# Newell Boathouse Renovations

# Boston, Massachusetts

# Notice of Intent

March 2022

**Submitted to:**

Boston Conservation Commission
1 City Hall Square
Room 709
Boston, MA 02108

**Applicant:**

Harvard University
FAS – Office of Physical Resources and Planning
60 JFK Street
Cambridge, MA

**Applicant's Representative:**

CHILDS ENGINEERING
WATERFRONT STRUCTURAL ENGINEERING

34 William Way
Bellingham, MA 02019

(508) 966 9092

childseng.com

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**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands
# WPA Form 3 – Notice of Intent
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

Allston
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.

tab

return

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):

801 Soldiers Field Road — a. Street Address
Allston — b. City/Town
02134 — c. Zip Code

Latitude and Longitude:
42.369661 — d. Latitude
-71.125867 — e. Longitude

Ward 22 — f. Assessors Map/Plat Number
2200577010 — g. Parcel /Lot Number

2. Applicant:

Edward — a. First Name
Milch — b. Last Name
Harvard University, FAS - Office of Physical Resources and Planning — c. Organization
60 JFK Street — d. Street Address
Cambridge — e. City/Town
MA — f. State
02138 — g. Zip Code
(617)496-2331 — h. Phone Number
i. Fax Number
emilch@fas.harvard.edu — j. Email Address

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

Priscilla — a. First Name
Geigis — b. Last Name
Department of Conservation and Recreation — c. Organization
251 Causeway Street Suite 600 — d. Street Address
Boston — e. City/Town
MA — f. State
02114 — g. Zip Code
h. Phone Number
i. Fax Number
Priscilla.geigis@mass.gov — j. Email address

4. Representative (if any):

Charlie — a. First Name
Roberts — b. Last Name
Childs Engineering Corporation — c. Company
34 William Way — d. Street Address
Bellingham — e. City/Town
MA — f. State
02019 — g. Zip Code
(508)966-9092 — h. Phone Number
i. Fax Number
robertsc@childseng.com — j. Email address

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

$2,922.50 — a. Total Fee Paid
$777.50 — b. State Fee Paid
$2,145.00 — c. City/Town Fee Paid

## A. General Information (continued)

6. General Project Description:

   Replacement of existing pier and floating docks, including an extension and additional pier. Installation of timber piles, pile caps, stringers, decking, and floating docks. The boathouse will also be renovated with upgrades to the building, landscape, grading and drainage.This also includes the removal of an existing building and a replacement with new covered boat racks.

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:

| | |
|---|---|
| Suffolk | |
| a. County | b. Certificate # (if registered land) |
| 2694 | 530 |
| c. Book | d. Page Number |

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

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

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

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

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

| Resource Area | Size of Proposed Alteration | Proposed Replacement (if any) |
|---|---|---|
| a. ☒ Bank | 100<br>1. linear feet | <br>2. linear feet |
| b. ☐ Bordering Vegetated Wetland | <br>1. square feet | <br>2. square feet |
| c. ☒ Land Under Waterbodies and Waterways | 83<br>1. square feet<br>0<br>3. cubic yards dredged | |

| Resource Area | Size of Proposed Alteration | Proposed Replacement (if any) |
|---|---|---|
| d. ☒ Bordering Land Subject to Flooding | 13,705<br>1. square feet<br>2,033<br>3. cubic feet of flood storage lost | <br>2. square feet<br><br>4. cubic feet replaced |
| e. ☐ Isolated Land Subject to Flooding | <br>1. square feet<br><br>2. cubic feet of flood storage lost | <br><br><br>3. cubic feet replaced |
| f. ☒ Riverfront Area | Charles River (inland)<br>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: 14,887 square feet

4. Proposed alteration of the Riverfront Area:

| 10,120 | 18,830 | 16,324 |
|---|---|---|
| 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<br>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 |

| | 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<br>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<br>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**

10/12/2021
b. Date of map

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

c. Submit Supplemental Information for Endangered Species Review*

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

(a) within wetland Resource Area ______ percentage/acreage

(b) outside Resource Area ______ percentage/acreage

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

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

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

(b) ☐ Photographs representative of the site

* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review (see https://www.mass.gov/ma-endangered-species-act-mesa-regulatory-review).
Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.

** MESA projects may not be segmented (321 CMR 10.16). The applicant must disclose full development plans even if such plans are not required as part of the Notice of Intent process.

**Massachusetts Department of Environmental Protection**
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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.

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands
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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.

Newell Boathouse Renovations
a. Plan Title

Childs Engineering
b. Prepared By

C. Roberts
c. Signed and Stamped by

March 25, 2022
d. Final Revision Date

1"=20'
e. Scale

See Attached
f. Additional Plan or Document Title

March 25, 2022
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:

10248
2. Municipal Check Number

11/8/21
3. Check date

10246
4. State Check Number

11/8/21
5. Check date

Childs
6. Payor name on check: First Name

Engineering
7. Payor name on check: Last Name

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands
# WPA Form 3 – Notice of Intent
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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.

Harvard University — 3.30.22
1. Signature of Applicant — 2. Date

4/5/22
3. Signature of Property Owner (if different) — 4. Date

3/30/2022
5. Signature of Representative (if any) — 6. Date

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

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

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

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

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands
# NOI Wetland Fee Transmittal Form
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

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

## A. Applicant Information

1. Location of Project:

801 Soldiers Field Road — a. Street Address
Allston — b. City/Town
c. Check number
d. Fee amount

2. Applicant Mailing Address:

Edward — a. First Name
Milch — b. Last Name
Harvard University, FAS - Office of Physical Resources and Planning — c. Organization
60 JFK Street — d. Mailing Address
Cambridge — e. City/Town
MA — f. State
02138 — g. Zip Code
(617)496-2331 — h. Phone Number
i. Fax Number
emilch@fas.harvard.edu — j. Email Address

3. Property Owner (if different):

Priscilla — a. First Name
Geigis — b. Last Name
Department of Conservation and Recreation — c. Organization
251 Causeway Street Suite 600 — d. Mailing Address
Boston — e. City/Town
MA — f. State
02114 — g. Zip Code
h. Phone Number
i. Fax Number
Priscilla.geigis@mass.gov — j. Email Address

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

## B. Fees

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.

## B. Fees (continued)

| Step 1/Type of Activity | Step 2/Number of Activities | Step 3/Individual Activity Fee | Step 4/Subtotal Activity Fee |
|---|---|---|---|
| Category 5 | 180 | $4/LF | $1080.00 |
| Category 2 | 1 | $500 | $500.00 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | **Step 5/Total Project Fee:** | $1580.00 |

**Step 6/Fee Payments:**

| | |
|---|---|
| Total Project Fee: | $1580.00<br>a. Total Fee from Step 5 |
| State share of filing Fee: | $777.50<br>b. 1/2 Total Fee **less $**12.50 |
| City/Town share of filling Fee: | $2,145.00*<br>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.)

City of Boston Environment

**NOTICE OF INTENT APPLICATION FORM**
Boston Wetlands Ordinance
City of Boston Code, Ordinances, Chapter 7-1.4

Boston File Number

MassDEP File Number

## A. GENERAL INFORMATION

1. Project Location

801 Soldiers Field Road — a. Street Address
Allston — b. City/Town
02134 — c. Zip Code
Ward 22 — f. Assessors Map/Plat Number
2200577010 — g. Parcel /Lot Number

2. Applicant

Edward — a. First Name
Milch — b. Last Name
Harvard University, FAS Office of Physical Resources and Planning — c. Company
60 JFK Street — d. Mailing Address
Cambridge — e. City/Town
MA — f. State
02138 — g. Zip Code
(617) 496-2331 — h. Phone Number
i. Fax Number
emilch@fas.harvard.edu — j. Email address

3. Property Owner

Priscilla — a. First Name
Geigis — b. Last Name
Department of Conservation and Recreation — c. Company
251 Causeway Street Suite 600 — d. Mailing Address
Boston — e. City/Town
MA 01746 — f. State
02114 — g. Zip Code
h. Phone Number
i. Fax Number
Priscilla.geigis@mass.gov — j. Email address

❑ Check if more than one owner

(If there is more than one property owner, please attach a list of these property owners to this form.)

4. Representative (if any)

Charlie — a. First Name
Roberts — b. Last Name
Childs Engineering Corporation — c. Company
34 William Way — d. Mailing Address
Bellingham — e. City/Town
MA — f. State
02019 — g. Zip Code
(508)966-9092 — h. Phone Number
i. Fax Number
robertsc@childseng.com — j. Email address

5. Is any portion of the proposed project jurisdictional under the Massachusetts Wetlands Protection Act M.G.L. c. 131 §40?

☒ Yes ☐ No

If yes, please file the WPA Form 3 - Notice of Intent with this form

6. General Information

Replacement of existing pier and floating docks, including an extension and additional pier.

Installation of timber piles, pile caps, stringers, decking, and floating docks.

The boathouse will also be renovated with upgrades to the building, landscape, grading and drainage.

7. Project Type Checklist

a. ☐ Single Family Home
b. ☐ Residential Subdivision
c. ☐ Limited Project Driveway Crossing
d. ☐ Commercial/Industrial
e. ☒ Dock/Pier
f. ☐ Utilities
g. ☐ Coastal Engineering Structure
h. ☐ Agriculture – cranberries, forestry
i. ☐ Transportation
j. ☐ Other

8. Property recorded at the Registry of Deeds

Suffolk
a. County

530
b. Page Number

2694
c. Book

d. Certificate # (if registered land)

**B. BUFFER ZONE & RESOURCE AREA IMPACTS**

Buffer Zone Only - Is the project located only in the Buffer Zone of a resource area protected by the Boston Wetlands Ordinance?

☐ Yes ☒ No

1. Coastal Resource Areas

| **Resource Area** | **Resource Area Size** | **Proposed Alteration*** | **Proposed Migitation** |
|---|---|---|---|
| ☐ *Coastal Flood Resilience Zone* | *Square feet* | *Square feet* | *Square feet* |

| | | | |
|---|---|---|---|
| ❑ *25-foot Waterfront Area* | *Square feet* | *Square feet* | *Square feet* |

2. Inland Resource Areas

| **Resource Area** | **Resource Area Size** | **Proposed Alteration*** | **Proposed Migitation** |
|---|---|---|---|
| ❑ *Inland Flood Resilience Zone* | *Square feet* | *Square feet* | *Square feet* |
| ❑ *Isolated Wetlands* | *Square feet* | *Square feet* | *Square feet* |
| ❑ *Vernal Pool* | *Square feet* | *Square feet* | *Square feet* |
| ❑ *Vernal Pool Habitat (vernal pool + 100 ft. upland area)* | *Square feet* | *Square feet* | *Square feet* |
| ☒ *25-foot Waterfront Area* | 13,632 *Square feet* | 5,352 *Square feet* | *Square feet* |

## C. OTHER APPLICABLE STANDARDS & REQUIREMENTS

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://www.mass.gov/dfwele/dfw/nhesp/nhregmap.htm.

   ❑ Yes ☒ No

   If *yes*, the project is subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18).

   **A. Submit Supplemental Information for Endangered Species Review**

   ☐ Percentage/acreage of property to be altered:

   (1) within wetland Resource Area __________ percentage/acreage

   (2) outside Resource Area __________ percentage/acreage

   ☐ Assessor's Map or right-of-way plan of site

2. Is the proposed project subject to provisions of the Massachusetts Stormwater Management

   Yes

3. Is any portion of the proposed project within an Area of Critical Environmental Concern?

   ❑ Yes ☒ No

4. Is the proposed project subject to provisions of the Massachusetts Stormwater Management Standards?

- [x] *Yes. Attach a copy of the Stormwater Checklist & Stormwater Report as required.*
  - [ ] *Applying for a Low Impact Development (LID) site design credits*
  - [ ] *A portion of the site constitutes redevelopment*
  - [x] *Proprietary BMPs are included in the Stormwater Management System*
- [x] *No. Check below & include a narrative as to why the project is exempt*
  - [ ] *Single-family house*
  - [ ] *Emergency road repair*
  - [ ] *Small Residential Subdivision (less than or equal to 4 single family houses or less than or equal to 4 units in a multifamily housing projects) with no discharge to Critical Areas*

5. Is the proposed project subject to Boston Water and Sewer Commission Review?

- [x] Yes
- [ ] No

## D. 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 Protection Ordinance.

| | |
|---|---|
| – Harvard University | 3-30-22 |
| Signature of Applicant | Date |
| | 4/5/22 |
| Signature of Property Owner (if different) | Date |
| | 3/30/2022 |
| Signature of Representative (if any) | Date |

# ATTACHMENT A

# Project Description

# and Additional Information

This summary outlines the proposed project activities, existing conditions, anticipated impacts and mitigation measures to ensure that the proposed project minimizes impacts on wetland resource areas.

## 1.0 PROPERTY ADDRESS

The address listed for the Newell Boathouse is 801 Soldiers Field Road, Allston, MA 02134. This is the address given when performing an online search for the boathouse. The City of Boston Assessing Department's abutter mailing list generator lists the parcel number as 2200577010 for the Newell Boathouse. The address for this parcel is 1345 Soldiers Field Road, 02135 according to the abutter mailing list generator.

## 2.0 PROJECT PURPOSE AND NEED

The Newell Boathouse is located on approximately 1.99 acres of land located within the Massachusetts Department of Conservation and Recreation (DCR) Charles River Reservation. More specifically, the Project Site is located on the Boston shoreline of the Charles River adjacent to Soldiers Field Road, and across the Charles River from the John F. Kennedy Memorial Park and northwest (upstream) of the Anderson Memorial Bridge. Harvard University leases the property from the Commonwealth though a long-term lease administered by DCR.

The existing Project Site includes a pile supported boathouse, an addition that was constructed in the 1960s, and a gravel parking lot. Fixed pile supported timber decks connect the original boathouse with floating docks on the Charles River.

The Newell Boathouse was designed by the architectural firm of Peabody & Stearns and was completed in 1900. The existing building has two stories containing approximately 21,000 square feet of space. A large ramped deck over the Charles River extends the width of the building and provides dock access. The facility serves as the home of the Harvard Varsity Men's Crew program.

As part of the renovations to the Newell Boathouse both the interior and exterior of the boathouse are being renovated. The interior is being updated to reflect the current and future uses and the exterior is being enhanced with the replacement of the docks and boat storage to provide a more complementary exterior that is fitting with the historic building and its natural environment, while being mindful of the DCR's master plan in the area, and updating the stormwater treatment.

The proposed exterior project involves replacing the existing pier and floating docks, as well as, extending the length of the floating dock, construction of an additional pier, within the Charles River. In the riverfront and waterfront areas and existing storage building will be removed and replaced with two smaller covered boat racks set back outside the riverfront area. The pier replacement will consist of removing the pier components, including cutting the timber piles at the mudline, installing new timber piles, pile caps, stringers, and decking. The covered boat racks are mostly open plan areas.

The landscape design goal is to provide a naturalistic and aesthetically understated landscape in a way that is complementary to the historic architecture, the proposed boat racks, and the riverside landscape it occupies. To achieve this design goal, the management strategy for the existing vegetation is critical – which is to prioritize the removal of the unhealthy and invasive plants throughout the site, and to protect and maintain the existing native vegetation wherever possible. The site program and associated grading design in coordination with the stormwater management and bioengineering strategies have been carefully developed in a way that work to protect the existing trees to remain.

Specifically, the proposal includes retaining all possible vegetation along the river, including a massive specimen red oak tree on the south side of the building. We see this tree as a signature element of the site, in that its size and age help to reflect the historic character of the site. The adjacent bioretention basin has been designed to avoid impacts to this specimen tree. Unfortunately, the adjacent mature oak trees that are very close to the existing building will need to be removed due to their proximity to the building. The proposed porous parking and covered boat storage racks are intentionally located in areas of the site historically used for boat and vehicle storage, where the existing vegetation has struggled to remain healthy as it has established itself in and around the remnants of the existing wooden boat ramps. Much of the existing vegetation in this area, including some of the paper birch trees have fallen, been removed or have otherwise been in conflict with the historic programmed boat storage and maneuvering uses in this part of the site. Along Soldiers Field Road on the western edge of the site, the existing unhealthy Japanese Zelkova and the invasive Norway Maple are proposed to be removed and replaced with native street tree species. Please see included “Newell Boathouse Tree Inventory and Management Plan, 2022” by project arborist Bartlett Tree Experts for more information. A summary of the tree removal is included at the end of this attachment.

The proposed planting design is intended to enhance the riverside landscape using locally native plant materials to create a naturalistic, aesthetically simple and understated landscape. All proposed planting including seed mixes selected from the “Landscape Restoration Plant Lists” developed and provided by the Department of Conservation & Recreation (DCR) Charles River Basin Riverbank Vegetation Management Plan, and / or the “The Vascular Plans of Massachusetts, a County Checklist” first edition. Much of landscape ground plan is proposed to be renovated with either low maintenance lawn seed or a naturalizing woodland seed mix, in order to maintain the open character and visibility to the river. Shade and understory trees as well as new foundation plantings are proposed in areas that are better protected from the stresses associated with the very heavily trafficked adjacent bike path and streetscape.

The pier has reached the end of its service life and is in need of replacement and the interior and exterior of the boathouse need to be renovated.  This is typical with this type of structure in this location.  Repairs have been performed over the life of the structure with the last set of repairs completed in 1980 and temporary pier repairs completed in 2019.

**Alternatives Analysis**

Alternatives were reviewed as part of the design process:
<u>Take no action</u>: This would continue to allow the structure and upland area to deteriorate and become a safety hazard that the goal of the project is to prevent, due to this it was not considered. The existing adjacent structure would remain in both the riverfront area waterfront area and stormwater would continue to run directly off into the river.

Repair the piles with encasements with minimal upland alteration: This would provide strength and protection to the piles but the superstructure would still need to be rebuilt. The upland areas would be left alone. This is a feasible option, however there would still need to be more repairs done at a later date and the size of the encasement creates a larger footprint than new piles. It would also leave the 1960's building in place rather than opening up the area, and it would leave the landscape with issues that would still need to be addressed in the short-term. While the impacts of replacing the above water component of the structure would have minimal impacts with no expansion of the structure there would be no improvements to the riverfront area and would likely just fall under maintenance of an existing waterfront structure.

Repair the piles with encasements with some upland alteration: This would provide strength and protection to the piles but the superstructure would still need to be rebuilt. The upland areas would be most left in place with minor stormwater upgrades but the existing building would still be removed and the replacement racks installed perpendicular the river. This is a feasible option, however there would still need to be more repairs done at a later date and the size of the encasement creates a larger footprint than new piles. The best option for the orientation of the covered boat racks is to have them perpendicular to the river and this better optimizes the amount of room they take up. This orientation however causes more impacts closer to the river and require more filling to increase the height of the racks above the FEMA 100yr Flood level, and therefore would increase the amount of flood storage area lost. Overall, this would provide a significant ratio for the minimal restoration within the riverfront area and the creation of a vegetative swale would help meet stormwater requirements, but larger areas in the buffer zone would remain unchanged and roof runoff would not change or be improved. It would meet 10.58(5)(f) and (g) due to the removal of the building and regrading and seeding in that area. No new dock structure would be built so the minimal restoration would be acceptable due to the building removal.

Replace the main structure in-kind, add additional pier, and update the landscape: The is the current plan as described above. This was selected over the encasements as it has a smaller pile footprint and will provide better longevity and an overall better final product. The addition of the dock in the area where the training facility will be removed allows much safer access for visiting teams to get their boats onto the water and will be able to do it without having to swing around over the bike path and road, and access that is accessible to the dock. It also allows the area to provide safer and more inviting landscaping with better stormwater management. The current building in the riverfront and waterfront areas would be removed and 2 smaller replacement covered boat racks would be placed further back than from the river and out of the riverfront area. It should also be noted that there were many conversations with DCR, the property owner, about the placement of the replacement boat rack location and the existing locations were chosen to get them back as far as possible from the river, with minimizing the impact to the existing trees, and allowing for safe vehicular and pedestrian access. While there are increase in the structure in the riverfront area to allow for accessible and safer access, the proposed work provides over a 13:1 ratio for the restoration vs alteration. As detailed above with infiltration, vegetative swales, and bioretention basins the stormwater has much improved infiltration, retention and treatment, and the majority of Riverfront Area has either low maintenance lawn or a woodland seed mix to reduce runoff and mitigate erosion.

## 3.0 ANTICIPATED IMPACTS AND MITIGATION MEASURES

**Resource Areas and Anticipated Impacts**
<u>Bank</u>

**A Bank is defined in 310 CMR 10.54(2) as:**
*(a) A Bank is the portion of the land surface which normally abuts and confines a water body. It occurs between a water body and a vegetated bordering wetland and adjacent flood plain, or, in the absence of these, it occurs between a water body and an upland. A Bank may be partially or totally vegetated, or it may be comprised of exposed soil, gravel or stone.*
*(b) The physical characteristics of a Bank, as well as its location, as described in 310 CMR 10.54(2)(a), are critical to the protection of the interests specified in 310 CMR 10.54(1).*
*(c) The upper boundary of a Bank is the first observable break in the slope or the mean annual flood level, whichever is lower. The lower boundary of a Bank is the mean annual low flow level.*

**The general performance standards for Bank are defined in 310 CMR 10.54(4) as:**
*(4) General Performance Standard.*
*(a) Where the presumption set forth in 310 CMR 10.54(3) is not overcome, any proposed*
*work on a Bank shall not impair the following:*
*1. the physical stability of the Bank;*
*2. the water carrying capacity of the existing channel within the Bank;*
*3. ground water and surface water quality;*
*4. the capacity of the Bank to provide breeding habitat, escape cover and food for fisheries;*
*5. the capacity of the Bank to provide important wildlife habitat functions. A project or projects on a single lot, for which Notice(s) of Intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 50 feet (whichever is less) of the length of the bank found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. In the case of a bank of a river or an intermittent stream, the impact shall be measured on each side of the stream or river. Additional alterations beyond the above threshold may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures contained in 310 CMR 10.60.*

The proposed repairs will not permanently alter the bank since the repairs will be made within the water and in the same footprint of the pier and will not change the overall footprint of the structure, additionally:
(1) The project will not impair the physical stability of the bank as the existing piles will be left in place and cut off at the mudline so not to cause stability issues and any tree removed along the bank will not have their stumps ground down;
(2) The project will not impair the water carrying capacity of the Charles River, as the number of piles will not be increased over the existing and the bank will not be significantly modified, other than a retaining wall in the area of the access pier;
(3) The project will not impair the ground and surface water quality, as no significant changes are being made to the footprint or impacts from the existing structure, but improvement are being made to the stormwater and retention so this should be increased;

(4) The repairs will not impair the capacity of the bank to provide breeding habitat, escape cover, and food for fisheries, as it will remain similar other that a small section where the access pier connects to the land;
(5) The repairs will not impair of the capacity of the bank to provide important wildlife functions, as it will remain similar other that a small section where the access pier connects to the land, see the attached wildlife habitat assessment;
(6) The repairs are not near a stream crossing;
The project site is not located within an estimated habitat of rare wildlife so it will not adversely affect this resource area.

<u>Bordering Land Subject to Flooding (BLSF)</u>

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

**The general performance standards for BLSF are defined in 310 CMR 10.57(4) as:**
*(4) General Performance Standards.*
*(a) Bordering Land Subject to Flooding.*
*1. Compensatory storage shall be provided for all flood storage volume that will be lost as the result of a proposed project within Bordering Land Subject to Flooding, when in the judgment of the issuing authority said loss will cause an increase or will contribute incrementally to an increase in the horizontal extent and level of flood waters during peak flows.*
*Compensatory storage shall mean a volume not previously used for flood storage and shall be incrementally equal to the theoretical volume of flood water at each elevation, up to and including the 100-year flood elevation, which would be displaced by the proposed project. Such compensatory volume shall have an unrestricted hydraulic connection to the same waterway or water body. Further, with respect to waterways, such compensatory volume shall be provided within the same reach of the river, stream or creek.*
*2. Work within Bordering Land Subject to Flooding, including that work required to provide the above-specified compensatory storage, shall not restrict flows so as to cause an increase in flood stage or velocity.*
*3. Work in those portions of bordering land subject to flooding found to be significant to the protection of wildlife habitat shall not impair its capacity to provide important wildlife habitat functions. Except for work which would adversely affect vernal pool habitat, a project or projects on a single lot, for which Notice(s) of Intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 5,000 square feet (whichever is less) of land in this resource area found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. Additional alterations beyond the above threshold, or altering vernal pool habitat, may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures contained in 310 CMR 10.60.*

1. The proposed project will not significantly alter the storage capacity of the Charles River basin, as there is grading being done inside of the flood zone mostly to improve the water quality into the Charles, with the additional vegetated swale, infiltration trenches, and bioretention basin, as well as to elevate the

adjacent covered boat racks above the 100 year flood elevation. The rest of the repairs are being done as a mostly in-kind replacement and an additional access pier. Figures 1 and 2 at the end of this section illustrate the cut and fill. The loss of flood storage has been mitigated against as much as possible with the addition of the vegetated swale but with the goal to keep the boat storage above the flood plain and adding a bioretention basin any more grading to remove material would likely be detrimental to the existing bank. In addition we have included mitigation measure as discussed under stormwater to clear and reduce the discharges during storm events. Even though it appear to be a large increase in impervious area the CN value only increased from 84 to 85 due to is being a gravel road currently but now that asphalt area is able to capture the stormwater in the infiltration system prior to its release to the river.

2. The work shall not increase the velocity of the water or further restrict flows as the structure is mostly being replaced in-kind using less that the total number of existing piles.
3. The grading for the bioretention basin and boat racks should have no adverse effects on wildlife habitats, and the revitalized landscape but due to the area exceeding 5,000SF a Habitat Assessment is included at the end of this section.
4. It should also be noted that the Charles River is dam controlled at this project site.
5. At the end of this section there are two figures illustrating the impact of the cut and fill at the site.

<u>Riverfront Area</u>

**A Riverfront Area is defined in 310 CMR 10.58(3) as:**
*A Riverfront Area is the area of land between a river's mean annual high water line and a parallel line measured horizontally. The riverfront area may include or overlap other resource areas or their buffer zones. The riverfront area does not have a buffer zone.*

**The general performance standards for Riverfront Area are defined in 310 CMR 10.58(4) as:**
*(4) General Performance Standard.*
*Where the presumption set forth in 310 CMR 10.58(3) is not overcome, the applicant shall prove by a preponderance of the evidence that there are no practicable and substantially equivalent economic alternatives to the proposed project with less adverse effects on the interests identified in M.G.L. c.131 § 40 and that the work, including proposed mitigation, will have no significant adverse impact on the riverfront area to protect the interests identified in M.G.L. c. 131 § 40. In the event that the presumption is partially overcome, the issuing authority shall make a written determination setting forth its grounds in the Order of Conditions and the partial rebuttal shall be taken into account in the application of 310 CMR 10.58 (4)(d)1.a. and c.; the issuing authority shall impose conditions in the Order that contribute to the protection of interests for which the riverfront area is significant.*
*(a) Protection of Other Resource Areas. The work shall meet the performance standards for all other resource areas within the riverfront area, as identified in 310 CMR 10.30 (Coastal Bank), 10.32 (Salt Marsh), 10.55 (Bordering Vegetated Wetland), and 10.57 (Land Subject to Flooding). When work in the riverfront area is also within the buffer zone to another resource area, the performance standards for the riverfront area shall contribute to the protection of the interests of M.G.L. c. 131, § 40 in lieu of any additional*

*requirements that might otherwise be imposed on work in the buffer zone within the riverfront area.*
*(b) Protection of Rare Species. No project may be permitted within the riverfront area which will have any adverse effect on specified habitat sites of rare wetland or upland, vertebrate or invertebrate species, as identified by the procedures established under 310 CMR 10.59 or 10.37, or which will have any adverse effect on vernal pool habitat certified prior to the filing of the Notice of Intent.*
*(c) Practicable and Substantially Equivalent Economic Alternatives. There must be no practicable and substantially equivalent economic alternative to the proposed project with less adverse effects on the interests identified in M.G.L. c. 131 § 40.*

The proposed repairs will not significantly permanently alter the riverfront area. The proposed repairs to the dock will mostly be within the same footprint and only the additional access pier will be added in this area once the smaller building is removed. The planned building to be removed is significantly within the riverfront area and the proposed replacement covered boat racks will not be in the riverfront area. There will be a small swale graded in the riverfront area to enable the stormwater to more naturally flow back to the river. Most of the impacts in these area relate to the reseeding with a woodland seed mix as shown on the Bioengineering plans, additionally:
(a) The proposed repairs meet the performance standards of the bank located within the riverfront area;
(b) The project site is not located within an estimated habitat of rare wildlife so it will not adversely affect this resource area;
(c) There is no practicable and substantially equivalent economic alternative to the proposed project with less adverse on the resource area as described in the alternatives analysis above.

*<u>(5) Redevelopment Within Previously Developed Riverfront Areas; Restoration and Mitigation</u>*
*Notwithstanding the provisions of 310 CMR 10.58(4)(c) and (d), the issuing authority may allow work to redevelop a previously developed riverfront area, provided the proposed work improves existing conditions. Redevelopment means replacement, rehabilitation or expansion of existing structures, improvement of existing roads, or reuse of degraded or previously developed areas.*
*A previously developed riverfront area contains areas degraded prior to August 7, 1996 by impervious surfaces from existing structures or pavement, absence of topsoil, junkyards, or abandoned dumping grounds. Work to redevelop previously developed riverfront areas shall conform to the following criteria:*
*(a) At a minimum, proposed work shall result in an improvement over existing conditions of the capacity of the riverfront area to protect the interests identified in M.G.L. c. 131 § 40. When a lot is previously developed but no portion of the riverfront area is degraded, the requirements of 310 CMR 10.58(4) shall be met.*
*(b) Stormwater management is provided according to standards established by the Department.*
*(c) Within 200 foot riverfront areas, proposed work shall not be located closer to the river than existing conditions or 100 feet, whichever is less, or not closer than existing conditions within 25 foot riverfront areas, except in accordance with 310 CMR 10.58(5)(f) or (g).*

*(d) Proposed work, including expansion of existing structures, shall be located outside the riverfront area or toward the riverfront area boundary and away from the river, except in accordance with 310 CMR 10.58(5)(f) or (g).*
*(e) The area of proposed work shall not exceed the amount of degraded area, provided that the proposed work may alter up to 10% if the degraded area is less than 10% of the riverfront area, except in accordance with 310 CMR 10.58(5)(f) or (g).*
*(f) When an applicant proposes restoration on-site of degraded riverfront area, alteration may be allowed notwithstanding the criteria of 310 CMR 10.58(5)(c), (d), and (e) at a ratio in square feet of at least 1:1 of restored area to area of alteration not conforming to the criteria. Areas immediately along the river shall be selected for restoration. Alteration not conforming to the criteria shall begin at the riverfront area boundary. Restoration shall include:*
*1. removal of all debris, but retaining any trees or other mature vegetation;*
*2. grading to a topography which reduces runoff and increases infiltration;*
*3. coverage by topsoil at a depth consistent with natural conditions at the site; and*
*4. seeding and planting with an erosion control seed mixture, followed by plantings of herbaceous and woody species appropriate to the site;*
*(g) When an applicant proposes mitigation either on-site or in the riverfront area within the same general area of the river basin, alteration may be allowed notwithstanding the criteria of 310 CMR 10.58(5)(c), (d), or (e) at a ratio in square feet of at least 2:1 of mitigation area to area of alteration not conforming to the criteria or an equivalent level of environmental protection where square footage is not a relevant measure. Alteration not conforming to the criteria shall begin at the riverfront area boundary. Mitigation may include off-site restoration of riverfront areas, conservation restrictions under M.G.L. c. 184, §§ 31 through 33 to preserve undisturbed riverfront areas that could be otherwise altered under 310 CMR 10.00, the purchase of development rights within the riverfront area, the restoration of bordering vegetated wetland, projects to remedy an existing adverse impact on the interests identified in M.G.L. c. 131, § 40 for which the applicant is not legally responsible, or similar activities undertaken voluntarily by the applicant which will support a determination by the issuing authority of no significant adverse impact. Preference shall be given to potential mitigation projects, if any, identified in a River Basin Plan approved by the Secretary of the Executive Office of Energy and Environmental Affairs.*
*(h) The issuing authority shall include a continuing condition in the Certificate of Compliance for projects under 310 CMR 10.58(5)(f) or (g) prohibiting further alteration within the restoration or mitigation area, except as may be required to maintain the area in its restored or mitigated condition. Prior to requesting the issuance of the Certificate of Compliance, the applicant shall demonstrate the restoration or mitigation has been successfully completed for at least two growing seasons.*

The proposed renovations meet the performance standards of 310 CMR 10.58 (5) due to the following reasons:
(a) The riverfront area is being improved with the removal of an existing structure that is partially in the Riverfront Area, the addition of a vegetated swale, and the planting of woodland seed mix over the majority of the area.
(b) Stormwater management is being provided according to the Departments standards, see the narrative below and the attached Stormwater Report.
(c) See responses to (f) and (g) below.
(d) See responses to (f) and (g) below.
(e) See responses to (f) and (g) below.

(f) For the total Riverfront area for the project (14,887 SF), 9,435 SF is restoration and stormwater improvements, and 685 SF is for the addition of the accessible pier. The restoration activities include protecting mature trees and providing treatments including pruning as recommended by a certified arborist, providing low maintenance lawn and woodland seed mix areas, as well as a vegetated swale to mitigate runoff and provide erosion control.
(g) See response to (f) above. The ratio of restoration to mitigation exceed 13:1, providing much great restoration that required.
(h) Further details of the ongoing maintenance can be found in the Stormwater Report O&M plan.

Land Under Water Bodies and Waterways (LUW)

**Land Under Water Bodies and Waterways is defined in 310 CMR 10.56(2) as:**
*Land beneath any creek, river, stream, pond or lake. The boundary of Land under Water Bodies and Waterways is the mean annual low water level.*

**The general performance standards for LUW are defined in 310 CMR 10.56(4) as:**
*(4) General Performance Standards.*
*(a) Where the presumption set forth in 310 CMR 10.56(3) is not overcome, any proposed work within Land under Water Bodies and Waterways shall not impair the following:*
*1. The water carrying capacity within the defined channel, which is provided by said land in conjunction with the banks;*
*2. Ground and surface water quality;*
*3. The capacity of said land to provide breeding habitat, escape cover and food for fisheries; and*
*4. The capacity of said land to provide important wildlife habitat functions. A project or projects on a single lot, for which Notice(s) of intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 5,000 square feet (whichever is less) of land in this resource area found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. Additional alterations beyond the above threshold may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures established under 310 CMR 10.60.*
*5. Work on a stream crossing shall be presumed to meet the performance standard set forth in 310 CMR 10.56(4)(a) provided the work is performed in compliance with the Massachusetts Stream Crossing Standards by consisting of a span or embedded culvert in which, at a minimum, the bottom of a span structure or the upper surface of an embedded culvert is above the elevation of the top of the bank, and the structure spans the channel width by a minimum of 1.2 times the bankfull width. This presumption is rebuttable and may be overcome by the submittal of credible evidence from a competent source. Notwithstanding the requirements of 310 CMR 10.56(4)(a)4., the impact on Land under Water Bodies and Waterways caused by the installation of a stream crossing is exempt from the requirement to perform a habitat evaluation in accordance with the procedures established under 310 CMR 10.60.*
*(b) Notwithstanding the provisions of 310 CMR 10.56(4)(a), the issuing authority may issue an Order in accordance with M.G.L. c. 131, § 40 to maintain or improve boat channels within Land under Water Bodies and Waterways when said work is designed and carried out using the best practical measures so as to minimize adverse effects*

*such as the suspension or transport of pollutants, increases in turbidity, the smothering of bottom organisms, the accumulation of pollutants by organisms or the destruction of fisheries habitat or nutrient source areas. (c) Notwithstanding the provisions of 310 CMR 10.56(4)(a) or (b), no project may be permitted which will have any adverse effect on specified habitat sites of rare vertebrate or invertebrate species, as identified by procedures established under 310 CMR 10.59.*

The proposed repairs will not significantly permanently alter land under water bodies and waterways since the repairs are being performed with less piles than the existing pier, additionally:
(1) The repairs will not impair the water carrying capacity of the Charles River, as no significant changes are being made to the existing structure and the access pier and existing pier repairs to increase the number of piles over the existing;
(2) The repairs will not impair the ground and surface water quality, as the structure is being rebuilt in-kind and additional runoff features such as the bioretention basin, swale, and infiltration have been implemented.
(3) The repairs will not impair the capacity of the bank to provide breeding habitat, escape cover, and food for fisheries, as the bank is not being significantly altered as part of the project;
(4) The repairs will not impair of the capacity of the bank to provide important wildlife functions as the bank is not being significantly altered as part of the project;
(5) The repairs are not near a stream crossing;
The project site is not located within an estimated habitat of rare wildlife so it will not adversely affect this resource area.

<u>*Wildlife Habitat Evaluations (10.60)*</u>

*(1) Measuring Adverse Effects on Wildlife Habitat.*
*(a) To the extent that a proposed project on inland Banks, Land under Water, Riverfront Area, or Land Subject to Flooding will alter vernal pool habitat or will alter other wildlife habitat beyond the thresholds permitted under 310 CMR 10.54(4)(a)5., 10.56(4)(a)4., 10.57(4)(a)3. and 10.58(4)(d)1., such alterations may be permitted only if they will have no adverse effects on wildlife habitat. Adverse effects on wildlife habitat mean the alteration of any habitat characteristic listed in 310 CMR 10.60(2), insofar as such alteration will, following two growing seasons of project completion and thereafter (or, if a project would eliminate trees, upon the maturity of replanted saplings) substantially reduce its capacity to provide the important wildlife habitat functions listed in 310 CMR 10.60(2). Such performance standard, however, shall not apply to the habitat of rare species, which are covered by the performance standards established under 310 CMR 10.59.*
*(b) An evaluation by the applicant of whether a proposed project will have an adverse effect on wildlife habitat beyond permissible thresholds shall be performed by an individual with at least a masters degree in wildlife biology or ecological science from an accredited college or university, or other competent professional with at least two years experience in wildlife habitat evaluation.*
*(c) Any wildlife habitat management practices conducted by the Division of Fisheries and Wildlife, and any wildlife management practices of any individual or organization if reviewed and approved in writing by said Division, shall be presumed to have no adverse effect on wildlife habitat. Such presumption is rebuttable, and may be overcome by a clear showing to the contrary*

*(2) Wildlife Habitat Characteristics of Inland Resource Areas.*
*(a) Banks. The topography, soil structure, and plant community composition and structure of banks can provide the following important wildlife habitat functions:*
*1. Food, shelter and migratory and breeding areas for wildlife*
*2. Overwintering areas for mammals and reptiles.*
*(b) Land under Water Bodies or Waterways. The plant community and soil composition and structure, hydrologic regime, topography and water quality of land under water bodies or waterways can provide the following important wildlife habitat functions:*
*1. Food, shelter and breeding areas for wildlife;*
*2. Overwintering areas for mammals, reptiles and amphibians.*
*(c) Vernal Pool Habitat. The topography, soil structure, plant community composition and structure, and hydrologic regime of vernal pool habitat can provide the following important twildlife habitat functions:*
*1. Food, shelter, migratory and breeding areas, and overwintering areas for amphibians;*
*2. Food for other wildlife.*
*(d) Lower Floodplains. The hydrologic regime, plant community and soil composition and structure, topography, and proximity to water bodies and waterways of lower floodplains can provide the following important wildlife habitat functions:*
*1. Food, shelter, migratory and overwintering areas for wildlife;*
*2. Breeding areas for birds, mammals and reptiles.*
*(e) Riverfront Area. The topography, soil structure, plant community composition and structure, and hydrologic regime can provide the following important wildlife habitat functions:*
*1. Food, shelter, overwintering and breeding areas for wildlife, including turtle nesting areas, nesting sites for birds which typically reuse specific nesting sites, cavity trees, and isolated depressions that function as vernal pools.*
*2. Migratory areas along the riparian corridor including the movement of wildlife unimpeded by barriers within the riverfront area.*
*(3) Restoration and Replication of Altered Habitat. Alterations of wildlife habitat characteristics beyond permissible thresholds may be restored onsite or replicated offsite in accordance with the following general conditions, and any additional conditions the issuing authority deems necessary to insure that the standard in 310 CMR 10.60(1)(a) is satisfied:*
*(a) the surface of the replacement area to be created ("the replacement area") shall be equal to that of the area that will be lost ("the lost area");*
*(b) the elevation of groundwater relative to the surface of the replacement area shall be approximately equal to that of the lost area;*
*(c) the replacement area shall be located within the same general area as the lost area. In the case of banks and land under water, the replacement area shall be located on the same water body or waterway if the latter has not been rechanneled or otherwise relocated. In the case of bordering land subject to flooding, the replacement area shall be located approximately the same distance from the water body or waterway as the lost area. In the case of vernal pool habitat, the replacement area shall be located in close proximity to the lost area;*
*(d) interspersion and diversity of vegetation, water and other wildlife habitat characteristics of the replacement area, as well as its location relative to neighboring wildlife habitats, shall be similar to that of the lost areas, insofar as necessary to maintain the wildlife habitat functions of the lost area;*
*(e) the project shall not alter ten or more acres of Land Subject to Flooding or Land under Water found to be significant to the protection of wildlife habitat, or 2,000 feet or*

*more of Bank found to be significant to the protection of wildlife habitat (in the case of a bank of a stream or river, this shall be measured on each side of said stream or river).*
*(f) if the replacement area is located in an area subject to M.G.L. c. 131, § 40, there shall be no adverse effect on the existing important wildlife habitat functions of said area as measured by the standards of 310 CMR 10.60;*
*(g) the "thresholds" established in 310 CMR 10.54(4)(a)5., 10.56(4)(a)4., 10.57(4)(a)3. And 10.58(4)(d)1.c. (below which alterations of resource areas are not deemed to impair capacity to provide important wildlife habitat functions) shall not apply to any replacement area; and*
*(h) the replacement area shall be provided in a manner which is consistent with all other General Performance Standards for each resource area in 310 CMR 10.51 through 10.60.*

**Wildlife Habitat Evaluation**
Below is a summary of the WHE full details, including the Appendix A, can be found at the end of this attachment.

<u>Introduction</u>

This WHE evaluation is performed pursuant to 310 CMR 10.57 and 10.60. Per 310 CM R 10.57(4)(a)(3), "Work in those portions of bordering land subject to flooding found to b e significant to the protection of wildlife habitat shall not impair its capacity to provide important wildlife habitat functions.
The Appendix A WHE form, found in the Massachusetts Wildlife Habitat Protection Guidance for Inland Wetlands document is the simplified evaluation that documents the presence of "important wildlife habitat features." Without these features, it may be presumed that important wildlife habitat functions are likely to not be present.
Per 310 CMR 10.60(1)(a), alterations may be permitted "only if they will have no adverse effects on wildlife habitat. Further, "Adverse effects on wildlife habitat mean the alteration of any habitat characteristic listedin 310 CMR 10.60(2)." Appendix A was crea ted to assist the reviewer in recognizing the habitat characteristic found in 310 CMR 10.60(2), as well as to determine base regulatory conditions that may lead to a determination of 'significant' or 'no significant' habitat features on-site. For example, whether or not habitats or rare wildlife are present.

<u>Evaluation</u>
The attached Appendix A Wildlife Habitat Evaluation form has no boxes checked. As such, no Important Habitat Features were observed on the subject Property. Further,

- No habitats of rare or endangered species occur on-site, and
- The Property is not within an area mapped as "Habitat of Potential Regional or Statewide Importance".
- The proposed alteration to BLSF is not twice the size of thresholds. The threshold for BLSF alteration, per 310 CMR 10.57(4)(a)(3), is 10% or 5,000 square feet (whichever is less) of land presumed significant to wildlife habitat. In this case, the total amount of BLSF on-site is +17,215 square feet.
- The maximum amount of fill (without taking a cut into consideration) proposed is 2,650 square feet. Therefore, alterations are not twice the size of thresholds.
- The total amount of bank of the Charles River to be altered exceeds 50 feet per 310 CMR 10.54(4)(a)5. However, based on the lack of important

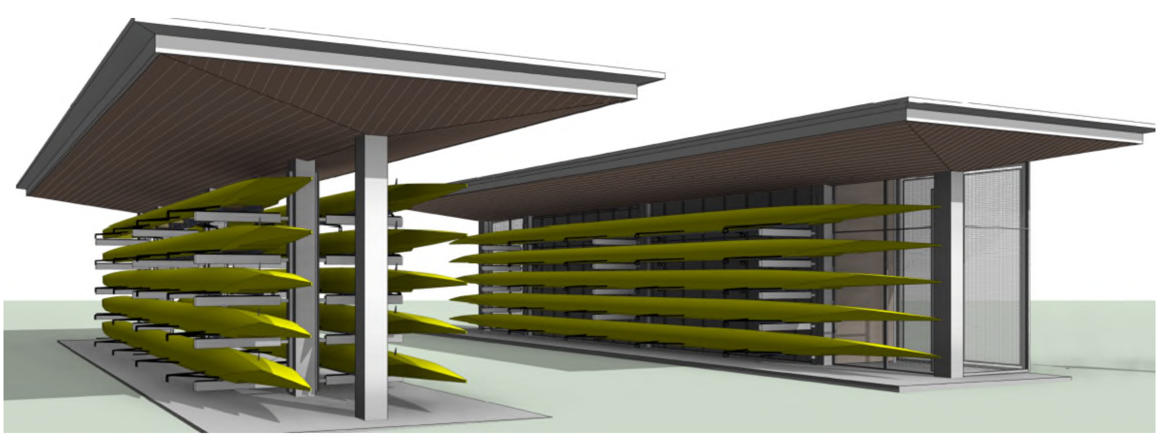
habitat features on-site leads to the conclusion that there will be no adverse impacts to wildlife habitat associated with bank.

Waterfront Area and Buffer Zone

Per the Boston Conservation Commission Local Ordinance: *The Buffer Zone is presumed important to the protection of the resource areas because activities undertaken in close proximity to resource areas have a reasonable probability of adverse impact upon the wetland or other resource, either immediately, as a consequence of construction, or over time, as a consequence of daily operation or existence of the activities. These adverse impacts from construction and use can include, without limitation, erosion, siltation, loss of groundwater recharge, degraded water quality, loss of wildlife habitat, degradation of wetland plant habitat, alteration of hydrology, soil contamination, and proliferation of invasive plants.*
*The Commission therefore may require that any person filing an application (hereinafter, the Applicant) restore or maintain a strip of continuous, undisturbed or restored vegetative cover or waterfront public access throughout the Waterfront Area, unless the Commission determines, based on adequate evidence, that the area or part of it may be altered without harm to the values of the resource areas protected by the Ordinance. Such disturbed areas must be minimized to the greatest extent possible.*

Waterfront Area

The existing building and ramps in the waterfront area will be demolished and replacement covered boat racks will be installed in their place. The new racks will be place further back from the river and have a reduced footprint. For example, the current building has 402 SF in the Riverfront Area and 958 SF in the Waterfront Area, whereas the covered area for the mostly open boat racks would only be 590 SF in the Waterfront Area and be out of the Riverfront Area. A rendering of the covered boat racks is shown below. With removal of the existing block structure and the six 75' long by 24" high timber boat ramps, that span from the river to 25 feet past the waterfront zone, both the waterfront and riverfront areas will be opened up. The removal of these structures, and the replacement with the more open racks and restoration of the riverfront area allows for a much more continuous strip with better public access to the waterfront with materials that are better suited to the various uses.



*Rendering of the Covered Boat Racks*

Buffer Zone

The buffer zone area will continue to be a pervious area, the above-mentioned existing building is predominantly in the buffer zone and the replacement racks will also be predominantly in the buffer zone. However, both these areas now have infiltration trenches, to help better manage water runoff and quality. On the east side of the building the buffer zone is mostly compromised of the bio retention basin to also aid with stormwater runoff and quality. The reinforced gravel will aid in preventing runoff and erosion of the materials during storm events and is much more suitable for the area that currently serves the same purpose. The bio-retention basin and low maintenance lawn areas will help significantly with improved infiltration, retention, and minimize the potential for erosion. The planting of these areas allows for the listed species to be planted and minimizes the proliferation of invasive plants. With the increased storage and treatment of the stormwater and the introduction of more suitable planting and grasses the whole site is much improved to provide a cleaner and slower release of stormwater back into the river compared to the existing site.

**Mitigation Measures**

One of the proposed mitigation measures to reduce impacts due to the construction activities will be to have the Contractor deploy a floating debris boom around the proposed repair areas.  This will prevent dispersal of debris material during construction work from migrating into the river.  Additionally, the contractor shall be required to have hazardous materials spill prevention and clean up kits available on site for any waterborne equipment. In the same manner the land based activities will also require a silt fence as shown on the plans, under the site prep notes.

It is anticipated that the contractor will stage the construction, including all equipment and materials, at the northwest area of the property adjacent to the building and parking lot.  We anticipate the contractor will use small work floats and a work skiff to stage the repairs and will remove all construction debris from the resource areas on a daily basis.

At the completion of the project, all construction equipment, material, and debris will be removed from the site.

**Stormwater**

This project consists of site improvements to an existing site development. Site improvements include new parking, sidewalks and boatsheds that will help improve accessibility to the river and help with boat storage. These developments will result in an increase of impervious area on site of approximately 11,700 SF. Due to this increase and significant exterior improvements throughout the site, the project will be classified as a “New Development” under the Massachusetts Stormwater Standards.

This project provides an opportunity to improve the quality of stormwater runoff that currently discharges to the Charles River with little to no treatment. This project will incorporate the installation of practical Best Management Practices (BMPs) that will demonstrate compliance with the State Stormwater Standards.

Existing Conditions
The existing site can be analyzed as two (2) watershed areas that contribute runoff to two (2) discharge points. Discharge Point 1 is the Charles River and Discharge Point 2 is Soldiers Field Road. Stormwater runoff travels via overland flow to these discharge points as indicated on the Figure 6 – Existing Watershed plan in the attached Stormwater Report.

Proposed Conditions
The proposed stormwater management analysis can be summarized as seven (7) watershed areas that contribute runoff to two (2) discharge points. The overall watershed area and discharge points of analysis are the same in the proposed condition as in the existing condition. To account for the proposed BMP's, some sections of the drainage areas are split up into smaller sub-watershed areas when compared to existing conditions. The proposed drainage areas are delineated in Figure 7 - Proposed Watershed Plan in the attached Stormwater Report. Five new stormwater Best Management Practices (BMPs), including a bioretention basin, three infiltration trenches and a subsurface basin, are proposed to meet peak rate attenuation as well as improve the quality of stormwater runoff into the Charles River and provide some recharge.

The peak flow rates were calculated for the 2-, 10-, 25- and 100-year storm events under proposed conditions and compared to the existing peak flow rates. There is a significant reduction in peak rates to DP-2 (Soldiers field Road). There is a decrease to peak rates to DP-1 (Charles River) for the 2-, 10- and 25-year storm events; however, there is a minor increase in peak flow rates for the 100-year storm event. The increase in peak rate for the 100-year storm event is 0.94 CFS, which is minimal give the large body of water the Charles River encompasses and should have no adverse impacts. Due to the close proximity of the site to the Charles River, the number of mature trees located throughout the site, existing utilities and minimal separation between the proposed ground elevation and the approximate seasonal high ground water level the ability to provide additional stormwater BMP's was not feasible. Refer to the attached Stormwater Report in the Appendix for the table of peak rates and more detailed information on compliance with the other State Standards.

Refer to the plans for more details on the bioengineered basins with seed mixes and planting. A Field Inspection checklist has also been included as part of this attachment.

## Floodplain

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) for the city of Boston FEMA Community Panel Map Number 25025C0057G was reviewed. As per review of the FIRM map, the project is located in Zone AE (EL. 4.0 in reference to NAVD88) of this resource area.

## Climate Change

One of the proposed mitigation measures to reduce impacts due to climate change is by increase the ability to treat and deal with stormwater runoff by the increase size of the retention basin and addition of infiltration units, this hopefully as the frequency of storms increases with climate change enable the stormwater to be held longer prior to reaching the river. The proposed site includes five new stormwater treatment practices that will collect, treat and infiltrate runoff (with the exception of the subsurface system which is lined) significantly improving not only the water quality runoff from the site, but also reducing peak rates. The site also has a significant reduction in peak rates to Soldiers Field Road, which has a closed drainage system; thereby helping with potential capacity issues in the future. The site was analyzed using the NOAA Atlas 14 rainfall events in the attached Stormwater Report.

The 2035 rainfall events for the 10-year and 100-year storm events were analyzed, the following is the updated peak rate information, which still shows a decrease in peak rates for the 10-year storms and a slight increase in peak rates for the 100-year storm for DP-1 (Charles River), which is in line with the current design. This shows that with an increased frequency of rainfall events, outside of major storms, that the proposed system will reduce the runoff back into the river for the present day and in the future.

Also runoff from the existing site currently sheet flows directly into the Charles River with little to no treatment. The proposed conditions will capture 92% of the impervious area on site and discharge to a combination of different stormwater treatment practices that will not only treat the runoff, but will reduce the runoff temperature through permeability of the runoff through these BMP's prior to overflowing into the Charles River. This is a significant improvement over existing conditions today.

When you look at both discharges together the total net discharge is reduced with the site improvements, while there is greater discharge for only the 100 yr storm directly into the river, there is more reduced flow into the closed system that ultimately also discharges into the same river above the dam. This reduction on the closed system allows for future increase.

In addition to the 54 existing trees (619± caliper inches) within the project lease area to be protected, a total of 28 trees (88± caliper inches) are proposed to be installed. Native large canopy shade trees American Elm and Red Maple are proposed within expanded landscape planting areas along Soldiers Field Road, the existing bike path and the proposed asphalt pavement, to help reduce the amount of direct runoff and provide more shading of the paved areas to reduce the heat island effect now and in the future.
The large existing building that is to be removed currently has a large black flat roof that will no longer be part of the project. Further, the flat black roof on the historic building to remain will be replaced with a white or light grey roof with an SRI of not less than 78, and the roofs of the sheds are proposed to be white or light grey.

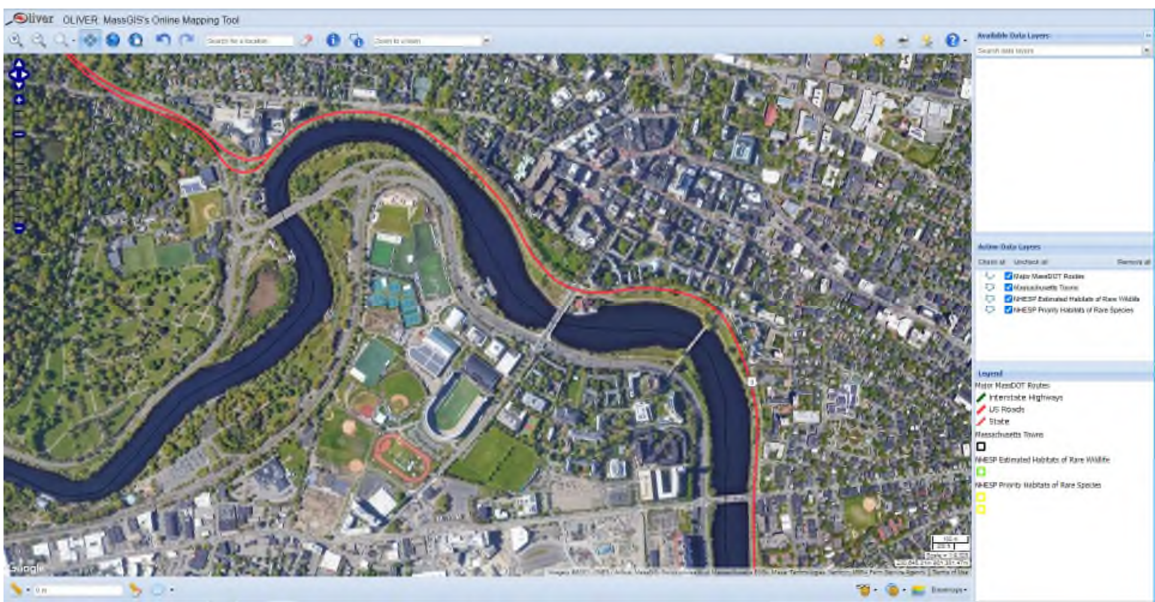
On the pier there is not a significant amount that can be done as the water elevation is controlled by the dam, but as can be seen by the drawings the elevation of the building and proposed structures is significantly higher than the floats on the river. In the future there is significant concern about the dam overtopping, however the building is at a higher elevation and the new plantings should provide a more stable bank.

## 4.0 FEE EXPLANATION

The proposed work is classified as work on a pier and therefore is *Category 5*. The category 5 pricing is based on the linear feet of the pier. The price per foot is $4. The fee is increased 50% due to repairs being within a Riverfront Area as well as another resource area (Bank). The area that is to be repaired is 180 linear feet. This means the fee is $4 x 180' x 1.50 = $834.00, plus $500 for Cat 2. The state fee is figured by dividing the total fee by 2 and subtracting $12.50, which is $777.50.

The Boston Conservation Commission does not accept the municipal portion of the NOI fee, they use a separate fee structure. The fee is determined by taking 0.075% of the fair project cost but not more than $1500. The estimated project cost is $1,500,000. This means the municipal portion of the fee is 0.075% x $1,500,000 = $1125.00. In addition for the Cat 5 180 LF x $4/LF= $720,plus $300 for Cat 2, therefore total fee = $2,145.

**<u>NHESP Map</u>**



**Site Photos**

Photo 1 – East side of the Boathouse

Photo 2 – Streetside looking northeast at the Boathouse

Photo 3 –Looking northwest away from the Boathouse

Photo 4 – Streetside looking northeast back towards the Boathouse on the bike path.

Photo 5 – Looking northwest from the top of the dock

Photo 6 – Looking east at the boathouse from the floats

GREEN INTERNATIONAL AFFILIATES, INC.
239 LITTLETON ROAD, SUITE 3 WESTFORD, MA 01886
TEL: (978) 923-0400 FAX: (978) 399-0033

# *MEMORANDUM*

| | |
|---|---|
| **To:** | Danielle Spicer, P.E. |
| **Cc:** | |
| **From:** | Brandon Faneuf, PWS |
| **Date:** | November 15, 2021 |
| **Project Name:** | Newell Boathouse; 801 Soldiers Field Road |
| **Project Number:** | Green No. 21030.0026 |
| **Subject:** | Wildlife Habitat Evaluation |

## Introduction

This memo is to act as a narrative to supplement the attached Appendix A Wildlife Habitat Evaluation (WHE). A WHE has been requested for requested fill volumes in Bordering Land Subject to Flooding (BLSF) for improvements to the property (Property) associated with the Newell Boathouse.

The WHE is performed pursuant to 310 CMR 10.60 using the document *Massachusetts Wildlife Habitat Protection Guidance for Inland Wetlands* (March 2006) by the Massachusetts Department of Environmental Protection.

## Wetland Resource Areas

There are three main wetland resource areas associated with the Property- Bank, Riverfront Area, and Bordering Land Subject to Flooding. All are closely related to the Charles River.

1. Bank- also the bankfull condition/mean annual high-water mark of the Charles River, is represented by flags 1 through 17 on the site plan.

2. Riverfront Area- in this case, flags 1 through 17 also represent the inner boundary of the 200’ Riverfront Area. The Riverfront Area extends perpendicularly from the flags without regard for topography.

3. Bordering Land Subject to Flooding- also known as the FEMA 100 year flood zone (aka floodplain, flood boundary), it is depicted on the site plans as being at elevation 10.46. BLSF boundaries are not flagged in the field.

A description of flagged wetland resource areas can be found below:

**Table 1. Wetland Resource Areas**

| Flag Series | Wetland Type | Approx. Location |
|---|---|---|
| 1-17 | Mean Annual High-Water line and Bank of the Charles River w/ associated 200' Riverfront Area | South / West bank of the Charles River |

## Other

The land below the mean annual low-water line associated with the Charles River is the Resource Area of **Land Under Waterbodies & Waterways (LUWW)**. LUWW is not delineated in the field.

A search of other critical resources within the project area were conducted using GIS software and data available through MASSGIS. The results of our search are listed in Table 2.

**Table 2. Selected MassGIS Environmental Data Layers**

| Mapped Resource On or Within Proximity to Site | Yes | No |
|---|---|---|
| Area of Critical Environmental Concern | | ✓ |
| NHESP Certified Vernal Pool | | ✓ |
| NHESP Potential Vernal Pool | | ✓ |
| NHESP Estimated Habitat of Rare Wildlife | | ✓ |
| NHESP Priority Habitat of Rare species | | ✓ |
| Outstanding Resource Waters | | ✓ |
| FEMA Flood Zones (BLSF) | ✓[1] | |
| Surface Water Protection Area | | ✓ |
| Interim Wellhead Protection Area | | ✓ |
| Zone II Wellhead Protection Area | | ✓ |
| Mass DCR Designated Coldwater Fisheries | | ✓ |
| Conservation Assessment and Prioritization Map | | ✓ |

1. The Charles River and immediate surrounding areas are located within FEMA Flood Zone.

## Wildlife Habitat Evaluation

*Introduction*

This WHE evaluation is performed pursuant to 310 CMR 10.57 and 10.60. Per 310 CMR 10.57(4)(a)(3), "Work in those portions of bordering land subject to flooding found to be significant to the protection of wildlife habitat shall not impair its capacity to provide important *wildlife habitat functions* [italics added for emphasis]. The Appendix A WHE form, found in the *Massachusetts Wildlife Habitat Protection Guidance for Inland Wetlands* document is the simplified evaluation that documents the presence of "important wildlife habitat features." Without these features, it may be presumed that important wildlife habitat functions are likely to not be present.

Per 310 CMR 10.60(1)(a), alterations may be permitted "only if they will have no adverse effects on wildlife habitat. Further, "Adverse effects on wildlife habitat mean the alteration of any habitat characteristic listed in 310 CMR 10.60(2)." Appendix A was created to assist the reviewer in recognizing the habitat characteristic found in 310 CMR 10.60(2), as well as to determine base regulatory conditions that may lead to a determination of 'significant' or 'no significant' habitat features on-site. For example, whether or not habitats or rare wildlife are present.

*Evaluation*
The attached Appendix A Wildlife Habitat Evaluation form has no boxes checked. As such, no Important Habitat Features were observed on the subject Property. Further,

- No habitats of rare or endangered species occur on-site, and
- The Property is *not* within an area mapped as "Habitat of Potential Regional or Statewide Importance" (see attached Figure 1).
- The proposed alteration to BLSF is *not* twice the size of thresholds. The threshold for BLSF alteration, per 310 CMR 10.57(4)(a)(3), is 10% or 5,000 square feet (whichever is less) of land presumed significant to wildlife habitat. In this case, the total amount of BLSF on-site is ±17,215 square feet. The maximum amount of fill (without taking a cut into consideration) proposed is 2,650 square feet. Therefore, alterations are not twice the size of thresholds.
- The total amount of bank of the Charles River to be altered exceeds 50 feet per 310 CMR 10.54(4)(a)5. However, based on the lack of important habitat features on-site leads to the conclusion that there will be no adverse impacts to wildlife habitat associated with bank.

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection – Wetlands program

# Wildlife Habitat Protection Guidance

**Appendix A: Simplified Wildlife Habitat Evaluation**

## Project Information

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

Newell Boathouse
Project Location (from NOI)

Brandon B. Faneuf, CWB — 11/15/2021
Name of Person Completing Form — Date

## Important Habitat Features

Direct alterations to the following important habitat features in resource areas may be permitted only if they will have no adverse effect (refer to Section V).

- ☐ Habitat for state-listed animal species (receipt of a positive opinion or permit from MNHESP shall be presumed to be correct. Do not refer to Section V).
- ☐ Sphagnum hummocks and pools suitable to serve as nesting habitat for four-toed salamanders
- ☐ Trees with large cavities (≥18" tree diameter at cavity entrance)
- ☐ Existing beaver, mink or otter dens
- ☐ Areas within 100 feet of existing beaver, mink or otter dens (if significant disturbance)
- ☐ Existing nest trees for birds that traditionally reuse nests (bald eagle, osprey, great blue heron)
- ☐ Land containing freshwater mussel beds
- ☐ Wetlands and waterbodies known to contain open water in winter with the capacity to serve as waterfowl winter habitat
- ☐ Turtle nesting areas
- ☐ Vertical sandy banks (bank swallows, rough-winged swallows or kingfishers)

The following habitat characteristics when not commonly encountered in the surrounding area:

- ☐ Stream bed riffle zones (e.g. in eastern MA)
- ☐ Springs
- ☐ Gravel stream bottoms (trout and salmon nesting substrate)
- ☐ Plunge pools (deep holes) in rivers or streams
- ☐ Medium to large, flat rock substrates in streams

# Wildlife Habitat Protection Guidance

**Appendix A: Simplified Wildlife Habitat Evaluation**

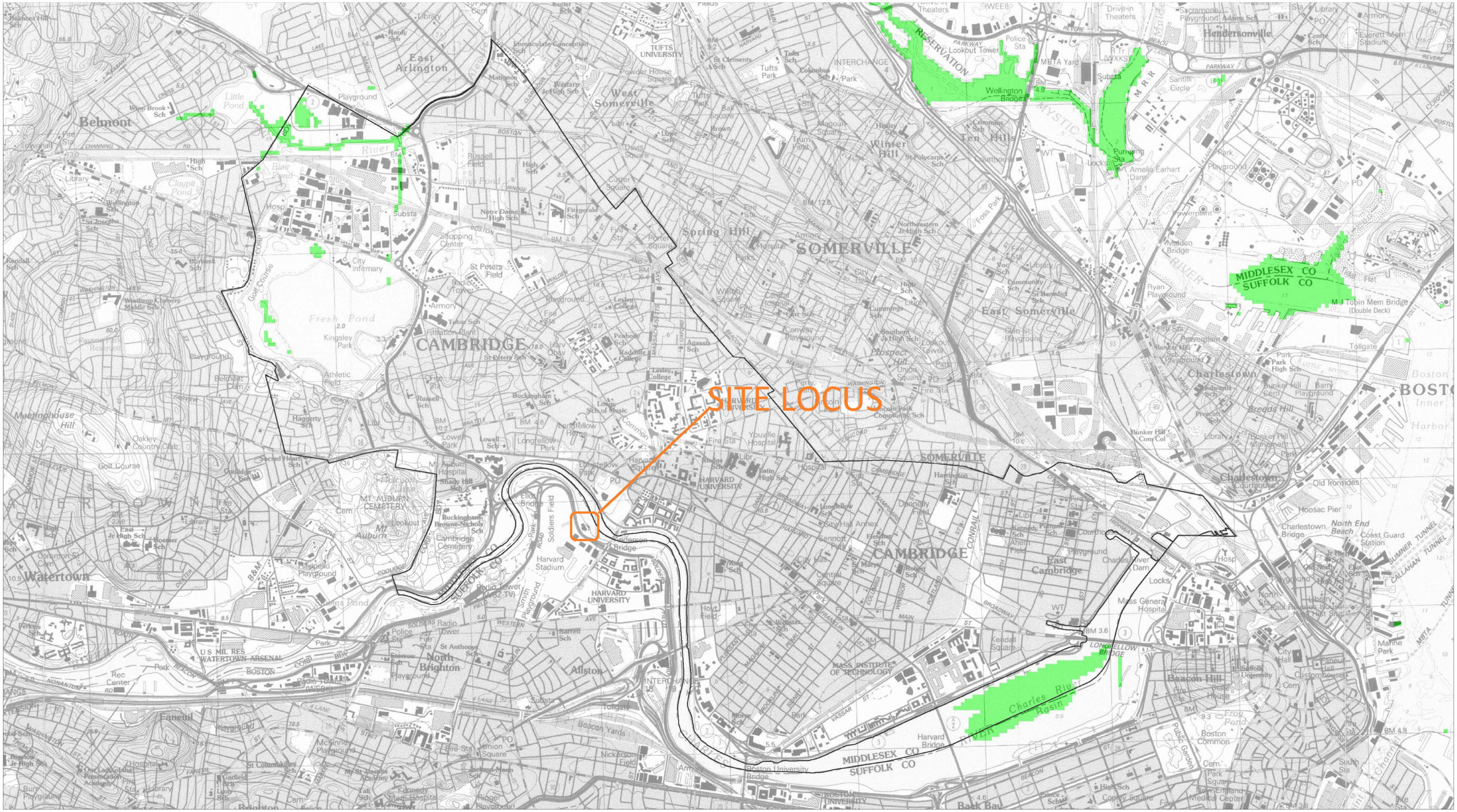
## Activities

When any one of the following activities is proposed within resource areas, applicants should complete a Detailed Wildlife Habitat Evaluation (refer to Appendix B).

- ☐ Activities located in mapped “Habitat of Potential Regional or Statewide Importance”
- ☐ Activities affecting certified or documented vernal pool habitat, including habitat within 100’ of a certified or documented vernal pool when within a resource area
- ☐ Activities in bank, land under water, bordering land subject to flooding (presumed significant) where alterations are more than twice the size of thresholds
- ☐ Activities affecting vegetated wetlands >5000 sq. ft. occurring in resource areas other than Bordering Vegetated Wetland
- ☐ Activities affecting the sole connector between habitats >50 acres in size
- ☐ Installation of structures that prevent animal movement
- ☐ Activities for the purpose of bank stabilization using hard structure solutions that significantly affect ability of stream channel to shift and meander, or disrupt continuity in cover that would inhibit animal passage
- ☐ Dredging (greater than 5,000 sf)

# Habitat of Potential Regional or Statewide Importance
# Town of CAMBRIDGE, MA

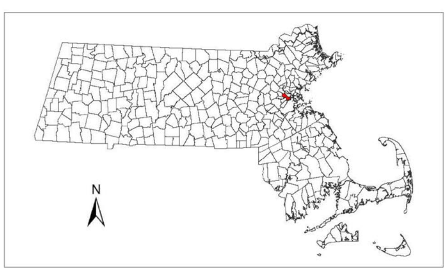
FIGURE 1




0 0.5 1 2 Miles

Important Wildlife Habitat

Updated November 2011




The MassDEP□s Massachusetts Wildlife Habitat Protection Guidance for Inland Wetlands, June 2006 adopted a new approach for assessing wildlife habitat impacts associated with work in wetlands. This approach utilizes maps developed at the University of Massachusetts Amherst using the Conservation Assessment and Prioritization System (CAPS). The maps depict □Habitat of Potential Regional or Statewide Importance□that may trigger more intensive levels of review. For more information on how to assess wildlife habitat impacts, see Section III of the Guidance document: http://www.mass.gov/dep/water/laws/wldhab.pdf.

The CAPS model assesses the ecological integrity of Massachusetts landscape features as influenced by environmental stressor metrics (e.g. pollution, fragmentation). CAPS relies on data that are broadly available across Massachusetts. Ecological features which are not consistently surveyed or uniformly available, such as certified vernal pools, rare species, and contamination sites are not included in CAPS. When available, this more specific ecological information may be used in conjunction with the CAPS outputs to better understand particular sites in Massachusetts and support informed conservation decision-making. For more information on the statewide maps produced by the CAPS model, see: http://www.masscaps.org.

These maps are funded in part by the Massachusetts Executive Office of Energy and Environmental Affairs, the Massachusetts Department of Environmental Protection and the U.S. Environmental Protection Agency under section 104 (b)(3) of the U.S. Clean Water Act. Environmental data sources include the Office of Geographic and Environmental Information (MassGIS).

MassDEP

UMass Extension
CENTER FOR AGRICULTURE

THE WILDLIFE SOCIETY

# The Wildlife Society

INCORPORATED IN WASHINGTON, D.C.

*grants the designation*

## Certified Wildlife Biologist

*to*

## Brandon B. Faneuf

*in recognition of fulfillment of all the professional requirements approved by The Wildlife Society and verified by the Society's Certification Review Board on this 14th day of October 2010. This certificate remains valid provided membership in the Society remains in good standing.*

President, The Wildlife Society

Chairman, Certification Review Board

Executive Director, The Wildlife Society


CHILDS ENGINEERING

34 WILLIAM WAY, BELLINGHAM, MA 02019 U.S.A.
Phone: (508) 966-9092 E-mail: mail@childseng.com

| Designed by: CMR | Date: 8/24/21 |
|---|---|
| Dwn by: TEQ / Ckd by: CMR | Design file no. 284318 LOCUS |
| Reviewed by: CMR | Scale: NONE |

NEWELL BOATHOUSE
CAMBRIDGE, MA

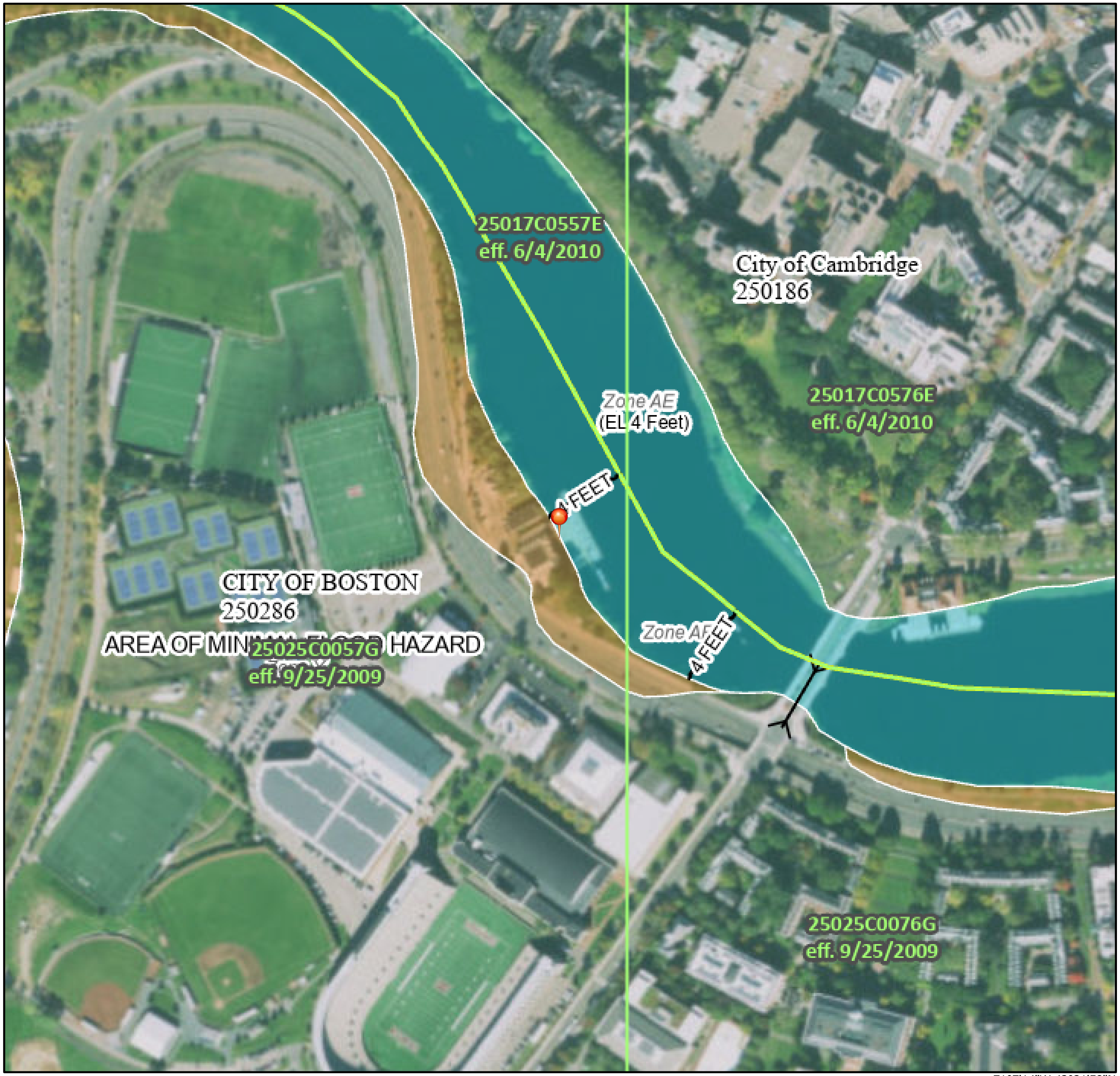
LOCUS MAP

Sheet reference number:
LOCUS
Sheet 1 of 1

# National Flood Hazard Layer FIRMette

FEMA

71°7'51"W 42°22'25"N




71°7'14"W 42°21'58"N

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

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 | B 20.2 / 17.5 | Cross Sections with 1% Annual Chance Water Surface Elevation |
| | 8 | Coastal Transect |
| | 513 | 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 |

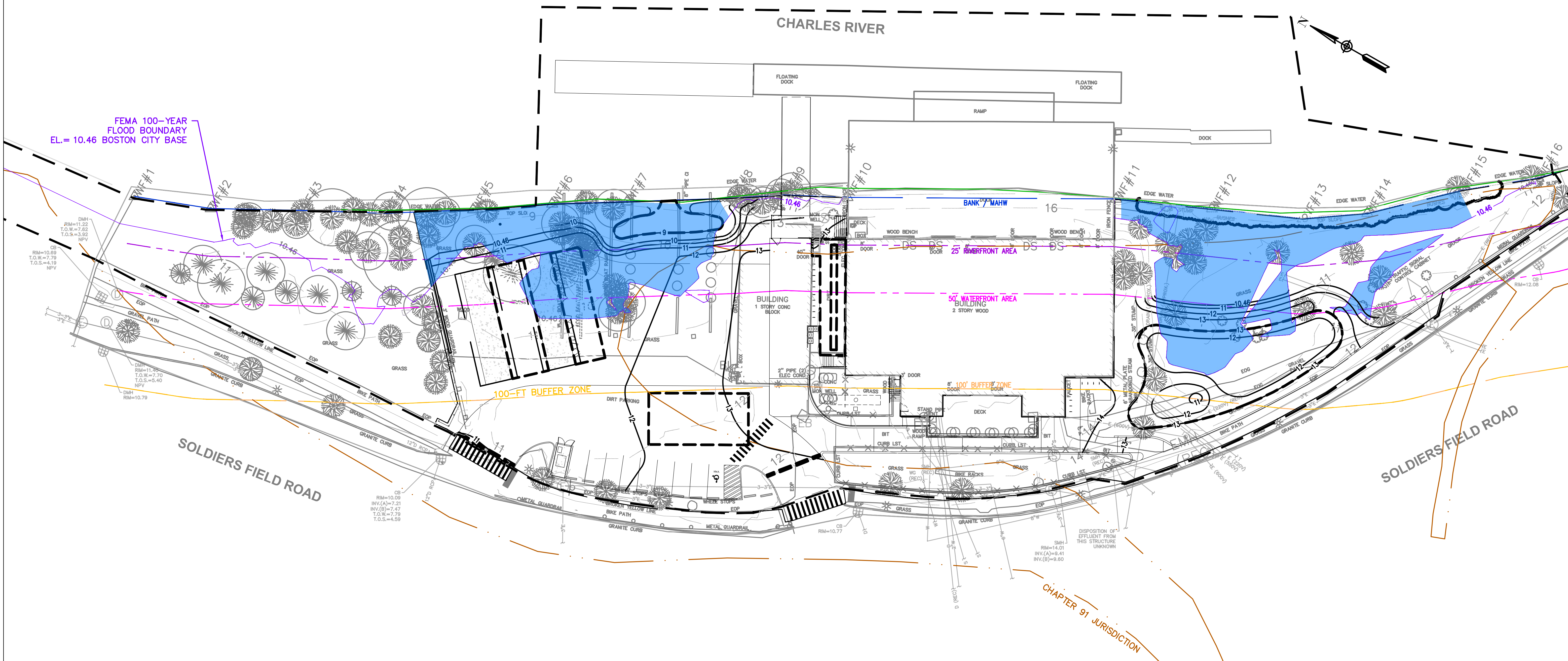
N

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 10/12/2021 at 6:47 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.




IMPACTED AREA WITHIN BLSF = 13,705 SF

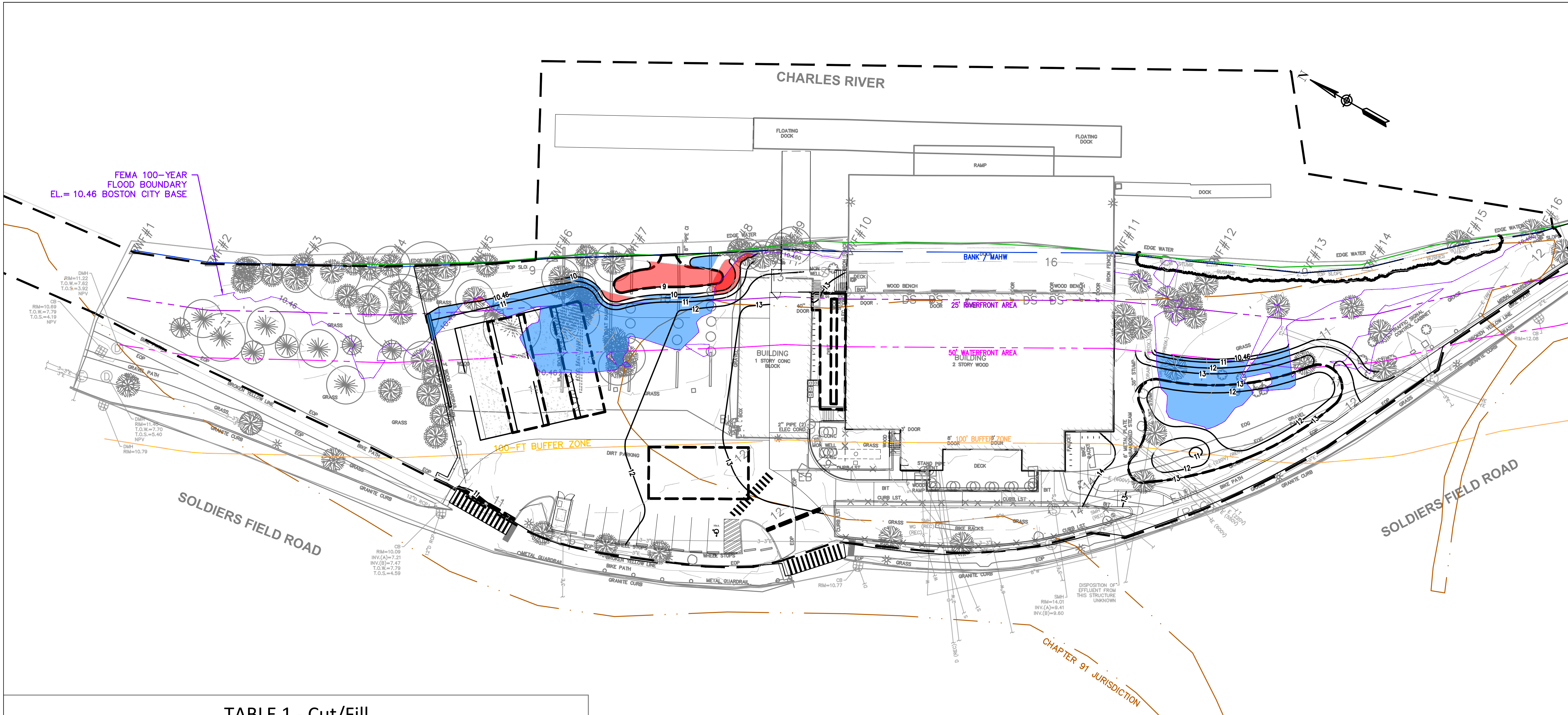
SCALE IN FEET
25 0 25 50
1" =50'

# BLSF IMPACT FIGURE

NEWELL BOATHOUSE
BOSTON, MASSACHUSETTS

| PREPARED BY: | PREPARED FOR: |
|---|---|
| **GREEN INTERNATIONAL AFFILIATES, INC.** CIVIL AND STRUCTURAL ENGINEERS 100 AMES POND DRIVE, TEWKSBURY, MA (978) 923-0400 24 ALBION RD, LINCOLN, RI (401) 305-7895 | **HARVARD UNIVERSITY ATHLETICS** 801 SOLDIER FIELD ROAD ALLSTON, MA 02134 |

| | | |
|---|---|---|
| SCALE: 1" = 50' | PROJECT NO. 21030 | FIGURE 1 |
| DATE: 3/30/2022 REVISED: | DRAWN BY: SB CHECKED BY: JT/DS | |




| TABLE 1 - Cut/Fill | | | |
|---|---|---|---|
| 100-yr Flood Elevation = 10.46 | | | |
| Elevation | Cut Volume (CF) | Fill Volume (CF) | Incremental Net Cut/Fill Volume (CF) |
| 8-9 | 283 | 38 | -245 |
| 9-10 | 375 | 94 | -281 |
| 10-10.46 | 80 | 1231 | 1151 |
| **Total** | 738 | 1363 | 625 |

LEGEND
CUT
FILL

SCALE IN FEET
25 0 25 50
1" =50'

FLOOD STORAGE CUT AND FILL

NEWELL BOATHOUSE
BOSTON, MASSACHUSETTS

PREPARED BY:
GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL AND STRUCTURAL ENGINEERS
100 AMES POND DRIVE, TEWKSBURY, MA (978) 923-0400
24 ALBION RD, LINCOLN, RI (401) 305-7895

PREPARED FOR:
HARVARD UNIVERSITY ATHLETICS
801 SOLDIER FIELD ROAD
ALLSTON, MA 02134

SCALE: 1" = 50'
PROJECT NO. 21030
DATE: 3/30/2022
REVISED:
DRAWN BY: SB
CHECKED BY: JT/DS

FIGURE 2

## EXISTING TREE SCHEDULE

| # | BOTANICAL NAME | COMMON NAME | NATIVE STATUS | JURISDICTION AREA | SIZE | COMMENTS |
|---|---|---|---|---|---|---|
| EXISTING TREES | | | | | | |
| N1 | ULMUS AMERICANA | AMERICAN ELM | N | W100 | 5" CAL. | |
| N2 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 15" CAL. | |
| N3 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 18" CAL. | |
| N4 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 9" CAL. | |
| N5 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 13" CAL. | |
| N6 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 14" CAL. | |
| N7 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 13" CAL. | |
| N8 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 13" CAL. | |
| N9 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 17" CAL. | |
| N10 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 4" CAL. | |
| N11 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 13" CAL. | |
| N12 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 14" CAL. | |
| N13 | CRATAEGUS SP. | HAWTHORN | W | W100 | 7" CAL. | |
| N14 * | CRATAEGUS SP. | HAWTHORN | W | W100 | 6" CAL. | |
| N15 | CRATAEGUS SP. | HAWTHORN | W | W100 | 6" CAL. | |
| N16 | CRATAEGUS SP. | HAWTHORN | W | W100 | 4" CAL. | |
| N17 | CRATAEGUS SP. | HAWTHORN | W | W100 | 4" CAL. | |
| N18 | ULMUS AMERICANA | AMERICAN ELM | N | - | 5" CAL. | |
| N19 | ULMUS AMERICANA | AMERICAN ELM | N | W100 | 6" CAL. | |
| N20 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 5" CAL. | |
| N21 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 9" CAL. | |
| N22 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 13" CAL. | |
| N23 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 5" CAL. | |
| N24 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 11" CAL. | |
| N25 | BETULA POPULIFOLIA | GREY BIRCH | N | B | 9" CAL. | |
| N26 * | ACER SACCHARINUM | SILVER MAPLE | N | R25 | 26" CAL. | |
| N27 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 9" CAL. | |
| N28 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 10" CAL. | |
| N29 | ACER RUBRUM | RED MAPLE | N | R25 | 6" CAL. | |
| N31 * | ACER SACCHARINUM | SILVER MAPLE | N | B | 24" CAL. | |
| N33 * | MALUS SP. | CRABAPPLE | - | R25 | 5" CAL. | |
| N34 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 12" CAL. | |
| N35 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 10" CAL. | |
| N36 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 18" CAL. | |
| N37 * | MALUS SP. | CRABAPPLE | - | R25 | 16" CAL. | TO BE REMOVED |
| N38 | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 7" CAL. | TO BE REMOVED |
| N39 * | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 14" CAL. | TO BE REMOVED |
| N40 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 21" CAL. | TO BE REMOVED |
| N41 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 5" CAL. | TO BE REMOVED |
| N42 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 6" CAL. | TO BE REMOVED |
| N45 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 7" CAL. | TO BE REMOVED |
| N46 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 15" CAL. | TO BE REMOVED |
| N47 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 8" CAL. | TO BE REMOVED |
| N48 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 4" CAL. | TO BE REMOVED |
| N49 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 4" CAL. | TO BE REMOVED |
| N50 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 13" CAL. | TO BE REMOVED |
| N51 * | ALNUS GLUTINOSA | COMMON ALDER | I | B | 11" CAL. | |
| N53 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 5" CAL. | TO BE REMOVED |
| N58 | ALNUS GLUTINOSA | COMMON ALDER | I | B | 4" CAL. | |
| N61 * | MORUS ALBA | WHITE MULBERRY | I | B | 5" CAL. | TO BE REMOVED |
| N62 | ALNUS GLUTINOSA | COMMON ALDER | I | B | 20" CAL. | TO BE REMOVED |
| N63 * | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 10" CAL. | |
| N64 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 11" CAL. | TO BE REMOVED |
| N65 | QUERCUS VELUTINA | BLACK OAK | N | W100 | 26" CAL. | |
| N66 * | QUERCUS PALUSTRIS | PIN OAK | I | W100 | 32" CAL. | TO BE REMOVED |
| N67 * | PRUNUS SEROTINA | BLACK CHERRY | N | W100 | 12" CAL. | TO BE REMOVED |
| N68 * | ACER RUBRUM | RED MAPLE | N | W100 | 16" CAL. | |
| N69 * | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 7" CAL. | |
| N70 | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 13" CAL. | |
| N71 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 11" CAL. | |
| N73 | MALUS SP. | CRABAPPLE | - | W100 | 6" CAL. | |
| N74 | QUERCUS RUBRA | NORTHERN RED OAK | N | R25 | 49" CAL. | SPECIMEN |
| N76 | ACER PLATANOIDES | NORWAY MAPLE | I, INV | W100 | 9" CAL. | |
| N78 | ULMUS AMERICANA | AMERICAN ELM | N | W100 | 11" CAL. | |
| N79 | ULMUS AMERICANA | AMERICAN ELM | N | B | 16" CAL. | |
| N80 | QUERCUS PALUSTRIS | PIN OAK | N | B | 19" CAL. | |
| N81 * | PYRUS CALLERYANA | PEAR | - | W100 | 13" CAL. | TO BE REMOVED |
| N82 | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 5" CAL. | TO BE REMOVED |
| N83 * | ACER PLATANOIDES | NORWAY MAPLE | I, INV | - | 25" CAL. | TO BE REMOVED |
| N84 | ACER PLATANOIDES | NORWAY MAPLE | I, INV | - | 15" CAL. | TO BE REMOVED |
| N85 | ACER PLATANOIDES | NORWAY MAPLE | I, INV | - | 16" CAL. | TO BE REMOVED |
| N86 | ZELKOVA SERRATA | JAPANESE ZELKOVA | - | - | 7" CAL. | TO BE REMOVED |
| N87 * | ZELKOVA SERRATA | JAPANESE ZELKOVA | - | - | 9" CAL. | TO BE REMOVED |
| N88 * | ZELKOVA SERRATA | JAPANESE ZELKOVA | - | - | 9" CAL. | TO BE REMOVED |
| N91 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 5" CAL. | |
| N92 | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 10" CAL. | |
| N93 | ALNUS GLUTINOSA | COMMON ALDER | I | R25 | 5" CAL. | |
| N94 * | ALNUS GLUTINOSA | COMMON ALDER | I | B | 13" CAL. | |
| N95 | MALUS SP. | CRABAPPLE | - | R25 | 8" CAL. | |
| N96 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 3" CAL. | |

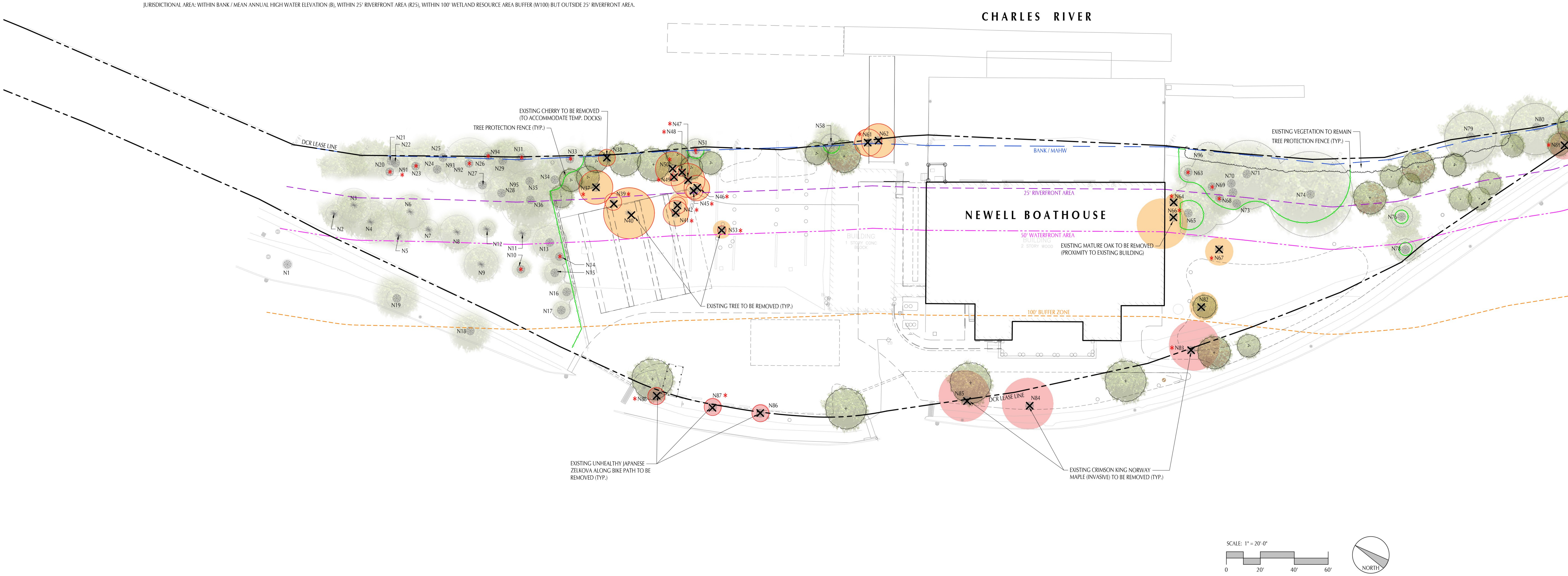
* TREES RECOMMENDED FOR REMOVAL BY ARBORIST BASED ON TREE HEALTH (NOT NECESSARILY PROPOSED TO BE REMOVED AS PART OF THIS PROJECT). REFER TO "NEWELL BOATHOUSE TREE INVENTORY AND MANAGEMENT PLAN | JANUARY 2022" BY BARTLETT TREE EXPERTS.

NATIVE STATUS: NATIVE STATUS FOR THE MIDDLESEX OR SUFFOLK COUNTIES PER "THE VASCULAR PLANTS OF MASSACHUSETTS: A COUNTY CHECKLIST, FIRST REVISION"
NATIVE = (N), INTRODUCED = (I), WAIF = (W), INVASIVE = (INV). NON-NATIVES LABELED ( - ).

JURISDICTIONAL AREA: WITHIN BANK / MEAN ANNUAL HIGH WATER ELEVATION (B), WITHIN 25' RIVERFRONT AREA (R25), WITHIN 100' WETLAND RESOURCE AREA BUFFER (W100) BUT OUTSIDE 25' RIVERFRONT AREA.

## LEGEND

| SYMBOL | DESCRIPTION | QUANTITY | CALIPER INCHES |
|---|---|---|---|
| | **EXISTING TREES (TOTAL)** | **80 TREES** | **923" CAL.** |
| × | **TO BE REMOVED (TOTAL)** | **26 TREES** | **304" CAL.** |
| | **TO BE REMOVED (PROGRAM + GRADING)**<br>NOTE: ALL BUT 2 RECOMMENDED FOR REMOVAL BY ARBORIST | **19 TREES** | **210" CAL.** |
| | **TO BE REMOVED (OTHER)**<br>PLANT HEALTH, NON-NATIVE / INVASIVE SPECIES, HISTORIC / CULTURAL | **7 TREES** | **94" CAL.** |
| * | **RECOMMENDED FOR REMOVAL BY ARBORIST** | **32 TREES** | **350" CAL.** |
| | **EXISTING TREES TO REMAIN** | **54 TREES** | **619" CAL.** |
| | **PROPOSED TREES** | **28 TREES** | **88" CAL.** |

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PETERSON
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156 Mt Auburn Street
Cambridge, MA 02138
617.354.2268
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Landscape Architects / Site Planning Consultants
1730 Massachusetts Avenue
Lexington, MA 02420
781.652.8809
shadleyassociates.com

# SUMMARY

## TREE REMOVAL ANALYSIS

# ATTACHMENT B

## Stormwater Report

STORMWATER REPORT

# Harvard University –
# Improvements to Newell Boathouse
# Boston, Massachusetts

Prepared for

BOSTON CONSERVATION COMMISSION

March 25, 2022

Prepared by

GREEN INTERNATIONAL AFFILIATES, INC.
*Civil and Structural Engineers*

Building Strong Client Relationships Through Engineering Excellence

## Table of Contents

## APPENDICES



## FIGURES



## TABLES

## EXECUTIVE SUMMARY

On behalf of Harvard University (Applicant), Green International Affiliates, Inc. (Green) is submitting this Stormwater Management Report to accompany the Notice of Intent Application to the Boston Conservation Commission for site and stormwater improvements at Newell Boathouse in the City of Boston, Massachusetts.

This project will include the renovation of the existing Newell Boathouse, the demolition of an existing structure and various site improvements including new parking, sidewalks and two new boatsheds. Per DEP's request during the Chapter 91 process, public access has been provided including a wood deck, bike racks, and a pervious pedestrian path in the northern portion of the project. New gas utilities as well as stormwater improvements will also be constructed. The proposed improvements will increase impervious area, but the addition of several stormwater BMP’s will improve the quality of stormwater runoff.

This project consists of improvements to an existing developed site including new pavement, sidewalks, boatsheds, a wood deck, bike racks, a pervious pedestrian path, and improved stormwater management. These developments will result in an increase of impervious area on site of approximately 11,700 SF. Due to this increase and significant exterior improvements throughout the site, the project will be classified as a “New Development” under the Massachusetts Stormwater Standards.

This project provides an opportunity to improve the quality of stormwater runoff that currently discharges to Charles River with little to no treatment. This project will incorporate the installation of practical Best Management Practices (BMPs). The goal of the proposed stormwater improvements is to improve the quality of stormwater runoff to the maximum extent that it is practical.

The following report was created in accordance with the “Massachusetts Stormwater Handbook” last revised in January 2008. The report is organized into sections that correspond to the categories listed in the “Massachusetts Stormwater Report Checklist”. The checklist is included in *Appendix A* of this report. The following is a more detailed description of the existing and proposed drainage areas and the design methodology for this project.

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## 1.0 PROJECT DESCRIPTION

Newell Boathouse is located at 801 Soldiers Field Road in Boston, MA along the bank of the Charles River near the Anderson Memorial Bridge. The boathouse is owned and maintained by Harvard University and serves as an access point to the Charles River for Harvard University Athletics. In addition to the boathouse, the property consists of a dock extending into the Charles River.

The purpose of the project is to provide improvements to the Newell Boathouse complex. Renovation of the existing building will help to improve and modernize amenities. Site improvements including new parking, sidewalks, a wood deck, bike racks, a pervious pedestrian path, and boatsheds will help improve accessibility to the river and help with boat storage. Site improvements will also allow for the installation of BMP's to help improve upon stormwater runoff quality entering the Charles River.

This project consists of site improvements to an existing site development. These developments will result in an increase of impervious area on site. Due to this increase, the project will be classified as a "new development". The project is therefore required to fully meet the standards outlined in the Massachusetts Stormwater Management Standards.

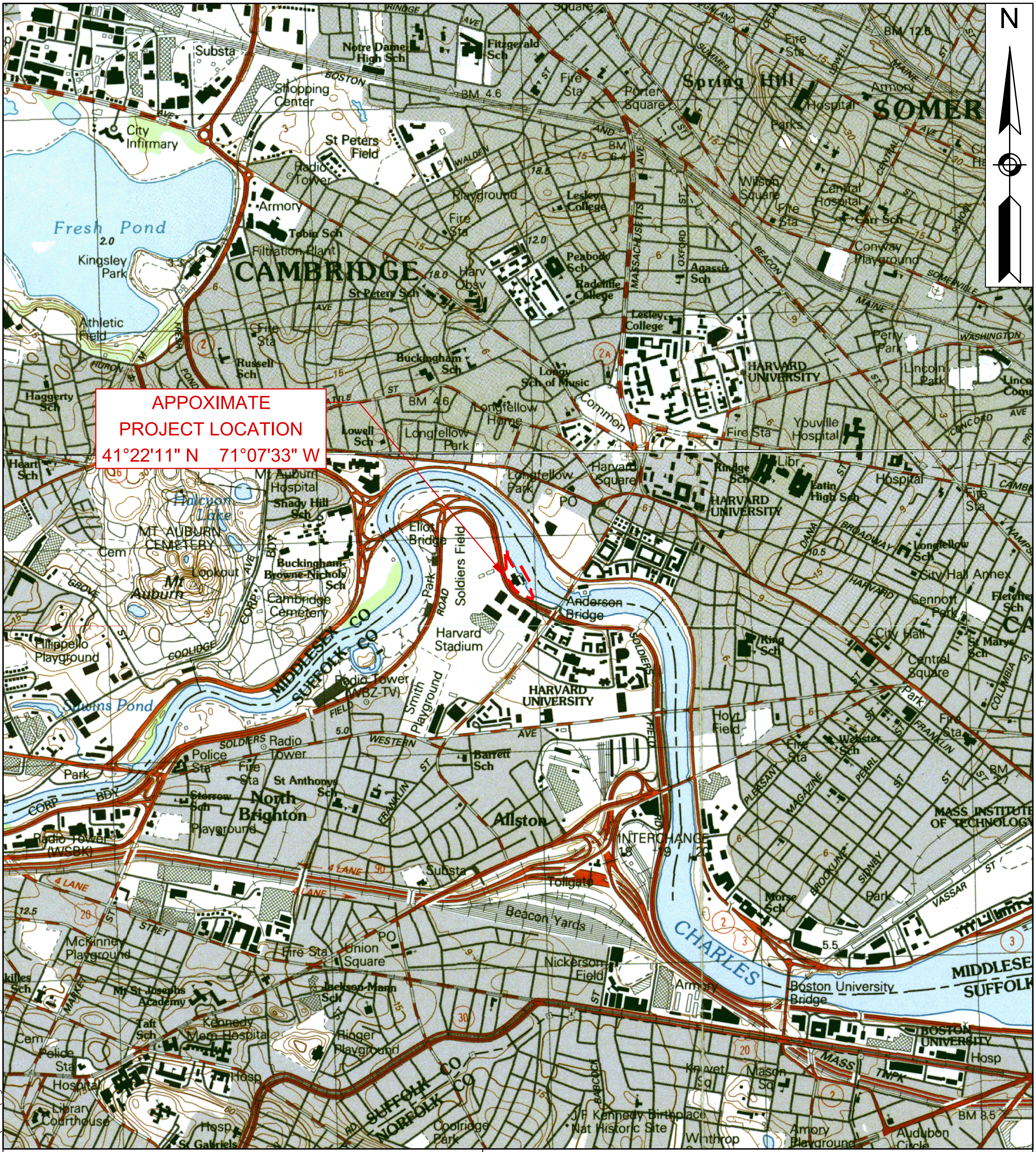
### 1.1 Topography, Geology and Soils

The general topography of the site slopes from Soldiers Field Road in the East down to the Charles River in the West. Typical seasonal high groundwater elevation for the site is approximately elevation 9 based on Boston City Base Datum. The Natural Resources Conservation Service (NRCS) Soil Survey of Suffolk County, Massachusetts defines the soils within the limit of work. Table 1.1 lists soil designations, soil names and the hydrological soil groups. See Figure 3 - Soils Map for location of soils within the site. Appendix D contains a soils report generated using the NRCS website containing soil definitions for the soils within the analyzed watershed.

***Table 1.1 – NRCS Soil Classification***

| Map Designation State/Publ. Sym. | Soil Name | Hydrologic Soil Group |
|---|---|---|
| 1 | Water | - |
| 602 | Urban Land | - |
| 603 | Urban land, wet substratum | - |
| 626B | Merrimac-Urban land complex, 0 to 8 percent slopes | A |
| 655 | Udorthents, wet substratum | - |

As part of this program, geotechnical analysis by Haley & Aldrich (H&A). As noted in H&A's geotechnical report dated 11/02/2021, a groundwater observation well was installed in the NB18-1 (OW) borehole and screened in the fluvial sand deposits in 2018. Groundwater elevation was measured at elevation 8.4 (BCB) in 2018. This well is no longer visible at ground surface and was likely destroyed. It was noted in H&A's Geotech report that *groundwater levels in the area fluctuate with the season and the water levels in the fill can be perched (higher) than those encountered in the sand unit. Groundwater at the site will be controlled* *by the adjacent Charles River, which is maintained at approximately El. 8 (BCB) by the downstream Charles River Dam. Groundwater levels typically match the adjacent Charles River levels in the range of El. 7 – 9 (BCB) and should be expected to fluctuate due to precipitation, surface runoff, local construction, utilities and the adjacent Charles River.* To be conservative, an assumed seasonal high groundwater at El. 9 (BCB) shall be used for proposed stormwater infiltration practices.




LEGEND

APPROXIMATE PROJECT LOCATION

# USGS LOCUS MAP

NEWELL BOATHOUSE
BOSTON, MASSACHUSETTS

PREPARED BY:

GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL AND STRUCTURAL ENGINEERS
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PREPARED FOR:

HARVARD UNIVERSITY ATHLETICS
801 SOLDIER FIELD ROAD
ALLSTON, MA 02134

SCALE IN FEET
1000 0 1000 2000
1" = 2000'
ELEVATIONS IN METERS

NOTE: DATA TAKEN FROM MASSGIS

| | | |
|---|---|---|
| SCALE: AS NOTED | PROJECT NO. 21030 | FIGURE 1 |
| DATE: 10/8/2021<br>REVISED: | DRAWN BY: SB<br>CHECKED BY: DS | |

Y:\Shared\Engineering\Projects\2021\21030\DWG\FIGS\Figure 1 USGS.dwg

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LEGEND

APPROXIMATE PROJECT LOCATION

# AERIAL LOCUS MAP

NEWELL BOATHOUSE
BOSTON, MASSACHUSETTS

PREPARED BY:
GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL AND STRUCTURAL ENGINEERS
239 LITTLETON RD, WESTFORD, MA (978) 923-0400
24 ALBION RD, LINCOLN, RI (401) 305-7895

PREPARED FOR:
HARVARD UNIVERSITY ATHLETICS
801 SOLDIER FIELD ROAD
ALLSTON, MA 02134

SCALE IN FEET
50 0 50 100
1" =100'

NOTE: DATA TAKEN FROM MASSGIS

| | | |
|---|---|---|
| SCALE: AS NOTED | PROJECT NO. 21030 | FIGURE 2 |
| DATE: 10/8/2021<br>REVISED: | DRAWN BY: SB<br>CHECKED BY: DS | |

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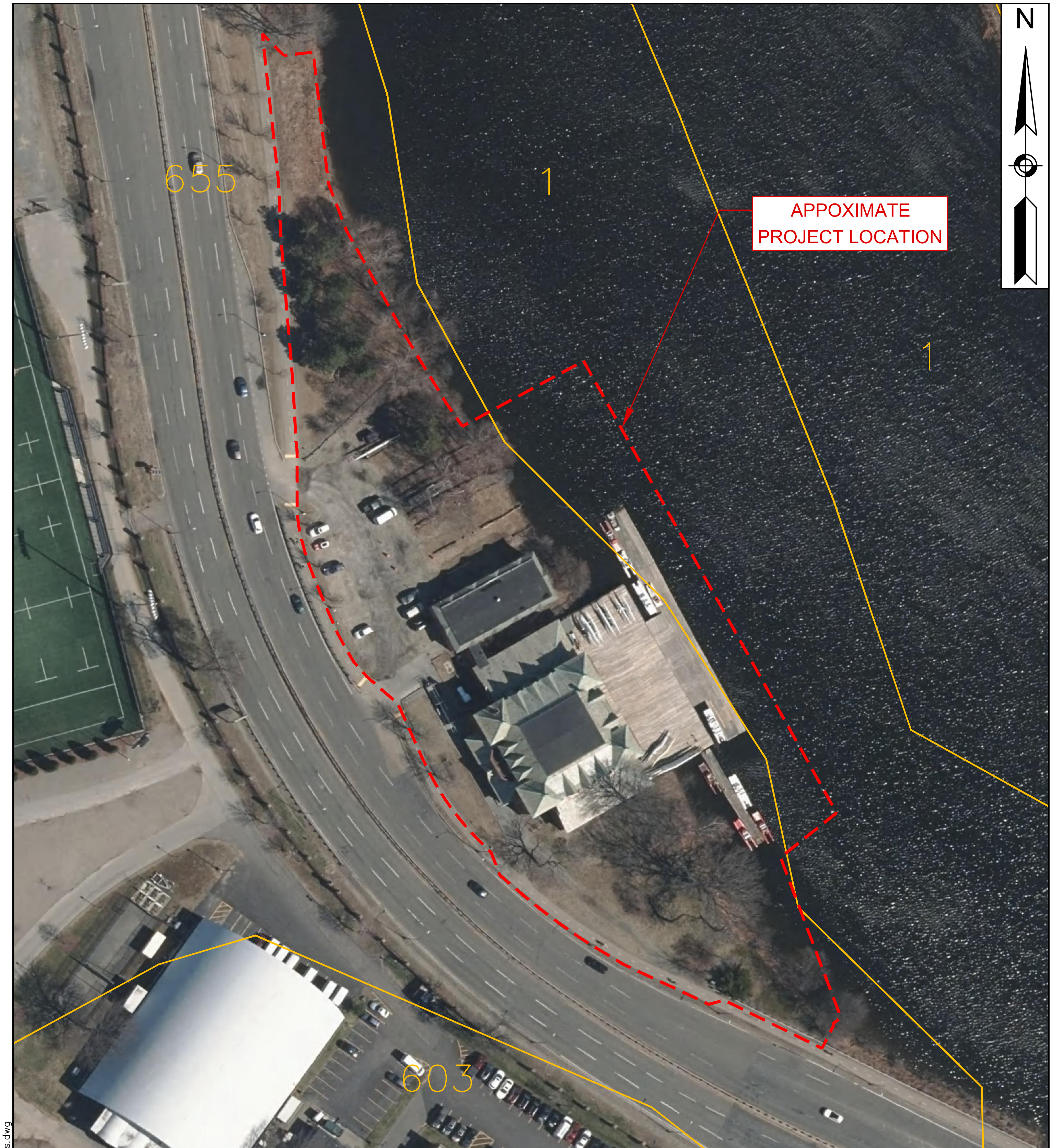


LEGEND

APPROXIMATE PROJECT LOCATION

NRCS SOIL SURVEY BOUNDARY

317C NRCS SOIL SURVEY SYMBOL

NOTE: MAP INFORMATION TAKEN FROM MASSGIS AND SOILS INFORMATION TAKEN FROM NRCS WEB SOIL SURVEY FOR BRISTOL COUNTY

SCALE IN FEET

50 0 50 100

1" =100'

# SOILS MAP

NEWELL BOATHOUSE
BOSTON, MASSACHUSETTS

PREPARED BY:

GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL AND STRUCTURAL ENGINEERS
239 LITTLETON RD, WESTFORD, MA (978) 923-0400
24 ALBION RD, LINCOLN, RI (401) 305-7895

PREPARED FOR:

HARVARD UNIVERSITY ATHLETICS
801 SOLDIER FIELD ROAD
ALLSTON, MA 02134

| | |
|---|---|
| SCALE: AS NOTED | PROJECT NO. 21030 |
| DATE: 10/8/2021 | DRAWN BY: SB |
| REVISED: | CHECKED BY: DS |

FIGURE 3

F:\Projects\2021\21030\DWG\FIGS\Figure 3 Soils.dwg

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## 2.0 LOW IMPACT DEVELOPMENT MEASURES CONSIDERED

The Massachusetts Stormwater Management Regulations require that the project consider environmentally sensitive site design and Low Impact Development (LID) techniques to manage stormwater.

Key features of LID stormwater management systems include implementing practices that maintain a site's existing hydrology, using decentralized practices to manage stormwater close to the source of generation, and maximizing onsite infiltration to reduce runoff and landscape watering requirements.

The following are the LID site planning and design strategies that have been incorporated into the design.

- Bioretention Basin

## 3.0 STANDARD 1: NO NEW UNTREATED DISCHARGES

The Massachusetts Stormwater Handbook, Standard 1, requires that the project demonstrates that there are no new untreated discharges and that new discharges will not cause erosion or scour to downstream wetlands.

As shown on Figure – 6 Existing Watershed plan, under existing conditions there is one discharge point located at the Charles River (DP-1) and one discharge point located at Soldiers Field Road (DP-2). Stormwater runoff is conveyed to each of these discharge points via overland flow.

The proposed design includes five (5) new BMP's to treat stormwater runoff consisting of three infiltration trenches, one bioretention basin pretreated by a forebay, and one subsurface chamber system pretreated by a proprietary Water Quality Structure. Three (3) of these BMP's will continue the existing drainage pattern and allow for overflow to discharge to the Charles River, DP-1, via overland flow. The subsurface basin is not able to infiltrate as 2' of separation cannot be provided, so it will be a filtering basin only. In addition, the infiltration trench located along the western side of the building is not able to provide an overflow that can sheet flow to the Charles River. Both proposed BMP's will have an outflow pipe that will act as an overflow and create one new point source discharge to the Charles River. All BMP discharges are fully treated.

There will be no new untreated point source discharges created because of this project. This standard is fully met.

# 4.0 STANDARD 2: PEAK RATE ATTENUATION

Standard 2 requires that the rates of flow be attenuated for the proposed development condition. The addition of a new parking area, boatsheds and sidewalks will result in a net increase of impervious area. The existing site discharges to two design points. Most of the site discharges to the Charles River (DP-1) while the remainder of the site discharges to Soldiers Field Road (DP-2).

## 4.1 Existing Conditions

### *4.1.1 Existing Contributing Areas*

The existing site can be analyzed as two (2) watershed areas that contribute runoff to two (2) discharge points. The existing drainage areas are delineated in Figure 6 - Existing Watershed Plan. For this hydrologic analysis, the following assumptions were made:

- When the watershed boundary fell outside of the limit of work an arbitrary line was delineated as the watershed boundary.
- The total watershed area for the existing conditions is used as the comparison base for the watershed area in the proposed conditions.

Under existing conditions, the site was analyzed as two watershed areas, EDA-1 and EDA-2 with two discharge points. Stormwater runoff travels via overland flow to these discharge points as indicated on the Figure 6 – Existing Watershed plan. Brief descriptions of each contributing area are below:

**DRAINAGE AREA EDA-1**

This area consists of a mostly a mixture of different pervious surfaces including lawn area, a dirt parking area, an impervious shared use path and a gravel pathway. There are also impervious surfaces consisting of the roof of the boathouse as well as a paved parking area and paved sidewalk. Stormwater runoff travels via overland flow from high points near Soldiers Field Road in the West to the low point of the Charles River in the East where it discharges without receiving any treatment.

**DRAINAGE AREA EDA-2**

This area consists mostly of impervious sidewalk and driveway openings adjacent to Soldiers Field Road. There are also pervious surfaces including sections of lawn and the dirt parking area. Runoff travels West via overland flow from high points located on the West side of the project area onto Soldiers Field Road. Beyond the site limits, stormwater runoff travels via gutter flow into the existing closed drainage system within Soldiers Field Road that most likely eventually outfalls to the Charles River.

#### *4.1.2 Existing Drainage Area Summary*

***Table 4.1 – Existing Conditions Drainage Area Characteristics***

| DRAINAGE AREA | AREA (ACRES) | % IMPERVIOUS | HSG | CURVE NUMBER | $T_C$ (MIN) |
|---|---|---|---|---|---|
| EDA-1 | 1.85 | 24% | C | 82 | 6 |
| EDA-2 | 0.39 | 47% | C | 88 | 6 |

#### *4.1.3 Peak Discharge Runoff Rates*

The existing peak flow rates, tributary to the design, were calculated for the 2-, 10-, 25- and 100-year storm events. The results are presented in Table 4.3 – Peak Rates of Runoff.

### 4.2 Proposed Conditions

#### *4.2.1 Proposed Contributing Areas*

The proposed stormwater management analysis can be summarized as seven (7) watershed areas that contribute runoff to two (2) discharge points. The overall watershed area and discharge points of analysis are the same in the proposed condition as in the existing condition. To account for the proposed BMP's, some sections of the drainage areas are split up into smaller sub-watershed areas when compared to existing conditions. The proposed drainage areas are delineated in Figure 7 - Proposed Watershed Plan.

Proposed work for this project includes the addition of a new parking area, new boatsheds, and new sidewalks. The addition of these site improvements will result in a net increase of impervious area. The grading of the proposed impervious surfaces, the grading of the site as a whole and the use of roof drains will help direct stormwater runoff towards five (5) new BMP's. These new BMP's will help to improve peak rate attenuation as well as the quality of stormwater runoff into the Charles River which under existing conditions currently provides no stormwater treatment.

A brief description of the contributing area is below:

**DRAINAGE AREA PDA-1A**

This area consists mostly of pervious gravel area and impervious roof area from a proposed boatshed. Stormwater runoff travels via overland flow across the gravel area or through closed drainage via roof drains from the shed into an infiltration trench. For larger storm events, the trench overflows following existing drainage patterns via overland flow to the Charles River at DP-1.

**DRAINAGE AREA PDA-1B**

This area consists mostly of impervious area coming from the roof of the proposed boatshed and a pervious gravel area. Stormwater runoff travels via overland flow across the gravel area and through closed drainage via a roof drain from the shed into an infiltration trench. For larger storm events, the trench overflows using a crushed stone spillway and discharges into the Charles River at DP-1.

### DRAINAGE AREA PDA-1C

This area consists mostly of impervious parking area, the Southwest portion of the boathouse roof, and a portion of the proposed sidewalk on the Southwest side of the boathouse. There is a small pervious grassed area as well. Stormwater runoff travels from East to Southwest via overland flow towards the Northwestern and Southeastern most edges of the proposed parking area. Stormwater runoff enters two trench drains, one on the Southeastern edge of the proposed parking area and one on the Northwestern edge of the proposed parking area. The trench drains convey runoff to a subsurface system that is pretreated by a Water Quality Structure. The subsurface infiltration system has an outlet control structure that overflows to the Charles River at DP-1.

### DRAINAGE AREA PDA-1D

This area consists mostly of impervious roof area, impervious sidewalk area, and a portion of landscaping area. Stormwater runoff travels via overland flow or via roof drains into an infiltration trench located within the landscaped area. For larger storm events, the trench overflows using an area drain that outfalls into the Charles River at DP-1.

### DRAINAGE AREA PDA-1E

This area consists mostly of impervious roof, sidewalk area, a portion of landscaped area. Stormwater runoff travels via overland flow from the sidewalk and lawn areas or via roof drains from the roof area towards a bioretention basin. The impervious overland flow area will be pretreated by a forebay before entering the bioretention basin. For larger storm events, the basin overflows via a rip rap spillway then overland flows to the Charles River at DP-1.

### DRAINAGE AREA PDA-1F

This area consists mostly of landscaped area, a wood deck, an existing impervious shared use path, a proposed concrete pad, and the dock. The drainage pattern follows the existing drainage pattern and has stormwater runoff flow via overland flow from high points in the South to the discharge point of the Charles River DP-1 in the North.

### DRAINAGE AREA PDA-2

This area mostly consists of impervious driveway and an impervious shared use path of with some pervious grassed areas. The drainage pattern follows the existing drainage pattern and runoff flows from East to West via overland flow into Soldiers Field Road. Beyond the site limits, stormwater runoff travels via gutter flow into the existing closed drainage system within Soldiers Field Road that most likely eventually outfalls to the Charles River.

### *4.2.2 Proposed Drainage Area Summary*

The following Table 4.2 – Proposed Conditions Drainage Characteristics summarizes the proposed drainage areas, including the pertinent information used for the hydrologic analysis:

*Table 4.2 – Proposed Conditions Drainage Area Characteristics*

| Drainage Area | Area (Acres) | % Impervious | HSG | Curve Number | $T_C$ (Min) |
|---|---|---|---|---|---|
| PDA-1A | 0.037 | 100% | C | 98 | 6.0 |
| PDA-1B | 0.054 | 69% | C | 98 | 6.0 |
| PDA-1C | 0.320 | 86% | C | 96 | 6.0 |
| PDA-1D | 0.147 | 84% | C | 95 | 6.0 |
| PDA-1E | 0.278 | 49% | C | 88 | 6.0 |
| PDA-1F | 1.089 | 12% | C | 78 | 6.0 |
| PDA-2 | 0.249 | 61% | C | 85 | 6.0 |

The proposed peak flow rates, tributary to the design, were calculated for the 2-, 10-, 25- and 100-year storm events. The results are presented in Table 4.3 – Peak Rates of Runoff.

### *4.2.3 Peak Discharge Runoff Rates*

The peak flow rates were calculated for the 2-, 10-, 25- and 100-year storm events under proposed conditions and compared to the existing peak flow rates. There is a reduction in peak rates to DP-2 (Soldiers Field Road). There is a decrease to peak rates to DP-1 (Charles River) for the 2-, 10- , and 25-year storm events. There is an increase for the 100-year storm of 0.94 CFS. The Charles River is a large body of water where an increase of 0.94 CFS will have no adverse impacts. Due to the close proximity of the site to the Charles River, the number of mature trees located throughout the site, existing utilities and minimal separation between the proposed ground elevation and the approximate seasonal high ground water level the ability to provide additional stormwater BMP's was not feasible.

The following Table 4.3 - Peak Rates of Runoff represents a comparison between existing and proposed conditions of the peak rates of runoff from the proposed development tributary to the discharge points.

*Table 4.3 – Peak Rates of Runoff*

| Discharge Point | | 2-Year Storm (CFS) | 10-Year Storm (CFS) | 25-Year Storm (CFS) | 100-Year Storm (CFS) |
|---|---|---|---|---|---|
| DP-1 | Existing | 3.53 | 6.54 | 8.96 | 13.93 |
| | Proposed | 2.54 | 5.94 | 8.63 | 14.87 |
| DP-2 | Existing | 1.01 | 1.65 | 2.15 | 3.16 |
| | Proposed | 0.62 | 1.04 | 1.38 | 2.05 |

## 4.3 Methodology and Design Criteria

### *4.3.1 Hydrologic Model Description*

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD 10.0 by HydroCAD Software Solutions, LLC.

### *4.3.2 Design Storms and Rainfall Depth*

The analysis was performed on the 2-, 10-, 25- and 100-year frequency rainfall events. Rainfall depths were taken from the NOAA Rainfall Frequency Atlas of the United States (Atlas-14). The events were based on the 24-Hour Type-III duration storm.

The following rainfall depths were used in the calculations:

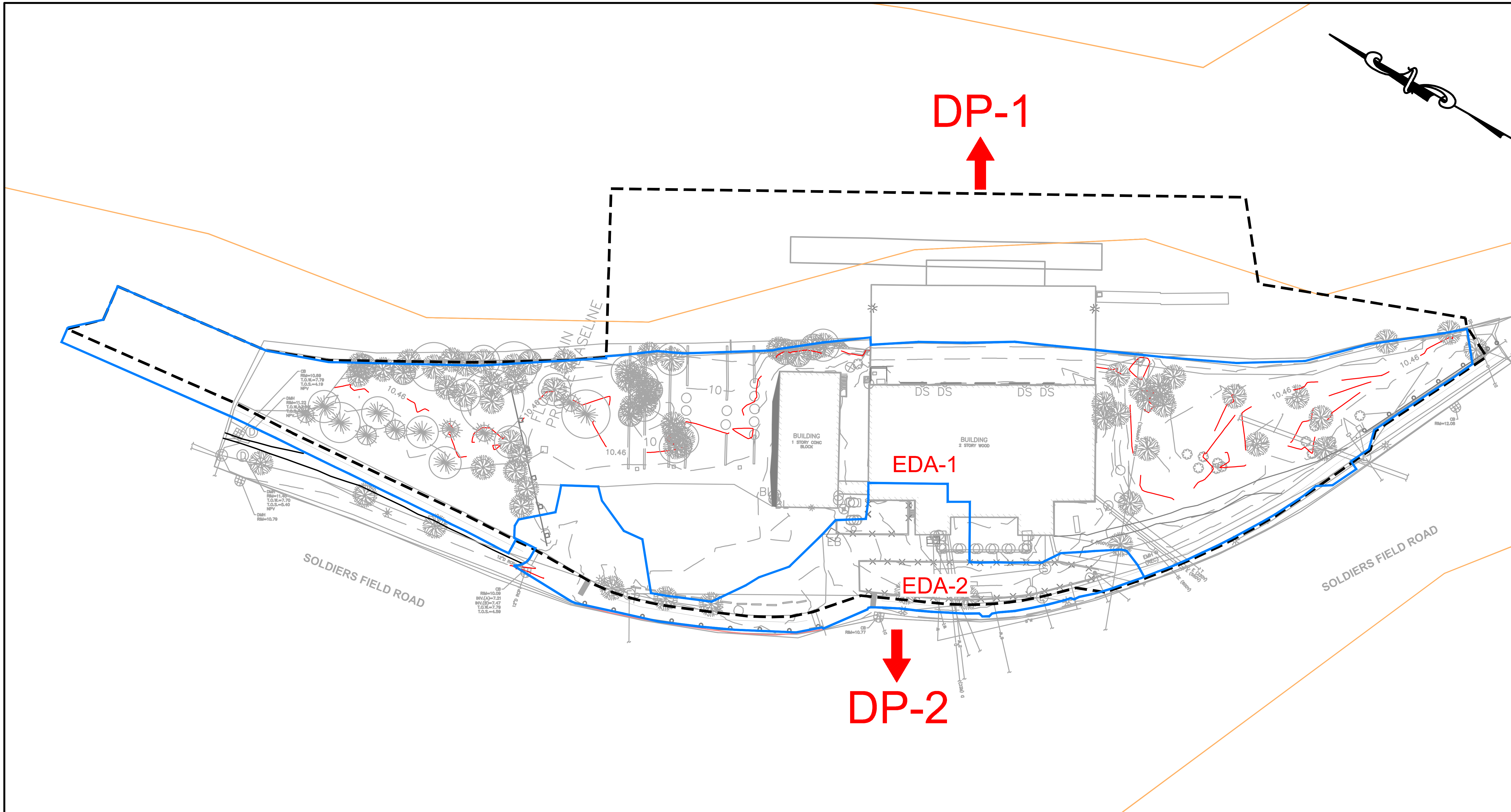
| Storm Event | Rainfall Depth |
|---|---|
| 2-Year | 3.26 inches |
| 10-Year | 4.90 inches |
| 25-year | 6.19 inches |
| 100-Year | 8.83 inches |

### *4.3.3 Time of Concentration*

The "time of concentration" ($T_c$) for each watershed was determined by finding the time necessary for runoff to travel from the hydraulically most distant point in the watershed to the point of concentration. The travel path was drawn based on the topography and the time was calculated using the TR-55 Method and HydroCAD. A minimum $T_c$ of 6.0 minutes was used.

### *4.3.4 Curve Numbers*

Curve numbers were developed for each of the different use categories and hydrologic soil group types within each watershed area. The curve numbers were based on the SCS TR-55 methodology and are included in the HydroCAD input and output found in Appendix B.




LEGEND

| | |
|---|---|
| LIMIT OF WORK | |
| WETLANDS | |
| 100-FT WETLAND BUFFER | |
| NRCS SOIL SURVEY BOUNDARY | |
| EXISTING WATERSHED BOUNDARY | |
| EXISTING WATERSHED NUMBER | EDA-1 |
| DESIGN POINT | DP-1 |

0' 30' 60' 120'

1" = 60 FEET

| DATE | REVISIONS |
|---|---|

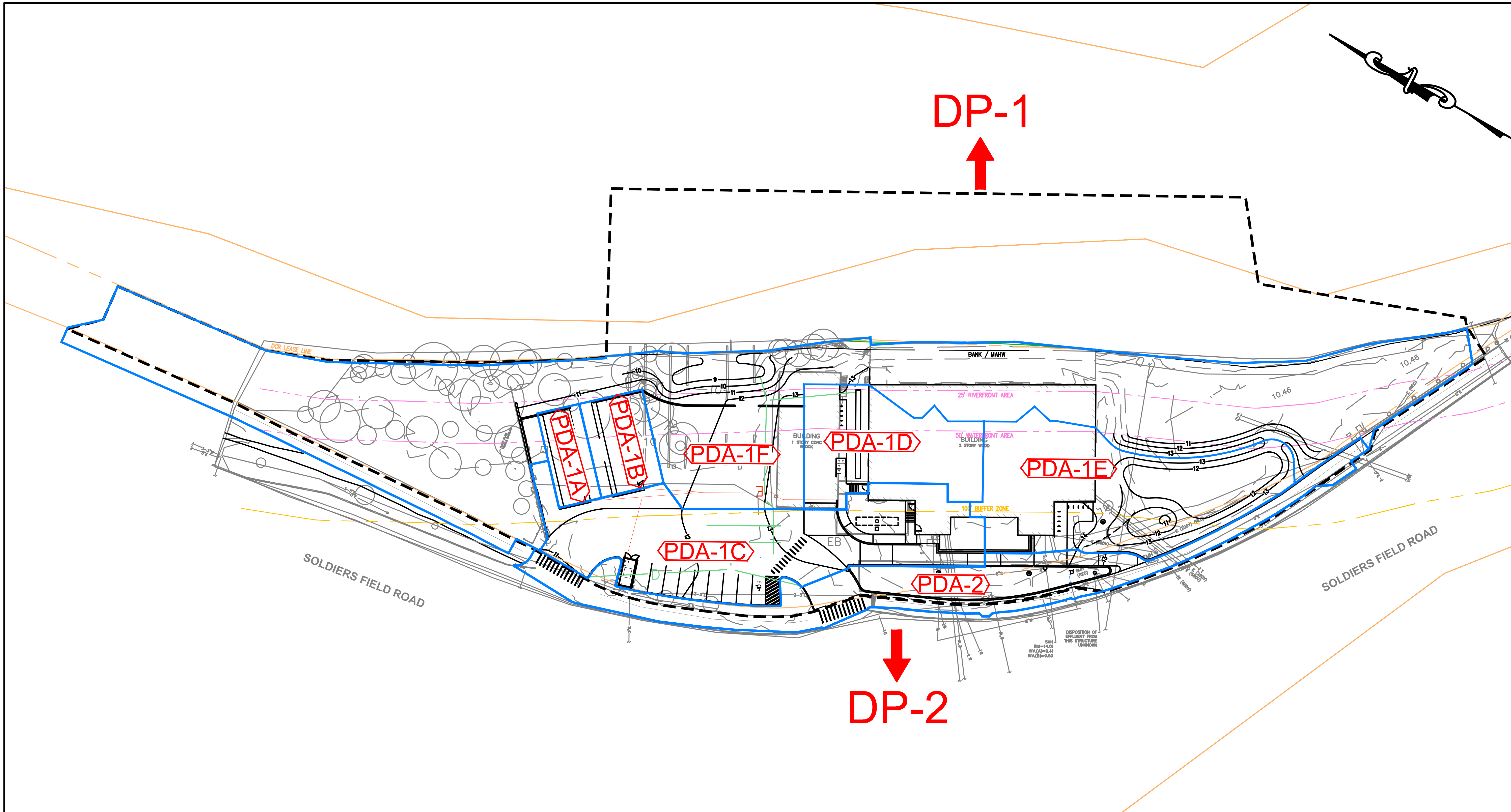
BOSTON, MASSACHUSETTS

NEWELL BOATHOUSE
EXISTING WATERSHED PLAN

GREEN INTERNATIONAL AFFILIATES, INC.

GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL & STRUCTURAL ENGINEERS WESTFORD, MASSACHUSETTS

| SCALE 1" = 60' | DATE: 10/1/2021 | PROJECT NO. 21030 |
|---|---|---|
| APPROVED: | DESIGNED BY: MW/SB<br>DRAWN BY: MW/SB<br>CHECKED BY: DS/JT | FIGURE NO.<br>6 |




## LEGEND

| | |
|---|---|
| LIMIT OF WORK | |
| WETLANDS | |
| 100-FT WETLAND BUFFER | |
| NRCS SOIL SURVEY BOUNDARY | |
| EXISTING WATERSHED BOUNDARY | |
| EXISTING WATERSHED NUMBER | PDA-1 |
| DESIGN POINT | DP-1 |

0' 30' 60' 120'

1" = 60 FEET

| DATE | REVISIONS |
|---|---|

BOSTON, MASSACHUSETTS

NEWELL BOATHOUSE
PROPOSED WATERSHED PLAN

GREEN INTERNATIONAL AFFILIATES, INC.

GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL & STRUCTURAL ENGINEERS TEWKSBURY, MASSACHUSETTS

| | | |
|---|---|---|
| SCALE 1" = 50' | DATE:3/25/2022 | PROJECT NO. 21030 |
| APPROVED: | DESIGNED BY: MW/SB<br>DRAWN BY: MW/SB<br>CHECKED BY: DS/JT | FIGURE NO.<br>7 |

## 5.0 STANDARD 3: STORMWATER RECHARGE

Standard 3 requires that three computations or demonstrations be fulfilled to satisfy the stormwater recharge requirements. They are as follows:

- Impervious Area
- Required Recharge Volume
- Bottom Area Sizing for Subsurface Systems and Porous Pavement

This project has 27,314 square feet of total existing impervious area within the limit of work and results in an increase in impervious area by approximately 11,700 square feet due to the addition of a new parking area, boatsheds, and sidewalk. The required recharge volume for the total proposed impervious area is 2,176 CF.

This project is proposing the implementation of one bioretention basin, one subsurface chamber system and three infiltration trenches. As noted in Section 1.1 of this report, to be conservative, an assumed seasonal high groundwater at El. 9 (BCB) was used for proposed stormwater infiltration practices. Since the subsurface chambers will not have 2' of separation to groundwater, it was not included in the recharge calculation. The Soil Survey Analysis is included in Section 1.1 of this report, Figure 3 Soils Map, and Appendix D Soil Information. The bottom of the proposed bioretention basin and three infiltration trenches will have a minimum of 2-feet separation to seasonal high groundwater. Based on the NRCS Soil information, the BMP is located within Udorthents, wet substratum with no Hydrologic soil group rating. Therefore, to be conservative, the required recharge calculations were made using C soils and are in Appendix C of this report.

For the bioretention basin BMP and the three infiltration trenches, the contributing impervious areas and its underlying Hydrologic Soil Group were used to estimate the recharge volume lost by development, which was used as its required recharge volume. The combined storage provided by the proposed bioretention basin and infiltration trenches is 2,946 CF. Therefore, standard 3 is fully met.

The BMP was designed using the static method, so that the storage available below the first overflow is equivalent or larger than the required recharge volume. Drawdown calculations were performed to show that the infiltration basin will drain within 72 hours. For this calculation, the RAWLs infiltration rates were used to estimate the recharge potential of each of the BMP. The drawdown calculations are in Appendix C.

## 6.0 STANDARD 4: WATER QUALITY

Standard 4 requires that all stormwater management systems be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The Massachusetts Stormwater Handbook states that this standard is met when:

- Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained.
- Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and
- Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

As stated previously, this project is a mix of redevelopment and new development and is required to fully meet Standard 3. As mentioned in Section 5, there is an increase in impervious area and five (5) BMP's are proposed as part of this project. It has been designed to provide water quality treatment for the area of impervious surface that it captures. The treatment practice is:

- (1) Bioretention Basin
- (3) Infiltration Trenches
- (1) Subsurface Chamber System

This standard is fully met.

### 6.1 Long-Term Pollution Prevention Plan

The long-term pollution prevention measures are combined with the Operation and Maintenance Plan for Harvard which include limited sand use, street sweeping, cleaning of water quality structures, subsurface chambers, infiltration trenches, and the bioretention basin.

### 6.2 Water Quality Treatment Volume

Massachusetts Stormwater Regulations require a "Water Quality Depth" of half (1/2) inch. For this project, a water quality depth of one (1) inch was used per BWSC standards. One of the objectives of the proposed stormwater improvements is to improve upon the quality of discharged stormwater.

The proposed design aims to improve the water quality by installing a five (5) new BMP's. The required water quality volume for the total impervious area within the limit of work is 3,252 CF. With the BMP's, the total water quality volume provided is 3,933 CF. Therefore, standard 4 is fully met.

### 6.3 TSS Removal Computations

Under existing conditions, most runoff flows into the Charles River via overland flow with no prior treatment. To meet 80% TSS removal, the project will include the installation of three (3) infiltration trenches, one (1) bioretention basin, and one (1) subsurface chamber system. A forebay and proprietary water quality structure will be used for pretreatment purposes.

The bioretention basin with the forebay will be able to achieve 93% TSS removal.

The subsurface chambers with the water quality structure and the subsurface chambers will be able to achieve 97% TSS removal.

The infiltration trenches will be able to achieve 80% TSS removal.

This is a significant improvement over existing conditions where there is little to no treatment. These systems will be maintained on a regular basis per the Harvard's Operation and Maintenance schedule.

The TSS calculations for all proposed BMP's are included in Appendix C.

## 7.0 STANDARD 5: LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

The project site is not considered a Land Use with Higher Potential Pollutant Loads (LUHPPL); therefore, Standard 5 is not applicable to this project.

## 8.0 STANDARD 6: CRITICAL AREAS

The project is not located within a “critical” area as defined in the Massachusetts Stormwater Handbook. Therefore, Standard 6 is not applicable to the proposed project.

## 9.0 STANDARD 7: REDEVELOPMENT

The improvements Newell Boathouse are considered to be a New Development; therefore, Standard 7 is not applicable to this project.

## 10.0 STANDARD 8: CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION & SEDIMENTATION CONTROL

Construction period pollution prevention and erosion and sedimentation control measures will be implemented at the project site to control construction related impacts during construction and land disturbance activities. The General Contractor for the project will be responsible for implementation of the construction period controls.

The project will disturb more than one acre of land during the construction process and will require a NPDES Construction General Permit issued by the Environmental Protection Agency. As a result, the General Contractor will be required to prepare a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP document will satisfy the requirements of the Construction General Permit and the construction period erosion, sedimentation and pollution prevention plan requirements outlined in Standard 8 of the Massachusetts Stormwater Handbook. A SWPPP has not been prepared for inclusion with this stormwater report; however, one will be prepared prior to any construction activities at the site by the General Contractor.

Without proper erosion and sediment control measures, grading, filling and installing new structures may cause erosion and sedimentation, resulting in temporarily increased turbidity and suspended solid loads. Runoff from construction sites may also transport sediment to downstream watercourses, where sediment deposition and accumulation will occur as flow velocities decrease.

Erosion and sedimentation controls will be employed to prevent the erosion and transport of sediment into resource areas during the earthwork and construction phases of the project. Erosion and sedimentation control measures will be installed prior to site excavation or disturbance and will be maintained throughout the construction period.

Below is a description of some of the erosion and sediment control measures that will be employed at the project and that will be included in the SWPPP.

### 10.1 Erosion and Sediment Control Measures

#### *10.1.1 Minimize Disturbed Area and Protect Natural Features and Soil*

The most important aspects of controlling erosion and sedimentation are limiting the extent of disturbance and limiting the size and length of the tributary drainage areas to the worksite and drainage structures. These fundamental principles will be the key factors in the Contractor's control of erosion on the project site. If appropriate, the Contractor will construct temporary diversion swales and settling basins or use a settling tank. If additional drainage or erosion control measures are needed, they will be located up-gradient from the compost filter tubes and sedimentation fences when possible.

The Contractor is responsible for the maintenance and repair of all on-site erosion control devices. All erosion control devices will be regularly inspected. At no time will silt-laden water be allowed to enter sensitive areas (wetlands, streams, and drainage systems). Any runoff from disturbed surfaces will be directed through a sedimentation process prior to being discharged to the existing on-site drainage system.

The contractor will establish a staging area(s) on areas to be disturbed for the overnight storage of equipment and stockpiling of materials.

In the staging area, the Contractor will have a stockpile of materials required to control erosion on-site to be used to supplement or repair erosion control devices. These materials will include, but are not limited to, compost filter tubes, sedimentation fence, erosion control matting and crushed stone. As mentioned previously, erosion and sedimentation controls will be employed to minimize the erosion and transport of sediment into resource areas during the earthwork and construction phases of the project. Erosion and sedimentation control measures will be installed prior to site excavation or disturbance and will be maintained throughout the construction period.

The Contractor is responsible for erosion control on the site and will utilize erosion control measures where needed, regardless of whether the measures are specified on the construction plans or in supplemental plans prepared for the Stormwater Pollution Prevention Plan (SWPPP).

Primary erosion control techniques proposed include compost filter tubes, sedimentation fence barriers, and a stabilized construction entrance. A detailed description of each technique is discussed below.

### *10.1.2 Best Management Practices (BMPs)*

#### COMPOST FILTER TUBES

Erosion control barriers (compost filter tubes and/or sedimentation fence) will be installed where required prior to the start of construction. These barriers will remain in place until all tributary surfaces have been fully stabilized.

Compost filter tube barriers will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. In areas where high runoff velocities or high sediment loads are expected, sedimentation fencing may be installed adjacent to the compost filter tubes. This semi-permeable barrier made of a synthetic porous fabric will provide additional protection. The sedimentation fences and compost filter tube barrier will be replaced as determined by periodic field inspection. Compost filter tubes and sedimentation fences will be maintained and cleaned until the tributary area is fully stabilized.

#### DRAINAGE SYSTEM PROTECTION

Sediment filters (silt sacks) will be installed at all existing and proposed drainage structures and maintained and cleaned as required to maintain their effectiveness. Catch basins, drain manholes and storm drain pipes will be cleaned of sediment and debris after the completion of construction. Sediment collected in structures will be disposed of properly and covered, if stored on-site. The following construction measures will be implemented to prevent the transport of sediment through the drainage system.

- Any proposed drainage system will be installed from the downstream end to the upstream end.
- Until tributary areas are stabilized, catch basin inlets will be filtered with a silt sack. If intense rainfall is predicted before all tributary areas are stabilized, erosion control measures will be reinforced for the duration of the storm. Downstream areas will be inspected, and any sediment removed at the end of the storm.
- Unfiltered water will not be allowed to enter pipes from unstabilized surfaces.

- Trench excavation will be limited to the minimum length required for daily pipe installation. All trenches will be backfilled as soon as possible. The ends of pipes will be closed nightly with plywood.
- Silt-laden waters will be intercepted prior to reaching catch basins during construction. Any gross depositions of materials on paved surfaces will be removed.
- Catch basins will be inspected monthly and cleaned in anticipation of the winter season in November.

**UTILITY CONSTRUCTION**

The Contractor will construct utility trenches in a manner that will not direct runoff toward wetlands resources or to drainage system structures.

### *10.1.3 Stabilization Activities*

All disturbed surfaces will be stabilized a maximum of 14 days after construction on any portion of the project site that is completed or is temporarily halted, unless additional construction is intended to be initiated within 21 days. The Contractor will not disturb more area than can be stabilized within 14 days unless the area is to remain active. The Contractor will not disturb more area than can be stabilized within the same construction season.

**SLOPE STABILIZATION**

The smallest practicable area of land will be exposed at a time. Slopes greater than three-to-one (horizontal to vertical) will be stabilized with seed, organic mulch, jute fabric, or riprap, as appropriate, to prevent erosion during construction. After disturbed areas have been stabilized, the temporary erosion control measures will be removed, and accumulated sediment will be removed and disposed of in an appropriate location. Disturbed areas will be stabilized with appropriate ground cover as soon as possible. After the removal of temporary erosion control measures, disturbed areas will receive a layer of topsoil for stabilization.

**STABILIZED CONSTRUCTION ENTRANCE**

Temporary stabilized construction entrances may be installed at the project site. The purpose of the stabilized construction entrance is to remove sediment attached to vehicle tires and to minimize sediment transport and deposition onto public road surfaces. The construction entrances will be composed of beds of crushed stone which will be replenished as necessary to maintain their proper function.

## 10.2 Construction Period Pollution Prevention

### *10.2.1 Good Housekeeping BMPs*

The following good housekeeping practices will be followed onsite during the construction project:

- An effort will be made to store only enough product required to do the job.
- All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.

- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, all of a product will be used up before disposing of the container.
- Manufacturer's recommendations for proper use and disposal will be followed.
- The site superintendent will inspect daily to ensure proper use and disposal of materials.
- The contractor will be required in the Contract documents to control dust.

### *10.2.2 Material Handling & Waste Management*

#### HAZARDOUS PRODUCTS

These practices will be used to reduce the risks associated with hazardous materials. Material Safety Data Sheets (MSDSs) for each substance with hazardous properties that is used on the job site will be obtained and used for the proper management of potential wastes that may result from these products. An MSDS will be posted in the immediate area where such product is stored and/or used and another copy of each MSDS will be maintained in the SWPPP file at the job site construction office. Since work is located adjacent to wetland resource areas, hazardous fuels or other potential contaminants shall not be stored on site. Each employee who must handle a substance with hazardous properties will be instructed on the use of MSDS sheets and the specific information in the applicable MSDS for the product they are using, particularly regarding spill control techniques.

- Products will be kept in original containers unless they are not re-sealable.
- Original labels and material safety data will be retained, as they contain important product information.
- Manufacturer, local state, and/or federal recommended methods for proper disposal will be followed if surplus product must be disposed of.

#### HAZARDOUS WASTE

All hazardous waste material will be disposed of by the Contractor in the manner specified by local, state, and/or federal regulations and by the manufacturer of such products. Site personnel will be instructed in these practices by the job site superintendent, who will also be responsible for seeing that these practices are followed.

#### SOLID AND CONSTRUCTION WASTES

All waste materials will be collected and stored in accordance with state and federal law in an appropriately covered container and/or securely lidded metal dumpster.

All trash and construction debris from the site will be deposited in the dumpster. No construction waste materials will be buried on site. All personnel will be instructed regarding the correct procedures for waste disposal.

All waste dumpsters and roll-off containers will be located in an area where the likelihood of the containers contributing to storm water discharges is negligible. If required, additional BMPs must be implemented, such as sandbags around the base, to prevent wastes from contributing to storm water discharges.

**SANITARY WASTES**

All sanitary waste will be collected from the portable units as required to maintain proper operation and sanitary conditions of these units. All maintenance work on portable sanitation units shall be performed by a licensed portable facility provider in complete compliance with local and state regulations.

All sanitary waste units will be located in an area where the likelihood of the unit contributing to storm water discharges is negligible. If required, additional BMPs must be implemented, such as sandbags around the base, to prevent wastes from contributing to storm water discharges.

### *10.2.3 Spill Prevention & Control Plan*

The Contractor will train all personnel in the proper handling and cleanup of spilled materials. No spilled hazardous materials or hazardous wastes will be allowed to come in contact with storm water discharges. If such contact occurs, the storm water discharge will be contained on site until appropriate measures in compliance with state and federal regulations are taken to dispose of such contaminated storm water. It shall be the responsibility of the job site superintendent to properly train all personnel in spill prevention and clean up procedures.

In order to minimize the potential for a spill of hazardous materials to come into contact with storm water, the following steps will be implemented:

- All materials with hazardous properties (such as pesticides, petroleum products, fertilizers, detergents, construction chemicals, acids, paints, paint solvents, cleaning solvents, additives for soil stabilization, concrete curing compounds and additives, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.

- During construction, liquid petroleum products and other hazardous materials with the potential to contaminate groundwater may not be stored or handled in areas of the site draining to an infiltration area. An “infiltration area” is any area of the site that by design or as a result of soils, topography and other relevant factors accumulates runoff that infiltrates into the soil. Dikes, berms, sumps, and other forms of secondary containment that prevent discharge to groundwater may be used to isolate portions of the site for the purposes of storage and handling of these materials.

- The minimum practical quantity of all such materials will be kept on the job site.

- A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided at the storage site.

- Manufacturers recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.

In the event of a spill, the following procedures should be followed:

- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with the hazardous substances.
- The project manager and the Engineer of Record will be notified immediately.
- Spills of toxic or hazardous materials will be reported to the appropriate federal, state, and/or local government agency, regardless of the size of the spill.
- If the spill exceeds a Reportable Quantity, the SWPPP must be modified within seven (7) calendar days of knowledge of the discharge to provide a description of the release, the circumstances leading to the release, and the date of the release. The plans must identify measures to prevent the recurrence of such releases and to respond to such releases.

The job site superintendent will be the spill prevention and response coordinator. He will designate the individuals who will receive spill prevention and response training. These individuals will each become responsible for a particular phase of prevention and response. The names of these personnel will be posted in the material storage area and in the office trailer on-site.

### *10.2.4 Allowable Non-Stormwater Discharge Management*

Certain types of discharges are allowed under the NPDES General Permit for Construction Activity and it is the intent of this project to allow such discharges. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come into contact with the water prior to or after its discharge. The control measures that have been outlined previously in this report will be strictly followed to ensure that no contamination of these non-stormwater discharges takes place. The following non-stormwater discharges that may occur from the job site include:

- Discharges from fire-fighting activities
- Fire hydrant flushing
- Waters used to wash vehicles where detergents are not used
- Water used to control dust in accordance with off-site vehicle tracking
- Potable water including uncontaminated water line flushing
- Routine external building wash down that does not use detergents
- Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used
- Uncontaminated air conditioner compressor condensate

- Uncontaminated ground water or spring water
- Foundation or footing drains where flows are not contaminated with process materials such as solvents
- Uncontaminated excavation dewatering
- Landscape irrigation

## 11.0 STANDARD 9: OPERATION & MAINTENANCE PLAN

The goal of the Operation and Maintenance (O&M) plan is not only to protect resources on-site or nearby, but also to protect resources in the region that may be affected by the activities at the site. Harvard will continue to be responsible for the operation and maintenance of the stormwater management system using current practices which include litter pick-up, street sweeping, catch basin and BMP cleanings. The O&M plan is included in Appendix F.

## 12.0 STANDARD 10: PROHIBITION OF ILLICIT DISCHARGES

Standard 10 of the Massachusetts Stormwater Handbook prohibits illicit discharges to stormwater management systems. As stated in the handbook, "The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater."

Proponents of projects within Wetland's jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system.

Standard 10 also states that "The Illicit Discharge Compliance Statement must be accompanied by a site map that is drawn to scale and that identifies the location of any systems for conveying stormwater on the site and shows that these systems do not allow the entry of any illicit discharges into the stormwater management system. The site map shall identify the location of any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater management systems and the location of any measures taken to prevent the entry of illicit discharges into the stormwater management system." Included with the Notice of Intent Submission are construction plans that displays the location of all the stormwater management components as well as other utilities (existing and proposed) on the project site and conforms to requirements of a "site map" to accompany the Illicit Discharge Compliance Statement.

An Illicit Discharge Compliance Statement is included in *Appendix E – Illicit Discharge Compliance Statement* of this Report.

Where a new, closed drainage system will be constructed, there will be no connections to sanitary sewer. In other areas, stormwater runoff discharges via overland flow.

# 13.0 COMPLIANCE WITH THE CHARLES RIVER TMDL

The site is located within the Lower Charles River Basin which has a TMDL for phosphorous and pathogens. The "Total Maximum Daily Load for Nutrients in the Lower Charles River Basin, Massachusetts CN 301.0" report, by DEP and EPA Region 1, dated June 2007 states that the Lower Charles River TMDL requires an overall 54 percent reduction in the phosphorous (TP) load. Table ES-2, Summary of Phosphorous TMDL for the Lower Charles River, in this report, breaks up the different components of the river and assigns a phosphorous reduction based on the Waste Load Allocation. The phosphorous reduction required for the site falls under Other Drainage Areas and requires a 65% phosphorous reduction. In addition to the total TMDL reduction for the Lower Charles River, there are specific TMDL's for land uses within the Charles River. This project is designated as Low Density Residential for land use. The TMDL for Low Density Residential requires 45% TP reduction as noted in Table 4 of the report noted above. To be conservative, the project has assumed a 65% TP reduction.

## 13.1 PHOSPHOROUS (TP) REDUCTION

The Project will exceed the 65% TP reduction for the Lower Charles River with the implementation of a subsurface system, bioretention basin and three infiltration trenches. The Structural BMP specification per the Massachusetts Stormwater Handbook identifies 30 to 90 percent TP removal for bioretention basins and 40 to 70 percent TP removal for infiltration trenches.

In addition to the MA Stormwater Handbook BMP specification, calculations are included comparing the provided recharge volume against the required total phosphorous per the Technical Report BMP Performance Curves in the Stormwater Best Management Practices (BMP) Performance Analysis by Tetra Tech, Inc., dated December 2008 for The United States Environmental Protection Agency – Region 1. The TP performance curve parameters are based off the following:

- BMP Performance Curve: Bioretention Basin, Infiltration Trench
- Land Use: Low Density Residential
- Soil Infiltration Rate: 0.27 in/hr (for "C" soils)
- Pollutant Removal Percentage (TP) Required : 65%
- Minimum Depth of Runoff required to be treated to meet 65% TP Removal: 0.37 inches

The Project Site will treat 4.07 inches of runoff in the bioretention basin as demonstrated in the TMDL Phosphorous Reduction calculations, resulting in 100% TP removal. The site will also treat 1.35, 1.06, and 1.35 inches of runoff in infiltration trenches 1, 2, and 3 respectively resulting in a minimum of 88% TP removal. The total combined TP removal for all BMPs for the site exceeds the Lower Charles River TMDL TP reduction requirement. A copy of the BMP Performance curves, and reduction calculations are included in Appendix C.

## 13.2 PATHOGEN REDUCTION

The "*Final Pathogen TMDL for the Charles River Watershed*" report, by DEP and EPA Region 1, dated January 2007 state that pathogen indicators consist of illicit connection of sewage to storm drains (discharging in dry or wet weather or both), failing sewer infrastructure, Combined Sewer Overflows (CSO's) and storm water discharges (included sheet flow runoff) are the leading sources of bacterial surface water pollution in the Charles Watershed. The proposed program will address pathogen pollution with the following mitigation measures:

- Illicit Connections:

There are no known illicit discharges at the Site.

- Failing Sewer Infrastructure:

There is currently no indication of any failing sewer infrastructure at the Site.

- Combined Sewer Overflows (CSOs):

There are no CSO's at the Site.

- Stormwater Runoff:

As stated previously, the Project will improve the water quality of runoff prior to discharging to the Charles River. Currently, runoff from the existing paved surfaces discharges with little to no treatment into the Charles River. Stormwater runoff will be managed through a system of BMPs including a bioretention area, infiltration trenches, and propriety water quality structure with a subsurface system. Stormwater runoff from paved areas will be treated where feasible to meet the requirements as outlined in the Massachusetts Stormwater Handbook. BMPs will achieve TSS removal greater than 80%. All DEP Stormwater Management Standards will be met.

Based on the above implementation measures the Project as designed will reduce the TMDL for pathogens (bacterial pollution) to the maximum extent practicable within the Charles River.

## *STORMWATER APPENDICIES*

Appendix A – Checklists

Appendix B – Hydrologic Calculations

Appendix C – Water Quality Calculations

Appendix D – Soil Information

Appendix E – Illicit Discharge Compliance Statement

Appendix F – Operation & Maintenance Plan (O&M)

Appendix G – Plans (Under Separate Cover)

## *APPENDIX A*

CHECKLISTS

- Massachusetts Stormwater Report Checklist
- Redevelopment Checklist

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

# Checklist for Stormwater Report

## A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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

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

# 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

COMMONWEALTH OF MASSACHUSETTS
JAMES W. THORNE
CIVIL
NO. 54912
REGISTERED PROFESSIONAL ENGINEER

8/25/2021

Signature and Date

## Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

# Checklist for Stormwater Report

## Checklist (continued)

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

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

**Standard 1: No New Untreated Discharges**

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

## **Checklist** (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.

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

## 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** (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 (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 (continued)

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

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

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

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

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

**Standard 9: Operation and Maintenance Plan**

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

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

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

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

**Standard 10: Prohibition of Illicit Discharges**

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

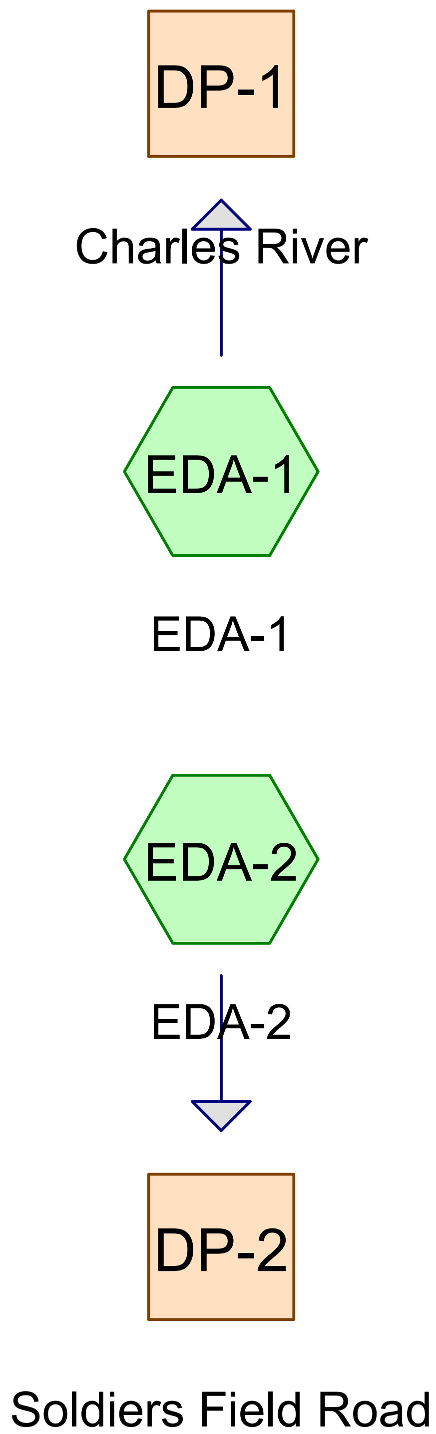
☒ An Illicit Discharge Compliance Statement is attached;

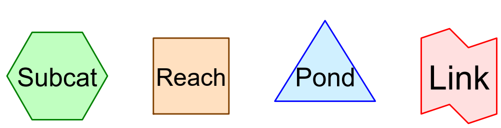
☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

## *APPENDIX B*

HYDROLOGIC CALCULATIONS

- Existing Conditions Calculations
- Proposed Conditions Calculations




**Routing Diagram for Existing Conditions**
Prepared by S. Barre - Green International, Printed 3/25/2022

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 1.211 | 74 | >75% Grass cover, Good, HSG C (EDA-1, EDA-2) |
| 0.113 | 87 | Dirt roads, HSG C (EDA-1) |
| 0.291 | 96 | Gravel surface, HSG C (EDA-1, EDA-2) |
| 0.115 | 98 | Paved parking, HSG C (EDA-1) |
| 0.149 | 98 | Paved roads w/curbs & sewers, HSG C (EDA-2) |
| 0.363 | 98 | Roofs, HSG C (EDA-1, EDA-2) |
| **2.241** | **84** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 2.241 | HSG C | EDA-1, EDA-2 |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **2.241** | | **TOTAL AREA** |

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EDA-1: EDA-1** Runoff Area=80,786 sf 24.04% Impervious Runoff Depth=1.66"
Tc=6.0 min CN=83 Runoff=3.53 cfs 0.256 af

**Subcatchment EDA-2: EDA-2** Runoff Area=16,852 sf 46.84% Impervious Runoff Depth=2.31"
Tc=6.0 min CN=91 Runoff=1.01 cfs 0.075 af

**Reach DP-1: Charles River** Inflow=3.53 cfs 0.256 af
Outflow=3.53 cfs 0.256 af

**Reach DP-2: Soldiers Field Road** Inflow=1.01 cfs 0.075 af
Outflow=1.01 cfs 0.075 af

**Total Runoff Area = 2.241 ac Runoff Volume = 0.331 af Average Runoff Depth = 1.77"**
**72.03% Pervious = 1.614 ac 27.97% Impervious = 0.627 ac**

## Summary for Subcatchment EDA-1: EDA-1

Runoff = 3.53 cfs @ 12.09 hrs, Volume= 0.256 af, Depth= 1.66"
Routed to Reach DP-1 : Charles River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| Area (sf) | CN | Description |
|---|---|---|
| 47,876 | 74 | >75% Grass cover, Good, HSG C |
| 5,016 | 98 | Paved parking, HSG C |
| 4,910 | 87 | Dirt roads, HSG C |
| 14,403 | 98 | Roofs, HSG C |
| 8,581 | 96 | Gravel surface, HSG C |
| 80,786 | 83 | Weighted Average |
| 61,367 | | 75.96% Pervious Area |
| 19,419 | | 24.04% Impervious Area |

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

## Summary for Subcatchment EDA-2: EDA-2

Runoff = 1.01 cfs @ 12.09 hrs, Volume= 0.075 af, Depth= 2.31"
Routed to Reach DP-2 : Soldiers Field Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| Area (sf) | CN | Description |
|---|---|---|
| 6,497 | 98 | Paved roads w/curbs & sewers, HSG C |
| 0 | 87 | Dirt roads, HSG C |
| 4,859 | 74 | >75% Grass cover, Good, HSG C |
| 1,397 | 98 | Roofs, HSG C |
| 4,099 | 96 | Gravel surface, HSG C |
| 16,852 | 91 | Weighted Average |
| 8,958 | | 53.16% Pervious Area |
| 7,894 | | 46.84% Impervious Area |

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

## Summary for Reach DP-1: Charles River

Inflow Area = 1.855 ac, 24.04% Impervious, Inflow Depth = 1.66" for 2-Year event
Inflow = 3.53 cfs @ 12.09 hrs, Volume= 0.256 af
Outflow = 3.53 cfs @ 12.09 hrs, Volume= 0.256 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

## Summary for Reach DP-2: Soldiers Field Road

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 0.387 ac, 46.84% Impervious, | Inflow Depth = 2.31" | for 2-Year event | |
| Inflow = | 1.01 cfs @ | 12.09 hrs, Volume= | 0.075 af | |
| Outflow = | 1.01 cfs @ | 12.09 hrs, Volume= | 0.075 af, | Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EDA-1: EDA-1** Runoff Area=80,786 sf 24.04% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=83 Runoff=6.54 cfs 0.477 af

**Subcatchment EDA-2: EDA-2** Runoff Area=16,852 sf 46.84% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=91 Runoff=1.65 cfs 0.125 af

**Reach DP-1: Charles River** Inflow=6.54 cfs 0.477 af
Outflow=6.54 cfs 0.477 af

**Reach DP-2: Soldiers Field Road** Inflow=1.65 cfs 0.125 af
Outflow=1.65 cfs 0.125 af

**Total Runoff Area = 2.241 ac Runoff Volume = 0.602 af Average Runoff Depth = 3.22"**
**72.03% Pervious = 1.614 ac 27.97% Impervious = 0.627 ac**

## Summary for Subcatchment EDA-1: EDA-1

Runoff = 6.54 cfs @ 12.09 hrs, Volume= 0.477 af, Depth= 3.08"
Routed to Reach DP-1 : Charles River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| Area (sf) | CN | Description |
|---|---|---|
| 47,876 | 74 | >75% Grass cover, Good, HSG C |
| 5,016 | 98 | Paved parking, HSG C |
| 4,910 | 87 | Dirt roads, HSG C |
| 14,403 | 98 | Roofs, HSG C |
| 8,581 | 96 | Gravel surface, HSG C |
| 80,786 | 83 | Weighted Average |
| 61,367 | | 75.96% Pervious Area |
| 19,419 | | 24.04% Impervious Area |

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

## Summary for Subcatchment EDA-2: EDA-2

Runoff = 1.65 cfs @ 12.09 hrs, Volume= 0.125 af, Depth= 3.89"
Routed to Reach DP-2 : Soldiers Field Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| Area (sf) | CN | Description |
|---|---|---|
| 6,497 | 98 | Paved roads w/curbs & sewers, HSG C |
| 0 | 87 | Dirt roads, HSG C |
| 4,859 | 74 | >75% Grass cover, Good, HSG C |
| 1,397 | 98 | Roofs, HSG C |
| 4,099 | 96 | Gravel surface, HSG C |
| 16,852 | 91 | Weighted Average |
| 8,958 | | 53.16% Pervious Area |
| 7,894 | | 46.84% Impervious Area |

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

## Summary for Reach DP-1: Charles River

Inflow Area = 1.855 ac, 24.04% Impervious, Inflow Depth = 3.08" for 10-Year event
Inflow = 6.54 cfs @ 12.09 hrs, Volume= 0.477 af
Outflow = 6.54 cfs @ 12.09 hrs, Volume= 0.477 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

## Summary for Reach DP-2: Soldiers Field Road

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 0.387 ac, | 46.84% Impervious, | Inflow Depth = 3.89" | for 10-Year event | |
| Inflow = | 1.65 cfs @ | 12.09 hrs, | Volume= | 0.125 af | |
| Outflow = | 1.65 cfs @ | 12.09 hrs, | Volume= | 0.125 af, | Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EDA-1: EDA-1** Runoff Area=80,786 sf 24.04% Impervious Runoff Depth=4.27"
Tc=6.0 min CN=83 Runoff=8.96 cfs 0.660 af

**Subcatchment EDA-2: EDA-2** Runoff Area=16,852 sf 46.84% Impervious Runoff Depth=5.14"
Tc=6.0 min CN=91 Runoff=2.15 cfs 0.166 af

**Reach DP-1: Charles River** Inflow=8.96 cfs 0.660 af
Outflow=8.96 cfs 0.660 af

**Reach DP-2: Soldiers Field Road** Inflow=2.15 cfs 0.166 af
Outflow=2.15 cfs 0.166 af

**Total Runoff Area = 2.241 ac Runoff Volume = 0.825 af Average Runoff Depth = 4.42"**
**72.03% Pervious = 1.614 ac 27.97% Impervious = 0.627 ac**

## Summary for Subcatchment EDA-1: EDA-1

Runoff = 8.96 cfs @ 12.09 hrs, Volume= 0.660 af, Depth= 4.27"
Routed to Reach DP-1 : Charles River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| Area (sf) | CN | Description |
|---|---|---|
| 47,876 | 74 | >75% Grass cover, Good, HSG C |
| 5,016 | 98 | Paved parking, HSG C |
| 4,910 | 87 | Dirt roads, HSG C |
| 14,403 | 98 | Roofs, HSG C |
| 8,581 | 96 | Gravel surface, HSG C |
| 80,786 | 83 | Weighted Average |
| 61,367 | | 75.96% Pervious Area |
| 19,419 | | 24.04% Impervious Area |

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

## Summary for Subcatchment EDA-2: EDA-2

Runoff = 2.15 cfs @ 12.09 hrs, Volume= 0.166 af, Depth= 5.14"
Routed to Reach DP-2 : Soldiers Field Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| Area (sf) | CN | Description |
|---|---|---|
| 6,497 | 98 | Paved roads w/curbs & sewers, HSG C |
| 0 | 87 | Dirt roads, HSG C |
| 4,859 | 74 | >75% Grass cover, Good, HSG C |
| 1,397 | 98 | Roofs, HSG C |
| 4,099 | 96 | Gravel surface, HSG C |
| 16,852 | 91 | Weighted Average |
| 8,958 | | 53.16% Pervious Area |
| 7,894 | | 46.84% Impervious Area |

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

## Summary for Reach DP-1: Charles River

Inflow Area = 1.855 ac, 24.04% Impervious, Inflow Depth = 4.27" for 25-Year event
Inflow = 8.96 cfs @ 12.09 hrs, Volume= 0.660 af
Outflow = 8.96 cfs @ 12.09 hrs, Volume= 0.660 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

## Summary for Reach DP-2: Soldiers Field Road

| | | | |
|---|---|---|---|
| Inflow Area = | 0.387 ac, 46.84% Impervious, Inflow Depth = 5.14" | for 25-Year event | |
| Inflow = | 2.15 cfs @ 12.09 hrs, Volume= | 0.166 af | |
| Outflow = | 2.15 cfs @ 12.09 hrs, Volume= | 0.166 af, Atten= 0%, Lag= 0.0 min | |

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EDA-1: EDA-1** Runoff Area=80,786 sf 24.04% Impervious Runoff Depth=6.77"
Tc=6.0 min CN=83 Runoff=13.93 cfs 1.047 af

**Subcatchment EDA-2: EDA-2** Runoff Area=16,852 sf 46.84% Impervious Runoff Depth=7.74"
Tc=6.0 min CN=91 Runoff=3.16 cfs 0.250 af

**Reach DP-1: Charles River** Inflow=13.93 cfs 1.047 af
Outflow=13.93 cfs 1.047 af

**Reach DP-2: Soldiers Field Road** Inflow=3.16 cfs 0.250 af
Outflow=3.16 cfs 0.250 af

**Total Runoff Area = 2.241 ac Runoff Volume = 1.296 af Average Runoff Depth = 6.94"**
**72.03% Pervious = 1.614 ac 27.97% Impervious = 0.627 ac**

## Summary for Subcatchment EDA-1: EDA-1

Runoff = 13.93 cfs @ 12.09 hrs, Volume= 1.047 af, Depth= 6.77"
Routed to Reach DP-1 : Charles River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| Area (sf) | CN | Description |
|---|---|---|
| 47,876 | 74 | >75% Grass cover, Good, HSG C |
| 5,016 | 98 | Paved parking, HSG C |
| 4,910 | 87 | Dirt roads, HSG C |
| 14,403 | 98 | Roofs, HSG C |
| 8,581 | 96 | Gravel surface, HSG C |
| 80,786 | 83 | Weighted Average |
| 61,367 | | 75.96% Pervious Area |
| 19,419 | | 24.04% Impervious Area |

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

## Summary for Subcatchment EDA-2: EDA-2

Runoff = 3.16 cfs @ 12.09 hrs, Volume= 0.250 af, Depth= 7.74"
Routed to Reach DP-2 : Soldiers Field Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| Area (sf) | CN | Description |
|---|---|---|
| 6,497 | 98 | Paved roads w/curbs & sewers, HSG C |
| 0 | 87 | Dirt roads, HSG C |
| 4,859 | 74 | >75% Grass cover, Good, HSG C |
| 1,397 | 98 | Roofs, HSG C |
| 4,099 | 96 | Gravel surface, HSG C |
| 16,852 | 91 | Weighted Average |
| 8,958 | | 53.16% Pervious Area |
| 7,894 | | 46.84% Impervious Area |

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

## Summary for Reach DP-1: Charles River

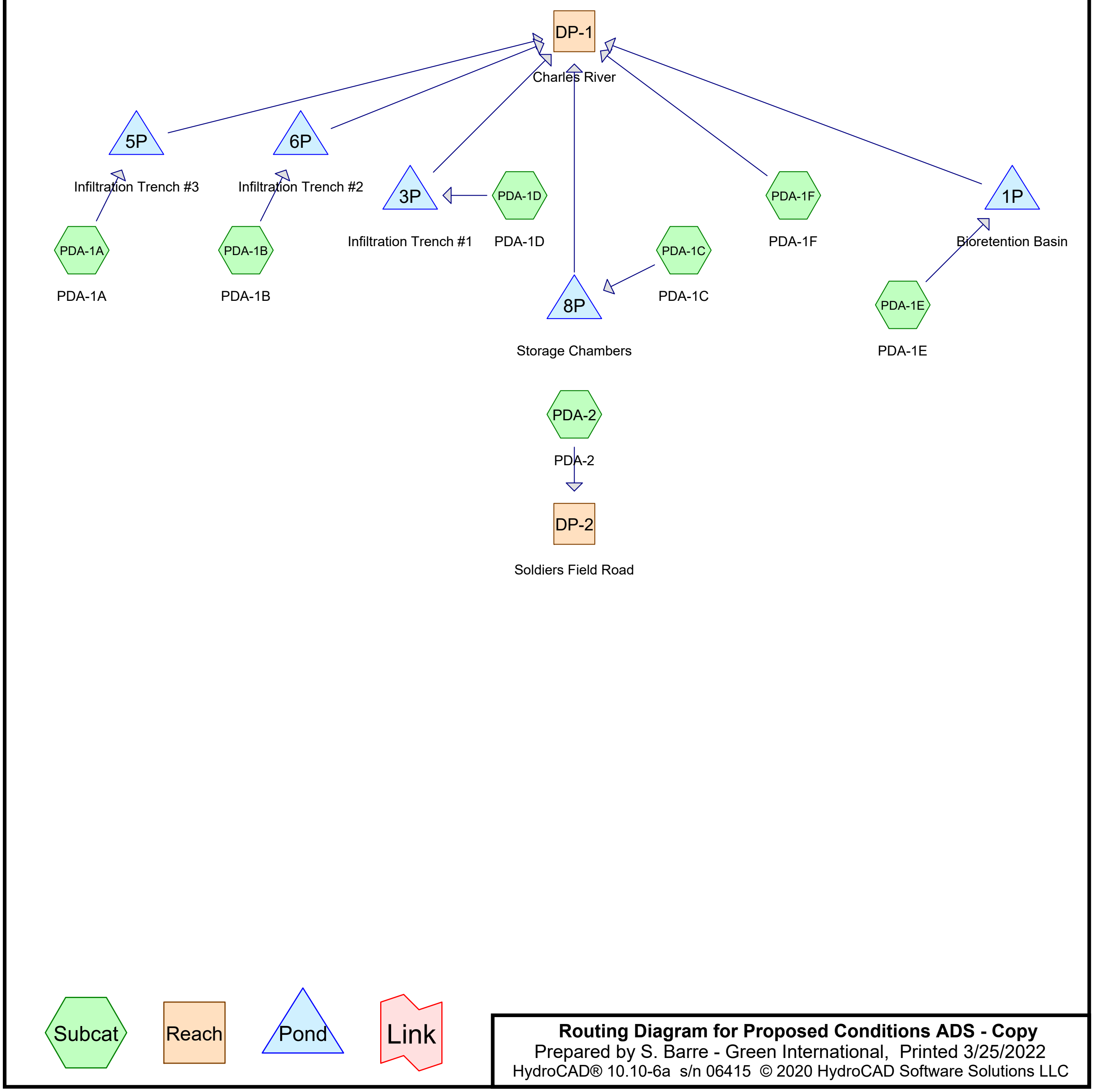
Inflow Area = 1.855 ac, 24.04% Impervious, Inflow Depth = 6.77" for 100-Year event
Inflow = 13.93 cfs @ 12.09 hrs, Volume= 1.047 af
Outflow = 13.93 cfs @ 12.09 hrs, Volume= 1.047 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

## Summary for Reach DP-2: Soldiers Field Road

| | | | |
|---|---|---|---|
| Inflow Area = | 0.387 ac, 46.84% Impervious, Inflow Depth = 7.74" | for 100-Year event | |
| Inflow = | 3.16 cfs @ 12.09 hrs, Volume= | 0.250 af | |
| Outflow = | 3.16 cfs @ 12.09 hrs, Volume= | 0.250 af, | Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs




**Routing Diagram for Proposed Conditions ADS - Copy**
Prepared by S. Barre - Green International, Printed 3/25/2022
HydroCAD® 10.10-6a s/n 06415 © 2020 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 1.061 | 74 | >75% Grass cover, Good, HSG C (PDA-1C, PDA-1D, PDA-1E, PDA-1F, PDA-2) |
| 0.075 | 98 | Concrete, HSG C (PDA-1F) |
| 0.097 | 87 | Dirt roads, HSG C (PDA-1F) |
| 0.170 | 89 | Gravel roads, HSG C (PDA-1C, PDA-1D, PDA-1F) |
| 0.017 | 98 | Infiltration Trench, HSG C (PDA-1B) |
| 0.461 | 98 | Paved parking, HSG C (PDA-1C, PDA-1D, PDA-1E, PDA-2) |
| 0.360 | 98 | Roofs, HSG C (PDA-1A, PDA-1B, PDA-1C, PDA-1D, PDA-1E, PDA-1F) |
| **2.241** | **85** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 2.241 | HSG C | PDA-1A, PDA-1B, PDA-1C, PDA-1D, PDA-1E, PDA-1F, PDA-2 |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **2.241** | | **TOTAL AREA** |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Width (inches) | Diam/Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3P | 9.50 | 9.20 | 21.3 | 0.0141 | 0.012 | 0.0 | 12.0 | 0.0 |
| 2 | 8P | 9.00 | 8.90 | 95.5 | 0.0010 | 0.013 | 0.0 | 12.0 | 0.0 |

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment PDA-1A: PDA-1A** Runoff Area=1,604 sf 100.00% Impervious Runoff Depth=3.03"
Tc=6.0 min CN=98 Runoff=0.12 cfs 0.009 af

**Subcatchment PDA-1B: PDA-1B** Runoff Area=2,369 sf 100.00% Impervious Runoff Depth=3.03"
Tc=6.0 min CN=98 Runoff=0.17 cfs 0.014 af

**Subcatchment PDA-1C: PDA-1C** Runoff Area=13,919 sf 85.78% Impervious Runoff Depth=2.81"
Tc=6.0 min CN=96 Runoff=0.98 cfs 0.075 af

**Subcatchment PDA-1D: PDA-1D** Runoff Area=6,381 sf 83.91% Impervious Runoff Depth=2.70"
Tc=6.0 min CN=95 Runoff=0.44 cfs 0.033 af

**Subcatchment PDA-1E: PDA-1E** Runoff Area=12,121 sf 48.79% Impervious Runoff Depth=1.89"
Tc=6.0 min CN=86 Runoff=0.62 cfs 0.044 af

**Subcatchment PDA-1F: PDA-1F** Runoff Area=50,395 sf 11.79% Impervious Runoff Depth=1.45"
Tc=6.0 min CN=80 Runoff=1.95 cfs 0.140 af

**Subcatchment PDA-2: PDA-2** Runoff Area=10,850 sf 61.22% Impervious Runoff Depth=2.14"
Tc=6.0 min CN=89 Runoff=0.62 cfs 0.044 af

**Reach DP-1: Charles River** Inflow=2.54 cfs 0.250 af
Outflow=2.54 cfs 0.250 af

**Reach DP-2: Soldiers Field Road** Inflow=0.62 cfs 0.044 af
Outflow=0.62 cfs 0.044 af

**Pond 1P: Bioretention Basin** Peak Elev=12.47' Storage=1,906 cf Inflow=0.62 cfs 0.044 af
Outflow=0.00 cfs 0.000 af

**Pond 3P: Infiltration Trench #1** Peak Elev=13.10' Storage=645 cf Inflow=0.44 cfs 0.033 af
Outflow=0.34 cfs 0.019 af

**Pond 5P: Infiltration Trench #3** Peak Elev=11.41' Storage=147 cf Inflow=0.12 cfs 0.009 af
Outflow=0.12 cfs 0.006 af

**Pond 6P: Infiltration Trench #2** Peak Elev=11.41' Storage=118 cf Inflow=0.17 cfs 0.014 af
Outflow=0.17 cfs 0.011 af

**Pond 8P: Storage Chambers** Peak Elev=10.26' Storage=946 cf Inflow=0.98 cfs 0.075 af
Outflow=0.25 cfs 0.074 af

**Total Runoff Area = 2.241 ac Runoff Volume = 0.359 af Average Runoff Depth = 1.92"**
**59.27% Pervious = 1.329 ac 40.73% Impervious = 0.913 ac**

## Summary for Subcatchment PDA-1A: PDA-1A

Runoff = 0.12 cfs @ 12.08 hrs, Volume= 0.009 af, Depth= 3.03"
Routed to Pond 5P : Infiltration Trench #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 1,604 | 98 | Roofs, HSG C |
| | 1,604 | | 100.00% Impervious Area |

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

## Summary for Subcatchment PDA-1B: PDA-1B

Runoff = 0.17 cfs @ 12.08 hrs, Volume= 0.014 af, Depth= 3.03"
Routed to Pond 6P : Infiltration Trench #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 1,625 | 98 | Roofs, HSG C |
| * | 744 | 98 | Infiltration Trench, HSG C |
| | 2,369 | 98 | Weighted Average |
| | 2,369 | | 100.00% Impervious Area |

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

## Summary for Subcatchment PDA-1C: PDA-1C

Runoff = 0.98 cfs @ 12.08 hrs, Volume= 0.075 af, Depth= 2.81"
Routed to Pond 8P : Storage Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 10,353 | 98 | Paved parking, HSG C |
| | 1,587 | 98 | Roofs, HSG C |
| | 770 | 74 | >75% Grass cover, Good, HSG C |
| | 1,209 | 89 | Gravel roads, HSG C |
| | 13,919 | 96 | Weighted Average |
| | 1,979 | | 14.22% Pervious Area |
| | 11,940 | | 85.78% Impervious Area |

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

## Summary for Subcatchment PDA-1D: PDA-1D

Runoff = 0.44 cfs @ 12.08 hrs, Volume= 0.033 af, Depth= 2.70"
Routed to Pond 3P : Infiltration Trench #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| Area (sf) | CN | Description |
|---|---|---|
| 3,425 | 98 | Roofs, HSG C |
| 1,929 | 98 | Paved parking, HSG C |
| 862 | 74 | >75% Grass cover, Good, HSG C |
| 165 | 89 | Gravel roads, HSG C |
| 6,381 | 95 | Weighted Average |
| 1,027 | | 16.09% Pervious Area |
| 5,354 | | 83.91% Impervious Area |

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

## Summary for Subcatchment PDA-1E: PDA-1E

Runoff = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af, Depth= 1.89"
Routed to Pond 1P : Bioretention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| Area (sf) | CN | Description |
|---|---|---|
| 4,747 | 98 | Roofs, HSG C |
| 1,167 | 98 | Paved parking, HSG C |
| 6,207 | 74 | >75% Grass cover, Good, HSG C |
| 12,121 | 86 | Weighted Average |
| 6,207 | | 51.21% Pervious Area |
| 5,914 | | 48.79% Impervious Area |

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

## Summary for Subcatchment PDA-1F: PDA-1F

Runoff = 1.95 cfs @ 12.09 hrs, Volume= 0.140 af, Depth= 1.45"
Routed to Reach DP-1 : Charles River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 34,185 | 74 | >75% Grass cover, Good, HSG C |
| | 2,696 | 98 | Roofs, HSG C |
| | 6,032 | 89 | Gravel roads, HSG C |
| | 4,235 | 87 | Dirt roads, HSG C |
| * | 3,247 | 98 | Concrete, HSG C |
| | 50,395 | 80 | Weighted Average |
| | 44,452 | | 88.21% Pervious Area |
| | 5,943 | | 11.79% Impervious Area |

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

## Summary for Subcatchment PDA-2: PDA-2

Runoff = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af, Depth= 2.14"
Routed to Reach DP-2 : Soldiers Field Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.26"

| Area (sf) | CN | Description |
|---|---|---|
| 4,208 | 74 | >75% Grass cover, Good, HSG C |
| 6,642 | 98 | Paved parking, HSG C |
| 10,850 | 89 | Weighted Average |
| 4,208 | | 38.78% Pervious Area |
| 6,642 | | 61.22% Impervious Area |

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

## Summary for Reach DP-1: Charles River

Inflow Area = 1.992 ac, 38.17% Impervious, Inflow Depth = 1.51" for 2-Year event
Inflow = 2.54 cfs @ 12.12 hrs, Volume= 0.250 af
Outflow = 2.54 cfs @ 12.12 hrs, Volume= 0.250 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Summary for Reach DP-2: Soldiers Field Road

Inflow Area = 0.249 ac, 61.22% Impervious, Inflow Depth = 2.14" for 2-Year event
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af
Outflow = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Bioretention Basin

Inflow Area = 0.278 ac, 48.79% Impervious, Inflow Depth = 1.89" for 2-Year event
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 12.47' @ 24.34 hrs Surf.Area= 3,148 sf Storage= 1,906 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 3,214 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc)<br>5,404 cf Overall - 2,190 cf Embedded = 3,214 cf |
| #2 | 11.00' | 657 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) Inside #1<br>2,190 cf Overall x 30.0% Voids |
| | | 3,871 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 2,190 | 0 | 0 |
| 12.00 | 2,190 | 2,190 | 2,190 |
| 13.00 | 4,237 | 3,214 | 5,404 |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 2,190 | 0 | 0 |
| 12.00 | 2,190 | 2,190 | 2,190 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.50' | **12.0' long x 14.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63 |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=11.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Summary for Pond 3P: Infiltration Trench #1

Inflow Area = 0.146 ac, 83.91% Impervious, Inflow Depth = 2.70" for 2-Year event
Inflow = 0.44 cfs @ 12.08 hrs, Volume= 0.033 af
Outflow = 0.34 cfs @ 12.15 hrs, Volume= 0.019 af, Atten= 23%, Lag= 4.0 min
Primary = 0.34 cfs @ 12.15 hrs, Volume= 0.019 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 13.10' @ 12.15 hrs Surf.Area= 1,023 sf Storage= 645 cf

Plug-Flow detention time= 203.8 min calculated for 0.019 af (57% of inflow)
Center-of-Mass det. time= 97.1 min ( 877.5 - 780.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 691 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>2,302 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 1,023 | 0 | 0 |
| 13.00 | 1,023 | 2,046 | 2,046 |
| 13.25 | 1,023 | 256 | 2,302 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Device 2 | 13.00' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #2 | Primary | 9.50' | **12.0" Round Culvert**<br>L= 21.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 9.50' / 9.20' S= 0.0141 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf |

**Primary OutFlow** Max=0.34 cfs @ 12.15 hrs HW=13.10' (Free Discharge)
└**2=Culvert** (Passes 0.34 cfs of 5.26 cfs potential flow)
　└**1=Orifice/Grate** (Weir Controls 0.34 cfs @ 1.05 fps)

## Summary for Pond 5P: Infiltration Trench #3

Inflow Area = 0.037 ac,100.00% Impervious, Inflow Depth = 3.03" for 2-Year event
Inflow = 0.12 cfs @ 12.08 hrs, Volume= 0.009 af
Outflow = 0.12 cfs @ 12.09 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.3 min
Primary = 0.12 cfs @ 12.09 hrs, Volume= 0.006 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 11.41' @ 12.09 hrs Surf.Area= 1,200 sf Storage= 147 cf

Plug-Flow detention time= 192.2 min calculated for 0.006 af (64% of inflow)
Center-of-Mass det. time= 90.2 min ( 846.2 - 756.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 180 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>600 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 1,200 | 0 | 0 |
| 11.50 | 1,200 | 600 | 600 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 11.40' | **78.0' long x 4.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66<br>2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32 |

**Primary OutFlow** Max=0.11 cfs @ 12.09 hrs HW=11.41' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.11 cfs @ 0.20 fps)

## Summary for Pond 6P: Infiltration Trench #2

Inflow Area = 0.054 ac,100.00% Impervious, Inflow Depth = 3.03" for 2-Year event
Inflow = 0.17 cfs @ 12.08 hrs, Volume= 0.014 af
Outflow = 0.17 cfs @ 12.09 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.2 min
Primary = 0.17 cfs @ 12.09 hrs, Volume= 0.011 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 11.41' @ 12.09 hrs Surf.Area= 960 sf Storage= 118 cf

Plug-Flow detention time= 134.9 min calculated for 0.011 af (81% of inflow)
Center-of-Mass det. time= 60.1 min ( 816.1 - 756.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 144 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>480 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 960 | 0 | 0 |
| 11.50 | 960 | 480 | 480 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 11.40' | **78.0' long x 4.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66<br>2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32 |

**Primary OutFlow** Max=0.17 cfs @ 12.09 hrs HW=11.41' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.17 cfs @ 0.23 fps)

## Summary for Pond 8P: Storage Chambers

Inflow Area = 0.320 ac, 85.78% Impervious, Inflow Depth = 2.81" for 2-Year event
Inflow = 0.98 cfs @ 12.08 hrs, Volume= 0.075 af
Outflow = 0.25 cfs @ 12.45 hrs, Volume= 0.074 af, Atten= 74%, Lag= 21.9 min
Primary = 0.25 cfs @ 12.45 hrs, Volume= 0.074 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 10.26' @ 12.45 hrs Surf.Area= 1,412 sf Storage= 946 cf

Plug-Flow detention time= 50.2 min calculated for 0.074 af (100% of inflow)
Center-of-Mass det. time= 47.5 min ( 821.0 - 773.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 8.97' | 604 cf | **27.00'W x 52.31'L x 1.83'H Field A**<br>2,589 cf Overall - 574 cf Embedded = 2,015 cf x 30.0% Voids |
| #2A | 9.30' | 574 cf | **ADS_StormTech SC-160LP +Cap** x 84 Inside #1<br>Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf<br>Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap<br>84 Chambers in 12 Rows |
| | | 1,179 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 9.00' | **12.0" Round Culvert**<br>L= 95.5' CMP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 9.00' / 8.90' S= 0.0010 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 10.35' | **4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>0.5' Crest Height |
| #3 | Device 1 | 9.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |

**Primary OutFlow** Max=0.25 cfs @ 12.45 hrs HW=10.26' (Free Discharge)
└─**1=Culvert** (Passes 0.25 cfs of 1.99 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 0.25 cfs @ 5.12 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment PDA-1A: PDA-1A** Runoff Area=1,604 sf 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.18 cfs 0.014 af

**Subcatchment PDA-1B: PDA-1B** Runoff Area=2,369 sf 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=98 Runoff=0.26 cfs 0.021 af

**Subcatchment PDA-1C: PDA-1C** Runoff Area=13,919 sf 85.78% Impervious Runoff Depth=4.43"
Tc=6.0 min CN=96 Runoff=1.51 cfs 0.118 af

**Subcatchment PDA-1D: PDA-1D** Runoff Area=6,381 sf 83.91% Impervious Runoff Depth=4.32"
Tc=6.0 min CN=95 Runoff=0.68 cfs 0.053 af

**Subcatchment PDA-1E: PDA-1E** Runoff Area=12,121 sf 48.79% Impervious Runoff Depth=3.37"
Tc=6.0 min CN=86 Runoff=1.09 cfs 0.078 af

**Subcatchment PDA-1F: PDA-1F** Runoff Area=50,395 sf 11.79% Impervious Runoff Depth=2.81"
Tc=6.0 min CN=80 Runoff=3.81 cfs 0.271 af

**Subcatchment PDA-2: PDA-2** Runoff Area=10,850 sf 61.22% Impervious Runoff Depth=3.68"
Tc=6.0 min CN=89 Runoff=1.04 cfs 0.076 af

**Reach DP-1: Charles River** Inflow=5.94 cfs 0.489 af
Outflow=5.94 cfs 0.489 af

**Reach DP-2: Soldiers Field Road** Inflow=1.04 cfs 0.076 af
Outflow=1.04 cfs 0.076 af

**Pond 1P: Bioretention Basin** Peak Elev=12.52' Storage=2,083 cf Inflow=1.09 cfs 0.078 af
Outflow=0.12 cfs 0.032 af

**Pond 3P: Infiltration Trench #1** Peak Elev=13.16' Storage=664 cf Inflow=0.68 cfs 0.053 af
Outflow=0.67 cfs 0.039 af

**Pond 5P: Infiltration Trench #3** Peak Elev=11.41' Storage=147 cf Inflow=0.18 cfs 0.014 af
Outflow=0.18 cfs 0.011 af

**Pond 6P: Infiltration Trench #2** Peak Elev=11.41' Storage=119 cf Inflow=0.26 cfs 0.021 af
Outflow=0.26 cfs 0.018 af

**Pond 8P: Storage Chambers** Peak Elev=10.53' Storage=1,063 cf Inflow=1.51 cfs 0.118 af
Outflow=1.31 cfs 0.118 af

**Total Runoff Area = 2.241 ac Runoff Volume = 0.631 af Average Runoff Depth = 3.38"**
**59.27% Pervious = 1.329 ac 40.73% Impervious = 0.913 ac**

## Summary for Subcatchment PDA-1A: PDA-1A

Runoff = 0.18 cfs @ 12.08 hrs, Volume= 0.014 af, Depth= 4.66"
Routed to Pond 5P : Infiltration Trench #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 1,604 | 98 | Roofs, HSG C |
| | 1,604 | | 100.00% Impervious Area |

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

## Summary for Subcatchment PDA-1B: PDA-1B

Runoff = 0.26 cfs @ 12.08 hrs, Volume= 0.021 af, Depth= 4.66"
Routed to Pond 6P : Infiltration Trench #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 1,625 | 98 | Roofs, HSG C |
| * | 744 | 98 | Infiltration Trench, HSG C |
| | 2,369 | 98 | Weighted Average |
| | 2,369 | | 100.00% Impervious Area |

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

## Summary for Subcatchment PDA-1C: PDA-1C

Runoff = 1.51 cfs @ 12.08 hrs, Volume= 0.118 af, Depth= 4.43"
Routed to Pond 8P : Storage Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 10,353 | 98 | Paved parking, HSG C |
| | 1,587 | 98 | Roofs, HSG C |
| | 770 | 74 | >75% Grass cover, Good, HSG C |
| | 1,209 | 89 | Gravel roads, HSG C |
| | 13,919 | 96 | Weighted Average |
| | 1,979 | | 14.22% Pervious Area |
| | 11,940 | | 85.78% Impervious Area |

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

## Summary for Subcatchment PDA-1D: PDA-1D

Runoff = 0.68 cfs @ 12.08 hrs, Volume= 0.053 af, Depth= 4.32"
Routed to Pond 3P : Infiltration Trench #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| Area (sf) | CN | Description |
|---|---|---|
| 3,425 | 98 | Roofs, HSG C |
| 1,929 | 98 | Paved parking, HSG C |
| 862 | 74 | >75% Grass cover, Good, HSG C |
| 165 | 89 | Gravel roads, HSG C |
| 6,381 | 95 | Weighted Average |
| 1,027 | | 16.09% Pervious Area |
| 5,354 | | 83.91% Impervious Area |

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

## Summary for Subcatchment PDA-1E: PDA-1E

Runoff = 1.09 cfs @ 12.09 hrs, Volume= 0.078 af, Depth= 3.37"
Routed to Pond 1P : Bioretention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| Area (sf) | CN | Description |
|---|---|---|
| 4,747 | 98 | Roofs, HSG C |
| 1,167 | 98 | Paved parking, HSG C |
| 6,207 | 74 | >75% Grass cover, Good, HSG C |
| 12,121 | 86 | Weighted Average |
| 6,207 | | 51.21% Pervious Area |
| 5,914 | | 48.79% Impervious Area |

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

## Summary for Subcatchment PDA-1F: PDA-1F

Runoff = 3.81 cfs @ 12.09 hrs, Volume= 0.271 af, Depth= 2.81"
Routed to Reach DP-1 : Charles River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 34,185 | 74 | >75% Grass cover, Good, HSG C |
| | 2,696 | 98 | Roofs, HSG C |
| | 6,032 | 89 | Gravel roads, HSG C |
| | 4,235 | 87 | Dirt roads, HSG C |
| * | 3,247 | 98 | Concrete, HSG C |
| | 50,395 | 80 | Weighted Average |
| | 44,452 | | 88.21% Pervious Area |
| | 5,943 | | 11.79% Impervious Area |

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

## Summary for Subcatchment PDA-2: PDA-2

Runoff = 1.04 cfs @ 12.09 hrs, Volume= 0.076 af, Depth= 3.68"
Routed to Reach DP-2 : Soldiers Field Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

| Area (sf) | CN | Description |
|---|---|---|
| 4,208 | 74 | >75% Grass cover, Good, HSG C |
| 6,642 | 98 | Paved parking, HSG C |
| 10,850 | 89 | Weighted Average |
| 4,208 | | 38.78% Pervious Area |
| 6,642 | | 61.22% Impervious Area |

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

## Summary for Reach DP-1: Charles River

Inflow Area = 1.992 ac, 38.17% Impervious, Inflow Depth = 2.94" for 10-Year event
Inflow = 5.94 cfs @ 12.11 hrs, Volume= 0.489 af
Outflow = 5.94 cfs @ 12.11 hrs, Volume= 0.489 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Summary for Reach DP-2: Soldiers Field Road

Inflow Area = 0.249 ac, 61.22% Impervious, Inflow Depth = 3.68" for 10-Year event
Inflow = 1.04 cfs @ 12.09 hrs, Volume= 0.076 af
Outflow = 1.04 cfs @ 12.09 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Bioretention Basin

Inflow Area = 0.278 ac, 48.79% Impervious, Inflow Depth = 3.37" for 10-Year event
Inflow = 1.09 cfs @ 12.09 hrs, Volume= 0.078 af
Outflow = 0.12 cfs @ 12.84 hrs, Volume= 0.032 af, Atten= 89%, Lag= 45.5 min
Primary = 0.12 cfs @ 12.84 hrs, Volume= 0.032 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 12.52' @ 12.84 hrs Surf.Area= 3,261 sf Storage= 2,083 cf

Plug-Flow detention time= 283.8 min calculated for 0.032 af (41% of inflow)
Center-of-Mass det. time= 162.6 min ( 967.8 - 805.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 3,214 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc)<br>5,404 cf Overall - 2,190 cf Embedded = 3,214 cf |
| #2 | 11.00' | 657 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) Inside #1<br>2,190 cf Overall x 30.0% Voids |
| | | 3,871 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 2,190 | 0 | 0 |
| 12.00 | 2,190 | 2,190 | 2,190 |
| 13.00 | 4,237 | 3,214 | 5,404 |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 2,190 | 0 | 0 |
| 12.00 | 2,190 | 2,190 | 2,190 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.50' | **12.0' long x 14.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63 |

**Primary OutFlow** Max=0.11 cfs @ 12.84 hrs HW=12.52' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.11 cfs @ 0.40 fps)

## Summary for Pond 3P: Infiltration Trench #1

Inflow Area = 0.146 ac, 83.91% Impervious, Inflow Depth = 4.32" for 10-Year event
Inflow = 0.68 cfs @ 12.08 hrs, Volume= 0.053 af
Outflow = 0.67 cfs @ 12.10 hrs, Volume= 0.039 af, Atten= 1%, Lag= 0.8 min
Primary = 0.67 cfs @ 12.10 hrs, Volume= 0.039 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 13.16' @ 12.10 hrs Surf.Area= 1,023 sf Storage= 664 cf

Plug-Flow detention time= 156.0 min calculated for 0.039 af (73% of inflow)
Center-of-Mass det. time= 68.4 min ( 837.2 - 768.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 691 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>2,302 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 1,023 | 0 | 0 |
| 13.00 | 1,023 | 2,046 | 2,046 |
| 13.25 | 1,023 | 256 | 2,302 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Device 2 | 13.00' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #2 | Primary | 9.50' | **12.0" Round Culvert**<br>L= 21.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 9.50' / 9.20' S= 0.0141 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf |

**Primary OutFlow** Max=0.67 cfs @ 12.10 hrs HW=13.16' (Free Discharge)
**2=Culvert** (Passes 0.67 cfs of 5.31 cfs potential flow)
**1=Orifice/Grate** (Weir Controls 0.67 cfs @ 1.32 fps)

## Summary for Pond 5P: Infiltration Trench #3

Inflow Area = 0.037 ac,100.00% Impervious, Inflow Depth = 4.66" for 10-Year event
Inflow = 0.18 cfs @ 12.08 hrs, Volume= 0.014 af
Outflow = 0.18 cfs @ 12.09 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.3 min
Primary = 0.18 cfs @ 12.09 hrs, Volume= 0.011 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 11.41' @ 12.09 hrs Surf.Area= 1,200 sf Storage= 147 cf

Plug-Flow detention time= 155.3 min calculated for 0.011 af (77% of inflow)
Center-of-Mass det. time= 72.0 min ( 820.3 - 748.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 180 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>600 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 1,200 | 0 | 0 |
| 11.50 | 1,200 | 600 | 600 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 11.40' | **78.0' long x 4.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66<br>2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32 |

**Primary OutFlow** Max=0.17 cfs @ 12.09 hrs HW=11.41' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.17 cfs @ 0.23 fps)

## Summary for Pond 6P: Infiltration Trench #2

Inflow Area = 0.054 ac,100.00% Impervious, Inflow Depth = 4.66" for 10-Year event
Inflow = 0.26 cfs @ 12.08 hrs, Volume= 0.021 af
Outflow = 0.26 cfs @ 12.09 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.2 min
Primary = 0.26 cfs @ 12.09 hrs, Volume= 0.018 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 11.41' @ 12.09 hrs Surf.Area= 960 sf Storage= 119 cf

Plug-Flow detention time= 106.7 min calculated for 0.018 af (87% of inflow)
Center-of-Mass det. time= 48.7 min ( 797.0 - 748.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 144 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>480 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 960 | 0 | 0 |
| 11.50 | 960 | 480 | 480 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 11.40' | **78.0' long x 4.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66<br>2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32 |

**Primary OutFlow** Max=0.26 cfs @ 12.09 hrs HW=11.41' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.26 cfs @ 0.26 fps)

## Summary for Pond 8P: Storage Chambers

Inflow Area = 0.320 ac, 85.78% Impervious, Inflow Depth = 4.43" for 10-Year event
Inflow = 1.51 cfs @ 12.08 hrs, Volume= 0.118 af
Outflow = 1.31 cfs @ 12.13 hrs, Volume= 0.118 af, Atten= 13%, Lag= 2.8 min
Primary = 1.31 cfs @ 12.13 hrs, Volume= 0.118 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 10.53' @ 12.13 hrs Surf.Area= 1,412 sf Storage= 1,063 cf

Plug-Flow detention time= 41.3 min calculated for 0.118 af (100% of inflow)
Center-of-Mass det. time= 39.6 min ( 802.4 - 762.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 8.97' | 604 cf | **27.00'W x 52.31'L x 1.83'H Field A**<br>2,589 cf Overall - 574 cf Embedded = 2,015 cf x 30.0% Voids |
| #2A | 9.30' | 574 cf | **ADS_StormTech SC-160LP +Cap** x 84 Inside #1<br>Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf<br>Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap<br>84 Chambers in 12 Rows |
| | | 1,179 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 9.00' | **12.0" Round Culvert**<br>L= 95.5' CMP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 9.00' / 8.90' S= 0.0010 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 10.35' | **4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>0.5' Crest Height |
| #3 | Device 1 | 9.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |

**Primary OutFlow** Max=1.31 cfs @ 12.13 hrs HW=10.53' (Free Discharge)
└**1=Culvert** (Passes 1.31 cfs of 2.36 cfs potential flow)
  ├**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.03 cfs @ 1.45 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.28 cfs @ 5.71 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

| | |
|---|---|
| **Subcatchment PDA-1A: PDA-1A** | Runoff Area=1,604 sf 100.00% Impervious Runoff Depth=5.95"<br>Tc=6.0 min CN=98 Runoff=0.22 cfs 0.018 af |
| **Subcatchment PDA-1B: PDA-1B** | Runoff Area=2,369 sf 100.00% Impervious Runoff Depth=5.95"<br>Tc=6.0 min CN=98 Runoff=0.33 cfs 0.027 af |
| **Subcatchment PDA-1C: PDA-1C** | Runoff Area=13,919 sf 85.78% Impervious Runoff Depth=5.72"<br>Tc=6.0 min CN=96 Runoff=1.92 cfs 0.152 af |
| **Subcatchment PDA-1D: PDA-1D** | Runoff Area=6,381 sf 83.91% Impervious Runoff Depth=5.60"<br>Tc=6.0 min CN=95 Runoff=0.87 cfs 0.068 af |
| **Subcatchment PDA-1E: PDA-1E** | Runoff Area=12,121 sf 48.79% Impervious Runoff Depth=4.59"<br>Tc=6.0 min CN=86 Runoff=1.46 cfs 0.106 af |
| **Subcatchment PDA-1F: PDA-1F** | Runoff Area=50,395 sf 11.79% Impervious Runoff Depth=3.95"<br>Tc=6.0 min CN=80 Runoff=5.34 cfs 0.381 af |
| **Subcatchment PDA-2: PDA-2** | Runoff Area=10,850 sf 61.22% Impervious Runoff Depth=4.92"<br>Tc=6.0 min CN=89 Runoff=1.38 cfs 0.102 af |
| **Reach DP-1: Charles River** | Inflow=8.63 cfs 0.687 af<br>Outflow=8.63 cfs 0.687 af |
| **Reach DP-2: Soldiers Field Road** | Inflow=1.38 cfs 0.102 af<br>Outflow=1.38 cfs 0.102 af |
| **Pond 1P: Bioretention Basin** | Peak Elev=12.57' Storage=2,239 cf Inflow=1.46 cfs 0.106 af<br>Outflow=0.60 cfs 0.060 af |
| **Pond 3P: Infiltration Trench #1** | Peak Elev=13.19' Storage=673 cf Inflow=0.87 cfs 0.068 af<br>Outflow=0.86 cfs 0.054 af |
| **Pond 5P: Infiltration Trench #3** | Peak Elev=11.41' Storage=148 cf Inflow=0.22 cfs 0.018 af<br>Outflow=0.22 cfs 0.015 af |
| **Pond 6P: Infiltration Trench #2** | Peak Elev=11.41' Storage=119 cf Inflow=0.33 cfs 0.027 af<br>Outflow=0.33 cfs 0.024 af |
| **Pond 8P: Storage Chambers** | Peak Elev=10.59' Storage=1,088 cf Inflow=1.92 cfs 0.152 af<br>Outflow=1.89 cfs 0.152 af |

**Total Runoff Area = 2.241 ac Runoff Volume = 0.855 af Average Runoff Depth = 4.58"**
**59.27% Pervious = 1.329 ac 40.73% Impervious = 0.913 ac**

## Summary for Subcatchment PDA-1A: PDA-1A

Runoff = 0.22 cfs @ 12.08 hrs, Volume= 0.018 af, Depth= 5.95"
Routed to Pond 5P : Infiltration Trench #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 1,604 | 98 | Roofs, HSG C |
| | 1,604 | | 100.00% Impervious Area |

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

## Summary for Subcatchment PDA-1B: PDA-1B

Runoff = 0.33 cfs @ 12.08 hrs, Volume= 0.027 af, Depth= 5.95"
Routed to Pond 6P : Infiltration Trench #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 1,625 | 98 | Roofs, HSG C |
| * | 744 | 98 | Infiltration Trench, HSG C |
| | 2,369 | 98 | Weighted Average |
| | 2,369 | | 100.00% Impervious Area |

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

## Summary for Subcatchment PDA-1C: PDA-1C

Runoff = 1.92 cfs @ 12.08 hrs, Volume= 0.152 af, Depth= 5.72"
Routed to Pond 8P : Storage Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 10,353 | 98 | Paved parking, HSG C |
| | 1,587 | 98 | Roofs, HSG C |
| | 770 | 74 | >75% Grass cover, Good, HSG C |
| | 1,209 | 89 | Gravel roads, HSG C |
| | 13,919 | 96 | Weighted Average |
| | 1,979 | | 14.22% Pervious Area |
| | 11,940 | | 85.78% Impervious Area |

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

## Summary for Subcatchment PDA-1D: PDA-1D

Runoff = 0.87 cfs @ 12.08 hrs, Volume= 0.068 af, Depth= 5.60"
Routed to Pond 3P : Infiltration Trench #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| Area (sf) | CN | Description |
|---|---|---|
| 3,425 | 98 | Roofs, HSG C |
| 1,929 | 98 | Paved parking, HSG C |
| 862 | 74 | >75% Grass cover, Good, HSG C |
| 165 | 89 | Gravel roads, HSG C |
| 6,381 | 95 | Weighted Average |
| 1,027 | | 16.09% Pervious Area |
| 5,354 | | 83.91% Impervious Area |

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

## Summary for Subcatchment PDA-1E: PDA-1E

Runoff = 1.46 cfs @ 12.09 hrs, Volume= 0.106 af, Depth= 4.59"
Routed to Pond 1P : Bioretention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| Area (sf) | CN | Description |
|---|---|---|
| 4,747 | 98 | Roofs, HSG C |
| 1,167 | 98 | Paved parking, HSG C |
| 6,207 | 74 | >75% Grass cover, Good, HSG C |
| 12,121 | 86 | Weighted Average |
| 6,207 | | 51.21% Pervious Area |
| 5,914 | | 48.79% Impervious Area |

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

## Summary for Subcatchment PDA-1F: PDA-1F

Runoff = 5.34 cfs @ 12.09 hrs, Volume= 0.381 af, Depth= 3.95"
Routed to Reach DP-1 : Charles River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 34,185 | 74 | >75% Grass cover, Good, HSG C |
| | 2,696 | 98 | Roofs, HSG C |
| | 6,032 | 89 | Gravel roads, HSG C |
| | 4,235 | 87 | Dirt roads, HSG C |
| * | 3,247 | 98 | Concrete, HSG C |
| | 50,395 | 80 | Weighted Average |
| | 44,452 | | 88.21% Pervious Area |
| | 5,943 | | 11.79% Impervious Area |

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

## Summary for Subcatchment PDA-2: PDA-2

Runoff = 1.38 cfs @ 12.08 hrs, Volume= 0.102 af, Depth= 4.92"
Routed to Reach DP-2 : Soldiers Field Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

| Area (sf) | CN | Description |
|---|---|---|
| 4,208 | 74 | >75% Grass cover, Good, HSG C |
| 6,642 | 98 | Paved parking, HSG C |
| 10,850 | 89 | Weighted Average |
| 4,208 | | 38.78% Pervious Area |
| 6,642 | | 61.22% Impervious Area |

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

## Summary for Reach DP-1: Charles River

Inflow Area = 1.992 ac, 38.17% Impervious, Inflow Depth = 4.14" for 25-Year event
Inflow = 8.63 cfs @ 12.09 hrs, Volume= 0.687 af
Outflow = 8.63 cfs @ 12.09 hrs, Volume= 0.687 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Summary for Reach DP-2: Soldiers Field Road

Inflow Area = 0.249 ac, 61.22% Impervious, Inflow Depth = 4.92" for 25-Year event
Inflow = 1.38 cfs @ 12.08 hrs, Volume= 0.102 af
Outflow = 1.38 cfs @ 12.08 hrs, Volume= 0.102 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Bioretention Basin

Inflow Area = 0.278 ac, 48.79% Impervious, Inflow Depth = 4.59" for 25-Year event
Inflow = 1.46 cfs @ 12.09 hrs, Volume= 0.106 af
Outflow = 0.60 cfs @ 12.30 hrs, Volume= 0.060 af, Atten= 59%, Lag= 13.0 min
Primary = 0.60 cfs @ 12.30 hrs, Volume= 0.060 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 12.57' @ 12.30 hrs Surf.Area= 3,357 sf Storage= 2,239 cf

Plug-Flow detention time= 208.3 min calculated for 0.060 af (57% of inflow)
Center-of-Mass det. time= 101.9 min ( 898.5 - 796.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 3,214 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>5,404 cf Overall - 2,190 cf Embedded = 3,214 cf |
| #2 | 11.00' | 657 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) Inside #1<br>2,190 cf Overall x 30.0% Voids |
| | | 3,871 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 2,190 | 0 | 0 |
| 12.00 | 2,190 | 2,190 | 2,190 |
| 13.00 | 4,237 | 3,214 | 5,404 |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 2,190 | 0 | 0 |
| 12.00 | 2,190 | 2,190 | 2,190 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.50' | **12.0' long x 14.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63 |

**Primary OutFlow** Max=0.59 cfs @ 12.30 hrs HW=12.57' (Free Discharge)
**1=Broad-Crested Rectangular Weir** (Weir Controls 0.59 cfs @ 0.70 fps)

## Summary for Pond 3P: Infiltration Trench #1

Inflow Area = 0.146 ac, 83.91% Impervious, Inflow Depth = 5.60" for 25-Year event
Inflow = 0.87 cfs @ 12.08 hrs, Volume= 0.068 af
Outflow = 0.86 cfs @ 12.10 hrs, Volume= 0.054 af, Atten= 1%, Lag= 0.8 min
Primary = 0.86 cfs @ 12.10 hrs, Volume= 0.054 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 13.19' @ 12.10 hrs Surf.Area= 1,023 sf Storage= 673 cf

Plug-Flow detention time= 138.1 min calculated for 0.054 af (79% of inflow)
Center-of-Mass det. time= 60.8 min ( 823.7 - 762.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 691 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>2,302 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 1,023 | 0 | 0 |
| 13.00 | 1,023 | 2,046 | 2,046 |
| 13.25 | 1,023 | 256 | 2,302 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Device 2 | 13.00' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #2 | Primary | 9.50' | **12.0" Round Culvert**<br>L= 21.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 9.50' / 9.20' S= 0.0141 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf |

**Primary OutFlow** Max=0.86 cfs @ 12.10 hrs HW=13.19' (Free Discharge)
└─**2=Culvert** (Passes 0.86 cfs of 5.33 cfs potential flow)
  └─**1=Orifice/Grate** (Weir Controls 0.86 cfs @ 1.43 fps)

## Summary for Pond 5P: Infiltration Trench #3

Inflow Area = 0.037 ac,100.00% Impervious, Inflow Depth = 5.95" for 25-Year event
Inflow = 0.22 cfs @ 12.08 hrs, Volume= 0.018 af
Outflow = 0.22 cfs @ 12.09 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.2 min
Primary = 0.22 cfs @ 12.09 hrs, Volume= 0.015 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 11.41' @ 12.09 hrs Surf.Area= 1,200 sf Storage= 148 cf

Plug-Flow detention time= 137.3 min calculated for 0.015 af (82% of inflow)
Center-of-Mass det. time= 64.1 min ( 808.7 - 744.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 180 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>600 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 1,200 | 0 | 0 |
| 11.50 | 1,200 | 600 | 600 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 11.40' | **78.0' long x 4.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66<br>2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32 |

**Primary OutFlow** Max=0.22 cfs @ 12.09 hrs HW=11.41' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.22 cfs @ 0.25 fps)

## Summary for Pond 6P: Infiltration Trench #2

Inflow Area = 0.054 ac,100.00% Impervious, Inflow Depth = 5.95" for 25-Year event
Inflow = 0.33 cfs @ 12.08 hrs, Volume= 0.027 af
Outflow = 0.33 cfs @ 12.09 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.2 min
Primary = 0.33 cfs @ 12.09 hrs, Volume= 0.024 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 11.41' @ 12.09 hrs Surf.Area= 960 sf Storage= 119 cf

Plug-Flow detention time= 92.1 min calculated for 0.024 af (90% of inflow)
Center-of-Mass det. time= 42.6 min ( 787.3 - 744.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 144 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>480 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 960 | 0 | 0 |
| 11.50 | 960 | 480 | 480 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 11.40' | **78.0' long x 4.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66<br>2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32 |

**Primary OutFlow** Max=0.33 cfs @ 12.09 hrs HW=11.41' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.33 cfs @ 0.29 fps)

## Summary for Pond 8P: Storage Chambers

Inflow Area = 0.320 ac, 85.78% Impervious, Inflow Depth = 5.72" for 25-Year event
Inflow = 1.92 cfs @ 12.08 hrs, Volume= 0.152 af
Outflow = 1.89 cfs @ 12.10 hrs, Volume= 0.152 af, Atten= 1%, Lag= 0.8 min
Primary = 1.89 cfs @ 12.10 hrs, Volume= 0.152 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 10.59' @ 12.10 hrs Surf.Area= 1,412 sf Storage= 1,088 cf

Plug-Flow detention time= 37.3 min calculated for 0.152 af (100% of inflow)
Center-of-Mass det. time= 35.9 min ( 793.5 - 757.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 8.97' | 604 cf | **27.00'W x 52.31'L x 1.83'H Field A**<br>2,589 cf Overall - 574 cf Embedded = 2,015 cf x 30.0% Voids |
| #2A | 9.30' | 574 cf | **ADS_StormTech SC-160LP +Cap** x 84 Inside #1<br>Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf<br>Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap<br>84 Chambers in 12 Rows |
| | | 1,179 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 9.00' | **12.0" Round Culvert**<br>L= 95.5' CMP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 9.00' / 8.90' S= 0.0010 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 10.35' | **4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>0.5' Crest Height |
| #3 | Device 1 | 9.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |

**Primary OutFlow** Max=1.89 cfs @ 12.10 hrs HW=10.59' (Free Discharge)
└─**1=Culvert** (Passes 1.89 cfs of 2.47 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.60 cfs @ 1.69 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.29 cfs @ 5.83 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment PDA-1A: PDA-1A** Runoff Area=1,604 sf 100.00% Impervious Runoff Depth=8.59"
Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026 af

**Subcatchment PDA-1B: PDA-1B** Runoff Area=2,369 sf 100.00% Impervious Runoff Depth=8.59"
Tc=6.0 min CN=98 Runoff=0.47 cfs 0.039 af

**Subcatchment PDA-1C: PDA-1C** Runoff Area=13,919 sf 85.78% Impervious Runoff Depth=8.35"
Tc=6.0 min CN=96 Runoff=2.76 cfs 0.222 af

**Subcatchment PDA-1D: PDA-1D** Runoff Area=6,381 sf 83.91% Impervious Runoff Depth=8.23"
Tc=6.0 min CN=95 Runoff=1.26 cfs 0.100 af

**Subcatchment PDA-1E: PDA-1E** Runoff Area=12,121 sf 48.79% Impervious Runoff Depth=7.14"
Tc=6.0 min CN=86 Runoff=2.22 cfs 0.166 af

**Subcatchment PDA-1F: PDA-1F** Runoff Area=50,395 sf 11.79% Impervious Runoff Depth=6.41"
Tc=6.0 min CN=80 Runoff=8.51 cfs 0.618 af

**Subcatchment PDA-2: PDA-2** Runoff Area=10,850 sf 61.22% Impervious Runoff Depth=7.50"
Tc=6.0 min CN=89 Runoff=2.05 cfs 0.156 af

**Reach DP-1: Charles River** Inflow=14.87 cfs 1.105 af
Outflow=14.87 cfs 1.105 af

**Reach DP-2: Soldiers Field Road** Inflow=2.05 cfs 0.156 af
Outflow=2.05 cfs 0.156 af

**Pond 1P: Bioretention Basin** Peak Elev=12.65' Storage=2,525 cf Inflow=2.22 cfs 0.166 af
Outflow=1.91 cfs 0.119 af

**Pond 3P: Infiltration Trench #1** Peak Elev=13.24' Storage=689 cf Inflow=1.26 cfs 0.100 af
Outflow=1.25 cfs 0.086 af

**Pond 5P: Infiltration Trench #3** Peak Elev=11.41' Storage=149 cf Inflow=0.32 cfs 0.026 af
Outflow=0.32 cfs 0.023 af

**Pond 6P: Infiltration Trench #2** Peak Elev=11.42' Storage=121 cf Inflow=0.47 cfs 0.039 af
Outflow=0.47 cfs 0.036 af

**Pond 8P: Storage Chambers** Peak Elev=10.69' Storage=1,131 cf Inflow=2.76 cfs 0.222 af
Outflow=2.64 cfs 0.222 af

**Total Runoff Area = 2.241 ac Runoff Volume = 1.327 af Average Runoff Depth = 7.10"**
**59.27% Pervious = 1.329 ac 40.73% Impervious = 0.913 ac**

## Summary for Subcatchment PDA-1A: PDA-1A

Runoff = 0.32 cfs @ 12.08 hrs, Volume= 0.026 af, Depth= 8.59"
Routed to Pond 5P : Infiltration Trench #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 1,604 | 98 | Roofs, HSG C |
| | 1,604 | | 100.00% Impervious Area |

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

## Summary for Subcatchment PDA-1B: PDA-1B

Runoff = 0.47 cfs @ 12.08 hrs, Volume= 0.039 af, Depth= 8.59"
Routed to Pond 6P : Infiltration Trench #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 1,625 | 98 | Roofs, HSG C |
| * | 744 | 98 | Infiltration Trench, HSG C |
| | 2,369 | 98 | Weighted Average |
| | 2,369 | | 100.00% Impervious Area |

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

## Summary for Subcatchment PDA-1C: PDA-1C

Runoff = 2.76 cfs @ 12.08 hrs, Volume= 0.222 af, Depth= 8.35"
Routed to Pond 8P : Storage Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 10,353 | 98 | Paved parking, HSG C |
| | 1,587 | 98 | Roofs, HSG C |
| | 770 | 74 | >75% Grass cover, Good, HSG C |
| | 1,209 | 89 | Gravel roads, HSG C |
| | 13,919 | 96 | Weighted Average |
| | 1,979 | | 14.22% Pervious Area |
| | 11,940 | | 85.78% Impervious Area |

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

## Summary for Subcatchment PDA-1D: PDA-1D

Runoff = 1.26 cfs @ 12.08 hrs, Volume= 0.100 af, Depth= 8.23"
Routed to Pond 3P : Infiltration Trench #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| Area (sf) | CN | Description |
|---|---|---|
| 3,425 | 98 | Roofs, HSG C |
| 1,929 | 98 | Paved parking, HSG C |
| 862 | 74 | >75% Grass cover, Good, HSG C |
| 165 | 89 | Gravel roads, HSG C |
| 6,381 | 95 | Weighted Average |
| 1,027 | | 16.09% Pervious Area |
| 5,354 | | 83.91% Impervious Area |

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

## Summary for Subcatchment PDA-1E: PDA-1E

Runoff = 2.22 cfs @ 12.08 hrs, Volume= 0.166 af, Depth= 7.14"
Routed to Pond 1P : Bioretention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| Area (sf) | CN | Description |
|---|---|---|
| 4,747 | 98 | Roofs, HSG C |
| 1,167 | 98 | Paved parking, HSG C |
| 6,207 | 74 | >75% Grass cover, Good, HSG C |
| 12,121 | 86 | Weighted Average |
| 6,207 | | 51.21% Pervious Area |
| 5,914 | | 48.79% Impervious Area |

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

## Summary for Subcatchment PDA-1F: PDA-1F

Runoff = 8.51 cfs @ 12.09 hrs, Volume= 0.618 af, Depth= 6.41"
Routed to Reach DP-1 : Charles River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 34,185 | 74 | >75% Grass cover, Good, HSG C |
| | 2,696 | 98 | Roofs, HSG C |
| | 6,032 | 89 | Gravel roads, HSG C |
| | 4,235 | 87 | Dirt roads, HSG C |
| * | 3,247 | 98 | Concrete, HSG C |
| | 50,395 | 80 | Weighted Average |
| | 44,452 | | 88.21% Pervious Area |
| | 5,943 | | 11.79% Impervious Area |

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

## Summary for Subcatchment PDA-2: PDA-2

Runoff = 2.05 cfs @ 12.08 hrs, Volume= 0.156 af, Depth= 7.50"
Routed to Reach DP-2 : Soldiers Field Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.83"

| Area (sf) | CN | Description |
|---|---|---|
| 4,208 | 74 | >75% Grass cover, Good, HSG C |
| 6,642 | 98 | Paved parking, HSG C |
| 10,850 | 89 | Weighted Average |
| 4,208 | | 38.78% Pervious Area |
| 6,642 | | 61.22% Impervious Area |

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

## Summary for Reach DP-1: Charles River

Inflow Area = 1.992 ac, 38.17% Impervious, Inflow Depth = 6.65" for 100-Year event
Inflow = 14.87 cfs @ 12.09 hrs, Volume= 1.105 af
Outflow = 14.87 cfs @ 12.09 hrs, Volume= 1.105 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Summary for Reach DP-2: Soldiers Field Road

Inflow Area = 0.249 ac, 61.22% Impervious, Inflow Depth = 7.50" for 100-Year event
Inflow = 2.05 cfs @ 12.08 hrs, Volume= 0.156 af
Outflow = 2.05 cfs @ 12.08 hrs, Volume= 0.156 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Bioretention Basin

Inflow Area = 0.278 ac, 48.79% Impervious, Inflow Depth = 7.14" for 100-Year event
Inflow = 2.22 cfs @ 12.08 hrs, Volume= 0.166 af
Outflow = 1.91 cfs @ 12.13 hrs, Volume= 0.119 af, Atten= 14%, Lag= 2.9 min
Primary = 1.91 cfs @ 12.13 hrs, Volume= 0.119 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 12.65' @ 12.13 hrs Surf.Area= 3,528 sf Storage= 2,525 cf

Plug-Flow detention time= 157.9 min calculated for 0.119 af (72% of inflow)
Center-of-Mass det. time= 69.0 min ( 853.5 - 784.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 3,214 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>5,404 cf Overall - 2,190 cf Embedded = 3,214 cf |
| #2 | 11.00' | 657 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) Inside #1<br>2,190 cf Overall x 30.0% Voids |
| | | 3,871 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 2,190 | 0 | 0 |
| 12.00 | 2,190 | 2,190 | 2,190 |
| 13.00 | 4,237 | 3,214 | 5,404 |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 2,190 | 0 | 0 |
| 12.00 | 2,190 | 2,190 | 2,190 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.50' | **12.0' long x 14.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63 |

**Primary OutFlow** Max=1.90 cfs @ 12.13 hrs HW=12.65' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.90 cfs @ 1.03 fps)

## Summary for Pond 3P: Infiltration Trench #1

Inflow Area = 0.146 ac, 83.91% Impervious, Inflow Depth = 8.23" for 100-Year event
Inflow = 1.26 cfs @ 12.08 hrs, Volume= 0.100 af
Outflow = 1.25 cfs @ 12.09 hrs, Volume= 0.086 af, Atten= 1%, Lag= 0.7 min
Primary = 1.25 cfs @ 12.09 hrs, Volume= 0.086 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 13.24' @ 12.09 hrs Surf.Area= 1,023 sf Storage= 689 cf

Plug-Flow detention time= 113.1 min calculated for 0.086 af (86% of inflow)
Center-of-Mass det. time= 51.1 min ( 806.1 - 755.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 691 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>2,302 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 1,023 | 0 | 0 |
| 13.00 | 1,023 | 2,046 | 2,046 |
| 13.25 | 1,023 | 256 | 2,302 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Device 2 | 13.00' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #2 | Primary | 9.50' | **12.0" Round Culvert**<br>L= 21.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 9.50' / 9.20' S= 0.0141 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf |

**Primary OutFlow** Max=1.24 cfs @ 12.09 hrs HW=13.24' (Free Discharge)
└─**2=Culvert** (Passes 1.24 cfs of 5.38 cfs potential flow)
  └─**1=Orifice/Grate** (Weir Controls 1.24 cfs @ 1.62 fps)

## Summary for Pond 5P: Infiltration Trench #3

Inflow Area = 0.037 ac,100.00% Impervious, Inflow Depth = 8.59" for 100-Year event
Inflow = 0.32 cfs @ 12.08 hrs, Volume= 0.026 af
Outflow = 0.32 cfs @ 12.09 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.2 min
Primary = 0.32 cfs @ 12.09 hrs, Volume= 0.023 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 11.41' @ 12.09 hrs Surf.Area= 1,200 sf Storage= 149 cf

Plug-Flow detention time= 111.7 min calculated for 0.023 af (87% of inflow)
Center-of-Mass det. time= 52.7 min ( 792.8 - 740.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 180 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>600 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 1,200 | 0 | 0 |
| 11.50 | 1,200 | 600 | 600 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 11.40' | **78.0' long x 4.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32 |

**Primary OutFlow** Max=0.32 cfs @ 12.09 hrs HW=11.41' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.32 cfs @ 0.28 fps)

## Summary for Pond 6P: Infiltration Trench #2

Inflow Area = 0.054 ac,100.00% Impervious, Inflow Depth = 8.59" for 100-Year event
Inflow = 0.47 cfs @ 12.08 hrs, Volume= 0.039 af
Outflow = 0.47 cfs @ 12.09 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.1 min
Primary = 0.47 cfs @ 12.09 hrs, Volume= 0.036 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 11.42' @ 12.09 hrs Surf.Area= 960 sf Storage= 121 cf

Plug-Flow detention time= 71.9 min calculated for 0.036 af (93% of inflow)
Center-of-Mass det. time= 34.0 min ( 774.1 - 740.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.00' | 144 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>480 cf Overall x 30.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.00 | 960 | 0 | 0 |
| 11.50 | 960 | 480 | 480 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 11.40' | **78.0' long x 4.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32 |

**Primary OutFlow** Max=0.47 cfs @ 12.09 hrs HW=11.42' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.47 cfs @ 0.32 fps)

## Summary for Pond 8P: Storage Chambers

Inflow Area = 0.320 ac, 85.78% Impervious, Inflow Depth = 8.35" for 100-Year event
Inflow = 2.76 cfs @ 12.08 hrs, Volume= 0.222 af
Outflow = 2.64 cfs @ 12.11 hrs, Volume= 0.222 af, Atten= 4%, Lag= 1.4 min
Primary = 2.64 cfs @ 12.11 hrs, Volume= 0.222 af
Routed to Reach DP-1 : Charles River

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 10.69' @ 12.11 hrs Surf.Area= 1,412 sf Storage= 1,131 cf

Plug-Flow detention time= 33.2 min calculated for 0.222 af (100% of inflow)
Center-of-Mass det. time= 32.2 min ( 782.7 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 8.97' | 604 cf | **27.00'W x 52.31'L x 1.83'H Field A** |
| | | | 2,589 cf Overall - 574 cf Embedded = 2,015 cf x 30.0% Voids |
| #2A | 9.30' | 574 cf | **ADS_StormTech SC-160LP +Cap** x 84 Inside #1 |
| | | | Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf |
| | | | Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap |
| | | | 84 Chambers in 12 Rows |
| | | 1,179 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 9.00' | **12.0" Round Culvert** |
| | | | L= 95.5' CMP, square edge headwall, Ke= 0.500 |
| | | | Inlet / Outlet Invert= 9.00' / 8.90' S= 0.0010 '/' Cc= 0.900 |
| | | | n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 10.35' | **4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) |
| | | | 0.5' Crest Height |
| #3 | Device 1 | 9.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |

**Primary OutFlow** Max=2.64 cfs @ 12.11 hrs HW=10.69' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.64 cfs @ 3.36 fps)
  ├─**2=Sharp-Crested Rectangular Weir** (Passes < 2.75 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 0.30 cfs potential flow)

## *APPENDIX C*

WATER QUALITY CALCULATIONS

- Pretreatment Calculations
- Recharge Volume Calculations
- Water Quality Calculations
- TSS Removal Calculations
- Phosphorus Removal Calculations

Green International Affiliates, Inc

## PRETREATMENT CALCULATION

**Date:** March 25, 2022
**Revised:**
**Project:** Newell Boathouse
**Project No:** 21030
**Location:** Boston, MA

**Prepared By:** JT/MW/SB
**Checked By:** DHS

***Objective:*** To determine the required pretreatment Volume for adaqute stormwater treatment

***Methodology:*** MA Department of Environmental Protection (DEP) Stormwater Management (Vol. 2, Ch. 2)

***Design Criteria:*** Volume to be treated = 0.1" x Post Development Impervious Area

***Calculation results:***

| Designation | Volume Required (cf) | Volume Provided (cf) |
|---|---|---|
| Drainage to Forebay | 9 | 269 |

***Volume to be Treated:***

**Drainage to Forebay**

| | | |
|---|---|---|
| Total Proposed Impervious Area: | 1,105 | sf |
| Total Volume to be treated: | **9** | **cf** |

***Volume Provided:***

**Forebay**

| | | | | |
|---|---|---|---|---|
| Top Elevation = | 12.20 | Area of contour = | 422 | sf |
| Bottom Elev = | 11.00 | Area of contour = | 27 | sf |
| | | Vol. of Treatment: | **269** | **cf** |

GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers

# RECHARGE VOLUME CALCULATIONS

**Date:** March 25, 2022
**Revised:**
**Project:** Newell Boathouse
**Project No:** 21030
**Location:** Boston, MA

**Prepared By:** MW/SB
**Checked By:** JT/DHS

## Recharge Volume Design

***Objective:*** Size infiltration BMPs that will approximate the annual recharge from the existing conditions.

***Methodology:*** MA Department of Environmental Protection (DEP) Massachusetts Stormwater Handbook (Vol.3, Ch.1)

***Design Criteria:***

The required recharge volume equals a depth of runoff corresponding to the soil type times the impervious areas covering that soil type at the post-development site.

Based on the Site Hydrologic Soil Group:

| Hydrologic Soil Group | Soil Texture | Target Depth Factor (F) |
|---|---|---|
| A | Sand | 0.60 inches |
| B | Loam | 0.35 inches |
| C | Silty Loam | 0.25 inches |
| D | Clay | 0.10 inches |

The soils are defined by the Soil Conservation Services (SCS) Soil Survey of Bristol County of Massachusetts. The site is comprised of 'C/D' soils. C soils were used for this calculation.

***Required Drawdown Time:*** Maximum of 72 Hours using the following equation:

$$\text{Drawdown Time} = \frac{R_v}{(K x A_{Bot})}$$

$R_v$ = Required Recharge Volume
$K$ = Permeability
$A_{Bot}$ = Bottom area of basin

***Calculation Results:***

| Designation | Total Volume Required (cf) | Volume Provided (cf) |
|---|---|---|
| **Total Recharge For Entire Site Project** | **2,176** | **2,946** |

***Recharge Volume Required:*** **Total Recharge Required**

| Hydrologic Soil Group | Impervious Area (SF) | Target Depth | Volume Required |
|---|---|---|---|
| A | 0 | 0.60 | 0 cf |
| B | 0 | 0.35 | 0 cf |
| C | 39,021 | 0.25 | 813 cf |
| D | 0 | 0.10 | 0 cf |
| Total | **39,021** | | **813** cf |

***Receiving Impervious Area by BMP:***

| | |
|---|---|
| Drainage to Bioretention Area | 5,914 sf |
| Drainage to Infiltration Trench #1 | 5,438 sf |
| Drainage to Infiltration Trench #2 | 1,625 sf |
| Drainage to Infiltration Trench #3 | 1,604 sf |
| **Total:** | **14,581** sf |

**Capture Area Adjustment**

| Hydrologic Soil Group | Impervious Area Routed to Basins | Capture Area Adjustment | Volume Required |
|---|---|---|---|
| A | 0 | | |
| B | 0 | | |
| C | 14,581 | | |
| D | 0 | | |
| Total | **14,581** | **2.676** | **2,176** cf |

***Recharge Volume Provided:***

**Sum of BMP's**
**METHOD USED:** STATIC

Rv = combined storage below lowest outlets for all BMP's = **2,946 cf**

**METHOD USED:** STATIC
**Drainage Area to Bioretention Area**

$R_v$ = storage below lowest outlet (orifice) = **2,008 cf** (Elev. 12.50, See HydroCAD Table)
$A_{Bot}$ = bottom area of basin = 2,190 sf

| $R_v$ cf | K in/hr | $A_{Bot}$ sf | Drawdown Time Hours | | |
|---|---|---|---|---|---|
| 2,008 | 0.27 | 2,190 | **40.75** | **<** | **72 Hours** |

**METHOD USED:** STATIC

**Drainage Area to Infiltration Trench #1**

$R_v$ = storage below lowest outlet (orifice) = **614 cf**

$A_{Bot}$ = bottom area of basin = 1,023 sf

| $R_v$ cf | K in/hr | $A_{Bot}$ sf | Drawdown Time Hours | | |
|---|---|---|---|---|---|
| 614 | 0.27 | 1,023 | **26.67** | **<** | **72 Hours** |

**METHOD USED:** STATIC

**Drainage Area to Infiltration Trench #2**

$R_v$ = storage below lowest outlet (orifice) = **144 cf**

$A_{Bot}$ = bottom area of basin = 960 sf

| $R_v$ cf | K in/hr | $A_{Bot}$ sf | Drawdown Time Hours | | |
|---|---|---|---|---|---|
| 144 | 0.27 | 960 | **6.67** | **<** | **72 Hours** |

**METHOD USED:** STATIC

**Drainage Area to Infiltration Trench #3**

$R_v$ = storage below lowest outlet (orifice) = **180 cf**

$A_{Bot}$ = bottom area of basin = 1,200 sf

| $R_v$ cf | K in/hr | $A_{Bot}$ sf | Drawdown Time Hours | | |
|---|---|---|---|---|---|
| 180 | 0.27 | 1,200 | **6.67** | **<** | **72 Hours** |

GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers

# WATER QUALITY CALCULATIONS

**Date:** March 25, 2022
**Revised:**
**Project:** Newell Boathouse
**Project No:** 21030
**Location:** Boston, MA

**Prepared By:** JT/BV/SB
**Checked By:** DHS

***Objective:*** To determine the required Water Quality Volume (WQV) for adaqute stormwater treatment

***Methodology:*** MA Department of Environmental Protection (DEP) Stormwater Management (Vol. 3, Ch. 1)

***Design Criteria:*** Volume to be treated =1.0" x Post Development Impervious Area

Critical Areas (include ORW, ACEC, recharge areas for public water supplies (Zone Is, Zone IIs and Interim Wellhead Protection Areas for ground water sources and Zone As for surface water sources), bathing beaches, cold water fisheries, shellfish growing areas and LUHPPL's

Volume to be treated = 1.0" x Post Development Impervious Area

**All WQ calculations will use 1" per BWSC**

***Calculation Results:***

| Designation | Volume Required (cf) | Volume Provided (cf) |
|---|---|---|
| **Drainage to Bioretention Basin** | **493** | **2,008** |
| **Drainage to Infiltration Trench #1** | **453** | **614** |
| **Drainage to Infiltration Trench #2** | **135** | **144** |
| **Drainage to Infiltration Trench #3** | **134** | **180** |
| **Drainage to Subsurface Chambers** | **986** | **987** |
| **Entire Site** | **3,252** | **3,933** |

***Required Water Quality Volume:***

| | |
|---|---|
| **Total Proposed Impervious Area:** | **39,021** sf |
| **Water Quality Volume Required:** | **3,252** cf |
| **Total Volume provided:** | 3,933 **cf** |

***Volume to be Treated:***

**Drainage to Bioretention Basin**

| | |
|---|---|
| Total Proposed Impervious Area: | **5,914** sf |
| Total Volume to be treated: | **493 cf** |

**Drainage to Infiltration Trench #1**

| | |
|---|---|
| Total Proposed Impervious Area: | **5,438** sf |
| Total Volume to be treated: | **453 cf** |

**Drainage to Infiltration Trench #2**

| | |
|---|---|
| Total Proposed Impervious Area: | **1,625** sf |
| Total Volume to be treated: | **135 cf** |

**Drainage to Infiltration Trench #3**

| | |
|---|---|
| Total Proposed Impervious Area: | **1,604** sf |
| Total Volume to be treated: | **134 cf** |

**Drainage to Subsurface Chambers**

| | |
|---|---|
| Total Proposed Impervious Area: | **11,836** sf |
| Total Volume to be treated: | **986 cf** |

***Volume Provided:***

**Drainage to Bioretention Basin**

| | | | | |
|---|---|---|---|---|
| Storage Volume Below Outlet | | 2,008 cf | (See HydroCAD storage table for WQv at elevation 12.50) | |

**Drainage to Infiltration Trench #1**

| | | | | | | |
|---|---|---|---|---|---|---|
| Top Elevation = | 13.00 | Area of contou | 1,023 sf | | | |
| Bottom Elev = | 11.00 | Area of contou | 1,023 sf | Vol. of Trench: | 2,046 cf | |
| | | Void Ratio of Crushed Stone= | 0.30 | **Vol. of Treatment:** | **614 cf** | |

**Drainage to Infiltration Trench #2**

| | | | | | |
|---|---|---|---|---|---|
| Top Elevation = | 11.50 | Area of contou | 960 sf | | |
| Bottom Elev = | 11.00 | Area of contou | 960 sf | Vol. of Trench: | 480 cf |
| | | Void Ratio of Crushed Stone= | 0.30 | **Vol. of Treatment:** | **144 cf** |

**Drainage to Infiltration Trench #3**

| | | | | | |
|---|---|---|---|---|---|
| Top Elevation = | 11.50 | Area of contou | 1,200 sf | | |
| Bottom Elev = | 11.00 | Area of contou | 1,200 sf | Vol. of Trench: | 600 cf |
| | | Void Ratio of Crushed Stone= | 0.30 | **Vol. of Treatment:** | **180 cf** |

**Drainage to Subsurface Chambers**

(See HydroCAD storage table for WQv at elevation 10.35)

**Vol. of Treatment:** **987 cf**

## Stage-Area-Storage for Pond 8P: Storage Chambers

| Elevation (feet) | Storage (cubic-feet) | Elevation (feet) | Storage (cubic-feet) | Elevation (feet) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 8.97 | 0 | 9.50 | 345 | 10.03 | 816 |
| 8.98 | 4 | 9.51 | 355 | 10.04 | 823 |
| 8.99 | 8 | 9.52 | 365 | 10.05 | 830 |
| 9.00 | 13 | 9.53 | 375 | 10.06 | 837 |
| 9.01 | 17 | 9.54 | 385 | 10.07 | 844 |
| 9.02 | 21 | 9.55 | 395 | 10.08 | 850 |
| 9.03 | 25 | 9.56 | 405 | 10.09 | 856 |
| 9.04 | 30 | 9.57 | 415 | 10.10 | 863 |
| 9.05 | 34 | 9.58 | 424 | 10.11 | 869 |
| 9.06 | 38 | 9.59 | 434 | 10.12 | 875 |
| 9.07 | 42 | 9.60 | 444 | 10.13 | 881 |
| 9.08 | 47 | 9.61 | 454 | 10.14 | 886 |
| 9.09 | 51 | 9.62 | 463 | 10.15 | 892 |
| 9.10 | 55 | 9.63 | 473 | 10.16 | 898 |
| 9.11 | 59 | 9.64 | 483 | 10.17 | 903 |
| 9.12 | 64 | 9.65 | 492 | 10.18 | 908 |
| 9.13 | 68 | 9.66 | 502 | 10.19 | 914 |
| 9.14 | 72 | 9.67 | 511 | 10.20 | 919 |
| 9.15 | 76 | 9.68 | 521 | 10.21 | 924 |
| 9.16 | 80 | 9.69 | 530 | 10.22 | 929 |
| 9.17 | 85 | 9.70 | 539 | 10.23 | 934 |
| 9.18 | 89 | 9.71 | 549 | 10.24 | 938 |
| 9.19 | 93 | 9.72 | 558 | 10.25 | 943 |
| 9.20 | 97 | 9.73 | 567 | 10.26 | 948 |
| 9.21 | 102 | 9.74 | 576 | 10.27 | 952 |
| 9.22 | 106 | 9.75 | 586 | 10.28 | 957 |
| 9.23 | 110 | 9.76 | 595 | 10.29 | 961 |
| 9.24 | 114 | 9.77 | 604 | 10.30 | 965 |
| 9.25 | 119 | 9.78 | 613 | 10.31 | 970 |
| 9.26 | 123 | 9.79 | 622 | 10.32 | 974 |
| 9.27 | 127 | 9.80 | 631 | 10.33 | 978 |
| 9.28 | 131 | 9.81 | 639 | 10.34 | 982 |
| 9.29 | 136 | 9.82 | 648 | 10.35 | 987 |
| 9.30 | 140 | 9.83 | 657 | 10.36 | 991 |
| 9.31 | 148 | 9.84 | 665 | 10.37 | 995 |
| 9.32 | 159 | 9.85 | 674 | 10.38 | 999 |
| 9.33 | 169 | 9.86 | 683 | 10.39 | 1,004 |
| 9.34 | 180 | 9.87 | 691 | 10.40 | 1,008 |
| 9.35 | 190 | 9.88 | 699 | 10.41 | 1,012 |
| 9.36 | 201 | 9.89 | 708 | 10.42 | 1,016 |
| 9.37 | 211 | 9.90 | 716 | 10.43 | 1,021 |
| 9.38 | 222 | 9.91 | 724 | 10.44 | 1,025 |
| 9.39 | 232 | 9.92 | 732 | 10.45 | 1,029 |
| 9.40 | 242 | 9.93 | 740 | 10.46 | 1,033 |
| 9.41 | 253 | 9.94 | 748 | 10.47 | 1,038 |
| 9.42 | 263 | 9.95 | 756 | 10.48 | 1,042 |
| 9.43 | 274 | 9.96 | 764 | 10.49 | 1,046 |
| 9.44 | 284 | 9.97 | 772 | 10.50 | 1,050 |
| 9.45 | 294 | 9.98 | 779 | 10.51 | 1,054 |
| 9.46 | 304 | 9.99 | 787 | 10.52 | 1,059 |
| 9.47 | 315 | 10.00 | 794 | 10.53 | 1,063 |
| 9.48 | 325 | 10.01 | 802 | 10.54 | 1,067 |
| 9.49 | 335 | 10.02 | 809 | 10.55 | 1,071 |

STORAGE VOLUME BELOW LOWEST OUTLET

## Stage-Area-Storage for Pond 8P: Storage Chambers (continued)

| Elevation (feet) | Storage (cubic-feet) |
|---:|---:|
| 10.56 | 1,076 |
| 10.57 | 1,080 |
| 10.58 | 1,084 |
| 10.59 | 1,088 |
| 10.60 | 1,093 |
| 10.61 | 1,097 |
| 10.62 | 1,101 |
| 10.63 | 1,105 |
| 10.64 | 1,110 |
| 10.65 | 1,114 |
| 10.66 | 1,118 |
| 10.67 | 1,122 |
| 10.68 | 1,127 |
| 10.69 | 1,131 |
| 10.70 | 1,135 |
| 10.71 | 1,139 |
| 10.72 | 1,143 |
| 10.73 | 1,148 |
| 10.74 | 1,152 |
| 10.75 | 1,156 |
| 10.76 | 1,160 |
| 10.77 | 1,165 |
| 10.78 | 1,169 |
| 10.79 | 1,173 |
| 10.80 | **1,177** |

## Stage-Area-Storage for Pond 1P: Bioretention Basin

| Elevation (feet) | Storage (cubic-feet) | Elevation (feet) | Storage (cubic-feet) | Elevation (feet) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 11.00 | 0 | 11.53 | 348 | 12.06 | 792 |
| 11.01 | 7 | 11.54 | 355 | 12.07 | 815 |
| 11.02 | 13 | 11.55 | 361 | 12.08 | 839 |
| 11.03 | 20 | 11.56 | 368 | 12.09 | 862 |
| 11.04 | 26 | 11.57 | 374 | 12.10 | 886 |
| 11.05 | 33 | 11.58 | 381 | 12.11 | 910 |
| 11.06 | 39 | 11.59 | 388 | 12.12 | 935 |
| 11.07 | 46 | 11.60 | 394 | 12.13 | 959 |
| 11.08 | 53 | 11.61 | 401 | 12.14 | 984 |
| 11.09 | 59 | 11.62 | 407 | 12.15 | 1,009 |
| 11.10 | 66 | 11.63 | 414 | 12.16 | 1,034 |
| 11.11 | 72 | 11.64 | 420 | 12.17 | 1,059 |
| 11.12 | 79 | 11.65 | 427 | 12.18 | 1,084 |
| 11.13 | 85 | 11.66 | 434 | 12.19 | 1,110 |
| 11.14 | 92 | 11.67 | 440 | 12.20 | 1,136 |
| 11.15 | 99 | 11.68 | 447 | 12.21 | 1,162 |
| 11.16 | 105 | 11.69 | 453 | 12.22 | 1,188 |
| 11.17 | 112 | 11.70 | 460 | 12.23 | 1,215 |
| 11.18 | 118 | 11.71 | 466 | 12.24 | 1,242 |
| 11.19 | 125 | 11.72 | 473 | 12.25 | 1,268 |
| 11.20 | 131 | 11.73 | 480 | 12.26 | 1,296 |
| 11.21 | 138 | 11.74 | 486 | 12.27 | 1,323 |
| 11.22 | 145 | 11.75 | 493 | 12.28 | 1,350 |
| 11.23 | 151 | 11.76 | 499 | 12.29 | 1,378 |
| 11.24 | 158 | 11.77 | 506 | 12.30 | 1,406 |
| 11.25 | 164 | 11.78 | 512 | 12.31 | 1,434 |
| 11.26 | 171 | 11.79 | 519 | 12.32 | 1,463 |
| 11.27 | 177 | 11.80 | 526 | 12.33 | 1,491 |
| 11.28 | 184 | 11.81 | 532 | 12.34 | 1,520 |
| 11.29 | 191 | 11.82 | 539 | 12.35 | 1,549 |
| 11.30 | 197 | 11.83 | 545 | 12.36 | 1,578 |
| 11.31 | 204 | 11.84 | 552 | 12.37 | 1,607 |
| 11.32 | 210 | 11.85 | 558 | 12.38 | 1,637 |
| 11.33 | 217 | 11.86 | 565 | 12.39 | 1,667 |
| 11.34 | 223 | 11.87 | 572 | 12.40 | 1,697 |
| 11.35 | 230 | 11.88 | 578 | 12.41 | 1,727 |
| 11.36 | 237 | 11.89 | 585 | 12.42 | 1,757 |
| 11.37 | 243 | 11.90 | 591 | 12.43 | 1,788 |
| 11.38 | 250 | 11.91 | 598 | 12.44 | 1,819 |
| 11.39 | 256 | 11.92 | 604 | 12.45 | 1,850 |
| 11.40 | 263 | 11.93 | 611 | 12.46 | 1,881 |
| 11.41 | 269 | 11.94 | 618 | 12.47 | 1,912 |
| 11.42 | 276 | 11.95 | 624 | 12.48 | 1,944 |
| 11.43 | 283 | 11.96 | 631 | 12.49 | 1,976 |
| 11.44 | 289 | 11.97 | 637 | 12.50 | 2,008 |
| 11.45 | 296 | 11.98 | 644 | 12.51 | 2,040 |
| 11.46 | 302 | 11.99 | 650 | 12.52 | 2,073 |
| 11.47 | 309 | 12.00 | 657 | 12.53 | 2,105 |
| 11.48 | 315 | 12.01 | 679 | 12.54 | 2,138 |
| 11.49 | 322 | 12.02 | 701 | 12.55 | 2,171 |
| 11.50 | 329 | 12.03 | 724 | 12.56 | 2,204 |
| 11.51 | 335 | 12.04 | 746 | 12.57 | 2,238 |
| 11.52 | 342 | 12.05 | 769 | 12.58 | 2,272 |

STORAGE VOLUME BELOW LOWEST OUTLET

## Stage-Area-Storage for Pond 1P: Bioretention Basin (continued)

| Elevation (feet) | Storage (cubic-feet) |
|---|---|
| 12.59 | 2,305 |
| 12.60 | 2,339 |
| 12.61 | 2,374 |
| 12.62 | 2,408 |
| 12.63 | 2,443 |
| 12.64 | 2,478 |
| 12.65 | 2,513 |
| 12.66 | 2,548 |
| 12.67 | 2,584 |
| 12.68 | 2,619 |
| 12.69 | 2,655 |
| 12.70 | 2,692 |
| 12.71 | 2,728 |
| 12.72 | 2,764 |
| 12.73 | 2,801 |
| 12.74 | 2,838 |
| 12.75 | 2,875 |
| 12.76 | 2,913 |
| 12.77 | 2,950 |
| 12.78 | 2,988 |
| 12.79 | 3,026 |
| 12.80 | 3,064 |
| 12.81 | 3,102 |
| 12.82 | 3,141 |
| 12.83 | 3,180 |
| 12.84 | 3,219 |
| 12.85 | 3,258 |
| 12.86 | 3,297 |
| 12.87 | 3,337 |
| 12.88 | 3,377 |
| 12.89 | 3,417 |
| 12.90 | 3,457 |
| 12.91 | 3,497 |
| 12.92 | 3,538 |
| 12.93 | 3,579 |
| 12.94 | 3,620 |
| 12.95 | 3,661 |
| 12.96 | 3,703 |
| 12.97 | 3,744 |
| 12.98 | 3,786 |
| 12.99 | 3,828 |
| 13.00 | **3,871** |

Green International Affiliates, Inc

# WATER QUALITY CALCULATIONS FOR PROPRIETARY DEVICES

**Date:** September 28, 2021
**Revised:**
**Project:** Newell Boathouse
**Project No:** 21030
**Location:** Boston, MA

**Prepared By:** MW
**Checked By:** JT

***Objective:*** To determine the required Water Quality Volume (WQV) for adequate stormwater treatment for Proprietary devices

***Methodology:*** MA Department of Environmental Protection (DEP) Standard method to convert required WQV to a discharge rate for sizing flow based manufactured proprietary stormwater treatment practices, dated 10/15/2013

***Design Criteria:*** Volume to be treated = 1" x Post Development Impervious

Critical Areas(include ORW, ACEC, recharge areas for public water supplies (Zone Is, Zone IIs and Interim Wellhead Protection Areas for ground water sources and Zone As for surface water sources), bathing beaches, cold water fisheries, shellfish growing areas and LUHPPL's

**All WQ calculations will use 1"**

$Q_1 = (qu)(A)(WQV)$

$Q_1$ = flow rate associated with first 1-inch of runoff
qu = the unit peak discharge, in csm/in
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1-inch in this case)

***Calculation results:***

| Designation | Flow Rate Required (cfs) | Flow Rate Provided |
|---|---|---|
| **Drainage to WQU-1** | **0.33** | **0.34** |

Green International Affiliates, Inc

***Flow Rate to be Treated:***

**<u>Drainage to WQU-1</u>**

| | | | |
|---|---|---|---|
| $T_c$ = | 6.0 | min | 0.1 hr |
| qu = | 774.0 | csm/in (Figure 2 - Ia/P Curve for Type III Storm Distribution) | |
| A = | 11,836 | sf | 0.0004246 sm |
| WQV = | 1.0 | in | |
| | | | |
| $Q_1$ = | 0.33 | cfs | |

***Volume Provided:***

**<u>Drainage to WQS-1 (Recharge System 1A pretreatment)</u>**

WQ Unit is = CDS1515-3 (or approved equal)

$WQ_r$ = flow rate treated before bypass= **0.34 cfs** (see Contech Flow Rate Table)

**Project:** **Harvard University Athletics - Newell Boathouse**
**Location:** **Allston, MA**
**Prepared For:** **Green International Affiliates**

CONTECH ENGINEERED SOLUTIONS

**Purpose:** To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

**Reference:** Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

**Procedure:** Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi$^2$/watershed inches (csm/in).

Compute Q Rate using the following equation:

**Q = (qu) (A) (WQV)**

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

| Structure Name | Impv. (acres) | A (miles$^2$) | $t_c$ (min) | $t_c$ (hr) | WQV (in) | qu (csm/in.) | Q (cfs) |
|---|---|---|---|---|---|---|---|
| CDS | 0.28 | 0.0004438 | 6.0 | 0.100 | 1.00 | 774.00 | 0.34 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

*Version 1, Automated: Mar. 4, 2008*

Location: Newell Boathouse, DP-1

# TSS Removal Calculation Worksheet

| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| Infiltration Trench | 0.80 | 1.00 | 0.80 | 0.20 |
| | 0.00 | 0.20 | 0.00 | 0.20 |
| | 0.00 | 0.20 | 0.00 | 0.20 |
| | 0.00 | 0.20 | 0.00 | 0.20 |
| | 0.00 | 0.20 | 0.00 | 0.20 |

**Total TSS Removal = 80%**

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

Project: 21030
Prepared By: MW
Date: 8/19/2021

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

*Mass. Dept. of Environmental Protection*

INSTRUCTIONS:

*Non-automated: Mar. 4, 2008*

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Newell Boathouse, DP-1

# TSS Removal Calculation Worksheet

| A<br>BMP[1] | B<br>TSS Removal Rate[1] | C<br>Starting TSS Load* | D<br>Amount Removed (B*C) | E<br>Remaining Load (C-D) |
|---|---|---|---|---|
| Proprietary Treatment Practice | 0.87 | **1.00** | 0.87 | 0.13 |
| Subsurface Structure | 0.80 | 0.13 | 0.10 | 0.03 |
| | | | | |
| | | | | |
| | | | | |

**Total TSS Removal =** 97%

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

Project: 21030
Prepared By: MW
Date: 8/19/2021

*Equals remaining load from previous BMP (E) which enters the BMP

*Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed*
*1. From MassDEP Stormwater Handbook Vol. 1*

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

*Version 1, Automated: Mar. 4, 2008*

Location: Newell Boathouse DP-1

**TSS Removal Calculation Worksheet**

| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| Bioretention Area | 0.90 | 1.00 | 0.90 | 0.10 |
| Sediment Forebay | 0.25 | 0.10 | 0.03 | 0.08 |
| | 0.00 | 0.08 | 0.00 | 0.08 |
| | 0.00 | 0.08 | 0.00 | 0.08 |
| | 0.00 | 0.08 | 0.00 | 0.08 |

**Total TSS Removal =** 93%

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

Project: 21030
Prepared By: MW
Date: 8/25/2021

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

# CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

## HARVARD UNIVERSITY ATHLETICS - NEWELL BOATHOUSE
## ALLSTON, MA

| | | | |
|---|---|---|---|
| Area | 0.28 ac | Unit Site Designation | CDS |
| Weighted C | 0.9 | Rainfall Station # | 69 |
| $t_c$ | 6 min | | |
| CDS Model | 1515-3 | CDS Treatment Capacity | 1.0 cfs |

| Rainfall Intensity[1] (in/hr) | Percent Rainfall Volume[1] | Cumulative Rainfall Volume | Total Flowrate (cfs) | Treated Flowrate (cfs) | Incremental Removal (%) |
|---|---|---|---|---|---|
| 0.02 | 10.2% | 10.2% | 0.01 | 0.01 | 9.9 |
| 0.04 | 9.6% | 19.8% | 0.01 | 0.01 | 9.3 |
| 0.06 | 9.4% | 29.3% | 0.02 | 0.02 | 9.1 |
| 0.08 | 7.7% | 37.0% | 0.02 | 0.02 | 7.4 |
| 0.10 | 8.6% | 45.6% | 0.03 | 0.03 | 8.2 |
| 0.12 | 6.3% | 51.9% | 0.03 | 0.03 | 6.0 |
| 0.14 | 4.7% | 56.5% | 0.04 | 0.04 | 4.4 |
| 0.16 | 4.6% | 61.2% | 0.04 | 0.04 | 4.4 |
| 0.18 | 3.5% | 64.7% | 0.05 | 0.05 | 3.3 |
| 0.20 | 4.3% | 69.1% | 0.05 | 0.05 | 4.1 |
| 0.25 | 8.0% | 77.1% | 0.06 | 0.06 | 7.4 |
| 0.30 | 5.6% | 82.7% | 0.08 | 0.08 | 5.1 |
| 0.35 | 4.4% | 87.0% | 0.09 | 0.09 | 4.0 |
| 0.40 | 2.5% | 89.5% | 0.10 | 0.10 | 2.3 |
| 0.45 | 2.5% | 92.1% | 0.12 | 0.12 | 2.3 |
| 0.50 | 1.4% | 93.5% | 0.13 | 0.13 | 1.2 |
| 0.75 | 5.0% | 98.5% | 0.19 | 0.19 | 4.2 |
| 1.00 | 1.0% | 99.5% | 0.26 | 0.26 | 0.8 |
| 1.50 | 0.0% | 99.5% | 0.38 | 0.38 | 0.0 |
| 2.00 | 0.0% | 99.5% | 0.51 | 0.51 | 0.0 |
| 3.00 | 0.5% | 100.0% | 0.77 | 0.77 | 0.2 |
| | | | | | 93.6 |

| | |
|---|---|
| Removal Efficiency Adjustment[2] = | 6.5% |
| Predicted % Annual Rainfall Treated = | 93.5% |
| **Predicted Net Annual Load Removal Efficiency =** | **87.2%** |

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Green International Affiliates, Inc

## TMDL - PHOSPHOROUS REDUCTION CALCULATIONS (DEP/EPA Method)

**Date:** March 25, 2022
**Revised:**
**Project:** Newell Boathouse
**Project No:** 21030
**Location:** Boston, MA

**Prepared By:** MW/SB
**Checked By:** JT/DHS

---

***Objective:*** Meet the Lower Charles River Watershed TMDL for Phosphorous using a conservative 62% removal rate

***Methodology:*** Stormwater BMP Permormance Analysis by Tetra Tech, December 2008 Distributed by EPA Region 1

***Design Criteria:*** The depth of runoff treated equals a depth of runoff corresponding to the pollutant removal based on the BMP used, land use and soil infiltration.

***Required TMDL:***

TMDL for Lower Charles Basin = 65% (MassDEP & EPA Region 1 Assessment)
BMP Performance Curve = Infiltration Basin
Land Use = Low Density Residential
Soil Infiltration = 0.27 in/hr

Minimum depth of Runoff Required = 0.42 inches (Infiltration Trench see BMP curve)
Minimum depth of Runoff Required = 0.64 inches (Bioretention Basin see BMP curve)
Minimum depth of Runoff Required = 0.38 inches (Infiltration Basin see BMP curve)

***Calculation Results:***

| Designation | Depth Required (inches) | Depth Provided (inches) |
|---|---|---|
| **Drainage Area to Bioretention Basin** | **0.64** | **4.07** |
| **Drainage Area to Infiltration Trench #1** | **0.42** | **1.35** |
| **Drainage Area to Infiltration Trench #2** | **0.42** | **1.06** |
| **Drainage Area to Infiltration Trench #3** | **0.42** | **1.35** |

***Runoff Treated:***

$$\text{Depth of Runoff Treated} = \frac{R_v}{12xA_{imp}}$$

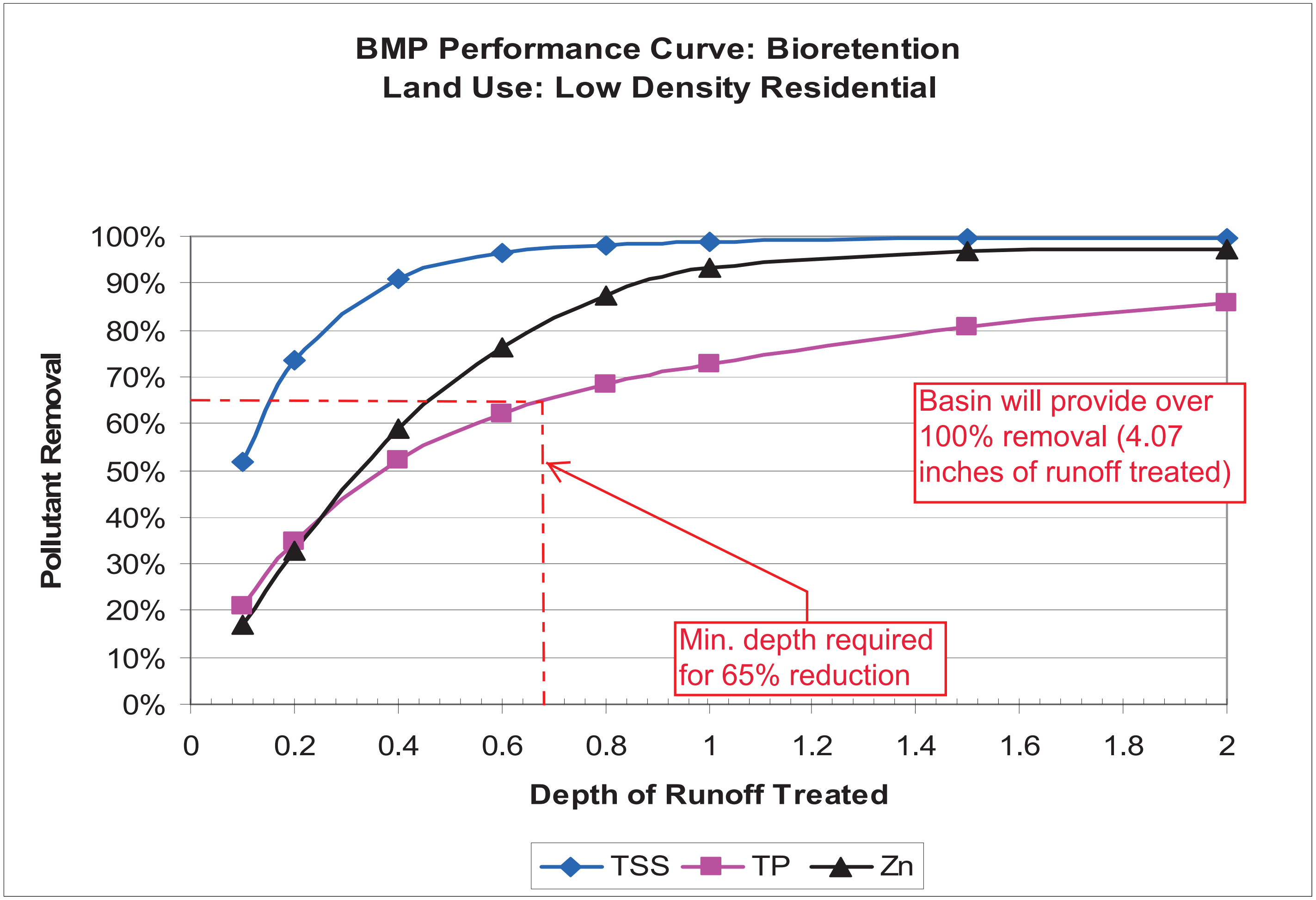
$R_v$ = Provided Recharge Volume
$A_{imp}$ = Impervious Area

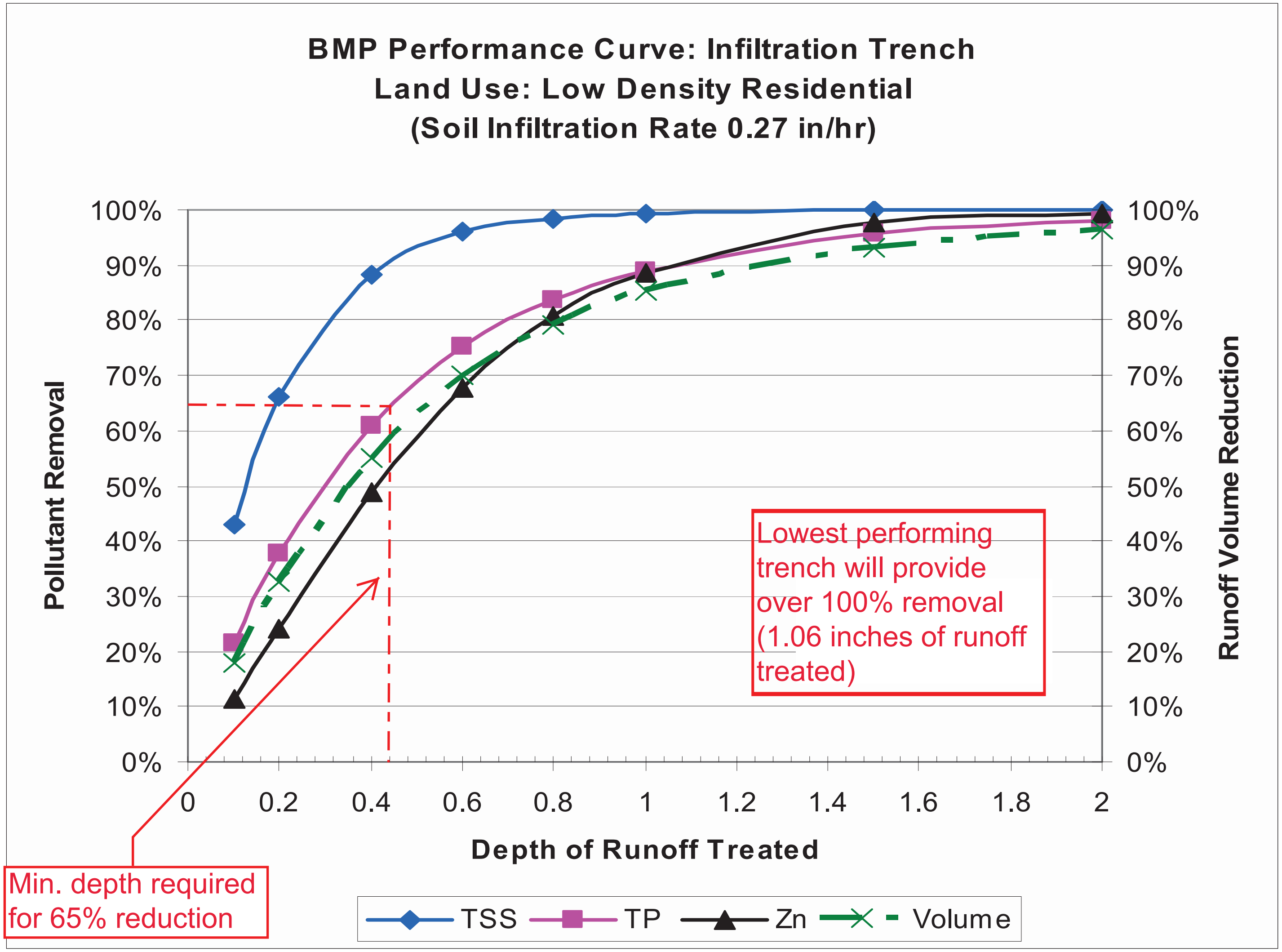
**<u>Drainage Area to Bioretention Basin</u>**
$R_v$ = storage below lowest outlet (orifice) = 2,008 cf (Elev. 12.50, see hydrocad table)
$A_{imp}$ *= 5,914 sf
**Depth of Runoff Treated = 4.07 inches**

**<u>Drainage Area to Infiltration Trench #1</u>**
$R_v$ = storage below lowest outlet (orifice) = 614 cf
$A_{imp}$ *= 5,438 sf
**Depth of Runoff Treated = 1.35 inches**

**<u>Drainage Area to Infiltration Trench #2</u>**
$R_v$ = storage below lowest outlet (orifice) = 144 cf
$A_{imp}$ *= 1,625 sf
**Depth of Runoff Treated = 1.06 inches**

**<u>Drainage Area to Infiltration Trench #3</u>**
$R_v$ = storage below lowest outlet (orifice) = 180 cf
$A_{imp}$ *= 1,604 sf
**Depth of Runoff Treated = 1.35 inches**


BMP Performance Curve: Bioretention
Land Use: Low Density Residential
Pollutant Removal
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Depth of Runoff Treated
Basin will provide over 100% removal (4.07 inches of runoff treated)
Min. depth required for 65% reduction
TSS
TP
Zn



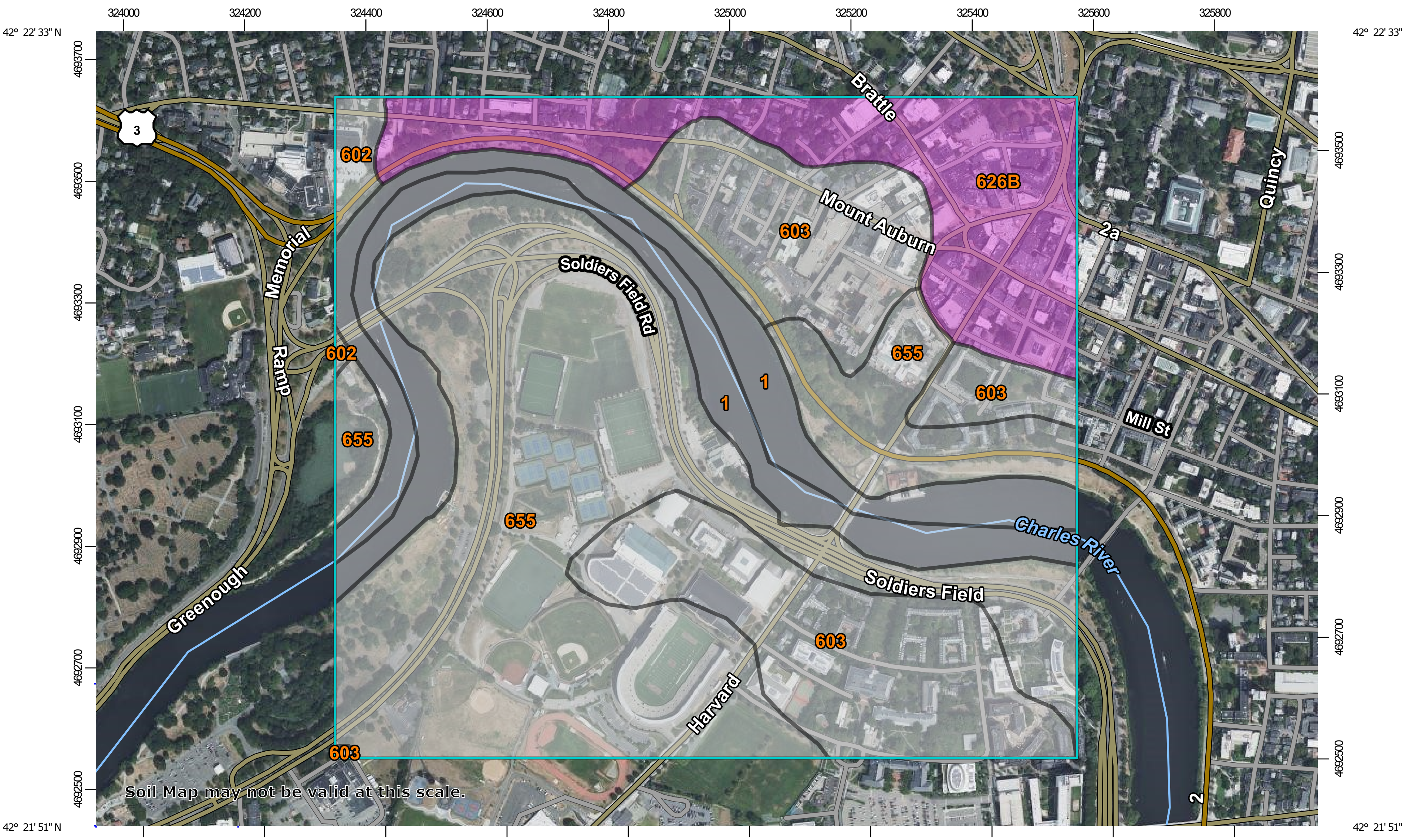
BMP Performance Curve: Infiltration Trench
Land Use: Low Density Residential
(Soil Infiltration Rate 0.27 in/hr)
Pollutant Removal
Runoff Volume Reduction
Depth of Runoff Treated
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Lowest performing trench will provide over 100% removal (1.06 inches of runoff treated)
Min. depth required for 65% reduction
TSS
TP
Zn
Volume

## *APPENDIX D*

SOIL INFORMATION

- NRCS Soils Report (from NRCS Website)

Hydrologic Soil Group—Middlesex County, Massachusetts, and Norfolk and Suffolk Counties, Massachusetts
(Newell Boathouse)




Map Scale: 1:9,210 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

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

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

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

**Soil Rating Lines**

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

**Soil Rating Points**

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

**Water Features**

- Streams and Canals

**Transportation**

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

**Background**

- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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: Middlesex County, Massachusetts
Survey Area Data: Version 20, Jun 9, 2020

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 13, 2020—Sep 15, 2020

## MAP LEGEND

## MAP INFORMATION

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

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1 | Water | | 25.0 | 7.6% |
| 602 | Urban land | | 3.8 | 1.2% |
| 603 | Urban land, wet substratum | | 35.1 | 10.6% |
| 626B | Merrimac-Urban land complex, 0 to 8 percent slopes | A | 48.1 | 14.6% |
| 655 | Udorthents, wet substratum | | 24.0 | 7.3% |
| **Subtotals for Soil Survey Area** | | | **136.1** | **41.2%** |
| **Totals for Area of Interest** | | | **330.0** | **100.0%** |

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1 | Water | | 26.5 | 8.0% |
| 603 | Urban land, wet substratum, 0 to 3 percent slopes | | 41.2 | 12.5% |
| 655 | Udorthents, wet substratum | | 126.2 | 38.2% |
| **Subtotals for Soil Survey Area** | | | **194.0** | **58.8%** |
| **Totals for Area of Interest** | | | **330.0** | **100.0%** |

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# *APPENDIX E*

ILLICIT DISCHARGE COMPLIANCE STATEMENT

# Illicit Discharge Compliance Statement

Per Standard 10 of the Massachusetts Stormwater Handbook, the following is an Illicit Discharge Compliance Statement:

The design plans submitted for the Notice of Intent have been designed in full compliance with current standards.

The Long-Term Pollution Prevention Plan is part of the Operation and Maintenance Plan and includes measures to prevent illicit discharges. There are no known combined sewer outfalls and to the best of our knowledge all closed stormwater systems discharge per Massachusetts DEP requirements. Based on observations during a site visit in May 2021 the site does not contain any known existing illicit discharges.

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
JAMES W. THORNE
CIVIL
NO. 54912
REGISTERED
PROFESSIONAL ENGINEER

6/25/2021

Signature and Date

# *APPENDIX F*

OPERATION AND MAINTENANCE PLAN (O&M)

GREEN INTERNATIONAL AFFILIATES, INC.
239 LITTLETON ROAD, SUITE 3, WESTFORD, MA 01886
TEL (978) 923-0400 FAX (978) 399-0033

# STORMWATER OPERATIONS & MAINTENANCE PLAN

**Newell Boathouse Improvements in Boston, MA**
**August 27, 2021**

All Operation and Maintenance shall be done in accordance with the relevant provisions of Harvard University's Standard Operating Procedure for Structural Stormwater BMP's, in addition to the site-specific items noted below for Newell Boathouse.

## OPERATION & MAINTENANCE PLAN – OUTFALLS

Outfalls should be inspected every six months during the first year and annually thereafter for sediment buildup, bare spots and vegetation health. Any erosion or low spots must be repaired.

## OPERATION & MAINTENANCE PLAN – OUTLET CONTROL STRUCTURES/AREA DRAINS

Area drains require regular cleaning. Inspect the area drain at least twice a year, including at the end of foliage- and snow removal-season. Sediment must also be removed when the depth of deposits is greater than or equal to half of the depth from the bottom of the invert of the lowest pipe in the catch basin. More frequent cleaning may be necessary in critical areas or areas with higher potential pollutant loads.

Vacuum trucks are preferable to clamshell buckets for cleaning, as vacuuming is faster and removes more sediment and supernatant.

## OPERATION & MAINTENANCE PLAN – BIORETENTION AREAS

The proposed bioretention area uses soils, plants and microbes to treat stormwater before it is infiltrated. To maintain functionality, the proposed bioretention area requires regular inspection and cleaning.

- Bioretention area shall be inspected monthly for litter and debris, sediment build-up, soil erosion, and standing water beyond 72 hours of a stormwater event.
- Bioretention area shall be inspected for invasive species monthly. Should invasive species occur they and their roots systems shall be manually removed.
- The base of the bioretention area shall be mown once a year in early spring. Should build up of cut plant material exceed 3 inches in depth it shall be removed.
- Shrubs planted surrounding the bioretention area slopes shall be protected from mowing. Low growing shrubs have been planted, however if desired for aesthetic reasons or to preserve views, shrubs can be pruned to a lower height. The design intent is for the shrubs to form masses and they should not be pruned as individual plants.

- Tall grasses and perennials surrounding the bioretention area shall be cut by hand, to a height of six inches, once in the early spring. Cut plant material from these plants shall be removed from the site.
- Should soil media and vegetation need to be replaced it shall be done in the late spring or early summer.
- The pretreatment for the Bioretention Area (crushed stone diaphragm) will be inspected for sediment build-up and debris will be removed at least once every six months and after every major storm events. Only the top 6” shall be removed and replaced.

<u>OPERATION & MAINTENANCE PLAN – INFILTRATION TRENCHES</u>

Infiltration trenches are prone to failure due to clogging and must be maintained on a regular schedule. To maintain functionality, infiltration must undergo routine maintenance including:

- Inspection after the first several rainfall events, after all major storm events, and on regularly scheduled dates every six months.
- Routine removal of grass clippings, leaves and accumulated sediment from the surface of the trench.
- Inspection 24 hours or several days after a rain event to look for ponded water. If there is ponded water, it is likely the trench surface that is clogged. To address clogging, remove the first layer of topsoil or stone aggregate and the filter fabric. If water is ponding inside the trench, it may indicate that the bottom of the trench has failed. TO rehabilitate a failed trench, all accumulated sediment must be stripped from the bottom, the bottom of the trench must be scarified and tilled to induce infiltration, and all the stone aggregate and filter fabric or media but be removed and replaced.

<u>OPERATION & MAINTENANCE PLAN – PROPRIETARY WATER QUALITY UNIT</u>

The regular maintenance of the water quality unit is essential. The maintenance of these units begins immediately at post-construction prior to putting the unit into service. For detailed maintenance information, see the attached maintenance plan from the manufacturer.

<u>OPERATION & MAINTENANCE PLAN – SUBSURFACE INFILTRATION SYSTEM</u>

Regular inspection and maintenance are essential to assure a properly functioning system. Inspection is accomplished through inspection ports which allow inspection to be accomplished from the surface without the need for confined space entry. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding three inches, cleanout is required.

The system should be initially inspected immediately after the completion of the site’s construction. Inspection and maintenance, if necessary, should be performed prior to the contractor passing responsibility over to the site’s owner. Once in normal service, the system should be inspected bi-annually until an understanding of the site’s characteristics is developed.

The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

The system proposed for this site does not include an isolator row which in general will making the cleaning of the system very difficult due to minimal access to key components. The key component to ensuring the long-term performance of the system is to remain diligent about the maintenance of the CDS unit upstream. Ensuring this upstream unit functions as intended will help to eliminate the inflow of debris and sediment into the infiltration system.

*f:\projects\2021\21030\docs\rpts\stormwater report\newell\appendices for sw report\appendix f - stormwater om.docx*

# CDS® Inspection and Maintenance Guide

## Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

## Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

## Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

| CDS Model | Diameter | | Distance from Water Surface to Top of Sediment Pile | | Sediment Storage Capacity | |
|---|---|---|---|---|---|---|
| | ft | m | ft | m | y³ | m³ |
| CDS1515 | 3 | 0.9 | 3.0 | 0.9 | 0.5 | 0.4 |
| CDS2015 | 4 | 1.2 | 3.0 | 0.9 | 0.9 | 0.7 |
| CDS2015 | 5 | 1.3 | 3.0 | 0.9 | 1.3 | 1.0 |
| CDS2020 | 5 | 1.3 | 3.5 | 1.1 | 1.3 | 1.0 |
| CDS2025 | 5 | 1.3 | 4.0 | 1.2 | 1.3 | 1.0 |
| CDS3020 | 6 | 1.8 | 4.0 | 1.2 | 2.1 | 1.6 |
| CDS3025 | 6 | 1.8 | 4.0 | 1.2 | 2.1 | 1.6 |
| CDS3030 | 6 | 1.8 | 4.6 | 1.4 | 2.1 | 1.6 |
| CDS3035 | 6 | 1.8 | 5.0 | 1.5 | 2.1 | 1.6 |
| CDS4030 | 8 | 2.4 | 4.6 | 1.4 | 5.6 | 4.3 |
| CDS4040 | 8 | 2.4 | 5.7 | 1.7 | 5.6 | 4.3 |
| CDS4045 | 8 | 2.4 | 6.2 | 1.9 | 5.6 | 4.3 |
| CDS5640 | 10 | 3.0 | 6.3 | 1.9 | 8.7 | 6.7 |
| CDS5653 | 10 | 3.0 | 7.7 | 2.3 | 8.7 | 6.7 |
| CDS5668 | 10 | 3.0 | 9.3 | 2.8 | 8.7 | 6.7 |
| CDS5678 | 10 | 3.0 | 10.3 | 3.1 | 8.7 | 6.7 |

MODEL BEING USED ON THIS SITE.

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

**Support**

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.



Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

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HATCH

# Newell Boathouse Field Inspection Checklist

## Bioretention Basin, Vegetated Swale, and Non-turf Areas

**Date of Inspection: ___________ Location: _______________________ Inspector: ________________________**

| Task | Frequency | | | | Comments |
|---|---|---|---|---|---|
| | 1M | 3M | 6M | 12M | |
| Inspect Bioretention Basin for sediment and debris | | | X | | ☐ Remove any accumulated sediment, debris, or trash.<br>☐ Stabilize/repair any eroded areas, bare spots and slopes/banks where appropriate.<br>☐ Properly dispose of all materials offsite.<br>☐ Ensure spillway is free of obstructions and debris. |
| Inspect Growing Medium (Planting Soils) | | | | X | ☐ In compacted areas or where ponding has occurred, remove top few inches of discolored material. Rake, till or amend with City-approved Biobasin soil mix.<br>☐ Remove sediment as necessary. If sediment removal results in 2” or more of soil has been removed then replace with City-approved Biobasin soil mix. |
| Weed (including invasives), Dead or Dying Vegetation | | | X | | ☐ Manually remove weeds and dead/dying vegetation.<br>☐ Basins should not appear overgrown.<br>☐ Plantings have distinct edges confined to planting areas.<br>☐ Properly dispose of all materials offsite. |

| | | | | | |
|---|---|---|---|---|---|
| Replace Vegetation | | | | AN | ☐ Replace dead plants (re-plant per original planting plan).<br>☐ Stabilize any eroded areas, bare spots and slopes/banks with additional approved plantings where appropriate.<br>☐ Do not apply fertilizers, herbicides or pesticides.<br>☐ Re-seed the Vegetated Swale as necessary. |
| Maintain Tall Turf and Woodland Grasses | X | | | X | ☐ Tall Turf Lawn areas shall be kept mowed with enough frequency to keep a maintained appearance throughout the growing season.<br>☐ Woodland Seed Mix areas should be trimmed to a height of six inches (6”) once annually to ensure woody species are removed.<br>☐ Manually cut perennial grasses and wildflowers within the Bioretention Basin and Vegetated Swale in early Spring as directed in Report.<br>☐ Properly dispose of all materials offsite. |

M = monthly; 3M = every three months; 6M =every six months; 12M = once annually; and AN = As Needed

| | | | | | |
|---|---|---|---|---|---|
| Vector Controls (Wildlife) | | | | X | ☐ Bioretention Basin shall not harbor mosquito larvae or rats that pose a threat to public health or facility structure.<br>☐ Note holes/burrows in and around Bioretention Basin.<br>☐ Record the time/date, weather and site conditions when vector activity is observed.<br>☐ Check for and note animal holes/burrows and any system short circuiting. Repair burrows when they occur, fill in and lightly compact holes with Town-approved biobasin soil mix. |
| Inspect Vegetated Swale | | | | X | ☐ Ensure vegetation is adequate. Replace as necessary.<br>☐ Look for signs of rilling/gullying. Repair any rills or gullies. |
| Inspect for Hardpan at Bottom of Bioretention Basin | | | | X | ☐ Hardpan occurs when the soil becomes cemented, forming an impervious layer. Where this has occurred, scarify the soil to a depth of four to six inches (4”-6”). |

**Inspection Notes and Additional Requirements:**

1. Complete inspections as noted and after a major storm event (rainfall totals greater than 0.5 inches in 24 hours).
2. All facilities should drain within 48 hours, if ponding is observed after two (2) days notify Harvard Facilities.
3. Maintain an annual inspection and maintenance log (including this form) with a summary of completed remediation efforts (ie. Date, contractor (if applicable,) replacement plant material, invasive plants removed, structural repairs and landscape maintenance activities.
4. Record photos (from consistent locations) should be taken of each facility during each inspection.
5. During first three (3) years of establishment, arrange for water with City of Boston as required during extended periods without rainfall.
6. Contact City of Boston for immediate assistance responding to any spills.
   a. Record the time/date, weather, and site conditions if site activities contaminate stormwater.
   b. Record the time/date and description of corrective action taken.

M = monthly; 3M = every three months; 6M =every six months; 12M = once annually; and AN = As Needed

# *APPENDIX G*

PLANS (UNDER SEPARATE COVER)

# ATTACHMENT C

## Project Plans


**HARVARD FACULTY OF ARTS AND SCIENCES**
Owner, Cambridge, MA

**HARVARD ATHLETICS**
Owners, Cambridge, MA

**OFFICE OF PHYSICAL RESOURCES AND PLANNING**
Project Manager, Cambridge, MA

**BRUNER/COTT ARCHITECTS**
Architect, Boston, MA

**PETERSON ARCHITECTS**
Architect, Cambridge, MA

**FOLEY, BUHL, ROBERTS & ASSOCIATES, INC.**
Structural Engineer, Newton, MA

**BUROHAPPOLD ENGINEERING**
MEP / FP Engineer, Boston, MA

**SHADLEY ASSOCIATES**
Landscape Architect, Lexington, MA

**GREEN INTERNATIONAL AFFILIATES**
Civil Engineer, Westford, MA

**CHILDS ENGINEERING**
Marine Engineer, Bellingham, MA

**KALIN ASSOCIATES, INC.**
Specifications, Newton, MA

**HAROLD R. CUTLER, P.E.**
Code Consultant, Sudbury, MA


# Harvard University Athletics
# Newell Boathouse Renovation

## Permit Plans
## March 2022

## LEGEND AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| WCS | WATER CURB STOP | PM | PARKING METER | | BUILDING FOOTPRINT |
| WG | WATER GATE | MW | MONITORING WELL | | BUILDING OVERHANG |
| GG | GAS GATE | B.R. | BIKE RACK | AC | AIR CONDITIONER |
| CB | CATCH BASIN | H.B. | HOSE BIB | BC | BOTTOM OF CURB |
| CB | ROUND CATCH BASIN | CCT | TRAFFIC SIGNAL CONTROLLER CABINET | BIT. | BITUMINOUS |
| AD | AREA DRAIN | × 24.39 | SPOT ELEVATION | BRE | BRICK EDGE |
| CMH | CABLE MANHOLE | 6" | 6" TREE | CONC. | CONCRETE |
| EMH | ELECTRIC MANHOLE | | BUSH | CW | CROSS WALK |
| EHH | ELECTRIC HANDHOLE | | TRAVERSE POINT | DIA. | DIAMETER |
| DMH | DRAIN MANHOLE | | BENCHMARK | DHF | DRILL HOLE FOUND |
| SMH | SEWER MANHOLE | | TEMPORARY BENCH MARK | DHS | DRILL HOLE SET |
| TMH | TELECOMMUNICATIONS MANHOLE | PPK | PARKING PAYMENT KIOSK | EXIST. | EXISTING |
| | UNKNOWN MANHOLE | BL | BOLLARD | FFE | FINISHED FLOOR ELEVATION |
| HH | HAND HOLE | SPP | STAND PIPE | FGC | FLUSH GRANITE CURB |
| HYD. | FIRE HYDRANT | | ELECTRIC OUTLET | GRAN. | GRANITE |
| | SIGN | | DETECTABLE WARNING PANEL | GRE | GRANITE EDGE |
| LP | ELECTRIC LIGHT POLE | | HEDGE LINE | L.O.C. | LEFT OUTSIDE CORNER |
| UPL | UTILITY POLE WITH LIGHT | | TREE CANOPY LINE | LSA | LANDSCAPE AREA |
| | UTILITY POLE | | WOOD FENCE | MGS | MAG NAIL SET |
| R.D. | ROOF DRAIN | | STEEL HAND RAIL | R.O.C. | RIGHT OUTSIDE CORNER |
| V | PVC VENT PIPE | 25 | MAJOR CONTOUR LINE | (REC.) | RECORD INFORMATION |
| SCO | SEWER CLEAN OUT | | MINOR CONTOUR LINE | WIF | WROUGHT IRON FENCE |
| | GAS METER | | | VGC | VERTICAL GRANITE CURB |
| GM | UNKNOWN GATE | | | | |

## SITE PREPARATION NOTES

1. THE LOCATION OF ALL UNDERGROUND UTILITIES SHOWN ON THIS PLAN SHALL BE CONSIDERED APPROXIMATE. THEREFORE, PRIOR TO THE START OF ANY WORK ON THE SITE, THE CONTRACTOR SHALL VERIFY THE ACTUAL LOCATION OF ALL UTILITIES, BEFORE COMMENCING WORK AND AGREE TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MAY BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ALL UNDERGROUND UTILITIES SHOWN OR NOT SHOWN ON THIS PLAN. CONTACT DIG–SAFE AT 811 OR 1–888–344–7233 (1–888–DIG–SAFE) AT LEAST 72 HOURS PRIOR TO THE START OF EXCAVATION. GREEN PROVIDES NO WARRANTY AS TO THE EXACT LOCATION OR COMPLETENESS OF EXISTING UNDERGROUND UTILITIES.

2. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR CONSTRUCTION MEANS, METHODS, TECHNIQUES AND PROCEDURES; AND FOR THE SAFETY PRECAUTIONS AND PROGRAMS REQUIRED FOR THE WORK UNDER THIS CONTRACT. THE CONTRACT DOCUMENTS DO NOT INCLUDE THE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY AND THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR PROVIDING ALL SAFETY BARRIERS, WARNING FLASHERS, AND THE LIKE AS REQUIRED FOR THE PROTECTION OF WORKERS AND THE PUBLIC. COMPLY WITH OSHA REQUIREMENTS.

3. THE CONTRACTOR SHALL MAINTAIN EROSION CONTROL MEASURES AT ALL TIMES UNTIL ALL EARTHWORK OPERATIONS ARE COMPLETE AND ALL AREAS ARE STABILIZED TO PREVENT THE MOVEMENT OF SOIL, SILT, SEDIMENT, AND DEBRIS INTO THE DRAINAGE SYSTEM ON AND NEAR THE SITE . THE CONTRACTOR SHALL REMOVE ALL EROSION CONTROL DEVICES UPON COMPLETION AND ACCEPTANCE OF THE WORK.

4. THE CONTRACTOR SHALL CONTROL DUST FROM CONSTRUCTION OPERATIONS THROUGHOUT THE DURATION OF THE PROJECT. DUST CONTROL SHALL INCLUDE THE WATERING OF UNPAVED ROAD SURFACES AND STREET SWEEPING OF PAVED SURFACES. STREET SWEEPING SHALL OCCUR ON THE PAVED SURFACES WITHIN THE SITE AND OFF THE SITE WHERE VEHICLE TRACKING OF SEDIMENTS HAS OCCURRED.

5. PRIOR TO THE START OF WORK, INSTALL SILTSACK WOVEN POLYPROPYLENE GEOTEXTILE FILTER BAGS IN CATCH BASINS AND/OR DRYWELL STRUCTURES ON AND NEAR THE SITE. WHEN INSTALLING FILTER BAGS, HOLD APPROXIMATELY SIX INCHES OUTSIDE THE FRAME AND REPLACE THE GRATE, USING THE WEIGHT OF THE GRATE TO HOLD THE FILTER BAG IN PLACE.

6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SECURING ALL NECESSARY CONSTRUCTION PERMITS REQUIRED FOR THIS PROJECT.

7. THE CONTRACTOR SHALL VERIFY THE DEPTHS OF ALL UTILITIES IN THE PROJECT AREA WITHIN THE PROPOSED TRENCHES. NOTIFY THE DESIGNER OF ANY CONFLICT WITH THE DESIGN PLANS AND AN EXISTING UTILITY. THE DESIGNER RESERVES THE RIGHT TO REALIGN STRUCTURE AND PIPING LOCATIONS TO SUIT ACTUAL FIELD CONDITIONS ENCOUNTERED. THE CONTRACTOR SHALL NOT BACKFILL THE TRENCH UNTIL THE CIVIL ENGINEER HAS OBSERVED AND APPROVED THE NEW UTILITY SERVICES INSTALLATIONS.

8. THE CONTRACTOR SHALL PROTECT ALL UTILITIES IN THE PROJECT AREA AND ADJACENT AREAS FROM DAMAGE AND UNDERMINING DURING EXCAVATION.

9. THE CONTRACTOR SHALL PROTECT AND RETAIN ALL UTILITIES WITHIN THE LIMIT OF WORK UNLESS NOTED OTHERWISE.

10. THE CONTRACTOR SHALL PERFORM ALL WORK IN THE PROJECT AREA IN CONFORMANCE WITH THE CITY OF BOSTON DEPARTMENT OF PUBLIC WORKS STANDARD, BOSTON WATER AND SEWER COMMISSION STANDARDS, AND HARVARD UNIVERSITY SPECIFICATIONS.

11. REMNANTS OF PREVIOUS BUILDING FOUNDATION, UTILITY STRUCTURES AND UNDERGROUND UTILITIES MAY BE ENCOUNTERED DURING EXCAVATION AND SHALL BE REMOVED AND DISPOSED LEGALLY OFF SITE.

15. PROVIDE TREE PROTECTION AT ALL TREE TRUNKS WITHIN 20' OF L.O.W. OR TEMPORARY STOCKPILES.

16. CONTRACTOR SHALL USE EXTREME CAUTION IN REMOVING PAVEMENT AND SUB–BASE UNDER DRIP LINE OF EXISTING TREES TO AVOID DAMAGE TO ROOTS AND OVERHEAD BRANCHES.

17. CONTRACTOR SHALL NOT STORE OR STOCKPILE EQUIPMENT OR MATERIALS UNDER TREES.

## PRE–CONSTRUCTION

1. PRIOR TO CONSTRUCTION, CONSTRUCTION FENCE OR OTHER SUITABLE FORM OF DEMARCATION SHALL BE INSTALLED AT THE LIMITS OF THE AREAS TO BE DISTURBED.

2. TEMPORARY CRUSHED STONE CONSTRUCTION ENTRANCES SHALL BE INSTALLED IN ACCORDANCE WITH THE DETAIL PROVIDED TO PREVENT VEHICLE TRACKING OF SEDIMENT ONTO OFF–SITE ROADWAYS. ENTRANCES SHALL BE PROPERLY MAINTAINED UNTIL THE PROJECT IS COMPLETED OR PAVEMENT IS IN PLACE.

3. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL DESIGNATE A STAGING AREA FOR STORAGE OF CONSTRUCTION EQUIPMENT AND MATERIALS.

4. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DEVELOP A CONSTRUCTION PHASING PLAN AND THAT EROSION CONTROL MEASURES ARE INSTALLED AND MAINTAINED

5. CONTRACTOR TO PROVIDE TEMPORARY DRAINAGE CONNECTION TO ACCOMMODATE EXISTING DRAINAGE THAT WILL NOT BE REMOVED DURING CONSTRUCTION.

## EROSION AND SEDIMENT CONTROLS

1. THE CONTRACTOR IS RESPONSIBLE FOR CONTROLLING THE EROSION AND SEDIMENT DURING THE CONSTRUCTION PROCESS. SITE SPECIFIC CONDITIONS MAY REQUIRE MODIFICATIONS IN THE FIELD, BUT THE CONTRACTOR MUST ENSURE THAT THE PROJECT SPECIFICATIONS THAT ARE DEVELOPED IN THE FIELD MEET THE MINIMUM REQUIREMENTS OF THIS PLAN.

2. IN ORDER TO MINIMIZE EROSION AND SEDIMENT RUNOFF FROM THE SITE, THE CONTRACTOR SHOULD MAINTAIN EXISTING VEGETATION WHERE POSSIBLE AND STABILIZE THE DISTURBED PORTIONS OF THE SITE AS QUICKLY AS POSSIBLE. THIS MAY INCLUDE PHASING THE PROJECT AS NEEDED TO MINIMIZE THE SIZE OF THE DISTURBED AREAS ON THE SITE.

3. THE CONTRACTOR MUST ALSO ANTICIPATE INCREASED RUNOFF FROM STEEPER SLOPES AND DURING HIGH GROUNDWATER CONDITIONS. THIS MAY OCCUR DURING THE WET SEASON (TYPICALLY MARCH THROUGH APRIL) OR AFTER SIGNIFICANT PRECIPITATION EVENTS.

4. THE CONTRACTOR IS RESPONSIBLE FOR THE INSTALLATION OF SILT FENCES, DRAINAGE SWALES, EARTH DIKES, TEMPORARY SETTLING BASINS, CHECK DAMS AND TEMPORARY OR PERMANENT SEDIMENT BASINS. THESE PRACTICES DIVERT FLOWS FROM EXPOSED SOILS, LIMIT RUNOFF AND THE DISCHARGE OF POLLUTANTS FROM EXPOSED AREAS OF THE SITE TO THE DEGREE ATTAINABLE.

5. ALL DISTURBED SURFACES SHALL BE STABILIZED WITHIN 14 DAYS AFTER CONSTRUCTION IN ANY PORTION OF THE SITE THAT HAS BEEN COMPLETED OR WHERE CONSTRUCTION HAS TEMPORARILY CEASED.

6. THE CONTRACTOR SHALL, AT ALL TIMES, HAVE A STOCKPILE OF COMPOST FILTER TUBES AND SILT FENCE ADEQUATE TO REINFORCE/REPLACE EROSION AND SEDIMENT CONTROL AS NEEDED.

7. ALL AREAS OF DISTURBANCE MUST HAVE TEMPORARY OR FINAL STABILIZATION WITHIN 14 DAYS OF THE INITIAL DISTURBANCE. AFTER THIS TIME, ANY DISTURBANCE IN THE AREA MUST BE STABILIZED AT THE END OF EACH WORK DAY. THE FOLLOWING EXCEPTIONS APPLY:
   i) STABILIZATION IS NOT REQUIRED IF WORK IS TO CONTINUE IN THE AREA WITHIN THE NEXT 24 HOURS AND THERE IS NO PRECIPITATION FORECAST FOR THE NEXT 24 HOURS.
   ii) STABILIZATION IS NOT REQUIRED IF THE WORK IS OCCURRING IN A SELF–CONTAINED EXCAVATION WITH A DEPTH OF 2 FEET OR GREATER.

8. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DEVELOP A CONSTRUCTION PHASING PLAN AND THAT EROSION CONTROL MEASURES ARE INSTALLED AND MAINTAINED.

9. IT IS ANTICIPATED THAT THE PROJECT WILL DISTURB MORE THAN ONE ACRE OF LAND AND A NPDES PERMIT WILL BE REQUIRED. PREPARATION OF A STORMWATER POLLUTION PREVENTION PLAN (SWPPP) SHALL BE PREPARED BY THE CONTRACTOR AND THE NOI MUST BE SUBMITTED TO EPA 14 DAYS PRIOR TO ANY EARTH DISTURBING ACTIVITIES.

## GENERAL CONSTRUCTION REQUIREMENTS

1. ALL CONSTRUCTION DEBRIS SHALL BE DISPOSED OF OFF SITE.

2. DURING CONSTRUCTION, TRENCHES ARE NOT TO BE LEFT IN A CONDITION THAT WOULD DIRECT RUNOFF AROUND TREATMENT AND DETENTION FACILITIES.

3. ALL SITE WORK SHOULD BE SECURED AT THE END OF THE WORK DAY TO REDUCE EROSION AND SEDIMENT PROBLEMS. THIS INCLUDES AS APPLICABLE, COVERING STOCKPILES OF SEDIMENT, INSTALLING TEMPORARY VEGETATION OR BY USING GEOTEXTILES TO COVER DISTURBED AREAS WITH STEEPER SLOPES.

4. DEWATERING OPERATION SHALL COMPLY WITH THE REQUIREMENTS OF THE U.S. EPA NPDES PHASE I CONSTRUCTION ACTIVITY GENERAL PERMIT FOR CONSTRUCTION SITES THAT ARE GREATER THAN 1 ACRE.

5. CONTRACTOR IS RESPONSIBLE FOR RESTORING SITE TO WORKING CONDITION UPON COMPLETION OF CONSTRUCTION.

## UTILITY NOTES

1. UTILITY WORK WITHIN THE ZONE **10** FT OUTSIDE OF FOUNDATION WALL OF THE BUILDING SHALL CONFORM TO EFFECTIVE BUILDING CODE REQUIREMENTS, HARVARD REQUIREMENTS AND THE MECHANICAL, ELECTRICAL AND PLUMBING SPECIFICATIONS. UTILITIES, WITHIN THIS AREA (10 FT FROM THE FOUNDATION WALL), ARE SHOWN ON THIS DRAWING FOR COORDINATION PURPOSES. REFER TO THE MECHANICAL, ELECTRICAL AND PLUMBING DRAWINGS AND SPECIFICATIONS FOR PIPE SIZES AND MATERIALS.

2. CONTRACTOR TO ADJUST UTILITY ELEMENT MEANT TO BE FLUSH WITH GRADE (CLEAN–OUTS, UTILITY MANHOLES, CATCH BASINS, INLETS, ETC.) THAT ARE AFFECTED BY SITE WORK OR GRADE CHANGES, WHETHER SPECIFICALLY NOTED ON THE PLANS OR NOT.

3. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, THE LOCATION, ELEVATION, AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR, AND THE INFORMATION FURNISHED TO THE ENGINEER FOR RESOLUTION OF THE CONFLICT.

4. THE CONTRACTOR SHALL ALTER THE MASONRY OF THE TOP SECTION OF ALL EXISTING DRAINAGE STRUCTURES AS NECESSARY FOR CHANGES IN GRADE, AND RESET ALL WATER AND DRAINAGE FRAMES, GRATES, AND BOXES TO THE PROPOSED FINISH SURFACE GRADE.

5. THE CONTRACTOR SHALL MAKE ALL ARRANGEMENTS FOR THE ALTERATION AND ADJUSTMENT OF ALL GAS, ELECTRIC, TELEPHONE, AND ANY OTHER PRIVATE UTILITIES BY THE UTILITY COMPANIES.

6. AREA OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION, AT THE CONTRACTOR'S EXPENSE.

7. REFER TO ARCHITECTURAL PLANS FOR PROPOSED LOCATION OF UTILITY SERVICE STUBS AT BUILDING.

8. THE LOCATION, SIZE, DEPTH, AND SPECIFICATIONS FOR CONSTRUCTION OF PRIVATE UTILITY SERVICES SHALL BE INSTALLED ACCORDING TO THE REQUIREMENTS PROVIDED BY, AND APPROVED BY, THE RESPECTIVE UTILITY COMPANY (GAS, TELEPHONE, ELECTRICAL). FINAL DESIGN AND LOCATIONS AT THE BUILDING WILL BE PROVIDED BY THE ARCHITECT. THE CONTRACTOR SHALL COORDINATE THE INSTALLATION OF THE UTILITY CONNECTION WITH THE RESPECTIVE COMPANIES PRIOR TO ANY UTILITY CONSTRUCTION.

9. ALL CEMENT LINED DUCTILE IRON JOINTS FOR FITTINGS (CLASS 56) VALVES, AND HYDRANT LATERALS SHALL BE MECHANICAL JOINT WITH NEOPRENE GASKETS. JOINTS AT OTHER LOCATIONS SHALL BE PUSH–ON TYPE WITH NEOPRENE OR SYNTHETIC RUBBER GASKETS. ALL WATER GATES SHALL OPEN PER CITY REQUIREMENTS. ALL WATER LINES SHALL HAVE A MINIMUM OF 5.0 FEET OF GROUND COVER AND A MINIMUM OF 10 FOOT SEPARATION FROM THE SEWER SYSTEM. AT WATER AND SEWER CROSSINGS, THE WATER LINE SHALL BE ENCASED IN SIX INCHES OF CONCRETE FOR A DISTANCE OF 10 FEET ON EITHER SIDE OF THE CROSSING.

IF THIS SHEET IS NOT: 36" x 48", IT HAS BEEN REDUCED OR ENLARGED.

C-100_NEWELL NOTES & LEGEND.DWG 25-Mar-2022


Bruner/Cott ARCHITECTS
225 Friend Street
Boston, MA 02114
617.492.8400
brunercott.com

PETERSON ARCHITECTS
156 Mt Auburn Street
Cambridge, MA 02138
617.354.2268
peterson-architects.com

GREEN INTERNATIONAL AFFILIATES, INC.
Civil Engineers
100 Ames Pond Drive, Suite 200
Tewksbury, MA 01876
(978) 923-0400 Green # 21030
greenintl.com


Newell Boathouse Renovation
Project# 17.017

Harvard University Athletics
801 Soldiers Field Road,
Allston, Massachusetts, 02134

3/25/2022 **Permit Plans**

| Rev. | Date | Remarks |
|---|---|---|

COMMONWEALTH OF MASSACHUSETTS
JAMES W. THORNE
CIVIL
NO. 54912
REGISTERED PROFESSIONAL ENGINEER
3/25/2022

Notes and Legend

# C-100

GENERAL NOTES:

1. THE EXISTING CONDITIONS SHOWN ON THIS BASEMAP ARE THE RESULT OF AN INSTRUMENT SURVEY PERFORMED ON THE GROUND BY GREEN INTERNATIONAL AFFILIATES, INC. BETWEEN APRIL 23-27, 2018 AND MAY 20-25, 2021.
2. HORIZONTAL DATUM IS MASSACHUSETTS STATE PLANE COORDINATE SYSTEM (NAD83) BASED ON HARVARD CONTROL DISKS USING STATIC GPS. VERTICAL DATUM IS BOSTON CITY BASE ESTABLISHED USING HARVARD CONTROL DISK ALBH02.
3. NO BOUNDARY INFORMATION IS SHOWN AT THIS TIME.
4. THE TOPOGRAPHIC SURVEY AND UTILITIES SHOWN WITHIN THE PUBLIC RIGHT OF WAY AND THE CHARLES RIVER WAS AN AUTOCAD FILE NAMED "210801308_survey.dwg" WHICH WAS PROVIDED BY HARVARD UNIVERSITY ON 5/12/2016.

UTILITY NOTES:

1. ALL UNDERGROUND UTILITIES AS SHOWN WERE COMPILED USING FIELD SURVEY INFORMATION AND AVAILABLE RECORD INFORMATION RECEIVED FROM PUBLIC AGENCIES, PRIVATE UTILITY COMPANIES, AND FROM THE HARVARD UNIVERSITY PROPERTY INFORMATION RESOURCE CENTER (PIRC).
2. RECORD UTILITY INFORMATION ARE APPROXIMATE ONLY AND ACTUAL LOCATIONS MUST BE DETERMINED IN THE FIELD.
3. ALL UTILITY COMPANIES, PUBLIC AND PRIVATE MUST BE NOTIFIED, INCLUDING THOSE IN CONTROL OF UTILITIES NOT SHOWN ON THIS PLAN, (SEE CHAPTER 370, ACTS OF 1963, MASSACHUSETTS) PRIOR TO DESIGNING, EXCAVATING, BLASTING, INSTALLING, BACKFILLING, GRADING, PAVEMENT RESTORING OR REPAVING.
4. THE LOCATION OF EXISTING PIPES OR OTHER UNDERGROUND STRUCTURES OR PROPERTY LINES ARE NOT WARRANTED TO BE EXACT, NOR IS IT WARRANTED THAT ALL UNDERGROUND PIPES OR STRUCTURES ARE SHOWN. THE CONTRACTOR SHALL CALL "DIG SAFE" (1-888-344-7233) 72 HOURS (EXCLUDING SATURDAYS, SUNDAYS AND HOLIDAYS) PRIOR TO ANY EXCAVATION TO OBTAIN ACCURATE UTILITY LOCATIONS.
5. EXCEPT WHERE OTHERWISE NOTED, SUBSURFACE UTILITY LOCATIONS HAVE BEEN PLOTTED TO MEET UTILITY QUALITY LEVEL "C" AS DESCRIBED IN ASCE STANDARD 38-02, AS SHOWN BELOW. THE UNDERGROUND UTILITIES ARE SHOWN IN APPROXIMATE LOCATIONS BASED ON ABOVE-GROUND FIELD OBSERVATION AND EXISTING RECORD INFORMATION.
6. THE EXISTING CONDITIONS PLAN IS TO BE USED FOR THE SPECIFIED PROJECT ONLY AND IS NOT WARRANTED TO BE COMPLETE FOR ANY OTHER FUTURE PROJECTS.

SUMMARY OF UTILITY MAPPING QUALITY LEVELS:

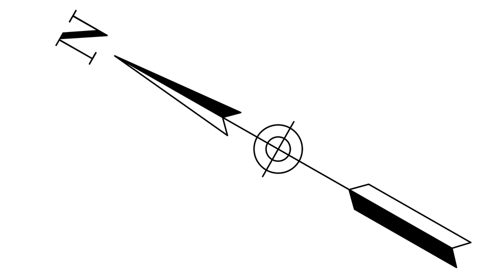
THE FOLLOWING IS A SUMMARY OF THE SURVEY MAPPING LEVELS FOR UTILITIES AS DESCRIBED IN ASCE STANDARD 38-02, "STANDARD GUIDELINE FOR THE DEPICTION OF EXISTING SUBSURFACE UTILITY DATA". THESE GUIDELINES ARE MORE FULLY DESCRIBED IN THE ASCE STANDARD.

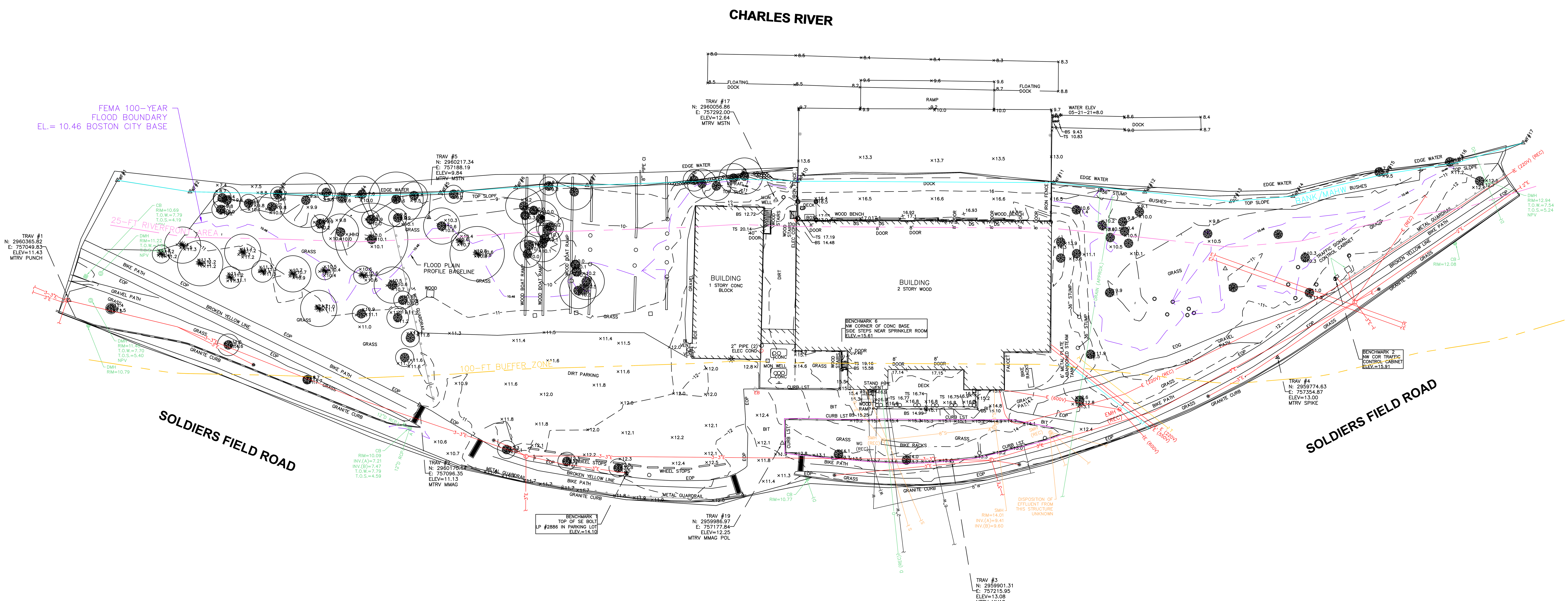
UTILITY QUALITY LEVEL A:
PRECISE HORIZONTAL AND VERTICAL LOCATION OF UTILITIES OBTAINED BY THE ACTUAL EXPOSURE (OR VERIFICATION OF PREVIOUSLY EXPOSED AND SURVEYED UTILITIES) AND SUBSEQUENT MEASUREMENT OF SUBSURFACE UTILITIES, USUALLY AT A SPECIFIC POINT. MINIMALLY INTRUSIVE EXCAVATION EQUIPMENT IS TYPICALLY USED TO MINIMIZE THE POTENTIAL FOR UTILITY DAMAGE. A PRECISE HORIZONTAL AND VERTICAL LOCATION, AS WELL AS OTHER UTILITY ATTRIBUTES, IS SHOWN ON PLAN DOCUMENTS. ACCURACY IS TYPICALLY SET TO 15-MM VERTICAL AND TO APPLICABLE HORIZONTAL SURVEY AND MAPPING ACCURACY AS DEFINED OR EXPECTED BY THE PROJECT OWNER.

UTILITY QUALITY LEVEL B:
INFORMATION OBTAINED THROUGH THE APPLICATION OF APPROPRIATE SURFACE GEOPHYSICAL METHODS TO DETERMINE THE EXISTENCE AND APPROXIMATE HORIZONTAL POSITION OF SUBSURFACE UTILITIES. QUALITY LEVEL B DATA SHOULD BE REPRODUCIBLE BY SURFACE GEOPHYSICS AT ANY POINT OF THEIR DEPICTION. THIS INFORMATION IS SURVEYED TO APPLICABLE TOLERANCES DEFINED BY THE PROJECT AND REDUCED ONTO PLAN DOCUMENTS.

UTILITY QUALITY LEVEL C:
INFORMATION OBTAINED BY SURVEYING AND PLOTTING VISIBLE ABOVE-GROUND UTILITY FEATURES AND BY USING PROFESSIONAL JUDGMENT IN CORRELATING THIS INFORMATION TO QUALITY LEVEL D INFORMATION.

UTILITY QUALITY LEVEL D:
INFORMATION DERIVED FROM EXISTING RECORDS OR ORAL RECOLLECTIONS.INFORMATION DERIVED FROM EXISTING RECORDS OR ORAL RECOLLECTIONS.






SCALE: 1" = 20'

IF THIS SHEET IS NOT: 36" x 48", IT HAS BEEN REDUCED OR ENLARGED.

25-Mar-2022

C-101_NEWELL EXISTING CONDITIONS.DWG

Bruner/Cott ARCHITECTS
225 Friend Street
Boston, MA 02114
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brunercott.com

PETERSON ARCHITECTS
156 Mt Auburn Street
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617.354.2268
peterson-architects.com

GREEN INTERNATIONAL AFFILIATES, INC.
Civil Engineers
100 Ames Pond Drive, Suite 200
Tewksbury, MA 01876
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greenintl.com

*Newell Boathouse Renovation*
***Project# 17.017***

*Harvard University Athletics*
***801 Soldiers Field Road,***
***Allston, Massachusetts, 02134***

*3/25/2022* ***Permit Plans***

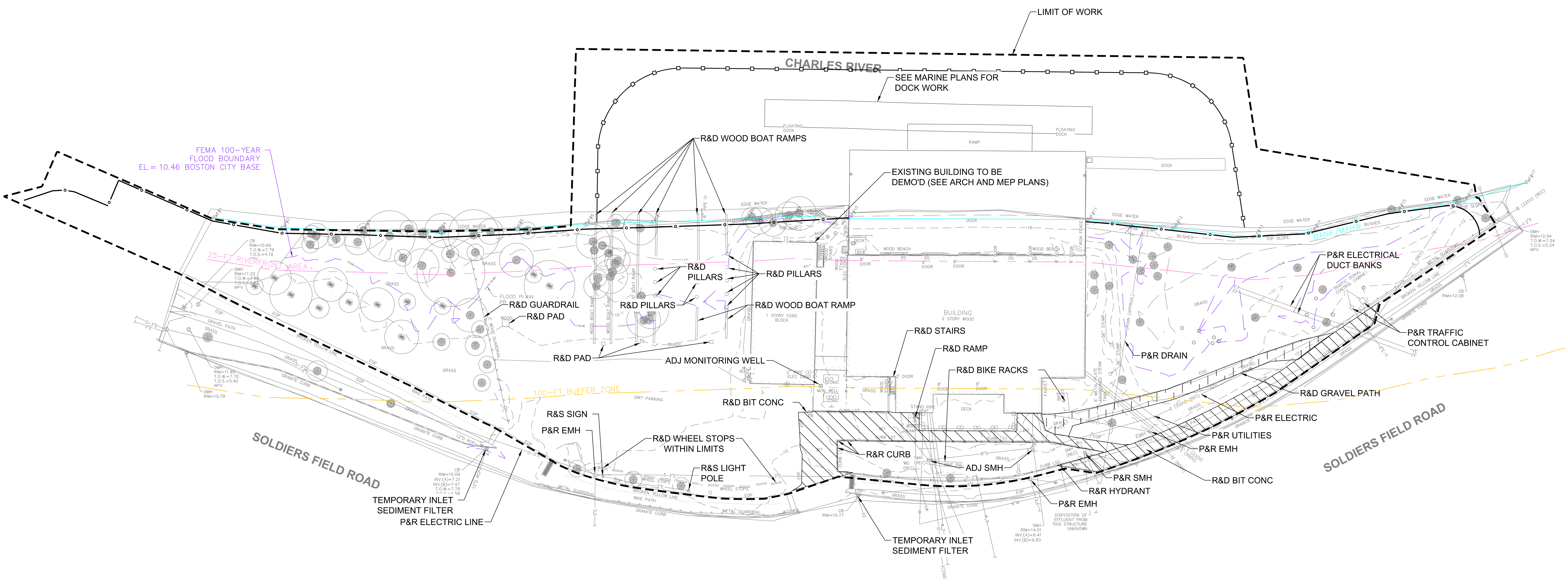
| *Rev.* | *Date* | *Remarks* |
|---|---|---|

COMMONWEALTH OF MASSACHUSETTS
PATRICK J. SCHOLLARD
No. 48436
REGISTERED
PROFESSIONAL LAND SURVEYOR

Patrick J. Schollard
12/16/21

*Existing Conditions*

**C-101**




LEGEND

| | |
|---|---|
| P&R | PROTECT & RETAIN |
| R&D | REMOVE & DISPOSE |
| R&R | REMOVE & RESET |
| R&S | REMOVE & SALVAGE |
| ADJ | ADJUST RIM TO FINISH GRADE |
| (hatched) | EXISTING BITUMINOUS PAVEMENT TO BE REMOVED AND DISPOSED |
| (gravel) | EXISTING GRAVEL TO BE REMOVED AND DISPOSED |
| —o— | SILT FENCE AND COMPOST FILTER TUBE |
| —□—□— | TURBIDITY CURTAIN |
| — — — | LIMIT OF WORK |

NOTE:

1. PROTECT AND RETAIN ALL UTILITIES WITHIN LIMIT OF WORK.
2. FOR TREE PROTECTION AND REMOVAL SEE LANDSCAPE PLANS.

0 20 40 60

SCALE: 1" = 20'

IF THIS SHEET IS NOT: 36" x 48", IT HAS BEEN REDUCED OR ENLARGED.


Bruner/Cott ARCHITECTS
225 Friend Street
Boston, MA 02114
617.492.8400
brunercott.com

PETERSON ARCHITECTS
156 Mt Auburn Street
Cambridge, MA 02138
617.354.2268
peterson-architects.com

GREEN INTERNATIONAL AFFILIATES, INC.
Civil Engineers
100 Ames Pond Drive, Suite 200
Tewksbury, MA 01876
(978) 923-0400 Green # 21030
greenintl.com


*Newell Boathouse Renovation*
***Project# 17.017***

*Harvard University Athletics*
***801 Soldiers Field Road, Allston, Massachusetts, 02134***

*3/25/2022* ***Permit Plans***

| Rev. | Date | Remarks |
|---|---|---|

COMMONWEALTH OF MASSACHUSETTS JAMES W. THORNE CIVIL NO. 54912 REGISTERED PROFESSIONAL ENGINEER 3/25/2022

*Site Preparation*

**C-102**

STORM WATER PROJECT INFORMATION

TOTAL LIMIT OF WORK AREA = 133,649 SF

EXISTING IMPERVIOUS AREA WITHIN LIMIT OF WORK = 24,177 SF

PROPOSED IMPERVIOUS AREA WITHIN LIMIT OF WORK = 35,532 SF

REQUIRED WATER QUALITY VOLUME = 2,963 CF

PROVIDED WATER QUALITY VOLUME = 5,247 CF

BIORETENTION BASIN

ROOF AREA = 4,747 SF

SIDEWALK AREA = 1,167 SF

REQUIRED WATER QUALITY VOLUME (ROOF/SIDEWALK) = 493 CF

PROVIDED WATER QUALITY VOLUME = 2,008 CF

SUBSURFACE CHAMBERS

IMPERVIOUS AREA = 11,940 SF

REQUIRED WATER QUALITY VOLUME = 986 CF

PROVIDED WATER QUALITY VOLUME = 987 CF

STORM WATER PROJECT INFORMATION

INFILTRATION TRENCH #1

ROOF AREA = 3,425 SF

SIDEWALK AREA = 1,929 SF

REQUIRED WATER QUALITY VOLUME (ROOF/SIDEWALK) = 453 CF

PROVIDED WATER QUALITY VOLUME = 614 CF

INFILTRATION TRENCH #2

ROOF AREA = 1,630 SF

REQUIRED WATER QUALITY VOLUME = 136 CF

PROVIDED WATER QUALITY VOLUME = 144 CF

INFILTRATION TRENCH #3

ROOF AREA = 1,607 SF

REQUIRED WATER QUALITY VOLUME = 134 CF

PROVIDED WATER QUALITY VOLUME = 180 CF


WARD 22 ,PARCEL # 2200577010, 2200577000
BWSC ACCOUNT # 1308356
801 SOLDIERS FIELD STREET
ALLSTON, MA 02134
SITE PLAN #
OWNER:
PRESIDENT & FELLOWS OF HARVARD COLLEGE
1350 MASSACHUSETTS AVENUE #980
CAMBRIDGE, MA 02138
CONTACT: EDWARD MILCH
TEL : 617-496-2331

FOR BWSC USE ONLY

BWSC INSPECTION

| | |
|---|---|
| ① HYDRANT<br>DATE: ____<br>INSPECTOR: ____ | ② WATER QUALITY STRUCTURE (WQS)<br>DATE: ____<br>INSPECTOR: ____ |
| ③ OUTLECT CONTROL STRUCTURE (OCS)<br>DATE: ____<br>INSPECTOR: ____ | ④ SUBSURFACE CHAMBER SYSTEM<br>DATE: ____<br>INSPECTOR: ____ |
| ⑤ INFILTRATION TRENCH (#1)<br>DATE: ____<br>INSPECTOR: ____ | ⑥ INFILTRATION TRENCH (#2)<br>DATE: ____<br>INSPECTOR: ____ |
| ⑦ INFILTRATION TRENCH (#3)<br>DATE: ____<br>INSPECTOR: ____ | ⑧ BIORETENTION BASIN<br>DATE: ____<br>INSPECTOR: ____ |

IF THIS SHEET IS NOT: 36" x 48", IT HAS BEEN REDUCED OR ENLARGED.

LEGEND

- PROPOSED GAS
- PROPOSED DRAIN
- PROPOSED DRAIN MANHOLE
- PROPOSED PAVERS
- LIMIT OF WORK

0 20 40 60

SCALE: 1" = 20'

C-103_NEWELL SITE UTILITY.DWG 25-Mar-2022

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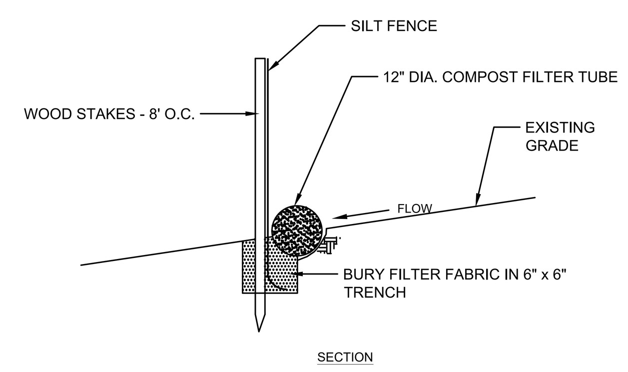
| Rev. | Date | Remarks |
|---|---|---|

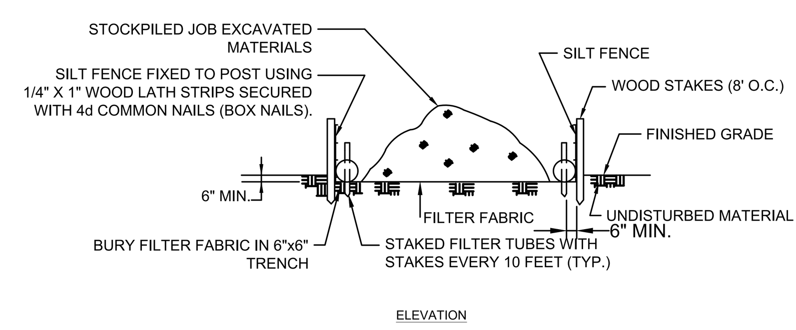
COMMONWEALTH OF MASSACHUSETTS JAMES W. THORNE CIVIL NO. 54912 REGISTERED PROFESSIONAL ENGINEER 3/25/22

*Site Utility*

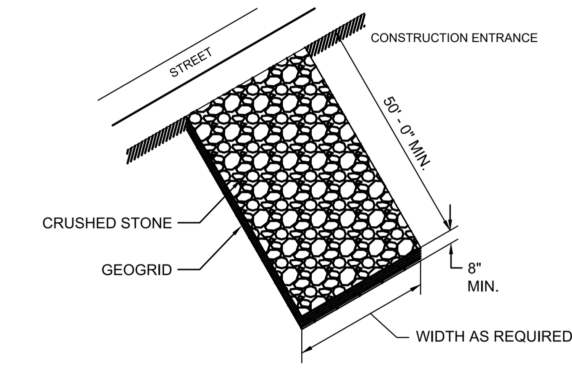
**C-103**



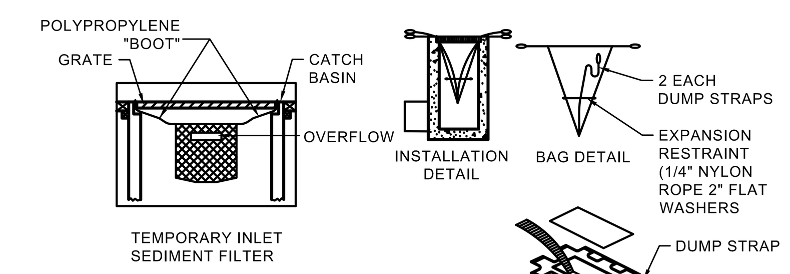

1 COMPOST FILTER TUBE / SILT FENCE
NOT TO SCALE

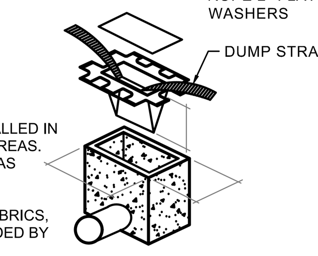



2 STOCKPILED MATERIAL
NOT TO SCALE




3 TEMPORARY CONSTRUCTION ENTRANCE
NOT TO SCALE

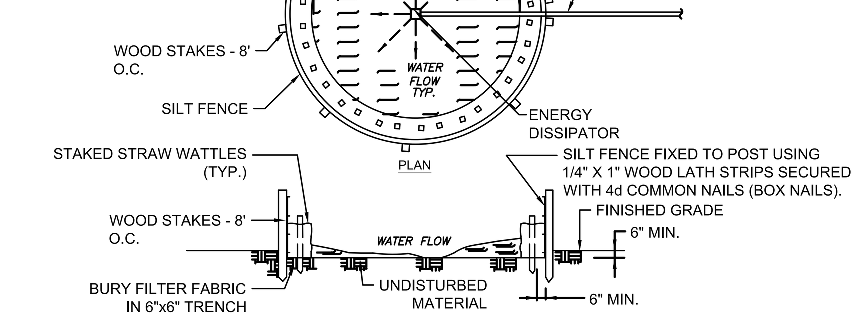


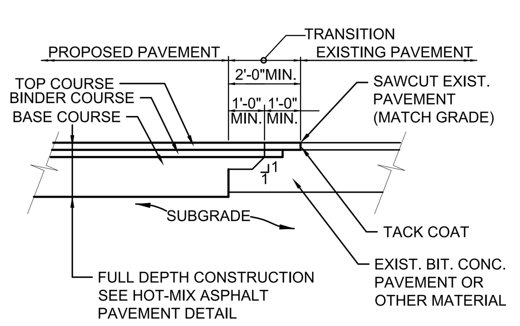

NOTE:
TEMPORARY INLET SEDIMENT FILTER TO BE INSTALLED IN ALL CATCH BASINS OR STORM INLETS IN PAVED AREAS. INLET FILTER TO BE SIMILAR TO "STREAMGUARD" AS MANUFACTURED BY STORMWATER SERVICES CORPORATION (206-767-0441) OR "SILTSACK" AS MANUFACTURED BY ATLANTIC CONSTRUCTION FABRICS, INC. (800-448-3636). CLEAN FILTER AS RECOMMENDED BY MANUFACTURER.

4 TEMPORARY INLET SEDIMENT FILTER
NOT TO SCALE

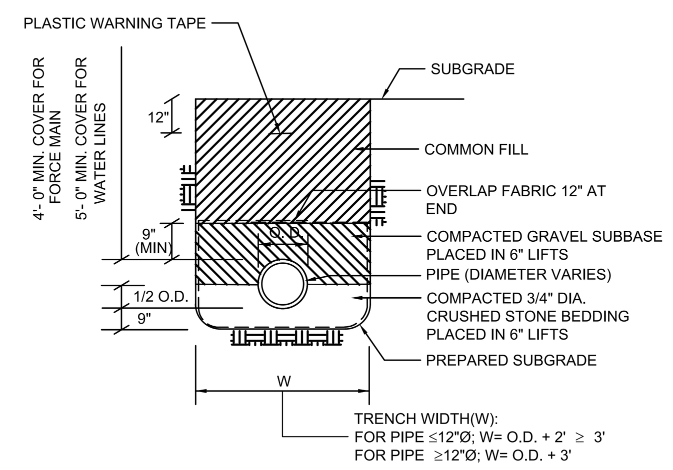
NOTE:
DETAIL SHOWN FOR EXAMPLE ONLY. DESIGN OF ANY DEWATERING BASINS IS THE RESPONSIBILITY OF THE CONTRACTOR.




5 DEWATERING BASIN
NOT TO SCALE



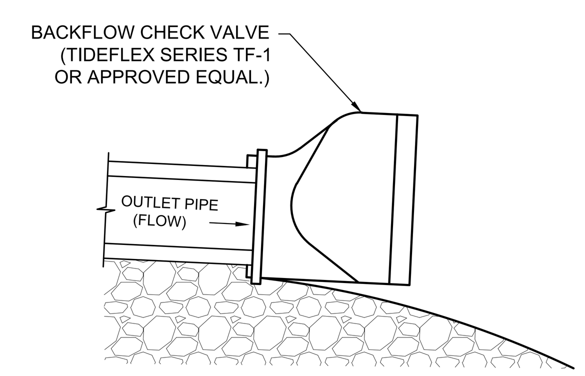

6 TYPICAL SAWCUT
NOT TO SCALE



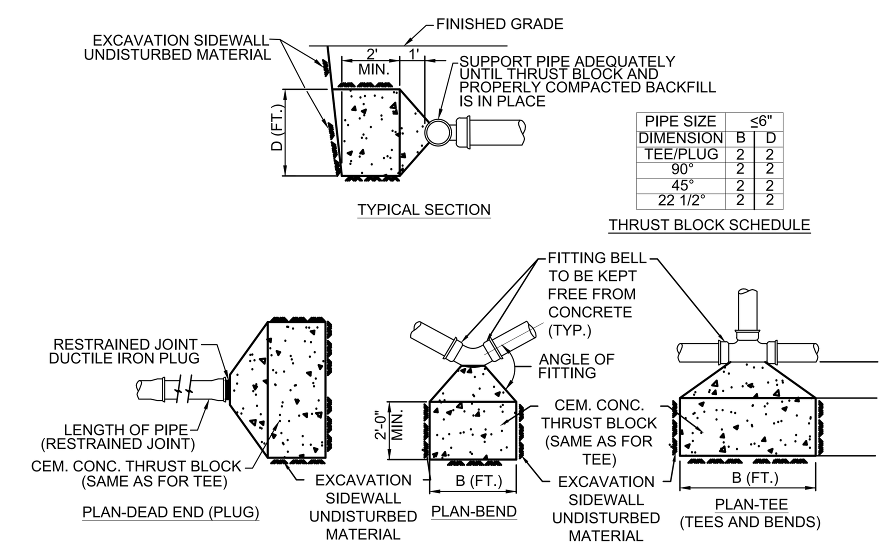

TRENCH EXCAVATION AND BACKFILLING:

1. EXCAVATE TRENCH BOTTOMS AS INDICATED. REMOVE STONES AND SHARP OBJECTS TO AVOID POINT LOADING. PLACE CRUSHED STONE PIPE BEDDING AS INDICATED.
2. PLACE AND COMPACT INITIAL BACKFILL OF SAND-GRAVEL MATERIAL, FREE OF PARTICLES GREATER THAN 1 INCH, TO A HEIGHT OF 12" ABOVE THE UTILITY LINE OR CONDUIT.
3. CAREFULLY COMPACT MATERIAL UNDER PIPE HAUNCHES AND BACKFILL EVENLY ON BOTH SIDES ALONG FULL LENGTH OF LINE TO AVOID DAMAGE OR DISPLACEMENT OF UTILITY SYSTEM.
4. COMPACT TRENCH BACKFILL IN 6" LIFTS WITH A HAND OPERATED (VIBRATOR PLATE) TAMPER AS FOLLOWS: UNDER PAVEMENT AND STRUCTURES; TO 95% MAX. DRY DENSITY PER ASTM D1557. UNDER LAWNS; 90% MAXIMUM DRY DENSITY PER ASTM D1557.

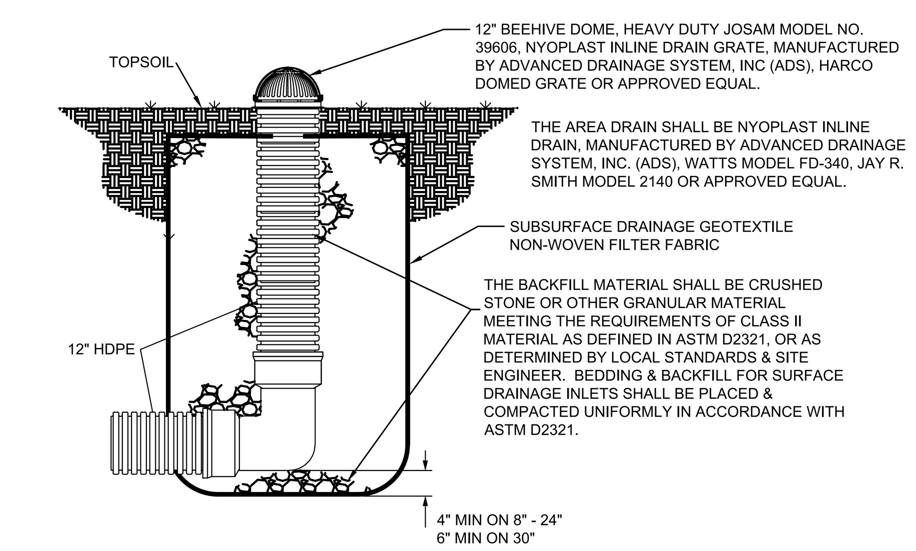
7 TYPICAL PIPE TRENCH
NOT TO SCALE




8 BACKFLOW CHECK VALVE
NOT TO SCALE



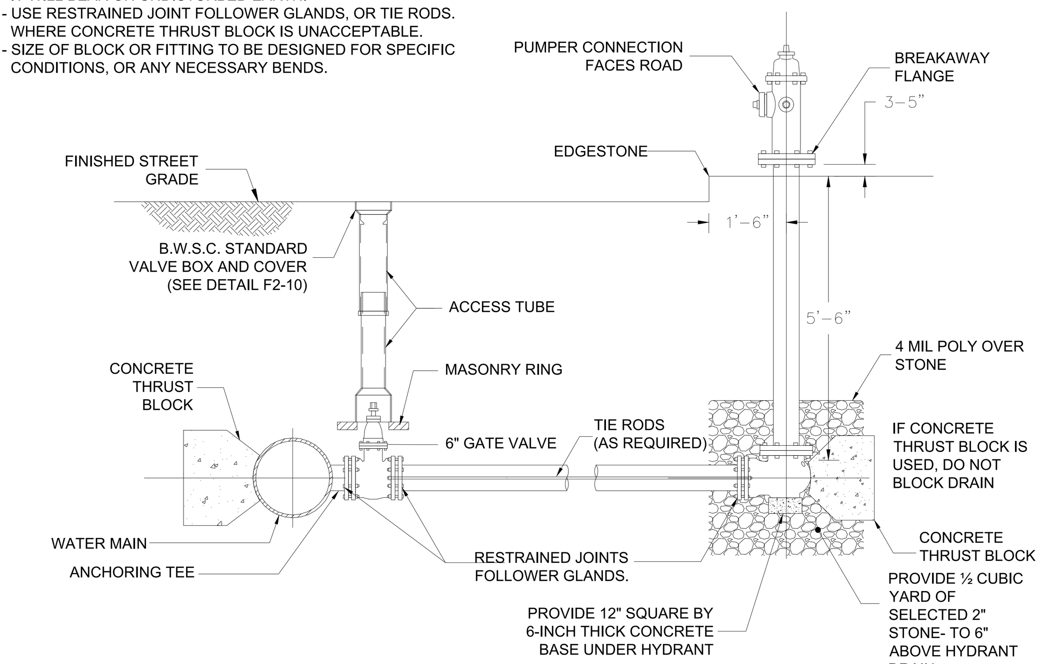

9 CEMENT CONCRETE THRUST BLOCK
NOT TO SCALE



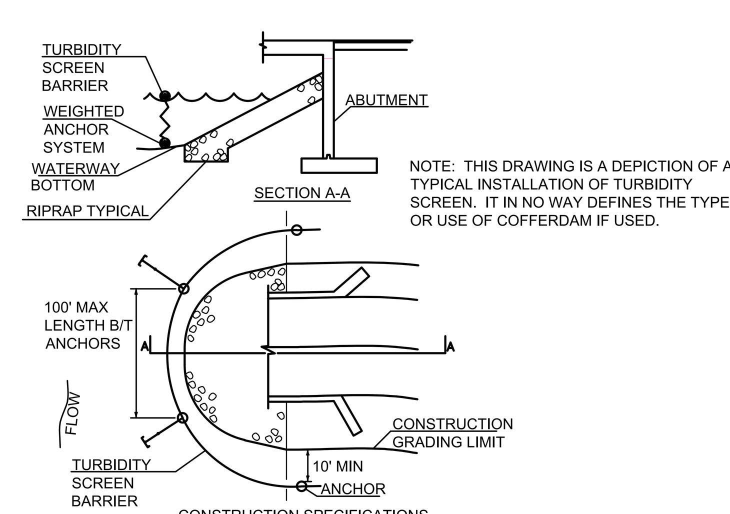

10 TYPICAL OVERFLOW AREA DRAIN
NOT TO SCALE

NOTES:

- CONCRETE THRUST BLOCK TO BE USED ONLY WHERE IT WILL BEAR ON UNDISTURBED EARTH.
- USE RESTRAINED JOINT FOLLOWER GLANDS, OR TIE RODS. WHERE CONCRETE THRUST BLOCK IS UNACCEPTABLE.
- SIZE OF BLOCK OR FITTING TO BE DESIGNED FOR SPECIFIC CONDITIONS, OR ANY NECESSARY BENDS.




11 TYPICAL BWSC FIRE HYDRANT CONNECTION DETAIL
NOT TO SCALE

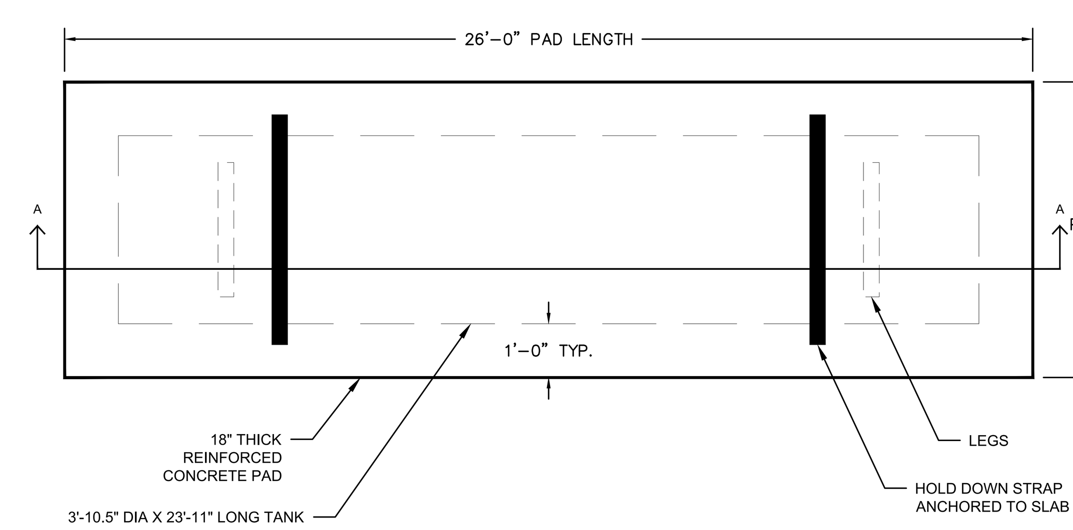



NOTE: THIS DRAWING IS A DEPICTION OF A TYPICAL INSTALLATION OF TURBIDITY SCREEN. IT IN NO WAY DEFINES THE TYPE OR USE OF COFFERDAM IF USED.

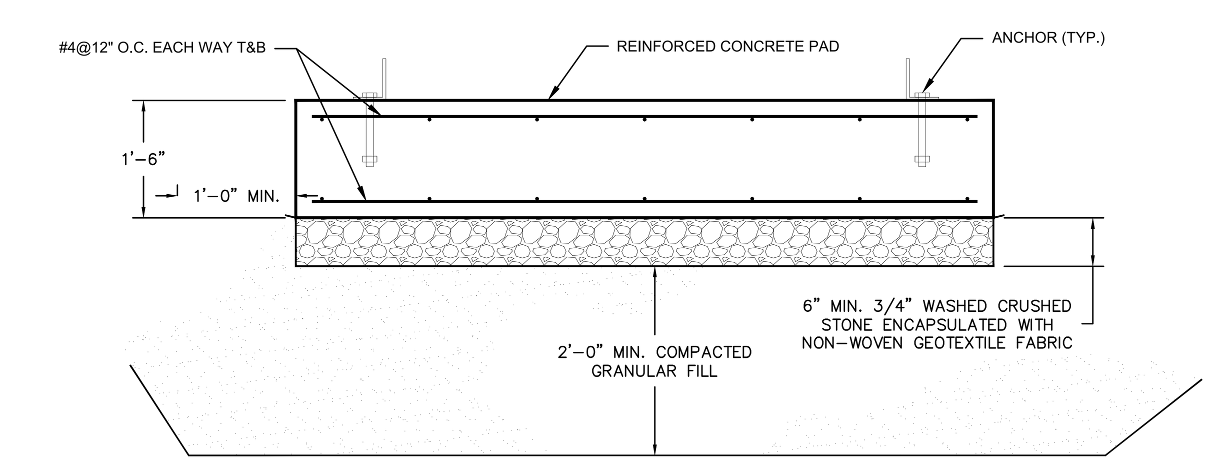
CONSTRUCTION SPECIFICATIONS

1. TURBIDITY SCREEN SHALL NOT BE PLACED ACROSS A FLOWING WATERWAY.
2. MAXIMUM 100' LENGTH BETWEEN ANCHORS.
3. LAST SECTION SHALL TERMINATE A MINIMUM OF 10' BEYOND LIMIT OF DISTURBANCE.
4. THE WEIGHTED ANCHOR SYSTEM SHALL BE A TYPE WHICH ALLOWS THE SCREEN TO CONFORM TO THE BOTTOM OF THE WATERWAY.
5. THE SCREEN SHALL BE REMOVED BY SLOWLY PULLING TOWARD THE SHORE MINIMIZING THE ESCAPE OF SEDIMENTS INTO WATERWAY.

12 TYPICAL TURBITY SCREEN (SILT SURTAIN)
NOT TO SCALE

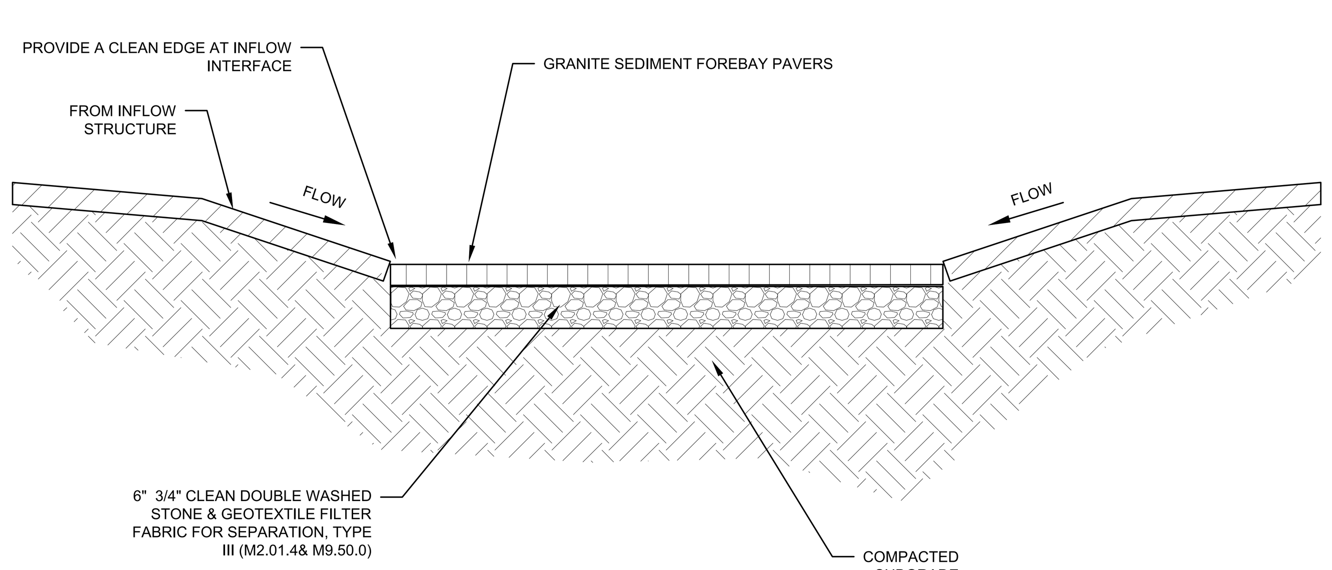



PLAN
NOT TO SCALE



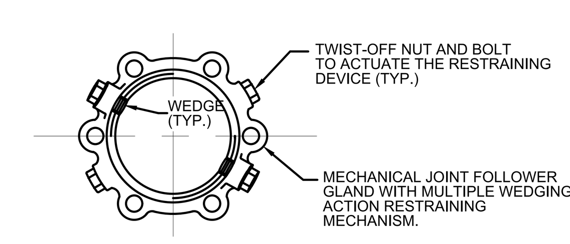

SECTION A-A
NOT TO SCALE

13 CONCRETE PAD FOR UNDERGROUND TANK
NOT TO SCALE

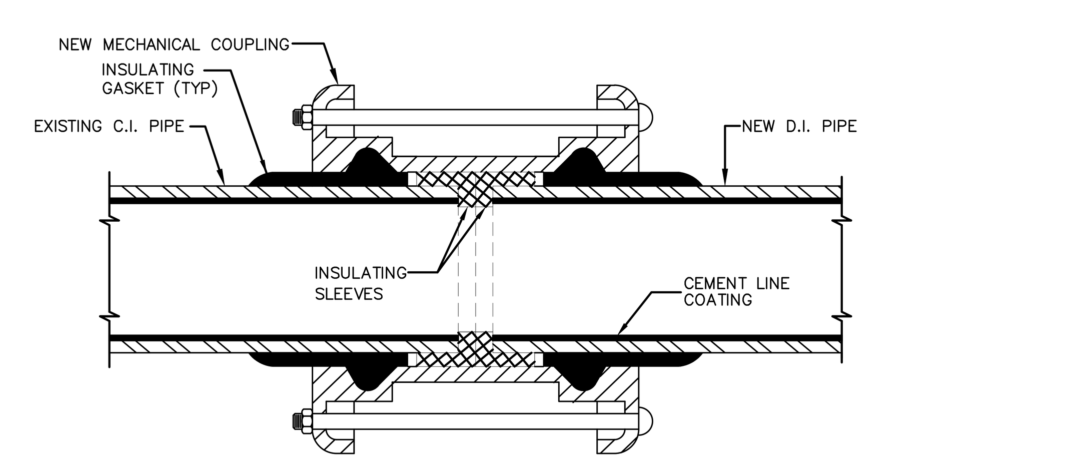



NOTES:
1. SEE SPECIFICATIONS FOR SEDIMENT FOREBAY PAVER REQUIREMENTS.
2. SEE PLANS FOR DIMENSIONS GRADING AND ELEVATIONS FOR SEDIMENT FOREBAY

14 SEDIMENT FOREBAY PAVERS
NOT TO SCALE




15 MECHANICAL JOINT RESTRAINT
NOT TO SCALE




16 INSULATING MECHANICAL TRANSITION COUPLINGS
NOT TO SCALE

NOTES:

1. CONTRACTOR TO VERIFY OUTSIDE DIAMETER OF ALL EXISTING AND PROPOSED PIPES FOR SIZING COUPLINGS PRIOR TO ORDERING COUPLINGS.
2. TRANSITION COUPLINGS WITH LARGER GASKETS OR REDUCING MIDDLE RINGS AS REQUIRED BY MANUFACTURER TO SPAN PIPES WITH DIFFERENT SIZE OUTSIDE DIAMETERS. A REDUCING MIDDLE RING SHALL BE USED AT LOCATIONS WHERE OUTSIDE DIAMETERS DIFFER BY 1-INCH OR MORE.
3. INSULATING MECHANICAL COUPLING AND ALL HARDWARE SHALL BE COMPLETELY WRAPPED WITH WAX-TAPE COATING SYSTEM.
4. MECHANICAL COUPLINGS AND ALL HARDWARE SHALL BE INSTALLED AND TESTED AS PER MANUFACTURER'S STANDARDS AND INSTALLATION GUIDELINES.

IF THIS SHEET IS NOT: 36" x 48", IT HAS BEEN REDUCED OR ENLARGED.

C-501_504_NEWELL DETAILS.DWG 25-Mar-2022

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peterson-architects.com

GREEN INTERNATIONAL AFFILIATES, INC.
Civil Engineers

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Project# 17.017

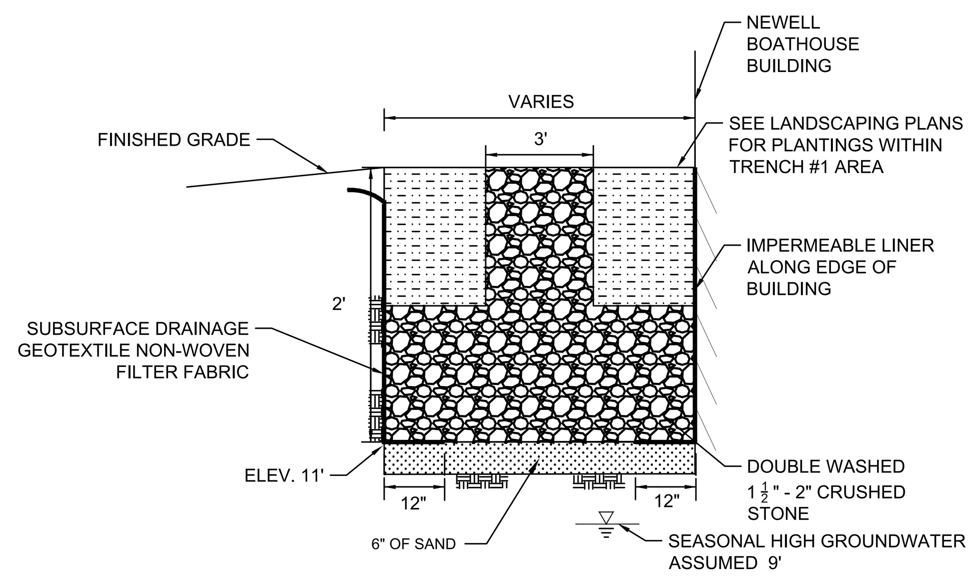
Harvard University Athletics
801 Soldiers Field Road,
Allston, Massachusetts, 02134

3/25/2022 Permit Plans

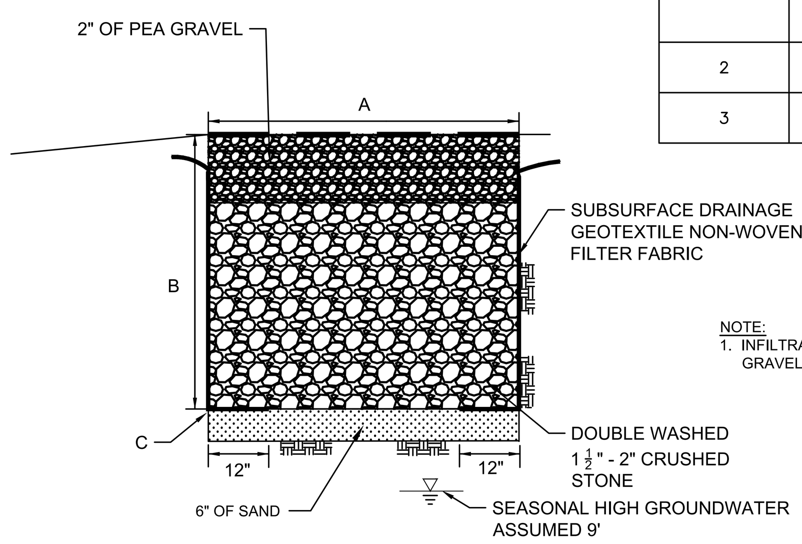
| Rev. | Date | Remarks |
|---|---|---|

Detail I

C-501



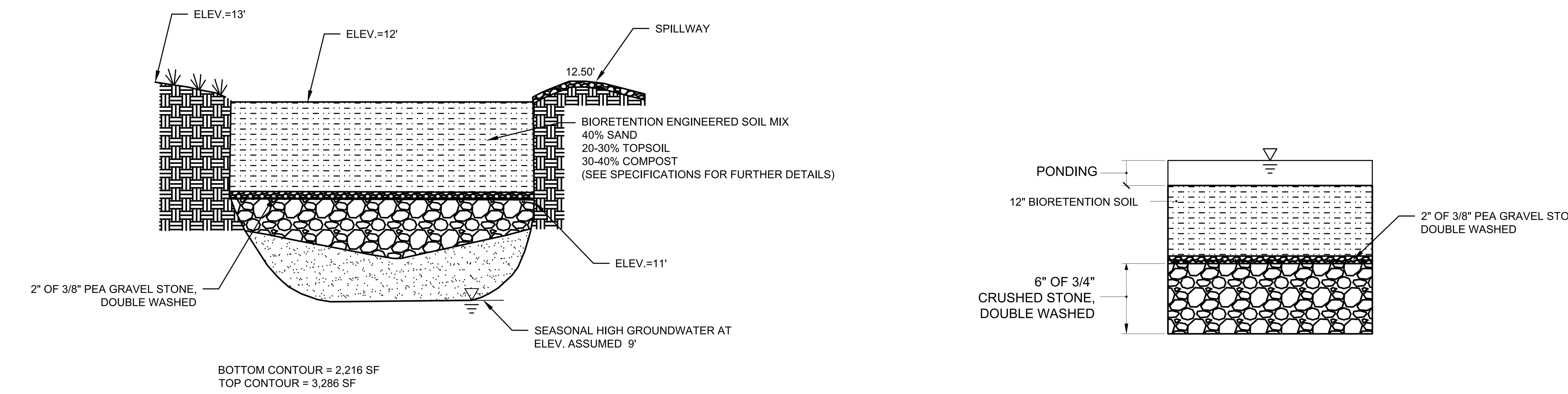

1 INFILTRATION TRENCH #1 SECTION
NOT TO SCALE



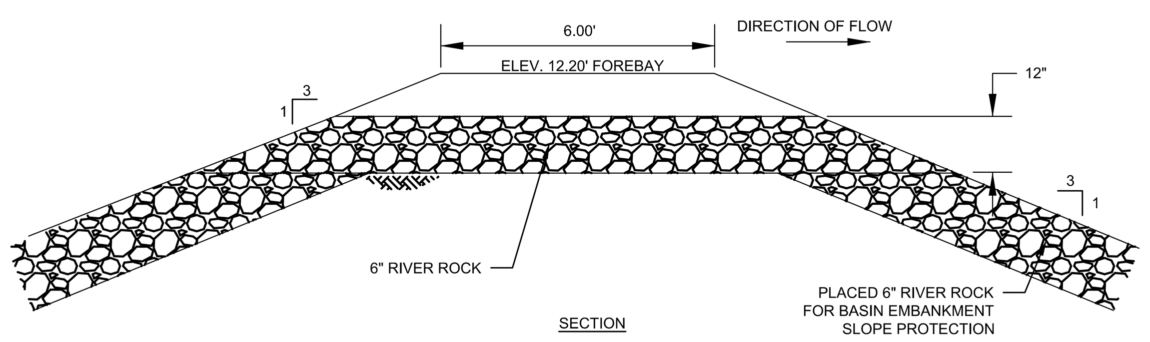

| TRENCH # | A (FT) | B(FT) | C (ELEV, FT) | LENGTH (FT) |
|---|---|---|---|---|
| 2 | 12 | 0.5 | 11 | 78 |
| 3 | 12 | 0.5 | 11 | 78 |

NOTE:
1. INFILTRATION TRENCH TO BE INSTALLED IN GRAVEL PAVE2. SEE LANDSCAPE DETAILS.

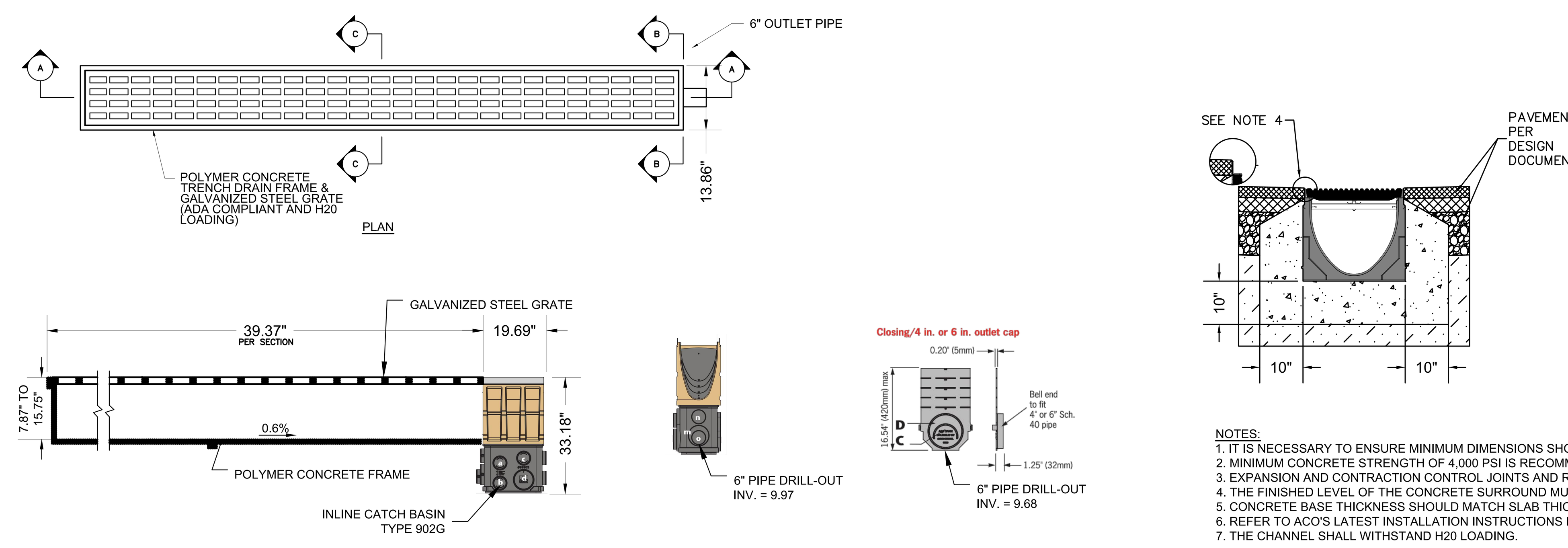
2 INFILTRATION TRENCH SECTION
NOT TO SCALE




3 BIORETENTION AREA
NOT TO SCALE




4 FOREBAY SPILLWAY DETAIL
NOT TO SCALE




### SPECIFICATION CLAUSE

### K200 KLASSIKDRAIN - LOAD CLASS E

*GENERAL*
THE SURFACE DRAINAGE SYSTEM SHALL BE POLYMER CONCRETE K200 CHANNEL SYSTEM WITH GALVANIZED STEEL EDGE RAILS AS MANUFACTURED BY ACO POLYMER PRODUCTS, INC.

*MATERIALS*
CHANNELS SHALL BE MANUFACTURED FROM POLYESTER RESIN POLYMER CONCRETE WITH AN INTEGRALLY CAST-IN GALVANIZED STEEL EDGE RAIL. MINIMUM PROPERTIES OF POLYMER CONCRETE WILL BE AS FOLLOWS:

| | |
|---|---|
| COMPRESSIVE STRENGTH: | 14,000 PSI |
| FLEXURAL STRENGTH: | 4,000 PSI |
| TENSILE STRENGTH: | 1,500 PSI |
| WATER ABSORPTION: | 0.07% |
| FROST PROOF | YES |
| DILUTED AND ALKALI RESISTANT | YES |
| B117 SALT SPRAY TEST COMPLIANT | YES |

THE SYSTEM SHALL BE 8" (200mm) NOMINAL INTERNAL WIDTH WITH A 10.2" (260mm) OVERALL WIDTH AND A BUILT-IN SLOPE OF 0.5%. CHANNEL INVERT SHALL HAVE DEVELOPED "V" SHAPE. ALL CHANNELS SHALL BE INTERLOCKING WITH A MALE/FEMALE JOINT.

THE COMPLETE DRAINAGE SYSTEM SHALL BE BY ACO POLYMER PRODUCTS, INC. ANY DEVIATION OR PARTIAL SYSTEM DESIGN AND/OR IMPROPER INSTALLATION WILL VOID ANY AND ALL WARRANTIES PROVIDED BY ACO POLYMER PRODUCTS, INC.

CHANNEL SHALL WITHSTAND LOADING TO PROPER LOAD CLASS AS OUTLINED BY EN 1433. GRATE TYPE SHALL BE APPROPRIATE TO MEET THE SYSTEM LOAD CLASS SPECIFIED AND INTENDED APPLICATION. GRATES SHALL BE SECURED USING 'QUICKLOK' BOLTLESS LOCKING SYSTEM. CHANNEL AND GRATE SHALL BE CERTIFIED TO MEET THE SPECIFIED EN 1433 LOAD CLASS. THE SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS.

NOTES:
1. IT IS NECESSARY TO ENSURE MINIMUM DIMENSIONS SHOWN ARE SUITABLE FOR EXISTING GROUND CONDITIONS.
2. MINIMUM CONCRETE STRENGTH OF 4,000 PSI IS RECOMMENDED. CONCRETE SHOULD BE VIBRATED TO ELIMINATE AIR POCKETS.
3. EXPANSION AND CONTRACTION CONTROL JOINTS AND REINFORCEMENT ARE RECOMMENDED TO PROTECT CHANNEL AND CONCRETE SURROUND.
4. THE FINISHED LEVEL OF THE CONCRETE SURROUND MUST BE APPROX. 1/8" [3mm] ABOVE THE TOP OF THE CHANNEL EDGE.
5. CONCRETE BASE THICKNESS SHOULD MATCH SLAB THICKNESS.
6. REFER TO ACO'S LATEST INSTALLATION INSTRUCTIONS FOR FURTHER DETAILS.
7. THE CHANNEL SHALL WITHSTAND H20 LOADING.

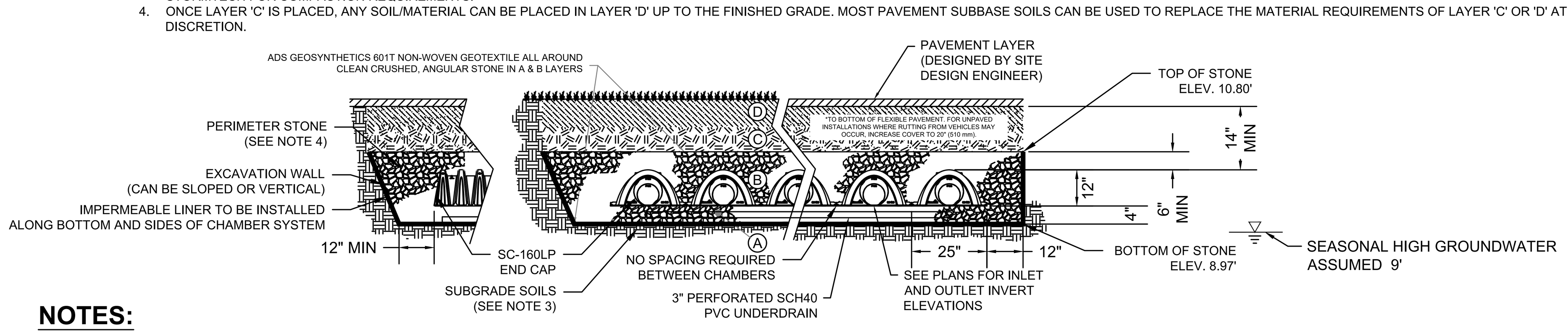
SECTION C-C

5 TRENCH DRAIN ACO K200
NOT TO SCALE

### ACCEPTABLE FILL MATERIALS: STORMTECH SC-160LP CHAMBER SYSTEMS

| MATERIAL LOCATION | | DESCRIPTION | AASHTO MATERIAL CLASSIFICATIONS | COMPACTION / DENSITY REQUIREMENT |
|---|---|---|---|---|
| D | **FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER | ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS. | N/A | PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS. |
| C | **INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 14" (355 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER. | GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE.<br>MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER. | AASHTO M145[1]<br>A-1, A-2-4, A-3<br>OR<br>AASHTO M43[1]<br>3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10 | BEGIN COMPACTIONS AFTER 12" (300 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" (150 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS. ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs (53 kN). DYNAMIC FORCE NOT TO EXCEED 20,000 lbs (89 kN). |
| B | **EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE. | CLEAN, CRUSHED, ANGULAR STONE | AASHTO M43[1]<br>3, 357, 4, 467, 5, 56, 57 | NO COMPACTION REQUIRED. |
| A | **FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER. | CLEAN, CRUSHED, ANGULAR STONE | AASHTO M43[1]<br>3, 357, 4, 467, 5, 56, 57 | PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3] |

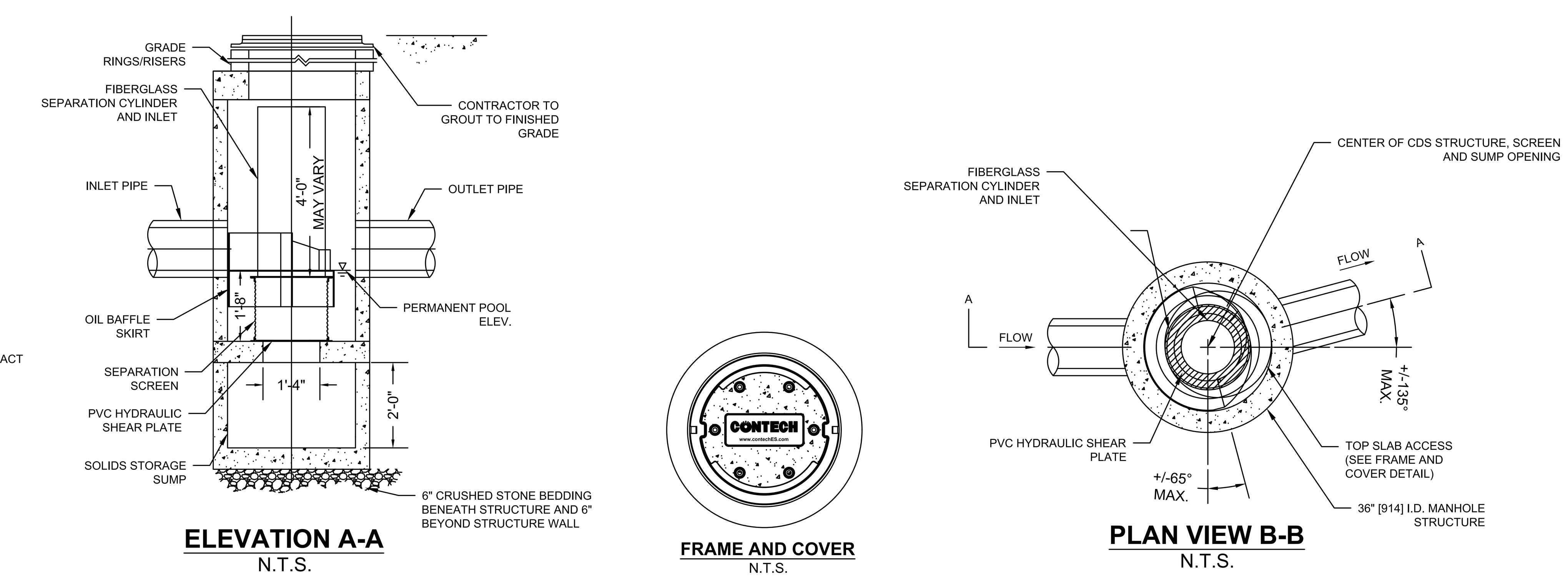
PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 6" (150 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.




## NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
3. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
4. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 1.5"
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 400 LBS/IN/IN. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

6 SUBSURFACE CHAMBER SYSTEM
NOT TO SCALE

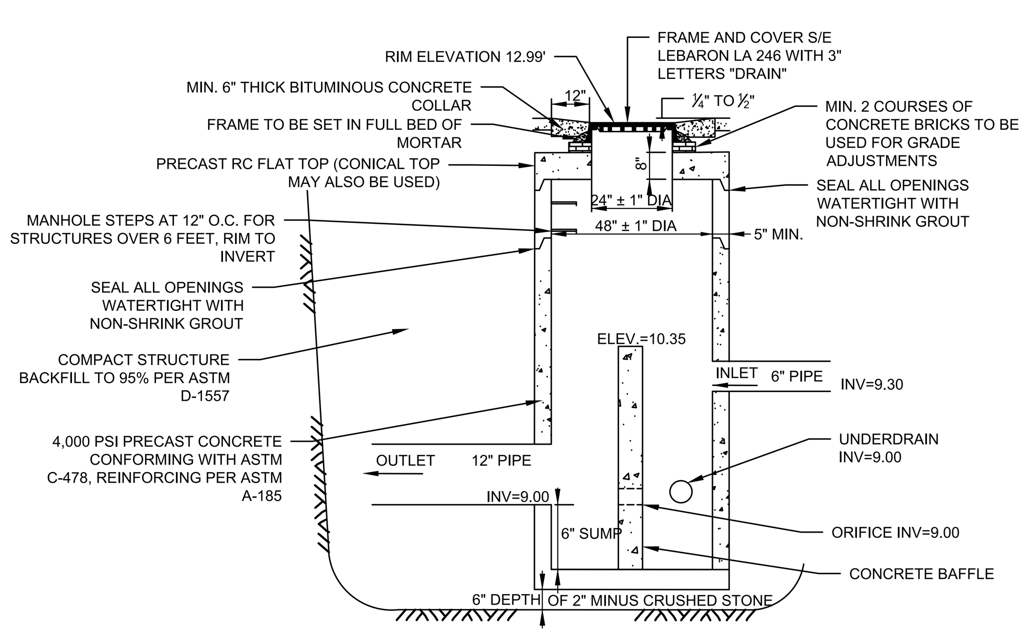



GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

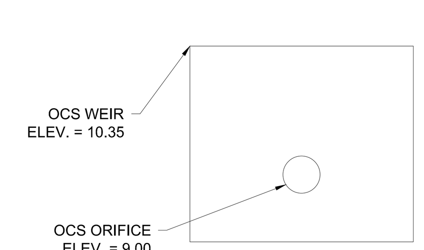
INSTALLATION NOTES
A. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
B. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
C. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

7 WATER QUALITY STRUCTURE (CDS1515-3-C)
NOT TO SCALE

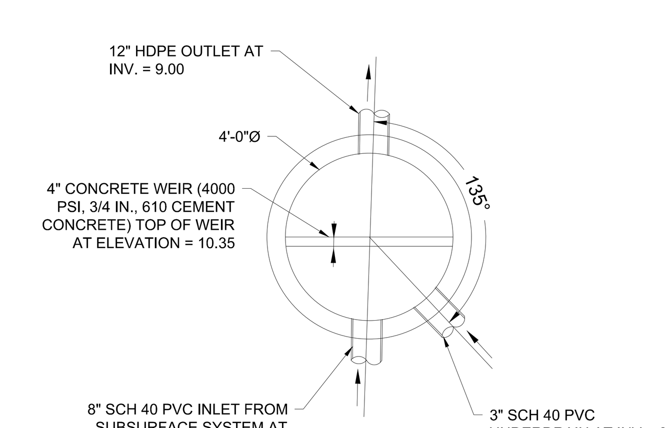





SECTION A-A




CONCRETE WEIR PROFILE




OCS PLAN

8 OUTLET CONTROL STRUCTURE
NOT TO SCALE

C-501_504_NEWELL DETAILS.DWG 25-Mar-2022

Bruner/Cott ARCHITECTS
225 Friend Street
Boston, MA 02114
617.492.8400
brunercott.com

PETERSON ARCHITECTS
156 Mt Auburn Street
Cambridge, MA 02138
617.354.2268
peterson-architects.com

GREEN INTERNATIONAL AFFILIATES, INC.
Civil Engineers
100 Ames Pond Drive, Suite 200
Tewksbury, MA 01876
(978) 923-0400 Green # 21030
greenintl.com

*Newell Boathouse Renovation*
***Project# 17.017***

*Harvard University Athletics*
***801 Soldiers Field Road,***
***Allston, Massachusetts, 02134***

3/25/2022 ***Permit Plans***

| Rev. | Date | Remarks |
|---|---|---|
| | | |

COMMONWEALTH OF MASSACHUSETTS
JAMES W. THORNE
CIVIL
NO. 54912
3/25/2022
REGISTERED PROFESSIONAL ENGINEER

*Detail II*

# C-502

## LAYOUT, MATERIALS AND LANDSCAPE NOTES

1. EXISTING CONDITIONS BASED ON PLAN TITLED "NOI SUBMISSION NEWELL - EXISTING CONDITIONS" DATED AUGUST 27, 2021 BY GREEN INTERNATIONAL AFFILIATES, INC.
2. SEE CIVIL PLANS FOR SUBGRADE DRAINAGE AND STORMWATER MANAGEMENT.
3. ALL LINE AND GRADE WORK PER DRAWINGS AND SPECIFICATIONS SHALL BE LAID OUT BY A REGISTERED CIVIL ENGINEER OR SURVEYOR ENGAGED BY THE CONTRACTOR.
4. ALL LINES AND DIMENSIONS ARE PARALLEL OR PERPENDICULAR TO THE LINES FROM WHICH THEY ARE MEASURED UNLESS OTHERWISE INDICATED.
5. ALL DIMENSIONS ARE FROM FACE OF BUILDING, WALL, OR CURB UNLESS OTHERWISE NOTED.
6. THE DIMENSIONS SHOWN ON THE DRAWINGS SHOW DESIGN INTENT AND MUST BE FIELD VERIFIED PRIOR TO PREPARATION OF SHOP DRAWINGS. SHOP DRAWINGS FOR ALL PAVEMENT AND CURBING LAYOUT SHALL BE BASED UPON ACTUAL LAYOUT AND FIELD MEASUREMENT BY THE CONTRACTOR.
7. AT ALL LOCATIONS WHERE EXISTING CURBING, BITUMINOUS CONCRETE OR CONCRETE PAVING ABUT NEW CONSTRUCTION, THE EDGE OF THE EXISTING CURB OR PAVEMENT SHALL BE SAWCUT TO A CLEAN, SMOOTH EDGE.
8. EXPANSION JOINT FILLER AND SEALANT SHALL BE PLACED WHERE PAVEMENT MEETS CURBING, WALLS OR OTHER VERTICAL ELEMENTS, INCLUDING LIGHT BASES, HYDRANTS, BUILDINGS AND BUILDING COLUMNS, WALLS, STAIRS AND AT OTHER VERTICAL CONDITIONS AS SHOWN ON THE DRAWINGS.
9. LAYOUT OF EXPANSION JOINTS SHOWN IS DIAGRAMMATIC ONLY. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS FOR LAYOUT BASED ON FIELD VERIFIED MEASUREMENTS. LAYOUT OF EXPANSION JOINTS SHALL BE REVIEWED IN THE FIELD BY THE OWNER'S REPRESENTATIVE PRIOR TO POURING CONCRETE.
10. CONTRACTOR SHALL STAKE THE CENTERLINE AND EDGES OF ALL ELEMENTS IN THE FIELD FOR APPROVAL BY THE OWNER'S REPRESENTATIVE PRIOR TO BEGINNING WORK.
11. RESTORE EXISTING CONDITIONS, INCLUDING REPAVING, RESETTING SITE IMPROVEMENTS AND SEEDING, AS NECESSARY IN AREAS OF PROPOSED UTILITY IMPROVEMENTS.
12. CONTRACTOR IS RESPONSIBLE FOR DOCUMENTING THE LOCATIONS OF ANY EXISTING SITE ELEMENTS TO BE RESET IN THEIR SAME HORIZONTAL LOCATION.
13. PROVIDE SLEEVES UNDER NEW PAVEMENT AS SHOWN ON THE DRAWINGS.
14. PROVIDE SITE LIGHTING INSTALLED PER MANUFACTURER'S RECOMMENDATIONS IN LOCATIONS AND QUANTITIES AS SHOWN.
15. PROVIDE BIKE RACKS INSTALLED PER MANUFACTURER'S RECOMMENDATIONS IN LOCATIONS AND QUANTITIES AS SHOWN.
16. INCLUDE IN THE PRICING AN ADDITIONAL $5,000 SIGNAGE ALLOWANCE.


IF THIS SHEET IS NOT 30" x 48", IT HAS BEEN REDUCED OR ENLARGED.

NOT FOR CONSTRUCTION

Bruner/Cott ARCHITECTS
225 Friend Street
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COMMONWEALTH OF MASSACHUSETTS JAMES P. SHADLEY NO. 993 REGISTERED LANDSCAPE ARCHITECT

| 2022-3-25 | Permit Plans |
|---|---|
| Rev. | Date | Remarks |

***Layout & Materials Plan***

# L-100

# EXISTING TREE SCHEDULE

| # | BOTANICAL NAME | COMMON NAME | NATIVE STATUS | JURISDICTION AREA | SIZE | COMMENTS |
|---|---|---|---|---|---|---|
| EXISTING TREES | | | | | | |
| N1 | ULMUS AMERICANA | AMERICAN ELM | N | W100 | 5" CAL. | |
| N2 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 15" CAL. | |
| N3 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 18" CAL. | |
| N4 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 9" CAL. | |
| N5 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 13" CAL. | |
| N6 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 14" CAL. | |
| N7 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 13" CAL. | |
| N8 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 13" CAL. | |
| N9 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 17" CAL. | |
| N10 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 4" CAL. | |
| N11 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 13" CAL. | |
| N12 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 14" CAL. | |
| N13 | CRATAEGUS SP. | HAWTHORN | W | W100 | 7" CAL. | |
| N14 * | CRATAEGUS SP. | HAWTHORN | W | W100 | 6" CAL. | |
| N15 | CRATAEGUS SP. | HAWTHORN | W | W100 | 6" CAL. | |
| N16 | CRATAEGUS SP. | HAWTHORN | W | W100 | 4" CAL. | |
| N17 | CRATAEGUS SP. | HAWTHORN | W | W100 | 4" CAL. | |
| N18 | ULMUS AMERICANA | AMERICAN ELM | N | - | 5" CAL. | |
| N19 | ULMUS AMERICANA | AMERICAN ELM | N | W100 | 6" CAL. | |
| N20 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 5" CAL. | |
| N21 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 9" CAL. | |
| N22 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 13" CAL. | |
| N23 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 5" CAL. | |
| N24 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 11" CAL. | |
| N25 | BETULA POPULIFOLIA | GREY BIRCH | N | B | 9" CAL. | |
| N26 * | ACER SACCHARINUM | SILVER MAPLE | N | R25 | 26" CAL. | |
| N27 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 9" CAL. | |
| N28 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 10" CAL. | |
| N29 | ACER RUBRUM | RED MAPLE | N | R25 | 6" CAL. | |

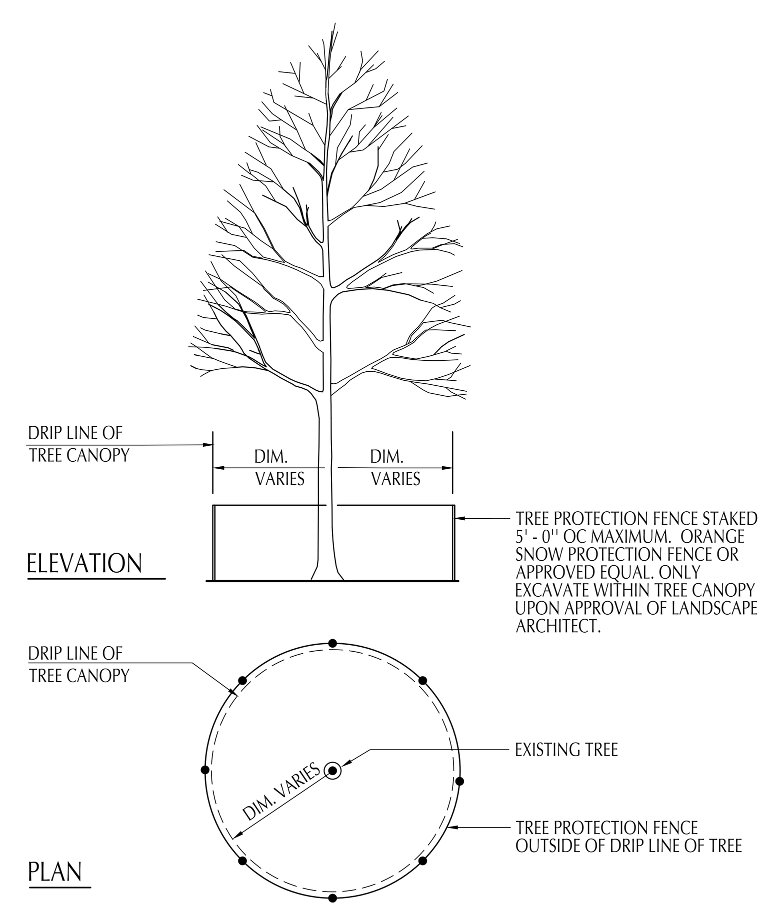
| # | BOTANICAL NAME | COMMON NAME | NATIVE STATUS | JURISDICTION AREA | SIZE | COMMENTS |
|---|---|---|---|---|---|---|
| EXISTING TREES | | | | | | |
| N31 * | ACER SACCHARINUM | SILVER MAPLE | N | B | 24" CAL. | |
| N33 * | MALUS SP. | CRABAPPLE | - | R25 | 5" CAL. | |
| N34 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 12" CAL. | |
| N35 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 10" CAL. | |
| N36 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 18" CAL. | |
| N37 * | MALUS SP. | CRABAPPLE | - | R25 | 16" CAL. | TO BE REMOVED |
| N38 | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 7" CAL. | TO BE REMOVED |
| N39 * | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 14" CAL. | TO BE REMOVED |
| N40 | PINUS NIGRA | AUSTRIAN PINE | - | W100 | 21" CAL. | TO BE REMOVED |
| N41 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 5" CAL. | TO BE REMOVED |
| N42 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 6" CAL. | TO BE REMOVED |
| N45 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 7" CAL. | TO BE REMOVED |
| N46 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 15" CAL. | TO BE REMOVED |
| N47 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 8" CAL. | TO BE REMOVED |
| N48 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 4" CAL. | TO BE REMOVED |
| N49 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 4" CAL. | TO BE REMOVED |
| N50 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 13" CAL. | TO BE REMOVED |
| N51 * | ALNUS GLUTINOSA | COMMON ALDER | I | B | 11" CAL. | |
| N53 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 5" CAL. | TO BE REMOVED |
| N58 | ALNUS GLUTINOSA | COMMON ALDER | I | B | 4" CAL. | |
| N61 * | MORUS ALBA | WHITE MULBERRY | I | B | 5" CAL. | TO BE REMOVED |
| N62 | ALNUS GLUTINOSA | COMMON ALDER | I | B | 20" CAL. | TO BE REMOVED |

| # | BOTANICAL NAME | COMMON NAME | NATIVE STATUS | JURISDICTION AREA | SIZE | COMMENTS |
|---|---|---|---|---|---|---|
| EXISTING TREES | | | | | | |
| N63 * | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 10" CAL. | |
| N64 * | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 11" CAL. | TO BE REMOVED |
| N65 | QUERCUS VELUTINA | BLACK OAK | N | W100 | 26" CAL. | |
| N66 * | QUERCUS PALUSTRIS | PIN OAK | I | W100 | 32" CAL. | TO BE REMOVED |
| N67 * | PRUNUS SEROTINA | BLACK CHERRY | N | W100 | 12" CAL. | TO BE REMOVED |
| N68 * | ACER RUBRUM | RED MAPLE | N | W100 | 16" CAL. | |
| N69 * | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 7" CAL. | |
| N70 | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 13" CAL. | |
| N71 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 11" CAL. | |
| N73 | MALUS SP. | CRABAPPLE | - | W100 | 6" CAL. | |
| N74 | QUERCUS RUBRA | NORTHERN RED OAK | N | R25 | 49" CAL. | SPECIMEN |
| N76 | ACER PLATANOIDES | NORWAY MAPLE | I, INV | W100 | 9" CAL. | |
| N78 | ULMUS AMERICANA | AMERICAN ELM | N | W100 | 11" CAL. | |
| N79 | ULMUS AMERICANA | AMERICAN ELM | N | B | 16" CAL. | |
| N80 | QUERCUS PALUSTRIS | PIN OAK | N | B | 19" CAL. | |
| N81 * | PYRUS CALLERYANA | PEAR | - | W100 | 13" CAL. | TO BE REMOVED |
| N82 | BETULA POPULIFOLIA | GREY BIRCH | N | W100 | 5" CAL. | TO BE REMOVED |
| N83 * | ACER PLATANOIDES | NORWAY MAPLE | I, INV | - | 25" CAL. | TO BE REMOVED |
| N84 | ACER PLATANOIDES | NORWAY MAPLE | I, INV | - | 15" CAL. | TO BE REMOVED |
| N85 | ACER PLATANOIDES | NORWAY MAPLE | I, INV | - | 16" CAL. | TO BE REMOVED |
| N86 | ZELKOVA SERRATA | JAPANESE ZELKOVA | - | - | 7" CAL. | TO BE REMOVED |
| N87 * | ZELKOVA SERRATA | JAPANESE ZELKOVA | - | - | 9" CAL. | TO BE REMOVED |
| N88 * | ZELKOVA SERRATA | JAPANESE ZELKOVA | - | - | 9" CAL. | TO BE REMOVED |
| N91 * | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 5" CAL. | |
| N92 | PRUNUS SEROTINA | BLACK CHERRY | N | R25 | 10" CAL. | |
| N93 | ALNUS GLUTINOSA | COMMON ALDER | I | R25 | 5" CAL. | |
| N94 * | ALNUS GLUTINOSA | COMMON ALDER | I | B | 13" CAL. | |
| N95 | MALUS SP. | CRABAPPLE | - | R25 | 8" CAL. | |
| N96 | BETULA POPULIFOLIA | GREY BIRCH | N | R25 | 3" CAL. | |

* TREES RECOMMENDED FOR REMOVAL BY ARBORIST BASED ON TREE HEALTH (NOT NECESSARILY PROPOSED TO BE REMOVED AS PART OF THIS PROJECT). REFER TO "NEWELL BOATHOUSE TREE INVENTORY AND MANAGEMENT PLAN | JANUARY 2022" BY BARTLETT TREE EXPERTS.

NATIVE STATUS: NATIVE STATUS FOR THE MIDDLESEX OR SUFFOLK COUNTIES PER "THE VASCULAR PLANTS OF MASSACHUSETTS: A COUNTY CHECKLIST, FIRST REVISION"
NATIVE = (N), INTRODUCED = (I), WAIF = (W), INVASIVE = (INV). NON-NATIVES LABELED ( - ).

JURISDICTIONAL AREA: WITHIN BANK / MEAN ANNUAL HIGH WATER ELEVATION (B), WITHIN 25' RIVERFRONT AREA (R25), WITHIN 100' WETLAND RESOURCE AREA BUFFER (W100) BUT OUTSIDE 25' RIVERFRONT AREA.




NOTES:

1. ALL TREES WITHIN LIMIT OF WORK OR OTHERWISE REQUESTED BY LANDSCAPE ARCHITECT OR OWNER' REPRESENTATIVE TO RECEIVE TREE PROTECTION.
2. DO NOT STORE ANY MACHINERY OR MATERIALS WITHIN AREA OF THE SNOW FENCE.
3. CONTRACTOR SHALL CONTACT ARBORIST PRIOR TO DEMOLITION TO PERFORM RECOMMENDED TREATMENTS (FERTILIZER, ROOT PRUNE, ETC.) ON SPECIMEN TREES WITHIN LIMIT OF WORK TO REMAIN BEFORE BEGINNING DEMOLITION.

1 TREE PROTECTION

SCALE: 1" = 1'-0"


## TREE PROTECTION PLAN NOTES

1. EXISTING CONDITIONS BASED ON PLAN TITLED "NOI SUBMISSION NEWELL - EXISTING CONDITIONS" DATED AUGUST 27, 2021 BY GREEN INTERNATIONAL AFFILIATES, INC.
2. EXISTING TREE SCHEDULE BASED ON 'NEWELL BOATHOUSE TREE INVENTORY AND MANAGEMENT PLAN | JANUARY 2022.
3. EXISTING TREES TO REMAIN ARE TO BE PROTECTED THROUGHOUT THE DURATION OF CONSTRUCTION, AND ARE TO BE EVALUATED BY PROJECT ARBORIST AND TREATED AS RECOMMENDED.
4. ALL TREES TO BE REMOVED TO TO HAVE STUMPS GROUND OUT, AND BACKFILLED WITH COMPACTED LOAM UNLESS OTHERWISE NOTED.

SCALE: 1" = 20'-0"

0 20' 40' 60'

NORTH

IF THIS SHEET IS NOT 36" x 48" IT HAS BEEN REDUCED OR ENLARGED.

NOT FOR CONSTRUCTION


Bruner/Cott ARCHITECTS
225 Friend Street
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*Newell Boathouse Renovation*
**Project # 17.017 | 20103.0.00**

*Harvard University Athletics*
**801 Soldiers Field Road,**
**Allston, Massachusetts, 02134**

2022-3-25 **Permit Plans**

| Rev. | Date | Remarks |
|---|---|---|

**TREE PROTECTION PLAN**

# L-100.1

## GRADING NOTES

1. EXISTING CONDITIONS BASED ON PLAN TITLED "NOI SUBMISSION NEWELL - EXISTING CONDITIONS" DATED AUGUST 27, 2021 BY GREEN INTERNATIONAL AFFILIATES, INC.
2. CONTRACTOR SHALL EMPLOY A LICENSED SURVEYOR OR REGISTERED ENGINEER TO VERIFY AND LAYOUT ALL GRADES AS SHOWN ON THE DRAWINGS.
3. PRIOR TO COMMENCING ANY EXCAVATION WORK, THE CONTRACTOR SHALL NOTIFY ALL UTILITY COMPANIES IN ACCORDANCE WITH THE "DIG SAFE" NOTIFICATION PROCEDURES PROMOTED BY RESPECTIVE UTILITY COMPANIES. THE "DIG SAFE" TELEPHONE NUMBER FOR MASSACHUSETTS IS 1-888-DIG-SAFE.
4. VERIFY ALL EXISTING GRADES IN THE FIELD AND REPORT ANY DISCREPANCIES IMMEDIATELY TO THE OWNER'S REPRESENTATIVE PRIOR TO STARTING WORK. THE STARTING OF WORK INDICATES THE CONTRACTOR HAS REVIEWED AND ACCEPTED EXISTING CONDITIONS.
5. CONTRACTOR SHALL NOTIFY OWNER'S REPRESENTATIVE OF ANY LOCATIONS WITH CONFLICTS BETWEEN UTILITY PLANS AND GRADING PLANS.
6. CONTRACTOR SHALL BLEND NEW EARTHWORK SMOOTHLY INTO EXISTING, PROVIDING VERTICAL CURVES OR ROUNDINGS AT THE TOP AND BOTTOM OF SLOPES.
7. PITCH EVENLY BETWEEN SPOT GRADES. ALL PAVED AREAS MUST PITCH TO DRAIN AT A MINIMUM SLOPE OF ONE-EIGHTH INCH ($\frac{1}{8}$") PER FOOT. ANY SITE CONDITIONS OR ISSUES NOT ALLOWING THIS TO OCCUR SHALL BE REPORTED TO THE OWNER'S REPRESENTATIVE PRIOR TO CONTINUING THE WORK. NEW PAVEMENT AREAS MUST HAVE POSITIVE DRAINAGE TOWARDS THE STREET CURB OR TOWARDS DRAINAGE STRUCTURES.
8. CONTRACTOR SHALL PROVIDE DUST CONTROL FOR EARTHWORK OPERATIONS AS APPROVED BY THE OWNER'S REPRESENTATIVE.
9. ALL GRADING SHALL COMPLY WITH THE RULES AND REGULATIONS OF THE LOCAL AND FEDERAL LAWS AND GUIDELINES FOR UNIVERSAL ACCESSIBILITY, INCLUDING ADA. IN CASE OF CONFLICT BETWEEN REGULATIONS, THE GUIDELINE PROVIDING GREATER ACCESS SHALL APPLY.
10. MAINTAIN THE INTEGRITY OF THE EXISTING DRAINAGE SYSTEM AT ALL TIMES.
11. THE CONTRACTOR SHALL MAINTAIN OR ADJUST TO NEW FINISHED GRADES AS NECESSARY ALL UTILITY AND SITE STRUCTURES SUCH AS LIGHT POLES, SIGN POLES, MANHOLES, DRAINAGE STRUCTURES, HAND HOLES, WATER AND GAS GATES, HYDRANTS, ETC., FROM MAINTAINED UTILITY AND SITE SYSTEMS UNLESS OTHERWISE NOTED ON THE UTILITY DRAWINGS OR AS DIRECTED BY THE OWNER'S REPRESENTATIVE.
12. RIM ELEVATIONS OF ALL DRAINAGE STRUCTURES AND OTHER UTILITY STRUCTURES SHALL BE SET FLUSH WITH FINAL SURROUNDING GRADES SO AS NOT TO CAUSE A TRIP EDGE.
13. FINAL SHAPING OF ALL EARTHWORK SHALL BE DIRECTED AND APPROVED IN THE FIELD BY THE OWNER'S REPRESENTATIVE, INCLUDING THE SUBGRADE IN THE PLANT BEDS, PRIOR TO PLACING ANY LOAM.


SCALE: 1" = 20'-0"

0 20' 40' 60'

NORTH

*NOT FOR CONSTRUCTION*

Bruner/Cott
ARCHITECTS
225 Friend Street
Boston, MA 02114
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brunercott.com

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MASSACHUSETTS JAMES P. SHADLEY NO. 993 REGISTERED LANDSCAPE ARCHITECT

| 2022-3-25 | Permit Plans | |
|---|---|---|
| **Rev.** | **Date** | **Remarks** |

***Grading Plan***

# L-101

## PLANT SCHEDULE

| SYM | QTY | BOTANICAL NAME | COMMON NAME | SIZE | COMMENTS |
|---|---|---|---|---|---|
| DECIDUOUS SHADE TREES | | | | | |
| AR | 3 | Acer rubrum | Red Maple | 3 - 3 1/2" CAL. | |
| UA | 4 | Ulmus Americana 'Valley Forge' | American Elm | 4 - 4 1/2" CAL. | |
| TA | 3 | Tilia americana | American Linden / Basswood | 3 - 3 1/2" CAL. | |
| QA | 1 | Quercus alba | White Oak | 4 - 4 1/2" CAL. | |
| QR | 2 | Quercus rubra | Red Oak | 4 - 4 1/2" CAL. | |
| ORNAMENTAL TREES | | | | | |
| AC | 6 | Amelanchier canadensis | Shadblow Serviceberry | 2 - 2 1/2" CAL. | MULTI-STEM |
| BP | 9 | Betula papyrifera | Paper Birch | 3 - 3 1/2" CAL. | |
| CF | 3 | Benthamidia (cornus florida L.) | Flowering Dogwood | 2 - 2 1/2" CAL. | |
| SHRUBS | | | | | |
| IG | 12 | Ilex glabra | Inkberry | 36 - 48" HT. | 42" O.C. |
| JC | 180 | Juniperus communis var. depressa Pursh | Common Juniper | 1 GAL. | 36" O.C. |
| GROUNDCOVERS, HERBACEOUS PERENNIALS, ORNAMENTAL GRASSES | | | | | |
| PV | 65 | Panicum virgatum | Switchgrass | #3 CONT. | 36" O.C. |
| SS | 150 | Schizachyrium scoparium | Little Bluestem | 1 GAL. | 24" O.C. |

NOTE: ALL PROPOSED PLANTS INCLUDING SEED MIXES SELECTED FROM THE "LANDSCAPE RESTORATION PLANT LISTS" DEVELOPED AND PROVIDED BY THE DEPARTMENT OF CONSERVATION & RECREATION (DCR) CHARLES RIVER BASIN RIVERBANK VEGETATION MANAGEMENT PLAN, AND/OR "THE VASCULAR PLANT OF MASSACHUSETTS, A COUNTY CHECKLIST" FIRST REVISION.

## PLANTING NOTES

1. EXISTING CONDITIONS BASED ON PLAN TITLED "NOI SUBMISSION NEWELL - EXISTING CONDITIONS" DATED AUGUST 27, 2021 BY GREEN INTERNATIONAL AFFILIATES, INC.
2. CONTRACTOR SHALL LOCATE AND VERIFY ALL EXISTING AND INSTALLED UTILITY LINES PRIOR TO PLANTING AND REPORT ANY CONFLICTS TO THE OWNER'S REPRESENTATIVE.
3. ALL NEW PLANT MATERIAL SHALL CONFORM TO THE "AMERICAN STANDARD FOR NURSERY STOCK", LATEST EDITION, PUBLISHED BY THE AMERICAN NURSERY AND LANDSCAPE ASSOCIATION, EXCEPT AS NOTED IN THE SPECIFICATIONS. IN ADDITION, ALL PLANT MATERIAL SHALL BE OF SPECIMEN QUALITY.
4. ALL NEW WOODY STEM PLANTS SHALL BE BALLED AND BURLAPPED OR CONTAINER GROWN UNLESS OTHERWISE NOTED ON THE PLANT LIST.
5. CONTRACTOR SHALL SUPPLY ALL NEW PLANT MATERIAL IN QUANTITIES SUFFICIENT TO COMPLETE THE PLANTING SHOWN ON THE DRAWINGS. IF MINOR DISCREPANCIES EXIST BETWEEN THE NUMBER OF PLANTS DRAWN ON THE PLANTING PLAN AND THE NUMBER OF PLANTS IN THE PLANT SCHEDULE, THE PLANTING PLAN SHALL GOVERN.
6. ANY PROPOSED SUBSTITUTIONS OF PLANT SPECIES SHALL BE MADE WITH PLANTS OF EQUIVALENT OVERALL FORM, HEIGHT, BRANCHING HABIT, FLOWER, LEAF, COLOR, FRUIT, AND CULTURE AND MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE.
7. ALL NEW TREES SHALL BE TAGGED AND APPROVED BY THE OWNER'S REPRESENTATIVE AT THE NURSERY PRIOR TO DIGGING OR DELIVERY TO THE SITE. FOR SHRUBS AND SMALLER MATERIALS, REPRESENTATIVE TAGGING BY THE LANDSCAPE ARCHITECT WILL BE ACCEPTABLE.
8. NO TREES SHALL BE PLANTED BEFORE ACCEPTANCE OF ROUGH GRADING. TREES SHALL BEAR SAME RELATIONSHIP TO FINISH GRADE AS THEY BORE TO FINISH GRADE BEFORE BEING DUG IN THE NURSERY. PRIOR TO PLANTING, REMOVE THE TOP OF THE BURLAP AND CONFIRM THAT PLANT ROOT CROWNS ARE NOT COVERED BY SOIL FROM THE NURSERY.
9. STAKE LOCATION OF ALL PROPOSED PLANTS FOR APPROVAL BY THE OWNER'S REPRESENTATIVE PRIOR TO COMMENCEMENT OF PLANTING.
10. MULCH TREES AND PLANTING BEDS PER DETAILS AND SPECIFICATIONS.
11. ALL NEW TREES SHALL BE GUARANTEED BY THE CONTRACTOR FROM THE TIME OF WRITTEN ACCEPTANCE. SEE SPECIFICATIONS FOR LENGTH OF GUARANTEE.
12. ALL LAWN AREAS DISTURBED BY CONSTRUCTION OPERATIONS INSIDE AND OUTSIDE THE LIMIT OF WORK SHALL BE LOAMED AND SEEDED AS SPECIFIED.
13. ALL AREAS TO BE SEEDED SHALL RECEIVE SOIL PREPARATION AS SPECIFIED PRIOR TO SEEDING, UNLESS OTHERWISE NOTED ON PLAN.
14. ALL EXISTING TREES TO REMAIN SHALL BE PRUNED AND FERTILIZED BY A CERTIFIED ARBORIST.
15. NO PHOSPHORUS BASED FERTILIZERS ARE TO BE USED OR INTRODUCED ON SITE.
16. ALL PROPOSED TURFGRASS LAWN AREAS SHALL INCLUDE 6" COMPACTED DEPTH OF LOAM OR RENOVATED EXISTING SOIL, AND THEN SEEDED WITH "NATURAL PERFECTION MIX" BY COLONIAL SEED / LAVOIE HORTICULTURE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

"NATURAL PERFECTION" LOW MAINTENANCE GRASS MIXTURE

Manufactured by Colonial Seed / LaVoie Horticulture

Ingredients: Sheep Fescue, Blue X Hard Fescue, Blue Fescue, Hard Fescue

Adapted: Sun/Shade, Dry Droughty Soils, Low PH, and Low Fertility.

Uses: Ideal mix for low maintenance lawns, windswept coastal expanses, and naturalized golf course roughs. At low rates Natural Perfection works well as a grass base for wildflowers, or legumes to be added from plugs or seed in year 2-3 upon successful weed suppression.

Features: Natural Perfection is the lowest growing lawn mix available; very fine textured with a wispy look that has gained broad acceptance, and tolerant of extreme drought, Natural Perfection can grow in low fertility/low PH soils. Fertilizer and water will improve the vigor and overall appearance of Natural Perfection. However when the area produces a layer of organic matter in year 2-3 these species can survive with NO FERTILIZER/NO WATER and one MOWING/YEAR in sandy soils.

Seeding Rate: Lawn Areas to be seeded at a rate of 4 pounds / 1,000 square feet.


SCALE: 1" = 20'-0"

0 20' 40' 60'

NORTH

IF THIS SHEET IS NOT 36" x 48", IT HAS BEEN REDUCED OR ENLARGED.

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tel. 978-740-0096 www.hatch.com

Newell Boathouse Renovation
Project # 17.017 | 20103.0.00

Harvard University Athletics
801 Soldiers Field Road,
Allston, Massachusetts, 02134

MASSACHUSETTS JAMES P. SHADLEY NO. 993 REGISTERED LANDSCAPE ARCHITECT

| Rev. | Date | Remarks |
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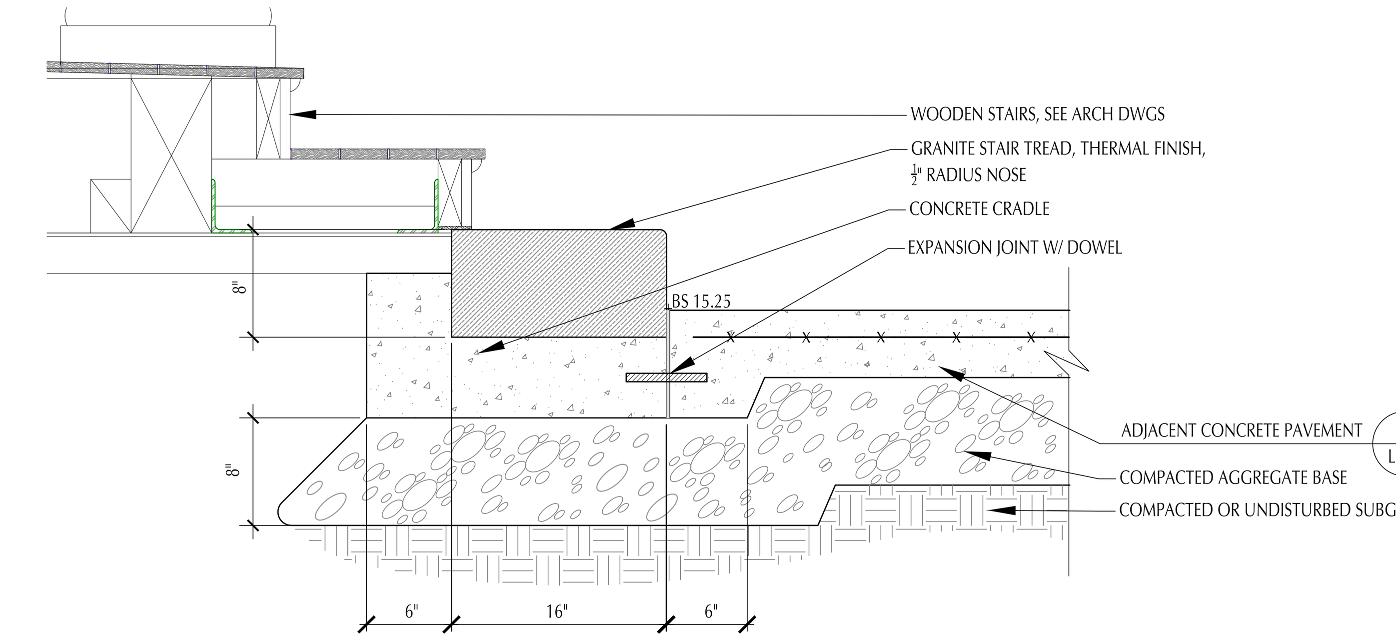
| | 2022-3-25 | Permit Plans |

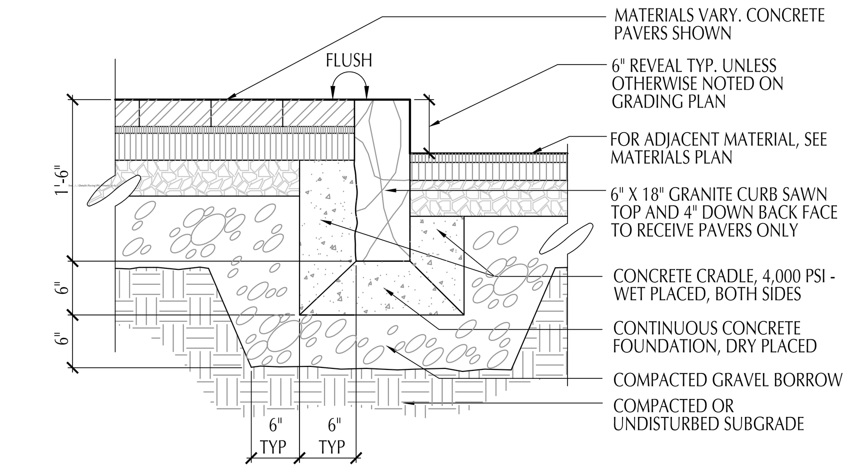
Planting Plan

L-102

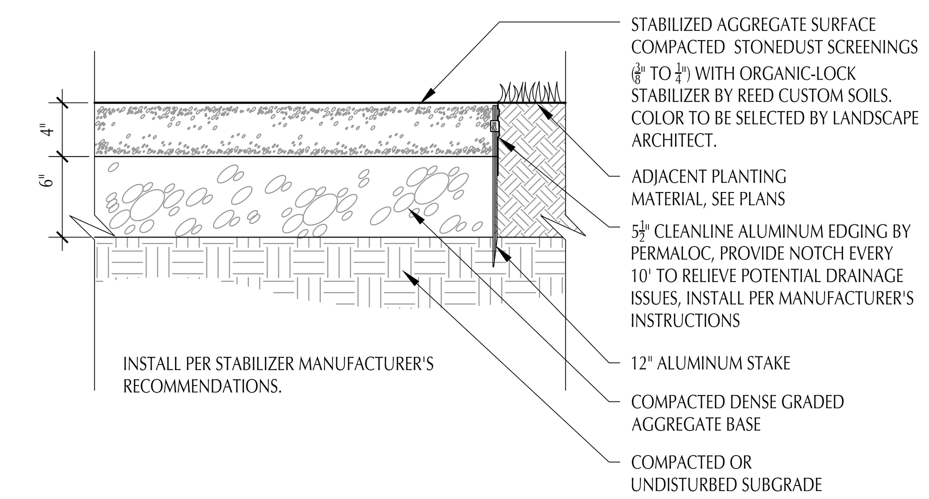

8 BIKE RACK
SCALE: N.T.S.



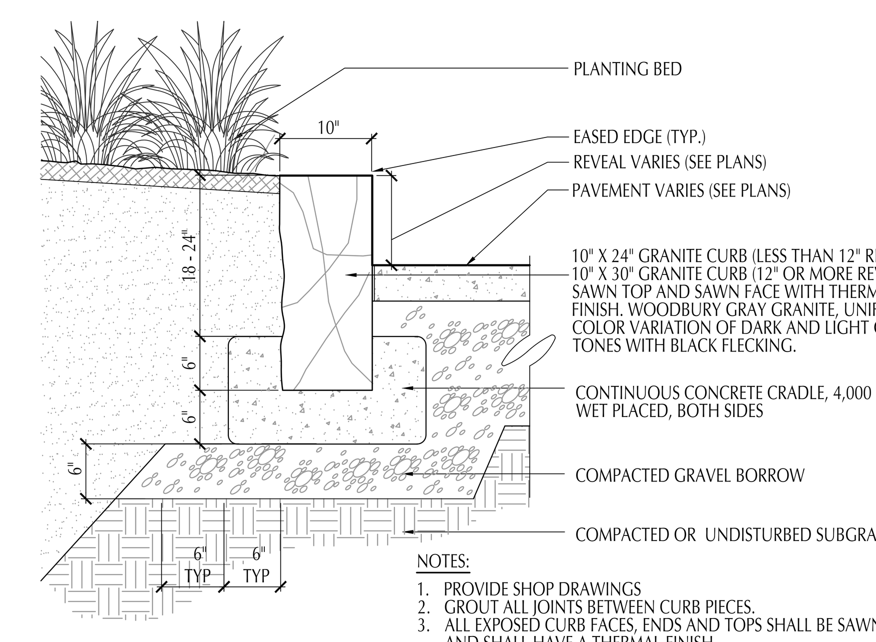

4A GRANITE STEP @ NEWELL ENTRY
SCALE: 1-1/2" = 1'-0"



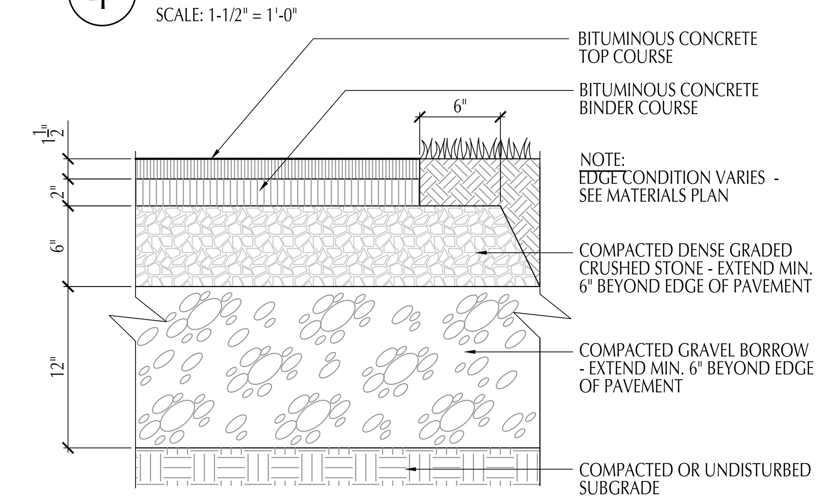

7 VERTICAL GRANITE CURB
SCALE: 1" = 1'-0"



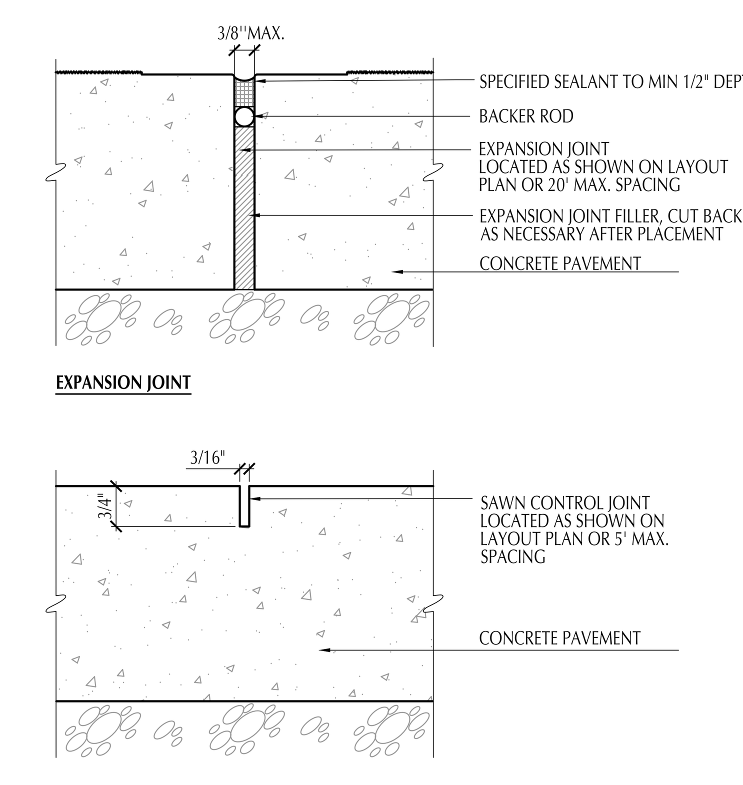

4 STABILIZED AGGREGATE WALKWAY
SCALE: 1-1/2" = 1'-0"



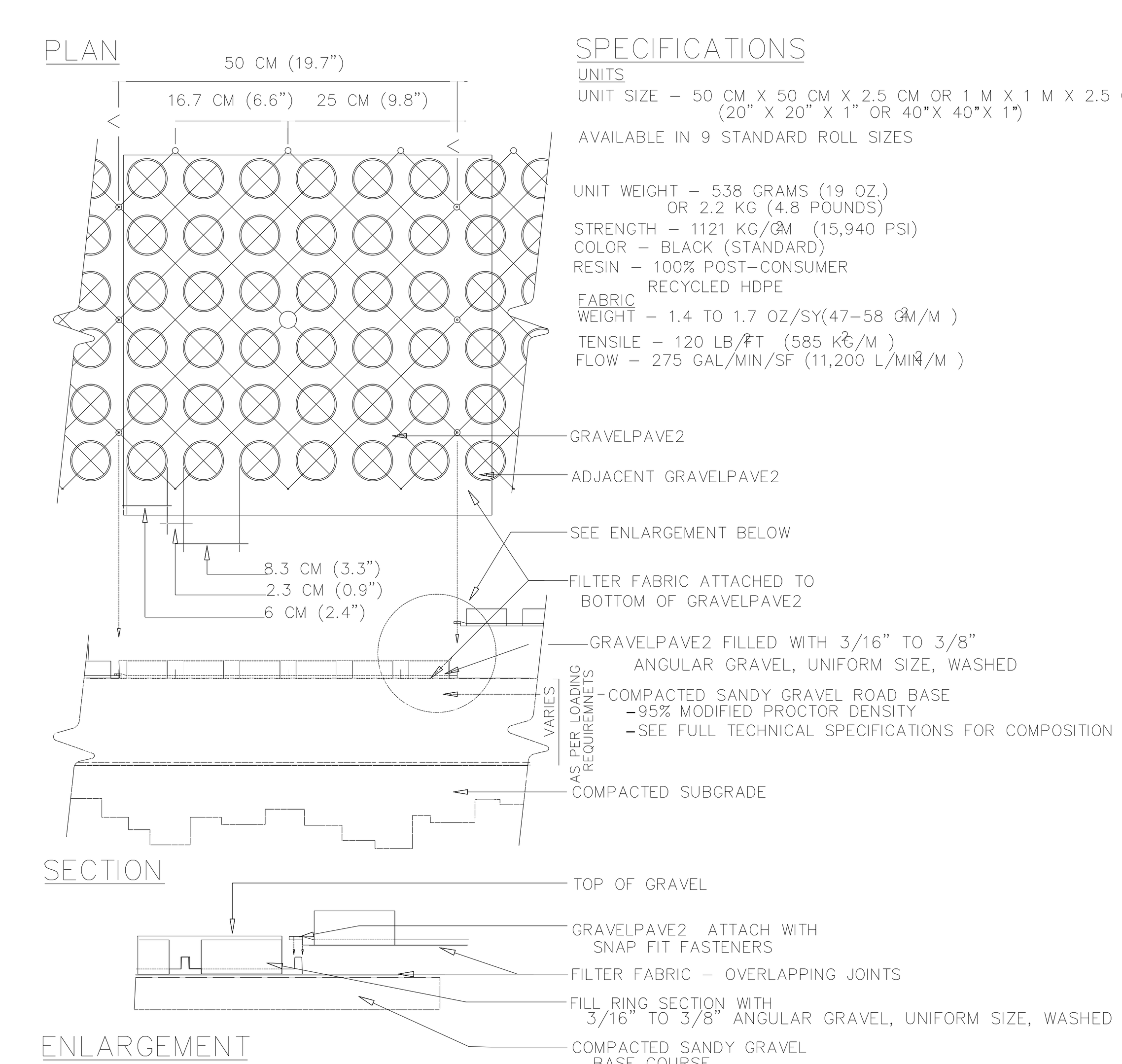

6 ORNAMENTAL GRANITE CURB
SCALE: 1/8" = 1'-0"




3 VEHICULAR BIT. CONC. PAVEMENT
SCALE: 1-1/2" = 1'-0"

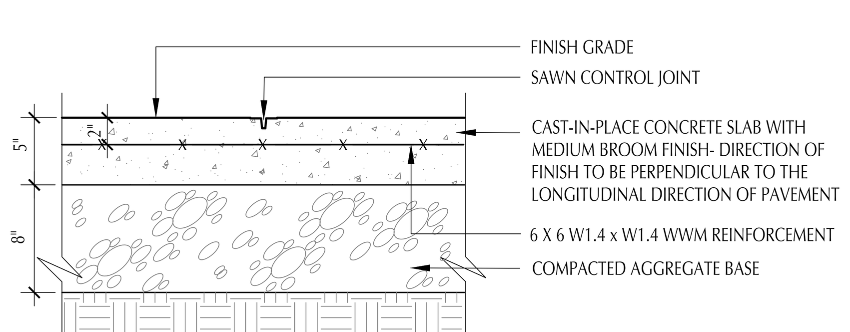



2 CONCRETE EXPANSION JOINTS
SCALE: 6" = 1'-0"

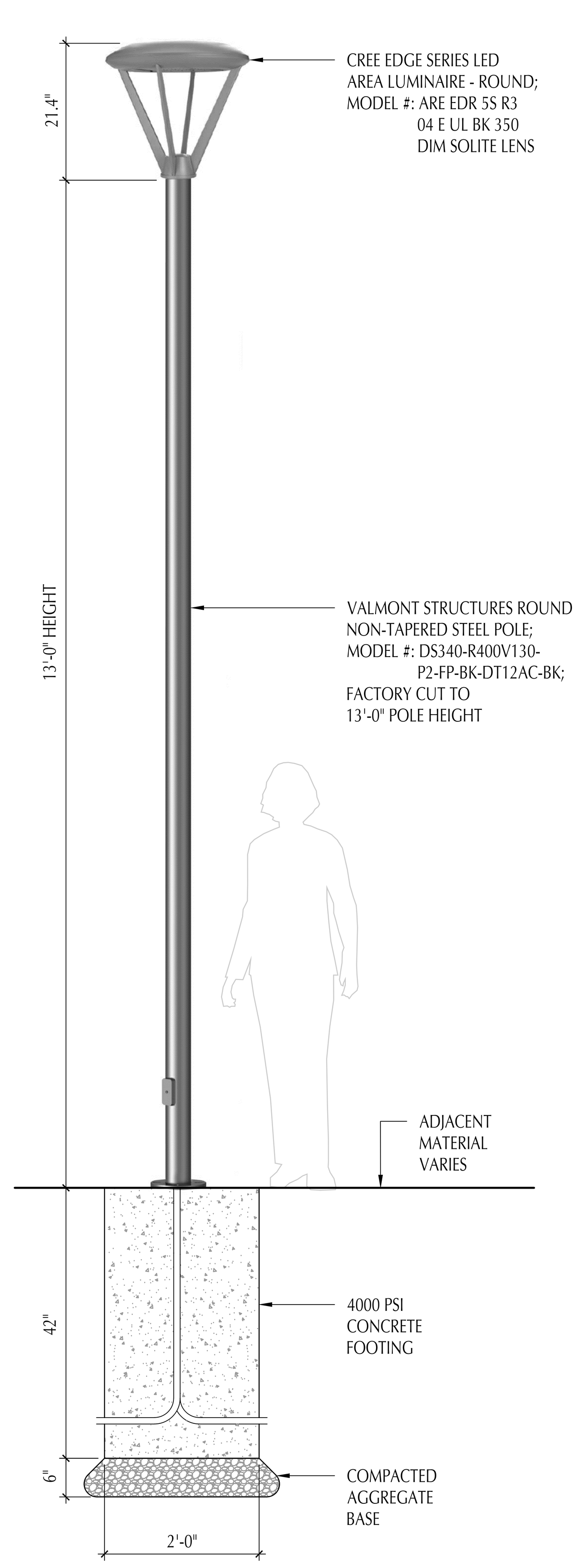



NOTES: ⅜" ANGULAR AGGREGATE TO BE USED OVER INFILTRATION TRENCHES. SEE CIVIL PLANS FOR DETAILS.

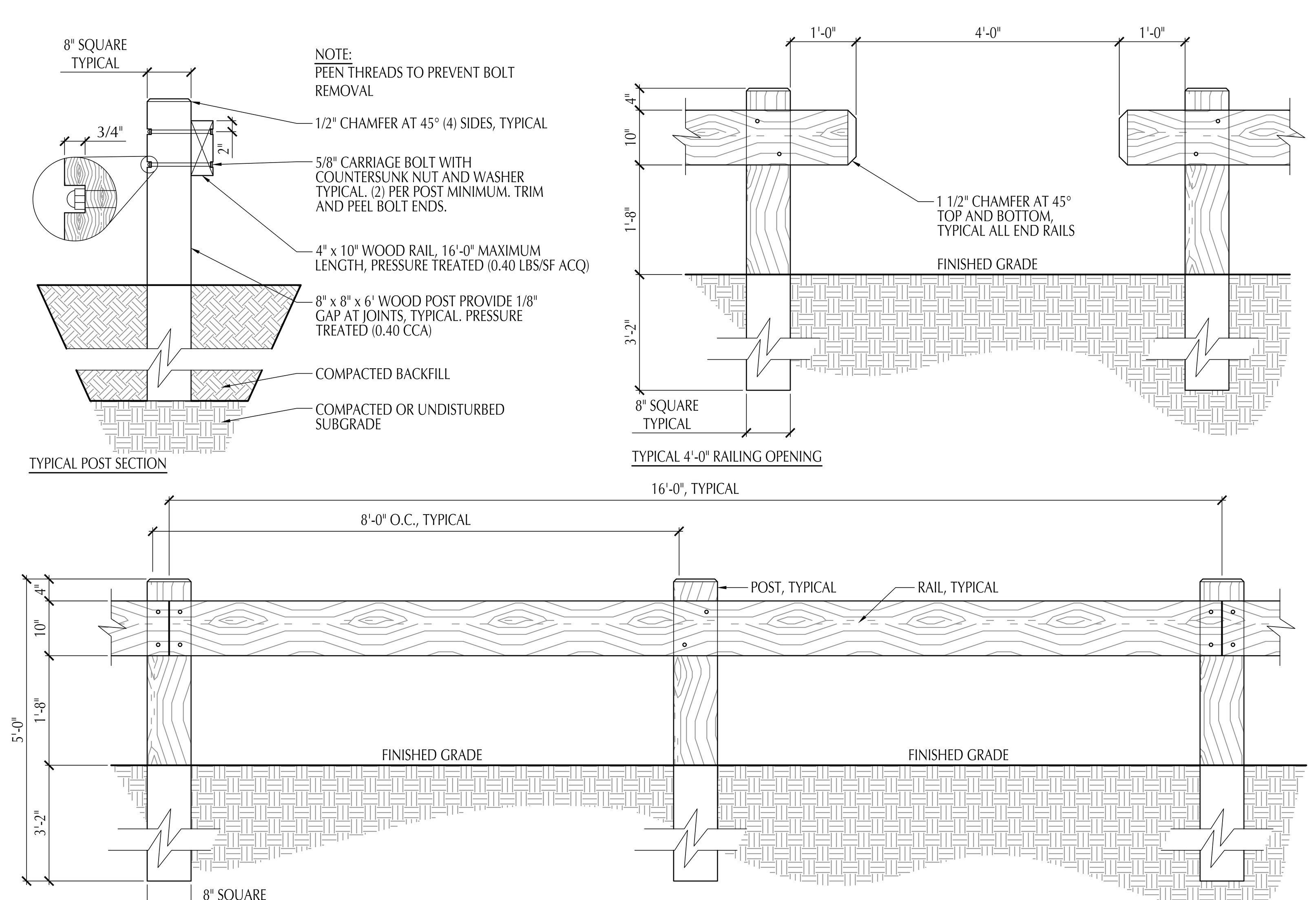
5 GRAVELPAVE2 REINFORCED GRAVEL PARKING SURFACE
SCALE: not to scale




1 CONCRETE PAVEMENT
SCALE: 1/8" = 1'-0"




10 PEDESTRIAN LIGHT
SCALE: 3/4" = 1'-0"




9 GUARD RAIL
SCALE: 3/4" = 1'-0"

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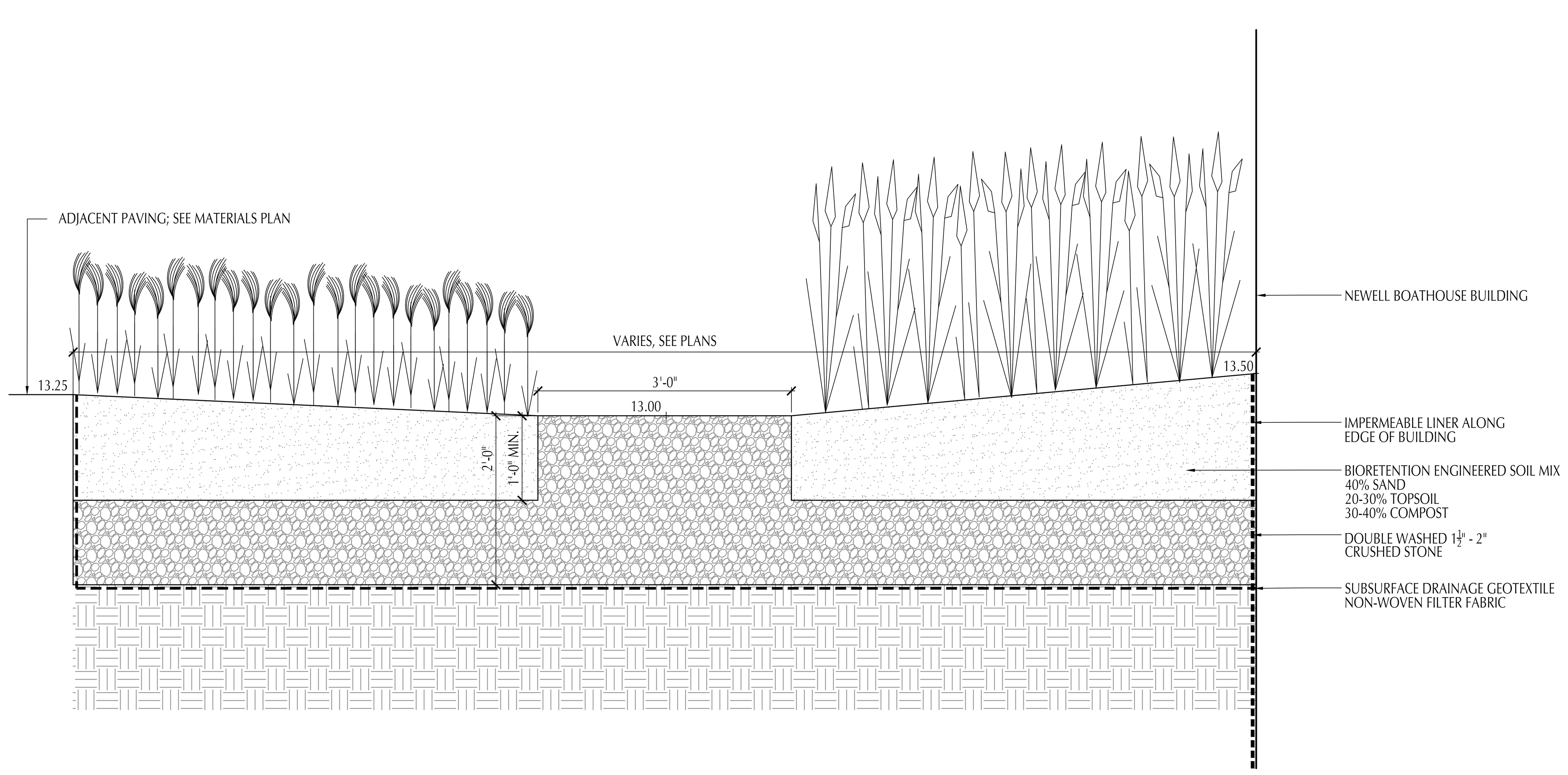
Site Details

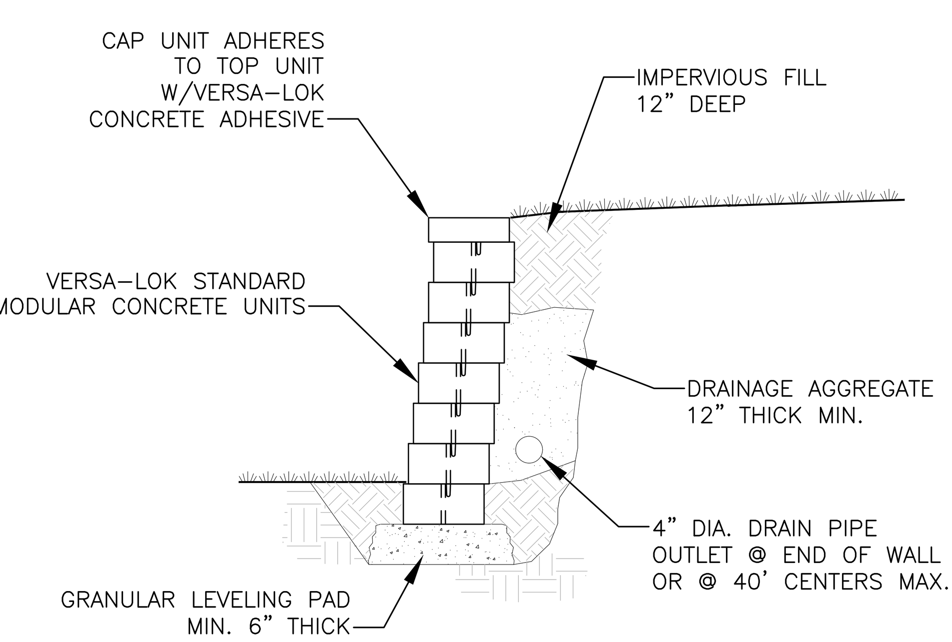
L-200

IF THIS SHEET IS NOT: 36" x 48", IT HAS BEEN REDUCED OR ENLARGED.



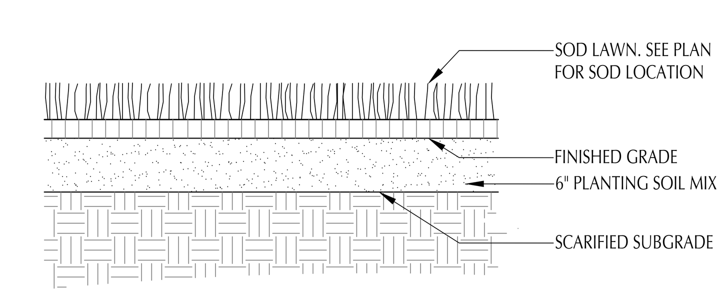

8 NORTHERN INFILTRATION TRENCH SCHEMATIC

SCALE: 1" = 1'-0"



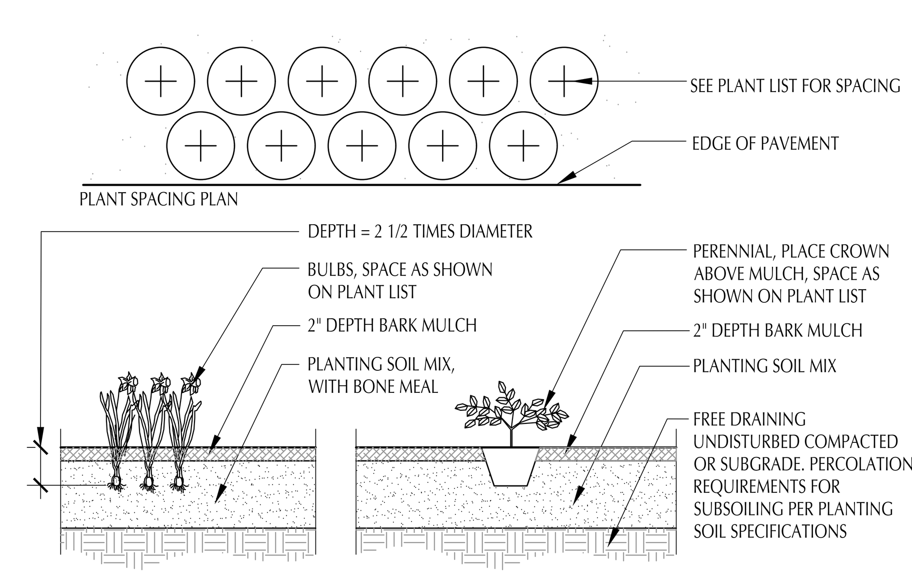

7 SEGMENTAL PRECAST UNIT WALL (UNREINFORCED)

SCALE: NTS



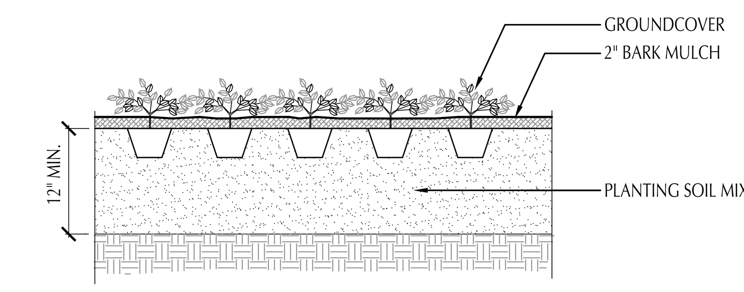

6 TURFGRASS LAWN

SCALE: NTS



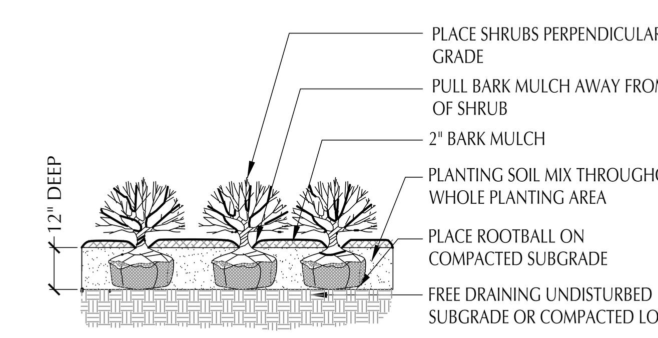

5 PERENNIAL & BULB PLANTING

SCALE: NTS



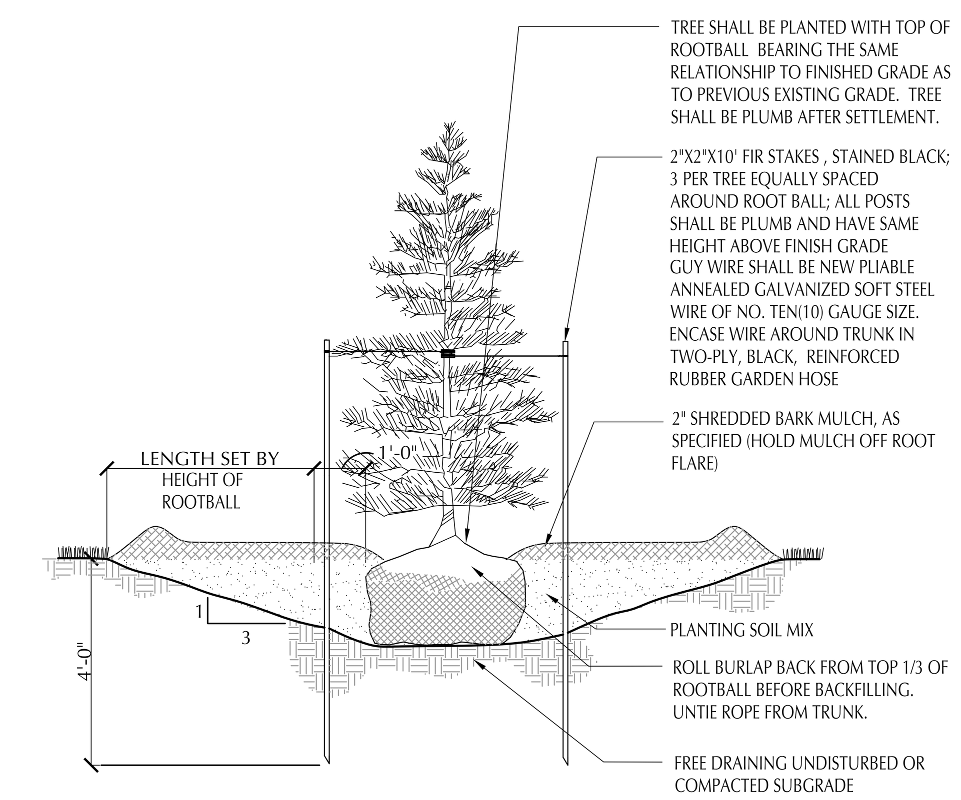

4 GROUNDCOVER PLANTING

SCALE: NTS



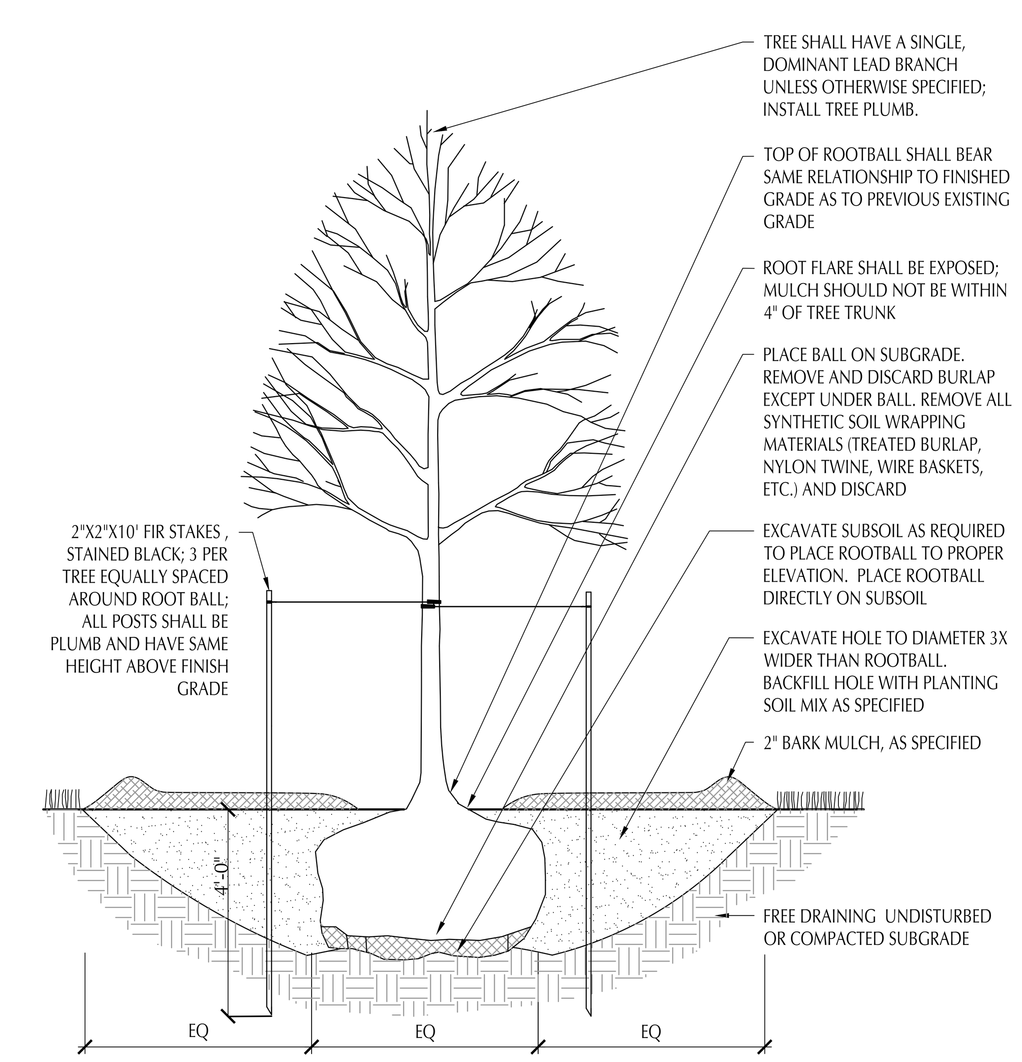

3 SHRUB PLANTING

SCALE: NTS




2 EVERGREEN TREE IN LAWN & PLANT BEDS

SCALE: NTS




1 DECIDUOUS SHADE TREE PLANTING IN LAWN & PLANT BEDS

SCALE: NTS

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MASSACHUSETTS
JAMES P. SHADLEY
NO. 993
REGISTERED LANDSCAPE ARCHITECT

| 2022-3-25 | Permit Plans | |
|---|---|---|
| Rev. | Date | Remarks |

**Site Details**

**L-201**

## PLANT SCHEDULE - VEGETATED SWALE:

| Symbol | Qty | Scientific Name | Common Name | Spacing | Size | Wetland Status |
|---|---|---|---|---|---|---|
| Vegetated Swale - Planting Soil (12" Depth) | | | | | | |
| AV | 100 | Andropogon virginicus | Broom Sedge | 12" | Plug | FACU |
| EPE | 50 | Eupitorium perfoliatum | Boneset | 12" | Plug | FACW |
| PV | 100 | Panicum virgatum | Switchgrass | 12" | Plug | FAC |
| RF | 50 | Rudbeckia fulgida | Black-eyed Susan | 12" | Plug | FAC |
| SN | 50 | Symphyotrichum novae-angliae | New England Aster | 12" | Plug | FACW |
| SR | 50 | Solidago rugosa | Rough Goldenrod | 12" | Plug | FAC |
| VH | 100 | Verbena hastata | Blue Vervain | 12" | Plug | FACW |
| ZA | 50 | Zizia aurea | Golden Alexanders | 12" | Plug | FAC |
| | 550 | Total Quantity | | | | |

## PLANT SCHEDULE - BIORETENTION BASIN:

| Symbol | Qty | Scientific Name | Common Name | Spacing | Size | Wetland Status |
|---|---|---|---|---|---|---|
| Forebay Planting - Hydric Soil (12" Depth) | | | | | | |
| CL | 50 | Carex lurida | Lurid Sedge | 12" | Plug | OBL |
| CV | 100 | Carex vulpinoidea | Fox Sedge | 12" | Plug | OBL |
| JC | 50 | Juncus canadensis | Canada Rush | 12" | Plug | OBL |
| JE | 100 | Juncus effusus | Soft Rush | 12" | Plug | OBL |
| IV | 50 | Iris versicolor | Blue Flag | 12" | Plug | OBL |
| VH | 50 | Verbena hastata | Blue Vervain | 12" | Plug | FACW |
| Bottom of Basin - Bioretention Basin Soil (12" Depth) | | | | | | |
| Symbol | Qty | Scientific Name | Common Name | Spacing | Size | Wetland Status |
| AC | 300 | Anemone canadensis | Windflower | 12" | Plug | FACW |
| EPE | 300 | Eupitorium perfoliatum | Boneset | 12" | Plug | FACW |
| LS | 300 | Liatris spicata | Marsh Blazing Star | 12" | Plug | FAC+ |
| PV | 300 | Panicum virgatum | Switchgrass | 12" | Plug | FAC |
| SN | 300 | Symphyotrichum novae-angliae | New England Aster | 12" | Plug | FACW |
| SR | 300 | Solidago rugosa | Rough Goldenrod | 12" | Plug | FAC |
| VH | 300 | Verbena hastata | Blue Vervain | 12" | Plug | FACW |
| ZA | 300 | Zizia aurea | Golden Alexanders | 12" | Plug | FAC |
| Side Slope of Basin - Planting Soil (12" Depth) | | | | | | |
| Symbol | Qty | Scientific Name | Common Name | Spacing | Size | Wetland Status |
| AC | 150 | Anemone canadensis | Windflower | 12" | Plug | FACW |
| AT | 150 | Asclepias tuberosa | Butterfly Weed | 12" | Plug | N/A |
| AV | 200 | Andropogon virginicus | Broom Sedge | 12" | Plug | FACU |
| EP | 150 | Echinacea purpurea | Purple Coneflower | 12" | Plug | FACU |
| RF | 150 | Rudbeckia fulgida | Black-eyed Susan | 12" | Plug | FAC |
| SB | 150 | Solidago bicolor | Silverrod | 12" | Plug | UPL |
| SS | 200 | Schizachyrium scoparium | Little Bluestem | 12" | Plug | FACU |
| SNE | 150 | Solidago nemoralis | Grey Goldenrod | 12" | Plug | UPL |
| SN | 150 | Symphyotrichum novae-angliae | New England Aster | 12" | Plug | FACW |
| VH | 150 | Verbena hastata | Blue Vervain | 12" | Plug | FACW |
| ZA | 150 | Zizia aurea | Golden Alexanders | 12" | Plug | FAC |
| | 4550 | Total Quantity | | | | |

## WOODLAND SEED MIX:

THE WOODLAND SEED MIX SHALL BE MANUFACTURED BY NEW ENGLAND WETLAND PLANTS OF AMHERST, MASSACHUSETTS, OR APPROVED EQUAL. THE SEED MIX SHALL CONSIST OF THE FOLLOWING SPECIES AND PERCENTAGES:

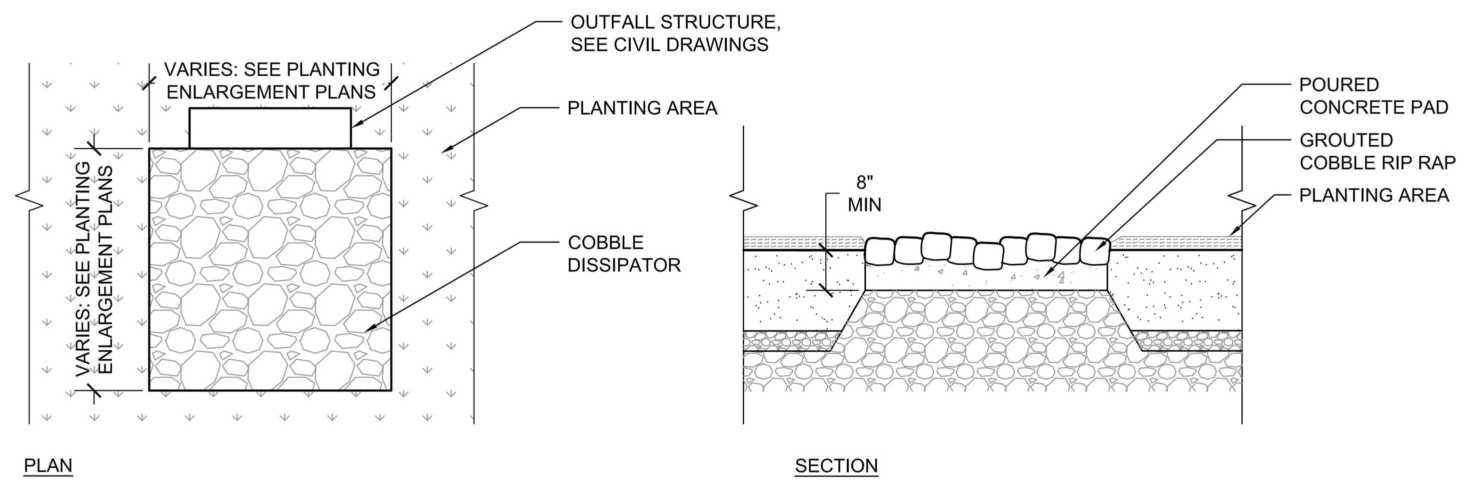
| BOTANICAL NAME | COMMON NAME | % BY WEIGHT |
|---|---|---|
| FESTUCA RUBRA | CREEPING RED FESCUE | 38.0% |
| AGROSTIS SCABRA | ROUGH BENTGRASS | 29.0% |
| AGROSTIS PERENNANS | AUTUMN BENTGRASS | 15.0% |
| JUNCUS TENUIS | PATH RUSH | 10.0% |
| EURYBIA DIVARICATUS | WHITE WOOD ASTER | 5.0% |
| SYMPHYOTRICHUM CORDIFOLIUM | HEART LEAVED ASTER | 3.0% |

* SEEDING RATE SHALL BE 35 POUNDS PER ACRE OR 1 POUND PER 1,000 SQUARE FEET. *

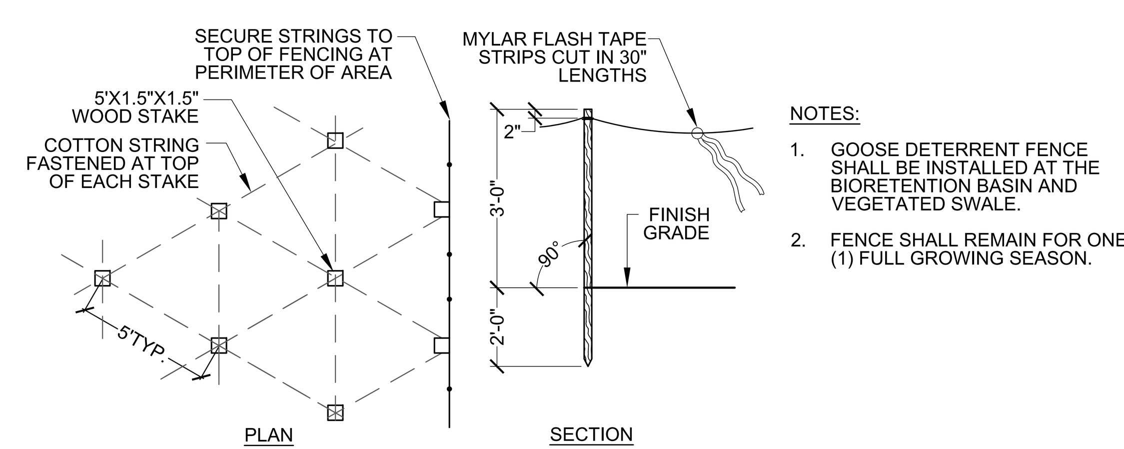
IF THIS SHEET IS NOT 36" x 48", IT HAS BEEN REDUCED OR ENLARGED.

## LEGEND:

- FOREBAY PLANTING AREA
- BOTTOM OF BASIN PLANTING AREA
- BASIN SLOPE PLANTING AREA
- VEGETATED SWALE PLANTING AREA
- EXTENTS OF PLANTING
- COBBLE DISSIPATOR
- BANK / MAHW LINE
- 25' RIVERFRONT AREA LINE
- 50' WATERFRONT AREA LINE
- 100' BUFFER ZONE LINE



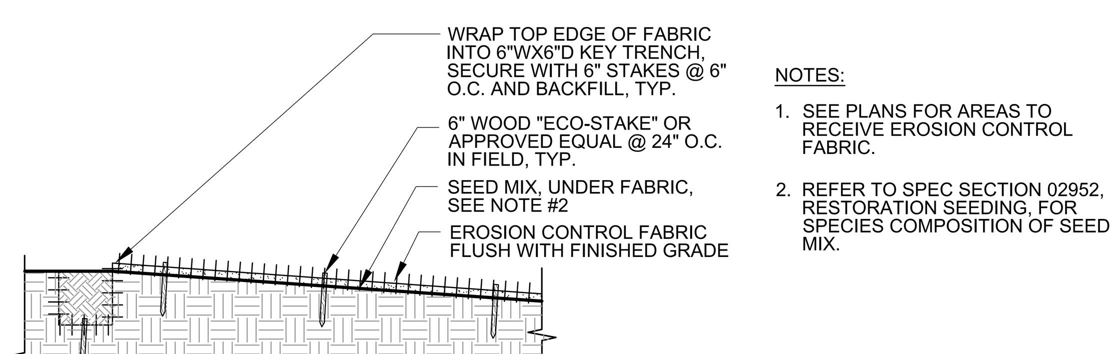

8 COBBLE DISSIPATOR
SCALE: NOT TO SCALE




NOTES:

1. GOOSE DETERRENT FENCE SHALL BE INSTALLED AT THE BIORETENTION BASIN AND VEGETATED SWALE.
2. FENCE SHALL REMAIN FOR ONE (1) FULL GROWING SEASON.

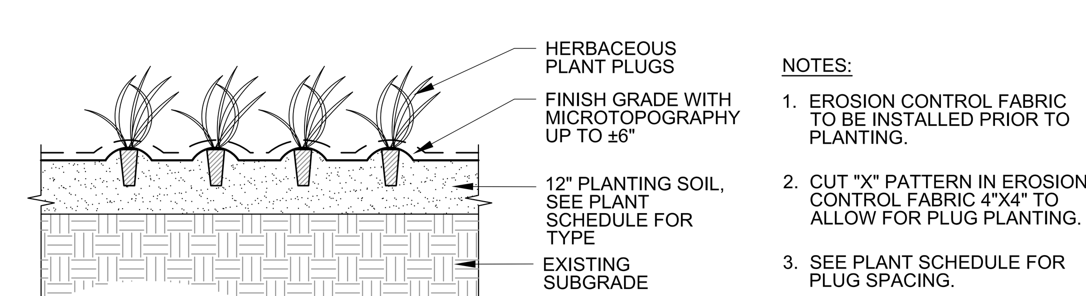
7 GOOSE DETERRENT FENCE
SCALE: NOT TO SCALE




NOTES:

1. SEE PLANS FOR AREAS TO RECEIVE EROSION CONTROL FABRIC.
2. REFER TO SPEC SECTION 02952, RESTORATION SEEDING, FOR SPECIES COMPOSITION OF SEED MIX.

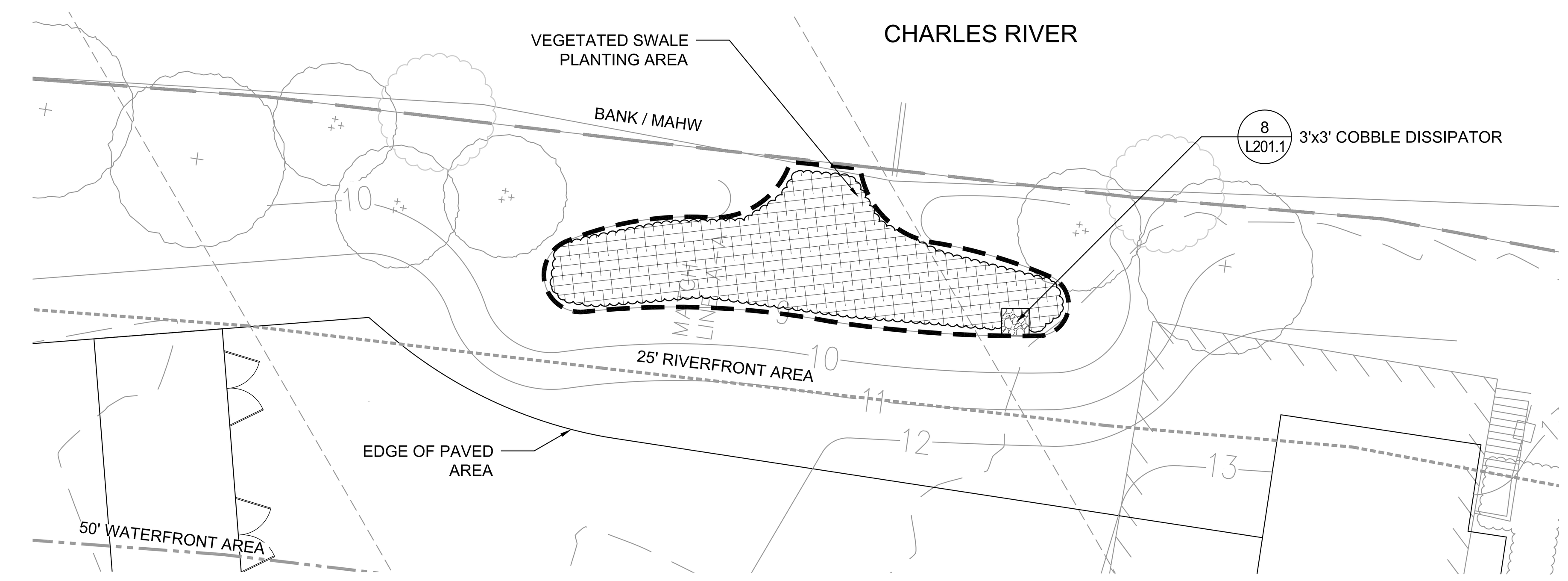
6 EROSION CONTROL BLANKET WITH KEY
SCALE: NOT TO SCALE



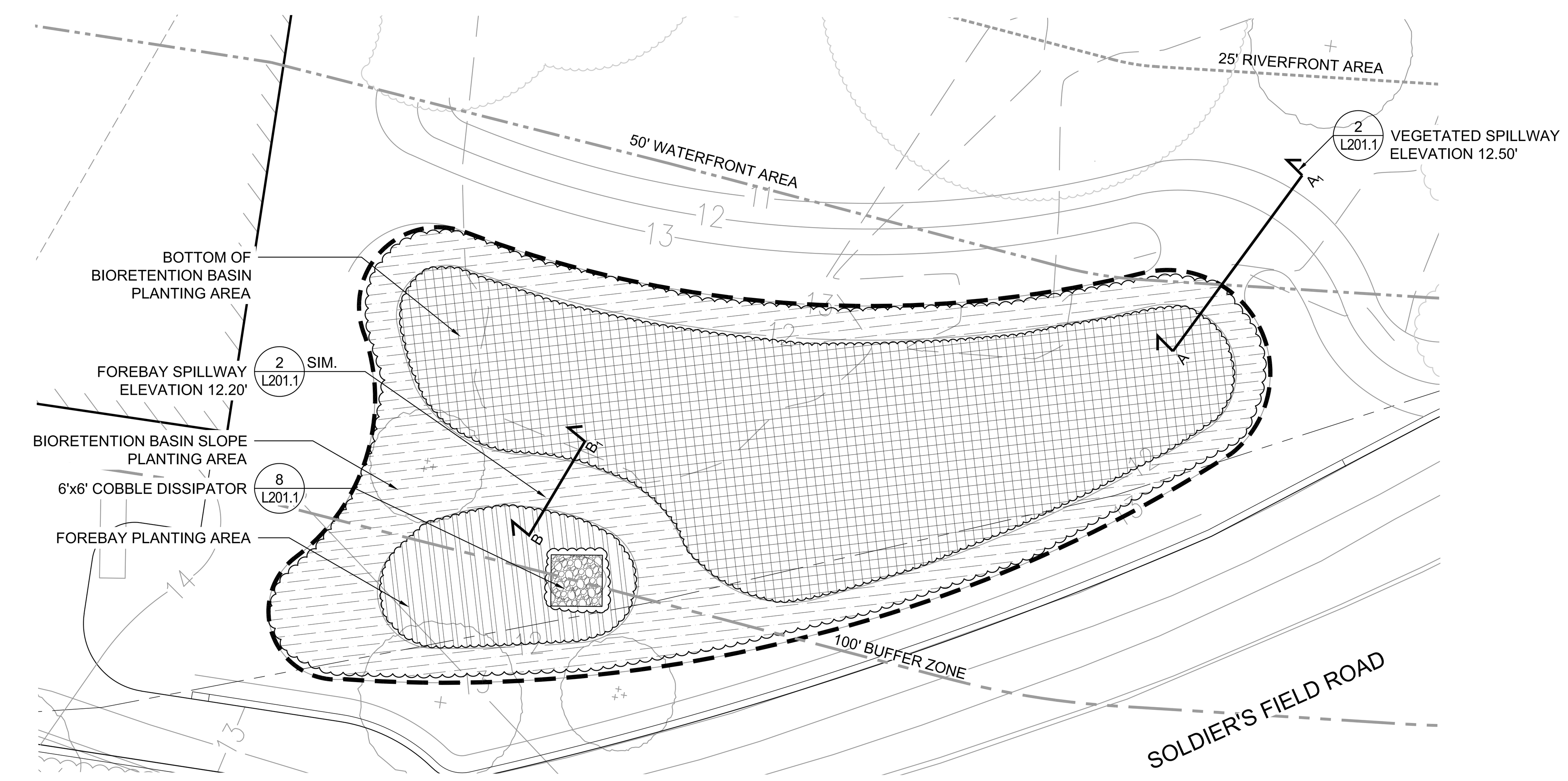

NOTES:

1. EROSION CONTROL FABRIC TO BE INSTALLED PRIOR TO PLANTING.
2. CUT "X" PATTERN IN EROSION CONTROL FABRIC 4"X4" TO ALLOW FOR PLUG PLANTING.
3. SEE PLANT SCHEDULE FOR PLUG SPACING.

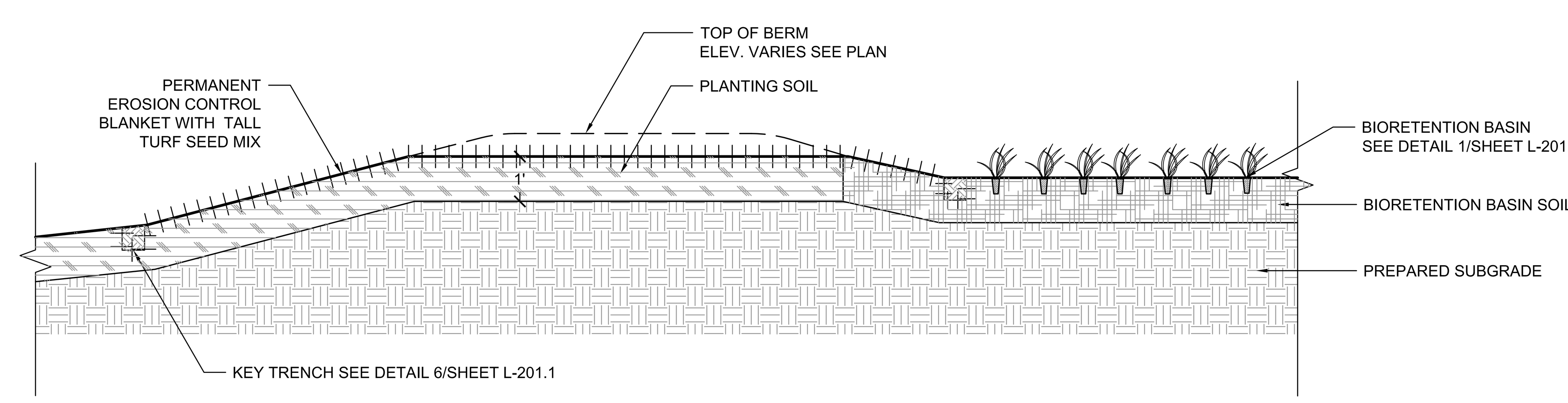
5 HERBACEOUS PLUG PLANTING
SCALE: NOT TO SCALE



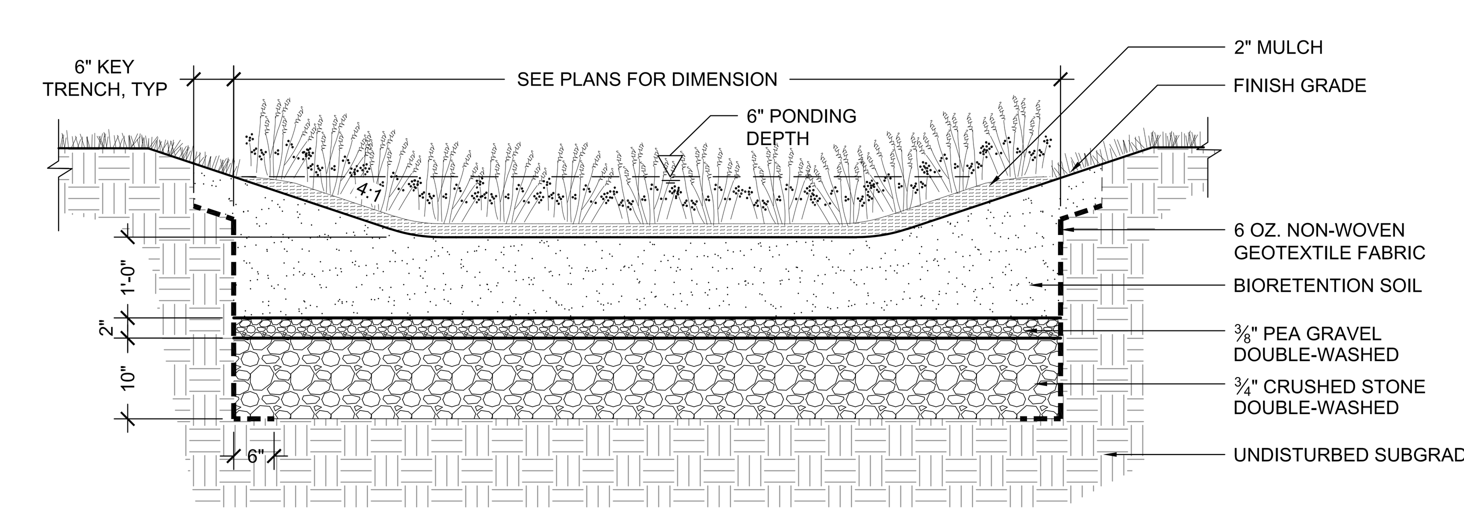

4 VEGETATED SWALE PLANTING PLAN
SCALE: 1" = 10'-0"
0 5 10 20 FT




3 BIORETENTION BASIN PLANTING PLAN
SCALE: 1" = 10'-0"
0 5 10 20 FT




2 VEGETATED SPILLWAY, TYPICAL
SCALE: NOT TO SCALE




NOTE:

1. LIMITS OF BASIN SHALL BE STAKES IN FIELD BY CONTRACTOR FOR APPROVAL BY LANDSCAPE ARCHITECT PRIOR TO COMMENCING CONSTRUCTION.

1 BIORETENTION BASIN
SCALE: NOT TO SCALE

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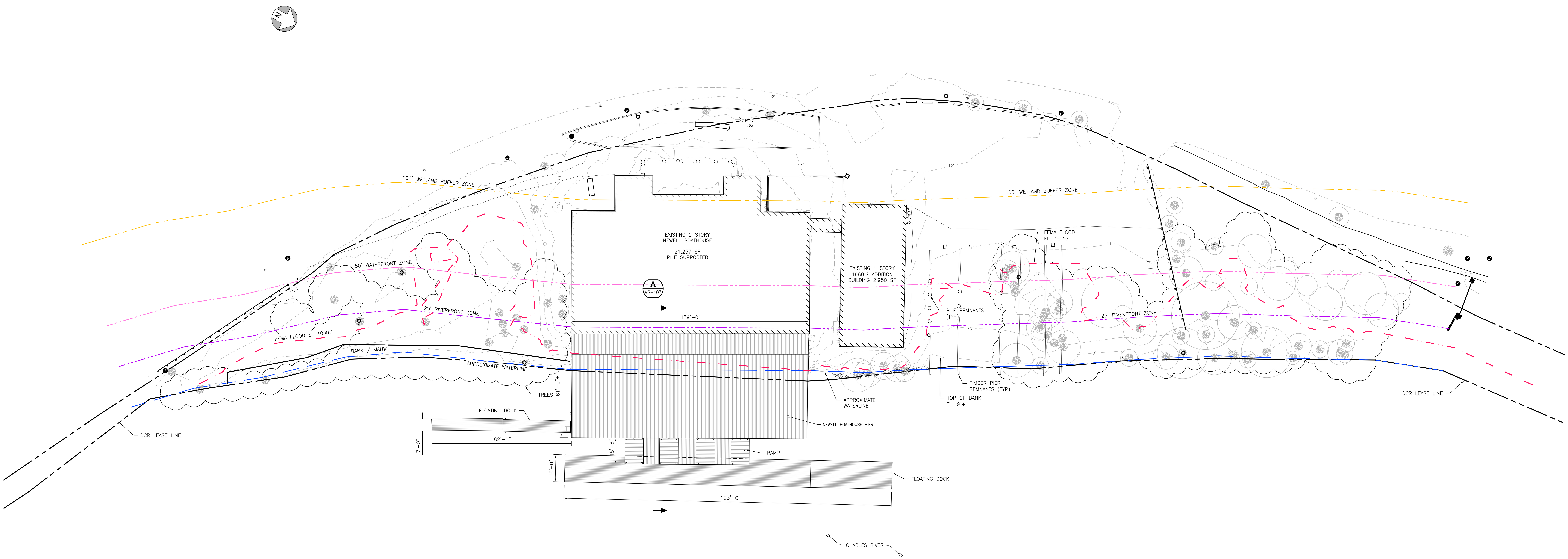
Bioengineering

L-201.1




**NEWELL EXISTING DECK PLAN**

SCALE: 1"=20'-0"

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CHILDS ENGINEERING
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508.966.9092
childseng.com

Newell Boathouse Renovation
Project # 17.017

Harvard University Athletics
801 Soldiers Field Road,
Allston, Massachusetts, 02134

| Rev. | Date | Remarks |
|---|---|---|
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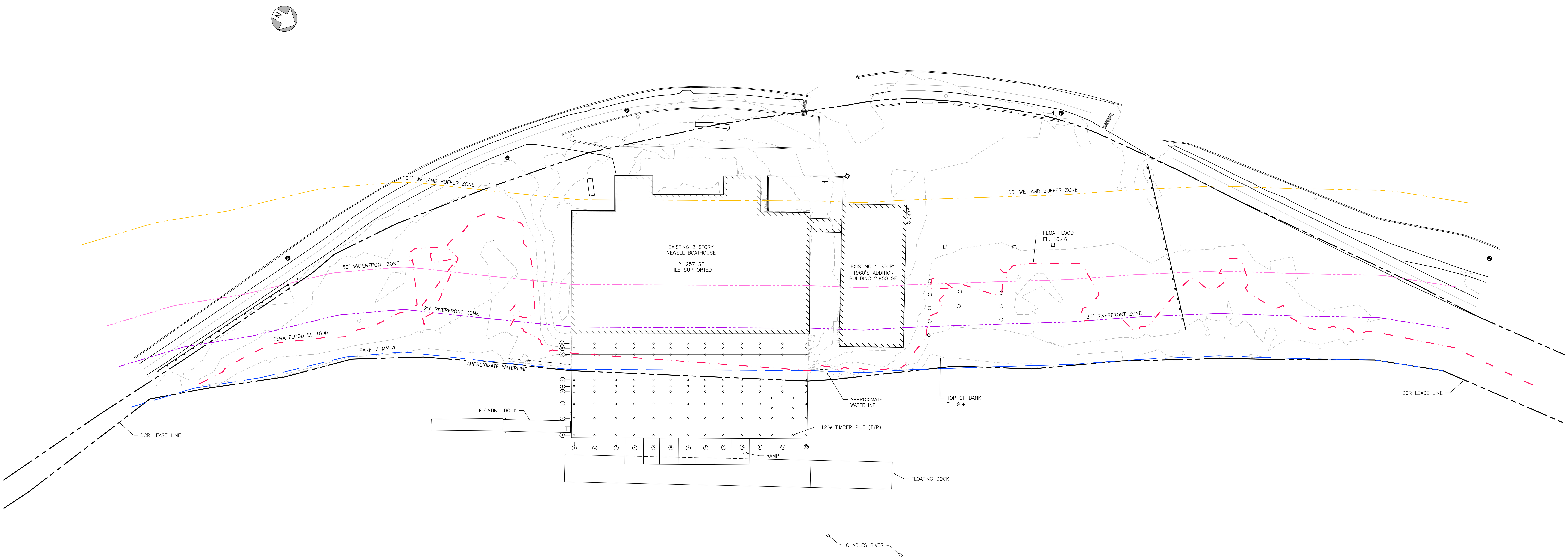
Newell Existing Deck Plan

# MS-101




## NEWELL EXISTING PILE PLAN

SCALE: 1"=20'–0"

LEGEND

| | |
|---|---|
| A | PILE ROW DESIGNATION |
| 1 | PILE BENT DESIGNATION |
| ○ | 12"ø TIMBER PILE TO BE CUT AT MUDLINE |

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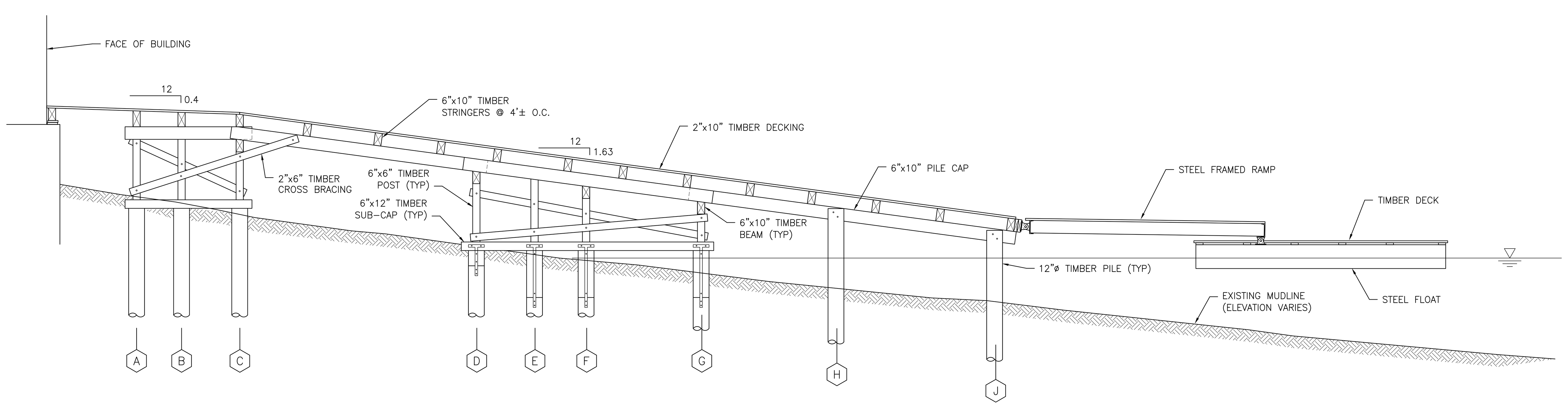
Newell Existing Pile Plan

MS-102




A
MS-101

**EXISTING NEWELL SECTION**

SCALE: 1/4"=1'-0"

1/4"=1'-0" 4 0 4 8

SCALE IN FEET

COMMONWEALTH OF MASSACHUSETTS
CHARLES MARSHALL ROBERTS
CIVIL
No. 50339
REGISTERED
PROFESSIONAL ENGINEER

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**Newell Existing Section**

# MS-103

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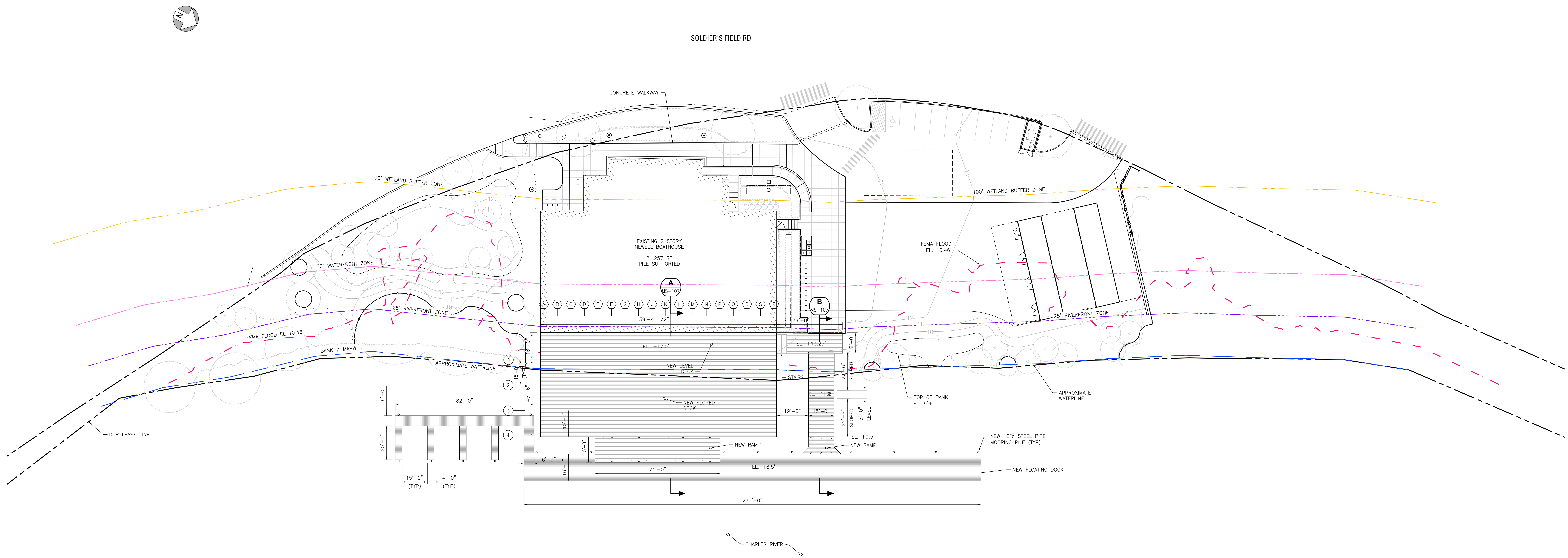


**NEWELL PROPOSED DECK PLAN**

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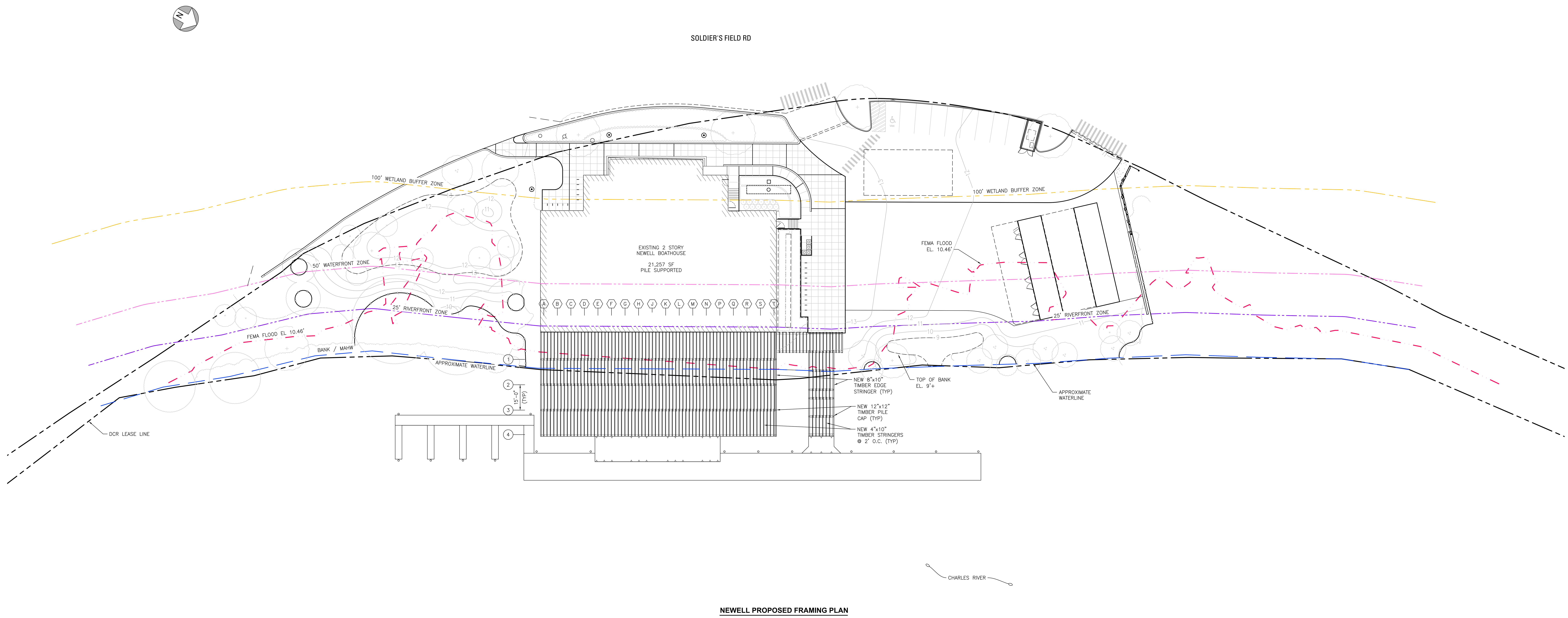
Newell Proposed Deck Plan

# MS-104




**NEWELL PROPOSED FRAMING PLAN**

SCALE: 1"=20'-0"

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|---|---|---|
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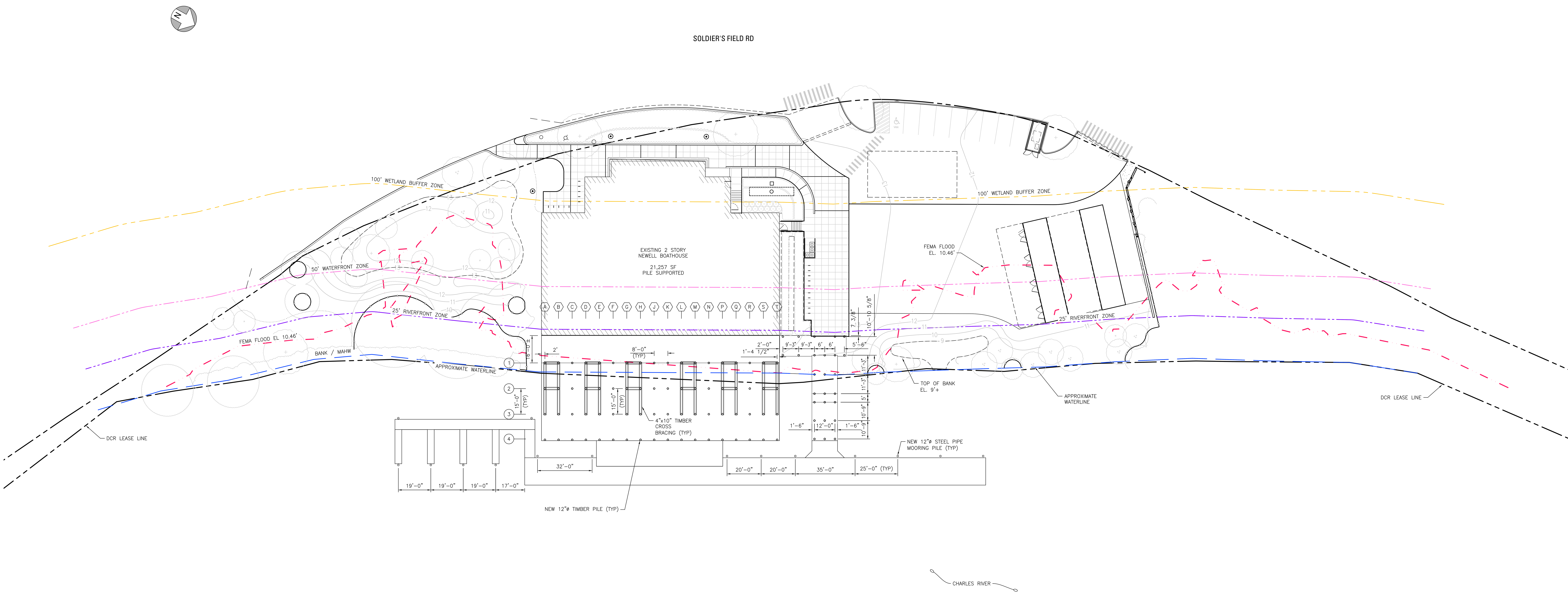
**Newell Proposed Framing Plan**

# MS-105




**NEWELL PROPOSED PILE PLAN**

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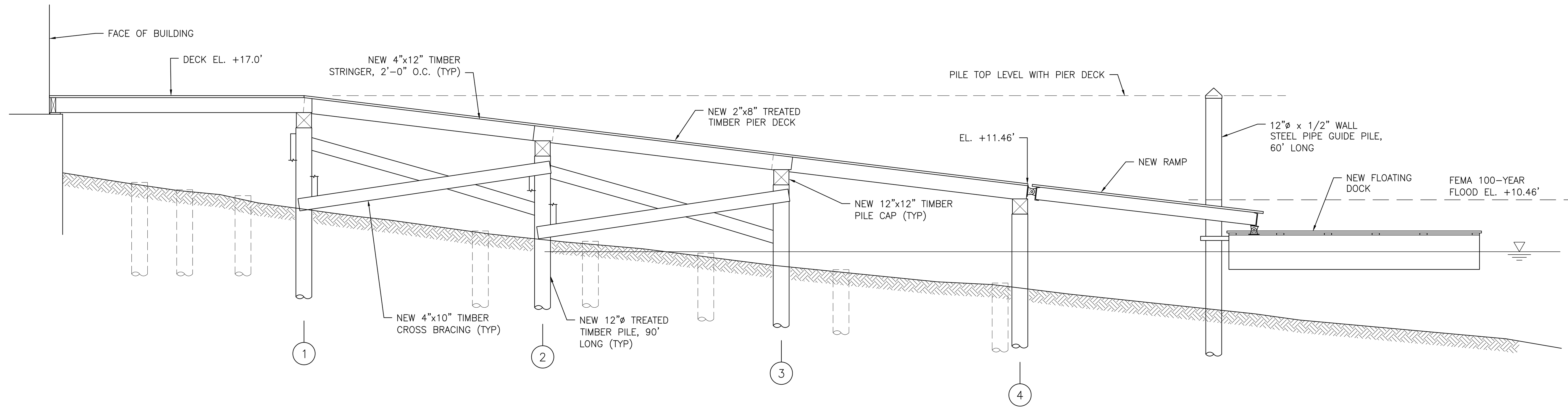
**Newell Proposed Pile Plan**

**MS-106**




**A** MS-104 **NEWELL PROPOSED SECTION**

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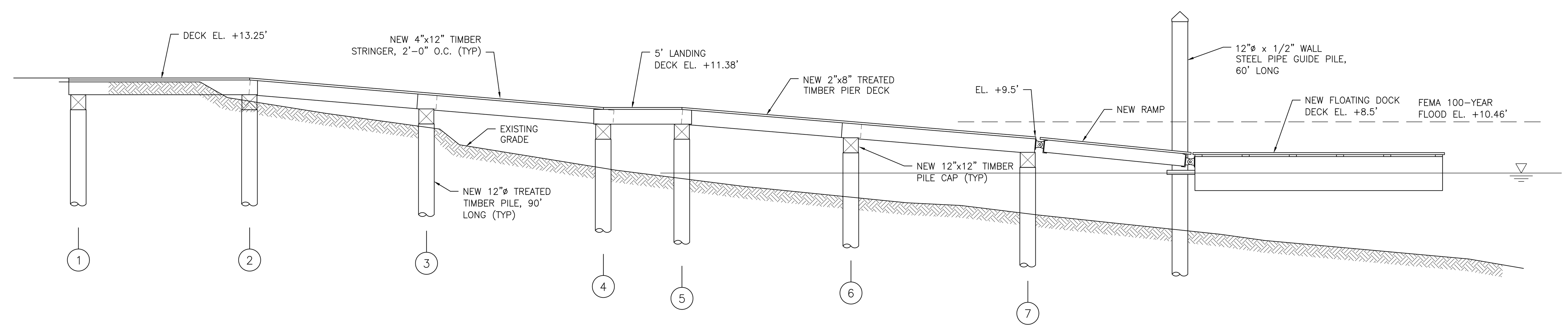
1/4"=1'-0" 4 0 4 8 SCALE IN FEET




**B** MS-104 **NEWELL PROPOSED SECTION**

SCALE: 1/4"=1'-0"

1/4"=1'-0" 4 0 4 8 SCALE IN FEET

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**Newell Proposed Section**

# MS-107

# ATTACHMENT D

# Tree Inventory and Management Plan

# Newell Boathouse
# Tree Inventory and Management Plan | 2022

Submitted by:
Bartlett Tree Experts

**Katherine Cummings, Regional Inventory Arborist**
ISA Certified Arborist & Municipal Specialist #NE-7396AM,
Massachusetts Certified Arborist #102013, ISA Tree Risk Assessment Qualified

**Andrew Balon, Commercial Arborist Representative**
ISA Certified Arborist #NE-7015A, ISA Tree Risk Assessment Qualified

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## TABLE OF CONTENTS

## MAKING THE MOST OF YOUR INVENTORY MANAGEMENT PLAN

Those who operate a large business or institution understand how inventory impacts operations and budgeting. One must know what's there, how much or how many, and where it all is. But the task doesn't end there. To obtain the greatest benefit from inventory, owners or their designees must manage it. Are a company's tools, for example, old and defective, in need of repair, in short supply, or useless and taking up space that could be better occupied? A good management plan will address these issues and keep the inventory current, in good condition, and functioning for the benefit and safety of those involved.

Managing trees on a large property can seem like an overwhelming task, but the same principles of inventory management apply. This inventory and management plan should provide managers the data they need to develop realistic budgets for their tree maintenance needs, and it will help make the Newell Boathouse a safer and more beautiful environment.

The following tips will assist you in making the most of this document:

### Who's Who

Those who conducted the inventory and prepared this document are members of the Bartlett Inventory Solutions team. They are also employees of Bartlett Tree Experts. The Bartlett Inventory Solutions team is overseen by Technical Advisors out of the Bartlett Tree Research Laboratories in Charlotte, North Carolina. The advisors are primarily charged with client support, coordination, quality control, and documentation of inventories and the related data. Extensively trained Regional Inventory Arborists from local Bartlett Tree Experts offices are the primary data collectors and authors of the management plans. Readers may interpret the terms "Bartlett Tree Experts," "Bartlett," "the Inventory Team," "the team," "we," and "our" as the Bartlett company and those who conducted the inventory and prepared this management plan. In addition to the primary author(s) listed on the cover page, Team Member(s) involved in this project included:

**Technical Advisor**
**Chris Breedlove, Consulting Advisor**
ISA Certified Arborist #SO-10506A, ISA Tree Risk Assessment Qualified

**Data Collection**
**Kat Cummings, Regional Inventory Arborist**
ISA Certified Arborist & Municipal Specialist #NE-7396AM,
Massachusetts Certified Arborist #102013, ISA Tree Risk Assessment Qualified

### Subject Trees

In this document, the term "subject trees" refers (depending on context) to some or all of the 80 trees included in the inventory.

### Definitions & Bolded Terms

Some definitions or specifications are detailed within a given section to explain how readers should interpret certain terms or classifications. We have also appended a Glossary for other terms that appear throughout the document. The first reference to each of these terms appears in **bold** for the reader's convenience.

### How This Document is Organized

An outline appears below that introduces the order in which the sections of the management plan will appear. The management plan layout is as follows:

- **Table of Contents**
    - Road map for the management plan
- **Making the Most of Your Inventory Management Plan**
    - Explanations for how to efficiently and effectively understand and navigate this management plan document
- **Executive Summary**
    - Synopsis of the major findings and recommendations
- **Introduction**
    - Brief explanation of the inventory and what was included
- **Goals & Objectives**
    - Explanation of the specific goals and objectives for this inventory
- **Data Collection & Tree Inspection Methodology**
    - Lists, explanations, and definitions of all data collected during the inventory
- **Tree Risk Assessment and Mitigation**
    - Summary of *overall tree risk ratings* assigned during the inventory with corresponding table and map displays with figures if applicable
    - Summary of *Level 3 Advanced assessments* recommended during the inventory (summarized in the *overall tree risk ratings* table) with a map display and figures if applicable
- **Stand Dynamics Results**
    - Summary information for the entire tree population inventoried

- **Recommendations**
    - Summary of all recommendations made during the inventory including associated table and map displays, explanations and examples, and figures if applicable
- **Defects or Observations**
    - List of all trees observed to have defects in the field in a table view with associated descriptive figures and maps if applicable
- **Entire Inventory**
    - List of all trees collected in a table display
- **Additional Resources**
    - Listing of all appended items for this management plan

## EXECUTIVE SUMMARY

In January 2022, the Bartlett Inventory Solutions (BIS) Team from Bartlett Tree Experts conducted an inventory of trees at the Newell Boathouse. We identified 80 trees which included 17 species. The attributes that we collected include tree latitude and longitude, size, age and condition class, and a visual assessment of tree structure, health, and **vigor**.

We conducted the attribute collection using a sub-meter accuracy Global Positioning Satellite Receiver (GPSr) device with an error-in-location potential of not greater than three meters. Our recommendations for the subject trees are based on the number of desired management cycles. All tree work activities will comply with current American National Standards Institute (ANSI) Z133.1 requirements for safety.

### Tree Risk Assessments and Mitigation

Perform the recommended tree risk mitigation activities for the 80 trees (100%) which we found defects or concerns that prompted the need to use the International Society of Arboriculture's (ISA) risk matrices in the field. Risk mitigation activities will comply with current ANSI A300 standard practices. Please see the Tree Risk Assessments, Limitations & Glossary section for more information.

#### *Level 3 Advanced Assessment*

Provide a *Level 3 Advanced assessment* for 1 tree (1%) to evaluate the impact of wood decay that shows potential for failure.

### Soil Sampling

Taking soil samples throughout planting beds and actively managed areas. Soil analysis provides information on the presence of soil nutrients, pH, organic matter, and cation exchange capacity.

### Bulk Density Sampling

Taking bulk density samples throughout planting beds and actively managed areas to determine the amount of soil compaction.

### Root Invigoration™

Perform Bartlett's patented Root Invigoration™ on 3 trees (4%) to improve aeration and promote more efficient root growth, especially for high-value trees in disturbed areas.

### Mulching

Wherever possible, apply 2-4 inches of mulch within the root zone to help moderate soil temperatures, reduce soil moisture loss, reduce soil compaction, provide nutrients, improve soil structure, and keep mowers and string trimmers away from tree trunks. The best mulch materials are wood chips, bark nuggets, composted leaves, or pine needles. To avoid potential disease problems, mulch should not be placed directly against the trunk.

**Root Collar Excavations**
Perform **root collar** excavations to 22 trees (28%) to lower risk of damaging conditions such as **girdling roots**, basal cankers, masking of root decay and lower-stem decay, and predisposing trees to various insect and disease pests.

**Plant Health Care (PHC)**
Implement Bartlett's PHC program to monitor pests and diseases on the subject trees. Treatments are therapeutic and preventive, and treatment timing is based on pest life cycle.

**Pruning**
Prune 39 trees (49%) for safety, health, structure, and appearance. Pruning will comply with current ANSI A300 standard practices for pruning.

**Structural Support**
There are structural support system recommendations for 2 trees (3%) to reduce risk of branch or whole tree failure. All structural support systems will comply with current ANSI A300 standard practices for supplemental support systems.

**Lightning Protection**
At the time of inventory, no trees were recommended for lightning protection systems. However, as trees continue to grow and site changes occur, we recommend continual consultation with your local Bartlett Arborist Representative to determine if lightning protection systems are warranted in the future.

**Removals**
Remove 31 trees (39%) due to condition or because of their location in relation to other trees to try and prevent competition or damage to infrastructure.

## INTRODUCTION

In January 2022, Shadley Associates retained Bartlett Tree Experts to perform an inventory of trees at the Newell Boathouse in Boston, MA. Team member Kat Cummings visited the site on January 6 to conduct the inventory.

The inventory included:

- identifying trees and assigning a Tree ID number (Tree ID numbers ranging from 1 to 96, with some gaps in numbers present in order to ensure plan tree numbers correspond with tree numbers on existing site maps);
- identifying the trees' condition, health, and vigor;
- recommending risk evaluations and removals of appropriate trees;
- recommending tree care, soil care, structural support, and pest management treatments to promote tree safety, health, appearance, and longevity; and
- mapping the trees using GPSr hardware and Geographic Information System (GIS) software, and Bartlett Tree Experts' ArborScope™ web-based management system

The methods and procedures we used to make the above determinations and recommendations are detailed in the following sections.

## GOALS & OBJECTIVES

An effective management plan communicates clear goals and the specific objectives designed to carry out those goals. We intend "goal" to mean the overall aim or result we expect to achieve for the client in producing the inventory and management plan. The objectives are the specific actions taken or recommended to support goal completion. The table below describes each goal and its corresponding objective(s).

**GOALS & OBJECTIVES**

| GOAL | OBJECTIVES TO ACCOMPLISH GOAL |
|---|---|
| **Establish the tree inventory (per numbers agreed) at the Newell Boathouse.** | • Using Trimble® Geo GPSr hardware and ArborScope™ Inventory Management Tools, collect data such as tree name, location, size, age class, and condition class.<br>• Assign a Tree ID number to each tree inventoried. |
| **Provide mechanism for managing inventory, recommendations, and related budget planning.** | • Provide map or maps of the inventoried trees to assist the client in managing property areas.<br>• Submit a comprehensive management plan that documents and organizes findings and provides other resources to assist the client in efficient use of the information. |
| **Maximize client understanding and implementation of management plan.** | • Include in management plan specific explanations and visuals related to plan recommendations.<br>• Provide appended resources that address health, procedures, and standards related to tree care.<br>• Make periodic contact with client to follow up and answer any questions about the management plan's contents. |
| **Maximize immediate and long-term tree health and aesthetics.** | Implement recommended plant-health-care program that uses<br>• integrated pest management<br>• soil care<br>• maintenance pruning |
| **Manage immediate and long-term risk associated with trees in high-use areas.** | Implement recommended risk-management measures that include<br>• risk-reduction pruning<br>• required removals<br>• tree structure evaluations |

## DATA COLLECTION & TREE INSPECTION METHODOLOGY

In conducting the inventory, we used specialized equipment and software and followed specific procedures to determine tree characteristics, risk evaluations, and recommendations. The following explanation will assist the reader in interpreting the findings of this management plan.

### Data Collection Equipment & Attribute Data

The Inventory Team used Trimble® Geo GPSr hardware units, TerraSync® and GPS Pathfinder® Office GIS software, and Bartlett Tree Experts' ArborScope™ web-based management system to inventory the trees. The attribute data we collected on site are listed below.

- botanical name and regional common name according to local ISA Chapter Tree Species List
- tree location based on GPS coordinate system
- tree ID number
- diameter at breast height (**DBH**)
- canopy radius
- age class
- height class
- condition class
- documented *Level 2 Basic assessment* for tree risk where defects or concerns were observed that prompted the need to use the ISA risk matrices in the field resulting in an *overall tree risk rating*
- Tree & Shrub Work phase (based on number of desired management cycles)
- pruning category
- need for and inspection of existing structural support systems
- need for and inspection of existing lightning protection systems
- need for *Level 3 Advanced assessment* for tree risk
- tree removals
- soil care recommendations
- plant health care recommendations
- noted defects/observations
- observed pests/diseases

## Specifications/Definitions

### Age Class

| | |
|---|---|
| **New Planting** | Tree not yet established |
| **Young** | Established tree but not in the landscape for many years |
| **Semi-mature** | Established tree but has not yet reached full growth potential |
| **Mature** | Tree within its full growth potential |
| **Over-mature** | Tree that is declining or beginning to decline due to its age |

## Height Class

| | |
|---|---|
| **Small** | Less than 15 feet |
| **Medium** | 15 to 40 feet |
| **Large** | Greater than 40 feet |

## Condition Class

| | |
|---|---|
| **Dead** | |
| **Poor** | Most of the canopy displays dieback and undesirable leaf color, inappropriate leaf size or inadequate new growth. Tree or parts of tree are in the process of failure. |
| **Fair** | Parts of canopy display undesirable leaf color, inappropriate leaf size, and inadequate new growth. Parts of the tree are likely to fail. |
| **Good** | Tree health and condition are acceptable. |

## Tree & Shrub Work Phase

Tree & Shrub Work phase takes into consideration tree species, condition, location, age, and proximity to infrastructure. We intend for this rating system to assist decision makers in prioritizing risk mitigation, tree pruning, cabling and bracing, and tree lightning protection recommendations. *Trees with an ASAP and an overall tree risk rating of extreme or high (see definitions in the next section) should be addressed immediately.* Prioritization does not take into account any budgetary or financial considerations.

Phase 1, 2, and 3 are all based on observations by the inventory arborist according to the manager's goals. The following additional information clarifies each priority:

| | |
|---|---|
| **ASAP** | Trees with recommendations that should be addressed As Soon As Possible. |
| **Phase 1** | Typically addressed in the first management cycle. Trees located in high-use sites, have a high aesthetic value, have an elevated *overall tree risk rating*, and/or parts that are currently in conflict with infrastructure. |
| **Phase 2** | Typically addressed in the second management cycle. Trees with moderate aesthetic value, don't have an elevated *overall tree risk rating*, and/or parts that are anticipated to be in conflict with infrastructure. |
| **Phase 3** | Typically addressed in the third management cycle. Tree parts that are anticipated to be in conflict with infrastructure and/or recommendations based on anticipated growth. |

## Pruning Category

All trees identified in this management plan that have tree care recommendations are listed within a specific pruning category. Trees within each pruning category can be prioritized by the specific goals of the manager. It is recommended that specific goals be discussed prior to any pruning.

| | |
|---|---|
| **Risk Mitigation** | This goal requires pruning of any tree where risk mitigation should take precedence over other pruning goals. Typically aims to reduce the *overall tree risk rating* by branch removal and/or branch reduction. |
| **Maintenance** | This goal typically requires routine pruning of large/mature trees. Includes branch removal and/or branch reduction to help reduce *likelihood of failure* and/or conflict with infrastructure. Trees with this goal are typically climbed or require the use of aerial lifts and/or other specialized equipment. |
| **Developmental** | This goal typically requires routine pruning of small/young trees. Includes structural pruning to develop a strong central stem, establish proper branch spacing, and/or develop branch structure. |
| **Ornamental** | This goal typically requires pruning of small trees. Includes reduction and/or shearing to its desired shape, size, and/or structure. |
| **Specialized** | Trees with this goal require a unique treatment that may include, but not limited to, targeted pruning cuts, removal of nuisance fruit/parasitic plants, and/or rejuvenation/internodal pruning. |

* The listed descriptions of goals, tools, and/or techniques are not limited to these definitions. Specific individual goals and species profiles should guide the pruning recommendations.

## Tree Risk Assessments, Limitations & Glossary

In accordance with industry standards, tree risk ratings are derived from a combination of three factors: the *likelihood of failure*, the *likelihood of the failed tree part impacting a target*, and the *consequences* of the target being struck. The guidelines used to classify each of these factors are presented in the *ISA's BMP for Tree Risk Assessment* and guidelines developed by the Bartlett Tree Research Laboratories. *These factors are then used to categorize tree risk as Extreme, High, Moderate or Low*. The factors used to define your risk ratings are identified in this report. An explanation of terms used in this report appears in the glossary located in the appendix. The information provided in this report is based on the conditions identified at the time of inspection. Tree conditions do change over time so reassessment is recommended annually and after major storm events.

## Limitations of Tree Risk Assessments

It is important for the tree owner or manager to know and understand that all trees pose some degree of risk from failure or other conditions. The information and recommendations within this report have been derived from the level of tree risk assessment identified in this report, using the information and practices outlined in the *International Society of Arboriculture's Best Management Practices for Tree Risk Assessment*, as well as the information available at the time of the inspection. However, the *overall tree risk rating*, the mitigation recommendations, or any other conclusions do not preclude the possibility of failure from undetected conditions, weather events, or other acts of man or nature. Trees can unpredictably fail even if no defects or other conditions are present. It is the responsibility of the tree owner or manager to schedule repeat or *Advanced assessments*, determine actions, and implement follow up recommendations, monitoring and/or mitigation.

Bartlett Tree Experts can make no warranty or guarantee whatsoever regarding the safety of any tree, trees, or parts of trees, regardless of the level of tree risk assessment provided, the risk rating, or the residual risk rating after mitigation. The information in this report should not be considered as making safety, legal, architectural, engineering, landscape architectural, land surveying advice or other professional advice. This information is solely for the use of the tree owner and manager to assist in the decision making process regarding the management of their tree or trees. Tree risk assessments are simply tools which should be used in conjunction with the owner or tree manager's knowledge, other information and observations related to the specific tree or trees discussed, and sound decision making.

## Glossary

Tree risk assessment has a unique set of terms with specific meanings. Definitions of all specific terms may be found in the International Society of Arboriculture's *Best Management Practice for Tree Risk Assessment*. Definitions of some of these terms used in this report are as follows:

The *likelihood of failure* may be categorized as imminent meaning that failure has started or could occur at any time; probable meaning that failure may be expected under normal weather conditions within the next 3 years; possible meaning that failure could occur, but is unlikely under normal weather conditions during that time frame; and improbable meaning that failure is not likely under normal weather conditions, and may not occur in severe weather conditions during that time frame.

*The likelihood of the failed tree part impacting a target* may be categorized as high meaning that a failed tree or tree part will most likely impact a target; medium meaning the failed tree or tree part could impact the target, but is not expected to do so; low meaning that the failed tree or tree part is not likely to impact a target; and very low meaning that the chance of a failed tree or tree part impacting the target is remote.

The *likelihood of failure and impact* is defined by the Likelihood Matrix below.

**LIKELIHOOD OF FAILURE AND IMPACT**

| Likelihood of Failure | Likelihood of Impacting Target | | | |
|---|---|---|---|---|
| | **Very Low** | **Low** | **Medium** | **High** |
| Imminent | Unlikely | Somewhat likely | Likely | Very Likely |
| Probable | Unlikely | Unlikely | Somewhat likely | Likely |
| Possible | Unlikely | Unlikely | Unlikely | Somewhat likely |
| Improbable | Unlikely | Unlikely | Unlikely | Unlikely |

The *consequences* of a known target being struck may be categorized as severe meaning that impact could involve serious personal injury or death, damage to high value property, or disruption to important activities; significant meaning that the impact may involve personal injury, property damage of moderate to high value, or considerable disruption; minor meaning that impact could cause low to moderate property damage, small disruptions to traffic or a communication utility, or minor injury; and negligible meaning that impact may involve low value property damage, disruption that can be replaced or repaired, and do not involve personal injury.

Targets are people, property, or activities that could be injured, damaged or disrupted by a tree failure.

*Levels of assessment* 1) *Limited visual assessments* are conducted to identify obvious defects. 2) *Basic assessments* are visual inspections done by walking around the tree looking at the site, buttress roots, trunk and branches. It may include the use of simple tools to gain information about the tree or defects. 3) *Advanced assessments* are performed to provide detailed information about specific tree parts, defects, targets of site conditions. Drilling to detect decay is an advanced assessment technique.

*Tree Risk Ratings* are terms used to communicate the level of risk rating. They are defined in defined in the Risk Matrix below as a combination of Likelihood and Consequences:

**ISA RISK MATRIX**

| Likelihood of Failure & Impact | Consequences of the Tree Failure | | | |
|---|---|---|---|---|
| | **Negligible** | **Minor** | **Significant** | **Severe** |
| Very Likely | Low | Moderate | High | Extreme |
| Likely | Low | Moderate | High | High |
| Somewhat likely | Low | Low | Moderate | Moderate |
| Unlikely | Low | Low | Low | Low |

*Overall tree risk rating* is the highest individual risk identified for the tree. The *residual risk* is the level of risk the tree should pose after the recommended mitigation.

Bartlett Tree Experts can inventory trees that have ropes courses, zip lines, swings, tree houses, or any other life support system attached for several different attributes; however, Bartlett Tree Experts is unable to provide tree risk assessment information on such trees, nor is Bartlett Tree Experts able to determine whether the correct hardware has been used, the systems are attached to the trees correctly, or whether the trees can withstand the additional forces that are placed on the tree or trees from such systems or structures. Bartlett Tree Experts does not recommend that any hardware or structures, other than those recommended by and installed by qualified arborists to aid the tree in structural support or protections from lightning, be installed in or attached to any tree(s). Bartlett Tree Experts recommends removing, or discontinuing the use of, any such system or recreational structure until the Client hires or consults with an engineer/specialist that deals specifically with ropes courses, zip lines, swings, tree houses, or any other life support systems and how they attach to and impact trees to determine if the trees can handle the forces being placed on them.

In the event that Bartlett Tree Experts observes an immediate safety issue with a tree with any such device attached, such as the presence of a dead, dying, or broken limb that could fall and injure a person or damage property, Bartlett Tree Experts may make a recommendation to remove or prune such a limb or otherwise mitigate the obvious safety issue. However, the Client should not infer that following such a recommendation and mitigating the immediate safety issue makes the tree in question safe for the use of the attached device or feature.

# TREE RISK ASSESSMENTS AND MITIGATION

## TREE RISK ASSESSMENTS AND MITIGATION

In reviewing the results and recommendations, the reader will find useful the specifications and definitions detailed in the preceding methodology. We used the following categories to organize the results and recommendations, which are displayed in tables:

- **Subject Trees Summarized According to:**
    - Tree Risk Assessment Results and Mitigation Recommendations
    - *Level 3 Advanced Assessment* Recommendations

## Tree Risk Assessments and Mitigation

As part of the inventory process, the Inventory Team conducts a *Level 2 Basic assessment* from the ground. While every tree poses a risk, typically low, any trees that were found to have conditions that posed a hazardous situation, prompting the arborists to go through the steps outlined in the Tree Risk Assessments, Limitations, and Glossary section of this plan. *Overall Tree Risk Ratings* are then assigned to these trees.

During the *Level 2 Basic assessment* the Regional Inventory Arborist can determine whether some aspect of tree structure or health indicates that a more comprehensive tree structure evaluation, called a *Level 3 Advanced assessment*, is needed to more thoroughly evaluate tree condition and *likelihood of failure*.

In such cases, we may recommend *Level 3 Advanced assessments* of the roots, stem, or crown. These assessments may include climbing inspections, examination of the root system using a compressed-air tool (that avoids damage to roots and underground utilities), resistance-recording drilling, or sonic tomography that produces a visual representation of internal conditions based on how sound moved through the tree. The goal is to use the appropriate method to evaluate impact of wood decay in stems and buttress roots that show potential for failure and to determine presence and condition of the root system. Once those *Level 3 Advanced assessments* are completed, more specific recommendations can be made, such as remediation, maintenance, or removal.

The Tree Risk Table below summarizes the inventoried trees that were observed posing a hazardous situation during the course of the inventory, including those trees recommended for *Level 3 Advanced assessments*. The table is organized first by *Overall Tree Risk Rating* (highest to lowest), then by Tree & Shrub Work Phase (ascending order), and finally by Tree ID (ascending order).

**TREE RISK ASSESSMENTS AND MITIGATION (80 Trees)**

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **46** | Birch-Gray | 15 | Fair | Moderate | Parking | 1 | • Removal | • Co-dominant stems<br>• Dead branches >2<br>• Hanger<br>• Included bark<br>• Poor branch structure |
| **39** | Pine-Austrian | 14 | Dead | Low | Parking | ASAP | • Removal | • Dead branches >2<br>• Dead/dying stem |
| **48** | Birch-Gray | 4 | Dead | Low | Parking | ASAP | • Removal | • Dead branches >2<br>• Dead/dying stem |
| **66** | Oak-Pin | 32 | Fair | Low | Building | ASAP | • Removal | • Butt swell<br>• Dead branches >2<br>• Fungi/conks<br>• Poor branch structure<br>• Uneven crown |
| **83** | Maple-Norway | 25 | Poor | Low | Path | ASAP | • Removal | • Co-dominant stems<br>• Dead branches >2<br>• Dieback (severe)<br>• Poor branch structure |
| **87** | Zelkova-Japanese | 9 | Poor | Low | Parking | ASAP | • Removal | • Buried root collar<br>• Dead branches >2<br>• Dieback (severe)<br>• Low vigor<br>• Wound-stem |

| **Tree ID** | **Common Name** | **DBH** | **Condition** | ***Overall Tree Risk Rating*** | **Primary Target** | **Tree & Shrub Work Phase** | **Recommendation** | **Defect(s) or Observation(s)** |
|---|---|---|---|---|---|---|---|---|
| **88** | Zelkova-Japanese | 9 | Poor | Low | Parking | ASAP | • Removal | • Buried root collar<br>• Co-dominant stems<br>• Dead branches >2<br>• Dieback (moderate)<br>• Low vigor<br>• Poor branch structure |
| **10** | Birch-Gray | 4,3 | Poor | Low | Path | 1 | • Removal | • Co-dominant stems<br>• Dead branches <=2<br>• Decay-root flare<br>• Poor branch structure<br>• Uneven crown<br>• Wound-root flare |
| **14** | Hawthorn-Washington | 6,3,3 | Poor | Low | Parking | 1 | • Removal | • Co-dominant stems<br>• Dead branches <=2<br>• Decay-root flare<br>• Fungi/conks<br>• Poor branch structure<br>• Uneven crown |
| **22** | Birch-Gray | 13,11 | Good | Low | Pond | 1 | • Prune: Reduce risk of branch stem and/or root failure<br>• Prune: Improve appearance<br>• Cable: New 1 | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **26** | Maple-Silver | 26 | Poor | Low | Pond | 1 | • Removal | • Broken branch(s)<br>• Co-dominant stems<br>• Dead branches >2<br>• Hanger<br>• Poor branch structure<br>• Storm damage |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **41** | Birch-Gray | 5,5,4 | Fair | Low | Parking | 1 | • Removal | • Co-dominant stems<br>• Growing against object<br>• Poor branch structure<br>• Uneven crown |
| **45** | Birch-Gray | 7,6,6,4 | Fair | Low | Parking | 1 | • Removal | • Co-dominant stems<br>• Growing against object<br>• Poor branch structure<br>• Uneven crown |
| **47** | Birch-Gray | 8,7 | Fair | Low | Parking | 1 | • Removal | • Co-dominant stems<br>• Dead branches >2<br>• Growing against object<br>• Included bark<br>• Poor branch structure<br>• Uneven crown |
| **49** | Birch-Gray | 4 | Fair | Low | Parking | 1 | • Removal | • Poor branch structure<br>• Uneven crown |
| **50** | Birch-Gray | 13,11 | Fair | Low | Parking | 1 | • Removal | • Co-dominant stems<br>• Dead branches <=2<br>• Growing against object<br>• Included bark<br>• Poor branch structure |
| **62** | Alder-Common | 20 | Fair | Low | Pond | 1 | • Prune: Clearance<br>• Prune: Improve appearance | • Dead branches >2<br>• Growing against object<br>• Poor branch structure<br>• Uneven crown |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **64** | Birch-Gray | 11 | Fair | Low | Building | 1 | • Removal | • Dead branches >2<br>• Poor branch structure<br>• Suppressed<br>• Uneven crown<br>• Wound-root |
| **65** | Oak-Black | 26 | Fair | Low | Building | 1 | • Prune: Improve appearance<br>• Cable: New 1 | • Co-dominant stems<br>• Poor branch structure<br>• Uneven crown<br>• Wound-root |
| **68** | Maple-Red | 16,12 | Poor | Low | Path | 1 | • Removal | • Cavity-stem<br>• Co-dominant stems<br>• Dead branches <=2<br>• Decay-stem<br>• Poor branch structure<br>• Uneven crown |
| **74** | Oak-Northern Red | 49 | Fair | Low | Pond | 1 | • Prune: Reduce risk of branch stem and/or root failure<br>• Prune: Reduce likelihood of storm damage<br>• Prune: Improve appearance | • Co-dominant stems<br>• Dead branches >2<br>• Poor branch structure |
| **85** | Maple-Norway | 16 | Good | Low | Path | 1 | • Prune: Clearance<br>• Prune: Develop branch structure<br>• Prune: Improve appearance<br>• RCX | • Girdling roots suspected<br>• Poor branch structure<br>• Wound-stem |
| **94** | Alder-Common | 13 | Poor | Low | Pond | 1 | • Removal | • Dead branches >2<br>• Dieback (severe)<br>• Poor branch structure |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **95** | Crabapple | 8 | Fair | Low | Pond | 1 | • Prune: Improve appearance<br>• Prune: Develop branch structure | • Broken branch(s)<br>• Dead branches <=2<br>• Decay-root flare<br>• Hanger |
| **1** | Elm-American | 5 | Fair | Low | Path | 2 | • Prune: Improve appearance<br>• Prune: Develop branch structure<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Seam |
| **11** | Pine-Austrian | 13,7 | Fair | Low | Path | 2 | • Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches >2<br>• Poor branch structure<br>• Uneven crown |
| **12** | Pine-Austrian | 14 | Fair | Low | Path | 2 | • Prune: Promote development of strong central stem<br>• Prune: Develop branch structure<br>• Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Included bark<br>• Poor branch structure |
| **17** | Hawthorn-Washington | 4 | Fair | Low | Parking | 2 | • Prune: Develop branch structure<br>• Prune: Improve light and air penetration through crown<br>• Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches >2<br>• Included bark<br>• Poor branch structure<br>• Wound-branch |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **19** | Elm-American | 6 | Good | Low | Path | 2 | • Prune: Develop branch structure<br>• Prune: Improve form and shape<br>• Prune: Clearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Poor branch structure<br>• Uneven crown<br>• Wound-stem |
| **20** | Birch-Gray | 5,5 | Fair | Low | Path | 2 | • Removal | • Co-dominant stems<br>• Poor branch structure<br>• Suppressed<br>• Uneven crown |
| **23** | Birch-Gray | 5 | Fair | Low | Pond | 2 | • Removal | • Dead branches <=2<br>• Poor branch structure<br>• Uneven crown<br>• Wound-root flare |
| **31** | Maple-Silver | 24 | Good | Low | Pond | 2 | • Removal | • Co-dominant stems<br>• Included bark<br>• Lean<br>• Poor branch structure<br>• Uneven crown |
| **33** | Crabapple | 5,4,4,4 | Poor | Low | Pond | 2 | • Removal | • Co-dominant stems<br>• Dead branches <=2<br>• Low vigor<br>• Poor branch structure<br>• Wound-root flare |
| **36** | Birch-Gray | 18 | Good | Low | Parking | 2 | • Prune: Improve appearance<br>• Prune: Reduce weight of branch ends<br>• Prune: Clearance | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **37** | Crabapple | 16 | Poor | Low | Parking | 2 | • Removal | • Co-dominant stems<br>• Dead branches <=2<br>• Decay-stem<br>• Poor branch structure<br>• Wound-root<br>• Wound-root flare |
| **40** | Pine-Austrian | 21 | Good | Low | Parking | 2 | • Prune: Clearance<br>• Prune: Develop branch structure<br>• Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **42** | Birch-Gray | 6 | Good | Low | Parking | 2 | • Removal | • Poor branch structure<br>• Uneven crown |
| **51** | Alder-Common | 11 | Good | Low | Pond | 2 | • Removal | • Co-dominant stems<br>• Poor branch structure<br>• Uneven crown |
| **53** | Birch-Gray | 5 | Fair | Low | Parking | 2 | • Removal | • Dead branches <=2<br>• Hanger<br>• Poor branch structure |
| **61** | Mulberry-White | 5,5,4,4,4 | Fair | Low | Pond | 2 | • Removal | • Co-dominant stems<br>• Included bark<br>• Poor branch structure<br>• Uneven crown |
| **63** | Cherry-Black | 10 | Fair | Low | Pond | 2 | • Removal | • Co-dominant stems<br>• Poor branch structure<br>• Uneven crown |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **67** | Cherry-Black | 12 | Poor | Low | Path | 2 | • Removal | • Co-dominant stems<br>• Dead branches >2<br>• Dieback (moderate)<br>• Lean<br>• Poor branch structure |
| **69** | Cherry-Black | 7 | Fair | Low | Pond | 2 | • Removal | • Dead branches <=2<br>• Low vigor<br>• Suppressed<br>• Sweep<br>• Uneven crown |
| **78** | Elm-American | 11 | Good | Low | Pond | 2 | • Prune: Clearance<br>• Prune: Develop branch structure<br>• Prune: Improve appearance | • Co-dominant stems<br>• Included bark<br>• Poor branch structure<br>• Uneven crown |
| **80** | Oak-Pin | 19 | Good | Low | Pond | 2 | • Prune: Develop branch structure<br>• Prune: Improve light and air penetration through crown<br>• Prune: Improve appearance | • Dead branches >2<br>• Poor branch structure |
| **81** | Pear-Callery | 13 | Poor | Low | Pond | 2 | • Removal | • Decay-stem<br>• Lean<br>• Poor branch structure<br>• Uneven crown<br>• Wound-stem |
| **84** | Maple-Norway | 15 | Good | Low | Path | 2 | • Prune: Promote development of strong central stem<br>• Prune: Develop branch structure<br>• Prune: Clearance<br>• RCX | • Co-dominant stems<br>• Girdling roots present<br>• Poor branch structure<br>• Wound-root |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **91** | Birch-Gray | 5 | Fair | Low | Pond | 2 | • Removal | • Dead branches <=2<br>• Low vigor<br>• Uneven crown |
| **2** | Pine-Austrian | 15 | Good | Low | Path | 3 | • Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Dead branches <=2 |
| **3** | Pine-Austrian | 18 | Fair | Low | Path | 3 | • Prune: Improve appearance<br>• RCX | • Broken branch(s)<br>• Buried root collar<br>• Dead branches <=2<br>• Uneven crown |
| **4** | Pine-Austrian | 9 | Good | Low | Path | 3 | • Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown |
| **5** | Pine-Austrian | 13 | Good | Low | Path | 3 | • Prune: Develop branch structure<br>• Prune: Improve appearance<br>• Prune: Improve form and shape<br>• RCX | • Buried root collar<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown |
| **6** | Pine-Austrian | 14 | Good | Low | Path | 3 | • Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Dead branches <=2 |
| **7** | Pine-Austrian | 13 | Good | Low | Path | 3 | • Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Dead branches <=2<br>• Uneven crown |
| **8** | Pine-Austrian | 13 | Fair | Low | Path | 3 | • Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Dead branches <=2<br>• Low vigor |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **9** | Pine-Austrian | 17 | Good | Low | Path | 3 | • Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Dead branches <=2<br>• Girdling roots present |
| **13** | Hawthorn-Washington | 7,6 | Good | Low | Parking | 3 | • Prune: Develop branch structure<br>• Prune: Improve light and air penetration through crown<br>• Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **15** | Hawthorn-Washington | 6,5 | Good | Low | Parking | 3 | • Prune: Develop branch structure<br>• Prune: Improve light and air penetration through crown<br>• Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **16** | Hawthorn-Washington | 4,4,4,4 | Good | Low | Parking | 3 | • Prune: Develop branch structure<br>• Prune: Improve light and air penetration through crown<br>• Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Included bark<br>• Poor branch structure |
| **24** | Birch-Gray | 11 | Good | Low | Pond | 3 | • Prune: Improve appearance | • Broken branch(s)<br>• Dead branches <=2<br>• Poor branch structure |
| **25** | Birch-Gray | 9 | Fair | Low | Pond | 3 | • Prune: Improve appearance | • Dead branches <=2<br>• Low vigor<br>• Uneven crown |

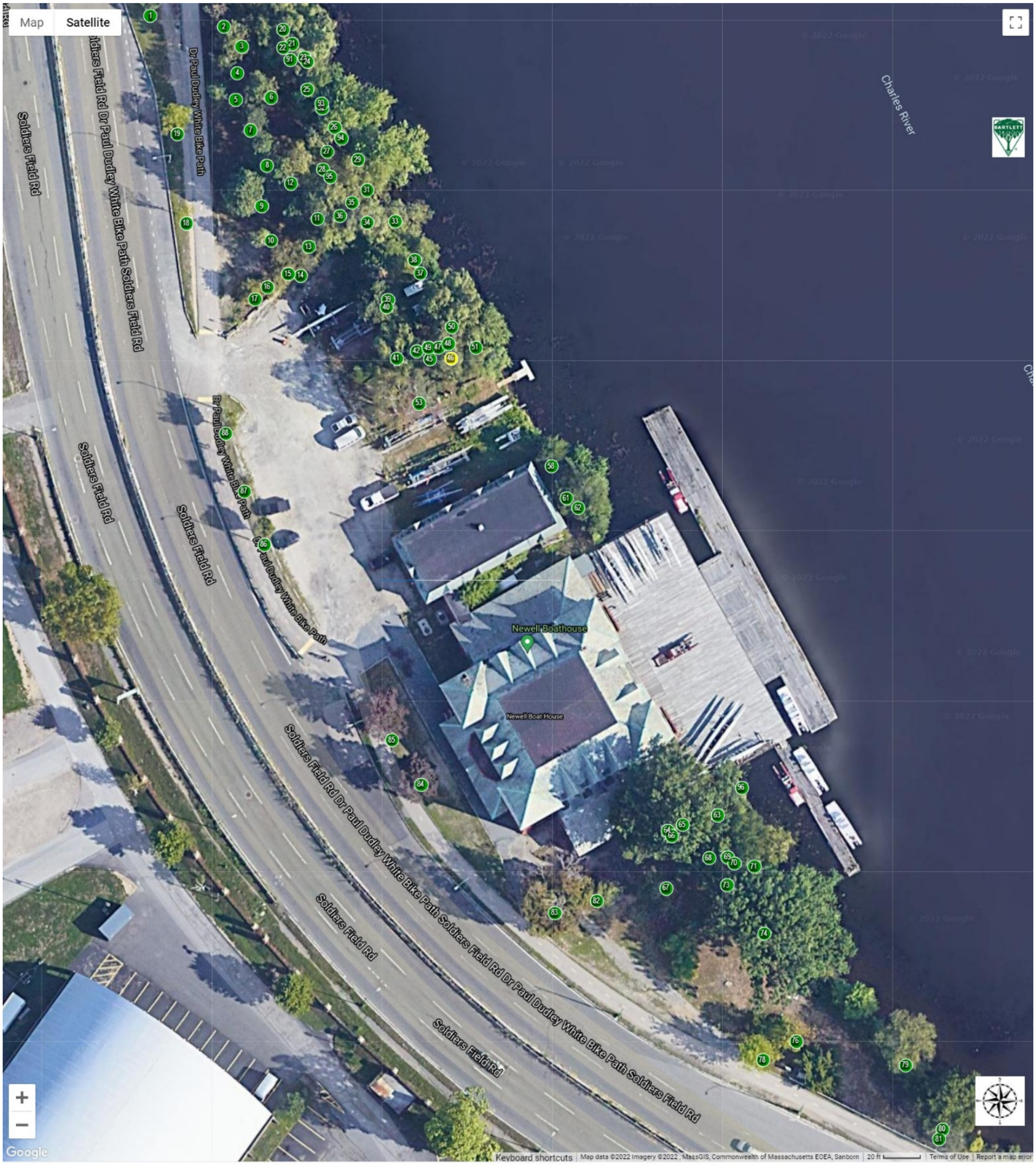
| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **27** | Birch-Gray | 9 | Good | Low | Pond | 3 | • Prune: Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown<br>• Wound-stem |
| **28** | Birch-Gray | 10 | Good | Low | Pond | 3 | • Prune: Improve appearance<br>• Prune: Improve light and air penetration through crown | • Dead branches <=2<br>• Girdling roots present<br>• Lean<br>• Uneven crown |
| **34** | Birch-Gray | 12 | Good | Low | Pond | 3 | • Prune: Improve appearance<br>• RCX | • Co-dominant stems<br>• Girdling roots present<br>• Poor branch structure<br>• Uneven crown |
| **35** | Birch-Gray | 10 | Good | Low | Pond | 3 | • Prune: Improve appearance<br>• Prune: Develop branch structure | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **73** | Crabapple | 6 | Fair | Low | Pond | 3 | • Prune: Develop branch structure<br>• Prune: Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Decay-root flare<br>• Poor branch structure<br>• Wound-branch |
| **79** | Elm-American | 16 | Good | Low | Pond | 3 | • Prune: Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Hanger<br>• Included bark<br>• Poor branch structure |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **82** | Birch-Gray | 5,4 | Good | Low | Pond | 3 | • Prune: Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Hanger<br>• Poor branch structure |
| **86** | Zelkova-Japanese | 7 | Fair | Low | Parking | 3 | • Prune: Improve appearance<br>• RCX | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Wound-branch |
| **92** | Cherry-Black | 10 | Fair | Low | Pond | 3 | • Prune: Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Hanger<br>• Poor branch structure |
| **18** | Elm-American | 5 | Good | Low | Path | ... | • RCX | • Buried root collar<br>• Co-dominant stems<br>• Poor branch structure<br>• Seam |
| **21 **** | Birch-Gray | 9 | Fair | Low | Pond | ... | ... | • Dead branches <=2<br>• Hanger<br>• Poor branch structure<br>• Seam<br>• Uneven crown |
| **29 **** | Maple-Red | 6 | Good | Low | Pond | ... | ... | • Poor branch structure |
| **38 **** | Alder-Common | 7 | Good | Low | Parking | ... | ... | • Broken branch(s)<br>• Dead branches <=2 |
| **58 **** | Alder-Common | 4,4,4 | Good | Low | Pond | ... | ... | • Co-dominant stems<br>• Included bark<br>• Poor branch structure |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Primary Target | Tree & Shrub Work Phase | Recommendation | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|---|---|
| **70 **** | Cherry-Black | 13 | Good | Low | Pond | ... | ... | • Co-dominant stems<br>• Poor branch structure<br>• Uneven crown |
| **71 **** | Birch-Gray | 11,8 | Good | Low | Pond | ... | ... | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown |
| **76 **** | Maple-Norway | 9 | Fair | Low | Pond | ... | ... | • Co-dominant stems<br>• Poor branch structure<br>• Wound-root flare |
| **93 **** | Alder-Common | 5 | Good | Low | Pond | ... | ... | • Poor branch structure<br>• Uneven crown |
| **96 **** | Birch-Paper | 3 | Good | Low | Pond | ... | ... | • Poor branch structure<br>• Uneven crown |

**Any tree without a mitigation recommendation or *Level 3 Advanced Assessment* recommendation should be retained and monitored.

**INVENTORIED TREES ASSIGNED *OVERALL TREE RISK RATINGS* AT THE TIME OF DATA COLLECTION**




*Overall Tree Risk Rating:* Low Moderate

# STAND DYNAMICS RESULTS

## STAND DYNAMICS RESULTS

In reviewing the results and recommendations, the reader will find useful the specifications and definitions detailed in the preceding methodology above. We used the following categories to organize the stand dynamics results, which are displayed in tables:

- **Subject Trees Summarized According to:**
    - Tree Species Identified
    - Condition Class
    - Suitability for Preservation
    - Age Class
    - Tree Size per DBH
    - Tree Location Value

Where appropriate, we have included explanations, photos, drawings, or other information to illuminate the table contents.

## Stand Dynamics

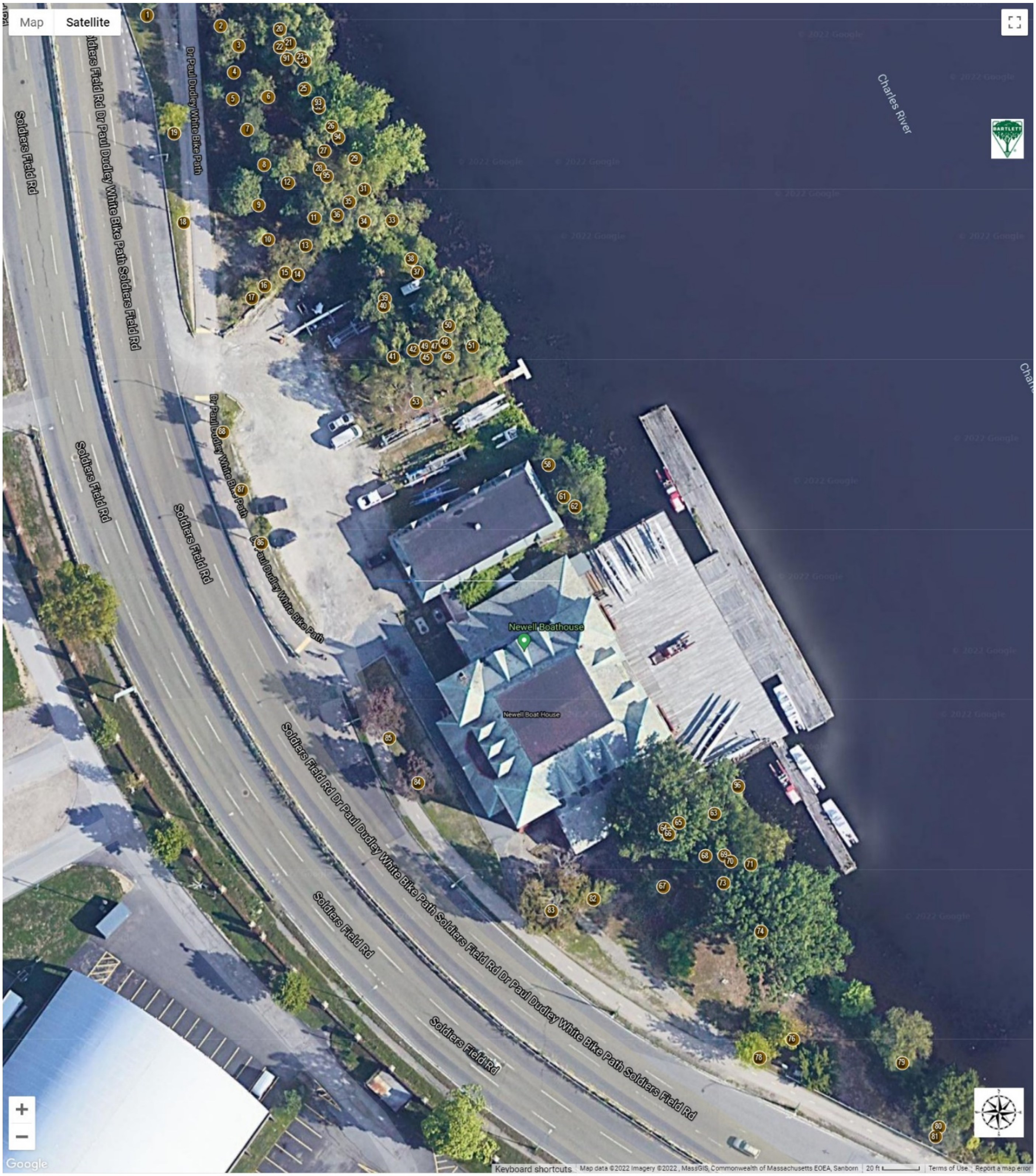
### Tree Species Identified

Our inventory revealed 17 species of trees, as detailed in the following table:

**TREE SPECIES IDENTIFIED**

| Genus | Species | Common Name | Count | % Distribution Total |
|---|---|---|---|---|
| ***Acer*** | *platanoides* | Maple-Norway | 4 | 5% |
| | *rubrum* | Maple-Red | 2 | 3% |
| | *saccharinum* | Maple-Silver | 2 | 3% |
| ***Acer* Total** | | | **8** | **10%** |
| ***Alnus*** | *glutinosa* | Alder-Common | 6 | 8% |
| ***Betula*** | *papyrifera* | Birch-Paper | 1 | 1% |
| | *populifolia* | Birch-Gray | 25 | 31% |
| ***Betula* Total** | | | **26** | **33%** |
| ***Crataegus*** | *phaenopyrum* | Hawthorn-Washington | 5 | 6% |
| ***Malus*** | sp. | Crabapple | 4 | 5% |
| ***Morus*** | *alba* | Mulberry-White | 1 | 1% |
| ***Pinus*** | *nigra* | Pine-Austrian | 12 | 15% |
| ***Prunus*** | *serotina* | Cherry-Black | 5 | 6% |
| ***Pyrus*** | *calleryana* | Pear-Callery | 1 | 1% |
| ***Quercus*** | *palustris* | Oak-Pin | 2 | 3% |
| | *rubra* | Oak-Northern Red | 1 | 1% |
| | *velutina* | Oak-Black | 1 | 1% |
| ***Quercus* Total** | | | **4** | **5%** |
| ***Ulmus*** | *americana* | Elm-American | 5 | 6% |
| ***Zelkova*** | *serrata* | Zelkova-Japanese | 3 | 4% |
| **Grand Total** | | | **80** | **100%** |

## 2022 TREE INVENTORY

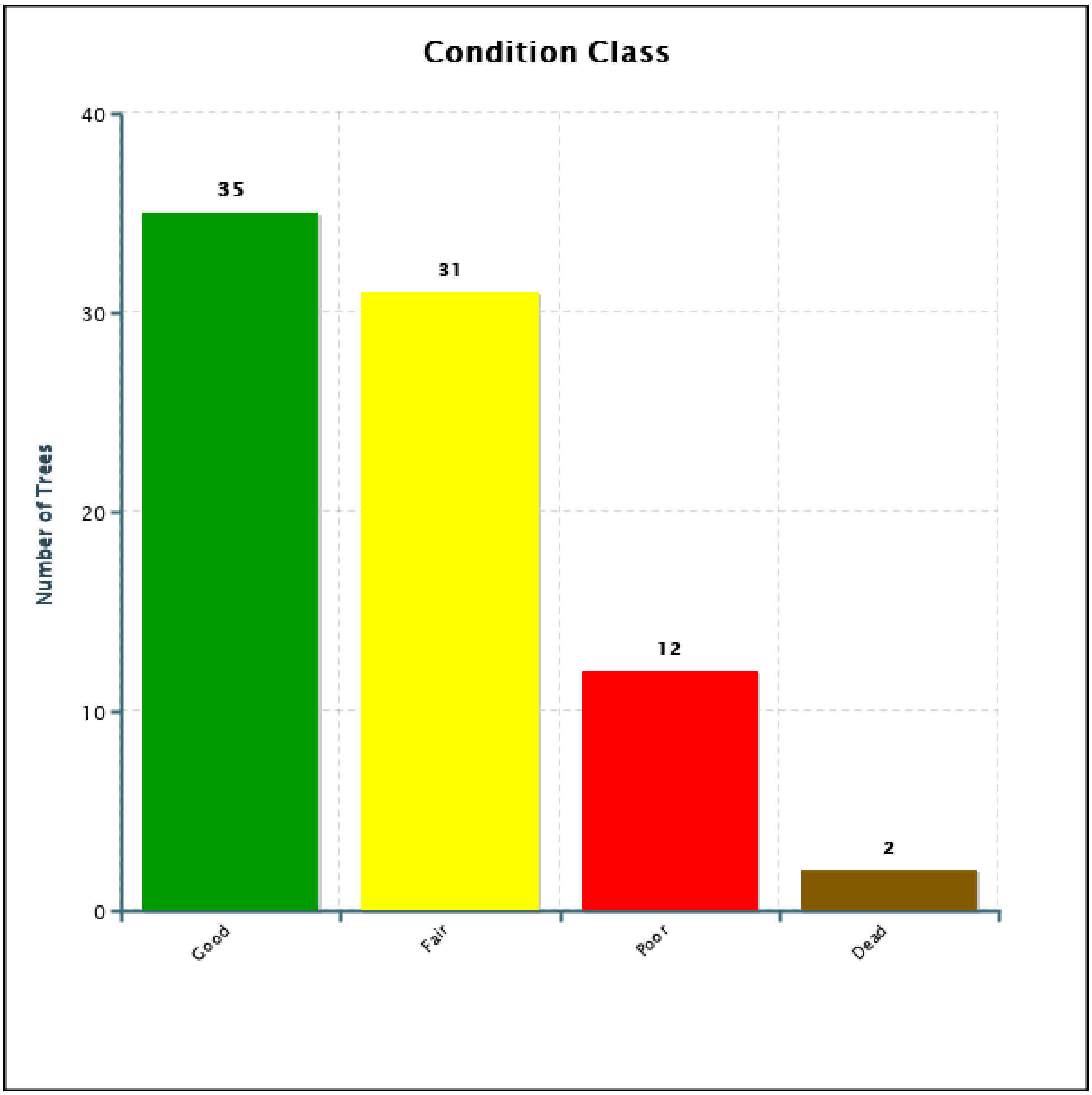


### Condition Class

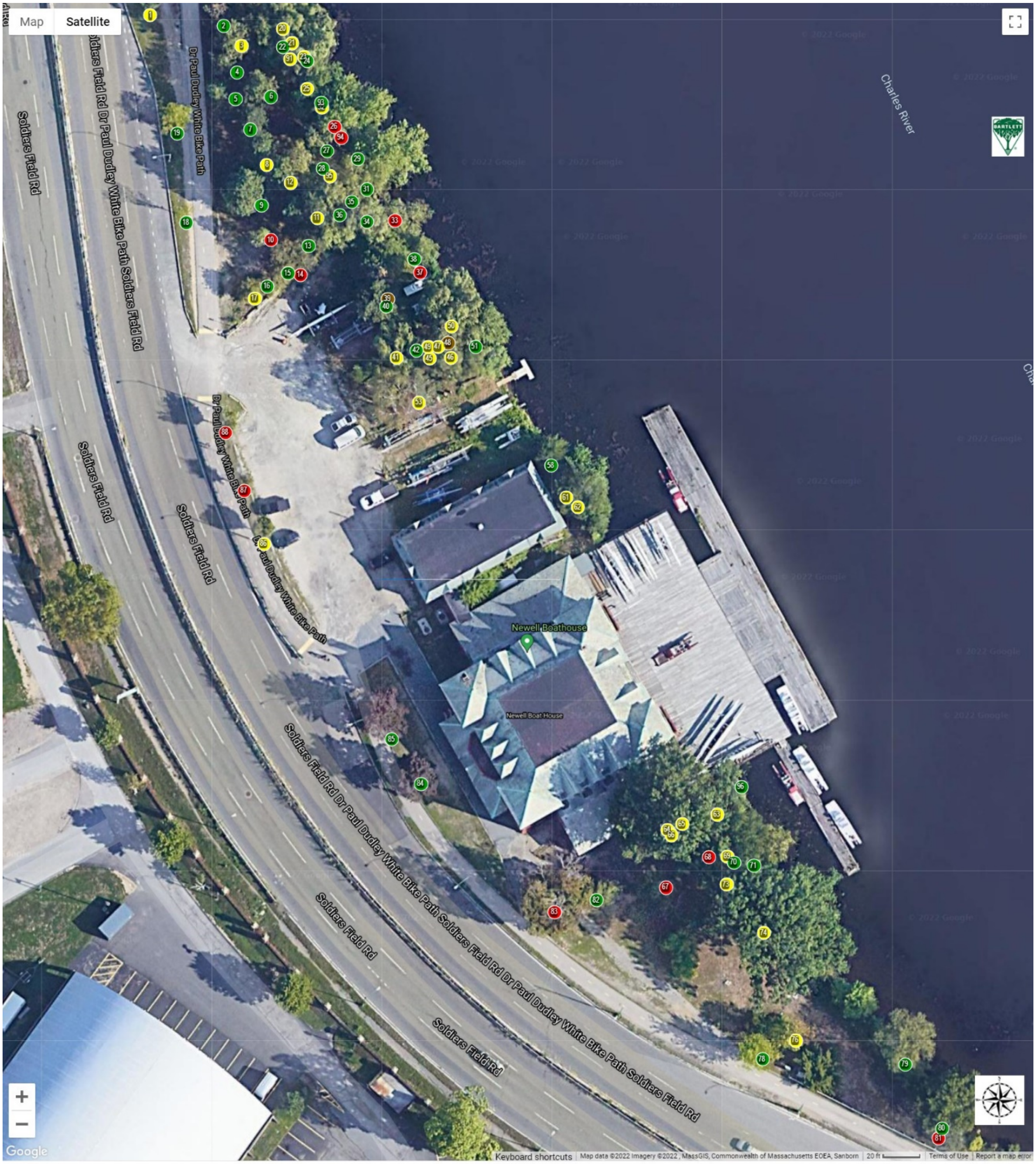
The breakdown of tree condition follows:

**CONDITION CLASS BREAKDOWN**

| Condition Class | Quantity | % of Total |
|---|---|---|
| **Good** | 35 | 44% |
| **Fair** | 31 | 39% |
| **Poor** | 12 | 15% |
| **Dead** | 2 | 3% |



## INVENTORIED TREES BY CONDITION CLASS




*Condition:* Good Fair Poor Dead

## Suitability for Preservation

Before evaluating the impacts that will occur during development, it is important to consider the quality of the tree resource itself, and the potential for individual trees to function well over an extended length of time. Trees that are preserved on development sites must be carefully selected to make sure that they may survive development impacts, adapt to a new environment and perform well in the landscape.

Our goal is to identify trees that have the potential for long-term health, structural stability, and longevity. For trees growing in open fields, away from areas where people and property are present, structural defects and/or poor health presents a low risk of damage or injury if they fail. However, we must be concerned about safety in use areas. Therefore, where development encroaches into existing plantings, we must consider their structural stability as well as their potential to grow and thrive in a new environment. Where development will not occur, the normal life cycles of decline, structural failure and death should be allowed to continue.

Evaluation of suitability for preservation considers several factors:

**• Tree Health**

Healthy, vigorous trees are better able to tolerate impacts such as root injury, demolition of existing structures, changes in soil grade and moisture, and soil compaction than are non-vigorous trees.

**•Structural Integrity**

Trees with significant amounts of wood decay and other structural defects that cannot be corrected are likely to fail. Such trees should not be preserved in areas where damage to people or property is likely.

**•Species Response**

There is a wide variation in the response of individual species to construction impacts and changes in the environment.

**•Tree Age and Longevity**

Old trees, while having significant emotional and aesthetic appeal, have limited physiological capacity to adjust to an altered environment. Young trees are better able to generate new tissue and respond to change.

**•Species Invasiveness**

Species that spread across a site and displace desired vegetation are not always appropriate for retention. This is particularly true when indigenous species are displaced.

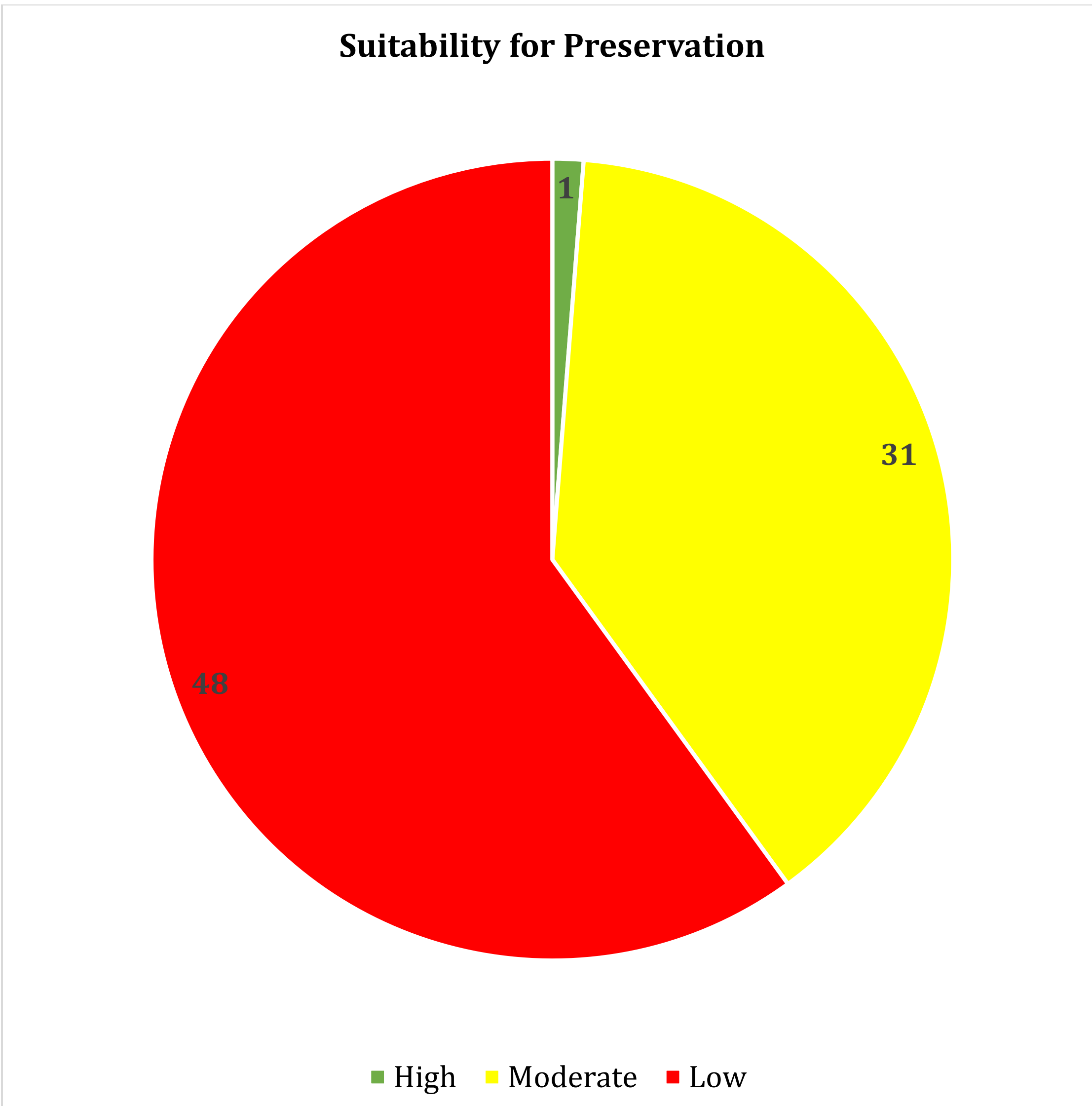
Each tree was rated for suitability for preservation based upon its age, health, structural condition, and ability to safely coexist within a development environment. We consider trees with high suitability for preservation to be the best candidates for preservation. We do not recommend retention of trees with low suitability for preservation in areas where people or property will be present. Retention of trees with moderate suitability for preservation depends upon the intensity of proposed site changes.

| | |
|---|---|
| **High** | These are trees with good health and structural stability that have the potential for longevity at the site. |
| **Moderate** | Trees in this category have fair health and/or structural defects that may be abated with treatment. These trees require more intense management and monitoring and may have shorter lifespans than those in the "high" category. |
| **Low** | Trees in this category are in poor health or have significant defects in structure that cannot be abated with treatment. These trees can be expected to decline regardless of management. The species or individual tree may possess either characteristics that are undesirable in landscape settings or be unsuited for use areas. |

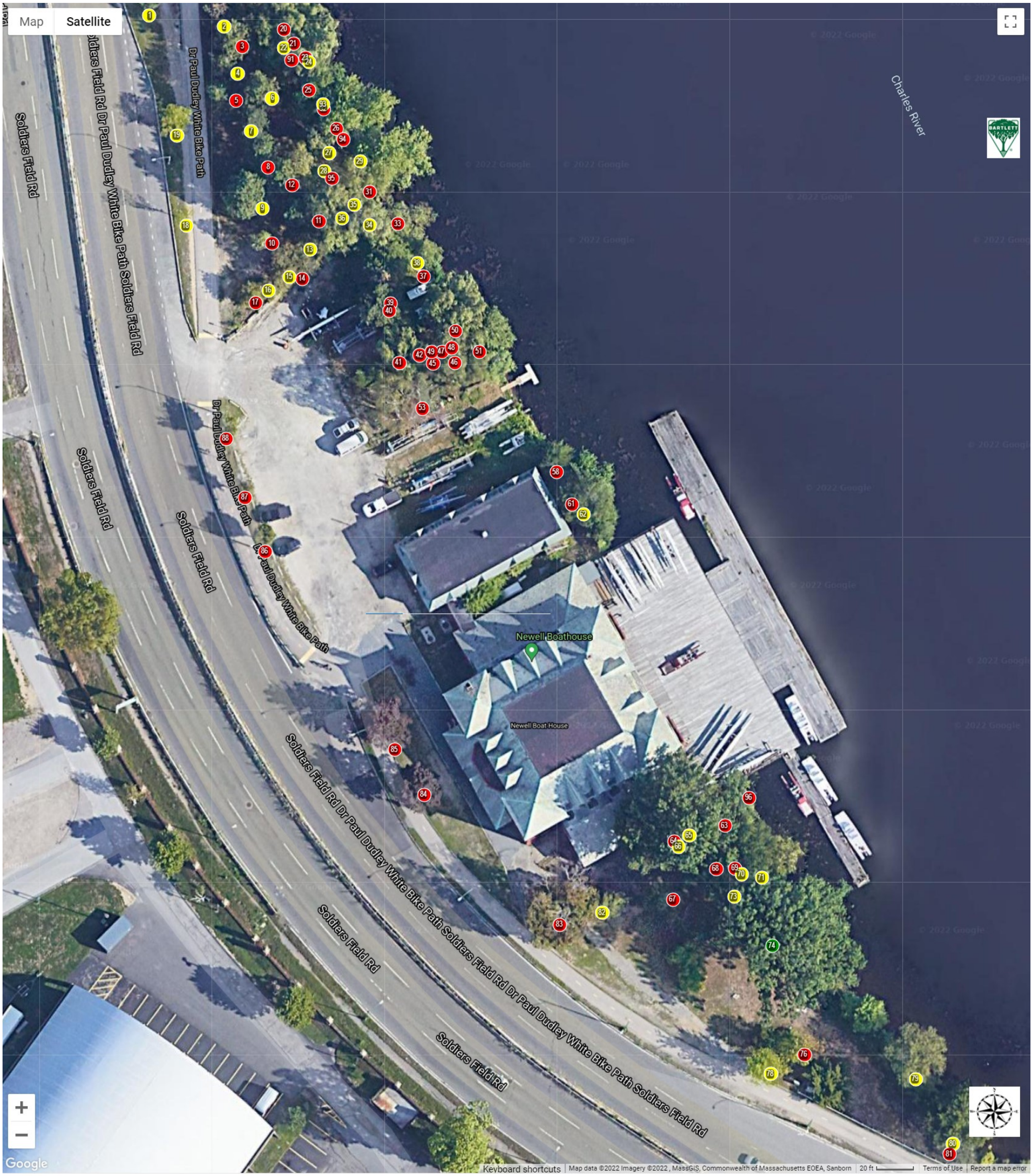
The breakdown of suitability for preservation is as followed:

**SUITABILITY FOR PRESERVATION BREAKDOWN**

| Suitability for Preservation | Quantity | % of Total |
|---|---|---|
| **High** | 1 | 8% |
| **Moderate** | 31 | 39% |
| **Low** | 48 | 60% |



## INVENTORIED TREES BY SUITABILITY FOR PRESERVATION



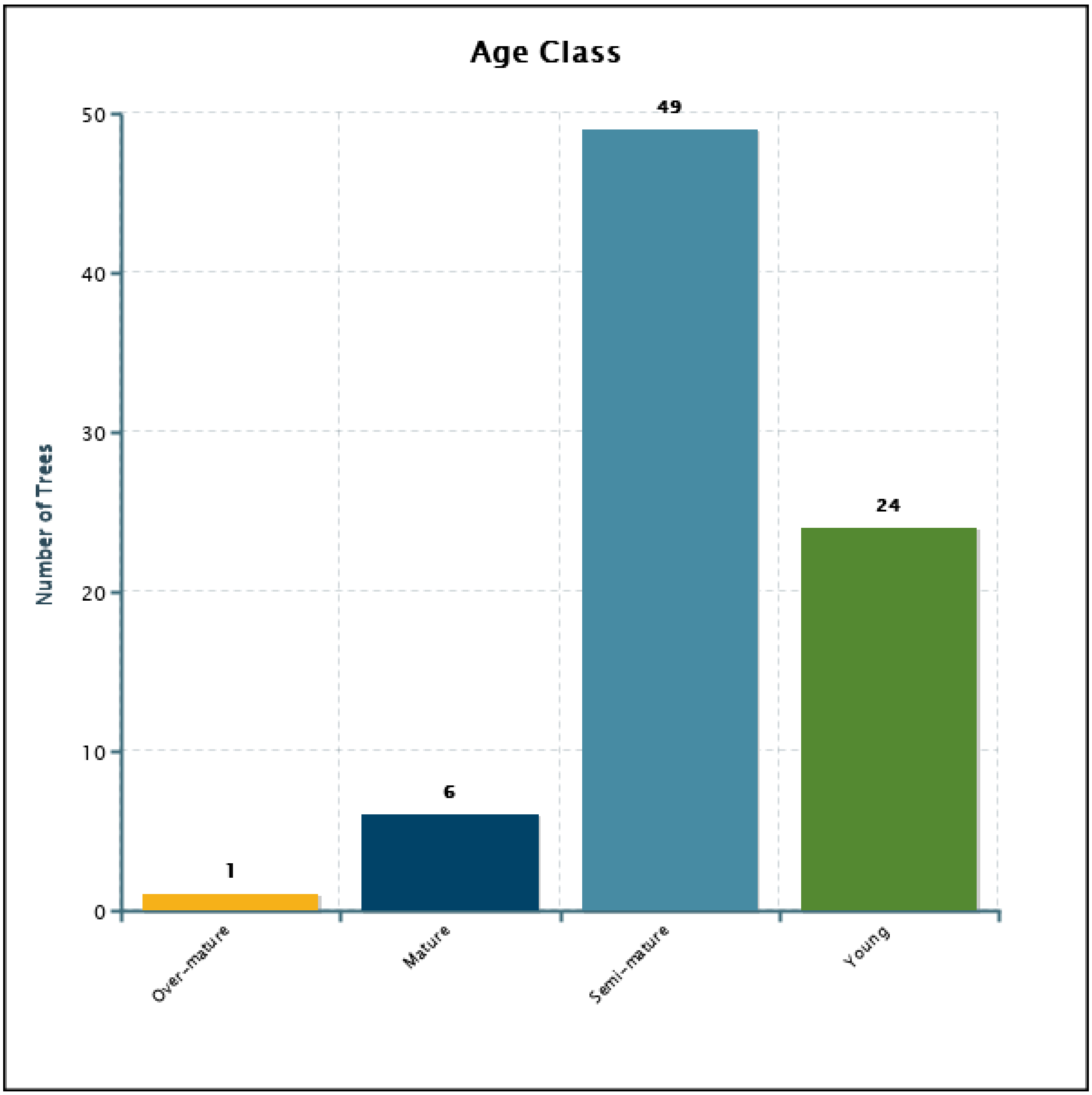

***Suitability for Preservation:*** High Moderate Low

## Age Class

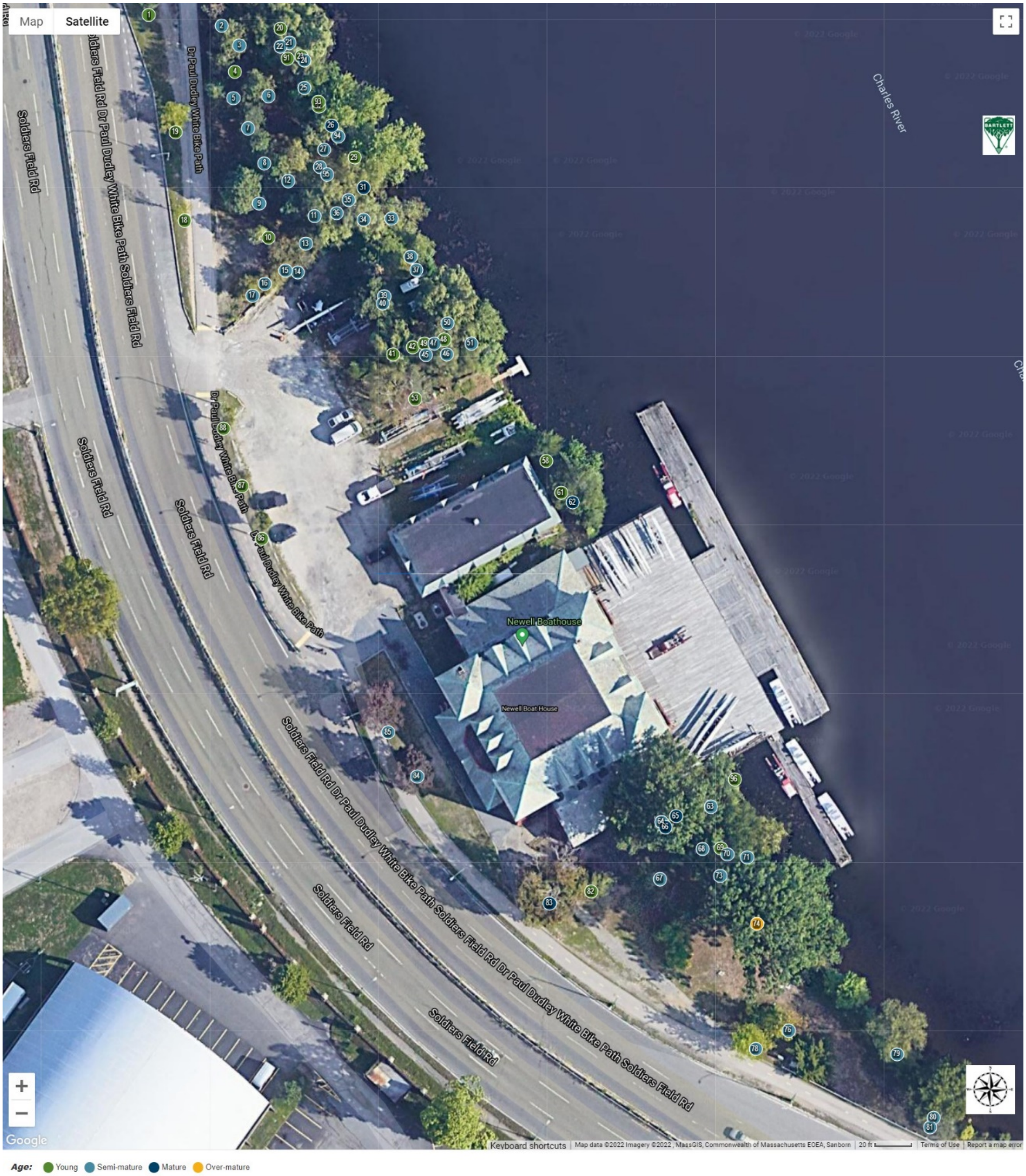
The breakdown of tree age class follows:

**AGE CLASS BREAKDOWN**

| Age Class | Quantity | % of Total |
|---|---|---|
| Over-mature | 1 | 1% |
| Mature | 6 | 8% |
| Semi-mature | 49 | 61% |
| Young | 24 | 30% |

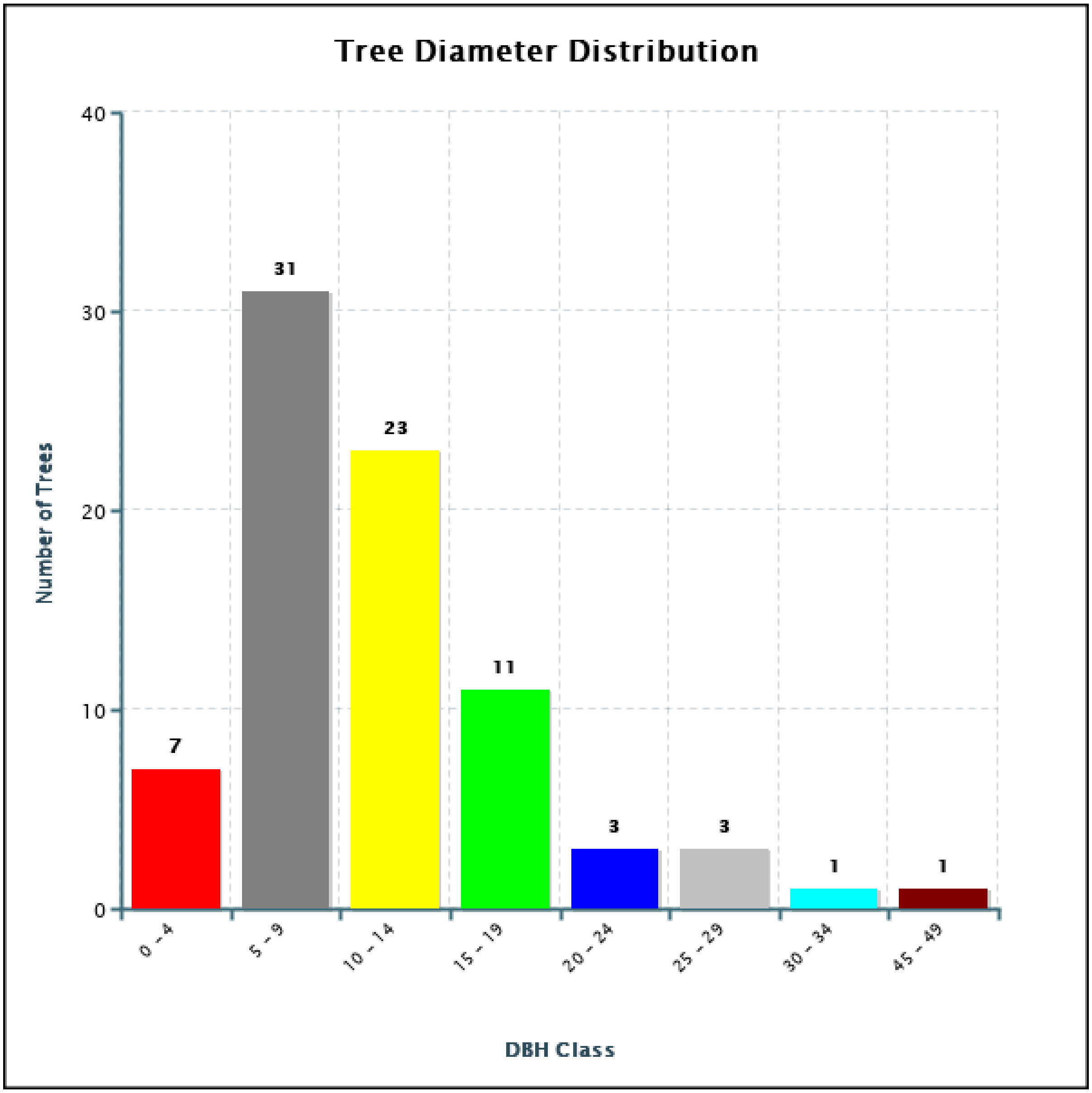


## INVENTORIED TREES BY AGE CLASS



## Tree Size (DBH)

The following chart illustrates numbers of trees according to size per DBH:



## Tree Location Value

Each tree at the Newell Boathouse was assigned a location value of good, fair, or poor. Forty one trees (51%) were assigned a location value of fair or poor due to present or anticipated conflicts with infrastructure or utilities. Trees with conflicts that can easily be mitigated with a one-time raise or reduction prune were not classified as existing in a fair or poor location.

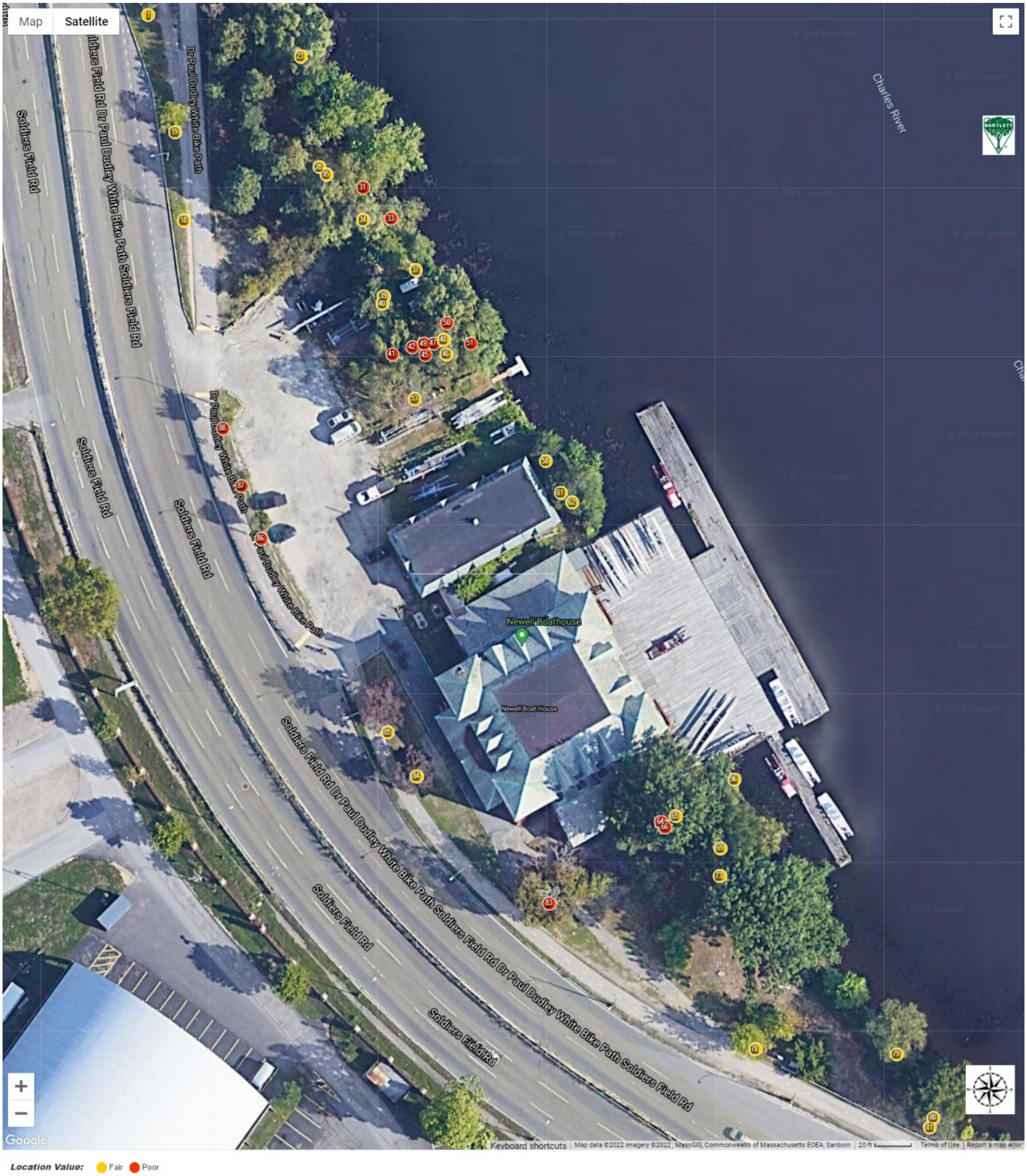
Thirteen trees (16%) at Newell Boathouse were assigned a location value of poor and are recommended for removal in the Tree Removal Section. These recommendations are made without consideration to tree health or the presence/absence of defects. Nine trees (11%) were assigned a location value of fair and were recommended for removal due to condition, defects, and/or risk. It is recommended that the remaining 19 trees (24%) with fair, or poor location values and not recommended for removal continue to be monitored for intolerable levels of conflict with the surrounding infrastructure. If the level of conflict continues to increase and cannot be easily mitigated, a removal and replacement program should be considered for these trees. If removal and replacement is deemed appropriate, please consult with your local Bartlett Arborist Representative for information on desirable replacement plantings.

**INVENTORIED TREES WITH A FAIR OR POOR LOCATION VALUE (41 Trees)**

| Tree ID | Common Name | Location Value | DBH |
|---|---|---|---|
| **31** | Maple-Silver | Poor | 24 |
| **33** | Crabapple | Poor | 5 |
| **41** | Birch-Gray | Poor | 5 |
| **42** | Birch-Gray | Poor | 6 |
| **45** | Birch-Gray | Poor | 7 |
| **47** | Birch-Gray | Poor | 8 |
| **49** | Birch-Gray | Poor | 4 |
| **50** | Birch-Gray | Poor | 13 |
| **51** | Alder-Common | Poor | 11 |
| **64** | Birch-Gray | Poor | 11 |
| **66** | Oak-Pin | Poor | 32 |
| **83** | Maple-Norway | Poor | 25 |
| **86** | Zelkova-Japanese | Poor | 7 |
| **87** | Zelkova-Japanese | Poor | 9 |
| **88** | Zelkova-Japanese | Poor | 9 |
| **1** | Elm-American | Fair | 5 |
| **18** | Elm-American | Fair | 5 |
| **19** | Elm-American | Fair | 6 |
| **23** | Birch-Gray | Fair | 5 |
| **28** | Birch-Gray | Fair | 10 |
| **34** | Birch-Gray | Fair | 12 |

| Tree ID | Common Name | Location Value | DBH |
|---|---|---|---|
| **37** | Crabapple | Fair | 16 |
| **39** | Pine-Austrian | Fair | 14 |
| **40** | Pine-Austrian | Fair | 21 |
| **46** | Birch-Gray | Fair | 15 |
| **48** | Birch-Gray | Fair | 4 |
| **53** | Birch-Gray | Fair | 5 |
| **58** | Alder-Common | Fair | 4 |
| **61** | Mulberry-White | Fair | 5 |
| **62** | Alder-Common | Fair | 20 |
| **65** | Oak-Black | Fair | 26 |
| **69** | Cherry-Black | Fair | 7 |
| **73** | Crabapple | Fair | 6 |
| **78** | Elm-American | Fair | 11 |
| **79** | Elm-American | Fair | 16 |
| **80** | Oak-Pin | Fair | 19 |
| **81** | Pear-Callery | Fair | 13 |
| **84** | Maple-Norway | Fair | 15 |
| **85** | Maple-Norway | Fair | 16 |
| **95** | Crabapple | Fair | 8 |
| **96** | Birch-Paper | Fair | 3 |

## INVENTORIED TREES WITH A FAIR OR POOR LOCATION VALUE



# RECOMMENDATIONS

# RECOMMENDATIONS

In reviewing the results and recommendations, the reader will find useful the specifications and definitions detailed in the preceding methodology. We used the following categories to organize the results and recommendations, which are displayed in tables:

**Recommendations**

- Soil Care
- Root Collar Excavation
- Plant Health Care
- Tree Pruning
- Structural Support Systems
- Lightning Protection Systems
- Tree Removal

## Soil Care

Healthy soil is critical to the health and longevity of trees. Soil provides trees with the essential nutrients required for their growth. Many secondary problems such as reduced vigor, inadequate growth, branch dieback, and pest or disease concerns are related to the primary stress of poor soil conditions. Undisturbed, native forest soils generally contain adequate levels of organic matter, soil microbes, and nutrients. Urban, suburban, and landscape soils (as opposed to forest soils) usually lack these qualities, and are often compacted. In many cases, trees in a landscaped environment suffer from inadequate soil fertility, soil compaction, root zone competition with turf grasses, and inadequate total soil volume. Soil Care treatments should be applied as soon as possible, therefore they do not have a Tree & Shrub Work phase.

Bartlett Tree Experts recommends several procedures and treatments that address soil quality. Taking soil samples is perhaps the most important. Proper tree care cannot be initiated unless it is known what type of soil environment the trees are growing in. Soil testing results can help to create a path forward for improved tree health. We address some of these below.

### Soil Sampling

Collecting soil samples and having them tested helps determine nutrients that may be lacking, unfavorable soil pH values, and adequacy of soil organic matter. Laboratory tests and analyses can determine the need for soil amendments.

### Bulk Density

Compacted soils are regrettably common in the urban setting. A bulk density test, which requires an undisturbed core sample, measures the level of soil compaction. Arborists can use the results to diagnose problems or to determine what size holes to dig for planting. If soil density exceeds a measured threshold for a given soil type and tree species, we recommend Bartlett's Root Invigoration™ program.

### Soil Rx®

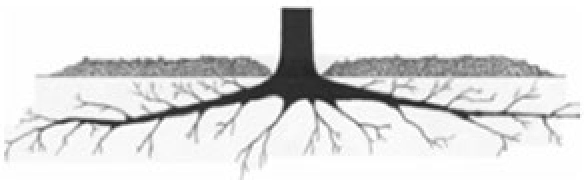
Bartlett's Soil Rx® program, which is a prescription soil amendment program, aims to correct nutrient deficiencies and optimize soil conditions for designated trees.

### Root Invigoration™

The aim of Bartlett's patented Root Invigoration™ Program is to improve soil conditions by addressing soil compaction and promoting efficient root growth, especially for high-value trees in disturbed areas. The process includes taking soil samples to determine what nutrients are deficient, performing a root collar excavation, "air-tilling" a portion of the root zone to find fine roots, incorporating organic matter, applying soil amendments (based on soil sample), and applying mulch. The area of the root system treated can vary by tree. For the Root Invigoration™ Program to be successful, proper watering techniques must be employed after the process is complete.

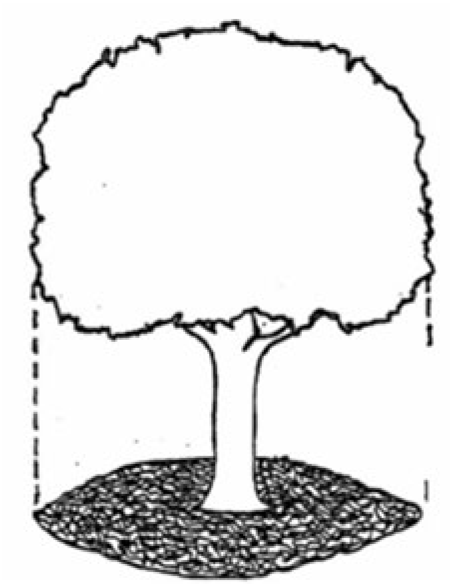
### Mulch Application

Proper mulching (top left and bottom left) provides many benefits to trees and shrubs. It moderates soil temperatures, reduces soil moisture loss, reduces soil compaction, provides nutrients, and improves soil structure. This practice results in more root growth and healthier plants. The image on the top right illustrates root growth density under grass versus mulch. Mulch is frequently applied incorrectly (bottom right), so we recommend that readers inspect the technical report on mulch application guidelines that appears in the Appendix.



Example of how mulch should be installed, 2-4 inches thick and not against the trunk.


Example of root density under grass versus mulch.



Example of how mulch should be applied from the trunk to the dripline.

Example of improper mulch application, known as "volcano mulch".

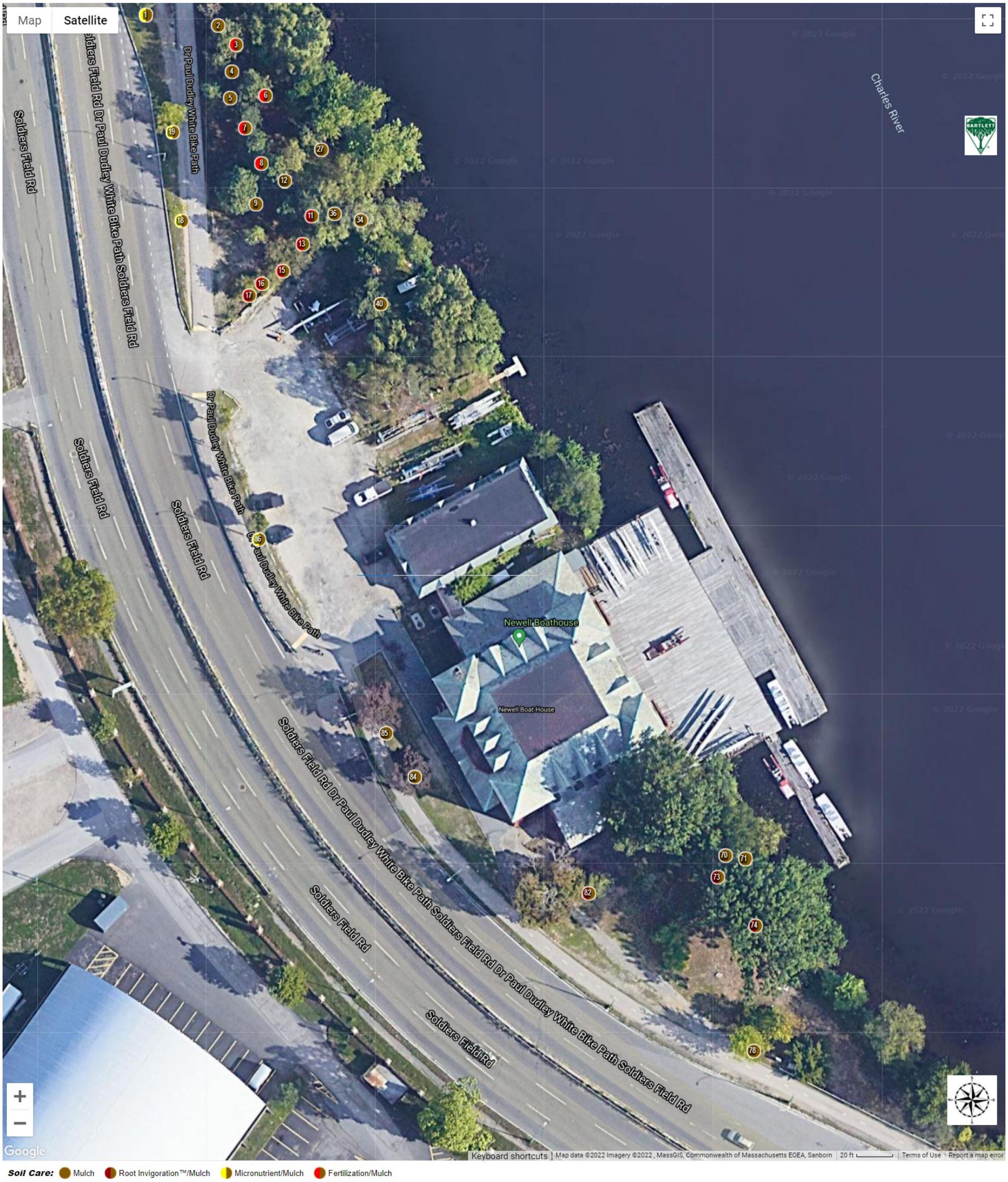
The following inventoried trees are recommended for soil care because of possible nutrient deficiencies, soil compaction, or inadequate soil conditions:

**INVENTORIED TREES RECOMMENDED FOR SOIL CARE (30 Trees)**

| Tree ID | Common Name | DBH | Soil Care | Mulch Recommended |
|---|---|---|---|---|
| **1** | Elm-American | 5 | • Micronutrient | Yes |
| **2** | Pine-Austrian | 15 | ... | Yes |
| **3** | Pine-Austrian | 18 | • Fertilization | Yes |
| **4** | Pine-Austrian | 9 | ... | Yes |

| Tree ID | Common Name | DBH | Soil Care | Mulch Recommended |
|---|---|---|---|---|
| **5** | Pine-Austrian | 13 | ... | Yes |
| **6** | Pine-Austrian | 14 | • Fertilization | Yes |
| **7** | Pine-Austrian | 13 | • Fertilization | Yes |
| **8** | Pine-Austrian | 13 | • Fertilization | Yes |
| **9** | Pine-Austrian | 17 | ... | Yes |
| **11** | Pine-Austrian | 13,7 | • Fertilization | Yes |
| **12** | Pine-Austrian | 14 | ... | Yes |
| **13** | Hawthorn-Washington | 7,6 | • Fertilization | Yes |
| **15** | Hawthorn-Washington | 6,5 | • Fertilization | Yes |
| **16** | Hawthorn-Washington | 4,4,4,4 | • Fertilization | Yes |
| **17** | Hawthorn-Washington | 4 | • Fertilization | Yes |
| **18** | Elm-American | 5 | • Micronutrient | Yes |
| **19** | Elm-American | 6 | • Micronutrient | Yes |
| **27** | Birch-Gray | 9 | ... | Yes |
| **34** | Birch-Gray | 12 | ... | Yes |
| **36** | Birch-Gray | 18 | ... | Yes |
| **40** | Pine-Austrian | 21 | ... | Yes |
| **70** | Cherry-Black | 13 | ... | Yes |
| **71** | Birch-Gray | 11,8 | ... | Yes |
| **73** | Crabapple | 6 | • Root Invigoration ™ | Yes |
| **74** | Oak-Northern Red | 49 | • Root Invigoration ™ | Yes |
| **78** | Elm-American | 11 | ... | Yes |
| **82** | Birch-Gray | 5,4 | • Root Invigoration ™ | Yes |
| **84** | Maple-Norway | 15 | ... | Yes |
| **85** | Maple-Norway | 16 | ... | Yes |
| **86** | Zelkova-Japanese | 7 | • Micronutrient | Yes |

# INVENTORIED TREES RECOMMENDED FOR SOIL CARE



## Root Collar Excavation

Excavating the root collar is necessary for trees whose buttress roots are covered by excess soil or mulch. Buried root collars can contribute to tree health problems, including girdling roots, basal cankers, and masking root and lower stem decay. Trees in the root collar excavation table do not have a Tree & Shrub Work phase and should be completed as soon as possible. The top image shows a buried root collar and the bottom image shows an exposed root collar.

Example of a buried root collar.

Example of an exposed root collar.

## Girdling Roots

Girdling roots (top left and right) restrict water and nutrient movement throughout the tree. If left untreated they can cause the tree to decline, fail (bottom), and eventually die in severe cases. Girdling roots should be removed as soon as possible, unless removal of roots will significantly impact the condition or stability of the tree. In some cases, the presence of significant or severe girdling roots may cause the tree to be recommended for removal.


**Examples of girdling roots.**

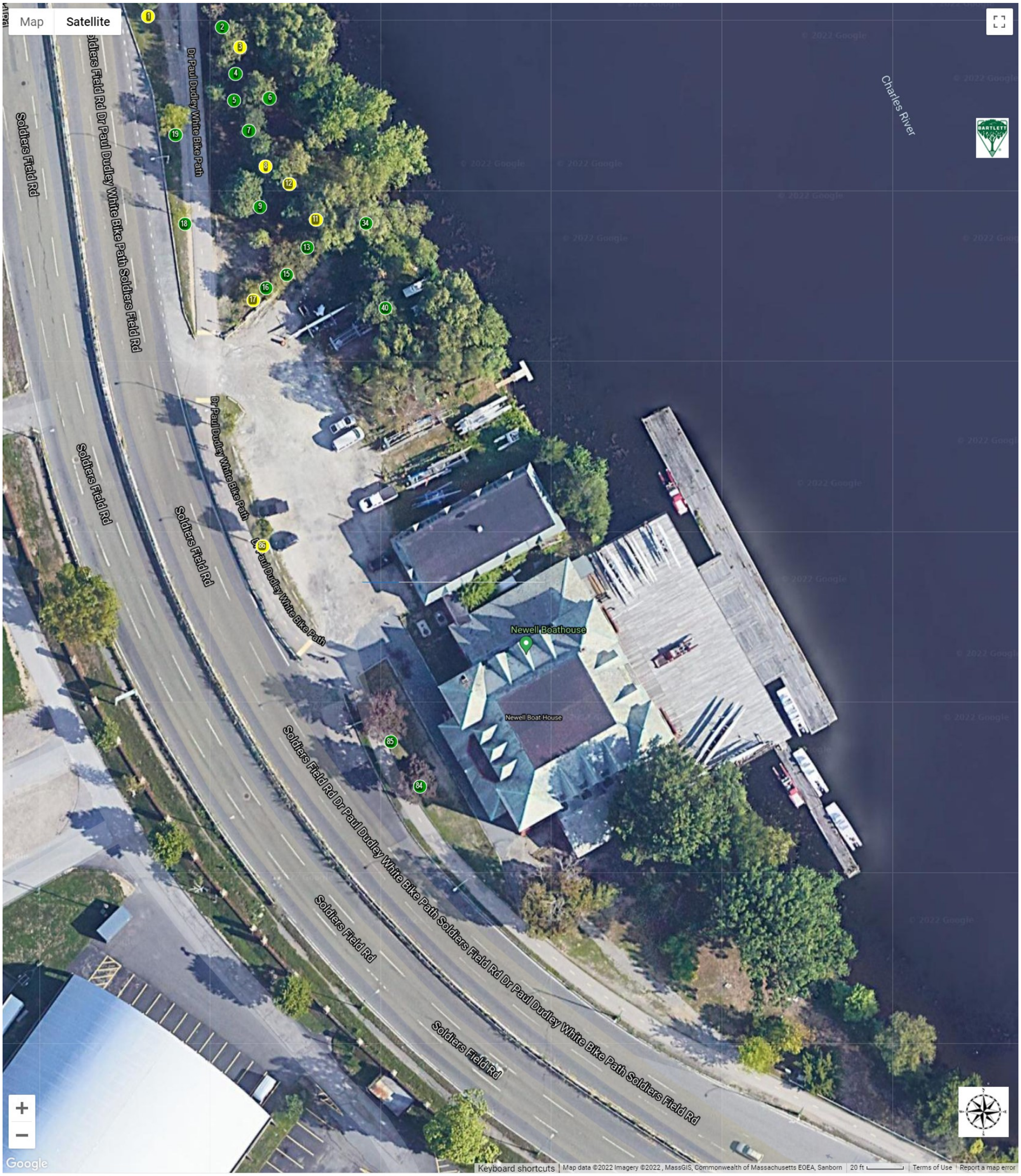
**Example of tree failure from girdling roots.**

The following trees are recommended for a root collar excavation:

**INVENTORIED TREES RECOMMENDED FOR A ROOT COLLAR EXCAVATION (22 Trees)**

| Tree ID | Common Name | DBH | Root Collar Observation |
|---|---|---|---|
| **1** | Elm-American | 5 | • Buried root collar |
| **2** | Pine-Austrian | 15 | • Buried root collar |
| **3** | Pine-Austrian | 18 | • Buried root collar |
| **4** | Pine-Austrian | 9 | • Buried root collar |
| **5** | Pine-Austrian | 13 | • Buried root collar |
| **6** | Pine-Austrian | 14 | • Buried root collar |
| **7** | Pine-Austrian | 13 | • Buried root collar |
| **8** | Pine-Austrian | 13 | • Buried root collar |
| **9** | Pine-Austrian | 17 | • Buried root collar<br>• Girdling roots present |
| **11** | Pine-Austrian | 13,7 | • Buried root collar |
| **12** | Pine-Austrian | 14 | • Buried root collar |
| **13** | Hawthorn-Washington | 7,6 | • Buried root collar |
| **15** | Hawthorn-Washington | 6,5 | • Buried root collar |
| **16** | Hawthorn-Washington | 4,4,4,4 | • Buried root collar |
| **17** | Hawthorn-Washington | 4 | • Buried root collar |
| **18** | Elm-American | 5 | • Buried root collar |
| **19** | Elm-American | 6 | • Buried root collar |
| **34** | Birch-Gray | 12 | • Girdling roots present |
| **40** | Pine-Austrian | 21 | • Buried root collar |
| **84** | Maple-Norway | 15 | • Girdling roots present |
| **85** | Maple-Norway | 16 | • Girdling roots suspected |
| **86** | Zelkova-Japanese | 7 | • Buried root collar |

## INVENTORIED TREES RECOMMENDED FOR A ROOT COLLAR EXCAVATION



## Plant Health Care

The Inventory Team also recommends Plant Health Care (PHC) programs for trees in the formal landscape. In addition, an Integrated Pest Management (IPM) program monitors for potentially damaging insects, diseases and cultural problems that are often seasonal and may not have been evident during our inventory visit. Plant Health Care treatments should be applied as soon as possible, therefore they do not have a Tree & Shrub Work phase. These pests and diseases include, but are not limited to, the following:

- Anthracnose - on a variety of species
- Aphids - on a variety of species
- Bacterial Leaf Scorch - on trees within red oak group
- Bagworms - on a variety of tree species
- Boring Insects - on a variety of tree species
- Caterpillar Defoliators - on a variety of tree species, especially oak
- Gall Insects - on a variety of species
- Lacebugs - on a variety of species
- Scab and Rust Fungi - on crabapple and apple species.
- Suspected Phytophthora Root Rot and Canker - on a variety of tree species, especially beech species
- Scale Insects - on a variety of tree species, especially oak
- Spider Mites - on a variety of tree species

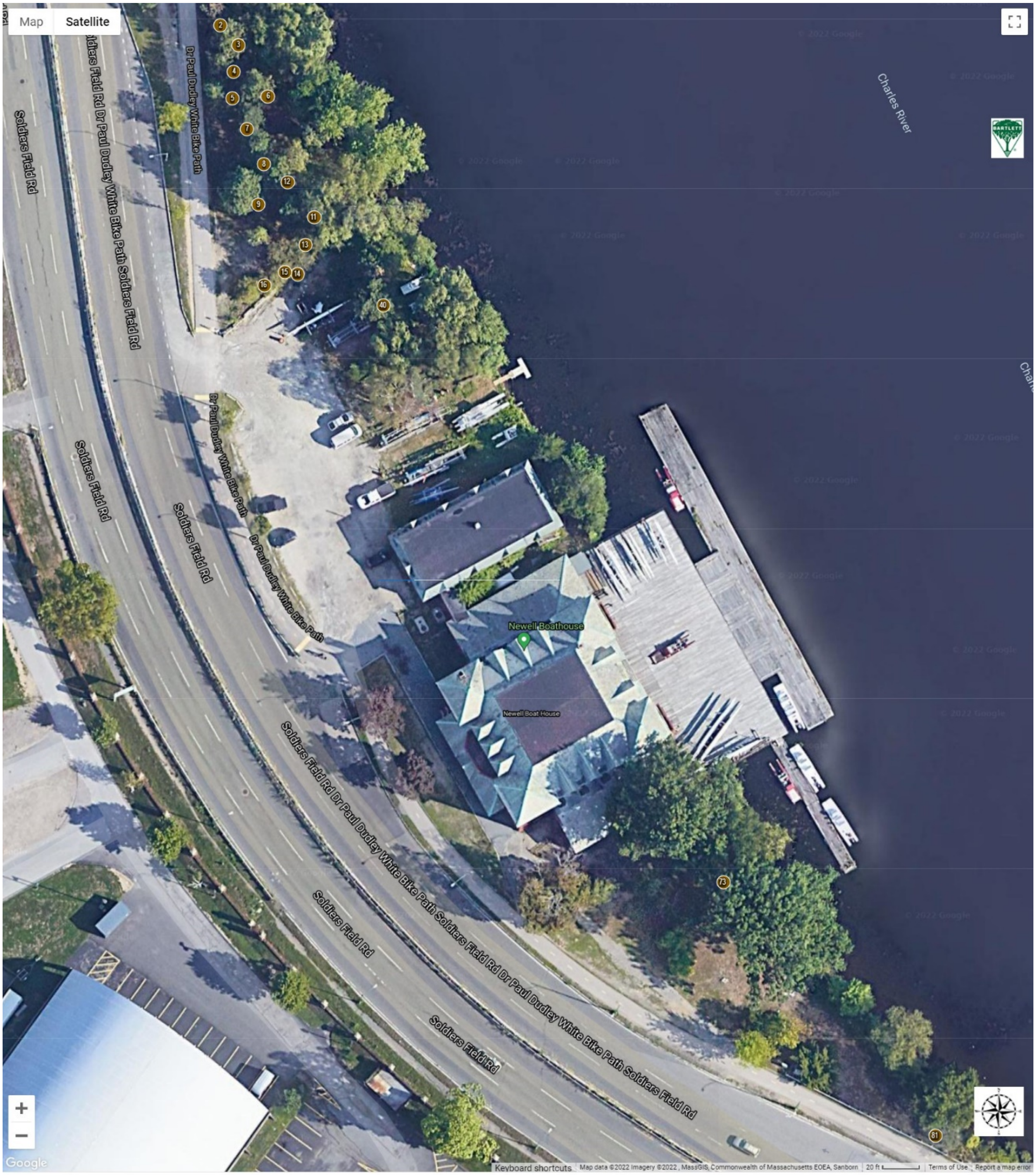
We identified pests or diseases and/or provided plant health care recommendations on the following inventoried trees at the time of the inventory:

**INVENTORIED TREES IDENTIFIED FOR PLANT HEALTH CARE (17 Trees)**

| Tree ID | Common Name | DBH | Pest(s) or Disease(s) |
|---|---|---|---|
| **2** | Pine-Austrian | 15 | • Borers<br>• Tip blight |
| **3** | Pine-Austrian | 18 | • Borers<br>• Tip blight |
| **4** | Pine-Austrian | 9 | • Borers<br>• Tip blight |
| **5** | Pine-Austrian | 13 | • Borers<br>• Tip blight |
| **6** | Pine-Austrian | 14 | • Borers<br>• Tip blight |
| **7** | Pine-Austrian | 13 | • Borers<br>• Tip blight |
| **8** | Pine-Austrian | 13 | • Borers<br>• Tip blight |

| Tree ID | Common Name | DBH | Pest(s) or Disease(s) |
|---|---|---|---|
| **9** | Pine-Austrian | 17 | • Borers<br>• Tip blight |
| **11** | Pine-Austrian | 13,7,7 | • Borers<br>• Tip blight |
| **12** | Pine-Austrian | 14 | • Borers<br>• Tip blight |
| **13** | Hawthorn-Washington | 7,6,6 | • Rust |
| **15** | Hawthorn-Washington | 6,5,5 | • Rust |
| **16** | Hawthorn-Washington | 4,4,4,4,4 | • Rust |
| **40** | Pine-Austrian | 21 | • Borers |
| **73** | Crabapple | 6 | • Cankers<br>• Rust |

## INVENTORIED TREES IDENTIFIED FOR PLANT HEALTH CARE



## Tree Pruning

A commonly offered service among tree companies, pruning trees is one of the most poorly executed practices by tree workers who lack training in the basics of tree biology. "Lion's tailing," topping, and flush cuts are a few examples, and these can lead to hazardous conditions over time.

Because this practice is so misunderstood, and because specific standards exist to perform pruning correctly, the Inventory Team decided to include some explanation in the main body of this management plan.

Tree owners and tree-care practitioners should always keep in mind that any pruning cut is a wound. Informed tree-care professionals have learned to manage that wounding to preserve the health, safety, and integrity of the tree.

### Improper Pruning Practices

A few of the most common pruning abuses are:

- Lion's Tailing - pruning that removes interior branches along the stem and scaffold branches. This encourages poor branch taper, poor wind load distribution, and risk of branch failure. It also deprives the tree of foliage it needs to produce **photosynthates**. See next page, top left.
- Topping - pruning cuts that reduce a tree's size by using heading cuts that shorten branches to a predetermined size. Topping substantially reduces the functional benefits a tree is capable of providing and predisposes trees to structural defects that can contribute to failures in the future. It also reduces the value of the trees substantially and deprives the tree of adequate foliage. See next page, top right.
- Flush Cuts - pruning cut through the **branch collar**, flush against the trunk or parent stem, causing unnecessary injury. See next page, bottom.
- Using Climbing Spikes Inappropriately - Using climbing spikes on a healthy tree, for example, wounds healthy stem tissues and can lead to infection by fungal pathogens.

Example of Lion's tailing.

Examples of topping.

Examples of flush cuts.

**Pruning with a Goal**

Below are illustrations of common pruning goals:

Illustration of improving airflow to reduce disease.

Illustration of branch weight reduction.

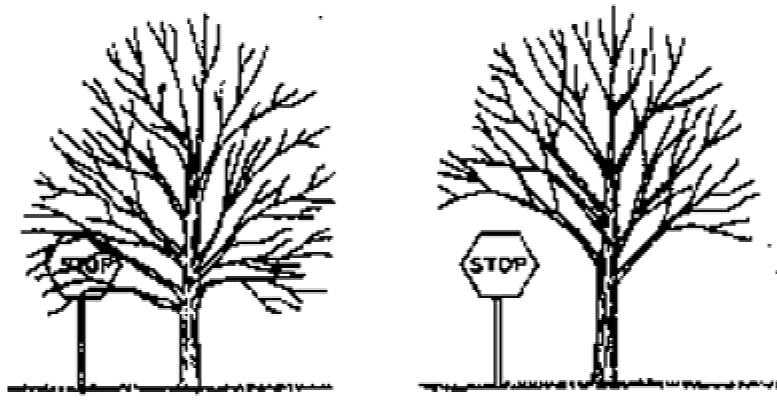



**Illustration of raising branch elevation to improve clearance.**

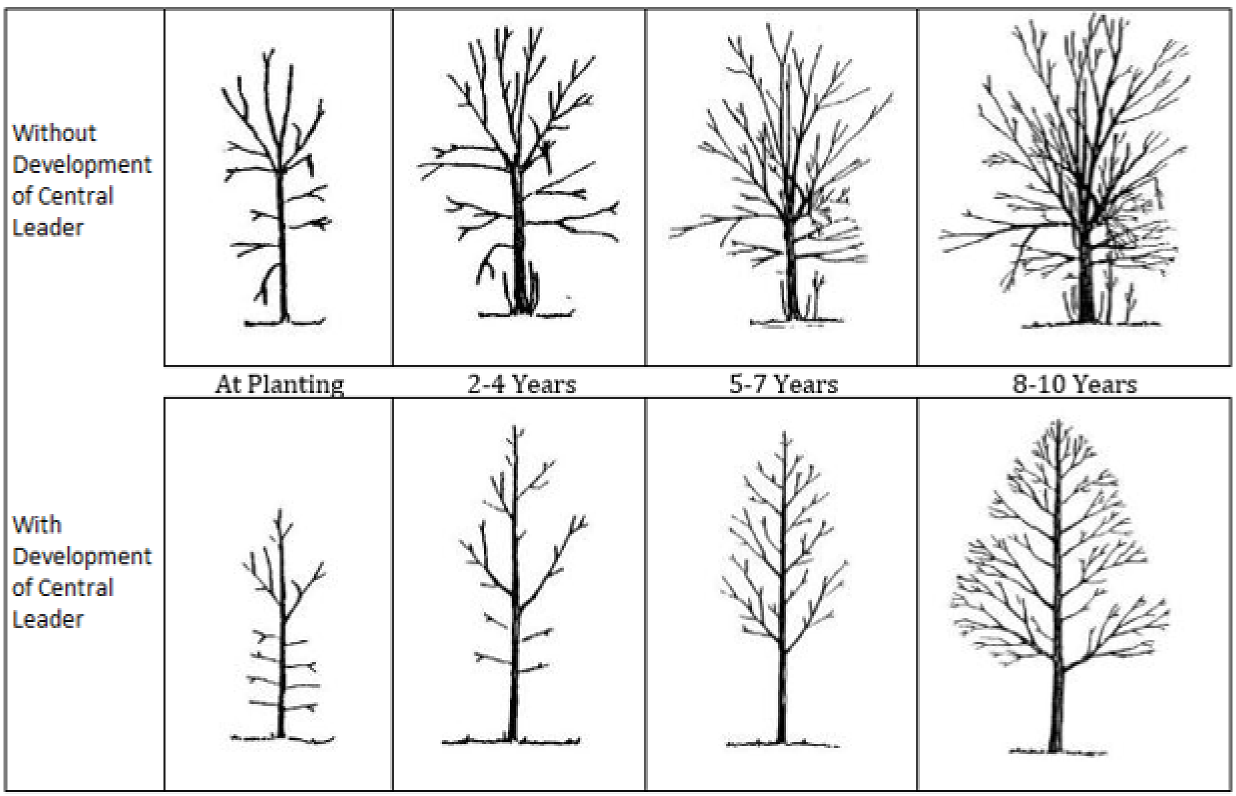



**Illustration of promoting a strong central leader.**

### Pruning Category

All trees identified in this management plan that have pruning recommendations are listed with a specific pruning category. The listed order of these pruning categories are typical to most managers. Trees within each category are prioritized by the specific goals of most managers. It is recommended that specific goals be discussed with your local Bartlett Arborist Representative. Pruning categories are separated into individual tables below where each table lists specific arboricultural pruning goals and recommendations for each tree.

### Risk Mitigation Pruning

Any tree identified with a Risk Mitigation Pruning category to reduce the *Overall Tree Risk Rating*, was previously summarized in the Tree Risk Assessments and Mitigation section earlier in the document.

### Maintenance Pruning

This goal typically requires routine pruning of large/mature trees. Includes branch removal and/or branch reduction to help reduce *likelihood of failure* and/or conflict with infrastructure. Trees with these goals are typically climbed or require the use of aerial lifts and/or other specialized equipment.

The trees in this table are recommended for maintenance pruning:

**INVENTORIED TREES RECOMMENDED FOR MAINTENANCE PRUNING (26 Trees)**

| Tree ID | Common Name | DBH | Tree & Shrub Work Phase | Pruning Goal | Defect(s) or Observation(s) |
|---|---|---|---|---|---|
| **22** | Birch-Gray | 13,11 | 1 | • Reduce risk of branch stem and/or root failure<br>• Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **62** | Alder-Common | 20 | 1 | • Clearance<br>• Improve appearance | • Dead branches >2<br>• Growing against object<br>• Poor branch structure<br>• Uneven crown |
| **65** | Oak-Black | 26 | 1 | • Improve appearance | • Co-dominant stems<br>• Poor branch structure<br>• Uneven crown<br>• Wound-root |
| **85** | Maple-Norway | 16 | 1 | • Clearance<br>• Develop branch structure<br>• Improve appearance | • Girdling roots suspected<br>• Poor branch structure<br>• Wound-stem |

| Tree ID | Common Name | DBH | Tree & Shrub Work Phase | Pruning Goal | Defect(s) or Observation(s) |
|---|---|---|---|---|---|
| **95** | Crabapple | 8 | 1 | • Improve appearance<br>• Develop branch structure | • Broken branch(s)<br>• Dead branches <=2<br>• Decay-root flare<br>• Hanger |
| **1** | Elm-American | 5 | 2 | • Improve appearance<br>• Develop branch structure | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Seam |
| **11** | Pine-Austrian | 13,7 | 2 | • Improve appearance | • Buried root collar<br>• Co-dominant stems<br>• Dead branches >2<br>• Poor branch structure<br>• Uneven crown |
| **40** | Pine-Austrian | 21 | 2 | • Clearance<br>• Develop branch structure<br>• Improve appearance | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **78** | Elm-American | 11 | 2 | • Clearance<br>• Develop branch structure<br>• Improve appearance | • Co-dominant stems<br>• Included bark<br>• Poor branch structure<br>• Uneven crown |
| **2** | Pine-Austrian | 15 | 3 | • Improve appearance | • Buried root collar<br>• Dead branches <=2 |
| **3** | Pine-Austrian | 18 | 3 | • Improve appearance | • Broken branch(s)<br>• Buried root collar<br>• Dead branches <=2<br>• Uneven crown |
| **4** | Pine-Austrian | 9 | 3 | • Improve appearance | • Buried root collar<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown |
| **6** | Pine-Austrian | 14 | 3 | • Improve appearance | • Buried root collar<br>• Dead branches <=2 |
| **7** | Pine-Austrian | 13 | 3 | • Improve appearance | • Buried root collar<br>• Dead branches <=2<br>• Uneven crown |
| **8** | Pine-Austrian | 13 | 3 | • Improve appearance | • Buried root collar<br>• Dead branches <=2<br>• Low vigor |
| **9** | Pine-Austrian | 17 | 3 | • Improve appearance | • Buried root collar<br>• Dead branches <=2<br>• Girdling roots present |

| Tree ID | Common Name | DBH | Tree & Shrub Work Phase | Pruning Goal | Defect(s) or Observation(s) |
|---|---|---|---|---|---|
| **24** | Birch-Gray | 11 | 3 | • Improve appearance | • Broken branch(s)<br>• Dead branches <=2<br>• Poor branch structure |
| **25** | Birch-Gray | 9 | 3 | • Improve appearance | • Dead branches <=2<br>• Low vigor<br>• Uneven crown |
| **27** | Birch-Gray | 9 | 3 | • Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown<br>• Wound-stem |
| **28** | Birch-Gray | 10 | 3 | • Improve appearance<br>• Improve light and air penetration through crown | • Dead branches <=2<br>• Girdling roots present<br>• Lean<br>• Uneven crown |
| **34** | Birch-Gray | 12 | 3 | • Improve appearance | • Co-dominant stems<br>• Girdling roots present<br>• Poor branch structure<br>• Uneven crown |
| **35** | Birch-Gray | 10 | 3 | • Improve appearance<br>• Develop branch structure | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **79** | Elm-American | 16 | 3 | • Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Hanger<br>• Included bark<br>• Poor branch structure |
| **82** | Birch-Gray | 5,4 | 3 | • Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Hanger<br>• Poor branch structure |
| **86** | Zelkova-Japanese | 7 | 3 | • Improve appearance | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Wound-branch |
| **92** | Cherry-Black | 10 | 3 | • Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Hanger<br>• Poor branch structure |

**INVENTORIED TREES RECOMMENDED FOR MAINTENANCE PRUNING**

**Developmental Pruning**

This goal typically requires routine pruning of small/young trees. Includes structural pruning to develop a strong central stem, establish proper branch spacing, and/or develop branch structure.

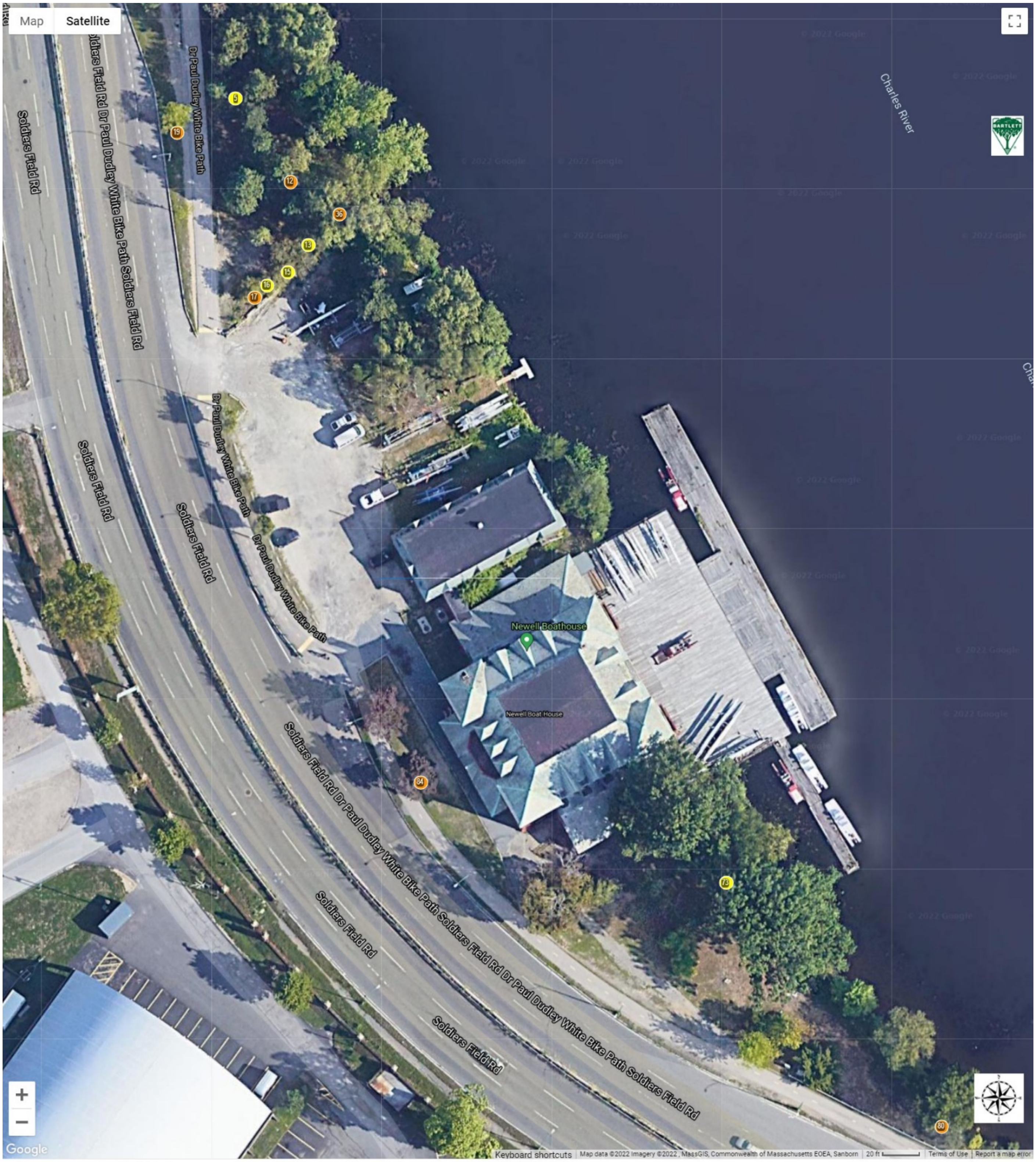
The trees in this table are recommended for developmental pruning:

**INVENTORIED TREES RECOMMENDED FOR DEVELOPMENTAL PRUNING (11 Trees)**

| Tree ID | Common Name | DBH | Tree & Shrub Work Phase | Pruning Goal | Defect(s) or Observation(s) |
|---|---|---|---|---|---|
| **12** | Pine-Austrian | 14 | 2 | • Promote development of strong central stem<br>• Develop branch structure<br>• Improve appearance | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Included bark<br>• Poor branch structure |
| **17** | Hawthorn-Washington | 4 | 2 | • Develop branch structure<br>• Improve light and air penetration through crown<br>• Improve appearance | • Buried root collar<br>• Co-dominant stems<br>• Dead branches >2<br>• Included bark<br>• Poor branch structure<br>• Wound-branch |
| **19** | Elm-American | 6 | 2 | • Develop branch structure<br>• Improve form and shape<br>• Clearance | • Buried root collar<br>• Co-dominant stems<br>• Poor branch structure<br>• Uneven crown<br>• Wound-stem |
| **36** | Birch-Gray | 18 | 2 | • Improve appearance<br>• Reduce weight of branch ends<br>• Clearance | • Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown |
| **80** | Oak-Pin | 19 | 2 | • Develop branch structure<br>• Improve light and air penetration through crown<br>• Improve appearance | • Dead branches >2<br>• Poor branch structure |
| **84** | Maple-Norway | 15 | 2 | • Promote development of strong central stem<br>• Develop branch structure<br>• Clearance | • Co-dominant stems<br>• Girdling roots present<br>• Poor branch structure<br>• Wound-root |

| Tree ID | Common Name | DBH | Tree & Shrub Work Phase | Pruning Goal | Defect(s) or Observation(s) |
|---|---|---|---|---|---|
| **5** | Pine-Austrian | 13 | 3 | • Develop branch structure<br>• Improve appearance<br>• Improve form and shape | • Buried root collar<br>• Dead branches <=2<br>• Poor branch structure<br>• Uneven crown |
| **13** | Hawthorn-Washington | 7,6 | 3 | • Develop branch structure<br>• Improve light and air penetration through crown<br>• Improve appearance | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **15** | Hawthorn-Washington | 6,5 | 3 | • Develop branch structure<br>• Improve light and air penetration through crown<br>• Improve appearance | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Poor branch structure |
| **16** | Hawthorn-Washington | 4,4,4,4 | 3 | • Develop branch structure<br>• Improve light and air penetration through crown<br>• Improve appearance | • Buried root collar<br>• Co-dominant stems<br>• Dead branches <=2<br>• Included bark<br>• Poor branch structure |
| **73** | Crabapple | 6 | 3 | • Develop branch structure<br>• Improve appearance | • Co-dominant stems<br>• Dead branches <=2<br>• Decay-root flare<br>• Poor branch structure<br>• Wound-branch |

## INVENTORIED TREES RECOMMENDED FOR DEVELOPMENTAL PRUNING




*Tree & Shrub Work Phase:* 2 3

## Ornamental Pruning

This goal typically requires pruning of small trees. Includes reduction and/or shearing to its desired shape, size, and/or structure.

At the time of inventory, no trees were recommended for ornamental pruning. However, we recommend close monitoring of trees for changes in condition, especially after weather events not considered normal for the area.

## Specialized Pruning

Trees with this goal require a unique treatment that may include, but not limited to, targeted pruning cuts, removal of nuisance fruit/parasitic plants, and/or rejuvenation/internodal pruning.

At the time of inventory, no trees were recommended for specialized pruning. However, we recommend close monitoring of trees for changes in condition, especially after weather events not considered normal for the area.

## Structural Support Systems

Structural support systems can reduce risk of tree or tree part(s) failure by limiting movement of stems or branches in certain situations. Examples include co-dominant stems or overextended branches with heavy foliage loads.

### Cabling

Cabling is the process of connecting two or more upright stems to one another to add stability and reduce the *likelihood of failure*. In some instances, a lateral branch may be secured to the central leader using a cabling system to support the weight of the branch.

### Bracing

Bracing is the process of securing the union of two co-dominant stems using high strength steel rods to alleviate stresses at the union and reduce the *likelihood of failure*. Bracing may also be used to reinforce trees that have a partial failure and are likely to benefit from bracing.

### Guying

Guying is the process of anchoring a tree's stem to the ground or another immovable object to reduce the likelihood of root failure. Guying can be temporary or permanent and is most often used for establishing a tree in the landscape.

### Propping

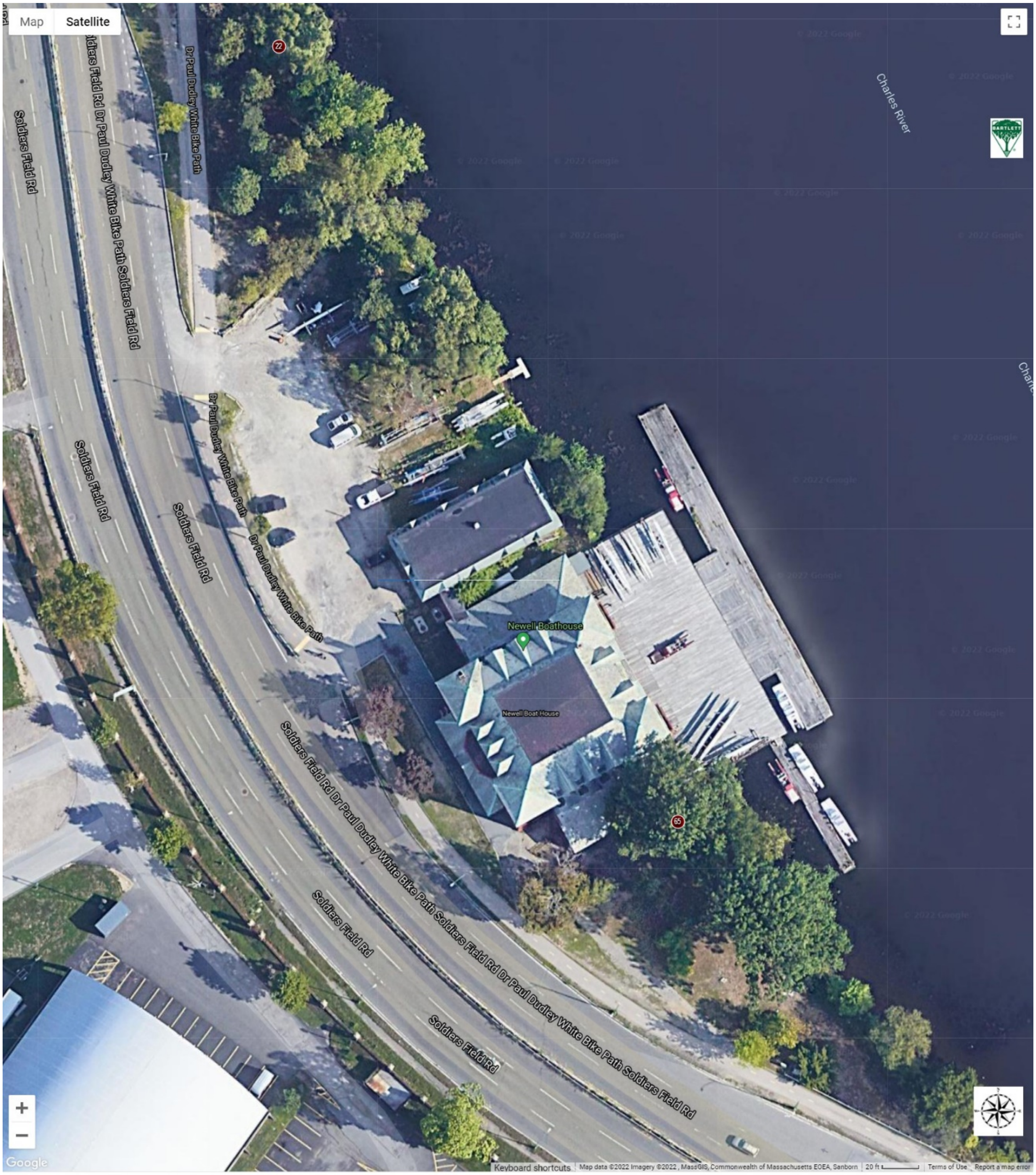
Propping is the process of using rigid structures that are built on or into the ground to help support the trunk or branch(s) that are oriented near the ground in a horizontal position to reduce the *likelihood of failure* from the weight or defect of the tree part being supported.

The following table lists all inventoried trees with structural support system recommendations:

**INVENTORIED TREES WITH STRUCTURAL SUPPORT SYSTEM RECOMMENDATIONS (2 Trees)**

| Tree ID | Common Name | DBH | Tree & Shrub Work Phase | Structural Support |
|---|---|---|---|---|
| **22** | Birch-Gray | 13,11 | 1 | • Cable: New 1 |
| **65** | Oak-Black | 26 | 1 | • Cable: New 1 |

## INVENTORIED TREES WITH STRUCTURAL SUPPORT SYSTEM RECOMMENDATIONS




***Structural Support:*** ● Cable

## Lightning Protection Systems

Lightning strikes kill many people each year and can cause significant damage to objects on the property. Lightning protection systems are designed to provide a preferred path for lightning to the ground in a manner that minimizes tree damage; adjacent tree damage; and also to buildings, property, animals, and people near the tree. Tree species that are naturally more susceptible to lightning strikes, valuable to the landscape, and trees that are within 10 feet of, taller than, or have limbs that are extending over a structure are recommended for lightning protection systems due to the possibility of damage, "sideflashes", and step voltage.

At the time of inventory, no trees were recommended for lightning protection systems. However, as trees continue to grow and site changes occur, we recommend continual consultation with your local Bartlett Arborist Representative to determine if lightning protection systems are warranted in the future.

## Tree Removal

In some cases, the inspector may determine need for removal while assessing the tree. Trees may be recommended for removal during the inventory for several reasons:

- The tree is dead;
- The tree is in poor condition and thought to be beyond rehabilitation;
- The tree is over-mature and will continue to decline in condition;
- The tree has significant structural weaknesses that cannot be addressed;
- The tree is already or will interfere with infrastructure (overhead lines for example);
- The location value for the tree is poor or unacceptable (for example, large maturing tree growing directly under overhead lines); and/or,
- The tree species has been declared an invasive for the given area or region.

The trees listed in the table below are recommended for removal:

**INVENTORIED TREES RECOMMENDED FOR REMOVAL (32 Trees)**

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Tree & Shrub Work Phase | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|
| **46** | Birch-Gray | 15 | Fair | Moderate | 1 | • Co-dominant stems<br>• Dead branches >2<br>• Hanger<br>• Included bark<br>• Poor branch structure |
| **39** | Pine-Austrian | 14 | Dead | Low | ASAP | • Dead branches >2<br>• Dead/dying stem |
| **48** | Birch-Gray | 4 | Dead | Low | ASAP | • Dead branches >2<br>• Dead/dying stem |
| **66** | Oak-Pin | 32 | Fair | Low | ASAP | • Butt swell<br>• Fungi/conks<br>• Uneven crown<br>• Poor branch structure<br>• Dead branches >2 |
| **83*** | Maple-Norway | 25 | Poor | Low | ASAP | • Co-dominant stems<br>• Dead branches >2<br>• Dieback (severe)<br>• Poor branch structure |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Tree & Shrub Work Phase | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|
| **87*** | Zelkova-Japanese | 9 | Poor | Low | ASAP | • Buried root collar<br>• Dead branches >2<br>• Dieback (severe)<br>• Low vigor<br>• Wound-stem |
| **88*** | Zelkova-Japanese | 9 | Poor | Low | ASAP | • Buried root collar<br>• Co-dominant stems<br>• Dead branches >2<br>• Dieback (moderate)<br>• Low vigor<br>• Poor branch structure |
| **10** | Birch-Gray | 4 | Poor | Low | 1 | • Co-dominant stems<br>• Dead branches <=2<br>• Decay-root flare<br>• Poor branch structure<br>• Uneven crown<br>• Wound-root flare |
| **14** | Hawthorn-Washington | 6 | Poor | Low | 1 | • Co-dominant stems<br>• Dead branches <=2<br>• Decay-root flare<br>• Fungi/conks<br>• Poor branch structure<br>• Uneven crown |
| **26** | Maple-Silver | 26 | Poor | Low | 1 | • Broken branch(s)<br>• Co-dominant stems<br>• Dead branches >2<br>• Hanger<br>• Poor branch structure<br>• Storm damage |
| **41*** | Birch-Gray | 5 | Fair | Low | 1 | • Co-dominant stems<br>• Growing against object<br>• Poor branch structure<br>• Uneven crown |
| **45*** | Birch-Gray | 7 | Fair | Low | 1 | • Co-dominant stems<br>• Growing against object<br>• Poor branch structure<br>• Uneven crown |
| **47*** | Birch-Gray | 8 | Fair | Low | 1 | • Co-dominant stems<br>• Dead branches >2<br>• Growing against object<br>• Included bark<br>• Poor branch structure<br>• Uneven crown |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Tree & Shrub Work Phase | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|
| **49*** | Birch-Gray | 4 | Fair | Low | 1 | • Poor branch structure<br>• Uneven crown |
| **50*** | Birch-Gray | 13 | Fair | Low | 1 | • Co-dominant stems<br>• Dead branches <=2<br>• Growing against object<br>• Included bark<br>• Poor branch structure |
| **64*** | Birch-Gray | 11 | Fair | Low | 1 | • Dead branches >2<br>• Poor branch structure<br>• Suppressed<br>• Uneven crown<br>• Wound-root |
| **68** | Maple-Red | 16 | Poor | Low | 1 | • Cavity-stem<br>• Co-dominant stems<br>• Dead branches <=2<br>• Decay-stem<br>• Poor branch structure<br>• Uneven crown |
| **94** | Alder-Common | 13 | Poor | Low | 1 | • Dead branches >2<br>• Dieback (severe)<br>• Poor branch structure |
| **20** | Birch-Gray | 5 | Fair | Low | 2 | • Co-dominant stems<br>• Poor branch structure<br>• Suppressed<br>• Uneven crown |
| **23** | Birch-Gray | 5 | Fair | Low | 2 | • Dead branches <=2<br>• Poor branch structure<br>• Uneven crown<br>• Wound-root flare |
| **31*** | Maple-Silver | 24 | Good | Low | 2 | • Co-dominant stems<br>• Included bark<br>• Lean<br>• Poor branch structure<br>• Uneven crown |
| **33*** | Crabapple | 5 | Poor | Low | 2 | • Co-dominant stems<br>• Dead branches <=2<br>• Low vigor<br>• Poor branch structure<br>• Wound-root flare |

| Tree ID | Common Name | DBH | Condition | *Overall Tree Risk Rating* | Tree & Shrub Work Phase | Defect(s) or Observation(s) |
|---|---|---|---|---|---|---|
| **37** | Crabapple | 16 | Poor | Low | 2 | • Co-dominant stems<br>• Dead branches <=2<br>• Decay-stem<br>• Poor branch structure<br>• Wound-root<br>• Wound-root flare |
| **42*** | Birch-Gray | 6 | Good | Low | 2 | • Poor branch structure<br>• Uneven crown |
| **51*** | Alder-Common | 11 | Good | Low | 2 | • Co-dominant stems<br>• Poor branch structure<br>• Uneven crown |
| **53** | Birch-Gray | 5 | Fair | Low | 2 | • Dead branches <=2<br>• Hanger<br>• Poor branch structure |
| **61** | Mulberry-White | 5 | Fair | Low | 2 | • Co-dominant stems<br>• Included bark<br>• Poor branch structure<br>• Uneven crown |
| **63** | Cherry-Black | 10 | Fair | Low | 2 | • Co-dominant stems<br>• Poor branch structure<br>• Uneven crown |
| **67** | Cherry-Black | 12 | Poor | Low | 2 | • Co-dominant stems<br>• Dead branches >2<br>• Dieback (moderate)<br>• Lean<br>• Poor branch structure |
| **69** | Cherry-Black | 7 | Fair | Low | 2 | • Dead branches <=2<br>• Low vigor<br>• Suppressed<br>• Sweep<br>• Uneven crown |
| **81** | Pear-Callery | 13 | Poor | Low | 2 | • Decay-stem<br>• Lean<br>• Poor branch structure<br>• Uneven crown<br>• Wound-stem |
| **91** | Birch-Gray | 5 | Fair | Low | 2 | • Dead branches <=2<br>• Low vigor<br>• Uneven crown |

* Trees that were assigned a poor or unacceptable location value.

**INVENTORIED TREES RECOMMENDED FOR REMOVAL**

# ENTIRE INVENTORY

## ENTIRE INVENTORY (80 Trees)

| Tree ID | Common Name | Genus | Species | DBH | Height Class | Age Class | Condition Class | Tree & Shrub Work Phase | Estimated\estimated Suitability For Preservation |
|---|---|---|---|---|---|---|---|---|---|
| **1** | Elm-American | *Ulmus* | *americana* | 5 | Medium | Young | Fair | 2 | Moderate |
| **2** | Pine-Austrian | *Pinus* | *nigra* | 15 | Medium | Semi-mature | Good | 3 | Moderate |
| **3** | Pine-Austrian | *Pinus* | *nigra* | 18 | Medium | Semi-mature | Fair | 3 | Low |
| **4** | Pine-Austrian | *Pinus* | *nigra* | 9 | Medium | Young | Good | 3 | Moderate |
| **5** | Pine-Austrian | *Pinus* | *nigra* | 13 | Medium | Semi-mature | Good | 3 | Low |
| **6** | Pine-Austrian | *Pinus* | *nigra* | 14 | Medium | Semi-mature | Good | 3 | Moderate |
| **7** | Pine-Austrian | *Pinus* | *nigra* | 13 | Medium | Semi-mature | Good | 3 | Moderate |
| **8** | Pine-Austrian | *Pinus* | *nigra* | 13 | Medium | Semi-mature | Fair | 3 | Low |
| **9** | Pine-Austrian | *Pinus* | *nigra* | 17 | Medium | Semi-mature | Good | 3 | Moderate |
| **10** | Birch-Gray | *Betula* | *populifolia* | 4,3 | Medium | Young | Poor | 1 | Low |
| **11** | Pine-Austrian | *Pinus* | *nigra* | 13,7 | Medium | Semi-mature | Fair | 2 | Low |
| **12** | Pine-Austrian | *Pinus* | *nigra* | 14 | Medium | Semi-mature | Fair | 2 | Low |
| **13** | Hawthorn-Washington | *Crataegus* | *phaenopyrum* | 7,6 | Medium | Semi-mature | Good | 3 | Moderate |
| **14** | Hawthorn-Washington | *Crataegus* | *phaenopyrum* | 6,3,3 | Medium | Semi-mature | Poor | 1 | Low |

| Tree ID | Common Name | Genus | Species | DBH | Height Class | Age Class | Condition Class | Tree & Shrub Work Phase | Estimated\estimated Suitability For Preservation |
|---|---|---|---|---|---|---|---|---|---|
| **15** | Hawthorn-Washington | *Crataegus* | *phaenopyrum* | 6,5 | Medium | Semi-mature | Good | 3 | Moderate |
| **16** | Hawthorn-Washington | *Crataegus* | *phaenopyrum* | 4,4,4,4 | Medium | Semi-mature | Good | 3 | Moderate |
| **17** | Hawthorn-Washington | *Crataegus* | *phaenopyrum* | 4 | Medium | Semi-mature | Fair | 2 | Low |
| **18** | Elm-American | *Ulmus* | *americana* | 5 | Medium | Young | Good | ... | Moderate |
| **19** | Elm-American | *Ulmus* | *americana* | 6 | Medium | Young | Good | 2 | Moderate |
| **20** | Birch-Gray | *Betula* | *populifolia* | 5,5 | Medium | Young | Fair | 2 | Low |
| **21** | Birch-Gray | *Betula* | *populifolia* | 9 | Medium | Semi-mature | Fair | ... | Low |
| **22** | Birch-Gray | *Betula* | *populifolia* | 13,11 | Medium | Semi-mature | Good | 1 | Moderate |
| **23** | Birch-Gray | *Betula* | *populifolia* | 5 | Medium | Young | Fair | 2 | Low |
| **24** | Birch-Gray | *Betula* | *populifolia* | 11 | Medium | Semi-mature | Good | 3 | Moderate |
| **25** | Birch-Gray | *Betula* | *populifolia* | 9 | Medium | Semi-mature | Fair | 3 | Low |
| **26** | Maple-Silver | *Acer* | *saccharinum* | 26 | Medium | Mature | Poor | 1 | Low |
| **27** | Birch-Gray | *Betula* | *populifolia* | 9 | Medium | Semi-mature | Good | 3 | Moderate |
| **28** | Birch-Gray | *Betula* | *populifolia* | 10 | Medium | Semi-mature | Good | 3 | Moderate |
| **29** | Maple-Red | *Acer* | *rubrum* | 6 | Medium | Young | Good | ... | Moderate |
| **31** | Maple-Silver | *Acer* | *saccharinum* | 24 | Medium | Mature | Good | 2 | Low |
| **33** | Crabapple | *Malus* | sp. | 5,4,4,4 | Small | Semi-mature | Poor | 2 | Low |
| **34** | Birch-Gray | *Betula* | *populifolia* | 12 | Medium | Semi-mature | Good | 3 | Moderate |

| Tree ID | Common Name | Genus | Species | DBH | Height Class | Age Class | Condition Class | Tree & Shrub Work Phase | Estimated\estimated Suitability For Preservation |
|---|---|---|---|---|---|---|---|---|---|
| **35** | Birch-Gray | *Betula* | *populifolia* | 10 | Medium | Semi-mature | Good | 3 | Moderate |
| **36** | Birch-Gray | *Betula* | *populifolia* | 18 | Medium | Semi-mature | Good | 2 | Moderate |
| **37** | Crabapple | *Malus* | sp. | 16 | Medium | Semi-mature | Poor | 2 | Low |
| **38** | Alder-Common | *Alnus* | *glutinosa* | 7 | Medium | Semi-mature | Good | ... | Moderate |
| **39** | Pine-Austrian | *Pinus* | *nigra* | 14 | Medium | Semi-mature | Dead | ASAP | Low |
| **40** | Pine-Austrian | *Pinus* | *nigra* | 21 | Medium | Semi-mature | Good | 2 | Low |
| **41** | Birch-Gray | *Betula* | *populifolia* | 5,5,4 | Medium | Young | Fair | 1 | Low |
| **42** | Birch-Gray | *Betula* | *populifolia* | 6 | Medium | Young | Good | 2 | Low |
| **45** | Birch-Gray | *Betula* | *populifolia* | 7,6,6,4 | Medium | Semi-mature | Fair | 1 | Low |
| **46** | Birch-Gray | *Betula* | *populifolia* | 15 | Medium | Semi-mature | Fair | 1 | Low |
| **47** | Birch-Gray | *Betula* | *populifolia* | 8,7 | Medium | Semi-mature | Fair | 1 | Low |
| **48** | Birch-Gray | *Betula* | *populifolia* | 4 | Medium | Young | Dead | ASAP | Low |
| **49** | Birch-Gray | *Betula* | *populifolia* | 4 | Medium | Young | Fair | 1 | Low |
| **50** | Birch-Gray | *Betula* | *populifolia* | 13,11 | Medium | Semi-mature | Fair | 1 | Low |
| **51** | Alder-Common | *Alnus* | *glutinosa* | 11 | Medium | Semi-mature | Good | 2 | Low |
| **53** | Birch-Gray | *Betula* | *populifolia* | 5 | Medium | Young | Fair | 2 | Low |
| **58** | Alder-Common | *Alnus* | *glutinosa* | 4,4,4 | Medium | Young | Good | ... | Low |
| **61** | Mulberry-White | *Morus* | *alba* | 5,5,4,4,4 | Medium | Young | Fair | 2 | Low |

| Tree ID | Common Name | Genus | Species | DBH | Height Class | Age Class | Condition Class | Tree & Shrub Work Phase | Estimated\estimated Suitability For Preservation |
|---|---|---|---|---|---|---|---|---|---|
| **62** | Alder-Common | *Alnus* | *glutinosa* | 20 | Medium | Mature | Fair | 1 | Moderate |
| **63** | Cherry-Black | *Prunus* | *serotina* | 10 | Medium | Semi-mature | Fair | 2 | Low |
| **64** | Birch-Gray | *Betula* | *populifolia* | 11 | Medium | Semi-mature | Fair | 1 | Low |
| **65** | Oak-Black | *Quercus* | *velutina* | 26 | Large | Mature | Fair | 1 | Moderate |
| **66** | Oak-Pin | *Quercus* | *palustris* | 32 | Large | Mature | Fair | ASAP | Moderate |
| **67** | Cherry-Black | *Prunus* | *serotina* | 12 | Medium | Semi-mature | Poor | 2 | Low |
| **68** | Maple-Red | *Acer* | *rubrum* | 16,12 | Large | Semi-mature | Poor | 1 | Low |
| **69** | Cherry-Black | *Prunus* | *serotina* | 7 | Medium | Young | Fair | 2 | Low |
| **70** | Cherry-Black | *Prunus* | *serotina* | 13 | Large | Semi-mature | Good | ... | Moderate |
| **71** | Birch-Gray | *Betula* | *populifolia* | 11,8 | Large | Semi-mature | Good | ... | Moderate |
| **73** | Crabapple | *Malus* | sp. | 6 | Small | Semi-mature | Fair | 3 | Moderate |
| **74** | Oak-Northern Red | *Quercus* | *rubra* | 49 | Large | Over-mature | Fair | 1 | High |
| **76** | Maple-Norway | *Acer* | *platanoides* | 9 | Medium | Semi-mature | Fair | ... | Low |
| **78** | Elm-American | *Ulmus* | *americana* | 11 | Medium | Semi-mature | Good | 2 | Moderate |
| **79** | Elm-American | *Ulmus* | *americana* | 16 | Medium | Semi-mature | Good | 3 | Moderate |
| **80** | Oak-Pin | *Quercus* | *palustris* | 19 | Medium | Semi-mature | Good | 2 | Moderate |
| **81** | Pear-Callery | *Pyrus* | *calleryana* | 13 | Medium | Semi-mature | Poor | 2 | Low |

| Tree ID | Common Name | Genus | Species | DBH | Height Class | Age Class | Condition Class | Tree & Shrub Work Phase | Estimated\estimated Suitability For Preservation |
|---|---|---|---|---|---|---|---|---|---|
| **82** | Birch-Gray | *Betula* | *populifolia* | 5,4 | Medium | Young | Good | 3 | Moderate |
| **83** | Maple-Norway | *Acer* | *platanoides* | 25 | Large | Mature | Poor | ASAP | Low |
| **84** | Maple-Norway | *Acer* | *platanoides* | 15 | Medium | Semi-mature | Good | 2 | Low |
| **85** | Maple-Norway | *Acer* | *platanoides* | 16 | Medium | Semi-mature | Good | 1 | Low |
| **86** | Zelkova-Japanese | *Zelkova* | *serrata* | 7 | Medium | Young | Fair | 3 | Low |
| **87** | Zelkova-Japanese | *Zelkova* | *serrata* | 9 | Medium | Young | Poor | ASAP | Low |
| **88** | Zelkova-Japanese | *Zelkova* | *serrata* | 9 | Medium | Young | Poor | ASAP | Low |
| **91** | Birch-Gray | *Betula* | *populifolia* | 5 | Medium | Young | Fair | 2 | Low |
| **92** | Cherry-Black | *Prunus* | *serotina* | 10 | Medium | Young | Fair | 3 | Low |
| **93** | Alder-Common | *Alnus* | *glutinosa* | 5 | Medium | Young | Good | ... | Moderate |
| **94** | Alder-Common | *Alnus* | *glutinosa* | 13 | Medium | Semi-mature | Poor | 1 | Low |
| **95** | Crabapple | *Malus* | sp. | 8 | Medium | Semi-mature | Fair | 1 | Low |
| **96** | Birch-Paper | *Betula* | *papyrifera* | 3 | Medium | Young | Good | ... | Low |

# APPENDIX

# ADDITIONAL RESOURCES

Bartlett publishes a variety of tree-resource documents, including technical reports, plant health care recommendations, and service brochures. The following technical reports may be pertinent to your inventory. To access these documents and view the complete Bartlett Resource Library online, please follow this URL:

**https://www.bartlett.com/resourcelist.cfm**

**Girdling Roots**

**Maintenance Pruning Program**

**Monitor IPM Program**

**Mulch Application Guidelines**

**Tree Risk Assessments**

**Tree Structure Evaluation**

## GLOSSARY OF TERMS

**air pollution removal:** removal of pollutants from the air by plants through natural processes

**arborist:** 1. An individual engaged in the profession of arboriculture who, through experience, education and related training, possesses the competence to provide for, or supervise the management of, trees and other woody ornamentals. [ANSI A300 (Part 1, 2, 4, 5, 6)] 2. An individual engaged in the profession of arboriculture. [ANSI Z133.1-2000 Safety Requirements for Arboricultural Operations]

**bracing:** The installation of lag-thread screw or threaded-steel rods in limbs, leaders, or trunks to provide supplemental support. [ANSI A300 (Part 3)-2000 Support Systems]

**branch:** An outgrowing shoot, stem or twig that grows from the main stem or trunk. [ANSI Z60.1-2004 Nursery Stock]

**buttress roots:** Lateral surface roots that aid in stabilizing the tree.

**cable:** 1) Zinc coated strand per ASTM A-475 for dead-end grip applications. 2) Wire rope or strand for general applications. 3) Synthetic-fiber rope or synthetic-fiber webbing for general applications. [ANSI A300 (Part 3)-2000 Support Systems]

**cabling:** The installation of a steel wire rope, steel strand, or synthetic-fiber system within a tree between limbs or leaders to limit movement and provide supplemental support. [ANSI A300 (Part 3)-2000 Support Systems]

**canopy:** collective branches and foliage of a tree or group of trees' crowns

**carbon sequestration:** removal of carbon from the air by plants through natural processes

**carbon storage:** storage of carbon removed from the air in plant tissues

**cation exchange capacity (CEC):** The ability of soil to absorb nutrients.

**cavity:** An open wound characterized by the presence of decay and resulting in a hollow.

**cleaning:** Selective pruning to remove one or more of the following parts: dead, diseased, and/ or broken branches (5.6.1). [ANSI A300 (Part 1)-2001 Pruning]

**co-dominant branches:** Equal in size and importance, usually associated with either the trunks, stems, or scaffold limbs.

**conk:** fruiting body or non-fruiting body of a fungus. Often associated with decay.

**critical root zone (CRZ):** area of soil around a tree trunk where roots are located that provide stability and uptake of water and minerals required for tree survival.

**crown:** 1. The leaves and branches of a tree measured from the lowest branch on the trunk to the top of the tree. [ANSI A300 (Part 1)-2001 Pruning] [ANSI A300 (Part 6)-2005 Transplanting] 2. The portion of a tree comprising the branches. [ANSI Z60.1-2004 Nursery Stock]

**D.B.H. [diameter at breast height]:** Measurement of trunk diameter taken at 4.5 feet (1.4 m) off the ground. [ANSI A300 (Part 6)-2005 Transplanting]

**decay:** The degradation of woody tissue caused by microorganisms. [ANSI A300 (Part 1)-2001 Pruning]

**Geographic Information System (GIS):** is any system for capturing, storing, analyzing and managing data and associated attributes which are spatially referenced to earth.

**girdling root:** A root that may impede proper development of other roots, trunk flare, and/or trunk. [ANSI A300 (Part 6)-2005 Transplanting]

**Global Positioning System (GPS):** A constellation of at least 24 Medium Earth Orbit satellites that transmit precise microwave signals, the system enables a GPS receiver to determine its location, speed, direction, and time.

**Global Positioning System receiver (GPSr):** A receiver that receives its input from GPS satellites to determine location, speed, direction, and time.

**heading:** cutting a shoot back to a bud or cutting branches back to buds, stubs, or lateral branches not large enough to assume apical dominance. Cutting an older branch or stem back to meet a structural objective

**integrated pest management (IPM):** A pest control strategy that uses an array of complementary methods: mechanical devices, physical devices, genetic, biological, legal, cultural management, and chemical management. These methods are done in three stages of prevention, Observation, and finally Intervention. It is an ecological approach that has its main goal is to significantly reduce or eliminate the use of pesticides.

**lateral branch:** A shoot or stem growing from a parent branch or stem. [ANSI A300 (Part 1)-2001 Pruning]

**leader:** A dominant or co-dominant, upright stem. [ANSI A300 (Part 1)-2001 Pruning]

**lean:** Departure from vertical of the stem, beginning at or near the base of the trunk.

**limb:** A large, prominent branch. [ANSI A300 (Part 1)-2001 Pruning]

**lion's tailing:** The removal of an excessive number of inner, lateral branches from parent branches. Lion's tailing is not an acceptable pruning practice (5.5.7). [ANSI A300 (Part 1)-2001 Pruning]

**macronutrient:** Nutrient required in relatively large amounts by plants, such as nitrogen (N), phosphorus (P), potassium (K), and sulfur (S). [ANSI A300 (Part 2)-2004 Fertilization]

**micronutrient:** Nutrient required in relatively small amounts by plants, such as iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), and boron (B). [ANSI A300 (Part 2)-2004 Fertilization]

**noise attenuation:** reducing sound levels via materials, structures, plants, etc.

**nutrient:** Element or compound required for growth, reproduction or development of a plant. [ANSI A300 (Part 2)-2004 Fertilization]

**organic matter:** material derived from the growth (and death) of living organisms. The organic components of soil.

**parent branch or stem:** A tree trunk, limb, or prominent branch from which shoots or stems grow. [ANSI A300 (Part 1)-2001 Pruning]

**pH:** unit of measurement that describes the alkalinity or acidity of a solution. Measured on a scale of 0 to 14. Greater than 7 Is alkaline, less than 7 is acid, and 7 is neutral (pure water).

**pruning:** The selective removal of plant parts to meet specific goals and objectives. [ANSI A300 (Part 1)-2001 Pruning]

**qualified arborist:** An individual who, by possession of a recognized degree, certification, or professional standing, or through related training and on-the-job experience, is familiar with the equipment and hazards involved in arboricultural operations and who has demonstrated ability in the performance of the special techniques involved. [ANSI Z133.1-2000 Safety Requirements for Arboricultural Operations]

**raising:** Selective pruning to provide vertical clearance (5.6.3). [ANSI A300 (Part 1)-2001 Pruning]

**reduction:** Selective pruning to decrease height and/or spread (5.6.4). [ANSI A300 (Part 1)-2001 Pruning]

**risk assessment:** process of evaluating what unexpected things could happen, how likely it is, and what the likely outcomes are. In tree management, the systematic process to determine the level of risk posed by a tree, tree part, or group of trees.

**root collar:** 1. The transition zone between the trunk and the root system. [ANSI A300

(Part 6)-2005 Transplanting] 2. See COLLAR. [ANSI Z60.1-2004 Nursery Stock]

**root flare or trunk flare:** The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk. [ANSI Z60.1-2004 Nursery Stock] [ANSI A300 (Part 6)-2005 Transplanting]

**root zone:** The volume of soil containing the roots of a plant. [ANSI A300 (Part 5)-2005 Management]

**secondary nutrient:** Nutrient required in moderate amounts by plants, such as calcium (Ca) and magnesium (Mg). [ANSI A300 (Part 2)-2004 Fertilization]

**seam:** Vertical line that appears where two edges of wound wood or callus ridge meet.

**soil amendment:** Any material added to soil to alter its composition and structure, such as sand, fertilizer, or organic matter. [ANSI A300 (Part6)-2005 Transplanting]

**soil pH:** A measure of the acidity or alkalinity of the soil.

**stormwater runoff:** water (generally from rain or snow melt) that flows over the ground after storm events.

**structural support system:** hardware installed in tree, may be; cables, braces, or guys, to provide supplemental support.

**sweep:** Departure from vertical of the stem, beginning above the base of the trunk.

**thinning:** Selective pruning to reduce density of live branches (5.6.2). [ANSI A300 (Part 1)-2001 Pruning]

**tree risk assessment:** Closer inspection of visibly damaged, dead, defected, diseased, leaning or dying tree to determine management needs.

**topping:** The reduction of a tree's size using heading cuts that shorten limbs or branches back to a predetermined crown limit. Topping is not acceptable pruning practice. (5.5.7). [ANSI A300 (Part 1)-2001 Pruning]

**tree inventory:** A comprehensive list of individual trees providing descriptive information on all or a portion of the project area. [ANSI A300 (Part 5)-2005 Management during site planning, site development, and construction]

**tree protection zone:** A space above and belowground within which trees are to be retained and protected. [ANSI A300 (Part 5)-2005 Management during site planning, site development, and construction]

**trunk:** That portion of a stem or stems of a tree before branching occurs. [ANSA Z60.1-

2004 Nursery Stock]

**vigor:** Overall health. Capacity to grow and resist stress. [ISA Municipal Specialist Certification Study Guide 2008]

**wound:** An opening that is created when the bark of a living branch or stem is penetrated, cut, or removed. [ANSI A300 (Part 1)-2001 Pruning]

# ATTACHMENT E

## Abutters List

City of Boston
Environment

CITY of BOSTON
Conservation Commission

# AFFIDAVIT OF SERVICE
# FOR ABUTTER NOTIFICATION

**Under the Massachusetts Wetlands Protection Act**
**and Boston Wetlands Ordinance**

I, Charlie Roberts_____________, hereby certify under pains and penalties of perjury that that at least one week prior to the public hearing, I gave notice to abutters in compliance with the second paragraph of Massachusetts General Laws Chapter 131, section 40, and the DEP Guide to Abutter Notification dated April 8, 1994, in connection with the following matter:

A Notice of Intent was filed under the Massachusetts Wetlands Protection Act and/or the Boston Wetlands Ordinance by Harvard University___________________ for the Newell Boathouse Renovations________________________________________ located at 801 Soldiers Field Road, Allston, MA 02134.________________________________.

The Abutter Notification For, the list of abutters to whom it was given, and their addresses are attached to this Affidavit of Service.

Charlie M. Roberts, P.E., D.PE Digitally signed by Charlie M. Roberts, P.E., D.PE DN: cn=Charlie M. Roberts, P.E., D.PE, o=Childs Engineering Corporation, ou, email=robertsc@childseng.com, c=US Date: 2022.04.08 12:20:49 -04'00'
Name

04/08/2022
Date

## Notification to Abutters

In accordance with the Massachusetts Wetlands Protection Act, Massachusetts General Laws Chapter 131, Section 40, and the Boston Wetlands Ordinance, you are hereby notified as an abutter to a project filed with the Boston Conservation Commission.

A. **Harvard University** has filed a Notice of Intent with the Boston Conservation Commission seeking permission to alter an Area Subject to Protection under the Wetlands Protection Act (General Laws Chapter 131, section 40) and Boston Wetlands Ordinance.

B. The address of the lot where the activity is proposed is 801 Soldiers Field Road, Allston, MA.

C. The project involves replacement of existing pier and floating docks, including an extension and additional pier. Installation of timber piles, pile caps, stringers, decking, and floating docks. Installation of two storage pads and renovation to the building interior, and exterior landscape, drainage, and grading.

D. Copies of the Notice of Intent may be obtained by contacting the Boston Conservation Commission at CC@boston.gov.

E. Copies of the Notice of Intent may be obtained from the representative Childs Engineering via email to robertsc@childseng.com.

F. In accordance with the Commonwealth of Massachusetts Executive Order Suspending Certain Provisions of the Open Meeting Law, the public hearing will take place virtually at https://zoom.us/j/6864582044. If you are unable to access the internet, you can call 1-929-205-6099, enter Meeting ID 686 458 2044 # and use # as your participant ID.

G. Information regarding the date and time of the public hearing may be obtained from the Boston Conservation Commission by emailing CC@boston.gov or calling (617) 635-3850 between the hours of 9 AM to 5 PM, Monday through Friday.

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

NOTE: Notice of the public hearing, including its date, tine, and place, will be posted on www.boston.gov/public-notices and in Boston City Hall not less than forty-eight (48) hours in advance.

NOTE: If you would like to provide comments, you may attend the public hearing or send written comments to CC@boston.gov or Boston City Hall, Environment Department, Room 709, 1 City Hall Square, Boston, MA 02201

NOTE: You also may contact the Boston Conservation Commission or the Department of Environmental Protection Northeast Regional Office for more information about this application or the Wetlands Protection Act. To contact DEP, call: the Northeast Region: (978) 694-3200.

LIST OF ABUTTERS

| Parcel No. | Property Address | Owner Name | Owner Address |
|---|---|---|---|
| 2200577000 | 525 Western Ave, Allston, MA 02135 | Commonwealth of Massachusetts | 525 Western Ave, Allston, MA 02134 |
| 2200533000 | 69 N Harvard St, Allston, MA 02135 | Harvard College | 69 N Harvard St, Allston, MA 02134 |

BABEL NOTICE

English:

**IMPORTANT!** This document or application contains **important information** about your rights, responsibilities and/or benefits. It is crucial that you understand the information in this document and/or application, and we will provide the information in your preferred language at no cost to you. If you need them, please contact us at cc@boston.gov or 617-635-3850.

Spanish:

**¡IMPORTANTE!** Este documento o solicitud contiene **información importante** sobre sus derechos, responsabilidades y/o beneficios. Es fundamental que usted entienda la información contenida en este documento y/o solicitud, y le proporcionaremos la información en su idioma preferido sin costo alguno para usted.  Si los necesita, póngase en contacto con nosotros en el correo electrónico cc@boston.gov o llamando al 617-635-3850.

Haitian Creole:

**AVI ENPÒTAN!** Dokiman oubyen aplikasyon sa genyen **enfòmasyon ki enpòtan** konsènan dwa, responsablite, ak/oswa benefis ou yo. Li enpòtan ke ou konprann enfòmasyon ki nan dokiman ak/oubyen aplikasyon sa, e n ap bay enfòmasyon an nan lang ou prefere a, san ou pa peye anyen.  Si w bezwen yo, tanpri kontakte nou nan cc@boston.gov oswa 617-635-3850.

Traditional Chinese:

**非常重要！**這份文件或是申請表格包含關於您的權利，責任，和／或福利的重要信息。請您務必完全理解這份文件或申請表格的全部信息，這對我們來說十分重要。我們會免費給您提供翻譯服務。如果您有需要請聯糸我們的郵箱 cc@boston.gov 電話# 617-635-3850..

Vietnamese:

**QUAN TRỌNG!** Tài liệu hoặc đơn yêu cầu này chứa **thông tin quan trọng** về các quyền, trách nhiệm và/hoặc lợi ích của bạn. Việc bạn hiểu rõ thông tin trong tài liệu và/hoặc đơn yêu cầu này rất quan trọng, và chúng tôi sẽ cung cấp thông tin bằng ngôn ngữ bạn muốn mà không tính phí. Nếu quý vị cần những dịch vụ này, vui lòng liên lạc với chúng tôi theo địa chỉ cc@boston.gov hoặc số điện thoại 617-635-3850.

Simplified Chinese:

**非常重要！**这份文件或是申请表格包含关于您的权利，责任，和／或福利的重要信息。请您务必完全理解这份文件或申请表格的全部信息，这对我们来说十分重要。我们会免费给您提供翻译服务。如果您有需要请联糸我们的邮箱 cc@boston.gov 电话# 617-635-3850.

Cape Verdean Creole:

**INPURTANTI**! Es dukumentu ó aplikason ten **informason inpurtanti** sobri bu direitus, rasponsabilidadis i/ó benefísius. Ê krusial ki bu intendi informason na es dukumentu i/ó aplikason ó nu ta da informason na língua di bu preferênsia sen ninhun kustu pa bó. Si bu prisiza del, kontata-nu na cc@boston.gov ó 617-635-3850.

Arabic:

**مهم!** يحتوي هذا المستند أو التطبيق على معلومات مهمة حول حقوقك ومسؤولياتك أو فوائدك. من الأهمية أن تفهم المعلومات الواردة في هذا المستند أو التطبيق. سوف نقدم المعلومات بلغتك المفضلة دون أي تكلفة عليك. إذا كنت في حاجة إليها، يرجى الاتصال بنا على cc@boston.gov أو 617-635-3850.

Russian:

**ВАЖНО!** В этом документе или заявлении содержится **важная информация** о ваших правах, обязанностях и/или льготах. Для нас очень важно, чтобы вы понимали приведенную в этом документе и/или заявлении информацию, и мы готовы бесплатно предоставить вам информацию на предпочитаемом вами языке. Если Вам они нужны, просьба связаться с нами по адресу электронной почты cc@boston.gov, либо по телефону 617-635-3850.

Portuguese:

**IMPORTANTE!** Este documento ou aplicativo contém **Informações importantes** sobre os seus direitos, responsabilidades e/ou benefícios. É importante que você compreenda as informações contidas neste documento e/ou aplicativo, e nós iremos fornecer as informações em seu idioma de preferência sem nenhum custo para você. Se precisar deles, fale conosco: cc@boston.gov ou 617-635-3850.

French:

**IMPORTANT !** Ce document ou cette demande contient des **informations importantes** concernant vos droits, responsabilités et/ou avantages. Il est essentiel que vous compreniez les informations contenues dans ce document et/ou cette demande, que nous pouvons vous communiquer gratuitement dans la langue de votre choix. Si vous en avez besoin, veuillez nous contacter à cc@boston.gov ou au 617-635-3850.

City of Boston Environment

City of Boston Mayor Martin J. Walsh

# 波士顿湿地保护委员会
# 项目邻近住户通知

根据《马萨诸塞州湿地保护法》、《马萨诸塞州普通法》第 131 章第 40 节以及《波士顿湿地条例》的规定，我们特此向您，即向波士顿湿地保护委员会提出申请的项目的邻近住户，发出以下通知。

A. **Harvard University** 已向波士顿湿地保护委员会提出申请，请求批准改建一块受《湿地保护法》（《普通法》第 131 章第 40 节）和《波士顿湿地条例》保护的地块。

B. 拟开展改建活动的地块地址为：**801 Soldiers Field Rd, Allston, MA** 。

C. 该项目涉及以下建设内容：*对现有码头及浮坞进行更换施工，包括扩建及增设码头。安装木桩、桩帽、桁条、桥面板和浮坞。船坞还将进行翻修，对建筑、景观、斜坡和排水系统进行升级改造。*

D. 可通過聯繫波士頓保護委員會取得意向通知書的副本，電子郵件是 CC@boston.gov。

E. 您可于 **8a-5p, Mon-Fri** 在 **Charlie Roberts, robertsc@childseng.com** 处获取意向通知的副本。

F. 根據《馬薩諸塞州行政命令》（暫緩執行《公開會議法》聽證會將在網上 https://zoom.us/j/6864582044 進行。 如果無法上互聯網 (Internet)，則可致電 1-929-205-6099，輸入會議編號(ID) 686 458 2044＃，然後使用＃作為您參與的編號( ID.)

G. 您可于**周一至周五上午 9 点到下午 5 点**联系**波士顿湿地保护委员会**，咨询公开听证会举行的日期和时间，邮箱地址：**CC@boston.gov**，电话：**(617) 635-4416**。

注：公开听证会的通知（包括其举行日期、时间和地点）将提前至少五天在**《波士顿先驱报》**上予以公布。

注：公开听证会的通知（包括其举行日期、时间和地点）将提前至少四十八（48）小时发布在以下网页之上以及波士顿市政厅内：www.boston.gov/public-notices。如果您想提出意见或建议，您可以参加该公开听证会或将书面形式的意见或建议发送至 CC@boston.gov 或邮寄至以下地址：Boston City Hall, Environment Department, Room 709, 1 City Hall Square, Boston, MA 02201。

注：您也可以联系波士顿湿地保护委员会或环境保护部东北地区办公室，咨询有关此项申请或《湿地保护法》的更多信息。如要联系环境保护部，请致电：东北地区：（978）694-3200。

注：如果您准备参加该公开听证会并需要口译服务，则请在听证会举行前一天中午 12 点前通过以下电子邮箱地址告知工作人员：CC@boston.gov。

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merrimack translations
Professional translation services

TRANSLATION CERTIFICATE

I, Muneebur Rahman, certify to the best of my knowledge and belief that the following is a true and accurate translation of the below-mentioned document(s) from English to Chinese completed under my supervision this 15th day of November, 2021.

Description of document(s): Abutter's notification

Number of pages: 3
Including --
Translation certificate: 1 page
Translation: 1 page(s)
Source: 1 page(s)

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SIGNATURE

On this 15th day of November, 2021, before me, the undersigned notary public, personally appeared Muneebur Rahman who proved to me through satisfactory evidence of identification, which was Massachusetts driver's license, to be the person who signed the above statement in my presence.

JENNIFER CANDIDA BORGES
Notary Public
Commonwealth of Massachusetts
My Commission Expires
December 25, 2026

NOTARY PUBLIC'S SIGNATURE & SEAL

*Replacement of existing pier and floating docks, including an extension and additional pier. Installation of timber piles, pile caps, stringers, decking, and floating docks. The boathouse will also be renovated with upgrades to the building, landscape, grading and drainage.*

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CORPORATE
SEAL
2019
MASSACHUSETTS

对现有码头及浮坞进行更换施工，包括扩建及增设码头。安装木桩、桩帽、桁条、桥面板和浮坞。船坞还将进行翻修，对建筑、景观、斜坡和排水系统进行升级改造。

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SEAL
2019
MASSACHUSETTS

# ATTACHMENT F

## Proof of Mailings