NOTICE OF INTENT

ACCESS DRIVEWAY TO FUTURE BOXFORD DEPARTMENT OF PUBLIC WORKS FACILITY

ASSESSORS MAP 19, LOT 28
BOXFORD, MASSACHUSETTS

Prepared for:

Town of Boxford
7 Spofford Road
Boxford, MA 01921

Prepared by:

TEC, Inc.
282 Merrimack Street
2nd Floor
Lawrence MA, 01843

January 19, 2023

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

Provided by MassDEP:

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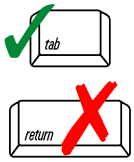
Boxford
City/Town

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):

7 Spofford Road — a. Street Address
Boxford — b. City/Town
01921 — c. Zip Code

Latitude and Longitude:
42.694238 — d. Latitude
-71.014731 — e. Longitude

19 — f. Assessors Map/Plat Number
28 — g. Parcel /Lot Number

2. Applicant:

Chris — a. First Name
Olbrot — b. Last Name
Town of Boxford, Massachusetts — c. Organization
7A Spofford Road — d. Street Address
Boxford — e. City/Town
MA — f. State
01921 — g. Zip Code
978-352-6555 — h. Phone Number
i. Fax Number
colbrot@town.boxford.ma.us — j. Email Address

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

a. First Name
b. Last Name
Town of Boxford — c. Organization
7 Spofford Road — d. Street Address
Boxford — e. City/Town
MA — f. State
01921 — g. Zip Code
h. Phone Number
i. Fax Number
j. Email address

4. Representative (if any):

Peter — a. First Name
Ellison — b. Last Name
TEC, Inc. — c. Company
282 Merrimack St — d. Street Address
Lawrence — e. City/Town
MA — f. State
01843 — g. Zip Code
978-794-1792 — h. Phone Number
i. Fax Number
pellison@theengineeringcorp.com — j. Email address

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

exempt — a. Total Fee Paid
exempt — b. State Fee Paid
exempt — c. City/Town Fee Paid

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A. General Information (continued)

6. General Project Description:

The purpose of this project is to improve vehicular traffic and drainage along the existing Department of Public Works' access road. The project scope includes full depth pavement placement, replacing the existing driveway. Also included are improvements to the existing drainage infrastucture and installation of stormwater improvements.

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)

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:

a. County	b. Certificate # (if registered land)
Southern Essex	
c. Book	**d. Page Number**
31666	652

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. linear feet	2. linear feet
b. ☐ Bordering Vegetated Wetland	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	1. square feet	2. square feet
	3. cubic feet of flood storage lost	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

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: _____ 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. _____

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

   08-2021
   (MassMapper)

   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. a. NHESP Tracking # b. Date submitted to NHESP

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

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

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

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

South Shore - 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).

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

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

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

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

   b. ACEC

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

   a. ☐ Yes ☒ No

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

   a. ☐ Yes ☒ No

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

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

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

      2. ☒ A portion of the site constitutes redevelopment

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

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

      1. ☐ Single-family house

      2. ☐ Emergency road repair

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

D. Additional Information

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

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

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

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

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

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D. Additional Information (cont'd)

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

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

Boxford DPW Access Road Plans
a. Plan Title

TEC, Inc.
b. Prepared By

Peter Ellison, PE
c. Signed and Stamped by

1/18/2023
d. Final Revision Date

As Noted
e. Scale

f. Additional Plan or Document Title

g. Date

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

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

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

8. ☒ Attach NOI Wetland Fee Transmittal Form

9. ☒ Attach Stormwater Report, if needed.

E. Fees

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

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

2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payor name on check: First Name

7. Payor name on check: Last Name

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F. Signatures and Submittal Requirements

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

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

1. Signature of Applicant

2. Date: 1-18-23

3. Signature of Property Owner (if different)

4. Date

5. Signature of Representative (if any)

6. Date: 1/19/2023

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

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

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

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

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NOI Wetland Fee Transmittal Form

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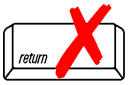

A. Applicant Information

1. Location of Project:

7 Spofford Road	Boxford
a. Street Address	b. City/Town
c. Check number	d. Fee amount

2. Applicant Mailing Address:

Chris		Olbrot
a. First Name		b. Last Name

Town of Boxford
c. Organization

7A Spofford Road
d. Mailing Address

Boxford	MA	01921
e. City/Town	f. State	g. Zip Code

978-352-6555		colbrot@town.boxford.ma.us
h. Phone Number	i. Fax Number	j. Email Address

3. Property Owner (if different):

a. First Name	b. Last Name

Town of Boxford
c. Organization

7 Spofford Road
d. Mailing Address

Boxford	MA	01921
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.

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B. Fees (continued)

Step 1/Type of Activity	Step 2/Number of Activities	Step 3/Individual Activity Fee	Step 4/Subtotal Activity Fee
exempt			

Step 5/Total Project Fee:

Step 6/Fee Payments:

Total Project Fee: exempt
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.)

1. NARRATIVE

Introduction

The Town of Boxford is proposing driveway and stormwater management improvements along the existing landfill access driveway in Boxford, MA. The purpose of this project is to improve driveway surface conditions by adding a partially widened section of full-depth pavement to allow efficient vehicular travel along the access driveway while improving upon drainage infrastructure. The stormwater design will treat stormwater prior to discharging to the buffer zones to resource areas and improve stormwater quality where feasible. The driveway improvements will also benefit the future Department of Public Works facility in Boxford.

The transportation improvements will include the addition of full depth pavement to the driveway, altering the width to accommodate vehicular traffic, and proposed best management practices (BMPs) to manage stormwater runoff. New drainage infrastructure will be implemented to further mitigate risk to surrounding resource areas and buffer zones, promoting recharge of stormwater through infiltration BMPs where practicable.

The proposed Project is located on Assessor's Map 19 Lot 28 within the Town of Boxford. This parcel is also labelled as 7 Spofford Road and is owned by the Town of Boxford. According to the Town of Boxford Zoning Map (2012), the Project is located within the Official or Open Space (O) Zone as well as the Pond Watershed Overlay District and is subject to zoning and additional bylaws for both zones. Upon review of the FEMA Flood Insurance Rate Maps, the limits of the project are just outside the limits of the 100-year Special Flood Hazard Area (without base flood elevation). The limits of the 100-year floodplain has been imported and mapped on the Site Plans to show the proximity to the proposed work.

This Notice of Intent has been prepared to show compliance with the Wetlands Protection Act and Town of Boxford Wetland Protection Bylaw & Regulations. The project includes work within multiple local & state buffer zones of jurisdictional wetlands. No permanent or temporary impacts to wetlands are proposed as part of the project. Nearly all proposed construction is to be done within the footprint and profile of the existing driveway (and shoulders), however some additional impacts to buffer zones are proposed due to the necessary widening of the driveway and implementation of stormwater improvements. Impacts to buffer zones have been avoided, minimized, and mitigated to the maximum extent practicable.

Existing Conditions

The topography of the existing access driveway varies between 1.79% and 9.54% and generally declines from the north and south to the midpoint. The Project begins at an elevation of 118', declines to 102' at about the midpoint of the driveway and begins to incline again to the project end at 118'. Grades east of the access driveway slope east down to the existing bordering vegetated wetland. The bordering vegetated wetland system is approximately 32 acres in size according to available Massachusetts geographic information systems (GIS) data.

It is located adjacent to and ultimately drains into Baldpate Pond. The entire project area is located within the Pond Watershed Overlay District in the Town of Boxford.

East of the landfill, the topography adjacent to the access driveway has a vertical height of approximately 15' and range between 3H:1V to 4.5H:1V. The landfill is capped with a solar panel facility and generally covered by lawn and fescue grasses. The side slope of the landfill drains to a stormwater swale, and ultimately to a stormwater BMP east of the project limits.

The site is comprised of several different soil types as shown in the *Web Soil Survey Report* provided by the United State Department of Agriculture, Natural Resources Conservation Service. The 1st section of the project area are comprised of Udorthents (fill material), not surprising because the site was previously used as a landfill located and is now comprised of athletic fields and municipal facilities. The 2nd section of the project area is comprised of Hinckley and Windsor soils, both outwash material with a hydrologic soil group A classification. The 3rd section of the project area is Wareham loamy sand, loose sandy glaciofluvial deposits with a hydrologic soil group A/D classification. The final section of the project area is Charlton fine sandy loam, hydrologic soil group B. See the attached Soil Map in Section C for a depiction of soils on site.

The existing access driveway begins as bituminous/gravel and transitions into a consistent heavily compacted dense grade gravel. The width of the driveway remains mostly constant with a 15' width. There are no existing sidewalks.

The existing driveway contains no drainage systems and all areas within the Project area utilize sheet flow. This runoff sheet flows over land and enters the buffer zones to existing wetlands untreated, east of the access driveway.

Proposed Conditions

The project proposes improvements to the existing DPW access driveway located north of the Town of Boxford's Town Hall, beginning at the gravel parking area adjacent to Johnson Field. The length of improvements along the existing driveway total about 900 feet, ending at the gated area east of the landfill which is currently used by DPW as a laydown/stockpile area. The driveway is proposed to be widened to 28-feet in driveway width to allow for adequate space for two trucks (or plows) to pass by one another. The 400-foot long stretch of driveway adjacent to the landfill is proposed to be 26-feet in width to reduce overall impacts to the buffer zone of bordering vegetated wetlands. This reduced width will likely require truck drivers to slow down and pull to the side of the driveway to create enough space to pass by one another.

Overall, the project will result in an increase of impervious area associated with the widening of the driveway. New stormwater improvements are proposed to mitigate the increase in impervious area. The improvements will also reflect the existing profile of the driveway, and no significant changes to grading are proposed other than the raising of the existing profile (~12 inches in most areas) to allow for the new pavement section.

The proposed improvements will consist of full depth pavement at a width ranging from 26 to 28 feet. Additional improvements to the driveway include 1 to 3 foot wide shoulders, stormwater collection swale, infiltration basin, and updated pavement markings and signage.

For more information on stormwater infrastructure and analysis, see Section 6 – Stormwater Report.

Resource Areas & Impacts

The proposed project includes driveway and associated stormwater improvements within the buffer zones of multiple local and state classified resource areas. Wetland resource areas at the site were delineated by Hancock Associates on October 25, 2022. For more information and further detail on the delineation performed, please refer to the Wetland Characterization Report in Section 5 of this notice of intent package. The following describes the type of wetlands and proposed impacts to each resource area and buffer zone in detail.

Bordering Vegetated Wetland (BVW)

A-series Wetland

The A-series wetland is a bordering vegetated wetland located east of the existing bituminous DPW access driveway. The limit of the A-series wetland is demarcated by a single series of twenty-four (24) wetland flags labeled A (100 through 123). The A-series wetland includes a 100-foot buffer zone under the Massachusetts Wetlands Protection Act as well as the Town of Boxford Wetland Protection Bylaw and Regulations. Additionally, the Boxford Bylaw & Regulations include a 25-foot no-disturb zone, as well as a 30-foot minim setback for driveways and retaining walls, and a 25-foot setback for other alterations of naturally vegetated buffer zone.

Due to the proximity of the A-series wetland to the existing driveway, impacts to the buffer zones are unavoidable. The project proposes impacts to the 100-foot buffer zone totaling 32,170 square feet. Additionally, the project proposes a retaining wall within the 30-foot setback to the bordering vegetated wetlands, and limited grading improvements totaling 2,318 SF within the 25-foot no-disturb zone to bordering vegetated wetlands. Unfortunately, impacts to the no-disturb zone are unavoidable due to existing topography and the proximity of the wetlands to the existing driveway. A retaining wall is proposed on the downhill side of the driveway to reduce and minimize impacts to the buffer zone. The driveway widening has also been minimized to 26-feet in width along the landfill to reduce overall impacts to the buffer zone. 26-feet is the minimum driveway width that will allow for safe passage of two trucks by one another. A stormwater swale is proposed along the driveway to mitigate the increased impervious area. The swale will improve the capture and treatment of runoff discharging to the buffer zone when compared to existing conditions.

Bordering Land Subject to Flooding (BLSF)

The project is located in proximity to, but just outside of, the 1% Special Flood Hazard Area (without mapped base flood elevation). This flood hazard area has been imported and mapped on the project site plans to show proximity to the improvements. The Town of Boxford Wetland Protection Bylaw & Regulations include a 100-foot buffer zone to BLSF.

Due to the proximity of the BLSF to the existing driveway, impacts to the buffer zone of BLSF is unavoidable. The project proposes impacts to the buffer zone totaling 15,485 square feet. The area of impact to the buffer zone is previously disturbed and comprised of the existing gravel driveway and landfill. A retaining wall is proposed on the downhill side of the driveway to reduce and minimize impacts to the buffer zone. The driveway widening has also been minimized to 26-feet in width at this location to minimize impacts. This is the minimum driveway width that will allow for safe passage of two trucks by one another. A stormwater swale is proposed along the driveway to mitigate the increased impervious area. The stormwater swale will improve the capture and treatment of runoff discharging to the buffer zone when compared to existing conditions.

Other Resource Areas
Based on TEC's review of available GIS data, there are no intermittent or perennial streams, vernal pools, rare species habitat, or other types of wetland resource areas within a 200-foot radius of the project area.

Construction Sequence

The following sequence is typical of site driveway construction; however, this may be modified based on any special conditions contained within the final Order of Conditions.

1. Obtain/record Order of Conditions from Boxford Conservation Commission.
2. Conduct pre-construction meeting with Conservation Commission agent, the Engineer, and the Town.
3. Install erosion control barriers consisting of 12-inch compost filter tube and silt fence along the proposed limit of work and silt sacks in existing catch basins as indicated on the project plans. All erosion control barriers will be approved by the Conservation Commission agent prior to the start of any land disturbing activities.
4. Perform general site prep including clearing and grubbing for new driveway widening and improvements.
5. Perform excavation for drainage BMPs and utility lines.
6. Install proposed drainage BMPs, proposed utility lines and curbing.
7. Install full depth pavement as indicated on the plans.
8. Repair/install removed or damaged sections of landscaped areas with loam and seed.
9. Install permanent traffic signs and pavement markings.
10. Perform final inspection and address punch list items.
11. Request final acceptance by the Town.
12. Request and obtain Certificate of Compliance from Conservation Commission (this may be up to three years following construction).
13. Remove erosion control barriers and silt sacks assuming landscaped areas are stabilized.

Mitigation

Prior to construction, erosion control and sedimentation barriers will be installed between the project and resource areas along the established limit-of-work. Additionally, silt sacks will be placed in all existing and proposed catch basins once installed, to intercept any construction sediments. These barriers will be placed downgradient of the project area to prevent runoff from entering resource areas and buffer zones. The proposed stormwater management system will provide a drastic improvement to the quality of runoff leaving the driveway and flowing to the nearby wetland resource area buffer zones. All project areas disturbed within the buffer zone will be restored and vegetated. Erosion control barriers will not be removed until site is completely stabilized.

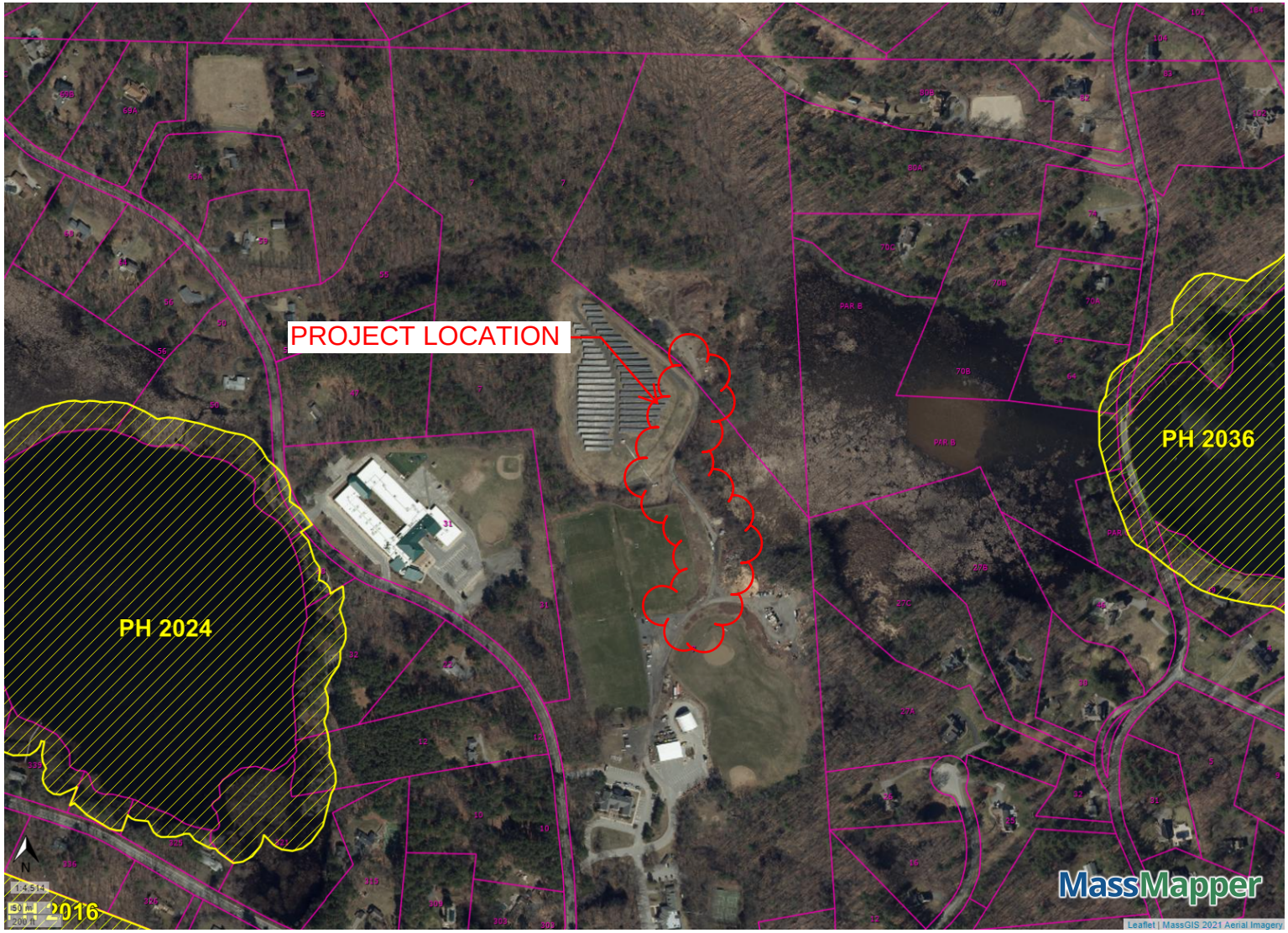
Conclusion

The Town of Boxford is proposing to make driveway and stormwater improvements along the existing DPW access driveway to replace and improve existing infrastructure. The project work includes full depth pavement, and installation of new stormwater management BMPs including a stormwater swale. The project does not propose any permanent or temporary impacts to wetland resource areas, however work within the buffer zones to the wetlands is unavoidable. Buffer zone impacts have been minimized to the maximum extent practicable, and the improvements are designed to mitigate impacts through the implementation of new stormwater management BMPs.

The Applicant requests that the Conservation Commission finds that the Project successfully upholds the interests of the Wetlands Protection Act and Town of Boxford Wetland Protection Bylaws & Regulations, and subsequently issues an Order of Conditions.

2. SUPPORTING MAPS AND DATA

Habitat

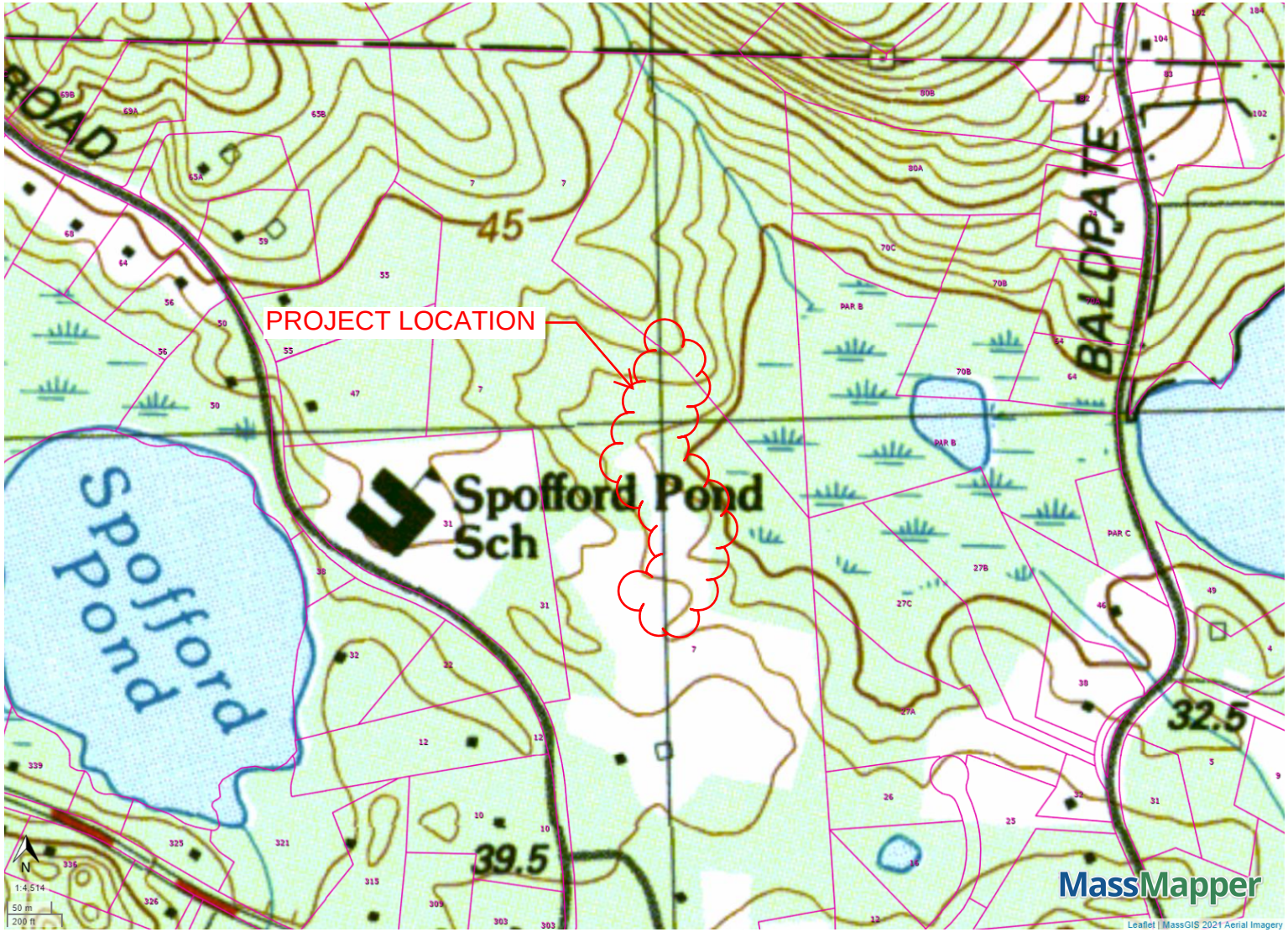


NHESP Priority Habitats of Rare Species

NHESP Estimated Habitats of Rare Wildlife

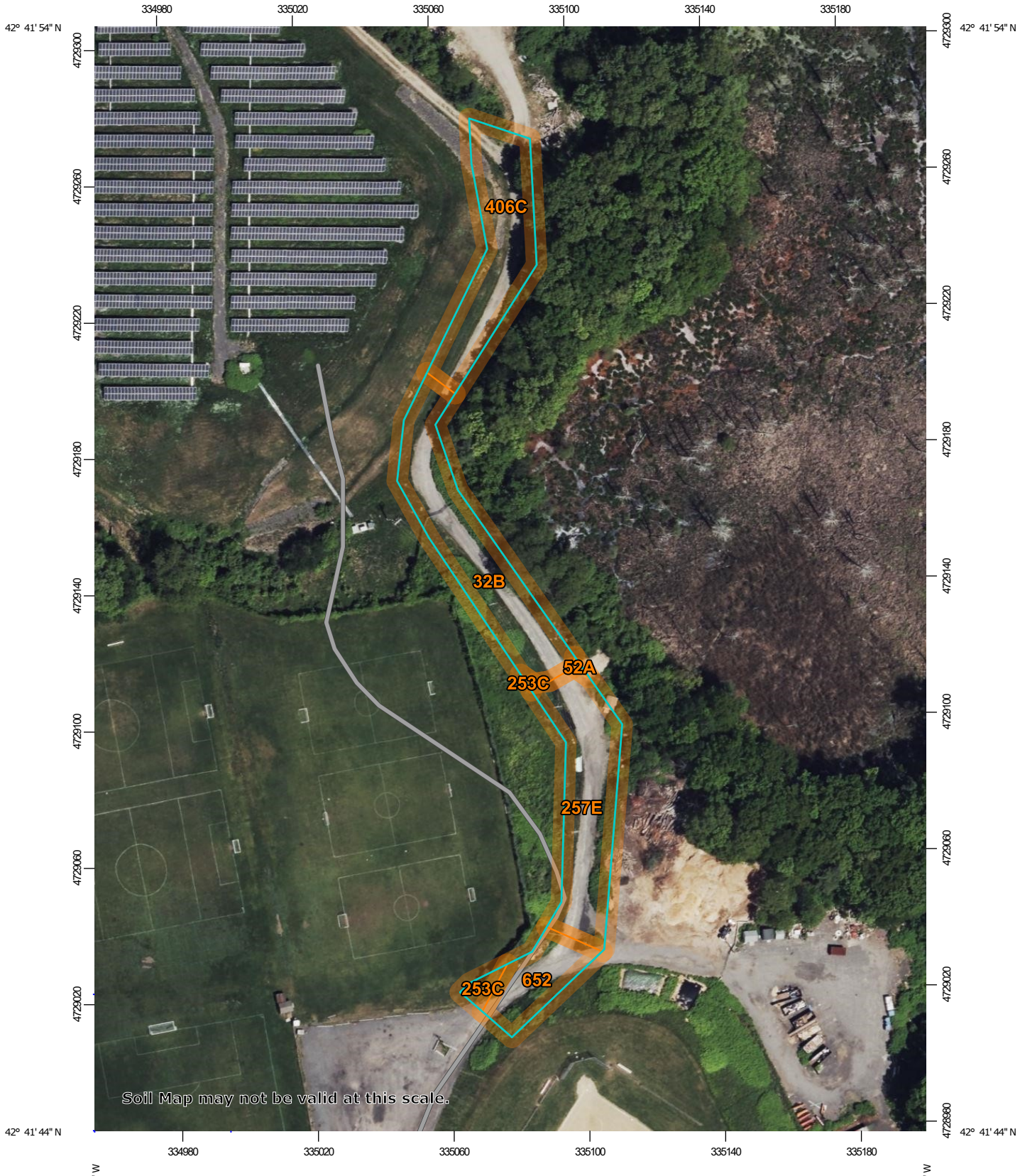
Property Tax Parcels

USGS Topo



Property Tax Parcels
USGS Topographic Maps

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,580 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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 18, Sep 9, 2022

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.

National Flood Hazard Layer FIRMette

FEMA

71°1'8"W 42°42'4"N

71°0'31"W 42°41'37"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 1/16/2023 at 11:59 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.

Merrimack Valley Planning Commission

Merrimack Valley Planning Commission does not make any warranty, expressed or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or usefulness of the Geographic Information System (GIS) Data or any other data provided herein. The GIS data is illustrative only in detail and should not be considered for any other purpose. The data does not take the place of a professional survey and has no legal bearing on the true shape, size, location, or existence of a geographic feature, property line, or political representation. Merrimack Valley Planning Commission requests that any use of this information be accompanied by a reference to its source and the Merrimack Valley Planning Commission's caveat that it makes no warranties or representations as to the accuracy of said information. Any use of this information is at the recipient's own risk.

Notes

This map is for assessment purposes only. It is not a valid document for legal description or conveyance. Lot dimensions were compiled from existing assessor maps and survey based plans. For legal determination please refer to parcel specific deeds or the Town of Boxford Assessor Office.

* Wetlands Note: The wetlands shown on the map do not depict their actual extent or boundary. A wetlands scientist should be consulted if a delineation is required.

Map Revision Date: January 1, 2021

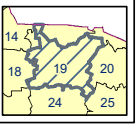
Town of Boxford
Property Parcel Maps
19

Scale: 1:7,200 1 in = 600 ft

200 100 0 200 400 600 800 1,000 Feet

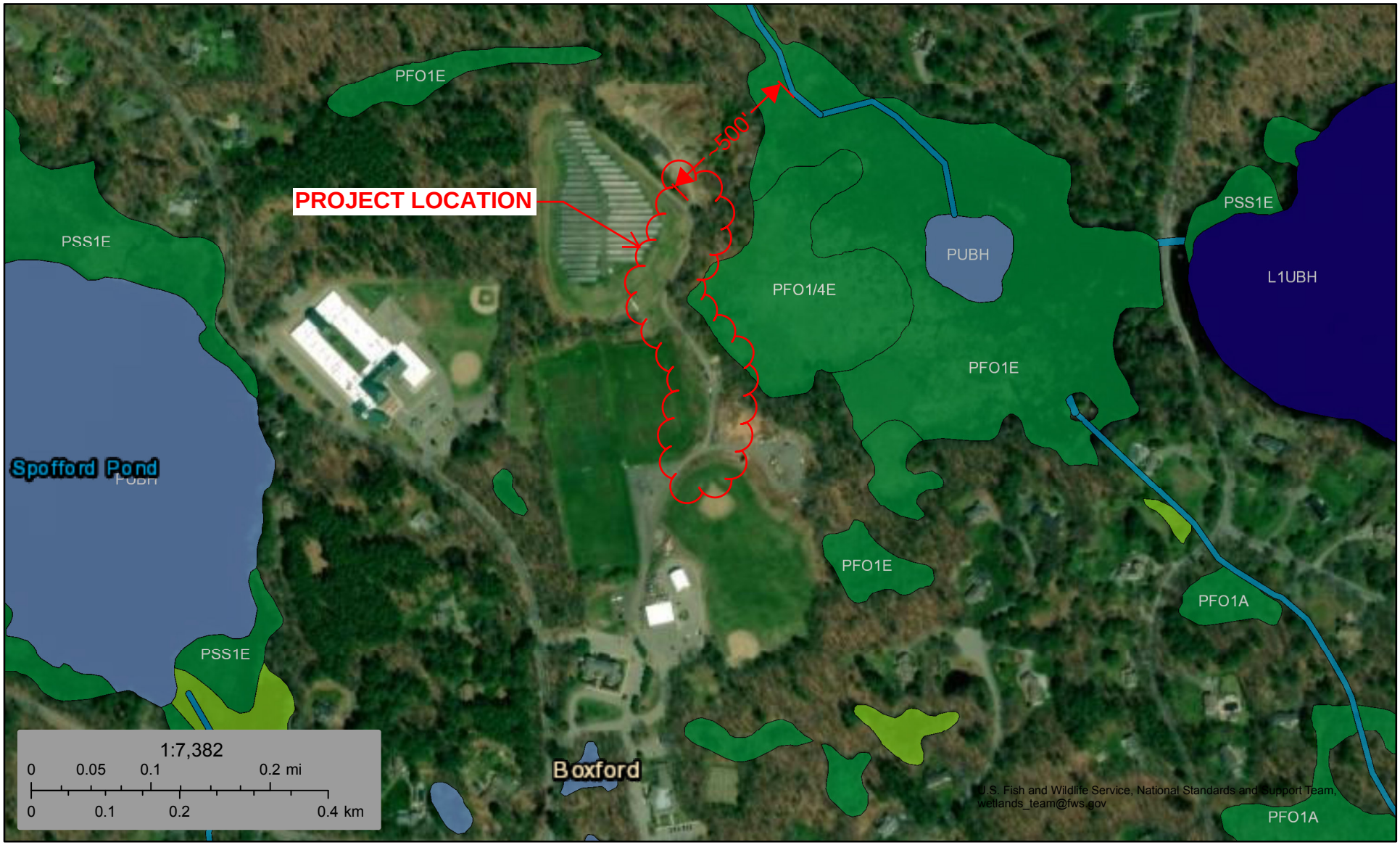
Legend

- Adjacent Maps
- Town Boundaries
- Map Boundaries
- Property Parcels
- Easements
- Building Footprint
- Hydrographic Features
- Streams
- Wetlands
- Commercial Land Use
- Industrial Land Use
- State
- County
- Municipal
- Private



U.S. Fish and Wildlife Service
National Wetlands Inventory

Wetlands



December 28, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

3. PHOTO LOG

PHOTO LOG

Figure 1 – DPW Access Driveway at Project Beginning. Photo taken facing north.

Figure 2 – DPW Access Driveway overview of driveway conditions. Photo taken facing northwest.

PHOTO LOG

Figure 3 – Status of chain linked fence perpendicular to the DPW Access Driveway. As well as wooded areas along the eastern perimeter of the driveway. Photo taken facing southeast.

Figure 4 – DPW Access Driveway overview of driveway conditions along curved corridor. Photo taken facing north.

PHOTO LOG

Figure 5 – DPW Access Driveway at Project ending. Photo taken facing northwest.

Figure 6 – DPW Access Driveway overview of driveway conditions along curved corridor taken from the project ending. Photo taken facing south.

4. ABUTTERS INFORMATION

19-03-28 - 7 SPOFFORD RD, BOXFORD ABUTTERS LIST
CONSERVATION COMMISSION 250'

Parcel ID	Location	Owner	Owner 2	Owner Address	Owner City/Town	Owner State	Zip Code
14-02-31	65B SPOFFORD RD	SOUCY CYNTHIA G. AND SOUCY PAUL K. TR	CYNTHIA G SOUCY REVOCABLE TRUST	65B SPOFFORD RD	BOXFORD	MA	01921
15-01-04	31 SPOFFORD RD	TOWN OF BOXFORD		7A SPOFFORD RD	BOXFORD	MA	01921
15-01-05	47 SPOFFORD RD	ERKSON EDWARD C JT	MARSHA M ERKSON	47 SPOFFORD RD	BOXFORD	MA	01921
15-01-06	55 SPOFFORD RD	ALM RICHARD B TE	JEANETTE C ALM	55 SPOFFORD RD	BOXFORD	MA	01921
15-01-08	22 SPOFFORD RD	MAHONEY ROBERT J	MAHONEY TARA L	22 SPOFFORD RD	BOXFORD	MA	01921
15-02-01	SPOFFORD RD	TOWN OF BOXFORD		7A SPOFFORD RD	BOXFORD	MA	01921
15-02-13-1	PAR B BALDPATE RD	TOWN OF BOXFORD		7A SPOFFORD RD	BOXFORD	MA	01921
19-01-01	12 SPOFFORD RD	GIALLOMBARDO ROBERT J TE	GIALLOMBARDO SUSAN R	12 SPOFFORD RD	BOXFORD	MA	01921
19-01-10	302 IPSWICH RD	SOLTISH CHRISTOPHER MICHAEL		302 IPSWICH RD	BOXFORD	MA	01921
19-01-02-A	10 SPOFFORD RD	ROSEN PAMELA B		10 SPOFFORD RD	BOXFORD	MA	01921
19-01-03	303 IPSWICH RD	KACAMBURAS CHARLES A	KACAMBURAS STEPHANIE	303 IPSWICH RD	BOXFORD	MA	01921
19-02-27	284 IPSWICH RD	SCOPA WILLIAM R JT	CHRISTINE E SPYROPOU	284 IPSWICH RD	BOXFORD	MA	01921
19-02-28	294 IPSWICH RD	NIU XIAO LIN	HUANG LI LI	294 IPSWICH RD	BOXFORD	MA	01921
19-02-29	175 HERRICK RD	ALLISON CHRISTINE A	ALLISON SEWARD	175 HERRICK RD	BOXFORD	MA	01921
19-03-18	27A POWDERHOUSE LN	COULOMBE RYAN	COULOMBE ALYSSA	27A POWDERHOUSE LN	BOXFORD	MA	01921
19-03-18-10	27C POWDERHOUSE LN	PAYNE JAMES MATTHEW	PAYNE NICOLE DESROCHERS	27C POWDERHOUSE LN	BOXFORD	MA	01921
19-03-18-11	27B POWDERHOUSE LN	ARSENAULT WALTER T	ARSENAULT SUSAN M	27B POWDERHOUSE LN	BOXFORD	MA	01921
19-03-18-3	6 POWDERHOUSE LN	MORGAN NICOLE		6 POWDERHOUSE LN	BOXFORD	MA	01921
19-03-18-6	12 POWDERHOUSE LN	LEE SANGWOOK	LEE YOONJIN	12 POWDERHOUSE LN	BOXFORD	MA	01921
19-03-18-7	16 POWDERHOUSE LN	ELMI SAEID		16 POWDERHOUSE LN	BOXFORD	MA	01921
19-03-18-8	26 POWDERHOUSE LN	MCGILLYCUDDY BRYANA T.	BEATON ALEXANDER D.	26 POWDERHOUSE LN	BOXFORD	MA	01921
19-03-26	281 IPSWICH RD	SIROIS, ROBERT L	SIROIS, JENNIFER M	281 IPSWICH RD	BOXFORD	MA	01921
19-03-27	283 IPSWICH RD	CHAFFEE, THOMAS L TR	BIRDSALL-CHAFFEE, MARIE TR	283 IPSWICH RD	BOXFORD	MA	01921
19-03-28	7 SPOFFORD RD	TOWN OF BOXFORD		7 SPOFFORD RD	BOXFORD	MA	01921
19-03-29	IPSWICH RD	TOWN OF BOXFORD		7A SPOFFORD RD	BOXFORD	MA	01921

CERTIFIED COPY
01/10/2023
Kristin Hanlon

ABUTTERS TO BOXFORD PARCEL 19-3-28 WITH PROPERTY IN TOWN OF GEORGETOWN

PARCEL ID	LOCATION	OWNER	OWNER 2	OWNER ADDRESS	OWNER CITY/TOWN	OWNER STATE	ZIPE CODE
1-18	SPOFFORD ST REAR	SOUCY, CYNTHIA G TR	SOUCY, PAUL K TR	65B SPOFFORD ROAD	BOXFORD	MA	01921
4-1	83 BALDPATE RD	NAROIAN KACHADOOR TRUSTEE	PINCKNEY NOMINEE TRUST	PO BOX 239	GEORGETOWN	MA	01833
4-2	BALDPATE & NELSON REAR	BALICH GARRETT W	NICOLE G BALICH	80 BALDPATE RD	BOXFORD	MA	01921
4-2c	BALDPATE RD	BALICH GARRETT W	NICOLE G BALICH	80 BALDPATE RD	BOXFORD	MA	01921

5. WETLAND CHARACTERIZATION REPORT

Client: TEC, Peter Ellison, PE
Project #: 26576
Address: 7 Spofford Road, Boxford MA
Date: November 7th, 2022

Bordering Vegetated Wetland (BVW) were field delineated by a Wetland Professional in Training Scientist (WPIT®) on October 25th, 2022, in accordance with MassDEP wetland delineation standards.

Bordering Vegetated Wetlands (BVW)

In accordance with the MA WPA implementing regulations set forth under 310 CMR 10.55 and the utilization of the methodology described within (1) "BVW: Bordering Vegetated Wetlands Delineation Criteria and Methodology," issued March 1, 1995; and (2) "Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act: A handbook," produced by the Massachusetts Department of Environmental Protection, date March 1995., Hancock Associates staff delineated the following Bordering Vegetated Wetlands (BVW), which are defined under 310 CMR 10.55(2)(a) as, "freshwater wetlands which border on creeks, rivers, streams, ponds, and lakes. The types of freshwater wetlands are wet meadows, marshes, swamps, and bogs. Bordering Vegetated Wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants". The limit of BVW is further defined as *"the line within which 50% or more of the vegetational community consists of wetland indicator plants and saturated or inundated conditions exist. Wetland indicator plants shall include but not necessarily be limited to those plant species identified in the Act. Wetland indicator plants are also those classified in the indicator categories of Facultative, Facultative+, Facultative Wetland-, Facultative Wetland, Facultative Wetland+, or Obligate Wetland in the National List of Plant Species That Occur in Wetlands: Massachusetts (Fish & Wildlife Services, U.S. Department of the Interior, 1988) or Plants Exhibiting Physiological or Morphological Adaptations to Life in the Saturated or Inundated Conditions"*.

BVW was delineated to the extent that it would broadcast associated buffer zone toward the limits of proposed work on the property. The delineation was based on observations of where vegetative species composition transitions from dominance of wetland indicator species, to dominance of upland indicator species. Notable hydrologic indicator characteristics were the presence of saturated, mucky peat soils and observations of ponding and inundated areas.

BVW was delineated with one (1) flag series, identified as Series A as follows:

A-series Wetland

The A series wetland is a BVW located east of the existing bituminous gravel and runs parallel north to south, which broadcasts associated buffer zones and setback zones in accordance with the Boxford Wetlands Bylaw/Ordinance. The limit of BVW associated with the A-series wetland was demarcated with a single series of twenty-four (24) wetland flags labeled A (100 through 123E).

Wetland indicator plant species within the jurisdictional wetland complex include cinnamon fern (*Osmundastrum cinnamomeum*, FACW), highbush blueberry (*Vaccinium corymbosum*, FACW), common reed (*Phragmites australis*, FACW), swamp white oak (*Quercus bicolor*, FACW), coastal sweet pepperbush (*Clethra alnifolia*, FAC), sheep laurel (Kalmia angustifolia, FAC), glossy false buckthorn (*Frangula alnus*, FAC) and red maple (*Acer rubrum*, FAC).

On the up-gradient side of the wetland flags, dominant upland species such as eastern hay scented fern (*Dennstaedtia punctilobula*, UPL), eastern spicy wintergreen (*Gaultheria procumbens*, FACU), northern red oak (*Quercus rubra*, FACU), common lowbush blueberry (*Vaccinium angustifolium*, FACU-), black huckleberry (*Gaylussacia baccata,* FACU) and eastern white pine (*Pinus strobus*, FACU).

As requested, one (1) set of data forms have been filled out accordingly and attached to this report.

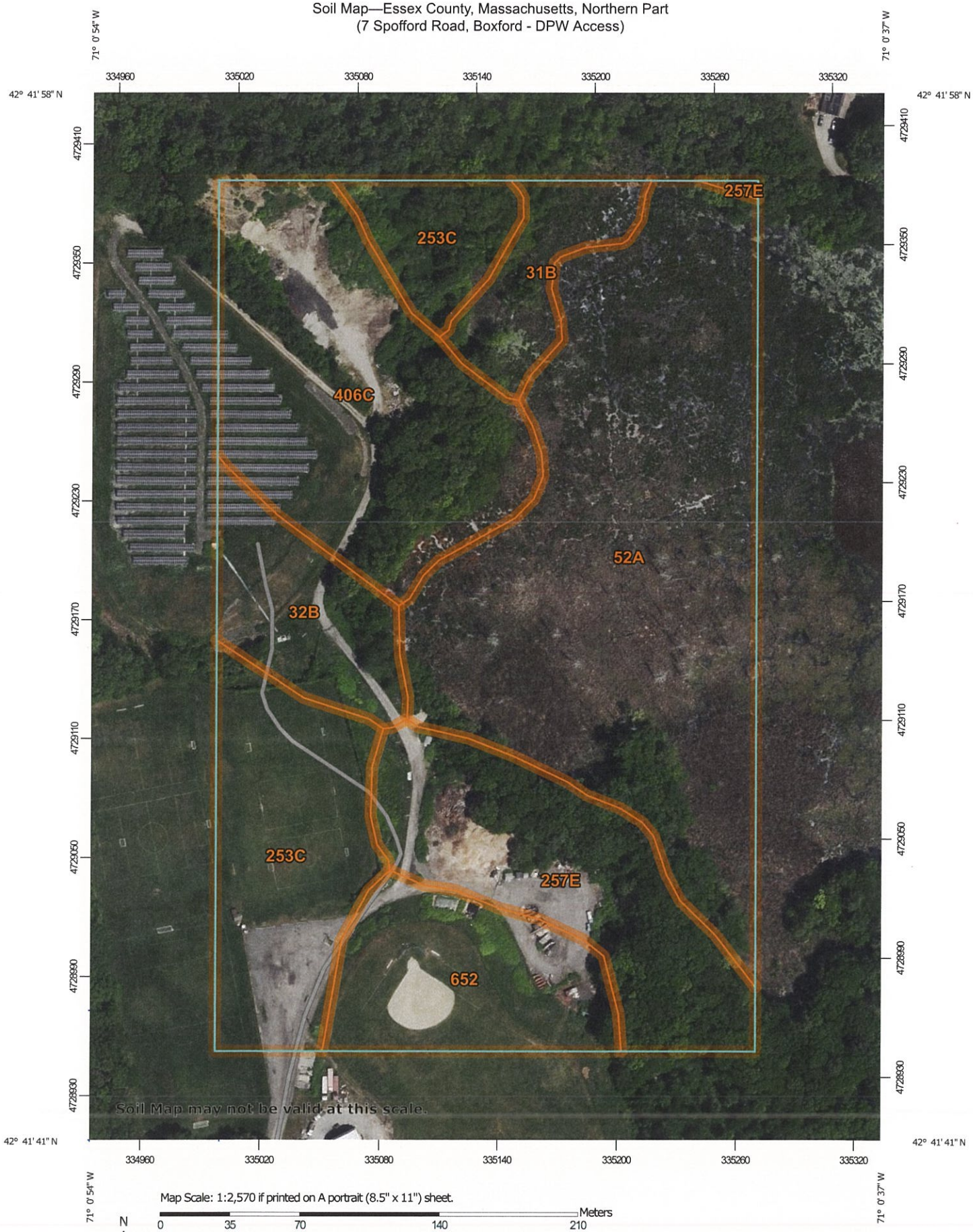
If you have any questions regarding the delineation, please contact me at dmorse@hancockassociates.com or 978-777-3050 ext. 413.

Devon Morse, WPIT
Project Manager/Wetland Scientist
Hancock Associates

Attachments:

A – Data Forms

Soil Map—Essex County, Massachusetts, Northern Part
(7 Spofford Road, Boxford - DPW Access)



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N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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
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- Saline Spot
- Sandy Spot
- Severely Eroded Spot
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- Wet Spot
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Water Features
- Streams and Canals

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

Background
- Aerial Photography

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

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Survey Area Data: Version 18, Sep 9, 2022

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
31B	Walpole fine sandy loam, 3 to 8 percent slopes	1.2	4.2%
32B	Wareham loamy sand, 3 to 8 percent slopes	1.8	6.2%
52A	Freetown muck, 0 to 1 percent slopes	10.5	35.3%
253C	Hinckley loamy sand, 8 to 15 percent slopes	4.4	14.9%
257E	Hinckley and Windsor soils, 25 to 35 percent slopes	3.7	12.6%
406C	Charlton fine sandy loam, 8 to 15 percent slopes, very stony	5.4	18.3%
652	Udorthents, refuse substratum	2.5	8.5%
Totals for Area of Interest		**29.7**	**100.0%**

MassDEP Field Data Form and Instructions

The Department of Environmental Protection's field data form should be used when delineating the boundary of a Bordering Vegetated Wetland (BVW) under the Massachusetts Wetlands Protection Act (M.G.L. Chapter 131, Section 40) and regulations (310 CMR 10.55). It should be used whether the boundary is delineated by vegetation alone or by vegetation and other indicators of wetland hydrology. Note: if detailed vegetative assessment is not necessary for the site, make a note on the data form and submit it. The field data form should be submitted with a Request for Determination of Applicability or a Notice of Intent. Details on the criteria for delineating a BVW boundary and the terminology used in this field data form are described in the handbook, *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act* (MA Department of Environmental Protection, Division of Wetlands and Waterways, 1995).

INSTRUCTIONS

The data form includes a section on project identification, including the applicant's name, the name of the person performing the delineation, project location, and the MassDEP file number, if available. If vegetation alone is presumed adequate to delineate the BVW boundary, mark the first box, complete Section I of the data form, and submit the document. If vegetation and other indicators of hydrology are used to delineate the BVW boundary, mark the second box, complete Sections I and II of the form, and submit the document. MassDEP has selected the dominance test as the preferred method of vegetation analysis at sample plot locations. The information gathered for that method should be recorded on the form. If a method other than the dominance test is used, mark the third box and explain the method and why it was used.

Section I: Vegetation

Section I should be used to record information about the vegetation within an observation plot and on a transect used to delineate the BVW boundary. Note the date of the delineation. Submit a separate data form for each observation plot. Attach supplemental sheets if more space is needed.

A. Sample Layer and Plant Species

Record each plant species using common and scientific names for the following layers:
Ground Cover: woody vegetation less than 3 feet in height (seedlings), non-climbing woody vines less than 3 feet in height, and non-woody vegetation (including mosses) of any height within a 5-foot radius plot; Shrubs: woody vegetation between 3 feet and 20 feet in height within a 15-foot radius plot;
Saplings: woody vegetation over 20 feet in height with a diameter at breast height (dbh) greater than or equal to 0.4 inches to less than 5 inches within a 15-foot radius plot; (note: dbh is measured 4.5 feet from the ground);
Climbing woody vines: woody vines that are attached, rooted, or climbing on trees, saplings, or shrubs within a 30-foot radius plot; and
Trees: woody vegetation with a dbh of 5 inches or greater and over 20 feet in height within a 30-foot radius plot.

If you do not recognize a plant species or do not know a plant's name, call it a generic name. Unknown plants need to be identified only if they are determined to be dominant plants. In that case, a plant identification book or key may be used to determine the species.

B. Percent Cover

Determine percent cover (or basal area for trees) for each plant species in each layer by visual analysis or measurement. (See handbook for information about determining percent cover, page 12.)

C. Percent Dominance

Determine percent dominance for each plant species by dividing the percent cover or basal area for each plant species by the total percent cover or basal area for the layer. (See handbook for information about the dominance test, pages 15-19.)

D. Dominant Plants

1. Identify the dominant plants. Dominant plants are:

   - plants with a percent dominance of 50 percent or greater, or plants whose percent dominance add up to immediately exceed 50 percent;
   - plants with a percent dominance of 20 percent or greater;
   - plants with a percent dominance equal to a plant already listed as a dominant species.

2. Determine common and scientific names for any unknown plants identified as dominant plants.

E. Wetland Indicator Category

1. Identify the Wetland Indicator Category for all dominant plant species using the *National List of Plant Species That Occur in Wetlands: Massachusetts.*
2. Use an asterisk to mark the wetland indicator plants. Wetland indicator plants are any of the following:
   - plant species listed in the Wetlands Protection Act;
   - plants in the genus *Sphagnum*;
   - plants listed as Facultative (FAC), Facultative+ (FAC+), Facultative Wetland(FACW-), Facultative Wetland (FACW), Facultative Wetland+ (FACW+) or Obligate (OBL);
   - plants with morphological or physiological adaptations (such as buttressed or
   - fluted trunks, shallow roots, or adventitious roots).

If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk (e.g. White pine, *Pinus strobus*, FacU*/shallow roots, buttressed trunks).

Vegetation Conclusion

List the number of dominant wetland indicator plants and the number of dominant non-wetland indicator plants. If the number of dominant wetland indicator plants is equal to or greater than the number of non-wetland indicator plants, and vegetation alone is presumed adequate for the delineation, the plot is located in a BVW.

If vegetation alone has been chosen for the delineation at this site, complete only Section I and submit the form with a Request for Determination of Applicability or a Notice of Intent. Otherwise, continue the delineation process and record information for Section II on the second page of the form.

Section II: Indicators of Hydrology

Section II should be used to record information on indicators of hydrology in those areas where vegetation alone is not presumed adequate to delineate the BVW boundary, or to overcome the presumption that vegetation alone is adequate.

Hydric Soil Interpretation

1. Soil Survey: Record information about the site from the Soil Survey Report prepared by the U.S. Natural Resources Conservation Service (NRCS) - formerly called the Soil Conservation Service.
2. Soil Description: Record information based on observations at a soil test hole located within the vegetation observation plot. Describe the soil profile of each soil horizon, noting the depth. Identify the matrix and mottles colors by hue, value, and chroma (information from Munsell Soil Color Charts). For example, 10YR 5/2. Notes on soil texture and other soil characteristics may be recorded in the Remarks section.
3. Other: note any additional information used to determine if hydric soil is present, such as regional field indicator guides.

Conclusion: Indicate whether the soil is hydric based on information observed in the field. (See list of Hydric Soil Indicators in the handbook, page 29.)

Other Indicators of Hydrology

Record observations of other indicators of hydrology. Check and describe all that apply. Due to their seasonal or temporal nature, these other indicators generally are used in conjunction with vegetation and soils to determine the location of the BVW boundary.

Vegetation and Hydrology Conclusion

Determine if the observation plot is in a BVW. The observation plot is in a BVW if the number of dominant wetland indicator plants is equal to or greater than the number of dominant non-wetland indicator plants, and if hydric soil or other indicators of hydrology are present.

For an observation plot located in a disturbed area, any one of the three indicators is sufficient to determine that the sample location is in a BVW. In that case, make a note on the form about that conclusion.

Submit the completed form with a Request for Determination of Applicability or a Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: **TEC** Prepared by: **Devon Morse, WPIT** Project location: **7 Spofford Road, Boxford** DEP File #: **N/A**

Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number: **UPL Plot 1**		Transect Number: **WFA123**	Date of Delineation: **October 25, 2022**
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Groundcover				
eastern hay scented fern (*Dennstaedtia punctilobula*)	3.0	50%	YES	UPL
spotted wintergreen (*Gaultheria procumbens*)	3.0	50%	YES	FACU
Shrub				
glossy buckthorn (*Frangula alnus*)	3.0	11.1%	NO	FAC*
lowbush blueberry (*Vaccinium angustifolium*)	10.5	38.8%	YES	FACU-
black huckleberry (*Gaylussacia baccata*)	10.5	38.8%	YES	FACU
sheep laurel (*Kalmia angustifolia*)	3.0	11.1%	NO	FAC*
Tree				
eastern white pine (*Pinus strobus*)	38.0	61.7%	YES	FACU
red maple (*Acer rubrum*)	3.0	4.8%	NO	FAC*
northern red oak (*Quercus rubra*)	20.5	33.3%	YES	FACU

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: **0 total** Number of dominant non-wetland indicator plants: **6 total**

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes **no**

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? **yes** no
title/date: **Essex County, Massachusetts, Northern Part**
map number: **MA605**
soil type mapped: **Hinckley and Windsor soils, 25 to 35 percent slopes**
hydric soil inclusions: **N/A**

Are field observations consistent with soil survey? **yes** no
Remarks:
Sandy gravel soils present

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	**2-0"**		
A	**0-5"**	**10YR 3/3 CLS**	
B	**5-14"**	**10YR 6/4 3/3**	

Remarks: **Refusal at 14"**

3. Other:

Conclusion: Is soil hydric? yes **no**

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: **N/A**
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other): _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	_____	**X**
Wetland hydrology present:		
Hydric soil present	_____	**X**
Other indicators of hydrology present	_____	**X**
Sample location is in a BVW	_____	**X**

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Field Data Form and Instructions

The Department of Environmental Protection's field data form should be used when delineating the boundary of a Bordering Vegetated Wetland (BVW) under the Massachusetts Wetlands Protection Act (M.G.L. Chapter 131, Section 40) and regulations (310 CMR 10.55). It should be used whether the boundary is delineated by vegetation alone or by vegetation and other indicators of wetland hydrology. Note: if detailed vegetative assessment is not necessary for the site, make a note on the data form and submit it. The field data form should be submitted with a Request for Determination of Applicability or a Notice of Intent. Details on the criteria for delineating a BVW boundary and the terminology used in this field data form are described in the handbook, *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act* (MA Department of Environmental Protection, Division of Wetlands and Waterways, 1995).

INSTRUCTIONS

The data form includes a section on project identification, including the applicant's name, the name of the person performing the delineation, project location, and the MassDEP file number, if available. If vegetation alone is presumed adequate to delineate the BVW boundary, mark the first box, complete Section I of the data form, and submit the document. If vegetation and other indicators of hydrology are used to delineate the BVW boundary, mark the second box, complete Sections I and II of the form, and submit the document. MassDEP has selected the dominance test as the preferred method of vegetation analysis at sample plot locations. The information gathered for that method should be recorded on the form. If a method other than the dominance test is used, mark the third box and explain the method and why it was used.

Section I: Vegetation

Section I should be used to record information about the vegetation within an observation plot and on a transect used to delineate the BVW boundary. Note the date of the delineation. Submit a separate data form for each observation plot. Attach supplemental sheets if more space is needed.

A. Sample Layer and Plant Species

Record each plant species using common and scientific names for the following layers:
Ground Cover: woody vegetation less than 3 feet in height (seedlings), non-climbing woody vines less than 3 feet in height, and non-woody vegetation (including mosses) of any height within a 5-foot radius plot; Shrubs: woody vegetation between 3 feet and 20 feet in height within a 15-foot radius plot;
Saplings: woody vegetation over 20 feet in height with a diameter at breast height (dbh) greater than or equal to 0.4 inches to less than 5 inches within a 15-foot radius plot; (note: dbh is measured 4.5 feet from the ground);
Climbing woody vines: woody vines that are attached, rooted, or climbing on trees, saplings, or shrubs within a 30-foot radius plot; and
Trees: woody vegetation with a dbh of 5 inches or greater and over 20 feet in height within a 30-foot radius plot.

If you do not recognize a plant species or do not know a plant's name, call it a generic name. Unknown plants need to be identified only if they are determined to be dominant plants. In that case, a plant identification book or key may be used to determine the species.

B. Percent Cover

Determine percent cover (or basal area for trees) for each plant species in each layer by visual analysis or measurement. (See handbook for information about determining percent cover, page 12.)

C. Percent Dominance

Determine percent dominance for each plant species by dividing the percent cover or basal area for each plant species by the total percent cover or basal area for the layer. (See handbook for information about the dominance test, pages 15-19.)

D. Dominant Plants

1. Identify the dominant plants. Dominant plants are:

   - plants with a percent dominance of 50 percent or greater, or plants whose percent dominance add up to immediately exceed 50 percent;
   - plants with a percent dominance of 20 percent or greater;
   - plants with a percent dominance equal to a plant already listed as a dominant species.

2. Determine common and scientific names for any unknown plants identified as dominant plants.

E. Wetland Indicator Category

1. Identify the Wetland Indicator Category for all dominant plant species using the *National List of Plant Species That Occur in Wetlands: Massachusetts.*
2. Use an asterisk to mark the wetland indicator plants. Wetland indicator plants are any of the following:
   - plant species listed in the Wetlands Protection Act;
   - plants in the genus *Sphagnum*;
   - plants listed as Facultative (FAC), Facultative+ (FAC+), Facultative Wetland(FACW-), Facultative Wetland (FACW), Facultative Wetland+ (FACW+) or Obligate (OBL);
   - plants with morphological or physiological adaptations (such as buttressed or
   - fluted trunks, shallow roots, or adventitious roots).

If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk (e.g. White pine, *Pinus strobus*, FacU*/shallow roots, buttressed trunks).

Vegetation Conclusion

List the number of dominant wetland indicator plants and the number of dominant non-wetland indicator plants. If the number of dominant wetland indicator plants is equal to or greater than the number of non-wetland indicator plants, and vegetation alone is presumed adequate for the delineation, the plot is located in a BVW.

If vegetation alone has been chosen for the delineation at this site, complete only Section I and submit the form with a Request for Determination of Applicability or a Notice of Intent. Otherwise, continue the delineation process and record information for Section II on the second page of the form.

Section II: Indicators of Hydrology

Section II should be used to record information on indicators of hydrology in those areas where vegetation alone is not presumed adequate to delineate the BVW boundary, or to overcome the presumption that vegetation alone is adequate.

Hydric Soil Interpretation

1. Soil Survey: Record information about the site from the Soil Survey Report prepared by the U.S. Natural Resources Conservation Service (NRCS) - formerly called the Soil Conservation Service.
2. Soil Description: Record information based on observations at a soil test hole located within the vegetation observation plot. Describe the soil profile of each soil horizon, noting the depth. Identify the matrix and mottles colors by hue, value, and chroma (information from Munsell Soil Color Charts). For example, 10YR 5/2. Notes on soil texture and other soil characteristics may be recorded in the Remarks section.
3. Other: note any additional information used to determine if hydric soil is present, such as regional field indicator guides.

Conclusion: Indicate whether the soil is hydric based on information observed in the field. (See list of Hydric Soil Indicators in the handbook, page 29.)

Other Indicators of Hydrology

Record observations of other indicators of hydrology. Check and describe all that apply. Due to their seasonal or temporal nature, these other indicators generally are used in conjunction with vegetation and soils to determine the location of the BVW boundary.

Vegetation and Hydrology Conclusion

Determine if the observation plot is in a BVW. The observation plot is in a BVW if the number of dominant wetland indicator plants is equal to or greater than the number of dominant non-wetland indicator plants, and if hydric soil or other indicators of hydrology are present.

For an observation plot located in a disturbed area, any one of the three indicators is sufficient to determine that the sample location is in a BVW. In that case, make a note on the form about that conclusion.

Submit the completed form with a Request for Determination of Applicability or a Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: **TEC** Prepared by: **Devon Morse, WPIT** Project location: **7 Spofford Road, Boxford** DEP File #: **N/A**

Check all that apply:

- ☐ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☐ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ☐ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number: **WET Plot 1**		Transect Number: **WFA120**	Date of Delineation: **October 25, 2022**
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Groundcover				
Cinnamon fern (*Osmundastrum cinnamomeum*)	63.0	60.5%	YES	FACW*
Common reed (*Phragmites australis*)	38.0	36.5%	YES	FACW*
eastern hay scented fern (*Dennstaedtia punctilobula*)	3.0	2.8%	NO	UPL
Shrub				
highbush blueberry (*Vaccinium corymbosum*)	63.0	56.5%	YES	FACW*
glossy buckthorn (*Frangula alnus*)	10.5	9.4%	NO	FAC*
coastal sweet pepperbush (*Clethra alnifolia*)	38.0	34%	YES	FAC*
Tree				
red maple (*Acer rubrum*)	20.5	37.6%	YES	FAC*
eastern white pine (*Pinus strobus*)	10.5	19.2%	NO	FACU
swamp white oak (*Quercus bicolor*)	20.5	37.6%	YES	FACW*
northern red oak (*Quercus rubra*)	3.0	5.5%	NO	FACU

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: **6 total** Number of dominant non-wetland indicator plants: **0 total**

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? **yes** no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? **yes** no
title/date: **Essex County, Massachusetts, Northern Part**
map number: **MA605**
soil type mapped: **Freetown muck, 0 to 1 percent slopes**
hydric soil inclusions: **Scarboro, Whitman and Swansea**

Are field observations consistent with soil survey? yes **no**
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	**2-0"**		
A	**0-10"**	**black mucky peat**	
B	**10+"**	**5YR 5/1**	

Remarks: **Mucky Peat Soils Observed**

3. Other:

Conclusion: Is soil hydric? **yes** no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: **Yes**
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: **Surface**
- ❑ Water marks: **Yes**
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
- ❑ Other: **Buttressed root systems, inundation**

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	**X**	____
Wetland hydrology present:		
Hydric soil present	**X**	____
Other indicators of hydrology present	**X**	____
Sample location is in a BVW	**X**	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

6. STORMWATER REPORT

STORMWATER REPORT

ACCESS DRIVEWAY TO FUTURE BOXFORD DEPARTMENT OF PUBLIC WORKS FACILITY

BOXFORD, MASSACHUSETTS

Prepared for:

Town of Boxford
7 Spofford Road
Boxford, MA 01921

Prepared by:

TEC, Inc.
282 Merrimack Street
2nd Floor
Lawrence MA, 01843

January 19, 2022

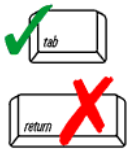
Table of Contents

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.

[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.

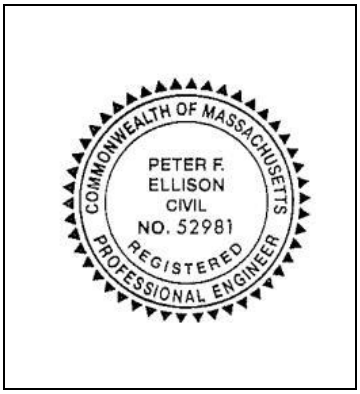
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



1/19/2023

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): Sand Filter

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.

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Narrative

Introduction

The Town of Boxford, the Applicant, is proposing driveway improvements to the existing Department of Public Works (DPW) access drive that is located just north of Boxford's Town Hall and DPW facility. The project will propose a full depth pavement driveway to serve as access to the future DPW facility. The purpose of this project is to provide permanent access to the future facility while simultaneously improving the collection, treatment, and discharge of stormwater at the site.

The Project is based north of the Town of Boxford's Town Hall, located at 7 Spofford Road and will include the construction of approximately 900 feet of driveway improvements. Due to the presence of wetlands east to the proposed drive aisle, a Notice of Intent (NOI) filing with the Boxford Conservation Commission is to be submitted.

A drainage study was performed to assess the potential impacts of the proposed improvements and to provide measures to mitigate any impacts to resource areas near the Project. The limits of disturbance for this Project are mostly confined to the existing footprint of the gravel access driveway, except where driveway widening is proposed. Runoff from the existing driveway sheet flows untreated into the surrounding wetland. The Project will provide a stormwater management system incorporating Low Impact Design (LID) and Best Management Practices (BMPs) design elements to comply with the Massachusetts Stormwater Management Handbook. This analysis has been prepared to verify that the Project will result in improved stormwater collection and treatment at the site.

The proposed stormwater management system outlined in this report has been designed to meet the Stormwater Standards identified in the Massachusetts Department of Environmental Protection (DEP) Massachusetts Stormwater Handbook to the maximum extent practicable. The design improves stormwater capture and treatment, reduces the risk of erosion and sedimentation, and improves stormwater runoff quality.

Existing Conditions

The existing driveway has been identified as one subcatchment area referenced in *Figure D-1* consisting of gently sloping, impervious area and vegetated landscaped areas. The topography of the existing access driveway varies between 1.79% and 9.54% and generally declines from the north and south to the midpoint (NAD83/NAVD88 survey datums). Grades east of the access driveway slope east down to the existing wetland. The side slopes along the eastern edge of the landfill have a vertical height of approximately 15' and range between 3H:1V to 4.5H:1V. The landfill side slopes are caught in an existing swale at the toe of slope, conveying stormwater to the base of the hill and into a stormwater BMP for treatment and recharge. Stormwater from the site will eventually reach one existing design point, the A-series bordering vegetated wetland.

The site is comprised of several different soil types as shown in the *Web Soil Survey Report* provided by the United State Department of Agriculture, Natural Resources Conservation Service. The 1st section of the project area are comprised of Udorthents (fill material), not surprising because the site was previously used as a landfill located and is now comprised of athletic fields and municipal facilities. The 2nd section of the project area is comprised of Hinckley and Windsor soils, both outwash material with a hydrologic soil group A classification. The 3rd section of the project area is Wareham loamy sand, loose sandy glaciofluvial deposits with a hydrologic soil group A/D classification. The final section of the project area is Charlton fine sandy loam, hydrologic soil group B. See the attached Soil Map in Section C for a depiction of soils on site.

Stormwater that hits the gravel access drive sheet flows over land and discharges directly into the adjacent buffer zone to the A-series wetland without receiving any form of treatment.

Proposed Conditions

The proposed conditions will include the construction of approximately 900 feet of full depth pavement to serve as permanent access to the future DPW facility. The driveway will be bituminous concrete with a width ranging from 26 to 28 feet. The driveway will be sloped to the east, directing stormwater runoff into a roadside grassed channel for collection and treatment. The existing impervious driveway is approximately 15-feet in width. The proposed widening will increase total impervious area by approximately 7,000 square feet.

The proposed drive aisle will consist of a 2-4% slope to direct run off from the eastern perimeter of the driveway towards the proposed grassed channel, located on the east side of the driveway. The northern drainage channel will collect and treat runoff, and ultimately direct the flows to a level

spreader before discharging to the wetlands. The southern drainage channel will convey runoff into the proposed sand filter for treatment, and overflow into the adjacent wetlands. The driveway has been designed to comply with the Massachusetts Highway Department's Project Development and Design Guide.

Proposed stormwater management on site will include grassed channels with check dams, a level spreader, and a sand filter. TSS removal calculations for this drainage system can be found in Appendix B. Stormwater will be routed through the drainage system and will maintain the same Design Point as in the existing conditions. The proposed drainage system will utilize outlets from the existing system to mimic existing drainage patterns. The proposed stormwater management system has been designed in accordance with the Massachusetts Stormwater Standards.

Overall, proposed improvements will promote effective stormwater management and mitigate risks to resources and issues associated. The design will mitigate the increased impervious areas, and provides water quality treatment (80%) for a portion of the new driveway. The system will provide an improvement in water quality over existing conditions.

Methodology

The Stormwater Management Plan, which will be implemented as part of this project, will provide improved collection, management, and treatment of the stormwater runoff.

Existing and proposed hydrologic conditions were analyzed using HydroCAD, an SCS TR-20 based program, to calculate existing and proposed peak discharge rates. This method considers existing and proposed pervious and impervious areas including soil types and hydrologic classifications. The 2-, 10-, 25-, 50- and 100-year storm frequencies were used in the analysis in accordance with the MassDEP and the Town of Boxford's requirements.

The "Regulatory Compliance" portion of this report addresses the MassDEP Stormwater Management Performance Standards under the Wetlands Protection Act.

Pre-Development Runoff

The drainage analysis is comprised of approximately 77,885 square feet of gravel driveway, grass landscaped area, and undisturbed woods. Stormwater runoff sheet flows over land to the A-series wetland east of the existing gravel driveway, which has been identified as Design Point A (DP-A).

The *Pre-Development Drainage Areas* are depicted in *Figure D-1* of this report. This figure presents the delineation of the existing subcatchment area

and the Design Point. There are 2 existing subcatchment areas which are outlined below:

Existing Subcatchment Area 101 (EX-101) is comprised of 9,021 SF of undisturbed wooded area and 47,553 SF of grassed landscape area. Stormwater within EX-101 currently sheet flows over land and into the existing wetland (DP-A).

Existing Subcatchment Area 102 (EX-102) is comprised of 21,311 SF of gravel driveway. Stormwater within EX-102 currently sheet flows over land and into the existing wetland (DP-A).

Post-Development Runoff

The proposed stormwater management system is designed to mimic existing drainage patterns and reduce the risk of erosion within nearby wetlands. In the proposed conditions analysis, the same design point was identified and analyzed under the existing conditions were considered. The post-development subcatchment areas are identified in *Figure D-2*, *Post Development Drainage Areas.* The post-development subcatchment areas will now include the proposed full depth pavement driveway and stormwater improvements.

Proposed Subcatchment Area 101i (PR-101i) is comprised of 10,527 SF of impervious pavement associated with the southern portion of the new driveway. Stormwater runoff from PR-101i sheet flows into the grassed channel on the east side of the proposed driveway and discharges to the sand filter for treatment. This sand filter will overflow into the existing wetland (DP-A).

Proposed Subcatchment Area 101p (PR-101p) is comprised of 25,190 SF of pervious grass slopes and the new drainage channel and sand filter. Stormwater runoff from PR-101p sheet flows into the grassed channel on the east side of the proposed driveway and discharges to the sand filter for treatment. This sand filter will overflow into the existing wetland (DP-A).

Proposed Subcatchment Area 102i (PR-102i) is comprised of 17,786 SF of impervious pavement associated with the northern portion of the new driveway. Stormwater runoff from PR-102i sheet flows into the grassed channel on the east side of the proposed driveway and discharges a level spreader before entering the adjacent wetland (DP-A).

Proposed Subcatchment Area 102p (PR-102p) is comprised of 24,382 SF of pervious grass slopes and the new grassed channel. Stormwater runoff from PR-102p sheet flows into the grassed channel on the east side of the proposed driveway and discharges a level spreader before entering the adjacent wetland (DP-A).

Regulatory Compliance

The MassDEP Stormwater Management Policy prescribes ten performance standards for site redevelopment projects. The proposed project has been designed in accordance with these standards. Compliance with the standards is outlined below.

1. *No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth*.

The project retains the existing discharge points along the Department of Public Work's access drive. The new stormwater system will collect and treat stormwater within grassed channels prior to discharge. The southern portion of the driveway is conveyed to a sand filter to receive full water quality treatment. A level spreader is provided at the discharge of the northern channel to spread water and prevent the risk of erosion adjacent to the wetlands. Rip rap pads will be used at the discharge of stormwater pipes and for the overflow spillway of the sand filter. The project fully meets Standard 1.

2. *Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates*.

Table 1 (Peak Flow Summary)

	2-Yr Storm		10-Yr Storm		25-Yr Storm		50-Yr Storm		100-Yr Storm	
Discharge Point	**Exist (cfs)**	**Prop (cfs)**	**Exist (cfs)**	**Prop (cfs)**	**Exist (cfs)**	**Prop (cfs)**	**Exist (cfs)**	**Prop (cfs)**	**Exist (cfs)**	**Prop (cfs)**
DP-A	1.45	1.42	2.36	2.24	3.19	2.87	4.08	3.40	5.17	4.03

Table 2 (Total Volume Summary)

	2-Yr Storm		10-Yr Storm		25-Yr Storm		50-Yr Storm		100-Yr Storm	
Discharge Point	**Exist (cf)**	**Prop (cf)**	**Exist (cf)**	**Prop (cf)**	**Exist (cf)**	**Prop (cf)**	**Exist (cf)**	**Prop (cf)**	**Exist (cf)**	**Prop (cf)**
DP-A	4,994	7,149	9,686	12,781	13,412	16,986	16,461	20,349	20,089	24,288

As summarized in the Table 1 Peak Flow Summary, the Project reduces peak discharge rates for the 2, 10, 25, 50 and 100-Year storm events for all Design Points in accordance with the Massachusetts Stormwater Handbook and Town of Boxford Stormwater Regulations. The MA Standards do not include a requirement for total volume reduction. As summarized in Table 2 above, the project will result in a modest increase in total volume of stormwater runoff for all storm events. Due to the location of the project

being adjacent to a landfill and existing wetlands, infiltration at this site is not feasible. Without infiltration, it is not feasible to provide a reduction in total volume. The project will require a waiver from Section 295-5 (2)(d) of the Boxford Stormwater Management Regulations.

The project fully meets Standard 2 of the Massachusetts Stormwater Handbook. The HydroCAD analysis and output can be found in Appendix A, *Hydrology Calculations*.

3. *Loss of annual recharge to groundwater should be minimized through the use of infiltration measures where feasible*.

The project does not propose any infiltration BMPs due to existing site constraints. As previously stated, the driveway is located between a landfill and existing wetlands. A majority of the existing driveway is within 50-feet of the wetland resource area. Additionally, there are steep slopes (3H:1V) on both sides of the existing driveway that are not suitable for infiltration practices.

The existing driveway has no stormwater BMPs and directly discharges stormwater runoff into adjacent wetland systems. The project proposes grassed channels with check dams and a sand filter which will provide treatment, however infiltration is not feasible. As a redevelopment project with specific site constraints, the design meets Standard 3 to the maximum extent practicable. The stormwater design provides an improvement over existing conditions.

Calculation Method 1 (Mass DEP Stormwater Handbook)
Rv = F x Impervious Area
Rv = Required Recharge Volume, expressed in cubic feet
F= Target Depth Factor associated with each Hydrologic Soil Group
Impervious Area= Pavement and rooftop area on site

Recharge Target Depth by Hydrologic Soil Group

NRCS HYDROLOGIC SOIL TYPE	APPROX. SOIL TEXTURE	TARGET DEPTH FACTOR (F)
A	**sand**	**0.6-inch**
B	loam	0.35-inch
C	silty loam	0.25-inch
D	clay	0.1-inch

Imperious Area Added = 7,002 SF
Rv = (0.6-inch) x 7,002 SF of Added Impervious Area
Rv = 350 cubic feet of Required Recharge Volume

Total Proposed Rv = 0 cubic feet < 350 cubic feet

According to Massachusetts Stormwater BMP's handbook, grassed channels offer no recharge value. Infiltration is not feasible on site due to the proximity of wetlands and the landfill. Therefore, the volume of stormwater infiltrated is met to the maximum extent practicable as an improvement over existing conditions.

4. *For new development, stormwater management systems must be designed to remove 80 percent of Total Suspended Solids*.

The project is classified as a mix of new development and re-development (existing gravel driveway). The souther portion (Subcatchment area 101i & 101p) of the project has been designed to provide 80% TSS removal using a grassed channel for pretreatment and a sand filter for water quality treatment. The total area of impervious within these subcatchments is 10,527 square feet. This amounts to more than the total increase of impervious area for the project overall.

The northern portion of the project meets Standard 4 to the maximum extent practicable as a redevelopment project. Under existing conditions, the gravel driveway discharges stormwater directly to the wetlands without receiving any treatment. The project will capture stormwater from the northern section of the driveway in a grassed channel. The channel will provide improved treatment (50% TSS removal), and will discharge stormwater to a level spreader before entering the wetlands. Overall, this design provides an improvement over existing conditions therefore meeting Standard 4 to the maximum extent practicable.

<u>Calculation Method for Water Quality Treatment Volume</u>
<u>(Mass DEP Stormwater Handbook)</u>

$V_{WQ} = (D_{WQ}/12 \text{ inches/foot}) * (A_{IMP})$

V_{WQ} = *Required Water Quality Volume* (in cubic feet)
D_{WQ} = 1 inch
A_{IMP} = Impervious Area (in square feet)

$V_{WQ} = (1"/12 \text{ inches/foot}) * (10{,}527 \text{ square feet})$
$V_{WQ} = (0.0833 \text{ feet}) * (10{,}527 \text{ square feet})$
$V_{WQ} = 877 \text{ Cubic Feet}$

1,726 CF > 877 CF, exceeding the requirement.

Please refer to the attached HydroCAD analysis for confirmation that the sand filter provides 1,726 cubic feet of water quality storage. As described above, the subcatchment areas flowing to the sand filter fully meet the water quality requirements of Standard 4. Overall, the project meets Standard 4 to the maximum extent practicable and will provide a significant improvement to the quality of runoff entering the adjacent wetlands.

5. *Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs*.

The project is considered a LUHPPL because it will be used by the Public Works Department. It is reasonable to assume that heavy trucks and machinery will utilize the driveway in the future. The sand filter has been selected as a treatment BMP because it is recommended for use on LUHPPL sites in the Massachusetts Stormwater Handbook. It is not feasible to provide the 44% TSS removal as pretreatment prior to discharge to the sand filter. As documented above, a portion of the project is a redevelopment and this meets Standard 5 to the maximum extent practicable.

6. *Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resource Waters, shell fish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies*.

The project site is not in a critical area and Standard 6 is not applicable.

7. *Redevelopment of previously developed areas must meet the Stormwater Management Standards to the maximum extent practicable*.

The Project is considered a redevelopment project and like previously stated, the Stormwater Management Standards 3, 4, and 5 were met to the maximum extent practicable. The project proposes to increase impervious area on site by converting existing gravel driveway to full depth pavement. Overall, the project will improve the quality of stormwater runoff that leaves the site by providing new stormwater channels and a sand filter. Overall, this report documents that the project will result in a significant improvement to stormwater capture, treatment, and discharge of runoff when compared to existing conditions. Standard 7 is fully met by the project.

8. *Erosion and sediment controls must be implemented to prevent impacts during construction or land disturbance activities*.

The project is less than one acre in disturbed area and will not require filing a NPDES Construction General Permit (CGP) prior to the start of construction. The Project has been designed to include erosion and sedimentation controls to prevent impacts to the resource areas. Construction activities will be isolated from downgradient areas by installing erosion control measures including a compost filter socks, silt fences and inlet protection devices.

9. *All stormwater management systems must have an operation and maintenance plan to ensure that systems function as designed*.

The Project includes a long-term Operation and Maintenance Plan. See attached document, to provide efficient operation of the features of the proposed drainage system.

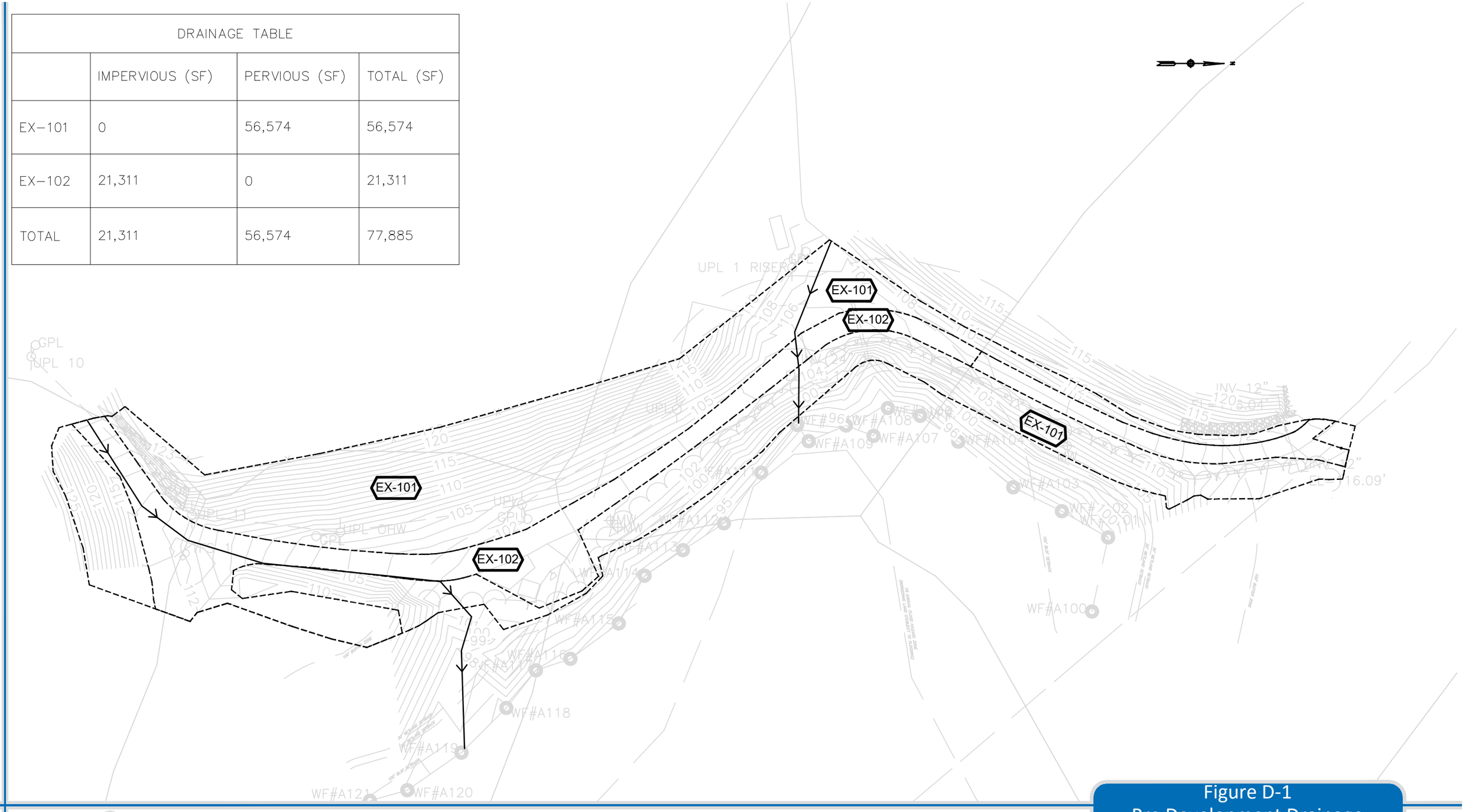
10*. Illicit Discharges*

Only stormwater will be conveyed to the stormwater management system. No illicit materials or connections are permitted. An Illicit Discharge Compliance Statement is included with the Notice of Intent package.

Conclusion

This project will provide a permanent access to serve the future Department of Works facility. The stormwater management plan controls the flow of stormwater, reduces the risk of erosion, and provides water quality treatment that complies with MassDEP Stormwater Standards to the maximum extent practicable. The plan also provides erosion and sediment control which will result in cleaner stormwater runoff and a Long-Term Operations and Maintenance plan to ensure the proper function of the system over time. The project has been designed in accordance with the Massachusetts Department of Environmental Protection Stormwater Management Policy.

DRAINAGE TABLE			
	IMPERVIOUS (SF)	PERVIOUS (SF)	TOTAL (SF)
EX–101	0	56,574	56,574
EX–102	21,311	0	21,311
TOTAL	21,311	56,574	77,885



TEC
The Engineering Corp
TEC, Inc.
282 Merrimack St
Lawrence, MA 01843

LEGEND

EX SUBCATCHMENT AREA

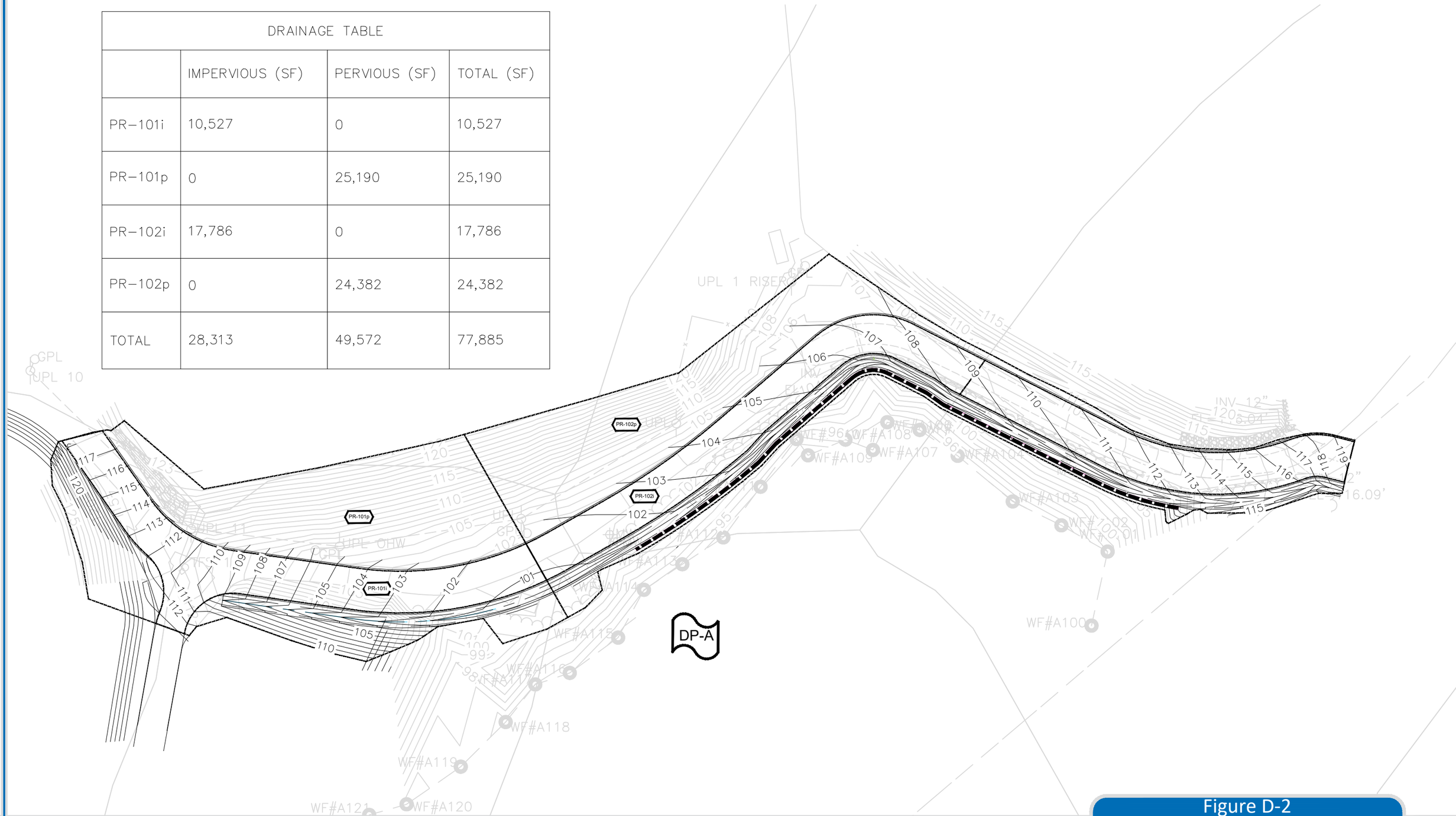
DP DESIGN POINT

DRAINAGE AREA BOUNDARY

Figure D-1
Pre Development Drainage

DPW Access Driveway
Boxford, Massachusetts

DRAINAGE TABLE			
	IMPERVIOUS (SF)	PERVIOUS (SF)	TOTAL (SF)
PR–101i	10,527	0	10,527
PR–101p	0	25,190	25,190
PR–102i	17,786	0	17,786
PR–102p	0	24,382	24,382
TOTAL	28,313	49,572	77,885



LEGEND

EX **SUBCATCHMENT AREA**

DP **DESIGN POINT**

DRAINAGE AREA BOUNDARY

TEC, Inc.
282 Merrimack St
Lawrence, MA 01843

Figure D-2
Post Development Drainage

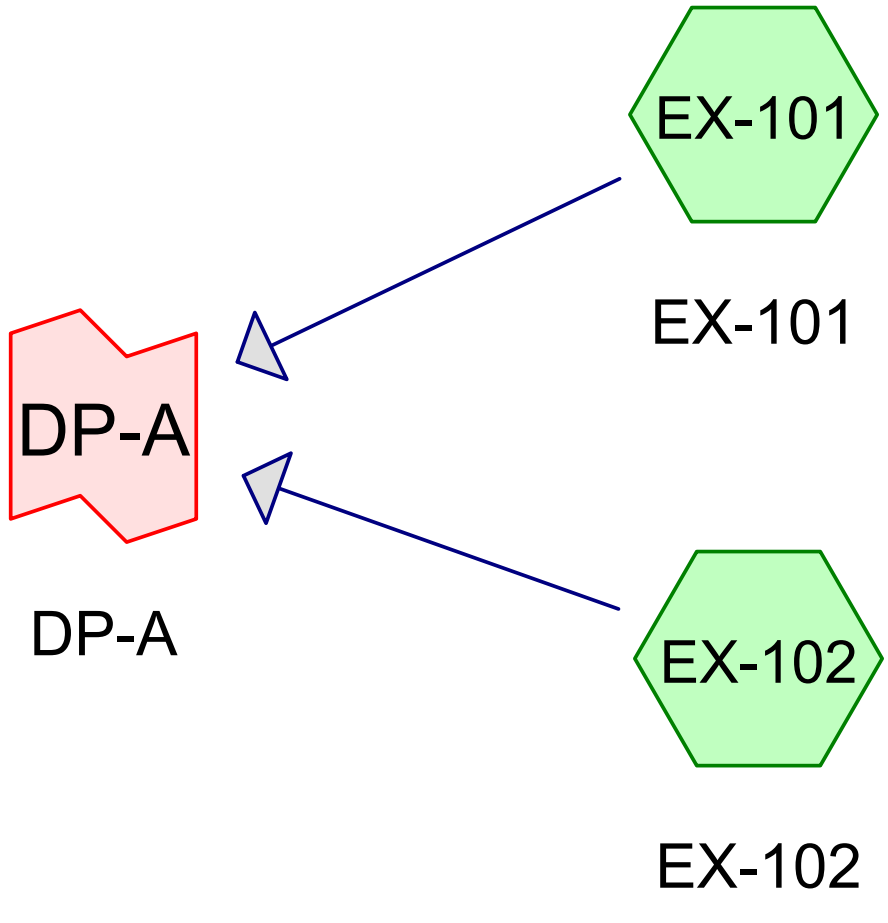
DPW Access Driveway
Boxford, Massachusetts

2

Appendix

A

Hydrologic Calculations



Subcat Reach Pond Link

Routing Diagram for 1204.7_Pre
Prepared by IO, Printed 1/18/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
42,635	39	>75% Grass cover, Good, HSG A (EX-101)
4,918	61	>75% Grass cover, Good, HSG B (EX-101)
17,843	96	Gravel surface, HSG A (EX-102)
3,468	96	Gravel surface, HSG B (EX-102)
5,343	30	Woods, Good, HSG A (EX-101)
3,678	55	Woods, Good, HSG B (EX-101)
77,885	**56**	**TOTAL AREA**

Summary for Subcatchment EX-101: EX-101

Runoff = 0.00 cfs @ 22.34 hrs, Volume= 42 cf, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.24"

Area (sf)	CN	Description
3,678	55	Woods, Good, HSG B
5,343	30	Woods, Good, HSG A
4,918	61	>75% Grass cover, Good, HSG B
42,635	39	>75% Grass cover, Good, HSG A
56,574	41	Weighted Average
56,574		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.24"
0.5	76	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.8	126	Total			

Summary for Subcatchment EX-102: EX-102

Runoff = 1.45 cfs @ 12.09 hrs, Volume= 4,952 cf, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.24"

Area (sf)	CN	Description
3,468	96	Gravel surface, HSG B
17,843	96	Gravel surface, HSG A
21,311	96	Weighted Average
21,311		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0840	2.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.24"
1.2	348	0.0530	4.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4					**Direct Entry,**
6.0	398	Total			

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 0.00% Impervious, Inflow Depth = 0.77" for 2-Year event
Inflow = 1.45 cfs @ 12.09 hrs, Volume= 4,994 cf
Primary = 1.45 cfs @ 12.09 hrs, Volume= 4,994 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EX-101: EX-101

Runoff = 0.13 cfs @ 12.41 hrs, Volume= 1,425 cf, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
3,678	55	Woods, Good, HSG B
5,343	30	Woods, Good, HSG A
4,918	61	>75% Grass cover, Good, HSG B
42,635	39	>75% Grass cover, Good, HSG A
56,574	41	Weighted Average
56,574		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.24"
0.5	76	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.8	126	Total			

Summary for Subcatchment EX-102: EX-102

Runoff = 2.36 cfs @ 12.09 hrs, Volume= 8,261 cf, Depth= 4.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
3,468	96	Gravel surface, HSG B
17,843	96	Gravel surface, HSG A
21,311	96	Weighted Average
21,311		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0840	2.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.24"
1.2	348	0.0530	4.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4					**Direct Entry,**
6.0	398	Total			

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 0.00% Impervious, Inflow Depth = 1.49" for 10-Year event
Inflow = 2.36 cfs @ 12.09 hrs, Volume= 9,686 cf
Primary = 2.36 cfs @ 12.09 hrs, Volume= 9,686 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EX-101: EX-101

Runoff = 0.42 cfs @ 12.21 hrs, Volume= 3,083 cf, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.29"

Area (sf)	CN	Description
3,678	55	Woods, Good, HSG B
5,343	30	Woods, Good, HSG A
4,918	61	>75% Grass cover, Good, HSG B
42,635	39	>75% Grass cover, Good, HSG A
56,574	41	Weighted Average
56,574		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.24"
0.5	76	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.8	126	Total			

Summary for Subcatchment EX-102: EX-102

Runoff = 2.91 cfs @ 12.09 hrs, Volume= 10,329 cf, Depth= 5.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.29"

Area (sf)	CN	Description
3,468	96	Gravel surface, HSG B
17,843	96	Gravel surface, HSG A
21,311	96	Weighted Average
21,311		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0840	2.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.24"
1.2	348	0.0530	4.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4					**Direct Entry,**
6.0	398	Total			

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 0.00% Impervious, Inflow Depth = 2.07" for 25-Year event
Inflow = 3.19 cfs @ 12.10 hrs, Volume= 13,412 cf
Primary = 3.19 cfs @ 12.10 hrs, Volume= 13,412 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EX-101: EX-101

Runoff = 0.87 cfs @ 12.15 hrs, Volume= 4,610 cf, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=7.15"

Area (sf)	CN	Description
3,678	55	Woods, Good, HSG B
5,343	30	Woods, Good, HSG A
4,918	61	>75% Grass cover, Good, HSG B
42,635	39	>75% Grass cover, Good, HSG A
56,574	41	Weighted Average
56,574		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.24"
0.5	76	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.8	126	Total			

Summary for Subcatchment EX-102: EX-102

Runoff = 3.32 cfs @ 12.09 hrs, Volume= 11,851 cf, Depth= 6.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=7.15"

Area (sf)	CN	Description
3,468	96	Gravel surface, HSG B
17,843	96	Gravel surface, HSG A
21,311	96	Weighted Average
21,311		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0840	2.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.24"
1.2	348	0.0530	4.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4					**Direct Entry,**
6.0	398	Total			

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 0.00% Impervious, Inflow Depth = 2.54" for 50-Year event
Inflow = 4.08 cfs @ 12.10 hrs, Volume= 16,461 cf
Primary = 4.08 cfs @ 12.10 hrs, Volume= 16,461 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EX-101: EX-101

Runoff = 1.47 cfs @ 12.13 hrs, Volume= 6,555 cf, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.10"

Area (sf)	CN	Description
3,678	55	Woods, Good, HSG B
5,343	30	Woods, Good, HSG A
4,918	61	>75% Grass cover, Good, HSG B
42,635	39	>75% Grass cover, Good, HSG A
56,574	41	Weighted Average
56,574		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.24"
0.5	76	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.8	126	Total			

Summary for Subcatchment EX-102: EX-102

Runoff = 3.77 cfs @ 12.09 hrs, Volume= 13,534 cf, Depth= 7.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.10"

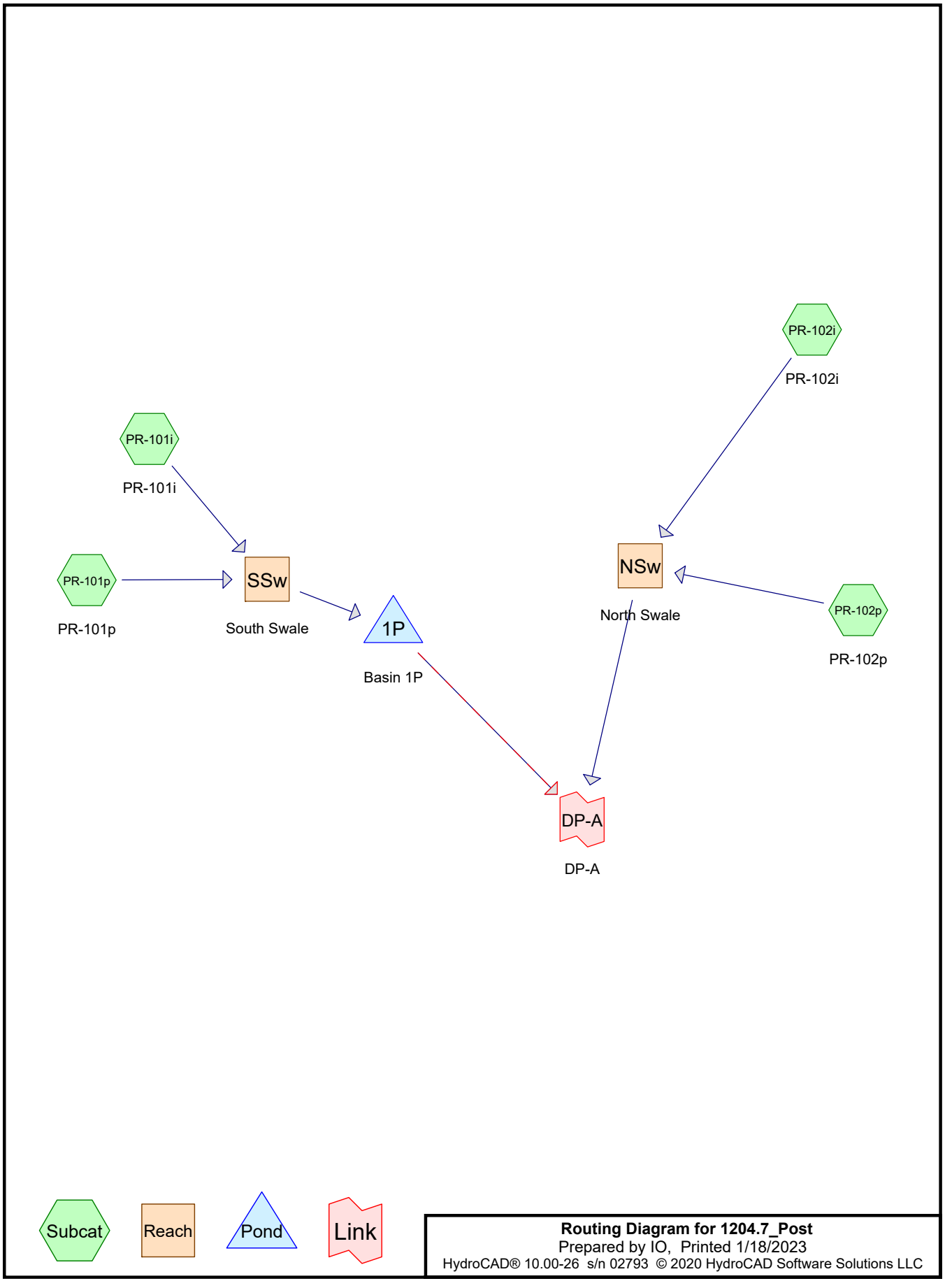
Area (sf)	CN	Description
3,468	96	Gravel surface, HSG B
17,843	96	Gravel surface, HSG A
21,311	96	Weighted Average
21,311		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0840	2.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.24"
1.2	348	0.0530	4.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4					**Direct Entry,**
6.0	398	Total			

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 0.00% Impervious, Inflow Depth = 3.10" for 100-Year event
Inflow = 5.17 cfs @ 12.10 hrs, Volume= 20,089 cf
Primary = 5.17 cfs @ 12.10 hrs, Volume= 20,089 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs



Routing Diagram for 1204.7_Post
Prepared by IO, Printed 1/18/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
45,357	39	>75% Grass cover, Good, HSG A (PR-101p, PR-102p)
4,215	61	>75% Grass cover, Good, HSG B (PR-102p)
20,464	98	Paved parking, HSG A (PR-101i, PR-102i)
7,849	98	Paved parking, HSG B (PR-102i)
77,885	**62**	**TOTAL AREA**

Summary for Subcatchment PR-101i: PR-101i

Runoff = 0.76 cfs @ 12.08 hrs, Volume= 2,638 cf, Depth= 3.01"

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 2-Year Rainfall=3.24"

Area (sf)	CN	Description
10,527	98	Paved parking, HSG A
10,527		100.00% Impervious Area

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

Summary for Subcatchment PR-101p: PR-101p

Runoff = 0.00 cfs @ 24.01 hrs, Volume= 2 cf, Depth= 0.00"

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 2-Year Rainfall=3.24"

Area (sf)	CN	Description
25,190	39	>75% Grass cover, Good, HSG A
25,190		100.00% Pervious Area

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

Summary for Subcatchment PR-102i: PR-102i

Runoff = 1.28 cfs @ 12.08 hrs, Volume= 4,457 cf, Depth= 3.01"

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 2-Year Rainfall=3.24"

Area (sf)	CN	Description
7,849	98	Paved parking, HSG B
9,937	98	Paved parking, HSG A
17,786	98	Weighted Average
17,786		100.00% Impervious Area

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

Summary for Subcatchment PR-102p: PR-102p

Runoff = 0.00 cfs @ 16.98 hrs, Volume= 51 cf, Depth= 0.03"

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 2-Year Rainfall=3.24"

Area (sf)	CN	Description
4,215	61	>75% Grass cover, Good, HSG B
20,167	39	>75% Grass cover, Good, HSG A
24,382	43	Weighted Average
24,382		100.00% Pervious Area

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

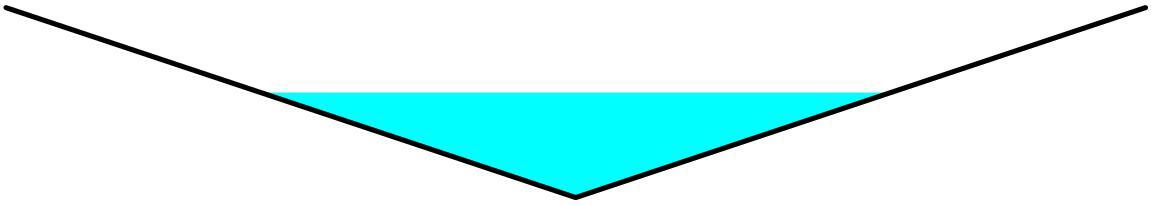
Summary for Reach NSw: North Swale

Inflow Area = 42,168 sf, 42.18% Impervious, Inflow Depth = 1.28" for 2-Year event
Inflow = 1.28 cfs @ 12.08 hrs, Volume= 4,508 cf
Outflow = 0.95 cfs @ 12.31 hrs, Volume= 4,508 cf, Atten= 26%, Lag= 13.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.04 fps, Min. Travel Time= 9.1 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 26.5 min

Peak Storage= 521 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 4.62 cfs

0.00' x 1.00' deep channel, n= 0.100 Very weedy reaches w/pools
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 568.0' Slope= 0.0290 '/'
Inlet Invert= 117.50', Outlet Invert= 101.00'



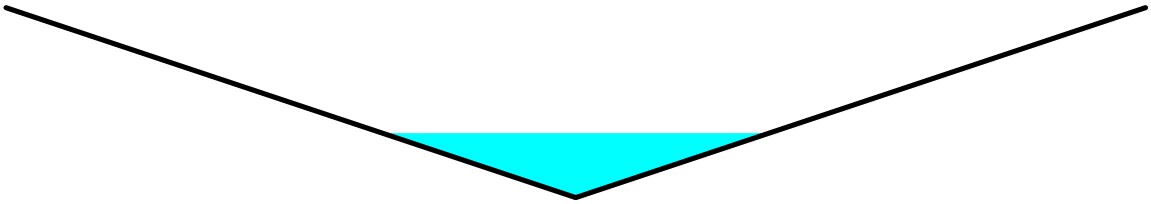
Summary for Reach SSw: South Swale

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 0.89" for 2-Year event
Inflow = 0.76 cfs @ 12.08 hrs, Volume= 2,640 cf
Outflow = 0.74 cfs @ 12.13 hrs, Volume= 2,640 cf, Atten= 2%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.14 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.82 fps, Avg. Travel Time= 3.7 min

Peak Storage= 64 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 13.20 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 184.7' Slope= 0.0379 '/'
Inlet Invert= 108.00', Outlet Invert= 101.00'



Summary for Pond 1P: Basin 1P

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 0.89" for 2-Year event
Inflow = 0.74 cfs @ 12.13 hrs, Volume= 2,640 cf
Outflow = 0.49 cfs @ 12.22 hrs, Volume= 2,640 cf, Atten= 34%, Lag= 5.6 min
Primary = 0.49 cfs @ 12.22 hrs, Volume= 2,640 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 98.29' @ 12.22 hrs Surf.Area= 253 sf Storage= 149 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 1.2 min (761.8 - 760.6)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	1,441 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)
#2	97.50'	285 cf	**Sand Filter (Prismatic)**Listed below (Recalc) 380 cf Overall x 75.0% Voids
		1,726 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	253	105.4	0	0	253
100.00	685	141.6	451	451	975
101.00	1,330	263.0	990	1,441	4,889

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.50	253	0	0
98.00	253	127	127
99.00	253	253	380

Device	Routing	Invert	Outlet Devices
#1	Primary	96.75'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 96.75' / 96.15' S= 0.0200 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	96.75'	**4.0" Vert. Underdrain** C= 0.600
#3	Device 1	100.80'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	100.80'	**5.5' 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=0.49 cfs @ 12.22 hrs HW=98.28' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 0.49 cfs of 3.85 cfs potential flow)
  ├─**2=Underdrain** (Orifice Controls 0.49 cfs @ 5.63 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=97.50' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 36.35% Impervious, Inflow Depth = 1.10" for 2-Year event
Inflow = 1.42 cfs @ 12.30 hrs, Volume= 7,149 cf
Primary = 1.42 cfs @ 12.30 hrs, Volume= 7,149 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment PR-101i: PR-101i

Runoff = 1.21 cfs @ 12.08 hrs, Volume= 4,284 cf, Depth= 4.88"

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 10-Year Rainfall=5.12"

Area (sf)	CN	Description
10,527	98	Paved parking, HSG A
10,527		100.00% Impervious Area

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

Summary for Subcatchment PR-101p: PR-101p

Runoff = 0.03 cfs @ 12.46 hrs, Volume= 472 cf, Depth= 0.22"

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 10-Year Rainfall=5.12"

Area (sf)	CN	Description
25,190	39	>75% Grass cover, Good, HSG A
25,190		100.00% Pervious Area

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

Summary for Subcatchment PR-102i: PR-102i

Runoff = 2.05 cfs @ 12.08 hrs, Volume= 7,237 cf, Depth= 4.88"

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 10-Year Rainfall=5.12"

Area (sf)	CN	Description
7,849	98	Paved parking, HSG B
9,937	98	Paved parking, HSG A
17,786	98	Weighted Average
17,786		100.00% Impervious Area

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

Summary for Subcatchment PR-102p: PR-102p

Runoff = 0.09 cfs @ 12.34 hrs, Volume= 788 cf, Depth= 0.39"

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 10-Year Rainfall=5.12"

Area (sf)	CN	Description
4,215	61	>75% Grass cover, Good, HSG B
20,167	39	>75% Grass cover, Good, HSG A
24,382	43	Weighted Average
24,382		100.00% Pervious Area

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

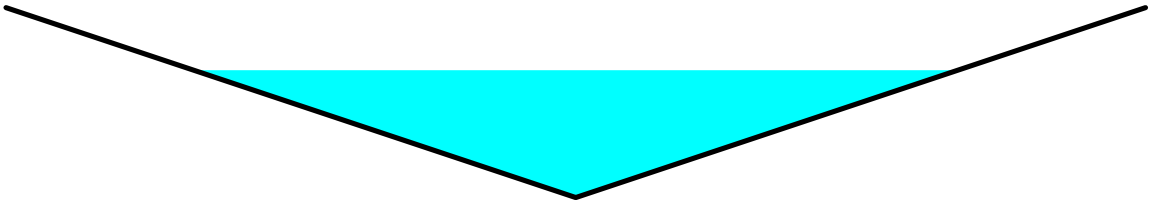
Summary for Reach NSw: North Swale

Inflow Area = 42,168 sf, 42.18% Impervious, Inflow Depth = 2.28" for 10-Year event
Inflow = 2.06 cfs @ 12.09 hrs, Volume= 8,025 cf
Outflow = 1.59 cfs @ 12.29 hrs, Volume= 8,025 cf, Atten= 23%, Lag= 12.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.18 fps, Min. Travel Time= 8.0 min
Avg. Velocity = 0.41 fps, Avg. Travel Time= 22.9 min

Peak Storage= 766 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 4.62 cfs

0.00' x 1.00' deep channel, n= 0.100 Very weedy reaches w/pools
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 568.0' Slope= 0.0290 '/'
Inlet Invert= 117.50', Outlet Invert= 101.00'



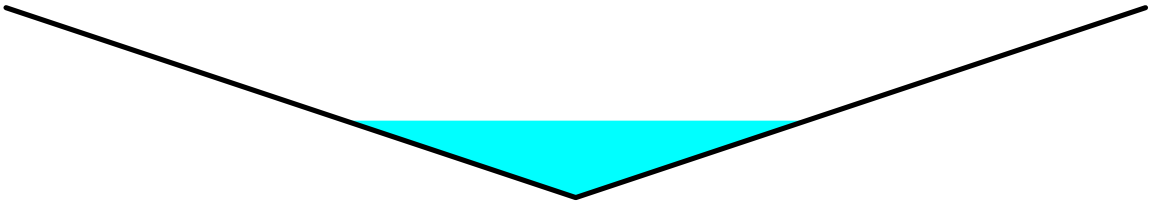
Summary for Reach SSw: South Swale

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 1.60" for 10-Year event
Inflow = 1.21 cfs @ 12.08 hrs, Volume= 4,756 cf
Outflow = 1.19 cfs @ 12.12 hrs, Volume= 4,756 cf, Atten= 2%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.41 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.97 fps, Avg. Travel Time= 3.2 min

Peak Storage= 91 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 13.20 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 184.7' Slope= 0.0379 '/'
Inlet Invert= 108.00', Outlet Invert= 101.00'



Summary for Pond 1P: Basin 1P

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 1.60" for 10-Year event
Inflow = 1.19 cfs @ 12.12 hrs, Volume= 4,756 cf
Outflow = 0.65 cfs @ 12.25 hrs, Volume= 4,756 cf, Atten= 45%, Lag= 7.7 min
Primary = 0.65 cfs @ 12.25 hrs, Volume= 4,756 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 99.34' @ 12.25 hrs Surf.Area= 628 sf Storage= 390 cf

Plug-Flow detention time= 2.6 min calculated for 4,756 cf (100% of inflow)
Center-of-Mass det. time= 2.5 min (779.1 - 776.6)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	1,441 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)
#2	97.50'	285 cf	**Sand Filter (Prismatic)**Listed below (Recalc) 380 cf Overall x 75.0% Voids
		1,726 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	253	105.4	0	0	253
100.00	685	141.6	451	451	975
101.00	1,330	263.0	990	1,441	4,889

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.50	253	0	0
98.00	253	127	127
99.00	253	253	380

Device	Routing	Invert	Outlet Devices
#1	Primary	96.75'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 96.75' / 96.15' S= 0.0200 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	96.75'	**4.0" Vert. Underdrain** C= 0.600
#3	Device 1	100.80'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	100.80'	**5.5' 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=0.65 cfs @ 12.25 hrs HW=99.34' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 0.65 cfs of 5.46 cfs potential flow)
  ├─**2=Underdrain** (Orifice Controls 0.65 cfs @ 7.49 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=97.50' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 36.35% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 2.24 cfs @ 12.28 hrs, Volume= 12,781 cf
Primary = 2.24 cfs @ 12.28 hrs, Volume= 12,781 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment PR-101i: PR-101i

Runoff = 1.49 cfs @ 12.08 hrs, Volume= 5,309 cf, Depth= 6.05"

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 25-Year Rainfall=6.29"

Area (sf)	CN	Description
10,527	98	Paved parking, HSG A
10,527		100.00% Impervious Area

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

Summary for Subcatchment PR-101p: PR-101p

Runoff = 0.13 cfs @ 12.31 hrs, Volume= 1,116 cf, Depth= 0.53"

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 25-Year Rainfall=6.29"

Area (sf)	CN	Description
25,190	39	>75% Grass cover, Good, HSG A
25,190		100.00% Pervious Area

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

Summary for Subcatchment PR-102i: PR-102i

Runoff = 2.52 cfs @ 12.08 hrs, Volume= 8,969 cf, Depth= 6.05"

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 25-Year Rainfall=6.29"

Area (sf)	CN	Description
7,849	98	Paved parking, HSG B
9,937	98	Paved parking, HSG A
17,786	98	Weighted Average
17,786		100.00% Impervious Area

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

Summary for Subcatchment PR-102p: PR-102p

Runoff = 0.29 cfs @ 12.13 hrs, Volume= 1,592 cf, Depth= 0.78"

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 25-Year Rainfall=6.29"

Area (sf)	CN	Description
4,215	61	>75% Grass cover, Good, HSG B
20,167	39	>75% Grass cover, Good, HSG A
24,382	43	Weighted Average
24,382		100.00% Pervious Area

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

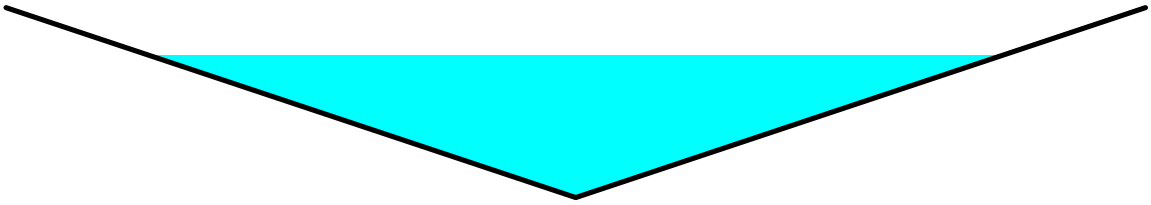
Summary for Reach NSw: North Swale

Inflow Area = 42,168 sf, 42.18% Impervious, Inflow Depth = 3.01" for 25-Year event
Inflow = 2.76 cfs @ 12.09 hrs, Volume= 10,562 cf
Outflow = 2.15 cfs @ 12.28 hrs, Volume= 10,562 cf, Atten= 22%, Lag= 11.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.27 fps, Min. Travel Time= 7.4 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 21.5 min

Peak Storage= 959 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 4.62 cfs

0.00' x 1.00' deep channel, n= 0.100 Very weedy reaches w/pools
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 568.0' Slope= 0.0290 '/'
Inlet Invert= 117.50', Outlet Invert= 101.00'



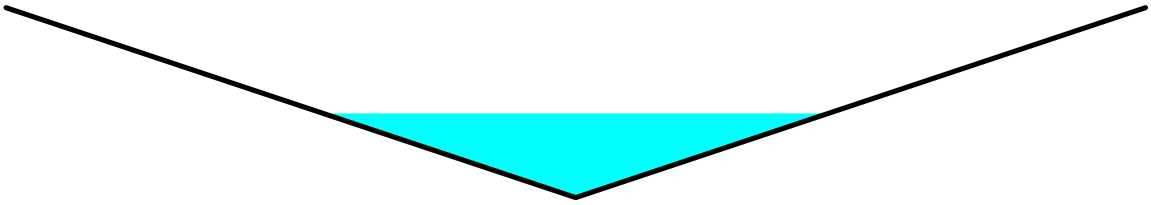
Summary for Reach SSw: South Swale

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 2.16" for 25-Year event
Inflow = 1.53 cfs @ 12.09 hrs, Volume= 6,425 cf
Outflow = 1.51 cfs @ 12.12 hrs, Volume= 6,425 cf, Atten= 2%, Lag= 2.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.56 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.04 fps, Avg. Travel Time= 3.0 min

Peak Storage= 109 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 13.20 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 184.7' Slope= 0.0379 '/'
Inlet Invert= 108.00', Outlet Invert= 101.00'



Summary for Pond 1P: Basin 1P

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 2.16" for 25-Year event
Inflow = 1.51 cfs @ 12.12 hrs, Volume= 6,425 cf
Outflow = 0.72 cfs @ 12.34 hrs, Volume= 6,424 cf, Atten= 52%, Lag= 12.7 min
Primary = 0.72 cfs @ 12.34 hrs, Volume= 6,424 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 99.87' @ 12.34 hrs Surf.Area= 871 sf Storage= 653 cf

Plug-Flow detention time= 4.1 min calculated for 6,423 cf (100% of inflow)
Center-of-Mass det. time= 4.0 min (787.5 - 783.5)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	1,441 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)
#2	97.50'	285 cf	**Sand Filter (Prismatic)**Listed below (Recalc) 380 cf Overall x 75.0% Voids
		1,726 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	253	105.4	0	0	253
100.00	685	141.6	451	451	975
101.00	1,330	263.0	990	1,441	4,889

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.50	253	0	0
98.00	253	127	127
99.00	253	253	380

Device	Routing	Invert	Outlet Devices
#1	Primary	96.75'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 96.75' / 96.15' S= 0.0200 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	96.75'	**4.0" Vert. Underdrain** C= 0.600
#3	Device 1	100.80'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	100.80'	**5.5' 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=0.72 cfs @ 12.34 hrs HW=99.87' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 0.72 cfs of 6.12 cfs potential flow)
  ├─**2=Underdrain** (Orifice Controls 0.72 cfs @ 8.28 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=97.50' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 36.35% Impervious, Inflow Depth = 2.62" for 25-Year event
Inflow = 2.87 cfs @ 12.28 hrs, Volume= 16,986 cf
Primary = 2.87 cfs @ 12.28 hrs, Volume= 16,986 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment PR-101i: PR-101i

Runoff = 1.70 cfs @ 12.08 hrs, Volume= 6,062 cf, Depth= 6.91"

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 50-Year Rainfall=7.15"

Area (sf)	CN	Description
10,527	98	Paved parking, HSG A
10,527		100.00% Impervious Area

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

Summary for Subcatchment PR-101p: PR-101p

Runoff = 0.28 cfs @ 12.14 hrs, Volume= 1,727 cf, Depth= 0.82"

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 50-Year Rainfall=7.15"

Area (sf)	CN	Description
25,190	39	>75% Grass cover, Good, HSG A
25,190		100.00% Pervious Area

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

Summary for Subcatchment PR-102i: PR-102i

Runoff = 2.86 cfs @ 12.08 hrs, Volume= 10,243 cf, Depth= 6.91"

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 50-Year Rainfall=7.15"

Area (sf)	CN	Description
7,849	98	Paved parking, HSG B
9,937	98	Paved parking, HSG A
17,786	98	Weighted Average
17,786		100.00% Impervious Area

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

Summary for Subcatchment PR-102p: PR-102p

Runoff = 0.53 cfs @ 12.11 hrs, Volume= 2,316 cf, Depth= 1.14"

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 50-Year Rainfall=7.15"

Area (sf)	CN	Description
4,215	61	>75% Grass cover, Good, HSG B
20,167	39	>75% Grass cover, Good, HSG A
24,382	43	Weighted Average
24,382		100.00% Pervious Area

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

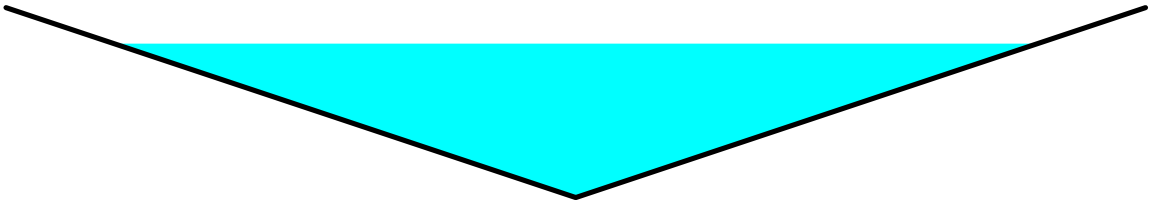
Summary for Reach NSw: North Swale

Inflow Area = 42,168 sf, 42.18% Impervious, Inflow Depth = 3.57" for 50-Year event
Inflow = 3.36 cfs @ 12.09 hrs, Volume= 12,559 cf
Outflow = 2.63 cfs @ 12.27 hrs, Volume= 12,559 cf, Atten= 22%, Lag= 10.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.34 fps, Min. Travel Time= 7.1 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 20.7 min

Peak Storage= 1,118 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 4.62 cfs

0.00' x 1.00' deep channel, n= 0.100 Very weedy reaches w/pools
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 568.0' Slope= 0.0290 '/'
Inlet Invert= 117.50', Outlet Invert= 101.00'



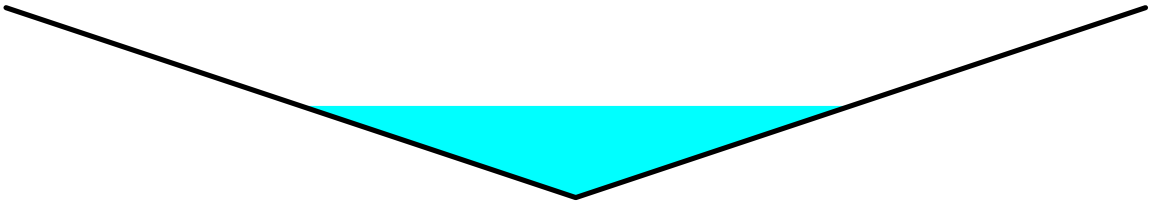
Summary for Reach SSw: South Swale

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 2.62" for 50-Year event
Inflow = 1.92 cfs @ 12.09 hrs, Volume= 7,789 cf
Outflow = 1.89 cfs @ 12.13 hrs, Volume= 7,789 cf, Atten= 2%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.71 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.09 fps, Avg. Travel Time= 2.8 min

Peak Storage= 129 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 13.20 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 184.7' Slope= 0.0379 '/'
Inlet Invert= 108.00', Outlet Invert= 101.00'



Summary for Pond 1P: Basin 1P

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 2.62" for 50-Year event
Inflow = 1.89 cfs @ 12.13 hrs, Volume= 7,789 cf
Outflow = 0.77 cfs @ 12.41 hrs, Volume= 7,789 cf, Atten= 59%, Lag= 16.8 min
Primary = 0.77 cfs @ 12.41 hrs, Volume= 7,789 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 100.31' @ 12.41 hrs Surf.Area= 1,115 sf Storage= 974 cf

Plug-Flow detention time= 5.8 min calculated for 7,788 cf (100% of inflow)
Center-of-Mass det. time= 5.8 min (792.7 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	1,441 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)
#2	97.50'	285 cf	**Sand Filter (Prismatic)**Listed below (Recalc)
			380 cf Overall x 75.0% Voids
		1,726 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	253	105.4	0	0	253
100.00	685	141.6	451	451	975
101.00	1,330	263.0	990	1,441	4,889

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.50	253	0	0
98.00	253	127	127
99.00	253	253	380

Device	Routing	Invert	Outlet Devices
#1	Primary	96.75'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 96.75' / 96.15' S= 0.0200 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	96.75'	**4.0" Vert. Underdrain** C= 0.600
#3	Device 1	100.80'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	100.80'	**5.5' 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=0.77 cfs @ 12.41 hrs HW=100.31' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 0.77 cfs of 6.61 cfs potential flow)
  ├─**2=Underdrain** (Orifice Controls 0.77 cfs @ 8.87 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=97.50' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 36.35% Impervious, Inflow Depth = 3.14" for 50-Year event
Inflow = 3.40 cfs @ 12.27 hrs, Volume= 20,349 cf
Primary = 3.40 cfs @ 12.27 hrs, Volume= 20,349 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment PR-101i: PR-101i

Runoff = 1.92 cfs @ 12.08 hrs, Volume= 6,895 cf, Depth= 7.86"

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 100-Year Rainfall=8.10"

Area (sf)	CN	Description
10,527	98	Paved parking, HSG A
10,527		100.00% Impervious Area

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

Summary for Subcatchment PR-101p: PR-101p

Runoff = 0.54 cfs @ 12.12 hrs, Volume= 2,517 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 100-Year Rainfall=8.10"

Area (sf)	CN	Description
25,190	39	>75% Grass cover, Good, HSG A
25,190		100.00% Pervious Area

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

Summary for Subcatchment PR-102i: PR-102i

Runoff = 3.25 cfs @ 12.08 hrs, Volume= 11,650 cf, Depth= 7.86"

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 100-Year Rainfall=8.10"

Area (sf)	CN	Description
7,849	98	Paved parking, HSG B
9,937	98	Paved parking, HSG A
17,786	98	Weighted Average
17,786		100.00% Impervious Area

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

Summary for Subcatchment PR-102p: PR-102p

Runoff = 0.83 cfs @ 12.11 hrs, Volume= 3,225 cf, Depth= 1.59"

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 100-Year Rainfall=8.10"

Area (sf)	CN	Description
4,215	61	>75% Grass cover, Good, HSG B
20,167	39	>75% Grass cover, Good, HSG A
24,382	43	Weighted Average
24,382		100.00% Pervious Area

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

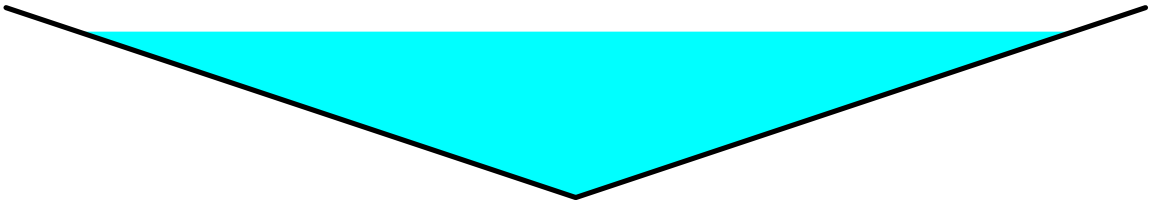
Summary for Reach NSw: North Swale

Inflow Area = 42,168 sf, 42.18% Impervious, Inflow Depth = 4.23" for 100-Year event
Inflow = 4.05 cfs @ 12.09 hrs, Volume= 14,875 cf
Outflow = 3.22 cfs @ 12.26 hrs, Volume= 14,875 cf, Atten= 21%, Lag= 10.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.41 fps, Min. Travel Time= 6.7 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 19.9 min

Peak Storage= 1,300 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 4.62 cfs

0.00' x 1.00' deep channel, n= 0.100 Very weedy reaches w/pools
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 568.0' Slope= 0.0290 '/'
Inlet Invert= 117.50', Outlet Invert= 101.00'



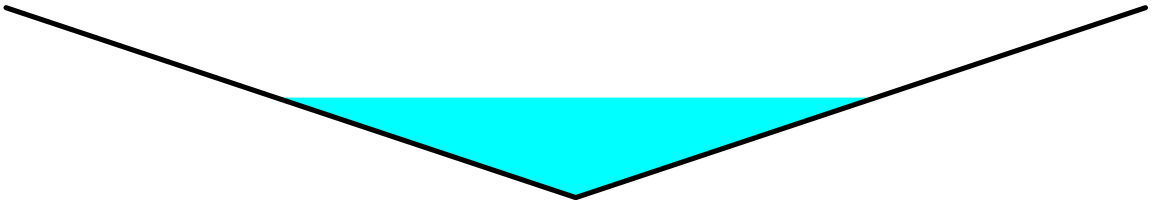
Summary for Reach SSw: South Swale

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 3.16" for 100-Year event
Inflow = 2.42 cfs @ 12.09 hrs, Volume= 9,413 cf
Outflow = 2.38 cfs @ 12.12 hrs, Volume= 9,413 cf, Atten= 1%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.87 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.13 fps, Avg. Travel Time= 2.7 min

Peak Storage= 154 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 13.20 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 184.7' Slope= 0.0379 '/'
Inlet Invert= 108.00', Outlet Invert= 101.00'



Summary for Pond 1P: Basin 1P

Inflow Area = 35,717 sf, 29.47% Impervious, Inflow Depth = 3.16" for 100-Year event
Inflow = 2.38 cfs @ 12.12 hrs, Volume= 9,413 cf
Outflow = 0.82 cfs @ 12.46 hrs, Volume= 9,412 cf, Atten= 65%, Lag= 20.2 min
Primary = 0.82 cfs @ 12.46 hrs, Volume= 9,412 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 100.77' @ 12.46 hrs Surf.Area= 1,416 sf Storage= 1,440 cf

Plug-Flow detention time= 8.5 min calculated for 9,410 cf (100% of inflow)
Center-of-Mass det. time= 8.4 min (797.9 - 789.4)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	1,441 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)
#2	97.50'	285 cf	**Sand Filter (Prismatic)**Listed below (Recalc) 380 cf Overall x 75.0% Voids
		1,726 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	253	105.4	0	0	253
100.00	685	141.6	451	451	975
101.00	1,330	263.0	990	1,441	4,889

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.50	253	0	0
98.00	253	127	127
99.00	253	253	380

Device	Routing	Invert	Outlet Devices
#1	Primary	96.75'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 96.75' / 96.15' S= 0.0200 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	96.75'	**4.0" Vert. Underdrain** C= 0.600
#3	Device 1	100.80'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	100.80'	**5.5' 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=0.82 cfs @ 12.46 hrs HW=100.77' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 0.82 cfs of 7.10 cfs potential flow)
  ├─**2=Underdrain** (Orifice Controls 0.82 cfs @ 9.45 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=97.50' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link DP-A: DP-A

Inflow Area = 77,885 sf, 36.35% Impervious, Inflow Depth = 3.74" for 100-Year event
Inflow = 4.03 cfs @ 12.26 hrs, Volume= 24,288 cf
Primary = 4.03 cfs @ 12.26 hrs, Volume= 24,288 cf, Atten= 0%, Lag= 0.0 min

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

B

Water Quality Data

Location: **Treatment Train (PR-101i)**

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Sand Filter	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal = **80%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project:	**T1204.07 Access Road to Boxford's DPW Facility**
Prepared By:	**TEC, Inc.**
Date:	**1/18/2023**

Location: **Treatment Train (PR-102i)**

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Grassed Channel	**0.50**	**1.00**	**0.50**	**0.50**

Total TSS Removal = **50%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **T1204.07 Access Road to Boxford's DPW Facility**

Prepared By: **TEC, Inc.**

Date: **1/18/2023**

Riprap Apron Sizing Computation – Basin 1P Culvert

Sizing calculations based on guidance from Federal Highway Administration Hydraulic Engineering Circular No. 14, 3rd edition, dated July 2006

By: TEC, Inc. 1/18/2023

$$D_{50} = 0.2D\left(\frac{Q}{\sqrt{gD^{2.5}}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

$$D_{50} = riprap\ size\ (ft)$$

$$Q = design\ discharge\ \left(\frac{ft^3}{s}\right)$$

$$D = culvert\ diameter\ (ft)$$

$$TW = tailwater\ depth\ (ft)$$

$$g = acceleration\ due\ to\ gravity\ \left(32.2\ \frac{ft}{s^2}\right)$$

Table 10.1. Example Riprap Classes and Apron Dimensions

Class	D_{50} (mm)	D_{50} (in)	Apron Length[1]	Apron Depth
1	125	5	4D	$3.5D_{50}$
2	150	6	4D	$3.3D_{50}$
3	250	10	5D	$2.4D_{50}$
4	350	14	6D	$2.2D_{50}$
5	500	20	7D	$2.0D_{50}$
6	550	22	8D	$2.0D_{50}$

[1]D is the culvert rise.

Proposed FES 1

$$D_{50} = 0.2(1.0\ ft)\left(\frac{0.56\ \frac{ft^3}{s}}{\sqrt{(32.2\ \frac{ft}{s^2})(1.0ft)^{2.5}}}\right)^{4/3}\left(\frac{1.0ft}{0.4(1.0ft)}\right) = 0.023\ ft = 0.3\ inches$$

$$= Class\ 1\ (Table\ 10.1)$$

$$Length = 4D = 4(1.0\ ft) = 4\ ft$$

$$Depth = 3.5(D_{50}) = 3.5\ (5\ in) = 17.5\ inches$$

Note: Design flow from HydroCAD was estimated to be 0.56 cfs (outflow from Basin 1, during a 10-year storm). Based on this low flow rate, the culvert has been designed with the minimum recommended length and depth of rip rap apron.

Riprap Apron Sizing Computation – South Swale Outlet

Sizing calculations based on guidance from Federal Highway Administration Hydraulic Engineering Circular No. 14, 3rd edition, dated July 2006

By: TEC, Inc. 1/18/2023

$$D_{50} = 0.2D\left(\frac{Q}{\sqrt{gD^{2.5}}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

$$D_{50} = riprap\ size\ (ft)$$

$$Q = design\ discharge\ \left(\frac{ft^3}{s}\right)$$

$$D = culvert\ diameter\ (ft)$$

$$TW = tailwater\ depth\ (ft)$$

$$g = acceleration\ due\ to\ gravity\ \left(32.2\ \frac{ft}{s^2}\right)$$

Table 10.1. Example Riprap Classes and Apron Dimensions

Class	D_{50} (mm)	D_{50} (in)	Apron Length[1]	Apron Depth
1	125	5	4D	$3.5D_{50}$
2	150	6	4D	$3.3D_{50}$
3	250	10	5D	$2.4D_{50}$
4	350	14	6D	$2.2D_{50}$
5	500	20	7D	$2.0D_{50}$
6	550	22	8D	$2.0D_{50}$

[1]D is the culvert rise.

Proposed FES 2

$$D_{50} = 0.2(1.0\ ft)\left(\frac{1.19\ \frac{ft^3}{s}}{\sqrt{(32.2\ \frac{ft}{s^2})(1.0ft)^{2.5}}}\right)^{4/3}\left(\frac{1.0ft}{0.4(1.0ft)}\right) = 0.062\ ft = 0.75\ inches$$
$$= Class\ 1\ (Table\ 10.1)$$

$$Length = 4D = 4(1.0\ ft) = 4\ ft$$

$$Depth = 3.5(D_{50}) = 3.5\ (5\ in) = 17.5\ inches$$

Note: Design flow from HydroCAD was estimated to be 1.19 cfs (outflow from the South Swale, during a 10-year storm). Based on this low flow rate, the riprap lined outlet has been designed with the minimum recommended length and depth of rip rap apron.

Riprap Apron Sizing Computation – North Swale Outlet

Sizing calculations based on guidance from Federal Highway Administration Hydraulic Engineering Circular No. 14, 3rd edition, dated July 2006

By: TEC, Inc. 1/18/2023

$$D_{50} = 0.2D\left(\frac{Q}{\sqrt{gD^{2.5}}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

$$D_{50} = riprap\ size\ (ft)$$

$$Q = design\ discharge\ \left(\frac{ft^3}{s}\right)$$

$$D = culvert\ diameter\ (ft)$$

$$TW = tailwater\ depth\ (ft)$$

$$g = acceleration\ due\ to\ gravity\ \left(32.2\ \frac{ft}{s^2}\right)$$

Table 10.1. Example Riprap Classes and Apron Dimensions

Class	D_{50} (mm)	D_{50} (in)	Apron Length[1]	Apron Depth
1	125	5	4D	$3.5D_{50}$
2	150	6	4D	$3.3D_{50}$
3	250	10	5D	$2.4D_{50}$
4	350	14	6D	$2.2D_{50}$
5	500	20	7D	$2.0D_{50}$
6	550	22	8D	$2.0D_{50}$

[1]D is the culvert rise.

Proposed FES 3

$$D_{50} = 0.2(1.0\ ft)\left(\frac{1.59\ \frac{ft^3}{s}}{\sqrt{(32.2\ \frac{ft}{s^2})(1.0ft)^{2.5}}}\right)^{4/3}\left(\frac{1.0ft}{0.4(1.0ft)}\right) = 0.092\ ft = 1.1\ inches$$

$$= Class\ 1\ (Table\ 10.1)$$

$$Length = 4D = 4(1.0\ ft) = 4\ ft$$

$$Depth = 3.5(D_{50}) = 3.5\ (5\ in) = 17.5\ inches$$

Note: Design flow from HydroCAD was estimated to be 1.59 cfs (outflow from the North Swale, during a 10-year storm). Based on this low flow rate, the riprap lined outlet has been designed with the minimum recommended length and depth of rip rap apron.

C

NRCS Soil Information

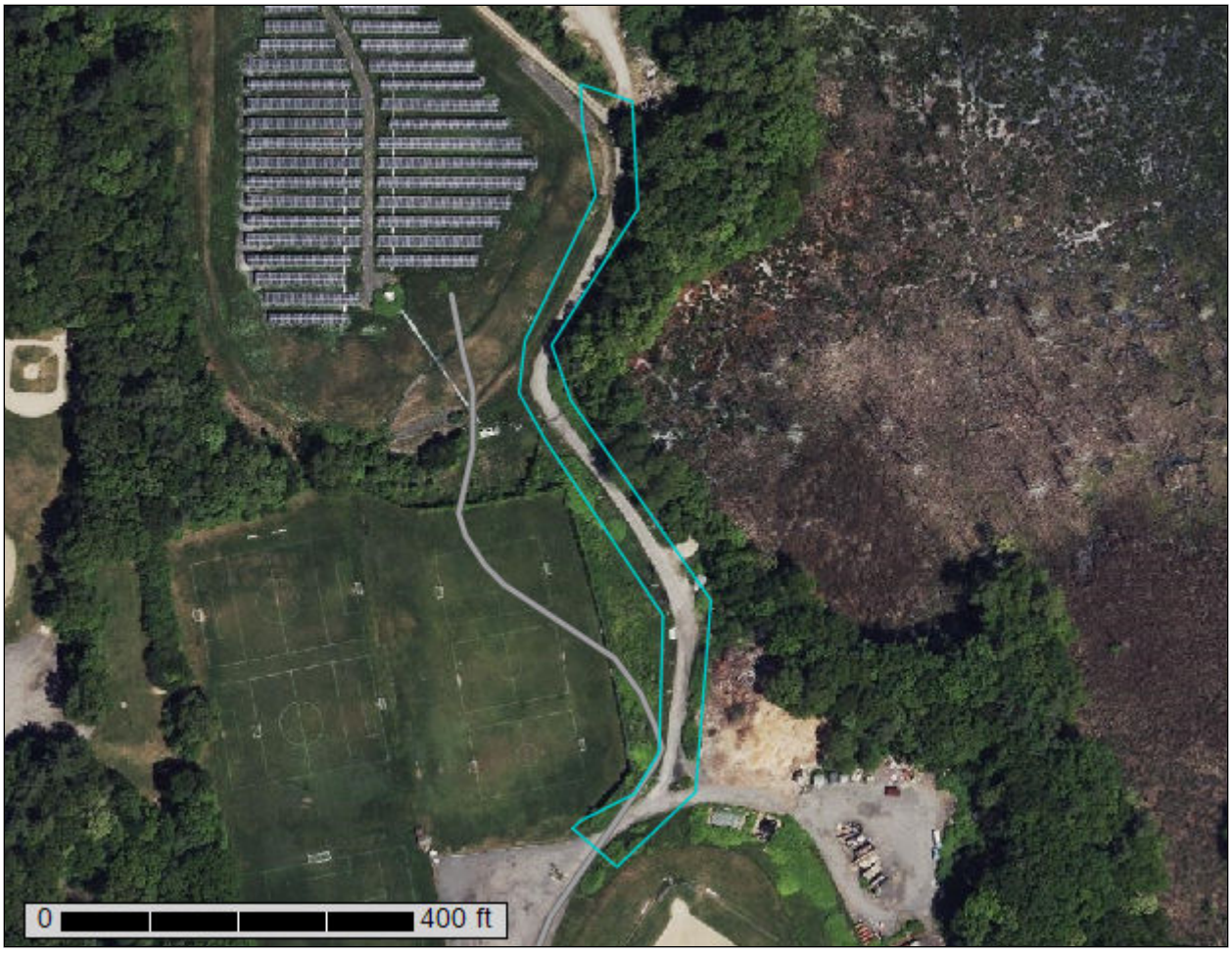
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Essex County, Massachusetts, Northern Part



December 20, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

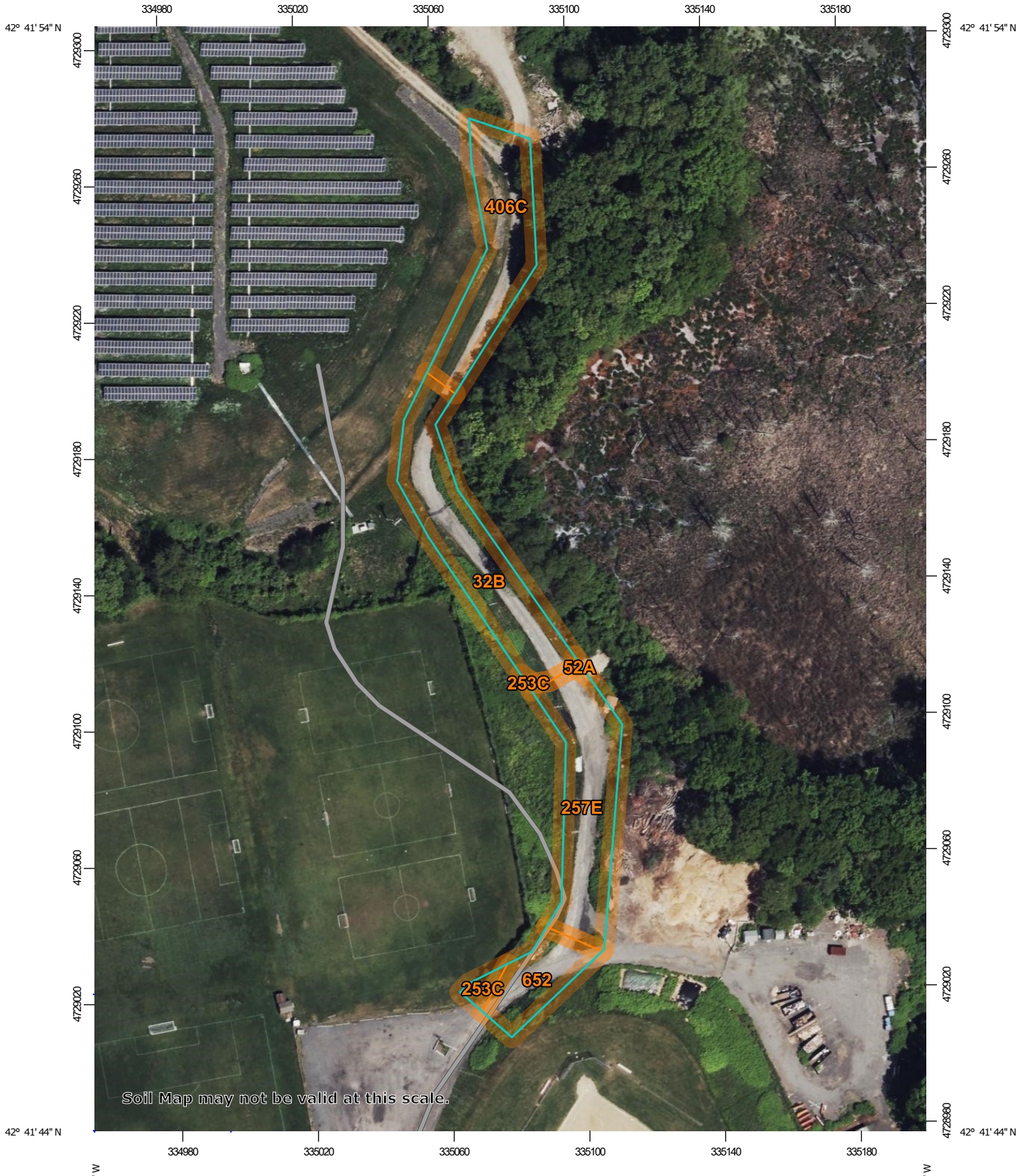
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,580 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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 18, Sep 9, 2022

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
32B	Wareham loamy sand, 3 to 8 percent slopes	0.3	32.0%
52A	Freetown muck, 0 to 1 percent slopes	0.0	0.2%
253C	Hinckley loamy sand, 8 to 15 percent slopes	0.0	1.8%
257E	Hinckley and Windsor soils, 25 to 35 percent slopes	0.3	28.4%
406C	Charlton fine sandy loam, 8 to 15 percent slopes, very stony	0.3	26.2%
652	Udorthents, refuse substratum	0.1	11.4%
Totals for Area of Interest		**1.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Essex County, Massachusetts, Northern Part

32B—Wareham loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vjxs
Elevation: 100 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Wareham and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wareham

Setting

Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: loamy sand
H2 - 10 to 17 inches: loamy sand
H3 - 17 to 32 inches: sand
H4 - 32 to 60 inches: stratified sand to fine sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 4 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

Minor Components

Scarboro

Percent of map unit: 15 percent
Landform: Terraces

Hydric soil rating: Yes

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Depressions, depressions, swamps, kettles, marshes, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Whitman

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 5 percent
Landform: Bogs, swamps, marshes, depressions, depressions, kettles
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

253C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svm9
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope

Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Kames, outwash plains, outwash terraces, moraines, eskers
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash deltas, moraines, outwash plains, kame terraces, outwash terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

257E—Hinckley and Windsor soils, 25 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2svm2
Elevation: 0 to 1,470 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hinckley and similar soils: 50 percent
Windsor and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Windsor

Setting

Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 10 percent
Landform: Kame terraces, outwash plains, kames, outwash terraces, moraines, eskers
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

406C—Charlton fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2wh0p
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Charlton, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton, Very Stony

Setting

Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: fine sandy loam
Bw - 4 to 27 inches: gravelly fine sandy loam
C - 27 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Paxton, very stony

Percent of map unit: 5 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Sutton, very stony

Percent of map unit: 5 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Chatfield, very stony

Percent of map unit: 3 percent
Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Leicester, very stony

Percent of map unit: 2 percent
Landform: Depressions, hills, ground moraines, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

652—Udorthents, refuse substratum

Map Unit Setting

National map unit symbol: vj7j
Frost-free period: 125 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Dumps: 94 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Leicester

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Raynham

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Walpole

Percent of map unit: 1 percent
Landform: Terraces
Hydric soil rating: Yes

Whitman

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Ridgebury

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Scarboro

Percent of map unit: 1 percent
Landform: Terraces
Hydric soil rating: Yes

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D

Operations & Maintenance Plan
Long Term Pollution Prevention Plan
Construction Period Pollution Prevention Plan

STORMWATER MANAGEMENT OPERATIONS AND MAINTENANCE PLAN

ACCESS DRIVEWAY TO FUTURE BOXFORD DEPARTMENT OF PUBLIC WORKS FACILITY

BOXFORD, MASSACHUSETTS

Prepared for:

Town of Boxford
7 Spofford Road
Boxford, MA 01921

Prepared by:

TEC, Inc.
282 Merrimack Street
2nd Floor
Lawrence MA, 01843

January 19, 2023

Stormwater Management Operation and Maintenance Plan
January 19, 2023

Name of Owner: **Town of Boxford**
Name of Facility: **DPW Access Driveway**
Location: **7 Spofford Road, Boxford MA**

A detailed, written log of all scheduled preventative and corrective maintenance performed for the stormwater management measures must be kept on site, including a record of all inspections and copies of maintenance-related work orders.

An "Inspection and Maintenance Check List" shall be maintained as a record of regularly scheduled inspection and maintenance items as outlined below for every year. Maintenance required and actions taken shall be recorded in a "Inspection and Maintenance Log". The funding, operation, and maintenance of all stormwater management Best Management Practices (BMPs) shall be provided by the Owner, or their appointee.

Maintenance routine and schedule: Routine inspections will be conducted monthly and thorough investigations will be conducted twice a year. Task systems include regular removal of accumulated sediments, floatables and debris, and scour inspection. Inspections will occur after every major storm event throughout construction and for the first six (6) months after construction is completed. Inspections will be conducted by a qualified person experienced in drainage design and stormwater management systems. Annual reports will be prepared detailing the status of the stormwater system and the maintenance performed. A copy of the annual report will be kept by the Town of Boxford, if requested.

The State agrees with a minimum maintenance schedule as follows:

1. **Grassed Channel.** Grassed Channels shall be inspected twice a year the first year after construction and at least once a year thereafter. Inspect the grass for growth and the side slopes for signs of erosion and formation of rills and gullies. Plant an alternative grass species if the original grass cover is not successfully established. While mowing, the blades shall be set no lower than 3 to 4 inches above the ground. Mow on an as-needed basis during the growing season so that the grass height does not exceed 6 inches.

2. **Inspection and cleaning of drainage pipes.** Drainage pipes shall be inspected and cleaned of sediment at least every five (5) years or as required to maintain adequate functionality of the stormwater conveyance system. All sediments shall be properly handled and disposed of in accordance with local, state, and federal guidelines and regulations.

3. **Outlet Control Structures.** The outlet control structures are utilized to control peak flow rates of stormwater. These structures contain low-flow outlets that shall be inspected & cleaned of sediment buildup at least twice annually, or as needed to limit sediment build-up to less than half the height of the low-flow outlets. Additional clearing & cleaning of the structure/pipes shall follow the maintenance frequency for drainage pipes and manholes.

4. **Sand Filter.** Inspect sand filters after every major storm in the first few months after construction to ensure proper function. Thereafter, inspect the sand filter at least once every 6 months. Sand filters require frequent manual maintenance. Important maintenance tasks include raking the sand and removing surface sediment, trash, and debris. Eventually a layer of sediment will accumulate on the top of the sand, which can be easily scraped off using rakes or other devices. Finer sediments will penetrate deeper into the sand over time, necessitating replacement of some (several inches) or all the sand. Discolored sand indicates the presence of fine sediments. De-water and properly dispose of sand removed from the filter.

5. **Level Spreader.** Inspect level spreaders regularly, especially after large rainfall events. Note and repair any erosion or low spots in the spreader.

6. **Snow removal.** Snow will maintain the same procedure as before.

The Long-Term Pollution Prevention Plan

The State agrees to comply with the following Long-Term Pollution Prevention Plan to ensure long-term stormwater quality discharge from the site:

- *Good housekeeping practices:* The project is a public roadway that will be maintained by the State, including snow removal, de-icing, street sweeping and BMP inspection/maintenance.

- *Provisions for storing materials and waste products inside or under cover*: Waste products are not anticipated to be produced or stored on this site.

- *Vehicle washing controls:* Vehicle washing is not anticipated as a reasonably foreseeable use of the site.

- *Spill prevention and response plans:* There are no proposed uses at the site that would provide an opportunity for a spill of oil or hazardous materials, other than a sudden, catastrophic, vehicle failure. If a vehicle release is the result of an accident, the police and fire department will respond and address any release.

- *Provisions for maintenance of lawns, gardens, and other landscaped areas:* The owner will provide long-term maintenance for the landscaped areas and stormwater BMPs.

- *Requirements for storage and use of fertilizers, herbicides, and pesticides:* At this time there would be no foreseeable need for fertilizers, herbicides, and pesticides.

- *Provisions for operation and management of septic systems:* Not Applicable

- *Provisions for solid waste management:* Not Applicable.

- *Snow disposal and plowing plans relative to Wetland Resource Areas:* No snow will be stored or disposed of in surrounding resource areas.

- *Street sweeping*: The owner will perform street sweeping as needed to minimize sediment build up along the driveway. Sediment build-up beyond half the height of curb reveal shall be removed.

- *Provisions for prevention of illicit discharges to the stormwater management system:* Only stormwater is proposed to be conveyed through the stormwater management system. No illicit materials will be permitted. The owners will be responsible to maintain this 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.* The project location is considered a LUHPPL, however in the event or a vehicular spill, the fire department and police department of Boxford will be responsible to clean up and contamination removal. The current stormwater design has BMPs in place to mitigate the risk of a spill and provide containment. There is no infiltration proposed as part of the project due to the proximity of wetlands and the landfill.

- *Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan:* Prior to implementation of the LTPPP, the Town shall provide an on-site meeting with the maintenance personnel to present the contents and requirements of the Stormwater Operation and Maintenance Plan and the LTPPP.

- *List of Emergency contacts for implementing Long-Term Pollution Prevention Plan*:

  Town of Boxford
  (978) 887-6000
  7 Spofford Road
  Boxford, MA 01921

Name of Applicant: Town of Boxford
Name of Facility: DPW Access Road
Location: 7 Spofford Road, Boxford, MA

INSPECTION AND MAINTENANCE CHECK LIST -
DPW Acess Road, Boxford, MA

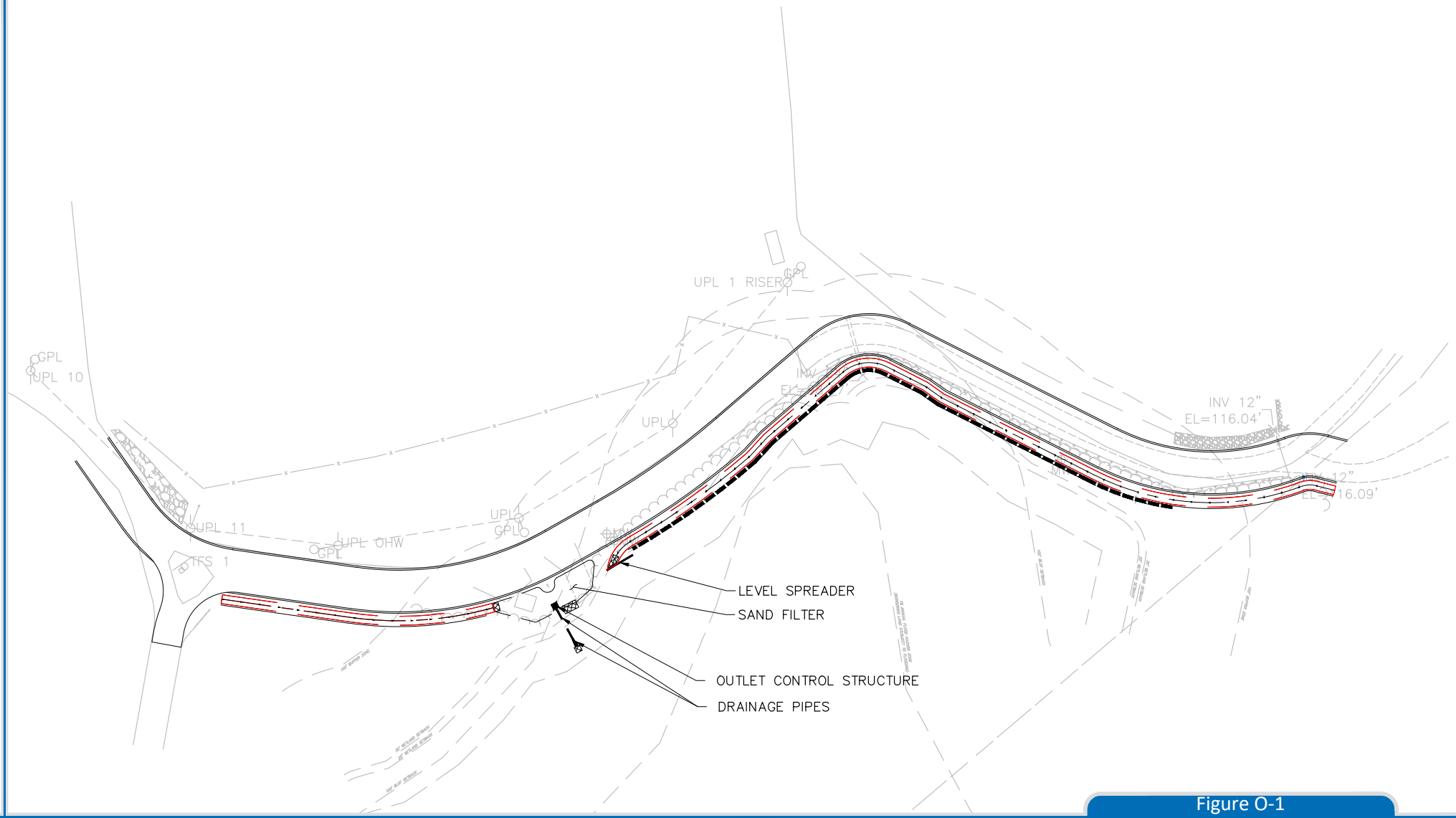
For Year: _____

	Inspection Item	Inspection Frequency*											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	Grassed Channel	■	■		■	■	■	■	■		■	■	■
2	Sand Filter	■		■		■		■		■		■	
3	Outlet Control Structure	■	■		■	■	■	■	■		■	■	■
4	Level Spreader	■		■		■		■		■		■	
5	Drainage Pipes	At least every 5 yeaes or as needed											

	Maintenance Item	Maintenance Frequency*											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Street Sweeping	As needed or when sediment buildup is over half the curb.											
2	Grassed Channel	As needed											
3	Sand Filter	■	■		■	■	■	■	■		■	■	■
4	Outlet Control Structure	■	■		■	■	■	■	■		■	■	■
5	Level Spreader	As needed											
6	Drainage Pipes	At least every 5 yeaes or as needed											

* Actual time of inspecting and maintaining items may vary. Chart shall be used to indicate frequency of events

** This chart shall be used in conjunction with the attached "Stormwater Management Operations and Maintenance Plan", dated January 19, 2023



LEGEND

GRASSED SWALE

TEC, Inc.
282 Merrimack St
Lawrence, MA 01843

Figure O-1
Operatins and Maintenance Plan

DPW Access Driveway
Boxford, Massachusetts

CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN
January 19, 2023

Name of Applicant: **Town of Boxford**
Name of Facility: **DPW Access Driveway**
Location: **7 Spofford Road**
Boxford, MA 01921

Good Housekeeping BMPs

Goals

Minimize the potential for contaminants to enter or runoff the site during construction activities. Fuel and other equipment related fluids will be properly stored. The Contractor shall establish secure storage areas that collect any spillage to meet requirements of the Town of Boxford Fire Department regarding the storage of flammable materials. The Contractor shall complete and submit the plans to the Engineer.

General Requirements

The following presents a proactive approach to all of the best management practices, erosion and sedimentation controls, mitigation measures, and monitoring activities for this Project.

Straw Bales and Silt Fence

Straw bales and silt fence are used as temporary perimeter controls where construction activities will disturb existing surfaces. They can also be used to contain soil stockpiles areas. Straw bales and silt fence consist of a length of filter fabric stretched between two anchoring posts spaced at regular intervals along the site at low/downslope areas with staked straw bales. The filter fabric should be entrenched in the ground between the support posts. When installed correctly and inspected frequently, straw bales and silt fence can be an effective barrier to sediment leaving the site in stormwater runoff.

Storm Drain Inlet Protection

Storm drain inlet protection measures prevent soil and debris from entering storm drain inlets. These measures will be implemented before the Site is disturbed by using silt sacks, compost filter socks, or staked bales in combination with silt fence. Storm drain inlet protection will be installed at all down gradient catch basins adjacent to the project site outside the protection of other erosion control barriers, all catch basins within the construction site, and at low points within the construction site that are connected to the storm drainage system.

Temporary Seeding and Slope Stabilization

Seeding shall be used to temporarily stabilize areas that will not be brought to final grade for a period of more than 30 working days and to stabilize disturbed areas before final grading or in a season not suitable for permanent seeding. Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation.

Vegetative slope stabilization will be used to minimize erosion on slopes of 3:1 or flatter. Annual grasses, such as annual rye, will be used to ensure rapid germination and production of root mass. Permanent stabilization will be completed with the planting of perennial grasses or legumes. Establishment of temporary and permanent vegetative cover may be established by hydro-seeding or sodding. A suitable topsoil, good seedbed preparation, and adequate lime, fertilizer, and water will be provided for effective establishment of these vegetative stabilization methods. Root systems restrain the soils so that they are less apt to be dislodged and carried offsite by stormwater runoff or wind. Temporary seeding also reduces the problems associated with mud and dust from bare soil surfaces during construction. Mulch will also be used after permanent seeding to protect soil from the impact of falling rain and to increase the capacity of the soil to absorb water.

General Maintenance

Refer to the Inspection and Maintenance Checklist (at the end of this section) identifying inspection and maintenance measures for each specific practice.

The contractor or subcontractor will be responsible for implementing each control shown on the Plan. In accordance with EPA regulations, the contractor must sign a copy of a certification to verify that a plan has been prepared and that permit regulations are understood.

The onsite contractor will inspect all sediment and erosion control structures weekly and after each rainfall event meeting the minimum requirements as defined in the Plan. Records of the inspections will be prepared and maintained onsite by the contractor as required by the Plan.

- Silt shall be removed from behind barriers if greater than 6-inches deep or as needed.
- Damaged or deteriorated items will be repaired immediately after identification.
- The underside of straw bales should be kept in close contact with the earth and reset as necessary.
- Sediment that is collected in structures shall be disposed of properly and covered if stored onsite.
- At a minimum establish good housekeeping BMPs for:
    - Material handling and waste management
    - Staging areas
    - Designate washout areas
    - Equipment vehicle fueling and maintenance
    - Spill prevention and control

Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

Spill Prevention and Control

The Contractor will actively maintain and manage the site activities with the procedures outlined in this Plan. In the event of petroleum or other deleterious substance spill, action will be taken by the Contractor to contain and remove the spill. The Contractor will comply with the relevant section(s) of the Oil Pollution Prevention Act, 40 CFR 112.7.

Responsibility

All project personnel share the responsibility for the initial control and reporting of the oil and other substance spill, especially the personnel that first discover the spill. The Site Safety and Health Officer (SSHO) will be responsible for determining the necessary safety equipment and for establishing safety practices to be followed by the Contractor during the clean-up operations. All personnel will be trained in the use of and location of this equipment, prior to the commencement of the construction.

The Contractor's goal is to provide effective, efficient, and coordinated action to minimize or mitigate damages to the environment and public health and welfare from oil or other substance discharges, conforming to applicable federal, state, and local regulations, as well as other provisions and restrictions. In the event of spills or releases that may occur during the Project, a representative on-site qualified by OSHA training requirements (29 CFR 1910.120) for a Level 3 Hazmat Technician will be provided and will have the responsibility and authority for supervising the cleanup. If the representative determines that the cleanup operations are beyond the capacity of the Contractor, assistance shall be requested from its Subcontractor.

In the event of an emergency spill, the Contractor will be responsible for retaining the environmental Subcontractor. The selected environmental subcontractor will develop a Hazardous Materials Health and Safety Plan, which will be referenced when a spill or release is discovered, and the control of the spill or release is beyond the scope of the Spill Prevention Control and Countermeasure plan. The Contractor's Project Manager is responsible for giving the SSHO directions for initiating the Hazardous Materials Health and Safety Plan.

Alert and reporting procedures will become effective immediately upon observance and indication of a spill or discharge of oil or other substances on the project.

Reportable observations are:

1. Leaks or spills
2. Soils which are discolored or have an odor
3. Discharge of oil or other similar substances from drain pipes

The Engineer will be informed immediately of all substantial spills, releases, or other substance discharges. All telephone numbers for the Emergency Response agencies will be posted on site. The Contractor or its Subcontractors will implement control and countermeasures immediately.

Fuel and Oil Delivery Trucks

The equipment superintendent or designee will monitor all truck unloading procedures to verify all hoses are tight and do not leak, and if necessary, will tighten, adjust, or replace them to prevent a release of any kind. In the event of a major spill, alert and initial report procedures will be implemented, and an emergency response contractor will be called in to perform the cleanup.

Equipment

Motorized equipment that require fuel and oil to operate will be inspected prior to the start of each work shift by the operator (in the field) to ensure there is no leakage of oil, fuel, or other material. Trucks will be inspected prior to use for potential leaks or drips. If a leak is found, repairs will be made immediately, and spillage will be cleaned up manually using sorbent material. Vehicles that are found to be leaking will be immediately taken out of service until repairs can be made.

Drum Storage

Drum storage, if any, will be located in a secure area within the Project limits away from environmental areas of concern. Petroleum liquids and other substances stored in drums will be kept in a drum container that consists of a drum rack and drip containment pan that is capable of containing 110% of the stored volume should the drum rupture.

Lubrication / Oil Maintenance

Replacement lubrication will be directly deposited from the lubrication truck to the equipment lubrication reservoir. No other container system will be used to transport oil to the equipment. Mobile equipment will be serviced off site or in the lay-down area. Equipment that cannot be moved will be serviced in the field. The Contractor will place a containment pan or absorbent below the service area prior to initiating service activities in the field. Waste disposal will be completed by the Contractor or by a waste disposal firm. Miscellaneous lubricants for operating equipment will be limited to daily quantities.

Spent Oil

Oil that has already been used on the job will be disposed of via a certified waste disposal firm. Spent oil will be stored in a labeled (hazardous waste signs) and vented fuel storage cell located at the staging area awaiting disposal by a certified waste disposal firm (i.e. Enpro, Inc.). The staging area will be located within the boundary of the project and inspected daily for leaks or spills. The storage cell will be bermed to contain 110% of the largest container or 10% of the total volume in storage, whichever is greater.

Special Oil Spill Equipment

Sorbent Pads

Sorbent pads will be available to absorb oil and petroleum compounds. If necessary, the pads will be used to absorb oil spills or leaks by placing them on the oil and giving them adequate time to absorb it. The sorbent pads will be stored in equipment box located in the maintenance area. The pads shall float and be water repellent, so they can absorb oil on water. Saturated/contaminated pads will be placed in an appropriate container and stored within the maintenance area. A certified waste disposal firm will dispose of the approved containers.

Sorbent Compound

The compound will be used for contaminants spilled on decks or hard surfaces. In most cases, it can be applied directly to spills, but if the spill is large, it can be used to form a dike around the spill to prevent further migration.

Best Management Practices – Maintenance/Evaluation Checklist
Construction Practices

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by
Filter tube and Silt Fence	Inspect at least once per week and after each rainstorm of 0.5 inch or greater.			• Silt shall be removed from behind barriers if greater than 6 inches deep or as needed. The underside of filter tubes should be kept in close contact with the earth and reset as necessary.			
Catch Basin Inlet Protection	Inspect at least once per week and after each rainstorm of 0.25 inch or greater.			• Check all temporary control measures after each storm event. • To maintain the capacity, remove accumulated sediment when the capacity is reduced by half.			
Temporary Seeding and Slopes	Inspect at least once per week and after every rainstorm.			• Seeding shall be used to temporarily stabilize areas that will not be brought to final grade for a period of more than 30 working days and to stabilize disturbed areas before final grading or in a season not suitable for permanent seeding. Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation.			

E

Illicit Discharge Statement

Illicit Discharge Compliance Statement

Name of Owner: **Town of Boxford**
Name of Facility: **DPW Access Driveway**
Location: **7 Spofford Road, Boxford, MA**

The Highway Plans and Stormwater Report for the Town of Boxford's Department of Public Works Driveway Project located along the above-mentioned sections of 7 Spofford Road, Boxford MA, meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook.

The Highway Plans were prepared by qualified personnel at the direction of the Town of Boxford. The Highway Plans identify the location of stormwater management and utility systems. As designed, the systems do not allow for any connections between the stormwater management and sanitary sewer utilities.

Signature: _____
(To be signed prior to occupancy)