs, Volume= 31,283 cf, Depth= 5.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
71,175	77	Brush, Poor, HSG C
71,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
4.1	425	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.6	475	Total			

Summary for Subcatchment E5: Johnson's Creek

Runoff = 20.01 cfs @ 12.13 hrs, Volume= 69,362 cf, Depth= 5.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
157,810	77	Brush, Poor, HSG C
157,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.7	360	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.1	410	Total			

Summary for Subcatchment E6: Southern Mound to Basin

Runoff = 96.34 cfs @ 12.11 hrs, Volume= 320,439 cf, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					**Direct Entry,**

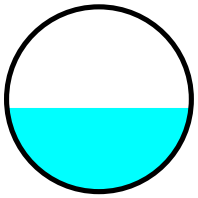
Summary for Reach C1-E: AP3 - 18" RCP West

Inflow Area = 54,250 sf, 0.00% Impervious, Inflow Depth = 5.27" for 100YearMass event
Inflow = 7.09 cfs @ 12.11 hrs, Volume= 23,844 cf
Outflow = 7.09 cfs @ 12.12 hrs, Volume= 23,844 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.13 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.21 fps, Avg. Travel Time= 0.2 min

Peak Storage= 31 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.68'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-E: Basin 1 - Existing

Inflow Area = 906,083 sf, 0.00% Impervious, Inflow Depth = 4.96" for 100YearMass event
Inflow = 109.60 cfs @ 12.11 hrs, Volume= 374,613 cf
Outflow = 27.93 cfs @ 12.54 hrs, Volume= 320,194 cf, Atten= 75%, Lag= 25.3 min
Primary = 27.93 cfs @ 12.54 hrs, Volume= 320,194 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 26.49' @ 12.54 hrs Surf.Area= 34,984 sf Storage= 171,150 cf

Plug-Flow detention time= 243.1 min calculated for 320,127 cf (85% of inflow)
Center-of-Mass det. time= 180.2 min (998.1 - 817.8)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	189,410 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	17,641	531.0	0	0	17,641
22.00	23,569	638.0	41,067	41,067	27,663
24.00	28,145	736.0	51,646	92,714	38,466
26.00	33,611	910.0	61,675	154,389	61,317
27.00	36,450	982.0	35,021	189,410	72,198

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 13.00' S= 0.0442 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.50'	**1.0" Vert. Orifice/Grate X 13.00 columns** X 11 rows with 2.0" cc spacing C= 0.600
#3	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=27.93 cfs @ 12.54 hrs HW=26.49' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 27.93 cfs of 32.65 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 6.60 cfs @ 8.47 fps)
  └─**3=Orifice/Grate** (Orifice Controls 21.33 cfs @ 6.79 fps)

Summary for Pond C2-E: AP4 - 18" RCP East Depression

Inflow Area = 71,175 sf, 0.00% Impervious, Inflow Depth = 5.27" for 100YearMass event
Inflow = 8.89 cfs @ 12.13 hrs, Volume= 31,283 cf
Outflow = 8.56 cfs @ 12.16 hrs, Volume= 31,283 cf, Atten= 4%, Lag= 1.7 min
Primary = 6.45 cfs @ 12.16 hrs, Volume= 30,330 cf
Secondary = 2.11 cfs @ 12.16 hrs, Volume= 953 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.69' @ 12.16 hrs Surf.Area= 1,833 sf Storage= 1,417 cf

Plug-Flow detention time= 3.5 min calculated for 31,277 cf (100% of inflow)
Center-of-Mass det. time= 3.5 min (816.6 - 813.1)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.94' S= 0.0015 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.45 cfs @ 12.16 hrs HW=28.69' TW=25.32' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 6.45 cfs @ 4.04 fps)

Secondary OutFlow Max=2.11 cfs @ 12.16 hrs HW=28.69' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.11 cfs @ 1.09 fps)

Summary for Link L-AP5-E: AP5 - Johnsons Creek

Inflow Area = 1,063,893 sf, 0.00% Impervious, Inflow Depth > 4.40" for 100YearMass event
Inflow = 40.05 cfs @ 12.17 hrs, Volume= 390,510 cf
Primary = 40.05 cfs @ 12.17 hrs, Volume= 390,510 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

APPENDIX E

POST-DEVELOPMENT
HYDROCAD DRAINAGE CALCULATIONS

FLOOD

EBB

Merrimack River

(LAND UNDER WATER RIVERWARD OF El.-1.25ft NAVD88)

3 D-2 TELEPHONE POLE MAST FOR EAGLE HABITAT. FINAL LOCATION TO BE DETERMINED.

3 D-1 PROPOSED EDGE OF LANDFILL CAP ALONG RIVER AND CREEK (TYP).

2 D-1 FINAL CAP SECTION-PLANTING AREAS (TYP).

PASSIVE LANDFILL GAS VENT (TYP). 1 D-2

MASS ELECTRIC PROPERTY

P1

P2

P3

P4

P5

P6
AREA FROM
2018 TIGHE &
BOND REPORT

SOUTHERN MOUND
(CAPPED)

EXISTING STORMWATER BASIN

LOT 26 ASH AREA

GROVELAND

HAVERHILL

Creek

Johnson's

100' WETLAND BUFFER ZONE

200' RIVERFRONT AREA

INACTIVE STORMWATER POND

OLD ACCESS ROAD

CONNELL DRIVE

HAVERHILL GROVELAND

TEMPLE ROAD

LEGEND

- WETLAND FLAG LOCATION AND NUMBER
- WETLAND BOUNDARY BY FLAG LOCATION
- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- MEAN HIGH WATER (EL. 4.47')
- 100' WETLAND BUFFER ZONE
- 100' HAVERHILL ORDINANCE BUFFER ZONE
- 200' RIVERFRONT AREA
- FEMA FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING
- HAVERHILL/GROVELAND MUNICIPAL BOUNDARY
- EXISTING EDGE OF WASTE
- PROPOSED CONTOUR
- FINAL EDGE OF WASTE
- GV PASSIVE LANDFILL GAS VENT
- PROPOSED TREE PLANTING AREA. SEE LANDSCAPE PLANS L-1 AND L-2

0 40 80 160

1" = 80'

NOT FOR CONSTRUCTION

REVISIONS

Langdon Environmental LLC

75 CONGRESS STREET SUITE 214 PO BOX 511
PORTSMOUTH, NH 03802
(617) 875-3693

Proj. Mgr.: BWH
Designed : JEC
Drawn : JEC
Checked : BWH
Scale : 1"=80'
Date : AUG 2021

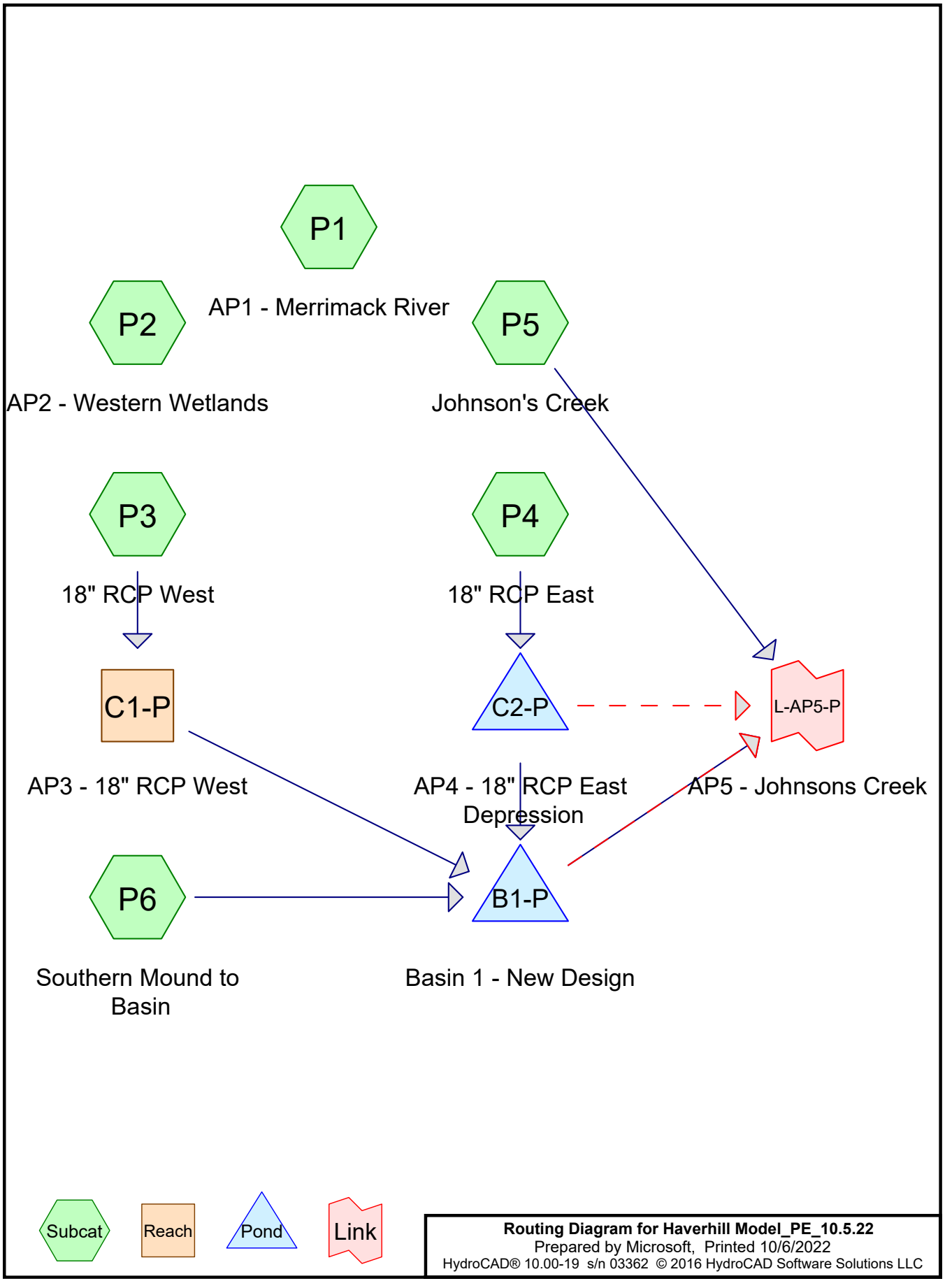
FINAL GRADING PLAN

HAVERHILL LANDFILL-NORTHERN MOUND
HAVERHILL, MASSACHUSETTS

Proj. No.

Dwg. No.

C-3



Routing Diagram for Haverhill Model_PE_10.5.22
Prepared by Microsoft, Printed 10/6/2022

Summary for Subcatchment P1: AP1 - Merrimack River

Runoff = 9.52 cfs @ 12.11 hrs, Volume= 32,274 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
286,650	74	>75% Grass cover, Good, HSG C
89,000	72	Woods/grass comb., Good, HSG C
375,650	74	Weighted Average
375,650		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.2	50	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	65	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	100	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.0	265	Total			

Summary for Subcatchment P2: AP2 - Western Wetlands

Runoff = 1.66 cfs @ 12.22 hrs, Volume= 7,211 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
76,130	74	>75% Grass cover, Good, HSG C
7,800	72	Woods/grass comb., Good, HSG C
83,930	74	Weighted Average
83,930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.0	475	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.9	635	Total			

Summary for Subcatchment P3: 18" RCP West

Runoff = 1.38 cfs @ 12.18 hrs, Volume= 5,537 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
64,450	74	>75% Grass cover, Good, HSG C
64,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.1	300	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.1	470	Total			

Summary for Subcatchment P4: 18" RCP East

Runoff = 1.74 cfs @ 12.19 hrs, Volume= 7,130 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
82,990	74	>75% Grass cover, Good, HSG C
82,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.1	100	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	285	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.7	475	Total			

Summary for Subcatchment P5: Johnson's Creek

Runoff = 4.07 cfs @ 12.15 hrs, Volume= 15,425 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

Area (sf)	CN	Description
149,840	74	>75% Grass cover, Good, HSG C
29,700	72	Woods/grass comb., Good, HSG C
179,540	74	Weighted Average
179,540		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.0	170	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	65	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	90	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.2	400	Total			

Summary for Subcatchment P6: Southern Mound to Basin

Runoff = 19.09 cfs @ 12.12 hrs, Volume= 67,069 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YearMass Rainfall=3.19"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					**Direct Entry,**

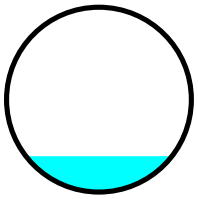
Summary for Reach C1-P: AP3 - 18" RCP West

Inflow Area = 64,450 sf, 0.00% Impervious, Inflow Depth = 1.03" for 2YearMass event
Inflow = 1.38 cfs @ 12.18 hrs, Volume= 5,537 cf
Outflow = 1.38 cfs @ 12.18 hrs, Volume= 5,537 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.76 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.35 fps, Avg. Travel Time= 0.3 min

Peak Storage= 10 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-P: Basin 1 - New Design

Inflow Area = 928,098 sf, 0.00% Impervious, Inflow Depth = 1.03" for 2YearMass event
Inflow = 21.50 cfs @ 12.13 hrs, Volume= 79,736 cf
Outflow = 0.42 cfs @ 23.45 hrs, Volume= 20,329 cf, Atten= 98%, Lag= 679.6 min
Primary = 0.42 cfs @ 23.45 hrs, Volume= 20,329 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 22.44' @ 23.45 hrs Surf.Area= 31,399 sf Storage= 70,028 cf

Plug-Flow detention time= 843.7 min calculated for 20,325 cf (25% of inflow)
Center-of-Mass det. time= 699.3 min (1,564.5 - 865.2)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	245,868 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	26,062	673.0	0	0	26,062
22.00	30,359	730.0	56,366	56,366	32,579
24.00	35,200	797.0	65,499	121,866	40,862
26.00	42,768	995.0	77,845	199,711	69,154
27.00	49,632	1,075.0	46,157	245,868	82,373

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 13.00' S= 0.0442 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.00'	**6.0" Vert. Orifice/Grate** C= 0.600

#3	Device 1	23.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	26.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.42 cfs @ 23.45 hrs HW=22.44' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.42 cfs of 11.73 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.42 cfs @ 2.26 fps)
  - **3=Orifice/Grate** (Controls 0.00 cfs)
  - **4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=20.00' TW=0.00' (Dynamic Tailwater)
- **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond C2-P: AP4 - 18" RCP East Depression

Inflow Area =	82,990 sf,	0.00% Impervious,	Inflow Depth =	1.03"	for 2YearMass event
Inflow =	1.74 cfs @	12.19 hrs,	Volume=	7,130 cf	
Outflow =	1.65 cfs @	12.23 hrs,	Volume=	7,130 cf,	Atten= 5%, Lag= 2.9 min
Primary =	1.65 cfs @	12.23 hrs,	Volume=	7,130 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 27.75' @ 12.23 hrs Surf.Area= 672 sf Storage= 281 cf

Plug-Flow detention time= 4.8 min calculated for 7,130 cf (100% of inflow)
Center-of-Mass det. time= 4.7 min (873.2 - 868.5)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.94' S= 0.0015 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.65 cfs @ 12.23 hrs HW=27.75' TW=20.79' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.65 cfs @ 2.71 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link L-AP5-P: AP5 - Johnsons Creek

Inflow Area = 1,107,638 sf, 0.00% Impervious, Inflow Depth > 0.39" for 2YearMass event
Inflow = 4.07 cfs @ 12.15 hrs, Volume= 35,754 cf
Primary = 4.07 cfs @ 12.15 hrs, Volume= 35,754 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1: AP1 - Merrimack River

Runoff = 23.37 cfs @ 12.10 hrs, Volume= 75,262 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
286,650	74	>75% Grass cover, Good, HSG C
89,000	72	Woods/grass comb., Good, HSG C
375,650	74	Weighted Average
375,650		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.2	50	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	65	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	100	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.0	265	Total			

Summary for Subcatchment P2: AP2 - Western Wetlands

Runoff = 4.09 cfs @ 12.21 hrs, Volume= 16,815 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
76,130	74	>75% Grass cover, Good, HSG C
7,800	72	Woods/grass comb., Good, HSG C
83,930	74	Weighted Average
83,930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.0	475	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.9	635	Total			

Summary for Subcatchment P3: 18" RCP West

Runoff = 3.40 cfs @ 12.17 hrs, Volume= 12,913 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
64,450	74	>75% Grass cover, Good, HSG C
64,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.1	300	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.1	470	Total			

Summary for Subcatchment P4: 18" RCP East

Runoff = 4.30 cfs @ 12.18 hrs, Volume= 16,627 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
82,990	74	>75% Grass cover, Good, HSG C
82,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.1	100	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	285	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.7	475	Total			

Summary for Subcatchment P5: Johnson's Creek

Runoff = 10.03 cfs @ 12.14 hrs, Volume= 35,971 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

Area (sf)	CN	Description
149,840	74	>75% Grass cover, Good, HSG C
29,700	72	Woods/grass comb., Good, HSG C
179,540	74	Weighted Average
179,540		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.0	170	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	65	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	90	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.2	400	Total			

Summary for Subcatchment P6: Southern Mound to Basin

Runoff = 46.90 cfs @ 12.12 hrs, Volume= 156,405 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YearMass Rainfall=5.05"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					**Direct Entry,**

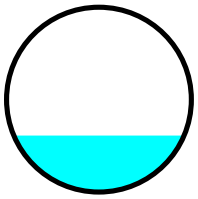
Summary for Reach C1-P: AP3 - 18" RCP West

Inflow Area = 64,450 sf, 0.00% Impervious, Inflow Depth = 2.40" for 10YearMass event
Inflow = 3.40 cfs @ 12.17 hrs, Volume= 12,913 cf
Outflow = 3.40 cfs @ 12.17 hrs, Volume= 12,913 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.47 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.85 fps, Avg. Travel Time= 0.2 min

Peak Storage= 18 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-P: Basin 1 - New Design

Inflow Area = 928,098 sf, 0.00% Impervious, Inflow Depth = 2.40" for 10YearMass event
Inflow = 52.89 cfs @ 12.12 hrs, Volume= 185,945 cf
Outflow = 2.16 cfs @ 16.18 hrs, Volume= 124,255 cf, Atten= 96%, Lag= 243.2 min
Primary = 2.16 cfs @ 16.18 hrs, Volume= 124,255 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 24.10' @ 16.18 hrs Surf.Area= 35,570 sf Storage= 125,494 cf

Plug-Flow detention time= 631.0 min calculated for 124,255 cf (67% of inflow)
Center-of-Mass det. time= 527.4 min (1,367.2 - 839.8)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	245,868 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	26,062	673.0	0	0	26,062
22.00	30,359	730.0	56,366	56,366	32,579
24.00	35,200	797.0	65,499	121,866	40,862
26.00	42,768	995.0	77,845	199,711	69,154
27.00	49,632	1,075.0	46,157	245,868	82,373

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 13.00' S= 0.0442 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.00'	**6.0" Vert. Orifice/Grate** C= 0.600

#3	Device 1	23.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	26.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.16 cfs @ 16.18 hrs HW=24.10' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.16 cfs of 22.80 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.29 cfs @ 6.55 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.87 cfs @ 4.45 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=20.00' TW=0.00' (Dynamic Tailwater)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond C2-P: AP4 - 18" RCP East Depression

Inflow Area = 82,990 sf, 0.00% Impervious, Inflow Depth = 2.40" for 10YearMass event
Inflow = 4.30 cfs @ 12.18 hrs, Volume= 16,627 cf
Outflow = 3.98 cfs @ 12.23 hrs, Volume= 16,627 cf, Atten= 7%, Lag= 3.2 min
Primary = 3.98 cfs @ 12.23 hrs, Volume= 16,627 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.23' @ 12.23 hrs Surf.Area= 1,198 sf Storage= 723 cf

Plug-Flow detention time= 3.8 min calculated for 16,623 cf (100% of inflow)
Center-of-Mass det. time= 3.8 min (847.0 - 843.2)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.94' S= 0.0015 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=3.98 cfs @ 12.23 hrs HW=28.23' TW=22.28' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 3.98 cfs @ 3.49 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link L-AP5-P: AP5 - Johnsons Creek

Inflow Area = 1,107,638 sf, 0.00% Impervious, Inflow Depth > 1.74" for 10YearMass event
Inflow = 10.03 cfs @ 12.14 hrs, Volume= 160,226 cf
Primary = 10.03 cfs @ 12.14 hrs, Volume= 160,226 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1: AP1 - Merrimack River

Runoff = 32.83 cfs @ 12.10 hrs, Volume= 105,253 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
286,650	74	>75% Grass cover, Good, HSG C
89,000	72	Woods/grass comb., Good, HSG C
375,650	74	Weighted Average
375,650		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.2	50	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	65	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	100	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.0	265	Total			

Summary for Subcatchment P2: AP2 - Western Wetlands

Runoff = 5.77 cfs @ 12.20 hrs, Volume= 23,516 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
76,130	74	>75% Grass cover, Good, HSG C
7,800	72	Woods/grass comb., Good, HSG C
83,930	74	Weighted Average
83,930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.0	475	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.9	635	Total			

Summary for Subcatchment P3: 18" RCP West

Runoff = 4.78 cfs @ 12.17 hrs, Volume= 18,058 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
64,450	74	>75% Grass cover, Good, HSG C
64,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.1	300	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.1	470	Total			

Summary for Subcatchment P4: 18" RCP East

Runoff = 6.05 cfs @ 12.18 hrs, Volume= 23,253 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
82,990	74	>75% Grass cover, Good, HSG C
82,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.1	100	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	285	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.7	475	Total			

Summary for Subcatchment P5: Johnson's Creek

Runoff = 14.11 cfs @ 12.14 hrs, Volume= 50,305 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

Area (sf)	CN	Description
149,840	74	>75% Grass cover, Good, HSG C
29,700	72	Woods/grass comb., Good, HSG C
179,540	74	Weighted Average
179,540		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.0	170	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	65	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	90	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.2	400	Total			

Summary for Subcatchment P6: Southern Mound to Basin

Runoff = 65.92 cfs @ 12.12 hrs, Volume= 218,731 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25YearMass Rainfall=6.21"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					**Direct Entry,**

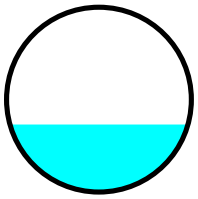
Summary for Reach C1-P: AP3 - 18" RCP West

Inflow Area = 64,450 sf, 0.00% Impervious, Inflow Depth = 3.36" for 25YearMass event
Inflow = 4.78 cfs @ 12.17 hrs, Volume= 18,058 cf
Outflow = 4.78 cfs @ 12.17 hrs, Volume= 18,058 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.22 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.07 fps, Avg. Travel Time= 0.2 min

Peak Storage= 23 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-P: Basin 1 - New Design

Inflow Area = 928,098 sf, 0.00% Impervious, Inflow Depth = 3.36" for 25YearMass event
Inflow = 74.29 cfs @ 12.12 hrs, Volume= 260,042 cf
Outflow = 6.46 cfs @ 13.63 hrs, Volume= 197,525 cf, Atten= 91%, Lag= 90.5 min
Primary = 6.46 cfs @ 13.63 hrs, Volume= 197,525 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 24.82' @ 13.63 hrs Surf.Area= 38,222 sf Storage= 152,036 cf

Plug-Flow detention time= 528.9 min calculated for 197,525 cf (76% of inflow)
Center-of-Mass det. time= 442.4 min (1,272.5 - 830.1)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	245,868 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	26,062	673.0	0	0	26,062
22.00	30,359	730.0	56,366	56,366	32,579
24.00	35,200	797.0	65,499	121,866	40,862
26.00	42,768	995.0	77,845	199,711	69,154
27.00	49,632	1,075.0	46,157	245,868	82,373

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 13.00' S= 0.0442 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.00'	**6.0" Vert. Orifice/Grate** C= 0.600

#3	Device 1	23.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	26.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.46 cfs @ 13.63 hrs HW=24.82' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 6.46 cfs of 26.17 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.52 cfs @ 7.72 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 1.19 cfs @ 6.04 fps)
  └─**4=Orifice/Grate** (Weir Controls 3.76 cfs @ 1.86 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=20.00' TW=0.00' (Dynamic Tailwater)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond C2-P: AP4 - 18" RCP East Depression

Inflow Area = 82,990 sf, 0.00% Impervious, Inflow Depth = 3.36" for 25YearMass event
Inflow = 6.05 cfs @ 12.18 hrs, Volume= 23,253 cf
Outflow = 5.48 cfs @ 12.24 hrs, Volume= 23,253 cf, Atten= 9%, Lag= 3.6 min
Primary = 5.48 cfs @ 12.24 hrs, Volume= 23,252 cf
Secondary = 0.01 cfs @ 12.24 hrs, Volume= 1 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.51' @ 12.24 hrs Surf.Area= 1,558 sf Storage= 1,099 cf

Plug-Flow detention time= 3.6 min calculated for 23,248 cf (100% of inflow)
Center-of-Mass det. time= 3.7 min (837.1 - 833.5)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.94' S= 0.0015 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.47 cfs @ 12.24 hrs HW=28.50' TW=23.34' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 5.47 cfs @ 3.84 fps)

Secondary OutFlow Max=0.01 cfs @ 12.24 hrs HW=28.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.17 fps)

Summary for Link L-AP5-P: AP5 - Johnsons Creek

Inflow Area = 1,107,638 sf, 0.00% Impervious, Inflow Depth > 2.68" for 25YearMass event
Inflow = 14.75 cfs @ 12.15 hrs, Volume= 247,830 cf
Primary = 14.75 cfs @ 12.15 hrs, Volume= 247,830 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1: AP1 - Merrimack River

Runoff = 47.97 cfs @ 12.10 hrs, Volume= 154,194 cf, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
286,650	74	>75% Grass cover, Good, HSG C
89,000	72	Woods/grass comb., Good, HSG C
375,650	74	Weighted Average
375,650		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.2	50	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	65	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	100	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.0	265	Total			

Summary for Subcatchment P2: AP2 - Western Wetlands

Runoff = 8.44 cfs @ 12.20 hrs, Volume= 34,451 cf, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
76,130	74	>75% Grass cover, Good, HSG C
7,800	72	Woods/grass comb., Good, HSG C
83,930	74	Weighted Average
83,930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.0	475	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.9	635	Total			

Summary for Subcatchment P3: 18" RCP West

Runoff = 7.00 cfs @ 12.17 hrs, Volume= 26,455 cf, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
64,450	74	>75% Grass cover, Good, HSG C
64,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.1	300	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.1	470	Total			

Summary for Subcatchment P4: 18" RCP East

Runoff = 8.85 cfs @ 12.18 hrs, Volume= 34,065 cf, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
82,990	74	>75% Grass cover, Good, HSG C
82,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0500	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.1	100	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	285	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.7	475	Total			

Summary for Subcatchment P5: Johnson's Creek

Runoff = 20.64 cfs @ 12.14 hrs, Volume= 73,696 cf, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

Area (sf)	CN	Description
149,840	74	>75% Grass cover, Good, HSG C
29,700	72	Woods/grass comb., Good, HSG C
179,540	74	Weighted Average
179,540		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.0	170	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	65	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	90	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.2	400	Total			

Summary for Subcatchment P6: Southern Mound to Basin

Runoff = 96.34 cfs @ 12.11 hrs, Volume= 320,439 cf, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YearMass Rainfall=8.00"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					**Direct Entry,**

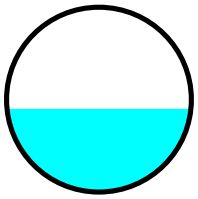
Summary for Reach C1-P: AP3 - 18" RCP West

Inflow Area = 64,450 sf, 0.00% Impervious, Inflow Depth = 4.93" for 100YearMass event
Inflow = 7.00 cfs @ 12.17 hrs, Volume= 26,455 cf
Outflow = 6.99 cfs @ 12.17 hrs, Volume= 26,455 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.11 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.34 fps, Avg. Travel Time= 0.2 min

Peak Storage= 31 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-P: Basin 1 - New Design

Inflow Area = 928,098 sf, 0.00% Impervious, Inflow Depth = 4.91" for 100YearMass event
Inflow = 108.34 cfs @ 12.12 hrs, Volume= 379,738 cf
Outflow = 20.50 cfs @ 12.63 hrs, Volume= 316,706 cf, Atten= 81%, Lag= 30.9 min
Primary = 20.50 cfs @ 12.63 hrs, Volume= 316,706 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 25.80' @ 12.63 hrs Surf.Area= 41,959 sf Storage= 191,035 cf

Plug-Flow detention time= 383.1 min calculated for 316,640 cf (83% of inflow)
Center-of-Mass det. time= 314.6 min (1,134.0 - 819.4)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	245,868 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	26,062	673.0	0	0	26,062
22.00	30,359	730.0	56,366	56,366	32,579
24.00	35,200	797.0	65,499	121,866	40,862
26.00	42,768	995.0	77,845	199,711	69,154
27.00	49,632	1,075.0	46,157	245,868	82,373

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 13.00' S= 0.0442 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.00'	**6.0" Vert. Orifice/Grate** C= 0.600

#3	Device 1	23.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	26.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=20.50 cfs @ 12.63 hrs HW=25.80' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 20.50 cfs of 30.12 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 9.07 fps)
  - **3=Orifice/Grate** (Orifice Controls 1.51 cfs @ 7.68 fps)
  - **4=Orifice/Grate** (Orifice Controls 17.21 cfs @ 5.48 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=20.00' TW=0.00' (Dynamic Tailwater)
- **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond C2-P: AP4 - 18" RCP East Depression

Inflow Area = 82,990 sf, 0.00% Impervious, Inflow Depth = 4.93" for 100YearMass event
Inflow = 8.85 cfs @ 12.18 hrs, Volume= 34,065 cf
Outflow = 8.64 cfs @ 12.20 hrs, Volume= 34,065 cf, Atten= 2%, Lag= 1.6 min
Primary = 6.47 cfs @ 12.20 hrs, Volume= 32,844 cf
Secondary = 2.17 cfs @ 12.20 hrs, Volume= 1,221 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.70' @ 12.20 hrs Surf.Area= 1,839 sf Storage= 1,423 cf

Plug-Flow detention time= 3.4 min calculated for 34,058 cf (100% of inflow)
Center-of-Mass det. time= 3.4 min (825.9 - 822.5)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.94' S= 0.0015 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.47 cfs @ 12.20 hrs HW=28.70' TW=24.67' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 6.47 cfs @ 4.05 fps)

Secondary OutFlow Max=2.17 cfs @ 12.20 hrs HW=28.70' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.17 cfs @ 1.10 fps)

Summary for Link L-AP5-P: AP5 - Johnsons Creek

Inflow Area = 1,107,638 sf, 0.00% Impervious, Inflow Depth > 4.24" for 100YearMass event
Inflow = 29.27 cfs @ 12.31 hrs, Volume= 391,623 cf
Primary = 29.27 cfs @ 12.31 hrs, Volume= 391,623 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

APPENDIX F

DRAFT WEEKLY CONSTRUCTION PERIOD INSPECTION REPORT

Weekly Stormwater Construction Site Inspection Report

Haverhill Landfill, Northern Mound, Old Groveland Road, Haverhill

General Information			
Project Name	**Northern Mound, Haverhill Landfill**		
MassDEP File Number:			
Date of Inspection		**Start/End Time**	
Inspector's Name(s) & Contact Information			

Type of Inspection:
❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event

Weather Information

Has there been a storm event since the last inspection? ❑Yes ❑No
If yes, provide:
Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):

Weather at time of this inspection?
❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds
❑ Other: Temperature:

Have any discharges occurred since the last inspection? ❑Yes ❑No
If yes, describe:

Are there any discharges at the time of inspection? ❑Yes ❑No
If yes, describe:

	Site – Specific BMPs	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1	Erosion Control Barrier	❑Yes ❑No	❑Yes ❑No	
2	Catch Basin Inlet Protection	❑Yes ❑No	❑Yes ❑No	
3	Temporary Soil Stabilization	❑Yes ❑No	❑Yes ❑No	
4	Stormwater System	❑Yes ❑No	❑Yes ❑No	

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____

Signature:_____ **Date:**_____

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	**Slopes** and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
2	**Natural Resource** areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
3	**Perimeter Controls** and sediment barriers adequately installed (keyed into substrate) and maintained?	❑Yes ❑No	❑Yes ❑No	
4	**Discharge Points** and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
5	**Storm Drain Inlets** properly protected?	❑Yes ❑No	❑Yes ❑No	
6	**Construction exit** preventing sediment from being tracked into the street?	❑Yes ❑No	❑Yes ❑No	
7	**Trash / Litter** from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
8	**Washout Facilities** (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	❑Yes ❑No	❑Yes ❑No	
9	**Vehicle and Equipment Fueling,** cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	
10	**Materials** that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No	❑Yes ❑No	
11	**Non-stormwater discharges** (wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	

APPENDIX G

STORMWATER MANAGEMENT SYSTEM
LONG-TERM OPERATION & MAINTENANCE (O & M) PLAN

STORMWATER MANAGEMENT SYSTEM

Long Term Operations and Maintenance Plan

Northern Mound
Haverhill Landfill
Old Groveland Road
Haverhill, MA

Prepared For:

Langdon Environmental
40 Pleasant Street, Suite 302
PO Box 511
Portsmouth, NH 03802

9.28.22

McCLURE
ENGINEERING, INC

119 Worcester Road – Charlton, Massachusetts 01507 – T: 508.248.2005

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TABLES

ATTACHMENTS

Long-Term Operation & Maintenance Plan
Site Stormwater Management System
Northern Mound, Haverhill Landfill

Property Owner/Responsible Party: **Trimount Bituminous**

Storm Water Management System Owner: **(same as above)**

Site subject to Wetlands Protection Act: **Yes**

The Responsible Party Shall:

- Prepare an **"Operation and Maintenance (O & M) Compliance Statement"**
- Implement the routine and non-routine operation, maintenance, and inspection tasks in accordance with the procedures specified in this document to ensure that all storm water management systems function as designed.
- Maintain a log of all operation and maintenance (O & M) activities. Keep records for the last three (3) years, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and disposal location).
- Make this log available to **Haverhill** official representatives upon request;
- Allow **Haverhill** official representatives to inspect each storm water system "best management practice" (BMP) to determine whether the responsible party is implementing the operation and maintenance plan;
- Agree to notify in writing all future property owners of the presence of the storm water management system and the requirement for proper operation and maintenance.

Responsible Party shall maintain a contract with the following companies:

Landscaping and Pavement Maintenance: _____

Snow Removal and Plowing: _____

Storm Water System Maintenance: _____

Site Description:

The project is located on the north side of Old Groveland Road. The Site is home to the Haverhill Landfill and is known as the "Northern Mound". The parcel is identified as Assessor's parcels 776-788-27, containing approximately 13.7 acres of land. The site is located along the southern side of the Merrimack River and the western side of Johnson Creek. There are also wetlands associated with an intermittent stream along the western side of the property.

According to the Massachusetts Geographic Information System, the area along the Merrimack River is a Priority Habitat area and work in this area will be conducted through approval of the NHESP. The Site falls outside of any surface water protection areas and wellhead protection areas. The section of the Merrimack River in which the site sits is considered a Class SB water.

There are on-site FEMA Flood Hazard areas per Flood Insurance Rate Map (FIRM) Number 25009C0093F, Effective on 07/03/2012 (see Appendix C).

The project proposes to complete the corrective actions required by the Solid Waste Management Regulations (310 CMR 19.000) promulgated by MassDEP at the Haverhill Landfill (Landfill). The activities include capping of an existing landfill known as the Northern Mound. The proposed project can be considered a redevelopment project.

Stormwater management controls are incorporated into landfill closure design to minimize impacts on the surrounding environment and to protect the landfill cap from damage caused by erosion. Stormwater controls provide the following critical functions:

• Maintain the integrity of the landfill cap by preventing erosion of the soil layers above the membrane cap;
• Minimize the potential production of leachate by diverting stormwater runoff away from the landfill surface and preventing water ponding on the capped landfill; and
• Minimize the transport of stormwater sediment from the capped landfill surface into adjacent receiving waters.

The integrity of the cap is maintained by the grass, topsoil, and drainage layer above the cap.

Operation and Maintenance (O&M) Plan

The purpose of this Storm Water Management System Operation and Maintenance Plan is to prevent erosion, sedimentation, pollution or other deterioration of the storm water management system and resource areas located on and adjacent to the property. The storm water management system shall be maintained properly to assure its continued performance. Inspection and maintenance for the system should be in compliance with Table 1.

TABLE 1

STORMWATER SYSTEM
INSPECTION AND MAINTENANCE SCHEDULE

Hudson Street Landfill
Marlborough, MA

Best Management Practice (BMP)	Inspection Frequency	Maintenance Frequency
STRUCTURAL BMPs		
Detention Basin	After every major storm during first 3 months of operation and twice a year thereafter and when there are discharges through the high outlet orifice.	Bi-Annual Min (Early Spring & Late Fall) and/or As Needed
Swales	The first few months after construction and twice a year thereafter.	Bi-Annual Min (Early Spring & Late Fall) and/or As Needed
Sediment Forebay	Monthly	Quarterly and/or As Needed
Pipe Outfall/ Rip Rap Apron/ Level Spreader	After heavy rains and Bi-Annually Min (Early Spring & Late Fall)	Bi-Annual Min (Early Spring & Late Fall) and/or As Needed
NON-STRUCTURAL STORMWATER CONTROLS		
Landscaping	Bi-Annual (Early Spring & Late Fall)	Seasonally As Needed
Parking Area Sweeping	Bi-Annual (Early Spring & Late Fall)	Bi-Annual (2-Times / Year) (Apr/May and Oct/Nov.)
Snow Removal	Seasonally As Needed	In Accordance with M.G.L. Title XIV. Public Ways and Works; Chapter 85
Site Inspections	Bi-Annual (Early Spring & Late Fall)	Keep Records on File at Site for Three (3) Years

Responsible Party shall be responsible for the system and all Operation and Maintenance procedures, including those outlined in the following sections.

STRUCTURAL STORM WATER BMP MAINTENANCE:

Detention Basin:
Inspect dry detention basins at least once per year to ensure that they are operating as intended. Inspect basins during and after storms to determine if the basin is meeting the expected detention times. Inspect the outlet structure for evidence of clogging or outflow release velocities that are greater than design flow. Potential problems that should be checked include: subsidence, erosion, cracking or tree growth on the embankment; damage to the emergency spillway; sediment accumulation around the outlet; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel; and erosion within the basin and banks. Make any necessary repairs immediately. During inspections, note changes to the detention basin or the contributing watershed because these changes could affect basin performance. Mow the side slopes, embankment, and emergency spillway at least twice per year. Remove trash and debris at this time. Remove sediment from the basin as necessary, and at least once every 10 years or when the basin is 50% full.

Swales:
The swale should be inspected periodically and after every major storm to determine the condition of the swale. Rills and damaged areas should be promptly repaired as necessary to prevent further deterioration. Remove sediments, and repair as necessary. Riprap should be checked at least annually and after heavy rains for scouring below the riprap layer, displaced stones, slumping, and erosion at edges, especially downstream or downslope. If the riprap has been damaged, it should be repaired immediately before further damage can take place. Rock may need to be added if sediment builds up in the pore spaces of the swale. Make repairs immediately using appropriate stone sizes. Plastic filter cloth, if used, should be completely covered and protected from sunlight. Woody vegetation should be removed from the rock riprap annually because tree roots will eventually dislodge the riprap. Woody vegetation should not be allowed to become established in the rock riprap and if present should be removed. Debris should not be allowed to accumulate in the channel. Give special attention to outlets and points where concentrated flow enters channel. Repair eroded areas promptly.

Inspect check dams after each rainfall event. Remove sediment accumulations. Check structure and abutments for erosion, piping, or rock displacement. Repair immediately. If stone is displaced from the face of the check dam, the stone size is too small and needs to be increased. If sediment is traveling through check dams, there is an inadequate layer of stone on the inside face of the check dam or the stone is too coarse to restrict flow through dam. If the issue is ongoing, consider adding a non-woven geotextile liner to inside of dam. Dispose of waste materials in designated disposal areas.

Sediment Forebay:
Sediment forebays should be readily accessible for maintenance and sediment removal. Inspect sediment forebays after each significant rainfall. Remove and properly dispose of sediment at least 2 times per year or when sediment deposits total approximately 12”. The effectiveness of a sediment forebay is based less on its size than on regular sediment removal. Place waste material in designated disposal areas. Smooth site to blend with surrounding area and stabilize. Clean or replace gravel when sediment pool does not drain properly. Stabilize the floor and sidewalls of

the sediment forebay before making it operational, otherwise the practice will discharge excess amounts of suspended sediments. After removing the sediment, replace any vegetation damaged during the clean-out by reseeding. When reseeding, incorporate practices such as hydroseeding with a tackifier, blanket, or similar practice to ensure that no scour occurs in the forebay, while the seeds germinate and develop roots. Check embankment, emergency spillway, and outlet for erosion damage. Check embankment for: settlement, seepage, or slumping along the toe or around pipe. Look for signs of seepage or erosion. Repair immediately. Remove trash and other debris from principal spillway, emergency spillway, and pool area.

Pipe Outfall/Rip Rap Apron/Level Spreader:
Inspect riprap outlet structures after heavy rains for erosion at sides and ends of apron and for stone displacement. Rock may need to be added if sediment builds up in the pore spaces of the outlet pad. Make repairs immediately using appropriate stone sizes. Do not place stones above finished grade. If erosion is occurring down gradient of the outfall, the down gradient vegetation is not stable and the area should be stabilized, the rip rap apron is not long or wide enough and needs to be increased, or the riprap stones are too small or not graded well. If movement of stone is occurring: riprap stones may be too small or not graded well, or the appropriate filter fabric may not be installed under riprap. If erosion occurs around apron and scour holes appear at outlet, foundation may not be excavated wide or deep enough. If erosion of the foundation is occurring, the appropriate filter fabric may not be installed under riprap.

NON - STRUCTURAL STORM WATER MANAGEMENT CONTROLS / GOOD HOUSEKEEPING PRACTICES:

Hay bales:
Inspect straw/hay bales before a forecasted storm event, immediately after each runoff producing rainfall and at least daily during prolonged rainfall. Ensure there are not gaps between bales or evidence of undermining. Close attention should be paid to the repair of damaged bales, undercutting beneath bales, and flow around the ends of the bales. Necessary repairs to barriers or replacement of bales should be accomplished promptly. Replace rotted or sediment covered bales as necessary. Sediment deposits should be checked after each runoff-producing rainfall. They must be removed when the level of deposition reaches approximately one-half the height of the barrier. Any sediment deposits remaining in place after the straw bale barrier is no longer required should be dressed to conform to the existing grade, prepared and seeded.

Silt Fence:
A sediment fence requires a great deal of maintenance. Silt fences should be inspected immediately after each rainfall and at least daily during prolonged rainfall. Remove accumulated sediment when it reaches one half the height of the sediment fence. Remove sediment deposits promptly to provide adequate storage volume for the next rain and to reduce pressure on fence. Take care to avoid undermining fence during cleanout. Sagging, frayed, torn, or otherwise damaged fabric should be repaired or replaced. Repair end runs and undercutting. Inspect reinforcement and staking materials for structural integrity, and replace when necessary. Sediment deposits remaining after the fabric has been removed should be graded to conform to the existing topography and vegetated.

Mulching:
Mulching shall be used in areas which cannot be seeded because of the season, or are otherwise unfavorable for plant growth (traffic and parking areas). When properly applied, mulch offers a fast, effective means of controlling erosion and dust. Soil surfaces should be roughened prior to mulching. Run track-mounted machinery up and down the slope in order to leave horizontal depressions in the soil running parallel to the slope. Roughened soil surfaces should be mulched and/or seeded as soon as possible. Ensure there is a continuous, uniform, even coverage. Ensure mulch layer is not so thick that it suppresses desired seed germination and plant growth. Ensure rilling or gullying does not occur beneath “binded” mulch. Replace or repair mulch if washed or blown away. On steep slopes and critical areas such as waterways, use netting or anchoring with mulch to hold it in place. Inspect after rainstorms to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, repair surface, reseed, remulch, and install new netting. Straw or grass mulches that blow or wash away should be repaired promptly. Blanket mulch that is displaced by flowing water should be repaired as soon as possible. Continue inspections until vegetation is well established.

Temporary & Permanent Seeding
Well-established vegetation is widely considered the most effective form of erosion control. The presence of temporary or permanent cover will provide stabilization and erosion protection to disturbed areas. Temporary seed mixes contain annual vegetation that grows quickly and helps stabilize an area until permanent vegetation can be established. Proper soil bed preparation, seeding method and soil moisture are critical for successful seed application. Before planting,

scarify/roughen the soil surface and install appropriate surface drainage measures to prevent erosion and scouring. Seed with an approved conservation cover mix during the specified growing season, using native plant species. Seeding operations should be performed within one of the following periods: April 1 - May 31, August 1 - September 10, November 1 - December 15 as a dormant seeding (seeding rates shall be increased by 50% for dormant seeding). As needed, provide water, fertilizer, lime, and mulch to the seedbed. If it is unlikely that growth will occur due to cold weather, apply mulch for temporary stabilization. Inspect within 6 weeks of planting to see if stands are adequate. Check for damage after heavy rains. Stands should be uniform and dense. Fertilize, reseed, and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary. Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather or on adverse sites. Water application rates should be controlled to prevent runoff. Inspect seeded areas for failure and make appropriate repairs and re-seed and re-plant as necessary. Inspect for bare spots, rilling, or gullying and correct as necessary. If stand has less than 40% cover, re-evaluate selection of seeding materials and quantities of fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations. If the season prevents resowing, mulch or jute netting is an effective temporary cover. Lack of water may also be an issue. Conduct a follow up survey after one year and re-seed failed areas. Temporarily stabilized areas will require permanent stabilization when the area has been completed as designed or when the growing season begins.

Landscape & Parking Area Maintenance

Landscape areas shall be maintained in a neat and orderly fashion. Landscape maintenance debris shall not be deposited on adjacent properties and properly disposed of off-site as necessary to maintain a clean and orderly appearance. Parking Areas shall be inspected often and after significant rainfall events. Inspect for signs of erosion, rilling, gullying. Regrade and repair parking areas as necessary. If areas are needing constant maintenance apply mulch/wood chips to help prevent further erosion. Areas not used for parking or traffic should be seeded for stabilization. All parking areas should be stabilized prior to off season shutdown, preferably with a mulch application.

Fertilizer, Herbicide, and Pesticide Storage

Storage of all fertilizers, herbicides, and pesticides will be indoors. Use of all fertilizers, herbicides, and pesticides shall be in a manner consistent with the products intended use.

Waste Storage & Trash Removal

All waste products are to be stored indoors, under cover, or within a covered dumpster. Inspect on-site area for litter and trash on a weekly basis. Any accumulated trash, litter, and discarded materials in this area will be removed and will be disposed of at a suitable location on a weekly basis. The loading and dumpster areas throughout the site will be inspected on a daily basis for cardboard and/or paper products and will be inspected on a weekly basis for any accumulated trash, litter, and discarded material. Dumpster to be kept closed when not in use.
Gates to the dumpster enclosure areas are proposed to be locked when not in use.

Hazardous Waste or Oil Spill Response Procedure

Initial Notification: In the event of a spill of hazardous waste or oil the facility manager or supervisor will be notified immediately by telephone.

Assessment – Initial Containment: The supervisor or manager will assess the incident and initiate control measures. The supervisor will first contact the City of Hopedale Fire Department and then notify the City of Hopedale. The Fire Department is ultimately responsible for matters of public health and safety and should be notified immediately.

Fire Department Telephone:	911 (Emergency) 978-373-8460 (Non-Emergency/Dispatch)
Police Department Telephone:	911 (Emergency) 978-373-1212 (Non-Emergency/Dispatch)

Further Notification: Based on the assessment by the Fire Chief, additional notification to a clean up contractor may be made. The Massachusetts Department of Environmental Protection and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of clean up and notification required.

SNOW MANAGEMENT PLAN:

Snow plowing will be done to allow access to the site and provide safe passage from vehicle to front door. No salt shall be used to treat unpaved areas during snow and ice conditions. Snow from lighter storms will be plowed to the perimeter of the parking lots and allowed to melt onto the pavement surfaces. Snow will be temporarily stock piled on the pavement surface during larger storm events to keep the parking area open for customers. This stockpiling will be temporary and will be located within designated areas throughout the Site, furthest away from the building entrances. If Site snow storage interferes with parking lot operations (i.e. blocking of travel aisles, sight distance, or parking) the snow pile will be either removed or reduced legally in a legal manner by the snow plow vendor within 24 hours.

Winter Road Salt & Sand Use Restrictions

Salt and sand for winter de-icing will only be stored indoors or under cover. Use of road salt and sand will only be used on a limited basis during the winter months to insure safe passage of pedestrian walkways and parking areas.

INSPECTIONS / RECORDKEEPING / TRAINING:

Routine Inspections

Routine inspections and maintenance to be conducted with the frequency described in this Operation and Maintenance Plan. An example inspection form is provided in **Attachment #1.**

Recordkeeping

Records of all drainage system inspections and maintenance shall be kept on file for a period of at least three (3) years and provided to the City of Marlborough upon request.

PUBLIC SAFETY FEATURES:

All cast iron storm water structure grates and covers shall be kept in good condition and kept closed at all times. Any damaged or broken structures will be replaced immediately upon discovery;

OPERATION AND MAINTENANCE BUDGET ESTIMATE:

The responsible party agrees to maintain an adequate annual budget to provide for the routine maintenance activities detailed in this document including but not limited to:

- Swale Maintenance
- Landscape Maintenance
- Trash Removal
- Snow Plowing & Removal

Attachment #1

Inspection & Maintenance Reports

Long-Term Operation and Maintenance Plan
Storm Water Management System

Northern Mound, Haverhill Landfill

INSPECTION AND MAINTENANCE REPORT FORM

Note: This Log should be copied prior to use. Note Additional Comments on back of Form.

Inspector's Name: _____ Date: _____ Time: _____ am/pm

Inspector's Qualifications: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____ inches

Item/Condition to be Checked	Maintenance Required		Corrective Action & Date
	No	Yes	
Detention Basin			
Sediment Forebay			
Pipe Outfall			
Swales			
Landscaping / Trash Removal			
Snow Removal (seasonal)			

Corrective Actions Taken (if necessary):

Attachment H

Orders of Resource Area Delineations and Extensions

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 7 – Extension Permit for Orders of Conditions

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

DEP File Number: 33-1434 Provided by DEP

A. General Information

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

1. Applicant:

City of Haverhill, c/o Water and Wastewater Division, Attn: Robert Ward, Deputy DPW Director
Name

40 South Porter Street
Mailing Address

Haverhill | MA | 01835
City/Town | State | Zip Code

2. Property Owner (if different):

Owner Lots 20, 26, & 27: Trimount Bituminous c/o Aggregate Industries – Northeast Region, Inc. Attn: Jarrett Temple 1715 Broadway Saugus, MA 01906	Owner Lot 1AA: Massachusetts Electric Company c/o Property Tax Department 40 Sylvan Road Waltham, MA 02451-2286

B. Authorization

The Order of Conditions (or Extension Permit) issued to the applicant or property owner listed above on:

January 19, 2018 (Date) Issued by: Haverhill (Conservation Commission)

for work at: Groveland Road (Street Address) Parcel IDs: 776-788-20, -26, -27, & -1AA (Assessor's Map/Plat Number) (Parcel/Lot)

recorded at the Registry of Deeds for:

Southern Essex District (County) | 36490 (Book) | 485 (Page)

(Certificate (if registered land))

is hereby extended until: January 19, 2024 (Date) N/A (Date the Order was last extended (if applicable))

This date can be no more than 3 years from the expiration date of the Order of Conditions or the latest extension. Only unexpired Orders of Conditions or Extension may be extended.

This Extension Permit must be signed by a majority of the Conservation Commission and a copy sent to the applicant and the appropriate DEP Regional Office (https://www.mass.gov/service-details/massdep-regional-offices-by-community).

B. Authorization (cont.)

Pursuant to the vote taken by the Conservation Commission on May 7, 2020, the following signatures are made in accordance with M.G.L. c.110G and pursuant to said Commission's electronic signature authorization vote recorded on May 21, 2020, with the Southern Essex District Registry of Deeds in Book 38538, Page 455.

Signatures:

/Harmony Wilson/	Harmony Wilson
Signature	Printed Name
/Ralph Basiliere/	Ralph Basiliere
Signature	Printed Name
/Thomas Wylie/	Thomas Wylie
Signature	Printed Name
/Phillip LaCroix/	Phillip LaCroix
Signature	Printed Name
/Joseph DiPietro/	Joseph DiPietro
Signature	Printed Name
/Frederick Clark/	Frederick Clark
Signature	Printed Name
	-
Signature	Printed Name
Signature	Printed Name

C. Recording Confirmation

The applicant shall record this document in accordance with General Condition 8 of the Order of Conditions (see below), complete the form attached to this Extension Permit, have it stamped by the Registry of Deeds, and return it to the Conservation Commission.

Note: General Condition 8 of the Order of Conditions requires the applicant, prior to commencement of work, to record the final Order (or in this case, the Extension Permit for the Order of Conditions) in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, it shall be noted in the Registry's Granter Index under the name of the owner of the land upon which the proposed work is to be done. In the case of registered land, it shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done.

Detach this page and submit it to the Conservation Commission prior to the expiration of the Order of Conditions subject to this Extension Permit.

To:

Haverhill
Conservation Commission

Please be advised that the Extension Permit to the Order of Conditions for the project at:

Groveland Road - Parcel IDs: 776-788-20, -26, -27, & -1AA
Project Location

33-1434
DEP File Number

has been recorded at the Registry of Deeds of:

Southern Essex Distict
County

for:

Property Owner

and has been noted in the chain of title of the affected property in accordance with General Condition 8 of the original Order of Conditions on:

Date | Book | Page

If recorded land the instrument number which identifies this transaction is:

Instrument Number

If registered land, the document number which identifies this transaction is:

Document Number

Signature of Applicant

For Registry of Deeds Use Only

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

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

Provided by MassDEP:
33-1434
MassDEP File Number

eDEP Transaction Number

Haverhill
City/Town

A. General Information

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.

From: Haverhill
1. Conservation Commission

2. This Issuance is for (check one):

a. ☒ Order of Resource Area Delineation

b. ☐ Amended Order of Resource Area Delineation

3. Applicant:

Applicant 1: City of Haverhill c/o Water & Wastewater Division Attn: Robert Ward, Deputy DPW Director 40 South Porter Street Haverhill, MA 01835	Applicant 2: Aggregate Industries – Northeast Region, Inc. Attn: Lisa Young, Regional Land & Environmental Manager 1715 Broadway Saugus, MA 01906

4. Property Owner (if different from applicant):

Owner Lots 20, 26, & 27: Trimount Bituminous c/o Aggregate Industries – Northeast Region, Inc. Attn: Lisa Young, Regional Land & Environmental Manager 1715 Broadway Saugus, MA 01906	Owner Lot 1AA: Massachusetts Electric Company c/o Property Tax Department 40 Sylvan Road Waltham, MA 02451-2286

5. Project Location:

Groveland Road — a. Street Address
Haverhill — b. City/Town
01835 — c. Zip Code
Parcel IDs: 776-788-20, -26, -27, & -1AA — d. Assessors Map/Plat Number
e. Parcel/Lot Number

Latitude and Longitude (in degrees, minutes, seconds):
N 42d 45m 21s — f. Latitude
W 71d 02m 43s — g. Longitude

6. Dates:
November 21, 2017 — a. Date ANRAD filed
December 27, 2017 (final plan submittal) — b. Date Public Hearing Closed
January 19, 2018 — c. Date of Issuance

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

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

Provided by MassDEP:
33-1434
MassDEP File Number

eDEP Transaction Number

Haverhill
City/Town

A. General Information (cont.)

7. Title and Date (or Revised Date if applicable) of Final Plans and Other Documents:

"Resource Area Plan, Haverhill Landfill - Northern Mound" (1 Sheet), prepared by Langdon Environmental, LLC — a. Title

Revised 12.14.2017 — b. Date

c. Title

d. Date

B. Order of Delineation

1. The Conservation Commission has determined the following (check whichever is applicable):

a. ☒ **Accurate**: The boundaries described on the referenced plan(s) above and in the Abbreviated Notice of Resource Area Delineation are accurately drawn for the following resource area(s):

1. ☒ Bordering Vegetated Wetlands

2. ☒ Other resource area(s), specifically: Bank, 200'-Riverfront Area, BLSF, Land Under Water, and locally-jurisdictional Isolated Vegetated Wetland and 100'-Buffer Zone

NOTE: Other jurisdictional resource areas may exist on this property, but are not subject to review under this application. The boundaries of these other resource areas are neither confirmed nor denied by the Haverhill Conservation Commission.

b. ☐ **Modified**: The boundaries described on the plan(s) referenced above, as modified by the Conservation Commission from the plans contained in the Abbreviated Notice of Resource Area Delineation, are accurately drawn from the following resource area(s):

1. ☐ Bordering Vegetated Wetlands

2. ☐ Other resource area(s), specifically:

a.

c. ☐ **Inaccurate**: The boundaries described on the referenced plan(s) and in the Abbreviated Notice of Resource Area Delineation were found to be inaccurate and cannot be confirmed for the following resource area(s):

1. ☐ Bordering Vegetated Wetlands

2. ☐ Other resource area(s), specifically:

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

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

Provided by MassDEP:
33-1434
MassDEP File Number

eDEP Transaction Number

Haverhill
City/Town

B. Order of Delineation (cont.)

3. ☐ The boundaries were determined to be inaccurate because:

C. Findings

This Order of Resource Area Delineation determines that the boundaries of those resource areas noted above, have been delineated and approved by the Commission and are binding as to all decisions rendered pursuant to the Massachusetts Wetlands Protection Act (M.G.L. c.131, § 40) and its regulations (310 CMR 10.00). This Order does not, however, determine the boundaries of any resource area or Buffer Zone to any resource area not specifically noted above, regardless of whether such boundaries are contained on the plans attached to this Order or to the Abbreviated Notice of Resource Area Delineation.

This Order must be signed by a majority of the Conservation Commission. The Order must be sent by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate DEP Regional Office (see http://www.mass.gov/eea/agencies/massdep/about/contacts/find-the-massdep-regional-office-for-your-city-or-town.html).

D. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate DEP Regional Office to issue a Superseding Order of Resource Area Delineation. When requested to issue a Superseding Order of Resource Area Delineation, the Department's review is limited to the objections to the resource area delineation(s) stated in the appeal request. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Any appellants seeking to appeal the Department's Superseding Order of Resource Area Delineation will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order or Determination, or providing written information to the Department prior to issuance of a Superseding Order or Determination.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act, (M.G.L. c. 131, § 40) and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal bylaw or ordinance, and not on the Massachusetts Wetlands Protection Act or regulations, the Department of Environmental Protection has no appellate jurisdiction.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

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

Provided by MassDEP:
33-1434
MassDEP File Number

eDEP Transaction Number

Haverhill
City/Town

E. Signatures

January 19, 2018
Date of Issuance

Please indicate the number of members who will sign this form. six
1. Number of Signers

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

This Order is valid for three years from the date of issuance.

If this Order constitutes an Amended Order of Resource Area Delineation, this Order does not extend the issuance date of the original Final Order, which expires on January 19, 2021 unless extended in writing by the issuing authority.

This Order is issued to the applicant and the property owner (if different) as follows:

2. ☐ By hand delivery on

a. Date

3. ☒ By certified mail, return receipt requested on

January 19, 2018
a. Date

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

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

Provided by MassDEP:
33-1434
MassDEP File Number

eDEP Transaction Number

Haverhill
City/Town

Recording Information

Prior to commencement of work, this Order of Resource Area Delineation must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Resource Area Delineation. The recording information on this page shall be submitted to the Conservation Commission listed below.

Haverhill
Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Haverhill
Conservation Commission

Please be advised that the Order of Resource Area Delineation for the Project at:

Groveland Road
Parcel IDs: 776-788-20, -26, -27 & -1AA
Project Location

33-1434
MassDEP File Number

Has been recorded at the Registry of Deeds of:

Southern Essex District
County

Book

Page

For:
Property Owner

and has been noted in the chain of title of the affected property in:

Book

Page

In accordance with the Order of Resource Area Delineation issued on:

Date

If recorded land, the instrument number identifying this transaction is:

Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant

Town of

Groveland

Groveland, Massachusetts
Town Hall
183 Main Street
Groveland, MA 01834

Conservation Commission

Dear Applicant,

Enclosed is the original extension certificate for your recent filing. These are the steps to complete the process.

- Make a copy of the permit for yourself and one for your contractor. Your contractor must have a copy of the entire permit on-site at all times. Please make sure they read it.

- Take the original to the Salem Registry of Deeds at Shetland Park, 45 Congress St., Suite 4100, Salem, MA (Phone: 978-741-0201) Recording hours are 8:00 a.m. to 4:00 p.m. Mon.- Fri. Register the extension and get a receipt with the book and page number.

- If applicable, call our office, 978-556-7214 and leave us a message at least 48 hours before you install the haybales and silt fence. Also tell us the book and page numbers from the Registry.

- If applicable, call us at 978-556-7214 at least 3 days before you are ready to begin work at the site to schedule the preconstruction meeting. At the meeting you will need to provide us with a copy of the registration form from the Registry of Deeds, give us a written timeline for the work and the name and number of the contractor(s). We will inspect the haybales and silt fence at this time also and give you the go ahead to start work if everything is in order.

- If required, file your Notice of Intent(s) and Groveland bylaw permit request(s) with the Commission. Leave enough time between filing and when you want to start your project. We can advise on typical timelines if you consult with our office.

Please call our office at 978-556-7214 if you have any questions regarding the permit or work at the site.

Sincerely,

Michael Dempsey
Chairman

Town of

Groveland

Groveland, Massachusetts
Town Hall
183 Main Street
Groveland, MA 01834

Conservation Commission

January 20, 2021

Bruce Haskell
Langdon Environmental LLC
2 Summer St STE 300
Natick MA 01760

Dear Sirs:

This letter will serve to confirm a positive vote of the Groveland Conservation Commission to extend both the MassDEP ORAD and Groveland Wetland Bylaw GORAD issued by the Commission for a period of two years as follows.

ORAD issued originally on 1/22/18

Essex South Registry of Deeds Book 36609 Page 51

DEP #	030-0445
Property Location:	5 Yemma Way, Groveland MA 01834 Assessors Map 32 Lot 20
Owner:	Trimount Bituminous Aggregate Industries – Northeast Region Inc. 1715 Broadway Saugus MA 01906
ORAD Extended Until:	January 22, 2023

ORAD / GORAD Extension
5 Yemma Way Groveland MA 01834

Signatures

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

Signature of Conservation Commission Member

This Order is valid for two years from the date of issuance.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

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

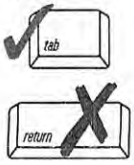
Provided by MassDEP: 030-0445
MassDEP File Number

eDEP Transaction Number

Groveland
City/Town

A. General Information

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.

From: Groveland Conservation Commission
1. Conservation Commission

2. This Issuance is for (check one):

a. ☒ Order of Resource Area Delineation

b. ☐ Amended Order of Resource Area Delineation

3. Applicant:

Bruce — a. First Name
Haskell — b. Last Name
Langdon Environmental LLC — c. Organization
2 Summer St., Suite 300 — d. Mailing Address
Natick — e. City/Town
MA — f. State
01760 — g. Zip Code

4. Property Owner (if different from applicant):

Trimount Bituminous — a. First Name
b. Last Name
Aggregate Industries-Northeast Region, Inc. — c. Organization
1715 Broadway — d. Mailing Address
Saugus — e. City/Town
MA — f. State
01906 — g. Zip Code

5. Project Location:

5 Yemma Rd — a. Street Address
Groveland — b. City/Town
01834 — c. Zip Code
Map 32 — d. Assessors Map/Plat Number
Lot 20 — e. Parcel/Lot Number
Latitude and Longitude (in degrees, minutes, seconds):
d m s — f. Latitude
d m s — g. Longitude

6. Dates:
11/22/17 — a. Date ANRAD filed
1/10/2018 — b. Date Public Hearing Closed
1/22/18 — c. Date of Issuance

7. Title and Date (or Revised Date if applicable) of Final Plans and Other Documents:

Resource Area Plan — a. Title
Sept 2017 — b. Date
c. Title
d. Date

6594 736