New Street Landscaping

East Boston, Massachusetts

Notice of Intent

April 3, 2019

submitted to
Boston Conservation Commission

submitted by
GEGC 2 New Street, LLC

prepared by
Fort Point Associates, Inc.

in association with
Nitsch Engineering, Inc.
Copley Wolff Design Group

Fort Point Associates, Inc.
Urban Planning Environmental Consulting Project Permitting

TABLE OF CONTENTS

TRANSMITTAL FORM

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

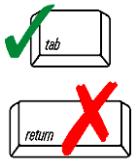
Provided by MassDEP:

MassDEP File Number

Document Transaction Number

East Boston
City/Town

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



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

A. General Information

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

10 New Street — a. Street Address
East Boston — b. City/Town
02128 — c. Zip Code

Latitude and Longitude:
42° 22' 16" — d. Latitude
71° 02' 42" — e. Longitude

Map 01054 — f. Assessors Map/Plat Number
Lot 09000 — g. Parcel /Lot Number

2. Applicant:

Kelly — a. First Name
Saito — b. Last Name
GEGC 2 New Street, LLC — c. Organization
1477 NW Everett Street — d. Street Address
Portland — e. City/Town
OR — f. State
97209 — g. Zip Code
(502) 299-6000 — h. Phone Number
i. Fax Number
kelly.saito@gerdingedlen.com — j. Email Address

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

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

4. Representative (if any):

Richard — a. First Name
Jabba — b. Last Name
Fort Point Associates, Inc. — c. Company
31 State Street, 3rd Floor — d. Street Address
Boston — e. City/Town
MA — f. State
02109 — g. Zip Code
(617) 357-7044 x208 — h. Phone Number
i. Fax Number
rjabba@fpa-inc.com — j. Email address

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

$287.50 — a. Total Fee Paid
$237.50 — b. State Fee Paid
$50.00 — c. City/Town Fee Paid

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A. General Information (continued)

6. General Project Description:

The project involves converting approximately 3,300 square feet of a small public lawn, which is frequently and improperly used for pet relief, into a combination of permeable pavers and pea stone in order to improve water quality and public enjoyment of the space.

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

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

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

1. ☐ Yes ☒ No

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

2. Limited Project Type

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

8. Property recorded at the Registry of Deeds for:

a. County	b. Certificate # (if registered land)
Suffolk	
c. Book	d. Page Number
52576	124

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

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

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

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

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

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Bank	1. linear feet	2. linear feet
b. ☐ Bordering Vegetated Wetland	1. square feet	2. square feet
c. ☐ Land Under Waterbodies and Waterways	1. square feet 3. cubic yards dredged	2. square feet

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
d. ☐ Bordering Land Subject to Flooding	1. square feet 3. cubic feet of flood storage lost	2. square feet 4. cubic feet replaced
e. ☐ Isolated Land Subject to Flooding	1. square feet 2. cubic feet of flood storage lost	3. cubic feet replaced
f. ☐ Riverfront Area	1. Name of Waterway (if available) - **specify coastal or inland**	

2. Width of Riverfront Area (check one):

☐ 25 ft. - Designated Densely Developed Areas only

☐ 100 ft. - New agricultural projects only

☐ 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project: _____ square feet

4. Proposed alteration of the Riverfront Area:

a. total square feet _____ b. square feet within 100 ft. _____ c. square feet between 100 ft. and 200 ft. _____

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

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

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

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

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

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

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

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

	Size of Proposed Alteration	Proposed Replacement (if any)
f. ☐ Coastal Banks	1. linear feet	
g. ☐ Rocky Intertidal Shores	1. square feet	
h. ☐ Salt Marshes	1. square feet	2. sq ft restoration, rehab., creation
i. ☐ Land Under Salt Ponds	1. square feet 2. cubic yards dredged	
j. ☐ Land Containing Shellfish	1. square feet	
k. ☐ Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above	
	1. cubic yards dredged	
l. ☒ Land Subject to Coastal Storm Flowage	1,100 (temporary) 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

   2017
   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 http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/). Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.

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

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

(c) ☐ MESA filing fee (fee information available at http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/mesa/mesa_fee_schedule.htm). 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, http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/mesa/mesa_exemptions.htm; 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@state.ma.us

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@state.ma.us

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.

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

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

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

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

   b. ACEC

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

   a. ☐ Yes ☒ No

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

   a. ☐ Yes ☒ No

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

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

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

      2. ☒ A portion of the site constitutes redevelopment

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

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

      1. ☐ Single-family house

      2. ☐ Emergency road repair

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

D. Additional Information

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

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

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

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

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

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D. Additional Information (cont'd)

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

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

See list of plans in Attachment A, Supplemental Information
a. Plan Title

b. Prepared By

c. Signed and Stamped by

d. Final Revision Date

e. Scale

f. Additional Plan or Document Title

g. Date

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

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

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

8. ☒ Attach NOI Wetland Fee Transmittal Form

9. ☒ Attach Stormwater Report, if needed.

E. Fees

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

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

197007128	04/02/2019
2. Municipal Check Number	3. Check date
197007130	04/02/2019
4. State Check Number	5. Check date
Tetra Tech, Inc.	
6. Payor name on check: First Name	7. Payor name on check: Last Name

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F. Signatures and Submittal Requirements

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

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

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

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

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

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

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

Application

WPA FORM 3 – NOTICE OF INTENT

Enter your transmittal number → X283220 (Transmittal Number)

Your unique Transmittal Number can be accessed online:
http://www.mass.gov/eea/agencies/massdep/service/approvals/transmittal-form-for-payment.html

Massachusetts Department of Environmental Protection

Transmittal Form for Permit Application and Payment

1. Please type or print. A separate Transmittal Form must be completed for each permit application.

2. Make your check payable to the Commonwealth of Massachusetts and mail it with a copy of this form to: MassDEP, P.O. Box 4062, Boston, MA 02211.

3. Three copies of this form will be needed.

Copy 1 - the original must accompany your permit application. **Copy 2** must accompany your fee payment. **Copy 3** should be retained for your records

4. Both fee-paying and exempt applicants must mail a copy of this transmittal form to:

MassDEP
P.O. Box 4062
Boston, MA
02211

*** Note:**
For BWSC Permits, enter the LSP.

A. Permit Information

1. Permit Code: 4 to 7 character code from permit instructions	2. Name of Permit Category
BRP WPA Form 3	Notice of Intent

3. Type of Project or Activity: Landscaping

B. Applicant Information – Firm or Individual

1. Name of Firm - Or, if party needing this approval is an individual enter name below: GEGC 2 New Street, LLC

2. **Last Name** of Individual	3. **First Name** of Individual	4. MI

5. Street Address: 1477 NW Everett Street

6. City/Town	7. State	8. Zip Code	9. Telephone #	10. Ext. #
Portland	OR	97209	(502) 299-6000	

11. Contact Person	12. e-mail address
Kelly Saito	kelly.saito@gerdingedlen.com

C. Facility, Site or Individual Requiring Approval

1. Name of Facility, Site Or Individual: The Eddy

2. Street Address: 10 New Street

3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #
East Boston	MA	02128		

8. DEP Facility Number (if Known)	9. Federal I.D. Number (if Known)	10. BWSC Tracking # (if Known)

D. Application Prepared by (if different from Section B)*

1. Name of Firm Or Individual: Fort Point Associates, Inc.

2. Address: 31 State Street, 3rd Floor

3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #
Boston	MA	02109	(617) 357-7044	208

8. Contact Person	9. LSP Number (BWSC Permits only)
Richard Jabba	

E. Permit - Project Coordination

1. Is this project subject to MEPA review? ☐ yes ☒ no
   If yes, enter the project's EOEA file number - assigned when an Environmental Notification Form is submitted to the MEPA unit:

EOEA File Number

F. Amount Due

DEP Use Only

Permit No:

Rec'd Date:

Reviewer:

Special Provisions:

1. ☐ **Fee** Exempt (city, town or municipal housing authority)(state agency if fee is $100 or less).
   There are no fee exemptions for BWSC permits, regardless of applicant status.
2. ☐ Hardship Request - payment extensions according to 310 CMR 4.04(3)(c).
3. ☐ Alternative Schedule Project (according to 310 CMR 4.05 and 4.10).
4. ☐ Homeowner (according to 310 CMR 4.02).

Check Number	Dollar Amount	Date
197007130	$237.50	04/02/2019

Massachusetts Department of Environmental Protection
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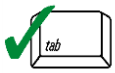
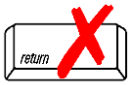
NOI Wetland Fee Transmittal Form

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:

10 New Street	East Boston
a. Street Address	b. City/Town
197007130	$237.50
c. Check number	d. Fee amount

2. Applicant Mailing Address:

Kelly	Saito		
a. First Name	b. Last Name		
GEGC 2 New Street, LLC			
c. Organization			
1477 Everett Street			
d. Mailing Address			
Portland	MA	97209	
e. City/Town	f. State	g. Zip Code	
(502) 299-6000		kelly.saito@gerdingedlen.com	
h. Phone Number	i. Fax Number	j. Email Address	

3. Property Owner (if different):

a. First Name	b. Last Name		
c. Organization			
d. Mailing Address			
e. City/Town	f. State	g. Zip Code	
h. Phone Number	i. Fax Number	j. Email Address	

B. Fees

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

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

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

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

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

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

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

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

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NOI Wetland Fee Transmittal Form

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B. Fees (continued)

Step 1/Type of Activity	Step 2/Number of Activities	Step 3/Individual Activity Fee	Step 4/Subtotal Activity Fee
2(j) Any other activity	1	$500.00	$500.00

Step 5/Total Project Fee:

Step 6/Fee Payments:

Total Project Fee:	$500.00 (a. Total Fee from Step 5)
State share of filing Fee:	$237.50 (b. 1/2 Total Fee **less $**12.50)
City/Town share of filling Fee:	$50.00 (Boston) (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.)

THE FACE OF THIS DOCUMENT CONTAINS A VOID PANTOGRAPH AND MICROPRINTING

TETRA TECH

TETRA TECH, INC
3475 E. Foothill Blvd.
Pasadena CA 91107-6024
626.470.2300

WELLS FARGO BANK, N.A.
Positive Pay Protected

56-382/412

197007130

DATE 04/02/2019

Pay Two Hundred Thirty-seven And 50/100 Dollars

******$237.50**

TO THE ORDER OF
COMMONWEALTH OF MASSACHUSETTS
DEPT OF ENVIRONMENTAL PROTECTION
BOX 4062
BOSTON, MA 02211

VOID AFTER 90 DAYS

⑈197007130⑈ ⑆041203824⑆960004850 5⑈

THE FACE OF THIS DOCUMENT CONTAINS A VOID PANTOGRAPH AND MICROPRINTING

TETRA TECH

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3475 E. Foothill Blvd.
Pasadena CA 91107-6024
626.470.2300

WELLS FARGO BANK, N.A.
Positive Pay Protected

56-382/412

197007128

DATE 04/02/2019

Pay Fifty Only Dollars

******$50.00**

TO THE ORDER OF
CITY OF BOSTON
TREASURY DEPT
PO BOX 9715
BOSTON, MA 02114

VOID AFTER 90 DAYS

⑈197007128⑈ ⑆041203824⑆960004850 5⑈

Attachment A

SUPPLEMENTAL INFORMATION

ATTACHMENT A
SUPPLEMENTAL INFORMATION

1.0 PROJECT SUMMARY

GEGC2 New Street, LLC (the "Applicant"), is proposing landscape changes to the existing waterfront site at 10 New Street, East Boston (the "Project Site"). The property is bound by New Street and the Maverick Landing residential area to the east, the city-owned LoPresti Park to the south, Boston Inner Harbor to the west, and the Boston Towing and Transportation property to the north (see Figure 1, Locus Plan). The purpose of this application is to seek authorization for a change in surface material of a small public lawn frequently used for pet relief. In addition to improving the appearance and use of this space, the Proponent will construct a designated dog area in order to minimize pet waste at and near this active public waterfront area (the "Project").

1.1 EXISTING CONDITIONS

The approximately 4-acre property has a 16-story and a 4-story building, both of which are for residential uses. A restaurant is located on the waterside of the 4-story building. A small lawn area is located on the seaward side of the 16-story building. Filled wharfs that are contained by vertical seawalls are located on the seaward side of the lawn area. See Figure 2, Aerial View and Existing Conditions Photograph Key Plan; and Figure 3, Existing Conditions Photograph.

The Project Site ranges in elevation from approximately 17.4 to 18.95 feet (BCB). The FEMA 100-Year Floodplain Elevation is 17.5 feet BCB (Zone AE 11, NAVD88), which is based on the Flood Insurance Rate Map No. 25025C0081J, March 16, 2016 (see Figure 4, FEMA Flood Insurance Rate Map). The wetland resource areas include Land Subject to Coastal Storm Flowage and the Buffer Zone to the Coastal Bank, which are described below.

The Project Site is adjacent to a Designated Port Area (DPA) that occupies the watersheet along the wharf. A structured turnaround area under the existing lawn was required to provide vehicular access from New Street to the DPA as part of a Chapter 91 license.

1.2 PROJECT NEED

The existing lawn area in front of the 16-story building has become a popular location for area residents to bring and relieve their pets. Despite signage indicating that dogs are not allowed on the lawn, the property managers have had a continual and significant challenge in preventing its use for this purpose. This has resulted in

damaged landscaping and poorly managed pet waste, deteriorating the quality of the public space. To address this issue, the management is proposing the public space be converted to a dedicated fenced area for all pet owners to bring their dogs. A dog management plan, which is detailed below, will supplement this area.

2.0 PROJECT DESCRIPTION

The Applicant intends to improve the use of the Project Site by making it more inviting for the public as well as improving nearby water quality by minimizing dog waste and runoff, as described below. Approximately 3,300 square feet (sf) of the lawn in front of the 16-story building will be converted to permeable pavers (approximately 2,700 sf) in one section and to pea stone (approximately 600 sf) in another section (see Attachment E, NOI Plans). The pea stone area will have a gated, chain link fence around it. Signage will indicate that the area is for public use.

2.1 DOG MANAGEMENT

A Dog Management Plan is a key component of this Project that will help reduce pet waste in the environment, improve water quality in Boston Harbor, and make the area more pet friendly and healthier for all users (see Attachment C, Dog Management Plan). It proposes new signage and dog (and owner) management measures that will work in combination to direct dog owners to use the designated dog area and properly dispose of dog waste. The management will continue to provide a pet waste bag dispenser and a disposal bin.

2.2 STORMWATER AND PERMEABILITY CHANGES

The existing grades and the stormwater drainage system will not be altered. A new subgrade drainage pipe on the down-slope side of the new pavers will be constructed to collect stormwater, which will eventually travel into the existing stormwater treatment system and empty into Boston Harbor.

Although the proposed changes in the land surface will result in slight decreases in runoff from the existing conditions, the Project will not necessitate a change in the stormwater design. The existing stormwater system, which treats runoff before it enters Boston Harbor, can accommodate runoff from one 2-year storm (1″ of rain) according to the engineer's calculations of the permeability of the new pavers and pea stone area (see plan L-1, Landscape Layout and Materials Plan). Furthermore, the pavers will continue to support the DPA vehicle access route and turn around area. Additional information regarding Project compliance with the Stormwater Standards is included in the attached Stormwater Report.

2.3 PROJECT PERMIT HISTORY

The proposed work was originally submitted as part of an RDA in November 2018. It included a canopy on the seaward side of the existing restaurant and landscaping for a dog park and paver replacement on the seaward side of the 16-story building. A Determination was issued in November for only the canopy. At the hearing for that RDA, the Commission requested that the Applicant provide additional information regarding the proposed landscape improvements, including the dog area. An updated RDA that included detailed information and cross sections of the proposed was submitted in March 2019 but was rejected by the Commission's Executive Secretary based on comments at the previous hearing, and a Notice of Intent was requested.

3.0 WETLANDS

3.1 WETLAND RESOURCE AREAS

The entire Project Site is within the 100-foot buffer zone of the Coastal Bank resource area. A small portion of the Project is within the FEMA 100-year flood zone or Land Subject to Coastal Storm Flowage (LSCSF) resource area. These coastal wetlands are subject to the Massachusetts Wetlands Protection Act (WPA) under state jurisdiction. The wetland resource areas are delineated in accordance with criteria developed by state regulatory agencies and were determined by using elevations near and within the Project Site.

The following sections identify the work proposed within coastal resource areas and include descriptions of existing conditions and the significance of the resource areas for the WPA interests. Table 1 provides the sizes of the resource areas impacted by the Project.

Table 1. Resource Area Impacts

Jurisdictional Area	Impact (sf)	Temporary/Permanent
LSCSF	1,100	Temporary
Coastal Bank Buffer Zone	3,200	Temporary

Land Subject to Coastal Storm Flowage

Land Subject to Coastal Storm Flowage is identified as a coastal wetland resource area within the Wetlands Protection Act. It consists of land up to the FEMA 100-Year Floodplain Elevation 17.5 BCB (Zone AE 11, NAVD88). This flood zone extends from the seawall to approximately the first third of the lawn, which slopes up as its distance increases from the water's edge. The only change in the LSCSF includes an approximately 1,100 sf lawn area that will be replaced with permeable pavers. This

landscape activity is well understood and frequently permitted and conditioned in Boston Harbor.

Coastal Bank Buffer Zone

Coastal Bank is defined in the WPA regulations at 310 CMR 10.30(2) as "…the seaward face or side of any elevated landform, other than a coastal dune, which lies at the landward edge of a coastal beach, land subject to tidal action, or other wetland." Coastal Bank resources exist near the Project Site along the edge of the wharf. The Coastal Bank is currently an altered, engineered shoreline comprised of vertical granite and concrete seawalls. The seawall retains fill and provides stability to the landform.

Within the 100-foot Coastal Bank Buffer Zone, changes will include conversion of 2,700 sf of lawn to permeable pavers and 600 sf of lawn to pea stone. A new chain link fence with a gate will surround this pea stone area. These activities will not impact the stability of the Coastal Bank.

3.2 OTHER WETLAND RESOURCE AREAS

There are no Inland Wetlands or Certified/Potential Vernal Pools within or near the work area. The work area is not within Priority or Estimated Habitat as regulated by the Massachusetts Natural Heritage and Endangered Species Program.

4.0 COMPLIANCE WITH PERFORMANCE STANDARDS

The regulations do not contain performance standards for Land Subject to Coastal Storm Flowage. The work activities, however, will protect the interests of the Wetlands Protection Act by not impacting the Coastal Bank or altering existing flood controls, as described below.

4.1 BUFFER ZONE TO COASTAL BANK – 310 CMR 10.30

Under the Wetland Protection Act, a Coastal Bank is determined to be significant to storm damage prevention or flood control because it is a vertical buffer to storm waters. Work will occur within the 100-foot buffer zone of the Coastal Banks, which runs landward 100 feet from the edge of the vertical, granite and concrete seawall. The Project will not alter or have any adverse effects on the stability of the Coastal Bank, as there will be no earth moving or digging within 10 feet of the Coastal Bank.

4.2 LAND SUBJECT TO COASTAL STORM FLOWAGE – 310 CMR 10.02

There are no performance standards for this resource area. The Project will not adversely alter current storm damage prevention or flood control of the resource

area. There will not be any changes in elevation to the existing elevations within the Land Subject to Coastal Storm Flowage. Potential Project-related impacts to wetland resource areas are temporary.

5.0 CONSTRUCTION MITIGATION MEASURES

The Project has been designed to avoid impacts to resource areas and minimize impacts in areas where they are unavoidable. For example, the grading will remain the same to minimize stormwater flows toward the Harbor, and all stormwater will be collected and treated using Best Management Practices to reduce impacts.

Appropriate construction mitigation measures will include safety fences, hay bales, and stormwater drainage sacks to minimize sediment or debris from entering into the stormwater system or nearby waters of Boston Harbor. The Project will employ several mitigation measures to minimize impacts to the resource areas:

- Temporary fencing and hay bales shall be provided until the Project is completed.
- Stormwater drainage sacks will be employed in the new drainage pipe.
- All work will be staged outside of the 100-foot buffer zone.
- There will be no discharge of any pollutants during construction or upon completion.
- The Project Site will be maintained in a clean and orderly manner during construction.

6.0 CONSTRUCTION METHOD AND SCHEDULE

The current construction schedule calls for construction to commence during the summer of 2019 for an approximately 2-month period with only one phase (see Table 2). The Project will not commence until a Determination has been made by the Boston Conservation Commission and other required local and state approvals are obtained.

Table 2. Construction Activities

No.	Main Activity	Activity
1	Site mobilization	Set up work area, safety barriers, and signage erosion control measures.
2	Site work and construction	Remove existing pavers and lawn. Prepare drainage. Install new pavers, stone, and fence.
3	Complete final treatments Demobilize	Install signage and waste bins. Clean Project Site and remove erosion control features, fencing, and safety signage.

7.0 DOCUMENTS SUBMITTED WITH THE NOTICE OF INTENT

The following plans and documents were submitted with this Notice of Intent.

Plans

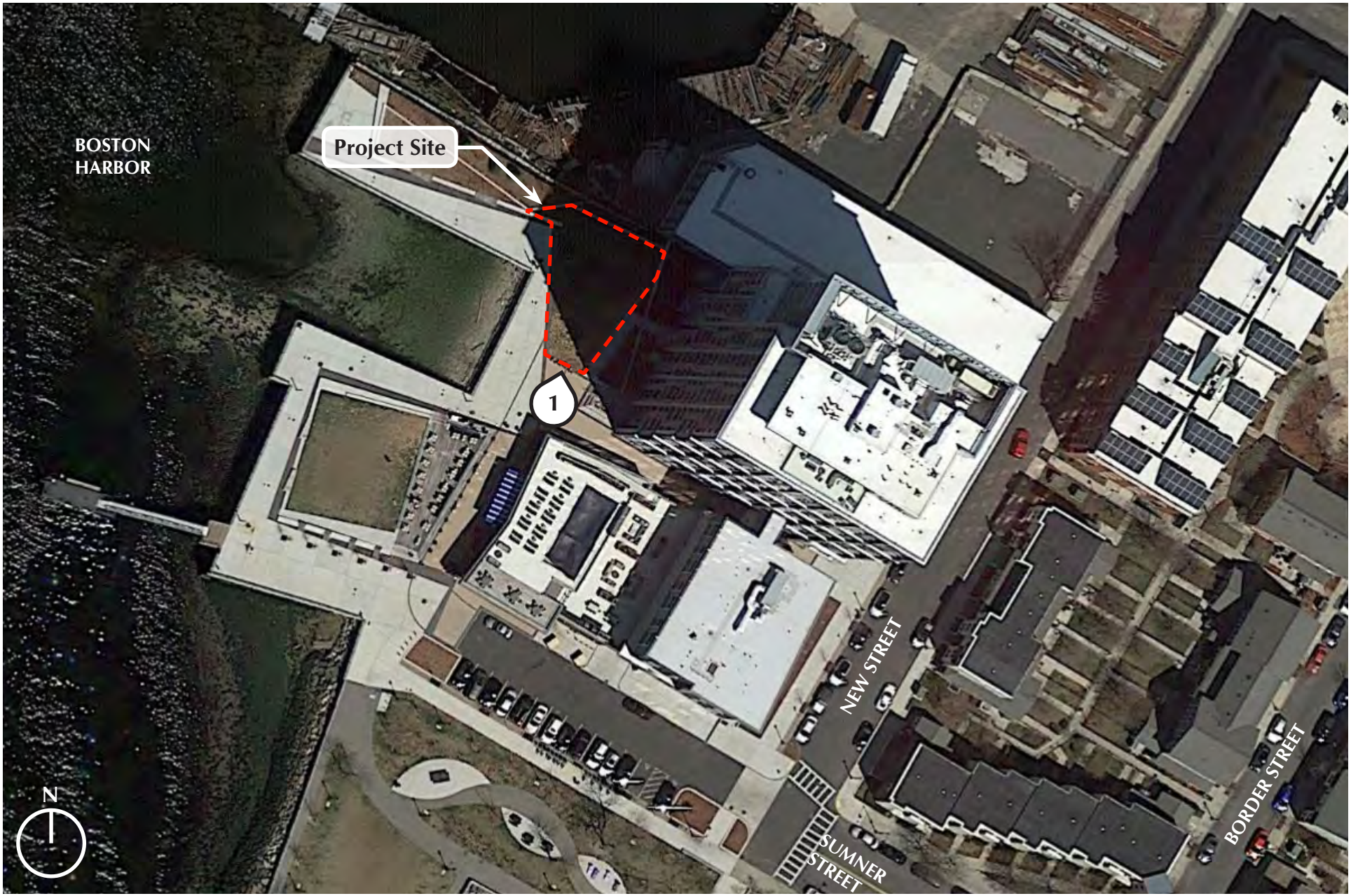
Plan Sheet	NOI-1	NOI-2	NOI-3	L-1
Plan Name	Site Utility Plan	Grading Plan	Stormwater Pollution Prevention Plan	Landscape Layout and Materials Plan
Date	March 2019	March 2019	March 2019	March 2019
Prepared by	Nitsch Engineering	Nitsch Engineering	Nitsch Engineering	Copley Wolff
Scale	1″ = 20′	1″ = 20′	1″ = 20′	1/8″ = 1′
Signed and Stamped by	John Schmid	John Schmid	John Schmid	John Henry Copley, Jr.

Documents

Title	**Prepared By**	**Date**
Stormwater Report	Nitsch Engineering	2019

East Boston, Massachusetts

Figure 1
Locus Map
Source: USGS, 2018



East Boston, Massachusetts

Figure 2

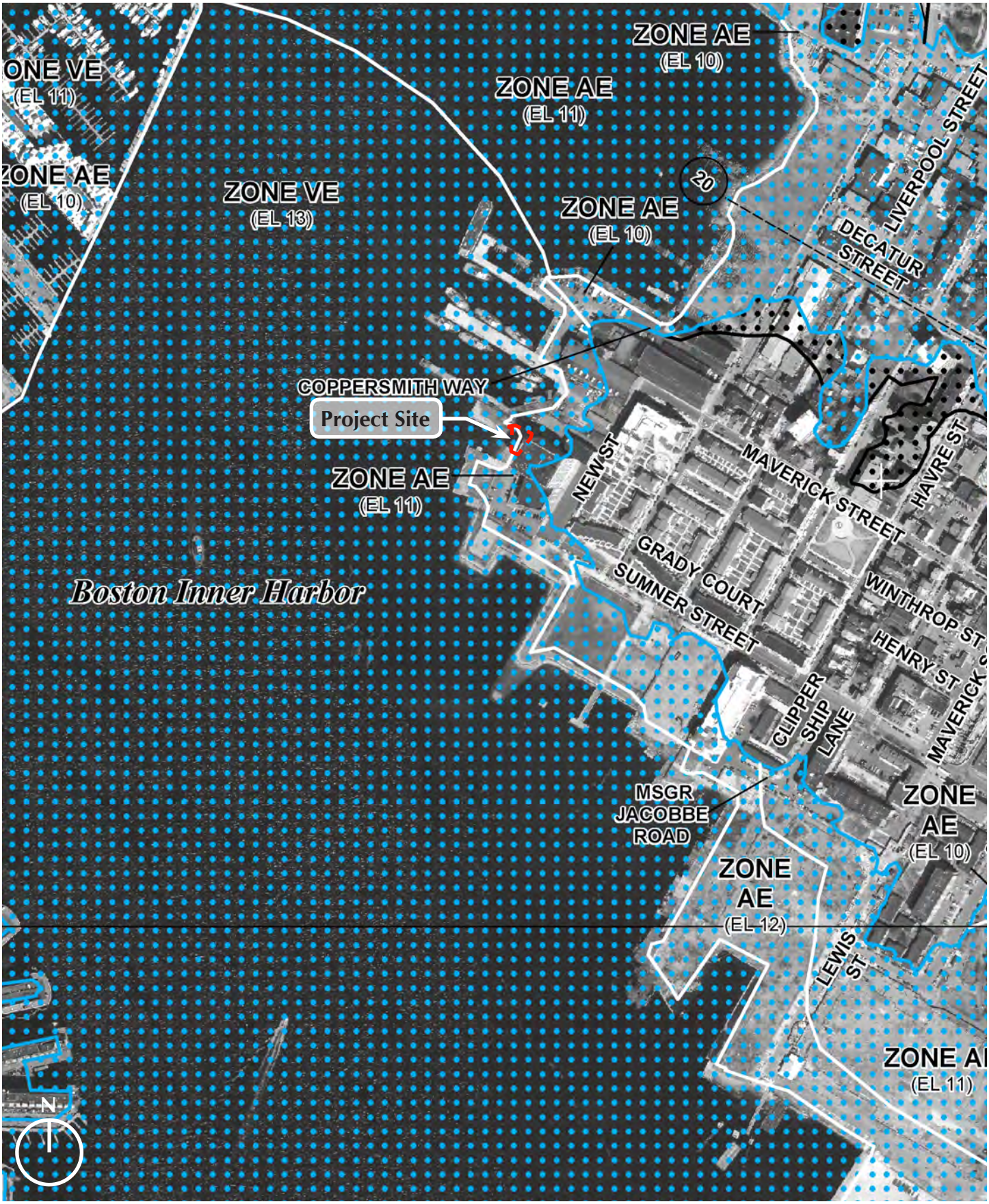
Aerial View and Existing Conditions Photograph Key Plan

Source: Bing Maps, 2017

1. Looking north toward Project Site

East Boston, Massachusetts

Figure 3
Existing Conditions Photograph
Source: Fort Point Associates, Inc., 2019



East Boston, Massachusetts

Figure 4

FEMA Flood Insurance Rate Map

Source: Federal Emergency Management Agency, 2016

Attachment B

NOTIFICATION INFORMATION

ATTACHMENT B
NOTIFICATION INFORMATION

The abutters information was gathered from City of Boston Assessing Office on line database. Abutters are taken within a 100-foot perimeter of the Project property line.

Abutters List

Property	Owner Name	Owner Address	Parcel #
Maverick Landing 3 New Street	Maverick Revitalization Corp.	Maverick Revitalization Corp. 52 Chauncy Street, 10th Floor Boston, MA 02111	0105609010
LoPresti Park	City of Boston	Boston Parks and Recreation 1010 Massachusetts Avenue, 3rd Floor Boston, MA 02118	0105404000
34 New Street	RTC New Street LLC	RTC New Street LLC c/o Reinaur Transportation Company 1983 Richmond Terrace Staten Island, NY 10302	0105411000

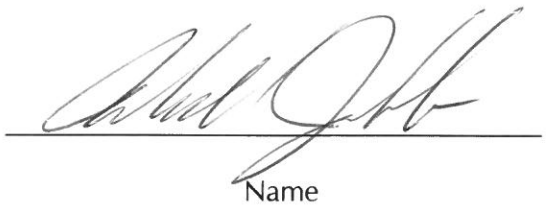
AFFIDAVIT OF SERVICE

Under the Massachusetts Wetlands Protection Act

I, Richard Jabba, hereby certify under the pains and penalties of perjury that on April 3, 2019, I gave notification 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:

The applicant has filed a Notice of Intent in order to alter the existing landscaping along the waterfront side of the existing development at 10 New Street, East Boston. A public hearing on this Project will be held by the Boston Conservation Commission on April 17, 2019 at 6:00 pm in the Piemonte Room, Boston City Hall, 5th Floor, One City Hall Square, Boston, MA.

The form of the notification and a list of the abutters to whom it was given and their addresses are attached to this Affidavit of Service.



Name

April 3, 2019

Date

COMMONWEALTH OF MASSACHUSETTS

Notification to Abutters Under the
Massachusetts Wetlands Protection Act

In accordance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40, you are hereby notified of the following:

A. The name of the applicant is **GEGC 2 New Street, LLC**. The applicant has filed a Notice of Intent with the Conservation Commission for the municipality of **Boston** seeking permission to remove, till, dredge or alter an Area Subject to Protection Under the Wetlands Protection Act (General Laws Chapter 131, section 40).

B. The address of the lot where the activity is proposed **10 New Street, East Boston.**

C. Copies of the Notice of Intent may be examined at **Boston City Hall** between the hours of **9 AM and 5 PM** on the following days of the weeks: **Monday through Friday**. For more information, call: **(617) 635-3850**.

D. Copies of the Notice of Intent may be obtained from the applicant's representative by calling this telephone number **(617) 357-7044 x208** between the hours of **9 AM and 5 PM** on following days of the week: **Monday through-Friday**

E. Information regarding the date, time, and place of the public hearing may be obtained from the **Boston Conservation Commission** by calling this telephone number **(617) 635-3850** between the hours of and on the following days of the week: **Monday through Friday 9 AM to 5 PM**

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, time, and place, will be posted in the City or Town Hall not less than forty-eight (48) hours in advance.

NOTE: You also may contact your local Conservation Commission or the nearest Department of Environmental Protection Regional Office for more information about this application or the Wetlands Protection Act. To contact DEP, call: the Northeast Region: (978) 694-3200.

Attachment C

DOG MANAGEMENT PLAN

Dog Management Plan

10 New Street, East Boston

Overview

The management of the residences at 10 New Street (the "Eddy") consider dog management a high priority in order to maintain a healthy and pet friendly environment. This Dog Management Plan expresses measures to ensure that dog waste is properly managed within the designated dog area to improve the quality of the common spaces at the Eddy. Compliance will likewise help improve Boston Harbor water quality by minimizing dog waste that would otherwise enter the stormwater system.

Designated Dog Area

A designated dog area has been provided on the north side of the site for dog owners to relieve their pets. The approximately 600-square feet area is surrounded by a chain link fence with a gate and has a pea stone surface. A station with a biodegradable dog waste bag dispenser and a disposal container will be placed within this dog area to promote owners to clean-up their pet waste.

The dog area will be maintained as follows:

- On a weekly basis, property maintenance personnel will replace filled can liners and refill the biodegradable waste bag dispensers as necessary.
- On a monthly basis, the "Public Dog Area" sign and the "Pick Up After Your Dog" sign will be checked and secured.
- Every six months, the gate and fence around the dog area will be checked and repaired as necessary.
- Property management will intermittently spot check the property to ensure compliance with the use of the dog waste area.

Signage

The following signs will be located as described below:

- "Public Dog Area" – Posted outside of the fenced dog area.
- "Dog Waste Bag Use Instructions" – Posted within the fenced area with instructions informing dog owners of proper use and disposal locations for biodegradable waste bags. The sign will also instruct users to notify management if there are no more bags.
- "Pick Up After Your Dog" – Posted at two locations: 1) on the outside of the fenced dog area, and 2) in the dog cleaning station within the residential building.

Attachment D

STORMWATER REPORT

Nitsch Engineering

STORMWATER REPORT

Accompanying the
Notice of Intent Report

for

New Street Landscape Improvements

East Boston, MA

Prepared for

New Street Development
6-26 New Street
East Boston, Massachusetts 02128

Prepared by

Nitsch Engineering
2 Center Plaza, Suite 403
Boston, Massachusetts 02108

Nitsch Project #6729.3

March 2019

Building better communities with you.

Nitsch Engineering

2 Center Plaza, Suite 430
Boston, MA 02108-1928
T: 617-338-0063
F: 617-338-6472
www.nitscheng.com

1.0 INTRODUCTION

Nitsch Engineering, Inc. (Nitsch) has performed a stormwater management analysis to compare the pre- and post-development conditions for the new permeable paver and pea stone area at 6-26 New Street, Boston, Massachusetts, between the recently built building and the Boston Harbor. The New Street Development Notice of Intent was permitted in February 2015 (MassDEP File #006-1235).

The proposed improvements include a new permeable paver section and pea stone section where reinforced grass was previously permitted and constructed. This area discharge to the Boston Harbor. There will be no impacts to the drainage system installed in 2015 that discharges to the east towards Sumner Street.

As part of this permit, existing and proposed conditions will be defined as:

> *Existing Conditions:* the current constructed conditions, as permitted in February 2015 (MassDEP File #006-1235);
>
> *Proposed Conditions:* The proposed improvements, which include removing the installed reinforced grass and installing permeable pavers and pea stone.

2.0 EXISTING CONDITIONS

The existing surface cover was reinforced grass (see sheet L-1 for Details). Runoff permeated through the grass, and sheet flowed to area drains to the east during larger storm events. The area drains discharge to the closed drainage system; the system includes a water quality structure designed to treat the water quality volume, a backwater valve to protect the upstream system/development, and an outfall to the Boston Harbor. The stormwater system was designed and permitted to reduce peak runoff rates from the site in the built-out condition compared to the existing conditions in the 2-, 10-, 25- and 100-year storm events. See the Stormwater Report for New Street Development, dated November 2014 for a detailed description of the constructed stormwater system.

The soils underlying the site are characterized by the National Resource Conservation Service (NRCS) as consisting of Udorthents-Urban land complex. Nitsch assumes the soils are classified as a hydrologic soil group D soil.

3.0 PROPOSED STORMWATER SYSTEM

The new peastone area will be a permeable area, and will function similar to the previously installed grass area by allowing water to naturally permeate through the surface material. This will not impact the downstream stormwater management system.

The new vehicular permeable paver section will have a footprint of approximately 2,700 square feet, and will have a stone reservoir with a perforated pipe overflow to prevent heaving during the winter. The perforated drain will overflow to the installed closed drainage system, which is treated by the water quality structure and discharges to the Boston Harbor, as permitted under the 6-26 New Street Project. A minimum of three (3) inches of clean crushed stone will provide dead storage below the perforated pipe, to allow for exfiltration to the subgrade. See L-1 for a proposed detail of the permeable unit paver section, and the layout of pavers. The proposed pea stone will be a permeable material which will not impact the proposed stormwater system.

Nitsch Engineering worked with the manufacturer of the pavers, The Belden/Redland Brick Company. The Manufacturer stated that the approximate permeability of the pavers after an assumed 50% clogging will be approximately 90 inches/hour, and the design slope is acceptable for the installation and permeability of the pavers. Please find enclosed the Technical Notes for the permeable pavers.

Nitsch analyzed the hydrology for the drainage areas with the Soil Conservation Service's (SCS) Runoff Curve Number (CN) methodology. HydroCAD Version 9.00 computer modeling system was used in conjunction with the SCS's methods to determine the peak rates of run-off for the 2-, 10-, 25-, and 100-year storm events.

The proposed conditions peak rates are less than the existing conditions peak rates to the closed drainage system which discharges to the Boston Harbor. The following table present existing peak runoff rates versus proposed peak runoff rates for the 2-, 10-, 25-, and 100-year storms at design point to the harbor [TO BOSTON HARBOR]. The eastern design point [TO SUMNER STREET] will not be impacted as part of these improvements. Find enclosed the existing and proposed HydroCAD analysis for full results.

Table 1: Pre- and Post- Peak Runoff Rates

TO BOSTON HARBOR	2-Year	10-Year	25-Year	100-Year
Existing Conditions	5.80	8.68	10.50	12.71
Proposed Conditions	5.69	8.48	10.23	12.40

The water quality structure, *WQS2,* has been sized per the water quality flow rate discharging to the treatment structure in the Existing Conditions. As discussed and shown in Table 1, the Proposed Conditions reduce the contributing flows to the drainage system discharging to the Boston Harbor, therefor *WQS2* is adequately sized for the proposed conditions.

Methodology

Nitsch Engineering completed a hydrologic analysis of the existing project site utilizing Soil Conservation Service (SCS) Runoff Curve Number (CN) methodology. The SCS method calculates the rate at which the runoff reaches the design point considering several factors: the slope and flow lengths of the subcatchment area, the soil type of the subcatchment area, and the type of surface cover in the subcatchment area. HydroCAD Version 10.00 computer modeling software was used in conjunction with the SCS method to determine the peak runoff rates and runoff volumes for the 2-, 10-, 25-, and 100-year, 24-hour storm events. The proposed project site is being analyzed with the same methodology.

The Site was divided into multiple drainage areas, or subcatchments, which drain to the design points along the property boundary and within the site. For each subcatchment area, SCS Runoff Curve Numbers (CNs) were selected by using the cover type and hydrologic soil group of each area. The peak runoff rates and runoff volumes for the 2-, 10-, 25- and 100-year 24-hour storm events were then determined by inputting the drainage areas, CNs, and time of concentration (T_c) paths into the HydroCAD model.

HydroCAD Version 10.00

The HydroCAD computer program uses SCS and TR-20 methods to model drainage systems. TR-20 (Technical Release 20) was developed by the Soil Conservation Service to estimate runoff and peak discharges in small watersheds. TR-20 is generally accepted by engineers and reviewing authorities as the standard method for estimating runoff and peak discharges.

HydroCAD Version 10.00 uses up to four types of components to analyze the hydrology of a given site: subcatchments, reaches, basins, and links. Subcatchments are areas of land that produce surface runoff. The area, weighted CN, and T_c characterize each individual subcatchment area. Reaches are generally uniform streams, channels, or pipes that convey water from one point to another. A basin is any impoundment that fills with water from one or more sources and empties via an outlet structure. Links are used to introduce hydrographs into a project from another source or to provide a junction for more than one hydrograph within a project. The time span for the model was set for 0-48 hours in order to prevent truncation of the hydrograph.

STORM EVENT

Nitsch used Technical Paper 40 by the National Weather Service to estimate the rainfall intensity for the 2, 10, 25, and 100-year storms. The rainfall intensity rates used are as follows:

Storm Event	24 Hour Precipitation (inches)
2-year	3.20
10-year	4.60
25-year	5.50
100-year	6.60

4.0 MassDEP Stormwater Management Standards

The Project is considered a combination of new development and redevelopment under the DEP Stormwater Management System. However, portions of the improvements located at the existing building and existing paved area could be considered re-development. The Site will be designed to meet and exceed the MassDEP Stormwater Management Standards to the maximum extent practicable as summarized below:

Standard 1: No New Untreated Discharges

The Project will not discharge any untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. Stormwater from the Site will be collected and treated in accordance with the MassDEP Stormwater Management Standards and stormwater outfalls will be stabilized to prevent erosion.

Standard 2: Peak Rate Attenuation

The proposed stormwater management system will be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates. To prevent storm damage and downstream flooding, the proposed stormwater management practices will mitigate peak runoff rates for the 2-, 10-, 25- and 100-year, 24 hour storm events. Therefore, the proposed system will exceed the DEP Stormwater Management Guidelines.

Standard 3: Groundwater Recharge

The Site was designed using environmentally-sensitive site design, low impact development techniques, and stormwater BMP treatment trains to minimize the loss of annual recharge to groundwater. Groundwater recharge was provided through surface infiltration systems, through storage below the underdrain. The annual recharge from the post-development site will approximate the annual recharge from pre-development conditions based on soil type using the guidelines provided in the MassDEP Stormwater Management Handbook.

The site Hydrologic Soil Group, as described, is design to HSG D.

Impervious Area = 2,700 cf
Rv (Recharge Volume) = 0.09 in. / (12 inches/ft)
= 21 cubic feet

Infiltration BMP	Recharge Volume Provided Below Outlet (cf)
Porous Paver Subsurface Reservoir (Outlet Elev. = 15.70) *See Proposed HydroCAD Report*	324

The HydroCAD reports provided in Appendix C indicate that all proposed infiltration BMPs will drain within 48 hours for the 2-, 10-, 25-, and 100-year storm events, exceeding the 72-hour MassDEP drawdown requirement.

Standard 4: Water Quality Treatment

The proposed stormwater management system will be designed to remove greater than 80% of the average annual post-construction load of Total Suspended Solids (TSS). The subsurface stone reservoir below the permeable pavers has a TSS removal rate of 80-90% through groundwater recharge.

Structural stormwater BMPs including a subsurface infiltration system sized for a minimum required water quality volume (1/2 inch over the project site) and remove a minimum of 80% of total suspended solids.

Impervious Area = 2,700 cf
Storage Below Outlet = 324 cf

WQV Provided = **1.4** inches over impervious area > 0.5" Req. WQV.....

Source control and pollution prevention measures, such as vacuum cleaning, street sweeping, proper snow management, and stabilization of eroded surfaces, are included in the Long-Term Pollution Prevention Plan and Operation and Maintenance Plan (Appendix E).

Standard 5: Land Uses with Higher Potential Pollutant Loads

The Project is not considered a Land Uses with Higher Potential Pollutant Loads (LUHPPLs) as defined by MassDEP.

Standard 6: Critical Areas

The Project is not located within any critical areas. Therefore, this standard is not applicable.

Standard 7: Redevelopments

The overall Project is considered a partial redevelopment under the MassDEP Stormwater Management Standards. A portion of the site falls under the definition of a redevelopment, however to maximize the effectiveness of the system, the Project complies with the MassDEP Stormwater Standards assuming the project is a new development.

Standard 8: Construction Period Pollution Prevention and Sedimentation Control

A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) will be developed and implemented during the Notice of Intent permitting process.

The Project does not disturb more than one-acre of area; a Notice of Intent is not required to be submitted to the Environmental Protection Agency (EPA) for coverage under the National Pollution Discharge Elimination System (NPDES) Construction General Permit.

Land disturbance will be kept to a minimum and the phasing of the work will be planned so that only the areas actively being developed are exposed. All other areas should have natural vegetation preserved, have good temporary cover, or permanent vegetation established. Permanent structures, temporary or permanent vegetation, and mulch/erosion netting will be employed by the Contractor as quickly as possible after land is disturbed. Disturbed areas will be protected from stormwater runoff by installing erosion control or stormwater management measures to prevent water from entering and running over disturbed areas, and to prevent erosion damage to downstream facilities. Perimeter control practices will be installed to isolate the construction site from surrounding areas.

Standard 9: Operation and Maintenance Plan

A post-construction operation and maintenance plan has been prepared and will be implemented to ensure that stormwater management systems function as designed. Source control and stormwater BMP operation requirements for the academic campus are summarized in the Long-Term Pollution Prevention Plan and Operation and Maintenance Plan provided in Appendix E.

Standard 10: Prohibition of Illicit Discharges

There will be no illicit discharges to the stormwater management system associated with the Project. An Illicit Discharge Compliance Statement is provided in Appendix A.

5.0 CONCLUSION

In conclusion, the proposed drainage system complies with the requirements of the Department of Environmental Protection Stormwater Management Policies and the Boston Water and Sewer Commission. The proposed changes will not increase the post-development flows from the site to the Boston Harbor and will be treated prior to discharge to the Boston Harbor.

APPENDIX A

Stormwater Management Standards Documentation

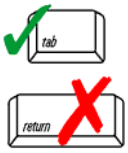
MassDEP Checklist for Stormwater Report
Standard 10: Illicit Discharge Compliance Statement
Technical Notes, Pavers

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

---

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

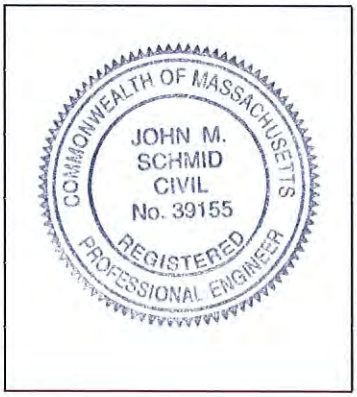
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



3/29/19

Signature and Date

Checklist

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

- ■ New development
- ☐ Redevelopment
- ☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

■ Soil Analysis provided.

■ Required Recharge Volume calculation provided.

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

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

■ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

■ An Illicit Discharge Compliance Statement is attached;

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

Nitsch Engineering

2 Center Plaza, Suite 430
Boston, MA 02108-1928
T: 617-338-0063
F: 617-338-6472
www.nitscheng.com

STANDARD 10: Illicit Discharge Compliance Statement

Project Name: New Street Landscape Improvements	Nitsch Project #: 6729.3
Location: Boston, MA	Date: 3/29/19

Standard 10 states: All illicit discharges to the stormwater management system are prohibited.

This is to verify:

1. Based on the information available there are no known or suspected illicit discharges to the stormwater management system at the New Street Landscape Improvements site in East Boston as defined in the MassDEP Stormwater Handbook.

2. The design of the stormwater system includes no proposed illicit discharges.

John Schmid, PE

3/29/19
Date

THE BRICK INDUSTRY ASSOCIATION
TECHNICAL NOTES on Brick Construction | 14D
1850 Centennial Park Drive, Reston, Virginia 20191 | www.gobrick.com | 703-620-0010
February 2012

Permeable Clay Brick Pavements

Abstract: This *Technical Note* describes the proper design and construction of permeable pavements made with clay pavers on an aggregate setting bed, an open-graded aggregate base, and an open-graded subbase. The purpose and performance of this type of paving in environmental protection and stormwater management are discussed. Options for stormwater design are reviewed, and guidance is given in material selection and installation.

Key Words: Best Management Practice (BMP), detention, exfiltration, infiltration, LEED, low impact development, paving, permeable paving, runoff, stormwater, sustainability.

SUMMARY OF RECOMMENDATIONS:

Stormwater Design
- A permeable pavement is part of a site's drainage and stormwater management system and must be designed as a part of that system by a qualified engineer

Pavement Thickness
- Use the greater of the thicknesses calculated for structural and hydrologic (stormwater management) requirements; both the base and subbase can contribute to the required thickness

Clay Pavers
- Use clay pavers meeting ASTM C902 or C1272 as appropriate for the traffic application
- Use clay pavers that have lugs or are shaped to accommodate open joints between adjacent pavers of at least ¼ in. (6.4 mm) wide for adequate permeability, but not more than ½ in. (13 mm) wide where universal accessibility is required

Joints
- Aggregate:
  - Do not fill joints with sand
  - Fill joints with a washed, open-graded, permeable aggregate such as ASTM D448 No. 8, No. 9, No. 89 or its local equivalent
- Thickness:
  - Install pavers with joints at least ¼ in. (6.4 mm) wide for adequate permeability, and not more than ½ in. (13 mm) wide where universal accessibility is required

Setting Bed Aggregate
- Use a washed, open-graded, permeable aggregate such as ASTM D448 No. 8 or its local equivalent; crushed, angular aggregate is preferred over rounded aggregate
- Do not use sand as a setting bed material

Edge Restraints
- Use edge restraints appropriate for the traffic application as described in *Technical Note* 14A, or use edge restraints specifically designed for permeable pavements

Base Course Aggregate
- Use a washed, open-graded, permeable aggregate, such as ASTM D448 No. 57 aggregate
- Choose crushed, angular aggregate over rounded aggregate

Subbase Course Aggregate
- Use open-graded, permeable aggregate such as ASTM D448 No. 2, No. 3 or its local equivalent

Geotextile
- Consider placing a geotextile over subgrades containing significant amounts of clay or silt or when other jobsite issues require it

Maintenance
- Vacuum affected areas when clogging sediment (mud, sand, organic matter or detritus) is visible on the joint-fill aggregate or when water percolation through the aggregate is visibly slow to restore permeability
- Do not power wash a permeable pavement

INTRODUCTION

Permeable clay brick pavements are an effective method of meeting stringent stormwater management requirements in communities while taking advantage of the natural benefits of clay pavers. Many Best Management Practices (BMPs) and low-impact developments (LIDs) use permeable clay brick pavements in fulfilling requirements for managing stormwater runoff and protecting water quality. Municipalities use permeable clay brick pavements to reduce the need for combined sewer overflows (CSOs) and to minimize localized flooding by infiltrating and treating stormwater on site. Permeable clay brick pavements aid in the health of street trees by allowing air and water to reach the roots easily. Permeable pavements do not increase the temperature of the runoff, minimizing the damage to aquatic life. The use of permeable clay brick pavements has shown to be cost-effective in new development and redevelopment since such pavements reduce or eliminate the need for storm sewers and detention ponds, while providing more land for buildings and other structures.

Permeable paving with clay pavers is appropriate in any public or private setting where impervious cover is to be limited or stormwater is to be managed under contemporary environmental requirements and traffic load is pedestrian or light vehicular (low volume). To a permeable pavement, clay pavers bring texture, traditional appearance, craftsmanship, color, durability and strength. Permeable clay brick pavements are still a small proportion of all paving installations, but their use is growing rapidly under today's environmental requirements.

Photo courtesy Whitacre Greer Company

Photo 1
Permeable Clay Brick Pavement Reduces Runoff at Youngstown State University

The distinctive, defining features of permeable clay brick pavements are the relatively wide joints between the pavers and the open-graded aggregate (Photo 1) — not sand or dense-graded material — making up the pavement's subbase, base, setting bed and joint fill. Both the traffic-bearing capacity and the stormwater management success of a permeable clay brick paving system depend on the total pavement section and not just the surface layer of clay pavers. These systems differ from those with clay pavers set in sand. Correct installation of a permeable clay brick pavement is not more difficult than that of sand-set systems, but its distinct design and installation requirements must be strictly adhered to.

The highly permeable aggregate that fills the joints is what gives the pavement surface as a whole its permeability, rather than the shape of the paver. In permeable pavements, spacers (lugs) on clay pavers are larger to maintain a uniform joint width of ¼ in. (6.4 mm) or wider. In contrast, pavements made with a sand setting bed have sand-filled joints as narrow as 1/16 in. (1.6 mm), which makes them comparatively impermeable. Alternatively, the shape of the paver may allow water to pass through openings formed by its edges or within its body. The pattern in which clay pavers are laid provides adequate opening area for drainage.

Permeable clay brick paving systems' limits on traffic type and speed are the same as those for other vehicular paving systems as described in *Technical Note* 14. Most individual clay pavers have high compressive strengths and, with sufficient thickness and proper installation, can develop interlock with surrounding pavers to help support vehicular loads. Strong, durable aggregate compacted into the stable base and subbase courses distributes any traffic loads.

Slip resistance, skid resistance and hydroplaning are comparable to those of sand-set paving systems, except during wet weather, when a permeable paving system makes a better drained surface with potentially improved safety for pedestrians and vehicles. Accessibility is comparable to that of sand-set pavers when the selected permeable pavement has joints no wider than ½ in. (13 mm). The use of pavers that form wider joints or openings should be limited to areas where accessibility is not required. In these cases, universal accessibility can be provided on nearby pathways constructed to comply with the Americans with Disabilities Act accessibility guidelines [Ref. 4].

Refer to *Technical Note* 14 for clay paver design considerations, including traffic, site conditions, drainage and appearance. Refer to *Technical Note* 14E for information about the design of accessible clay pavements.

FEATURES OF PERMEABLE PAVEMENTS

The purpose of this type of construction is to provide permeability through the entire pavement section without compromising structural capacity. Much of the information presented herein is based on information presented in *Permeable Interlocking Concrete Pavements* [Ref. 9]. Most of the principles and concepts for permeable segmental paving systems made with concrete paver units can be used in the design and construction of systems using clay paver units, since the modulus of elasticity and compressive strength of the units are comparable. The system relies upon permeable aggregate in the joints, setting bed, base and subbase courses, while maintaining paver interlock and base course stability. An engineer should be consulted for structural design and hydrology.

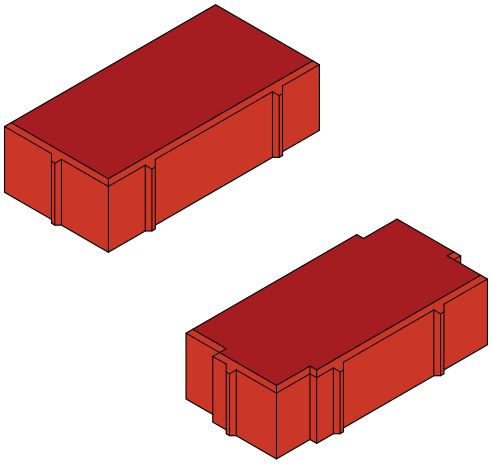


Figure 1
Typical Shapes Used for Permeable Pavements

Photo courtesy General Shale Brick, Inc.

Photo 2
Permeable Clay Pavers with Openings at Corners

Hydrologic Design

The pavement as a whole is designed as a component of the site's drainage and stormwater management system or BMP, contributing pervious land cover, detention and water quality treatment. Although the paver units are impermeable, the pavement surface is highly permeable because of the highly permeable aggregate used in the joints and openings. The pavers' lugs leave joints ¼ in. (6 mm) wide or wider, not the 1/16 in. (1.6 mm) to 3/16 in. (5 mm) joints familiar in impervious sand-set construction. Typical paver shapes are shown in Figure 1 and Photo 2. Joints and openings typically occupy approximately 10 percent of the finished pavement area.

The aggregate in the joints conforms to ASTM D448, *Standard Classification for Sizes of Aggregate for Road and Bridge Construction* [Ref. 1] Sizes No. 8, No. 89 or No. 9. Each of these gradations is considered "open-graded" because it specifies a relatively narrow range of particle sizes where no fine particles fill the voids. While the numeric designations for jointing, bedding, open-graded base and subbase aggregate gradations are found in ASTM D448, the same gradations can be found in ASTM C33, *Standard Specification for Concrete Aggregates* [Ref. 2] or AASHTO M43, *Sizes of Aggregate for Road and Bridge Construction* [Ref. 1]. Many of the numeric designations for aggregates are supplied by local quarries and may use local nomenclature.

The joint fill aggregate's permeability is more than 2000 in./hr (50.8 m/h), which gives the surface as a whole potential permeability of hundreds of inches per hour (tens of meters per hour). In the setting bed, similar aggregate transmits water rapidly into the base and subbase courses. The setting bed thickness is usually 2 in. (51 mm), but its thickness is not taken into account when determining the hydrologic capacity. Fine aggregates (often referred to as concrete sand) conforming to ASTM C33 are not recommended because of the fine particles within not allowing infiltration.

The pavement's base and subbase courses are often collectively called the "base reservoir" because they have a hydrologic function in addition to the structural function as a pavement layer. The base reservoir is made of larger open-graded aggregate that is even more rapidly permeable than the aggregates in the joints and setting bed. It is not the dense-graded aggregate used in the base course of typical sand-set construction. The ASTM D448 No. 57 aggregate commonly used in a permeable base has particles mostly about ½ in. (13 mm) to 1 in. (25 mm) in size. Large open voids between the particles give the material permeability of thousands of inches per hour (hundreds of meters per hour). The pavement's subbase course is often combined with the base course when determining the reservoir capacity, but it is often a coarser material than the base course. ASTM D448 No. 2 stone is usually more economical than No. 57 stone and is 1½ in. (38.1 mm) to 2 ½ in. (63.5 mm) in size. As will be explained, the permeable base and subbase aggregates are also a substrate for microorganisms that improve water quality. When excess water occurs in the base reservoir, the material transmits it readily to a designed discharge point, where it exits at a controlled rate.

Structural Design

In a permeable paving system, clay pavers make a segmental, flexible wearing course, as they do in other clay paver systems. The paver unit is strong and durable, meeting the same ASTM standards as pavers in other clay paver systems. The joints between pavers transfer horizontal and vertical forces, producing interlock from paver to paver and between aggregate and pavers.

Just as importantly, the aggregate material in the base and subbase courses is strong and durable, and compacted in lifts. Stone-to-stone interlock makes a stable structural skeleton, while the material's pores remain open and permeable. The base and subbase courses are well drained due to their very high permeability. Sufficient thickness of subbase, base and paver layers spread out traffic load and inhibit pavement deformation, even when the subgrade soil is wet from the pavement's retained water.

APPLICATIONS

Permeable clay brick pavements are appropriate where traffic loads are not excessive and where reduction of runoff and improvement of water quality would be beneficial. In many land use districts, pavements are two-thirds of the potentially impervious land cover (the other one-third is roof area), so making pavements permeable greatly improves the water quality and stormwater management for an entire site or district.

Permeable clay brick pavements are applicable in a wide range of land use or neighborhood contexts. On residential sites, they are suitable for driveways, patios and walkways. In commercial and public areas, they serve as parking lots, sidewalks, plazas, courtyards and walkways. They are also appropriate on city streets, parking lanes and other pavements subjected to vehicular traffic. For the heaviest vehicular loadings, the pavers and supporting pavement layers are increased in thickness.

Photo 3
Permeable Clay Brick Street Installed as Part of a CSO Reduction Program

Retrofit of existing city streets is a growing municipal application of permeable clay brick pavements that provides the advantages of improved drainage, stormwater management and combined sewer overflow (CSO) reduction. Retrofit requires removing the old impervious pavement and its impervious base layers and replacing them with an entirely new permeable clay brick paving system, as described in this *Technical Note*. An example of a retrofit installation is shown in Photo 3.

The underlying subgrade soil may dictate the type of permeable system that is appropriate for an application. On rapidly permeable sandy soil, most water exfiltrates to the subgrade even during large storms, so additional detention to control peak runoff rates may not be necessary. Such need depends on the project's land use and jurisdictional requirements.

On clay soil, or where there is a shallow water table and water cannot be rapidly exfiltrated to the subgrade soil, a perforated drainage pipe is ordinarily required to discharge excess water from large storms after it has been treated and detained in the pavement. Further detention may be necessary to control peak downstream flows, depending on the project's land use and jurisdiction. A permeable pavement over clay soil can:

- reduce impervious cover;
- reduce runoff coefficient;
- detain peak flows;
- treat water quality; and
- recharge aquifers by gradual exfiltration of rainwater from small, numerous, year-round storms.

Where a permeable pavement is used, do not allow water to exfiltrate from the base reservoir into the soils of septic tank leaching fields, brownfield soils with leachable toxins, water supply wells or steep unstable slopes.

Instead, in those conditions, line the base reservoir with an impermeable geomembrane to prevent exfiltration while continuing to take advantage of the permeable system's stormwater detention and treatment. The water table should be 1 to 2 ft (305 to 610 mm) below the bottom of the permeable pavement system.

Permeable clay brick pavements' environmental advantages are given credit in the U.S. Green Building Council's LEED rating system [Ref. 10] for sustainable development. LEED points that are related to the use of clay pavers are listed in Table 1. Other rating systems, such as the Sustainable Sites Initiative, NAHB's National Green Building Standard and ASHRAE 189.1, provide points for permeable clay brick pavements for managing stormwater on site and protecting water resources and water quality.

TABLE 1
Potentially Available Points in the LEED Rating System for New Construction

Sustainable Sites		
Credit	**Item**	**Permeable Paving's Potential Role**
5.1	Protect or restore habitat	Reduce space developed for retention basin, and increase success of trees
6.1	Control stormwater quantity	Decrease impervious cover, and reduce stormwater volume
6.2	Control stormwater quality	Reduce suspended solids, and infiltrate water
7.1	Reduce heat island	Support tree shade, and select paver with high Solar Reflectance Index
Water Efficiency		
Credit	**Item**	**Permeable Paving's Potential Role**
1.1 & 1.2	Reduce irrigation water use	Keep water on site
Materials and Resource		
Credit	**Item**	**Permeable Paving's Potential Role**
4.1	Recycled content	Select recycled aggregate
5.1	Local sources of materials	Select local aggregate or locally manufactured pavers

MATERIALS AND INSTALLATION

The entire pavement section is designed and constructed for structural stability with permeability. A typical permeable clay brick pavement section is shown in Figure 2.

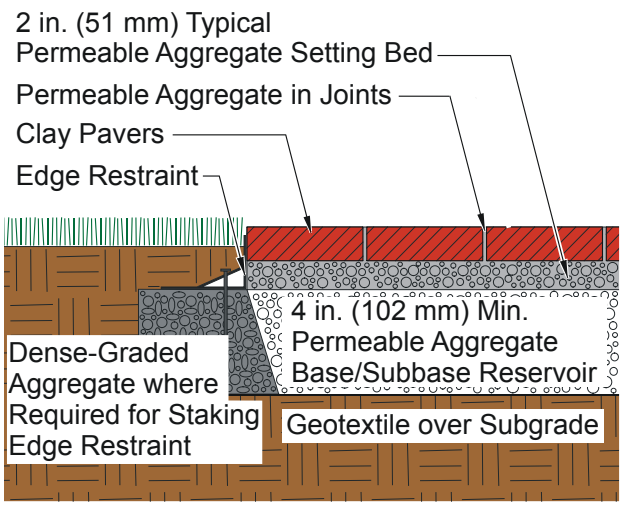


Figure 2
Typical Pedestrian Section

Subgrade

Compaction of the subgrade as described in *Technical Note* 14 may be performed if required by site condition tests because it increases strength, limits future settlement, reduces freeze-thaw action and is low-cost; however, compaction reduces the soil's infiltration rate. Some projects have specified limited compaction, such as a minimum of 92 percent standard Proctor and a maximum of 96 percent. This limited compaction ensures a degree of compacted stability while retaining some favorable infiltration capacity. Swelling soils must be compacted and stabilized as they are under any other structure. Organic material or other material unsuitable for supporting a pavement structure should be removed and replaced with open-graded aggregate subbase. For maximum infiltration of the subgrade, use an adequate subbase and an uncompacted subgrade.

Geotextiles

Geotextiles are not typically usually used in permeable pavement applications because they are easily clogged. However, it may be beneficial to use a geotextile conforming to AASHTO M288, *Standard Specification for*

Geotextile Specification for Highway Applications, Class 2 [Ref. 1] to separate subgrade soil, especially plastic clay or silt soil, from the void spaces in the open-graded base or subbase aggregate. Without the separation, plastic soil could flow into the base's void spaces, compromising the base reservoir's capacity and integrity.

Base and Subbase Aggregate

Base and subbase materials must be open-graded so they can store and convey water. These are not the same dense-graded aggregate as used in sand-set pavements. The gradations in successive aggregate layers must satisfy "filter criteria" so small particles in one layer will not migrate significantly into the void spaces of a lower layer. The most common base material is washed ASTM D448 No. 57 aggregate. Its particles are approximately ½ to 1 in. (13 to 25 mm) in size. The material is compacted in lifts up to about 4 in. (102 mm) thick. The 4 in. (102 mm) thick base is combined with an appropriately thick subbase for the loading conditions. The base can be used alone when supporting a pedestrian pavement application with well-drained native soils and approved by an engineer as stable. To deepen the section for frost protection, additional hydraulic capacity or structural capacity, a minimum 6 in. (152 mm) subbase should be added below the base with larger-sized No. 2 aggregate. Properties of the base and subbase aggregates used in permeable pavements are shown in Table 2. By comparison, the ASTM D2940 dense-graded aggregates used in non-permeable paving systems have maximum permeabilities that are estimated to range from approximately 5 to 1000 in./hr for base aggregates and from 1 to 4400 in./hr for subbase aggregates, both of which are significantly lower than the estimated minimum permeabilities of open-graded aggregates. The correct permeable aggregate must be clearly specified by the designer and exclusively followed by the installer. No soil, sand, fill, dense-graded aggregate or any material other than the specified open-graded aggregates must be used to replace these aggregates for any part of the subbase or base. These open-graded aggregates should be angular (90 percent fractured) in structure, not rounded.

TABLE 2
Properties of Permeable Base and Subbase Aggregates[1]

Open-graded aggregate used in permeable construction (ASTM D448)			
Designation	**Approximate size range**	**Porosity (vol/vol)**	**Permeability (in./hr)**[2]
No. 57	¾ in. to ½ in.	0.38 to 0.44	27,000 to 155,000
No. 2	2½ in. to 1½ in.	0.43 to 0.46	1.8 M to 5.0 M

1. Unclogged porosity and permeability estimated with formulas of Kasenow, 2002, Eqs. 10.2 and 11.1 [Ref. 6]; estimated aggregate characteristics are subject to verification by testing of actual aggregate from specific sources.
2. 1 in./hr = 25.4 mm/h

Edge Restraint

To maintain paver position and interlock, edge restraints such as those described in *Technical Note* 14A must be present in permeable clay brick paving systems. Where the edge restraint is not provided by a curb or other fixed structure adjoining the pavement, a restraint can be added in the form of a concrete band or a manufactured metal or plastic edging. Proprietary edge restraints specially designed for permeable pavements are available from several manufacturers. The restraint must rest on or be adjacent to the dense-graded base course material so that it restrains both the pavers and the setting bed. When using spiked-in-place edge restraints, open-graded base aggregates should be replaced with dense-graded aggregates along the edge of the pavement to provide adequate support (see Figure 2).

Setting Bed Aggregate

The setting bed is made of permeable open-graded aggregate, rather than the sand used as bedding in more common systems using clay pavers. Table 3 lists gradations commonly used. No. 8 aggregate has particles small enough to provide a level for paver setting but large enough to meet filter criteria over No. 57 base aggregate. The particles interlock with one another and with the underlying base aggregate. The aggregate is commonly specified to be washed free of clinging particles. Unwashed aggregates will compromise the performance of the pavement.

The typical thickness of the setting bed is 2 in. (51 mm) to accommodate variations in the paver and some minor variances in the base. The setting bed aggregate is screeded moist into the top of the No. 57 base. Properties

TABLE 3

Properties of Permeable Setting Bed and Joint Fill Aggregates[1]

Permeable systems' joint-fill and setting bed aggregates (ASTM D448)			
Designation	**Approximate Size**	**Porosity (vol/vol)**	**Permeability (in./hr)**[2]
No. 8	⅜ in. to No. 4 sieve	0.39 to 0.45	8000 to 60,000
No. 89	⅜ in. to No. 16	0.39 to 0.45	2000 to 15,000
No. 9	No. 4 sieve to No. 8 sieve	0.39 to 0.45	2000 to 15,000

1. Unclogged porosity and permeability estimated with formulas of Kasenow, 2002, Eqs. 10.2 and 11.1 [Ref. 6]; all estimated aggregate characteristics are subject to verification by testing of actual aggregate from specific sources.
2. 1 in./hr = 25.4 mm/h

of open-graded aggregate used for permeable setting beds, joints and openings are shown in Table 3. C33 concrete sand used to fill joints in other pavements is not appropriate because it has significantly lower permeability, estimated to range between approximately 10 and 335 in./hr in sand-set construction. The correct permeable aggregate must be clearly specified by the designer and exclusively followed by the installer. Soil, sand, fill, dense-graded aggregate or any material must not replace the specified open-graded aggregates to bring any part of the pavement up to grade or for any part of the setting bed.

Photo courtesy Boral Bricks, Inc.

Photo 4

Joints Filled with Permeable Aggregate

Pavers

Permeable clay brick pavers are shaped to leave joints or openings that give the pavement surface its permeability. A paver must be selected for its irregular shape or lugs, producing joints ¼ in. (6.4 mm) wide. These joints are wider than the joints between pavers intended to be placed on a sand setting bed, which are usually no wider than 3⁄16 in. (4.8 mm). Joints ¼ in. (6.4 mm) wide are sufficiently wide to receive Nos. 8, 89 and 9 permeable joint fill aggregate (Photo 4).

Clay pavers used in these paving systems should comply with ASTM C902, *Standard Specification for Pedestrian and Light Traffic Paving Brick* [Ref. 2], or ASTM C1272, *Standard Specification for Heavy Vehicular Paving Brick* [Ref. 2]. Clay pavers that comply with either ASTM standard can support light vehicular loads when properly installed. The most common thickness is 2¼ in. (57.2 mm), but other thicknesses are available. Other characteristics that may be considered in paver selection are described in *Technical Note* 14, including texture, color, edge treatment and bond patterns. Pavers can be installed using mechanical installation techniques when available.

Joint Fill Aggregate

The joint fill aggregate for permeable pavements is open-graded for high permeability, with particles small enough to fit into the paver joints but large enough to meet filter criteria with the underlying setting bed aggregate. This is the same No. 8 aggregate (or No. 89 or No. 9 stone) commonly used in the setting bed of clay paver systems that have joints filled with sand. The aggregate is commonly specified to be washed free of clinging particles. It is swept into the paver joints and openings, and the pavers are vibrated to level. The joints must not be left unfilled. One of the purposes of the aggregate is to trap sediment and debris near the pavement surface, where it can be removed by vacuuming, as described below under "Maintenance." The correct permeable aggregate must be clearly specified by the designer and exclusively followed by the installer. Soil, sand, fill, dense-graded aggregate or any material other than the specified open-graded aggregate must not be used to fill any part of the joint.

ENVIRONMENTAL PERFORMANCE

Research has been conducted and experience has been gained in segmental permeable pavements and other types of permeable pavements in many places in North America and around the world. The results have been scientifically monitored. Observed results defeat false rumors and make misconceptions unnecessary. The following results apply to permeable clay brick pavements that are correctly designed, installed and maintained as described in this *Technical Note*.

Surface Infiltration Rate

Permeable segmental paving systems that are properly designed, installed and maintained have high surface infiltration rates (surface permeabilities) of 40 to 2700 in./hr (1 to 68.6 m/h). At these rates, essentially all rainwater passes through the surface and into the pavement system. Poorly maintained pavements that are clogged with sediment have infiltration rates as low as 1 to 10 in./hr (25.4 to 254 mm/h). The absorption of water into the paving system is effective irrespective of the underlying soil type. Several studies demonstrating infiltration rates in installed pavements are accessible through the North Carolina State University's permeable pavement research website [Ref. 7].

Runoff Coefficient

Permeable paving has a low runoff coefficient, which is defined as the percentage of the total rainfall that will become runoff. The runoff coefficient is used in the rational method of analysis. The most frequent runoff coefficient that has been measured with natural rainfall on properly built and maintained permeable paving systems is zero. There is no runoff because the surface permeability is so high compared with natural rainfall rates, but in a long, intense storm, the base reservoir may become saturated and the water may overflow across the surface or through a perforated drainage pipe if one is provided. At that point the pavement would in effect be generating runoff. So when designing or evaluating a permeable clay brick pavement, it is prudent to use some positive number — not zero — for the runoff coefficient. For example, set the runoff coefficient equal to that of the local jurisdiction's "predevelopment" condition, which might be forest, meadow or grass. Reasonable values for the runoff coefficient, C, are 0.25 for high-infiltration soils and 0.4 for low-infiltration soils. While this method can be used to design permeable pavements, it does not accurately account for permeable clay brick pavement's retention capacity [Ref. 9].

Perviousness

The word "perviousness" means the ability to pass water into and through the material or structure, so it is equivalent to permeability. In jurisdictions that regulate pervious and impervious cover, permeable paving meets objective criteria for a completely pervious surface. Properly constructed and maintained permeable pavement's infiltration rate is higher than that of almost any natural soil and greater than the rate of almost any natural rainfall. It is more pervious than anything that is already called "pervious," so a surface of this type meets the criteria to be given complete credit for "100 percent perviousness," as does a meadow or a forest.

Detention/Retention

Reduction of stormwater runoff flow rate is expected in most contemporary stormwater requirements in order to protect downstream drainage systems and water bodies. This effect is vitally important in old neighborhoods with CSO where lower runoff rates can reduce the frequency of overflows. In permeable clay brick pavements like the one shown in Photo 5, the base and subbase aggregate's void space is a reservoir in the same sense as any other stormwater detention/retention reservoir. The base and subbase reservoir stores storm flows until it exfiltrates or the

Photo courtesy Pine Hall Brick Company, Inc.

Photo 5
Permeable Paving Providing Stormwater Retention at Luray, VA Train Depot

water leaves at a rate controlled by the outlet. The peak outflow rate is lower than the peak rainfall rate entering through the surface, and it occurs later in time. The total amount of discharging water is less than the amount entering through the surface, because some water remains clinging to the reservoir aggregate's particles, where it later evaporates.

Water Quality

Water quality improvement is one of the fundamental purposes of contemporary stormwater requirements. Oil from vehicles is the most generic pollutant originating on city pavements. In a permeable pavement, the open-graded base and subbase aggregate is a suitable substrate for natural water quality treatment. Oil that enters through the surface clings to the aggregate particles. It then migrates slowly down and has an extended residence time in the pavement structure. Naturally occurring microorganisms ingest the oil and biodegrade it, thereby reducing the oil's hydrocarbons to their simpler chemical constituents. The pavement's interior is aerated, it is moistened from time to time, and its temperature is moderate and stable compared with that at the surface; so it is a favorable place to support this natural microecosystem. What used to be oil goes off into the atmosphere and ceases to exist as a water quality pollutant before it can reach the bottom of the pavement section. The pavement's water quality benefit occurs within the pavement system, without regard to the underlying soil; the soil is only a redundant "backup" system. Other benefits may include the reduction of zinc, copper, phosphorous and total suspended solids [Ref. 8].

Exfiltration

Exfiltration of water from the base and subbase reservoir into the subgrade soil reduces the total volume of runoff, eases the loads on city sewers and stream channels, further improves water quality in the soil, and replenishes groundwater aquifers with clean water. Some water exfiltrates from permeable pavements even where the subgrade is low-permeability clay. For example, monitoring in North Carolina [Ref. 3] observed that water exfiltrated into a clay soil at a slow rate — less than 0.1 in./hr (2.5 mm/h) — but it continued every hour of the day, as long as the water was in contact with the soil at the bottom of the pavement. Over a period of days, this added up to a substantial amount of exfiltrated water, restoring the base reservoir's capacity to receive water from the next rainstorm. It accounted for a large portion of all the rainwater over a period of months.

Development Cost

Some form of stormwater management is required in almost any contemporary development. In developments with impervious pavements, stormwater management consists of inlets, culverts, swales, retention ponds and detention basins, and the land to place those items on. Permeable pavement is a completely different approach in which stormwater is absorbed into pavement that is built as part of the development. Because permeable pavement effectively manages stormwater, it reduces or eliminates the need for specialized stormwater facilities. Where a permeable pavement is used intelligently in a development to absorb and treat stormwater, and the municipality gives credit for its stormwater functions, total development cost is commonly reduced. Absorbing the stormwater management function into a permeable pavement can increase the amount of development possible on a given property and make otherwise unusable lands developable, by letting the whole site be used for necessary construction up to the zoning jurisdiction's full regulated density.

DESIGN CONSIDERATIONS

The pavement thickness is designed for both structural and hydrologic (stormwater management) requirements. The structural and hydrologic theories underlying thickness calculations are the same for clay pavers as for pavers made of other materials. Structural design takes into account traffic level, soil bearing capacity and strength of pavement materials. Wet subgrade conditions should be assumed, as is common in all pavement design. Stormwater design uses the pavement's runoff coefficient. Capacity and sizing take into account the local storm intensity and soil type, and the hydraulic capacity in the pavement's void space. The amount of water entering a pavement varies with precipitation in the pavement's region, and the size of any area draining in laterally. The proportion of the rainwater to be stored varies with jurisdictional requirements. A pavement's required thickness is the greater of the two thicknesses calculated for structural and hydrologic design. The structural and hydrologic implications of several alternative thicknesses are listed in Table 4. Available software for permeable segmental pavement design is listed in Table 5.

TABLE 4

Minimum Base and Subbase Thicknesses Under Certain Conditions[1]

Base Thickness	Structural Capacity	Hydrologic Capacity
6 in. (152 mm) No. 57 base	Pedestrian traffic, on soil with soaked California Bearing Ratio (CBR) of 4 to 10	2.1 in. (53 mm)
4 in. (102 mm) No. 57 base + 6 in. (152 mm) No. 2 subbase	50,000 ESALs or residential driveway, on soil with soaked CBR of 4 (poor)	3.8 in. (97 mm)
4 in. (102 mm) No. 57 base + 13 in. (330) No. 2 subbase	200,000 ESALs (busy street with some truck traffic), on soil with soaked CBR of 4 (poor)	6.6 in. (167 mm)
4 in. (102 mm) No. 57 base + 22 in. (560) No. 2 subbase	600,000 ESALs (parking lot traffic), on soil with soaked CBR of 4 (poor)	10.2 in. (259 mm)
4 in. (102 mm) No. 57 base + 11 in. (279) No. 2 subbase	600,000 ESALs (parking lot traffic), on soil with soaked CBR of 10 (good)	5.8 in. (147 mm)

1. Structural capacity from the Interlocking Concrete Pavement Institute, Figure 3-1; structural capacity assumes lifetime equivalent single axel loads (ESALs) with 10 percent commercial vehicles; hydrologic capacity assumes 35 percent void space in No. 57 aggregate, and 40 percent in No. 2.

TABLE 5

Available Software for Permeable Segmental Pavement Design

Name	Design role	Source contact
Lockpave Pro with PCSWMM	Hydrologic & structural	www.uni-groupusa.org
Lockpave-Permpave	Hydrologic & structural	www.cmaa.com.au
PCSWMM Permeable Pavement Wizard	Hydrologic	www.chiwater.com
Permeable Design Pro	Hydrologic & structural	www.icpi.org

DETAILING CONSIDERATIONS

A permeable clay brick pavement requires a few simple but important special detailing considerations, because it is both a pavement structure and a drainage and stormwater management device.

Excess water must be permitted to discharge from the reservoir. Three forms of outlet are shown in Figure 3: no exfiltration, partial exfiltration and full exfiltration. Where a perforated pipe is placed at the floor of the pavement, all water is treated and detained in the paving system, then discharged laterally out of the pipe. This type of system is referred to as no exfiltration, since exfiltration to the subgrade is only incidental. The lateral outflow rate can be controlled by an orifice or weir at the pipe's outlet. Where a perforated pipe is placed at an intermediate level in the base reservoir, all water is treated and detained, and a substantial portion is forced to exfiltrate into the subgrade. In the event that water rises above the pipe's elevation, it discharges laterally out of the pipe after being treated and detained in the pavement system. Full exfiltration is where overflow occurs from the surface only at the pavement's low edge, a substantial portion of water is forced to exfiltrate and the excess overflows after being treated and detained.

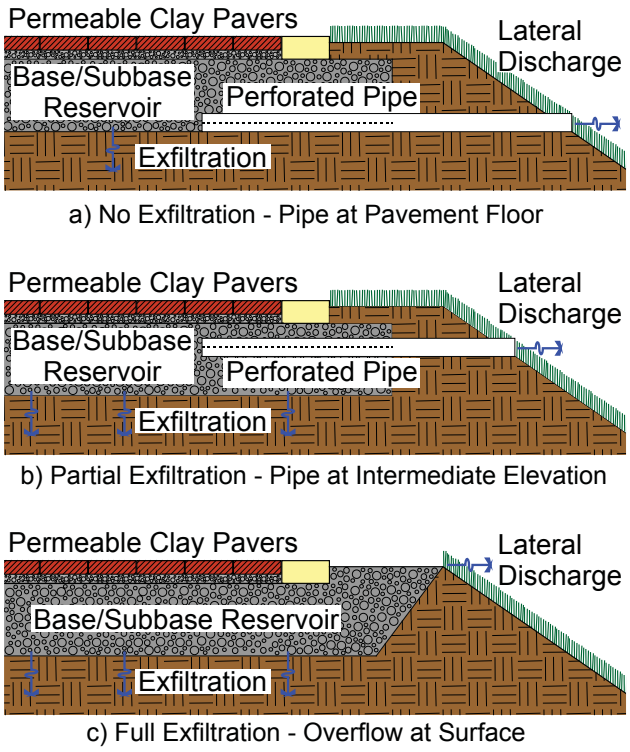


Figure 3

Base Reservoir Drainage Design Options

On a long, sloping pavement, the base reservoir should be divided into cells to prevent water from concentrating in the pavement's low edge, where it would fail to use the entire base reservoir for storage, fail to use the entire subgrade surface for exfiltration, and overflow frequently. As shown in Figure 4, add subsurface trenches, berms or geomembranes to divide the base reservoir into cells where water is forced to be stored and cannot flow downslope. The subgrade typically has a maximum 5 percent slope.

Surface overflow may occur in any permeable pavement configuration, as in any component of a drainage or stormwater management system. In all cases it is vital to identify the point where surface overflow is likely and to make sure that that point is safe from clogging and is non-erodible in an overflow event.

In many instances the minimum surface slope can be as little as zero percent — dead level — because drainage is primarily vertically through the pavement, not laterally across the surface. A level "floor" has the advantage of holding water in contact with subgrade soil for exfiltration. An important exception is at the edges of buildings, where, to protect the building from inadvertent overflows, the slope should be 2 percent or more away from the building for at least 6 in. (152 mm) downward. In addition, to protect the foundation, the subgrade slope should be downward away from the building wall for at least 3 ft (0.9 m) horizontally, and until the subgrade is 6 in. (152 mm) lower than at the wall. In this sloping area, the subgrade must be compacted to prevent water infiltration. Where the building is poorly waterproofed, it should be protected by an impermeable geomembrane placed against the building wall, down the sloping subgrade soil, and into a trench to prevent water penetration. These measures are shown in Figure 5.

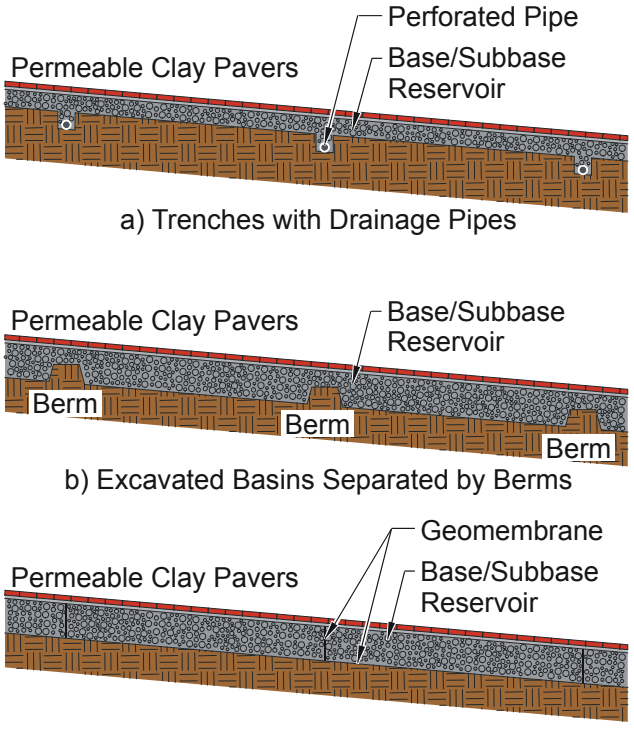


Figure 4
Water Control on Long Sloping Pavements

Pavements often border, or are bordered by grass or plantings, as shown in Photo 6. Earth adjacent to permeable pavements should be shaped and sloped downward away from every pavement edge where possible to prevent sediment from washing onto the pavement. Soil can erode and generate pavement-clogging sediment. Where necessary, add a swale to divert inflowing runoff and sediment. Runoff from adjacent vegetated areas impervious roofs or pavements may be drained onto a permeable pavement, since vegetated areas, roofs and pavements do not produce sediment the way soil does.

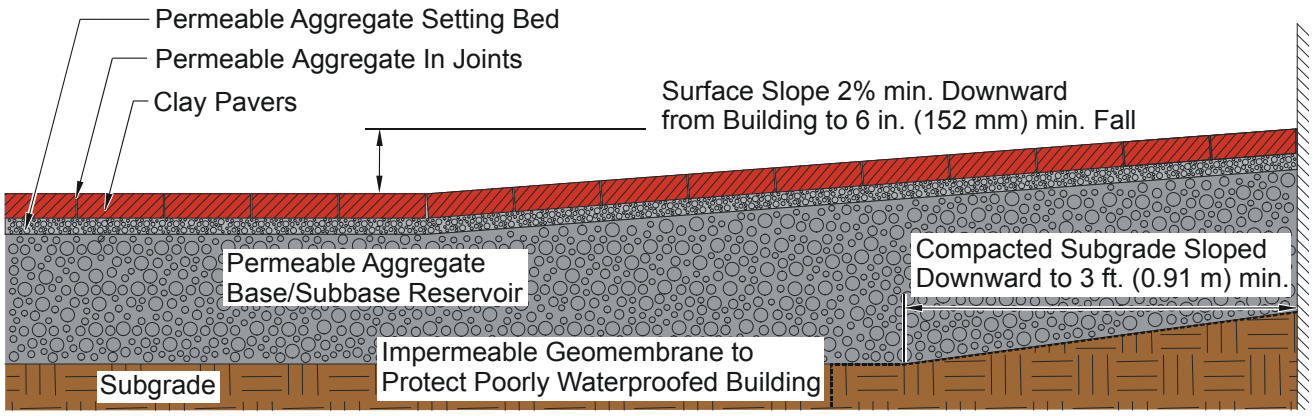


Figure 5
Pavement Detailing at Building Edge

Where a permeable pavement adjoins a conventional impervious pavement, the impervious pavement was probably not designed to have water in it, and it must be protected from subsurface water migrating out of the permeable pavement. This can be accomplished with a concrete grade beam or impermeable plastic sheet (geomembrane) separating the two sections, as shown in Figure 6.

If a hazardous or toxic chemical is spilled on the pavement surface, immediate and complete cleanup is necessary. No pavement or drainage system is designed for this contingency, with the exception of industries that produce such chemicals.

CONSTRUCTION

During construction, the pavement must be protected from construction-related sediment. There must be no dropping, tracking or storing of sand, mud, mulch, soil or other potentially clogging material on the pavement's subbase, base course, setting bed or surface during any stage of construction or after construction is complete. Temporary storage of soil, sand or mulch on the pavement is possible if a plastic sheet is placed to protect the pavement and carefully pulled up afterward to prevent spillage. In the event of tracking or spilling of sediment onto the pavement, the affected area must be vacuumed immediately as described below.

The subgrade is typically not compacted unless a need for doing so is established, since compaction reduces the soil's infiltration rate. The base and subbase aggregates are installed in lifts and compacted to the design thickness prescribed. Proper compaction is often measured with a nuclear density instrument (backscatter mode) or stiffness gauge. Setting bed aggregate is often best installed when moist but should not be compacted until after the pavers have been placed. Pavers can be installed manually or mechanically when possible (Photo 7). Pavers should be installed in the designated pattern so that no cut pavers are less than one-third of a paver. The pavers are compacted after the joints have been filled with aggregate. To prevent pavers from chipping during vibration, the underside of the plate compactor can be fitted with a rubber mat. Pavers may also be covered with a sheet of geotextile or sheets of plywood during vibration.

MAINTENANCE

Sediment that can clog a pavement's pores can come from construction sand, muddy construction traffic, eroded soil, grit applied to pavements for

Photo courtesy Glen-Gery Brick

Photo 6
Mulch Runoff Can Clog Permeable Pavements

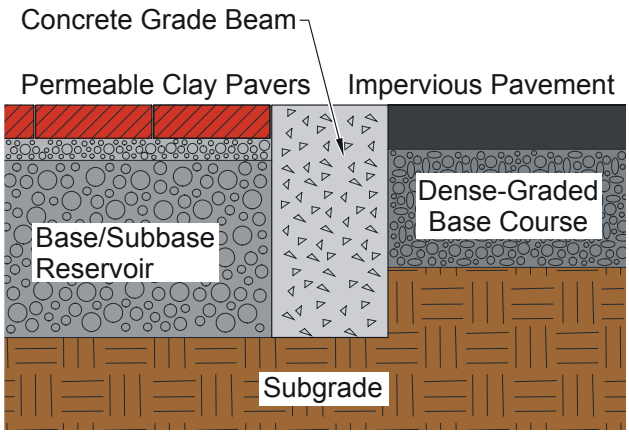


Figure 6
Separation of Differing Pavements

Photo courtesy Belden Brick Company

Photo 7
Mechanical Installation of Permeable Pavers

winter traction and overhanging trees. Nevertheless, with proper maintenance, a properly designed and installed permeable clay brick paving system should remain permeable indefinitely.

The key process for maintaining a permeable pavement is vacuuming. Vacuum equipment is either truck-mounted or walk-behind. Most urban municipalities and most large property management companies already own the required type of equipment. Sediment accumulates mostly in the uppermost 1 in. (25 mm) of joint aggregate, where it is accessible by vacuum suction. Vacuuming lifts sediment out and restores the pores to their original open condition. The surface should be dry when cleaning; vacuuming should not be accompanied by washing. Vacuuming may pull up some joint-fill aggregate with the sediment; vacuum strength settings can be adjusted for pulling up of sediment alone, or sediment plus aggregate. The aggregate can be replenished immediately after vacuuming. Washing the pavement is not an acceptable alternative to vacuuming; it would only drive sediment farther down into the pores.

It is easy to monitor a pavement's relative permeability and need for vacuuming over time. The simplest method is a visual inspection. When a properly constructed permeable pavement is clean and unclogged, the space between open-graded aggregate particles in joints and openings is clearly visible; if the open space within the aggregate is not visible, then sediment is clogging the pavement. A simple confirming test is to pour water from a bottle gently onto the middle of a paver. If the water disappears rapidly and completely into the first joint or opening it finds, then the pavement has relatively high permeability and requires no maintenance. However, if the water flows over a number of joints and openings before completely infiltrating, then the aggregate is clogged and it is time for vacuuming. More sophisticated testing can be completed with infiltrometers, if necessary.

Grit or sand should not be applied to the pavement for winter traction. Instead, rely only on snow removal and deicing agents. In a municipality where grit or sand is spread on public streets, vehicles can track it onto parking lots and driveways. The material tends to concentrate where piles of snow are pushed during the winter. Vacuuming will be necessary at least once per year: in the spring, following snowmelt. Where appropriate, No. 8 or No. 9 aggregate can be used for traction control. Deicing salt does not clog permeable clay brick pavements, nor cause any deterioration to the pavers. Deicing agents dissolve readily and then flush through with meltwater, without accumulating in the pavement. Research at the University of New Hampshire suggests that permeable pavements require less salting than impervious pavements or none at all, because meltwater drains away so readily through the pores.

A permeable pavement that is free from eroding soil and winter sanding may not need vacuuming for many years. Instead, vacuuming may be needed only in isolated instances such as construction vehicles tracking mud onto the surface. In this case, the vacuuming should be limited to the pavement area actually affected by sediment. Local clogging of one area of a pavement does not reduce the permeability of other parts of the system. Seasonal blowing to remove surface debris such as tree litter, mulch and loose dry soil is also beneficial and reduces the need for, or the required frequency of, vacuuming.

SUMMARY

Permeable clay brick pavements provide a cost-effective way of meeting stringent stormwater management requirements. When properly designed and constructed, the permeable aggregate in joints and openings provide high permeability, low runoff, stormwater detention and water quality treatment without compromising pavement stability under traffic. This *Technical Note* provides the basic information required to properly select pavers and permeable aggregate materials and to design, construct and maintain permeable clay brick pavements. It is recommended that an engineer be consulted, as these systems are very site specific. Further information about the properties of other brick pavements and concepts not unique to permeable pavements is discussed in the *Technical Notes* 14 series.

REFERENCES

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   M43, "Sizes of Aggregate for Road and Bridge Construction"
   M288, "Standard Specification for Geotextile Specification for Highway Applications"

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   ASTM C33, "Standard Specification for Concrete Aggregates"
   Vol. 04.03
   ASTM D448, "Standard Classification for Sizes of Aggregate for Road and Bridge Construction"
   Vol. 04.05
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   ASTM C1272, "Standard Specification for Heavy Vehicular Paving Brick"

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10. U.S. Green Building Council, "LEED 2009 for New Construction and Major Renovation," Washington, DC, 2009.

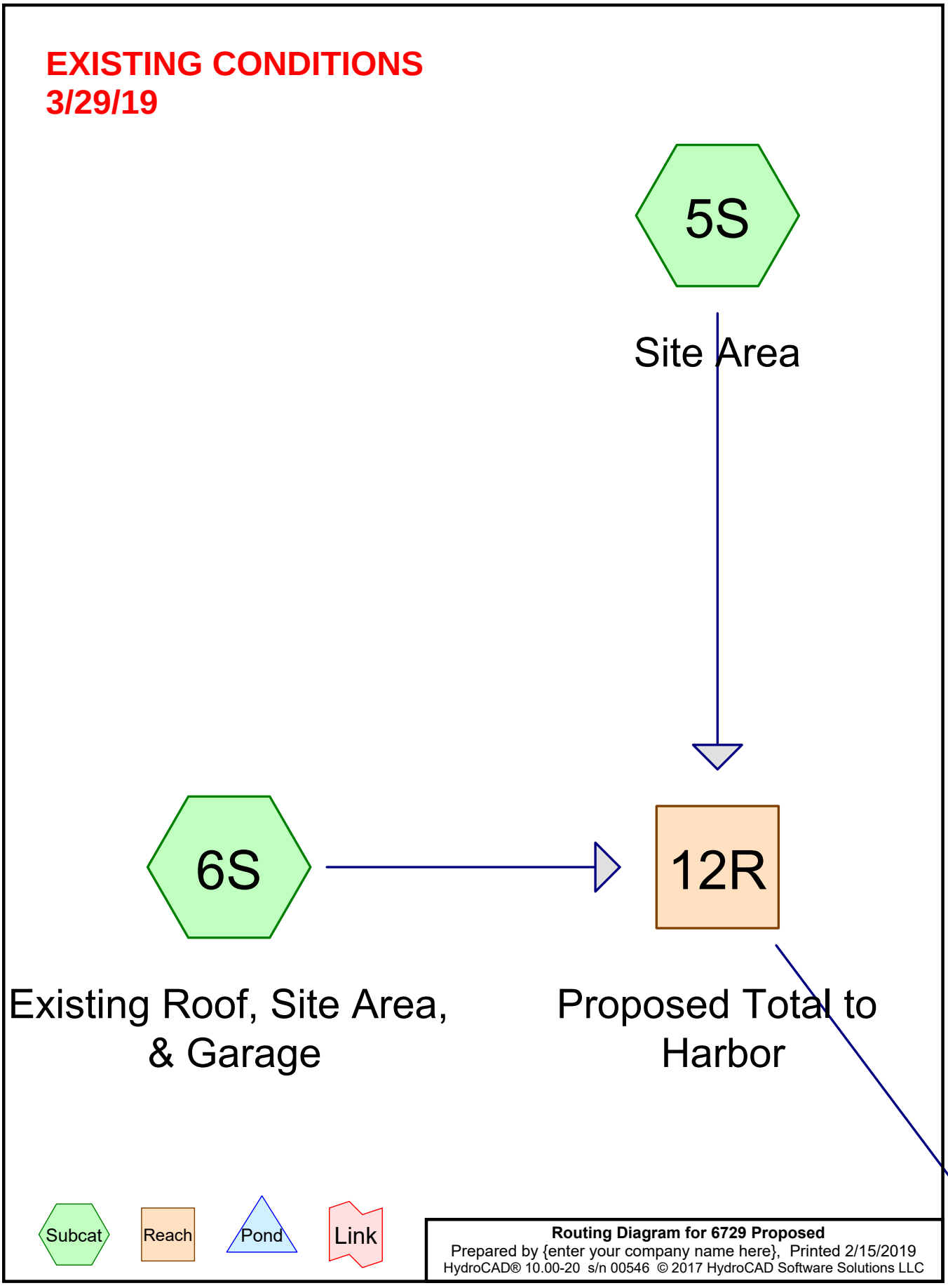
Acknowledgments

Bruce K. Ferguson
The Belden Brick Company
Boral Bricks, Inc.
Endicott Clay Products Company
General Shale, Inc.
Glen-Gery Brick
Pine Hall Brick Company, Inc.
Stiles & Hart Brick Company
Whitacre Greer Company

APPENDIX B

Pre-Development Conditions – HydroCAD Calculations

EXISTING CONDITIONS
3/29/19



Routing Diagram for 6729 Proposed
Prepared by {enter your company name here}, Printed 2/15/2019
HydroCAD® 10.00-20 s/n 00546 © 2017 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
13,481	80	>75% Grass cover, Good, HSG D (5S, 6S)
22,037	98	Paved parking, HSG D (5S, 6S)
25,257	98	Roofs, HSG D (6S)
60,775	**94**	**TOTAL AREA**

Summary for Subcatchment 5S: Site Area

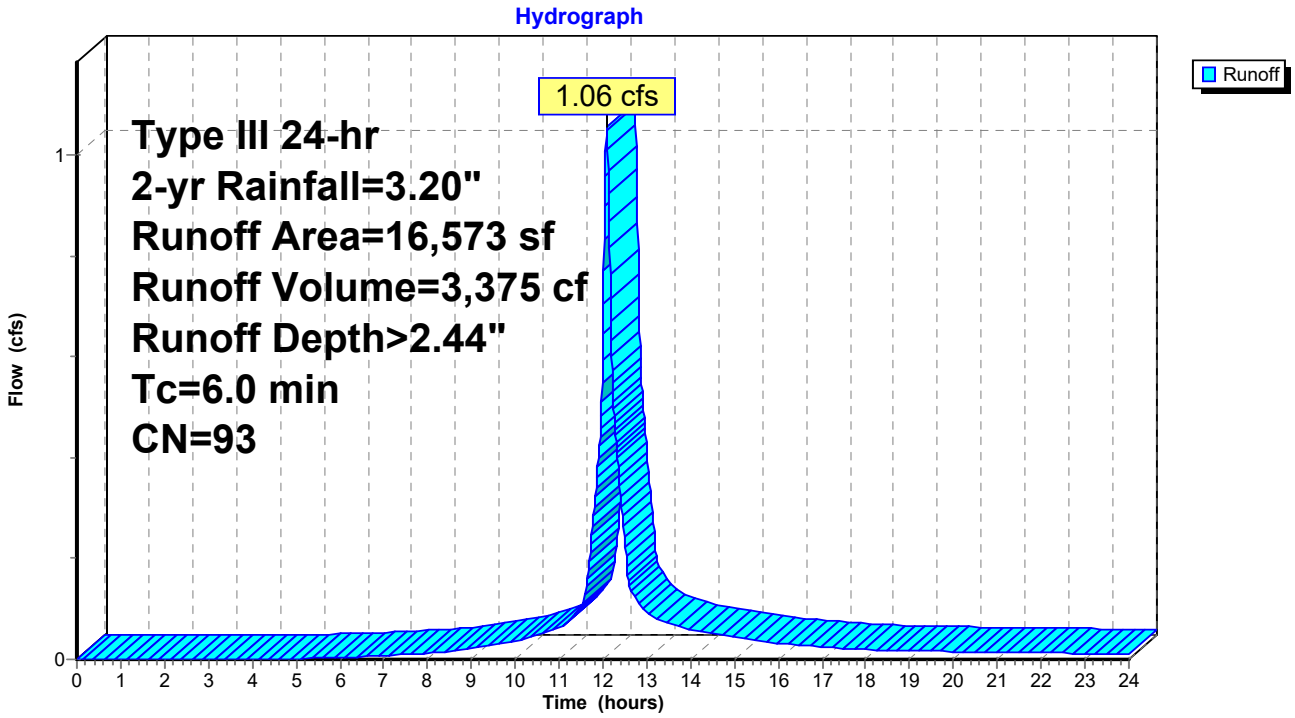
Runoff = 1.06 cfs @ 12.09 hrs, Volume= 3,375 cf, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
4,531	80	>75% Grass cover, Good, HSG D
12,042	98	Paved parking, HSG D
16,573	93	Weighted Average
4,531		27.34% Pervious Area
12,042		72.66% Impervious Area

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

Subcatchment 5S: Site Area



Summary for Subcatchment 6S: Existing Roof, Site Area, & Garage

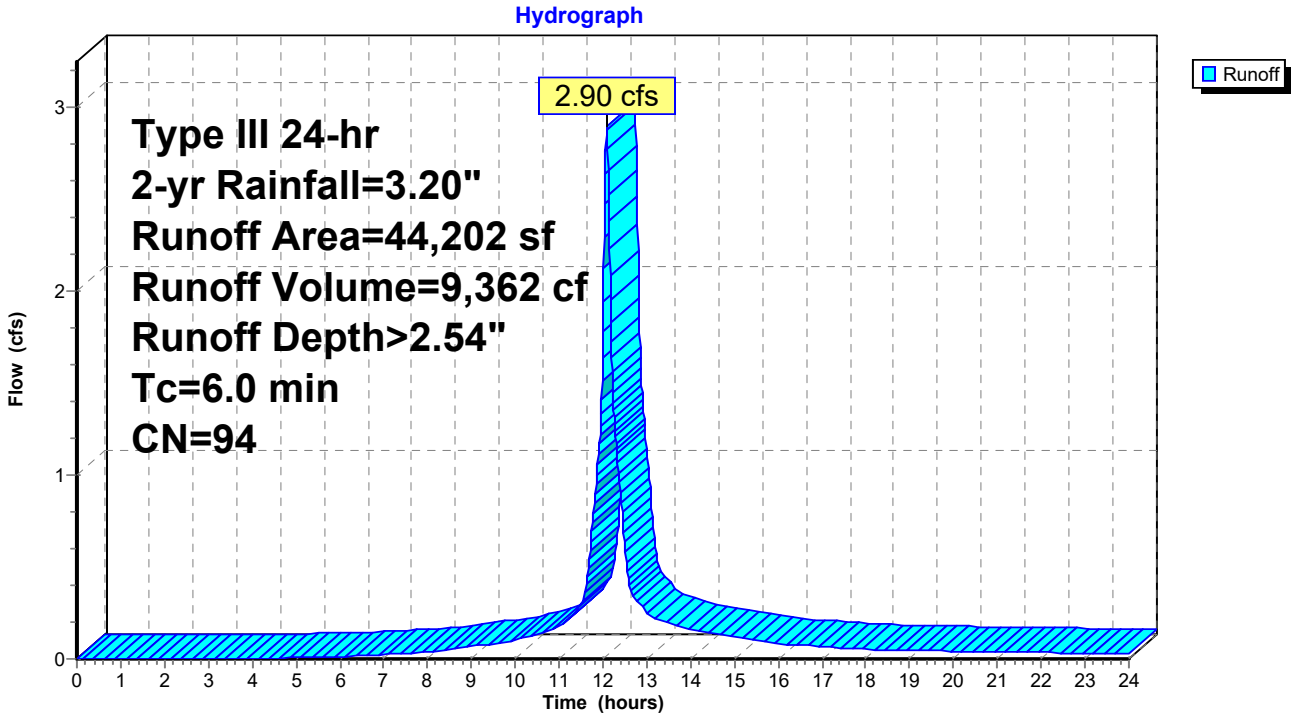
Runoff = 2.90 cfs @ 12.08 hrs, Volume= 9,362 cf, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
25,257	98	Roofs, HSG D
9,995	98	Paved parking, HSG D
8,950	80	>75% Grass cover, Good, HSG D
44,202	94	Weighted Average
8,950		20.25% Pervious Area
35,252		79.75% Impervious Area

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

Subcatchment 6S: Existing Roof, Site Area, & Garage



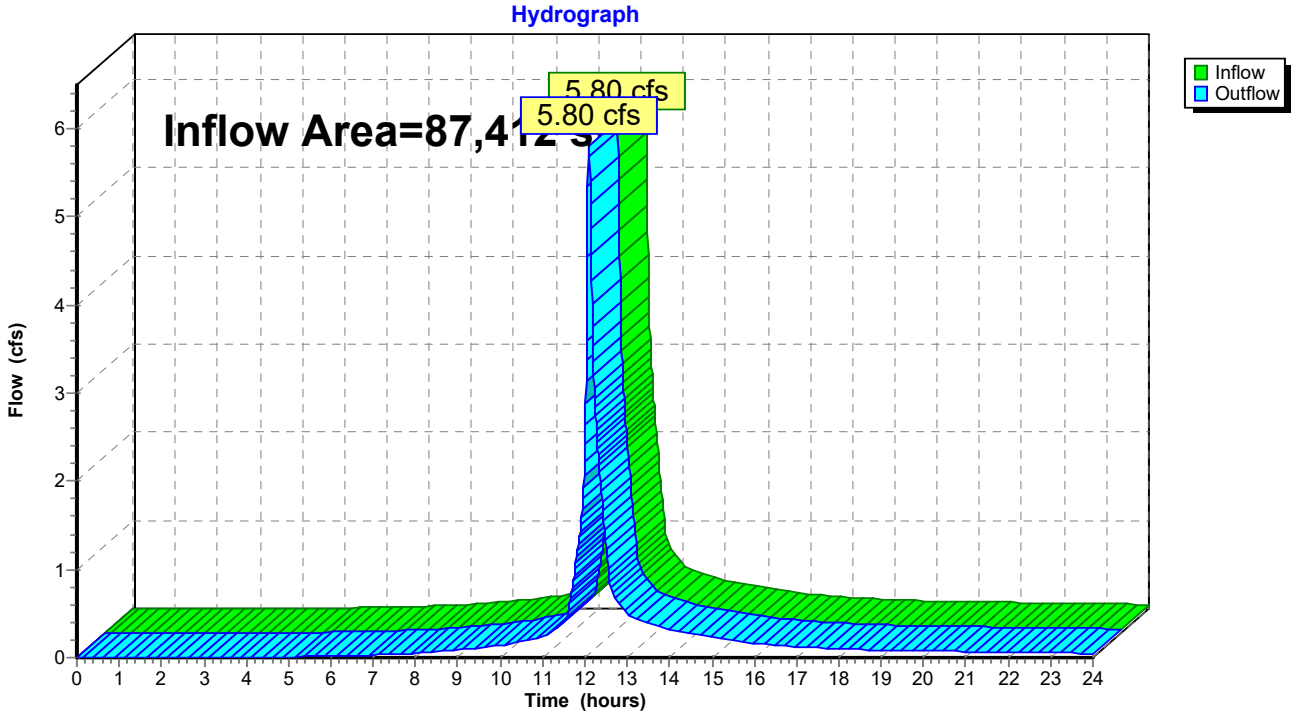
Summary for Reach 12R: Proposed Total to Harbor

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,412 sf, 84.58% Impervious, Inflow Depth > 2.23" for 2-yr event
Inflow = 5.80 cfs @ 12.09 hrs, Volume= 16,209 cf
Outflow = 5.80 cfs @ 12.09 hrs, Volume= 16,209 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 12R: Proposed Total to Harbor



Summary for Subcatchment 5S: Site Area

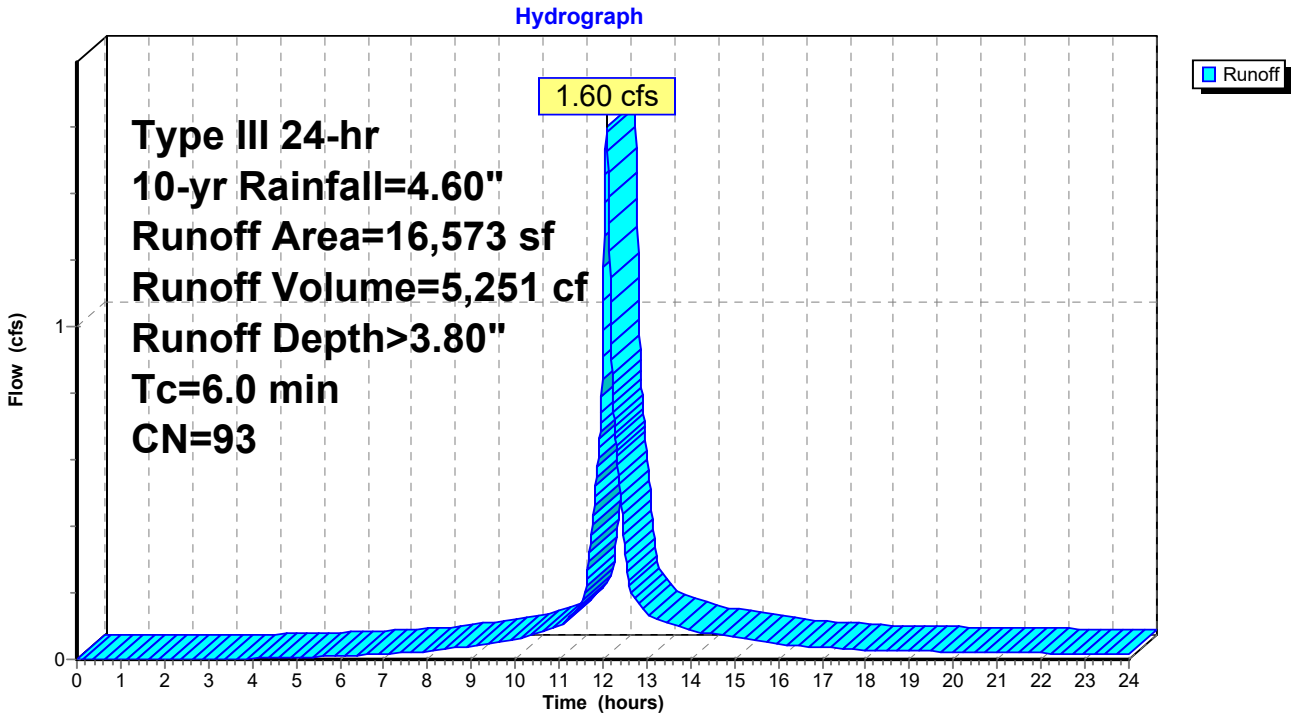
Runoff = 1.60 cfs @ 12.08 hrs, Volume= 5,251 cf, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.60"

Area (sf)	CN	Description
4,531	80	>75% Grass cover, Good, HSG D
12,042	98	Paved parking, HSG D
16,573	93	Weighted Average
4,531		27.34% Pervious Area
12,042		72.66% Impervious Area

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

Subcatchment 5S: Site Area



Summary for Subcatchment 6S: Existing Roof, Site Area, & Garage

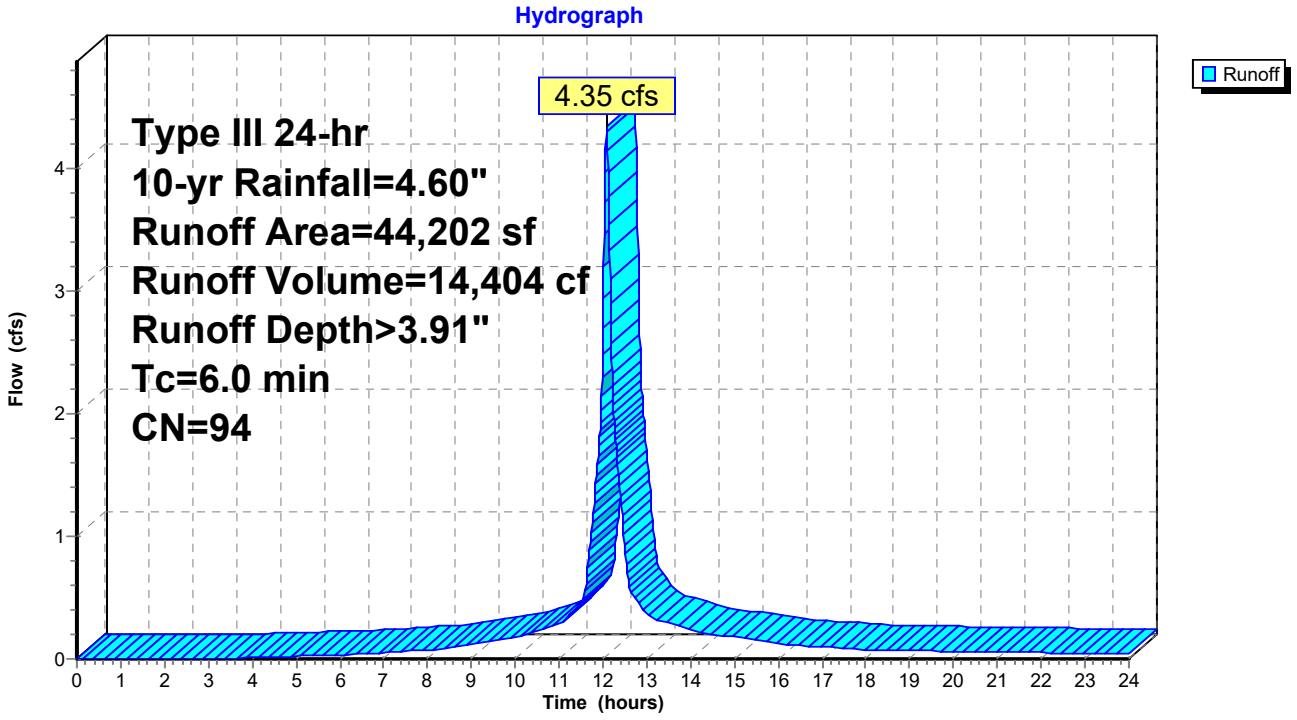
Runoff = 4.35 cfs @ 12.08 hrs, Volume= 14,404 cf, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.60"

Area (sf)	CN	Description
25,257	98	Roofs, HSG D
9,995	98	Paved parking, HSG D
8,950	80	>75% Grass cover, Good, HSG D
44,202	94	Weighted Average
8,950		20.25% Pervious Area
35,252		79.75% Impervious Area

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

Subcatchment 6S: Existing Roof, Site Area, & Garage



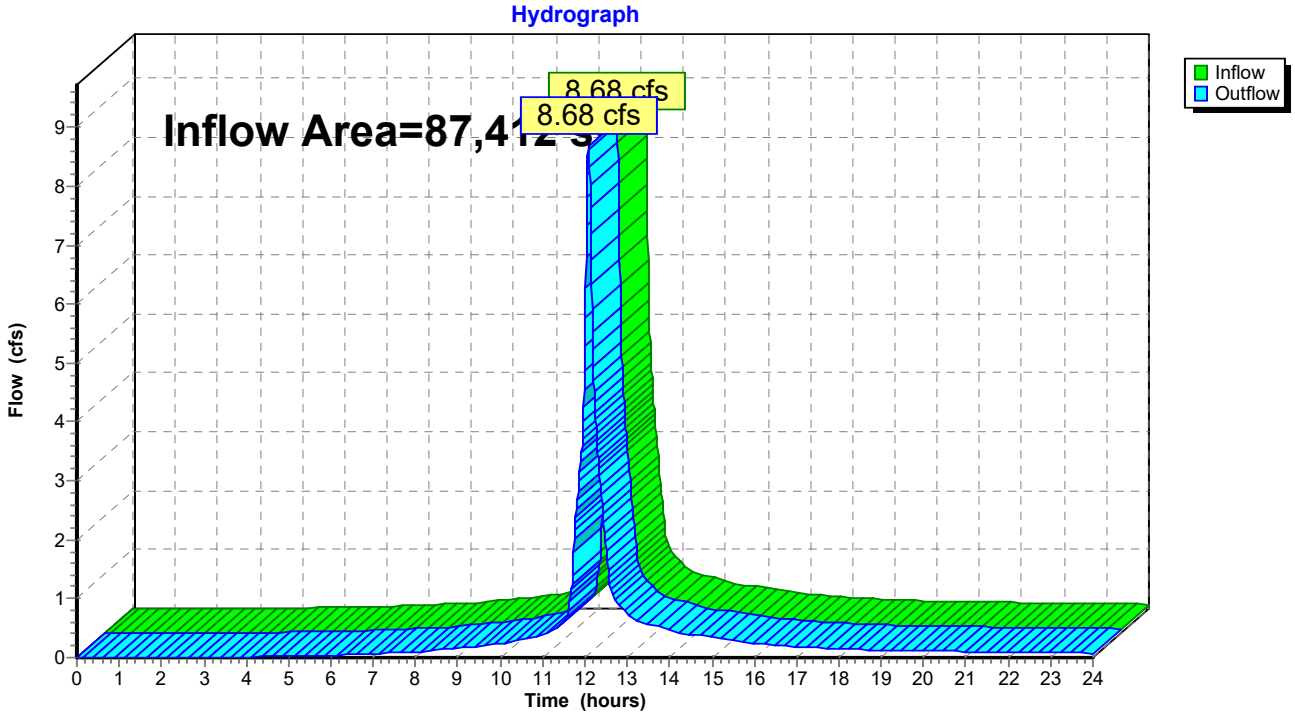
Summary for Reach 12R: Proposed Total to Harbor

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,412 sf, 84.58% Impervious, Inflow Depth > 3.60" for 10-yr event
Inflow = 8.68 cfs @ 12.09 hrs, Volume= 26,202 cf
Outflow = 8.68 cfs @ 12.09 hrs, Volume= 26,202 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 12R: Proposed Total to Harbor



Summary for Subcatchment 5S: Site Area

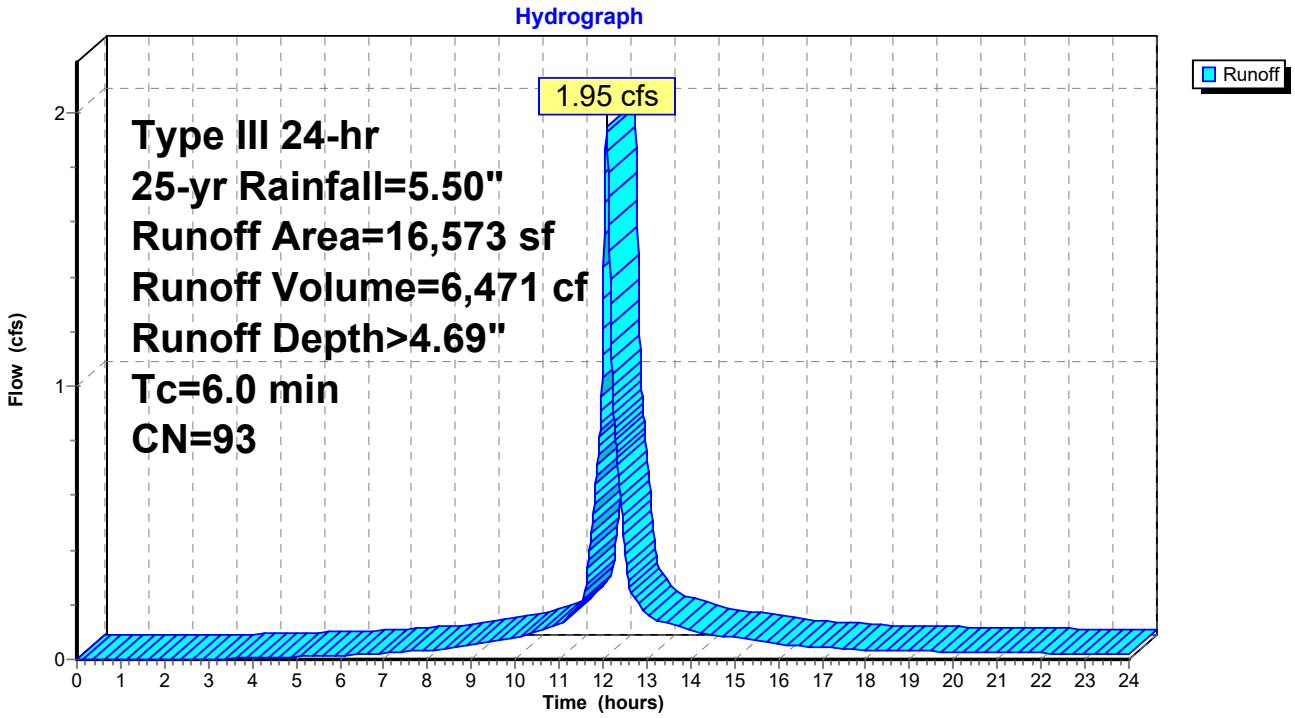
Runoff = 1.95 cfs @ 12.08 hrs, Volume= 6,471 cf, Depth> 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.50"

Area (sf)	CN	Description
4,531	80	>75% Grass cover, Good, HSG D
12,042	98	Paved parking, HSG D
16,573	93	Weighted Average
4,531		27.34% Pervious Area
12,042		72.66% Impervious Area

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

Subcatchment 5S: Site Area



Summary for Subcatchment 6S: Existing Roof, Site Area, & Garage

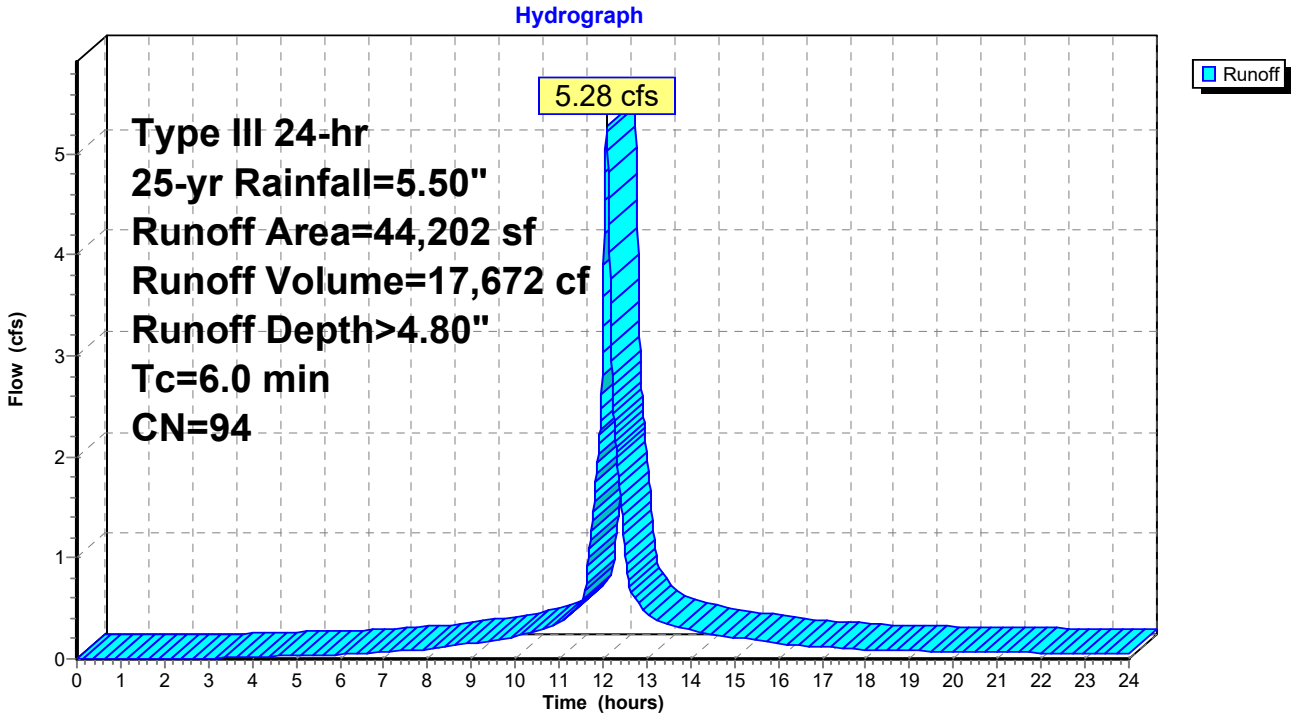
Runoff = 5.28 cfs @ 12.08 hrs, Volume= 17,672 cf, Depth> 4.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.50"

Area (sf)	CN	Description
25,257	98	Roofs, HSG D
9,995	98	Paved parking, HSG D
8,950	80	>75% Grass cover, Good, HSG D
44,202	94	Weighted Average
8,950		20.25% Pervious Area
35,252		79.75% Impervious Area

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

Subcatchment 6S: Existing Roof, Site Area, & Garage



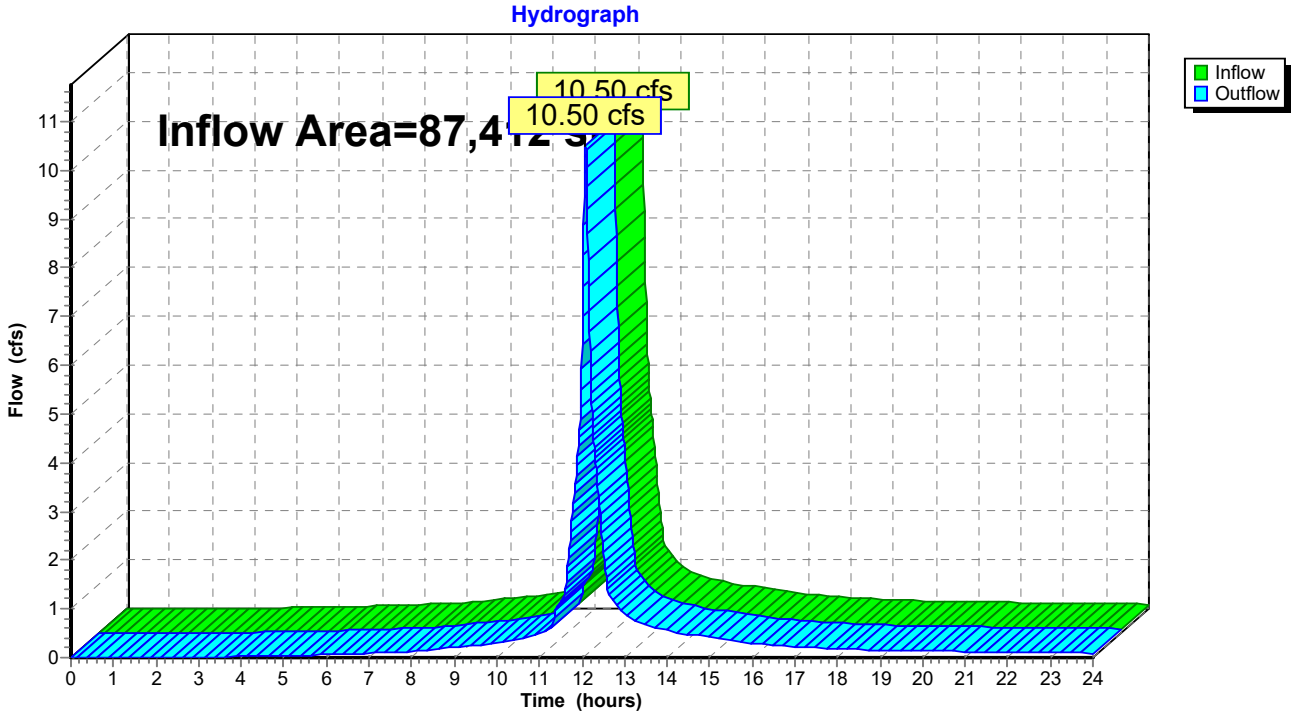
Summary for Reach 12R: Proposed Total to Harbor

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,412 sf, 84.58% Impervious, Inflow Depth > 4.49" for 25-yr event
Inflow = 10.50 cfs @ 12.09 hrs, Volume= 32,673 cf
Outflow = 10.50 cfs @ 12.09 hrs, Volume= 32,673 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 12R: Proposed Total to Harbor



Summary for Subcatchment 5S: Site Area

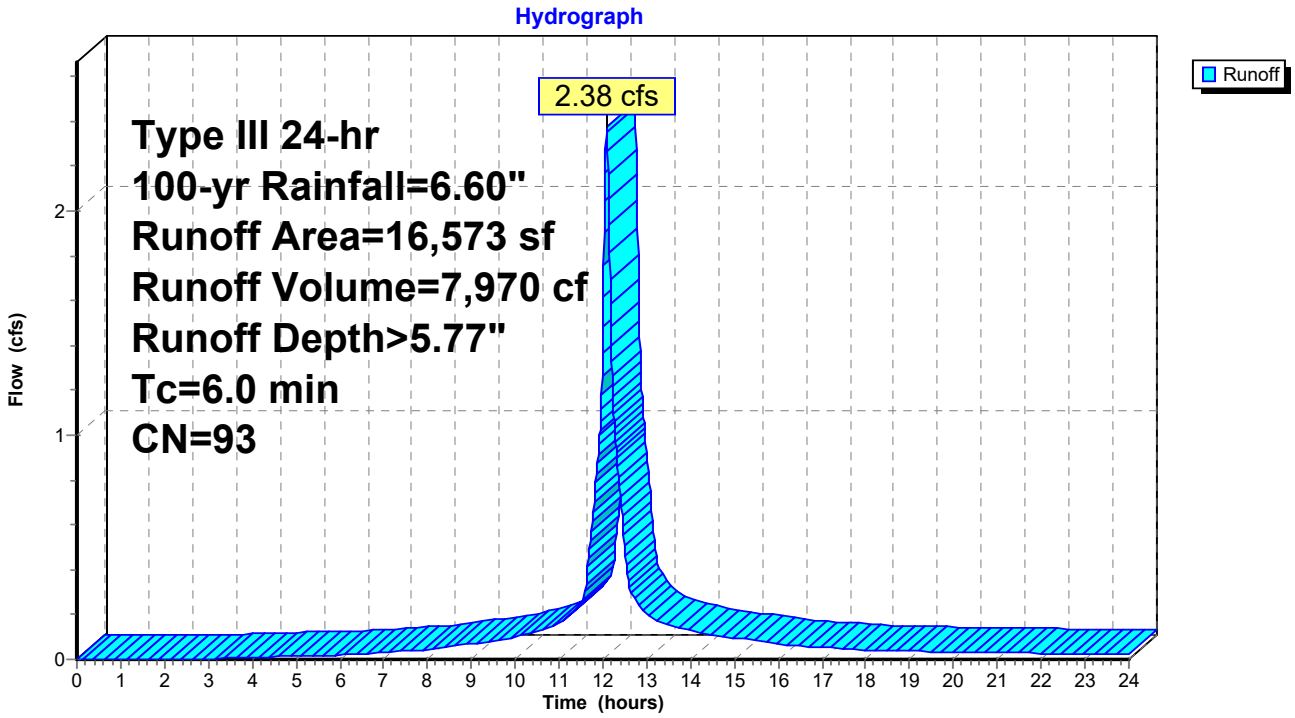
Runoff = 2.38 cfs @ 12.08 hrs, Volume= 7,970 cf, Depth> 5.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

Area (sf)	CN	Description
4,531	80	>75% Grass cover, Good, HSG D
12,042	98	Paved parking, HSG D
16,573	93	Weighted Average
4,531		27.34% Pervious Area
12,042		72.66% Impervious Area

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

Subcatchment 5S: Site Area



Summary for Subcatchment 6S: Existing Roof, Site Area, & Garage

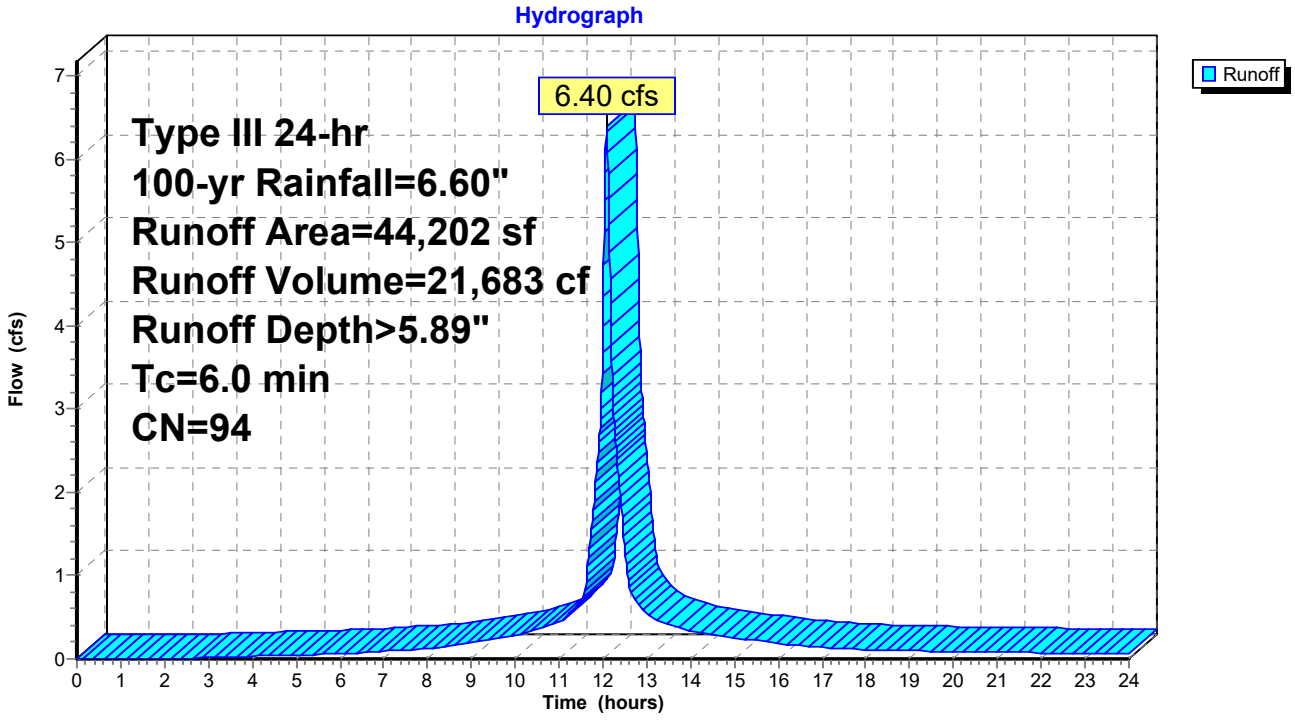
Runoff = 6.40 cfs @ 12.08 hrs, Volume= 21,683 cf, Depth> 5.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

Area (sf)	CN	Description
25,257	98	Roofs, HSG D
9,995	98	Paved parking, HSG D
8,950	80	>75% Grass cover, Good, HSG D
44,202	94	Weighted Average
8,950		20.25% Pervious Area
35,252		79.75% Impervious Area

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

Subcatchment 6S: Existing Roof, Site Area, & Garage



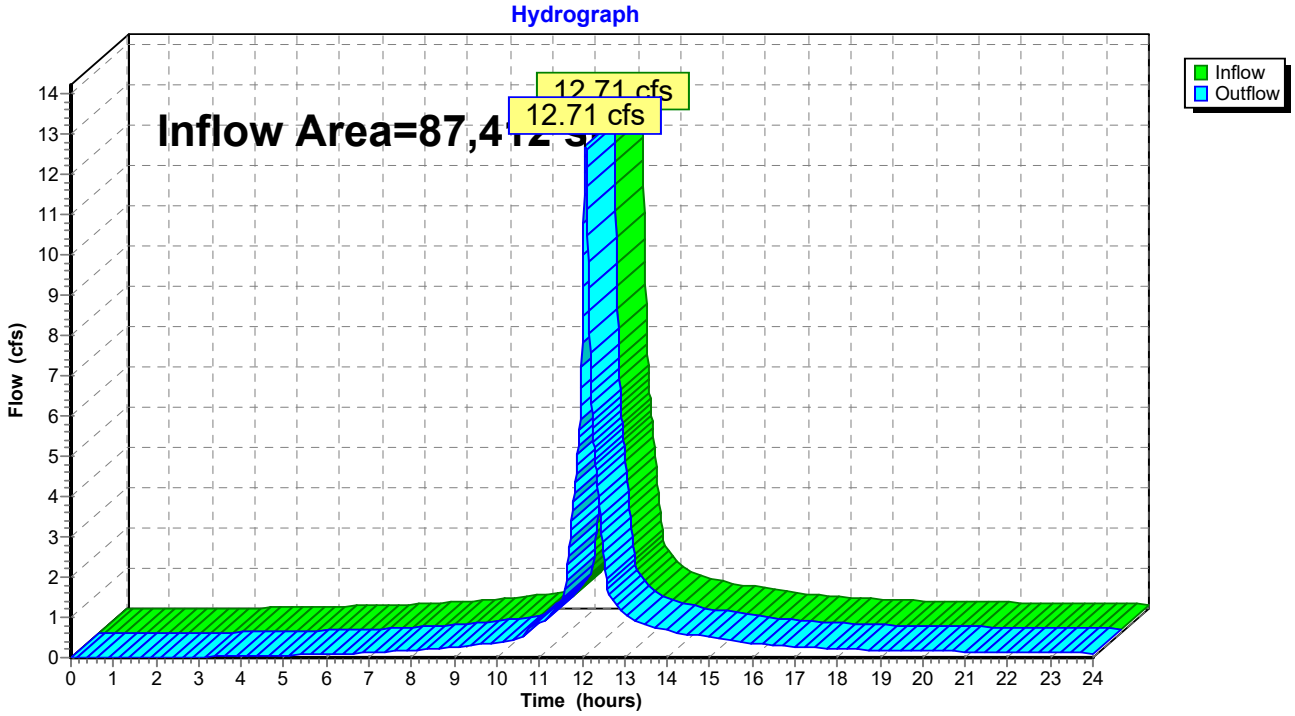
Summary for Reach 12R: Proposed Total to Harbor

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,412 sf, 84.58% Impervious, Inflow Depth > 5.57" for 100-yr event
Inflow = 12.71 cfs @ 12.09 hrs, Volume= 40,609 cf
Outflow = 12.71 cfs @ 12.09 hrs, Volume= 40,609 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

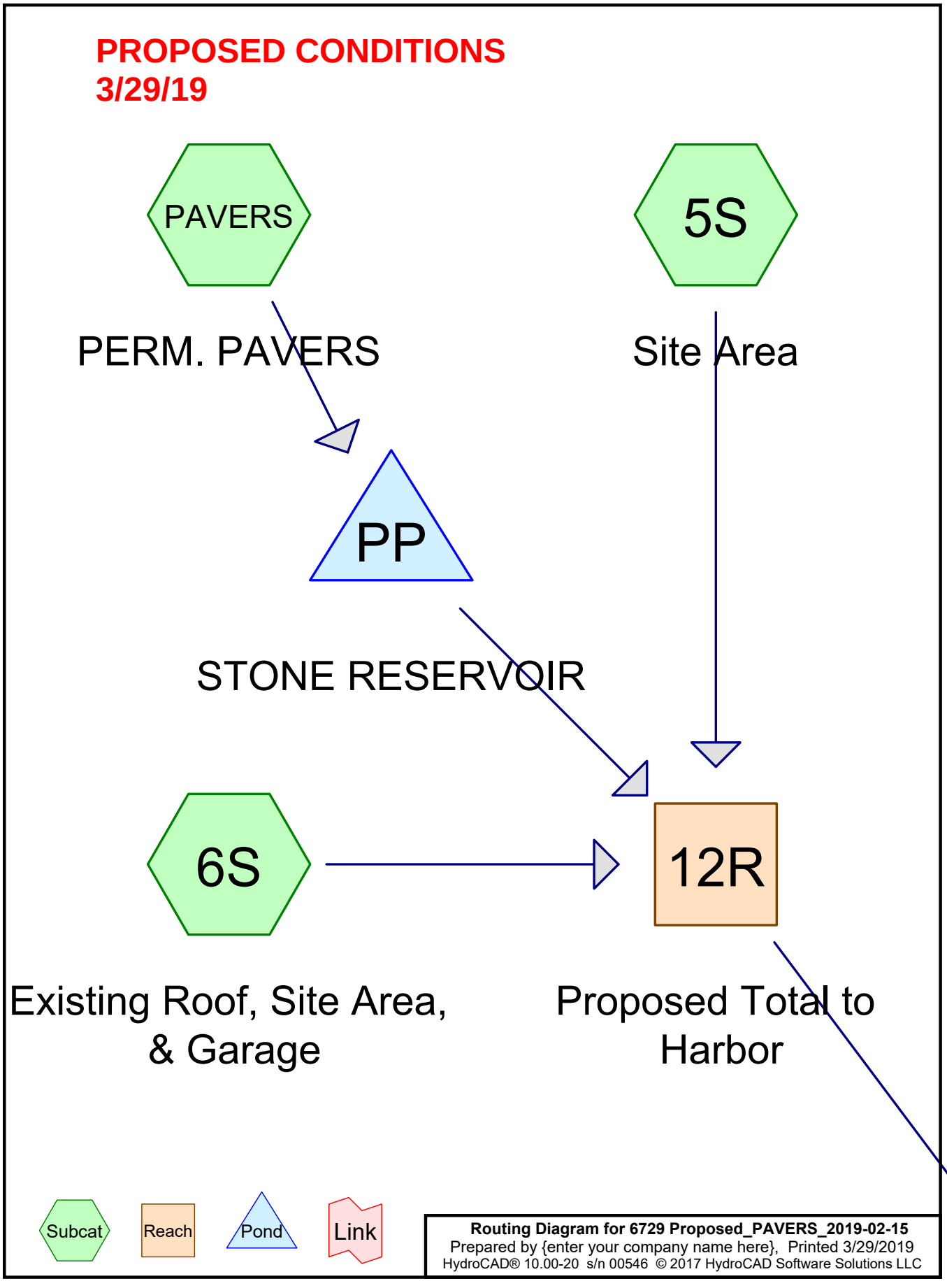
Reach 12R: Proposed Total to Harbor



APPENDIX C

Post-Development Conditions – HydroCAD Calculations

PROPOSED CONDITIONS
3/29/19



Routing Diagram for 6729 Proposed_PAVERS_2019-02-15
Prepared by {enter your company name here}, Printed 3/29/2019
HydroCAD® 10.00-20 s/n 00546 © 2017 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
10,281	80	>75% Grass cover, Good, HSG D (5S, 6S)
22,037	98	Paved parking, HSG D (5S, 6S)
2,700	98	Pavers (PAVERS)
500	80	Peastone (5S)
25,257	98	Roofs, HSG D (6S)
60,775	**95**	**TOTAL AREA**

Summary for Subcatchment 5S: Site Area

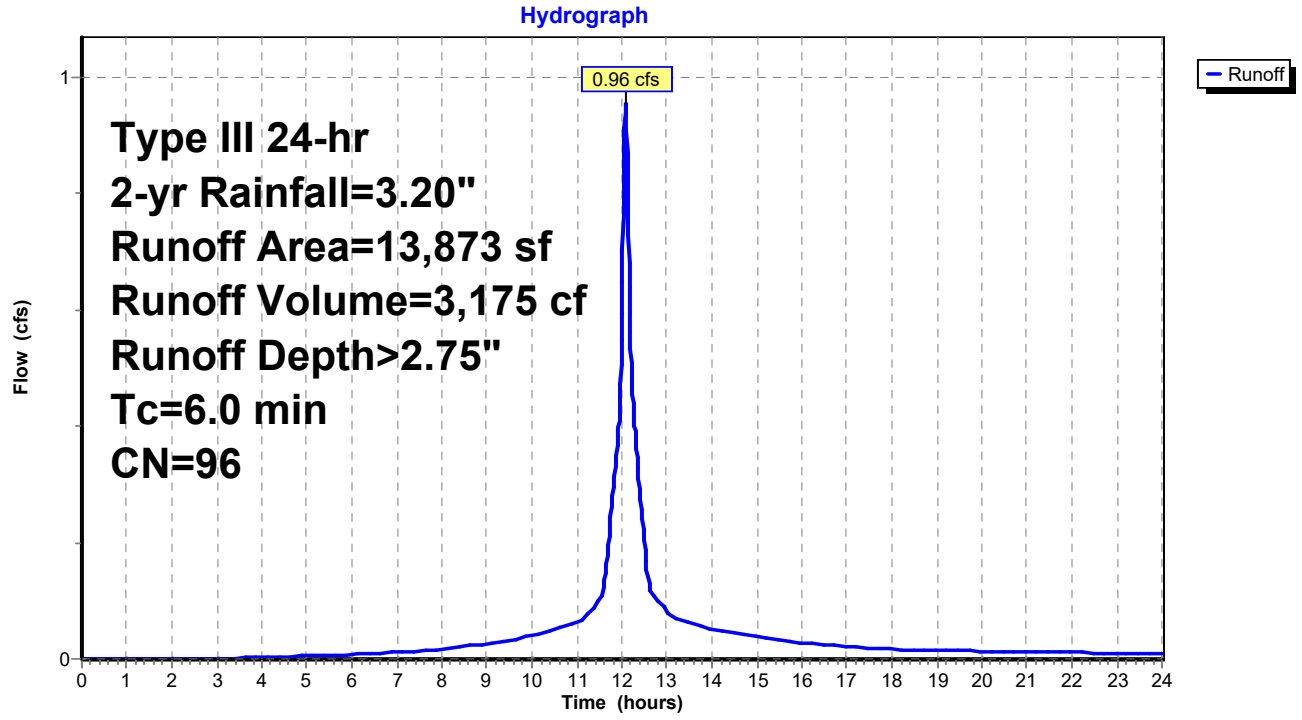
Runoff = 0.96 cfs @ 12.08 hrs, Volume= 3,175 cf, Depth> 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

	Area (sf)	CN	Description
	1,331	80	>75% Grass cover, Good, HSG D
	12,042	98	Paved parking, HSG D
*	500	80	Peastone
	13,873	96	Weighted Average
	1,831		13.20% Pervious Area
	12,042		86.80% Impervious Area

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

Subcatchment 5S: Site Area



Summary for Subcatchment 6S: Existing Roof, Site Area, & Garage

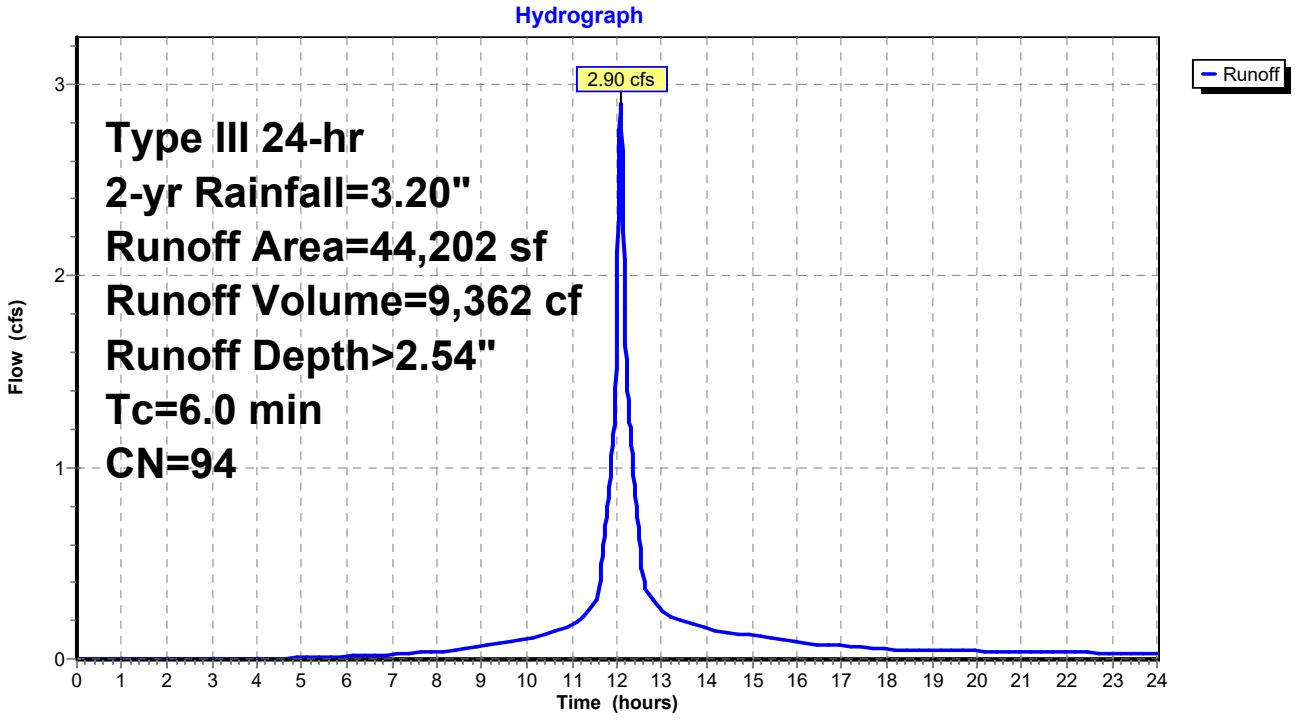
Runoff = 2.90 cfs @ 12.08 hrs, Volume= 9,362 cf, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
25,257	98	Roofs, HSG D
9,995	98	Paved parking, HSG D
8,950	80	>75% Grass cover, Good, HSG D
44,202	94	Weighted Average
8,950		20.25% Pervious Area
35,252		79.75% Impervious Area

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

Subcatchment 6S: Existing Roof, Site Area, & Garage



Summary for Subcatchment PAVERS: PERM. PAVERS

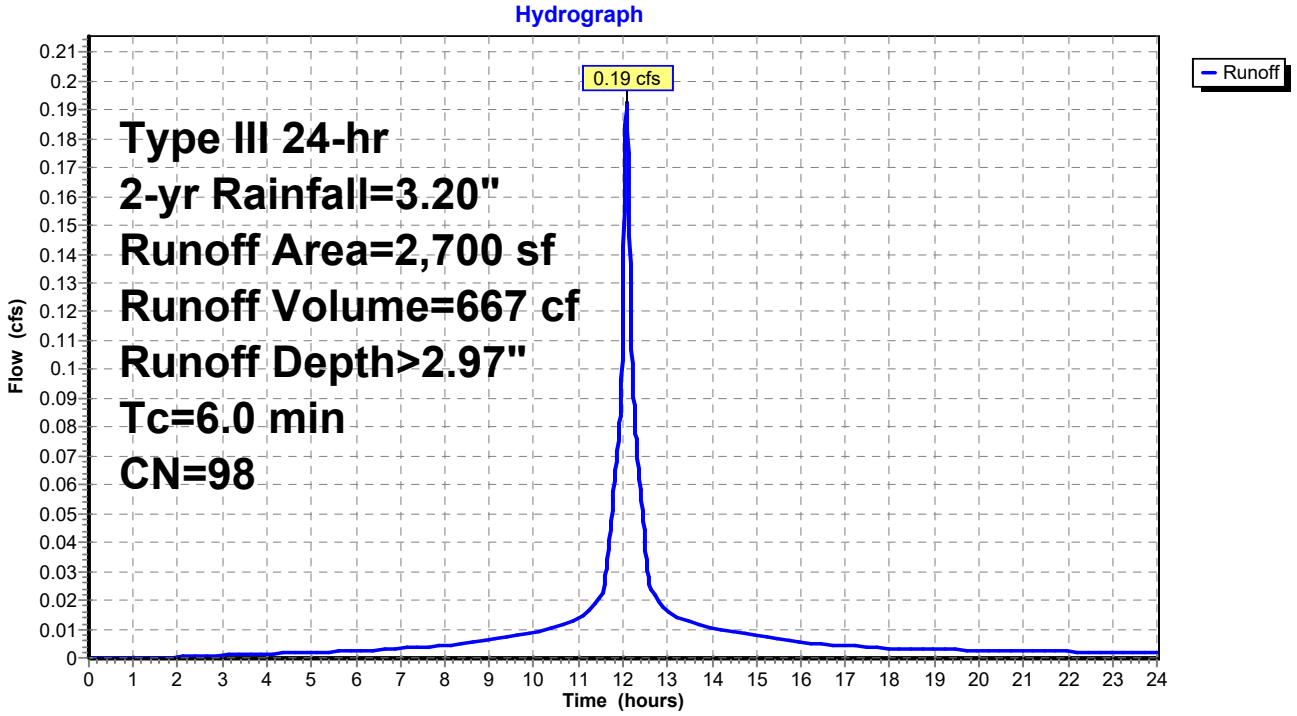
Runoff = 0.19 cfs @ 12.08 hrs, Volume= 667 cf, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

	Area (sf)	CN	Description
*	2,700	98	Pavers
	2,700		100.00% Impervious Area

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

Subcatchment PAVERS: PERM. PAVERS



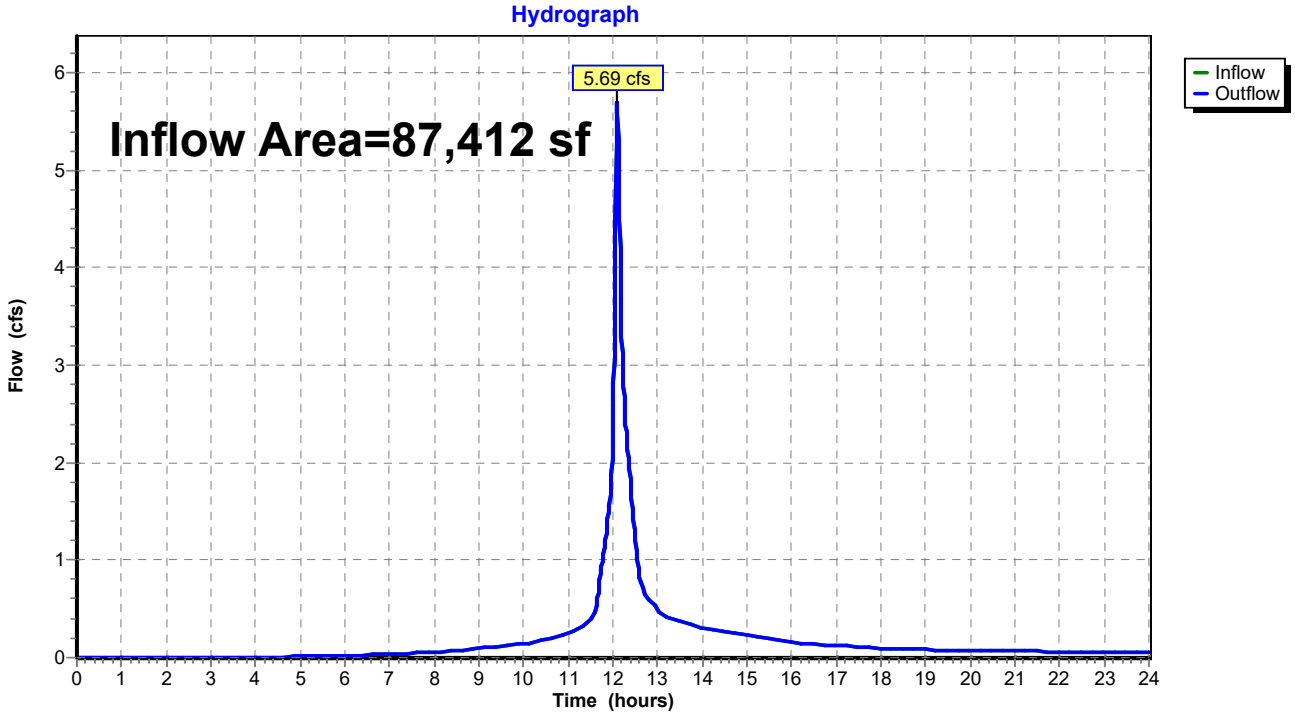
Summary for Reach 12R: Proposed Total to Harbor

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,412 sf, 87.67% Impervious, Inflow Depth > 2.20" for 2-yr event
Inflow = 5.69 cfs @ 12.09 hrs, Volume= 16,010 cf
Outflow = 5.69 cfs @ 12.09 hrs, Volume= 16,010 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 12R: Proposed Total to Harbor



Summary for Pond PP: STONE RESERVOIR

Inflow Area = 2,700 sf,100.00% Impervious, Inflow Depth > 2.97" for 2-yr event
Inflow = 0.19 cfs @ 12.08 hrs, Volume= 667 cf
Outflow = 0.01 cfs @ 13.86 hrs, Volume= 632 cf, Atten= 94%, Lag= 106.4 min
Discarded = 0.01 cfs @ 13.86 hrs, Volume= 632 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 15.65' @ 13.86 hrs Surf.Area= 2,700 sf Storage= 286 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 184.2 min (940.0 - 755.8)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	810 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 2,700 cf Overall x 30.0% Voids

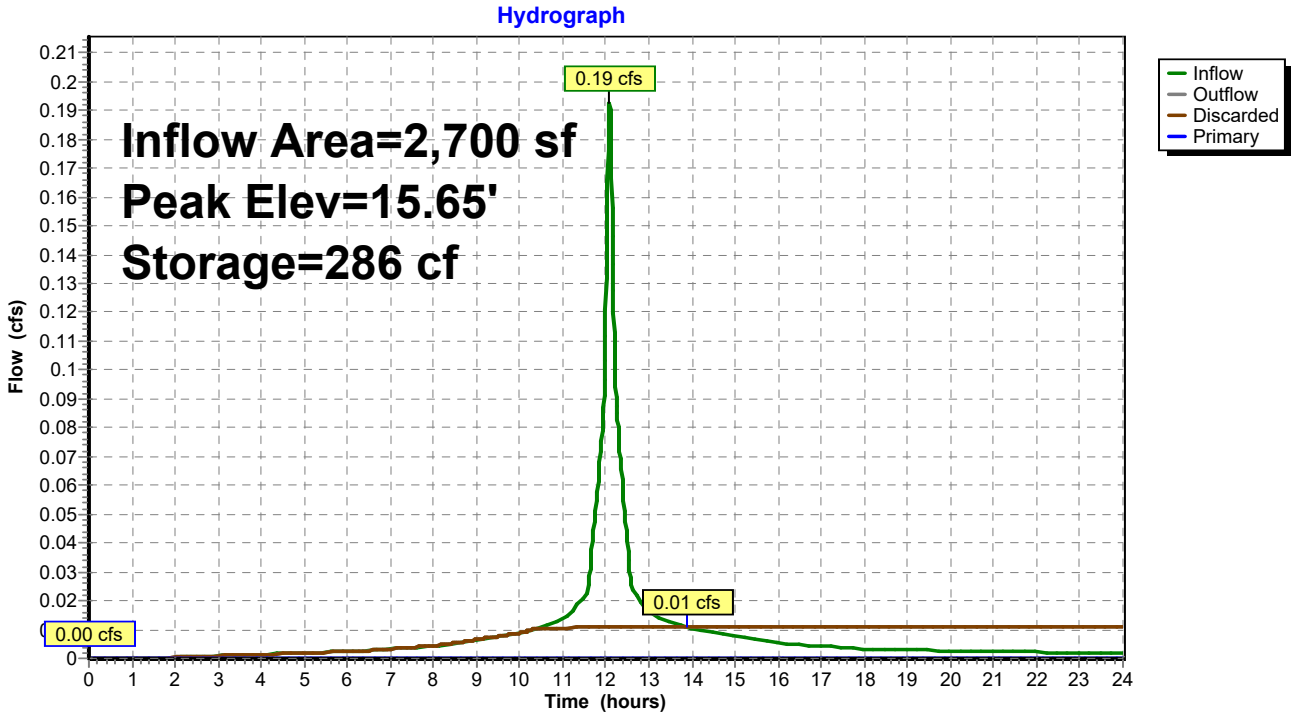
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.30	2,700	0	0
16.30	2,700	2,700	2,700

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	15.70'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 15.70' / 15.20' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 13.86 hrs HW=15.65' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=15.30' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond PP: STONE RESERVOIR



Stage-Area-Storage for Pond PP: STONE RESERVOIR

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
15.30	**2,700**	0
15.31	2,700	8
15.32	2,700	16
15.33	2,700	24
15.34	2,700	32
15.35	2,700	41
15.36	2,700	49
15.37	2,700	57
15.38	2,700	65
15.39	2,700	73
15.40	2,700	81
15.41	2,700	89
15.42	2,700	97
15.43	2,700	105
15.44	2,700	113
15.45	2,700	122
15.46	2,700	130
15.47	2,700	138
15.48	2,700	146
15.49	2,700	154
15.50	2,700	162
15.51	2,700	170
15.52	2,700	178
15.53	2,700	186
15.54	2,700	194
15.55	2,700	203
15.56	2,700	211
15.57	2,700	219
15.58	2,700	227
15.59	2,700	235
15.60	2,700	243
15.61	2,700	251
15.62	2,700	259
15.63	2,700	267
15.64	2,700	275
15.65	2,700	283
15.66	2,700	292
15.67	2,700	300
15.68	2,700	308
15.69	2,700	316
15.70	2,700	324
15.71	2,700	332
15.72	2,700	340
15.73	2,700	348
15.74	2,700	356
15.75	2,700	364
15.76	2,700	373
15.77	2,700	381
15.78	2,700	389
15.79	2,700	397
15.80	2,700	405
15.81	2,700	413
15.82	2,700	421
15.83	2,700	429
15.84	2,700	437
15.85	2,700	446
15.86	2,700	454
15.87	2,700	462
15.88	2,700	470
15.89	2,700	478
15.90	2,700	486
15.91	2,700	494
15.92	2,700	502
15.93	2,700	510
15.94	2,700	518
15.95	2,700	527
15.96	2,700	535
15.97	2,700	543
15.98	2,700	551
15.99	2,700	559
16.00	2,700	567
16.01	2,700	575
16.02	2,700	583
16.03	2,700	591
16.04	2,700	599
16.05	2,700	608
16.06	2,700	616
16.07	2,700	624
16.08	2,700	632
16.09	2,700	640
16.10	2,700	648
16.11	2,700	656
16.12	2,700	664
16.13	2,700	672
16.14	2,700	680
16.15	2,700	689
16.16	2,700	697
16.17	2,700	705
16.18	2,700	713
16.19	2,700	721
16.20	2,700	729
16.21	2,700	737
16.22	2,700	745
16.23	2,700	753
16.24	2,700	761
16.25	2,700	769
16.26	2,700	778
16.27	2,700	786
16.28	2,700	794
16.29	2,700	802
16.30	2,700	**810**

STORAGE BELOW OUTLET

Summary for Subcatchment 5S: Site Area

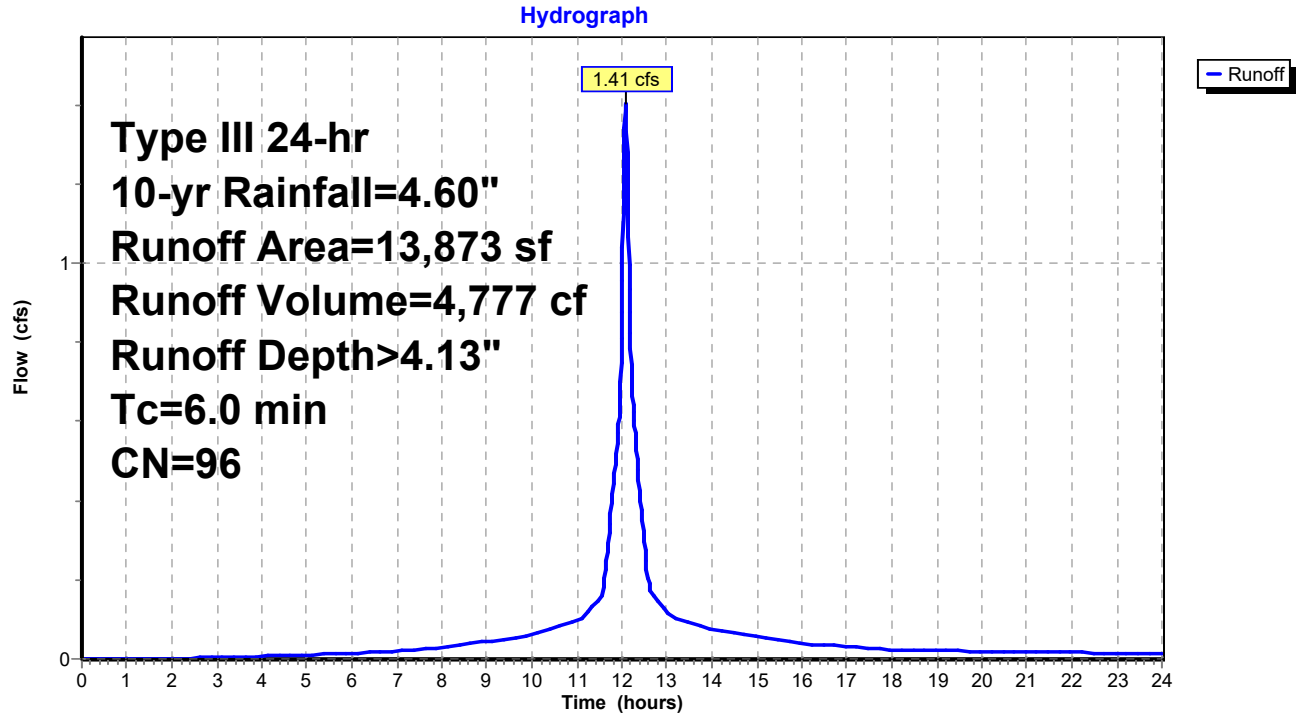
Runoff = 1.41 cfs @ 12.08 hrs, Volume= 4,777 cf, Depth> 4.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.60"

	Area (sf)	CN	Description
	1,331	80	>75% Grass cover, Good, HSG D
	12,042	98	Paved parking, HSG D
*	500	80	Peastone
	13,873	96	Weighted Average
	1,831		13.20% Pervious Area
	12,042		86.80% Impervious Area

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

Subcatchment 5S: Site Area



Summary for Subcatchment 6S: Existing Roof, Site Area, & Garage

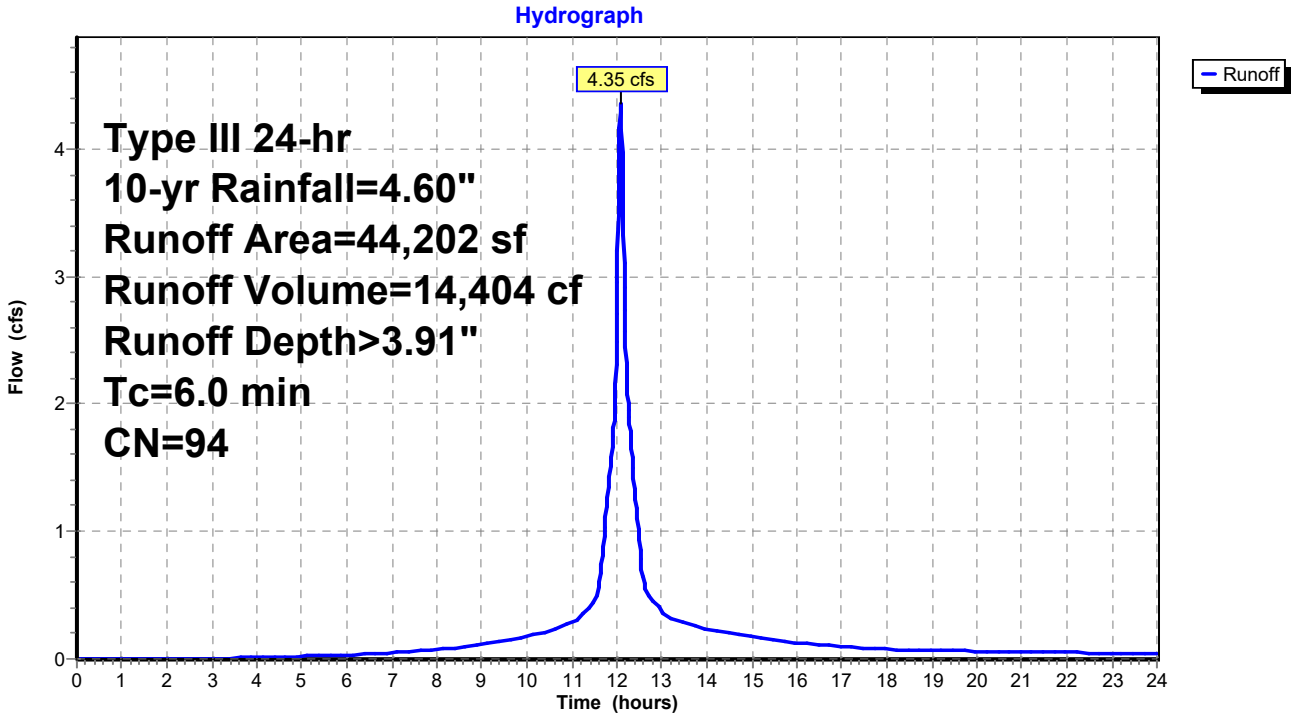
Runoff = 4.35 cfs @ 12.08 hrs, Volume= 14,404 cf, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.60"

Area (sf)	CN	Description
25,257	98	Roofs, HSG D
9,995	98	Paved parking, HSG D
8,950	80	>75% Grass cover, Good, HSG D
44,202	94	Weighted Average
8,950		20.25% Pervious Area
35,252		79.75% Impervious Area

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

Subcatchment 6S: Existing Roof, Site Area, & Garage



Summary for Subcatchment PAVERS: PERM. PAVERS

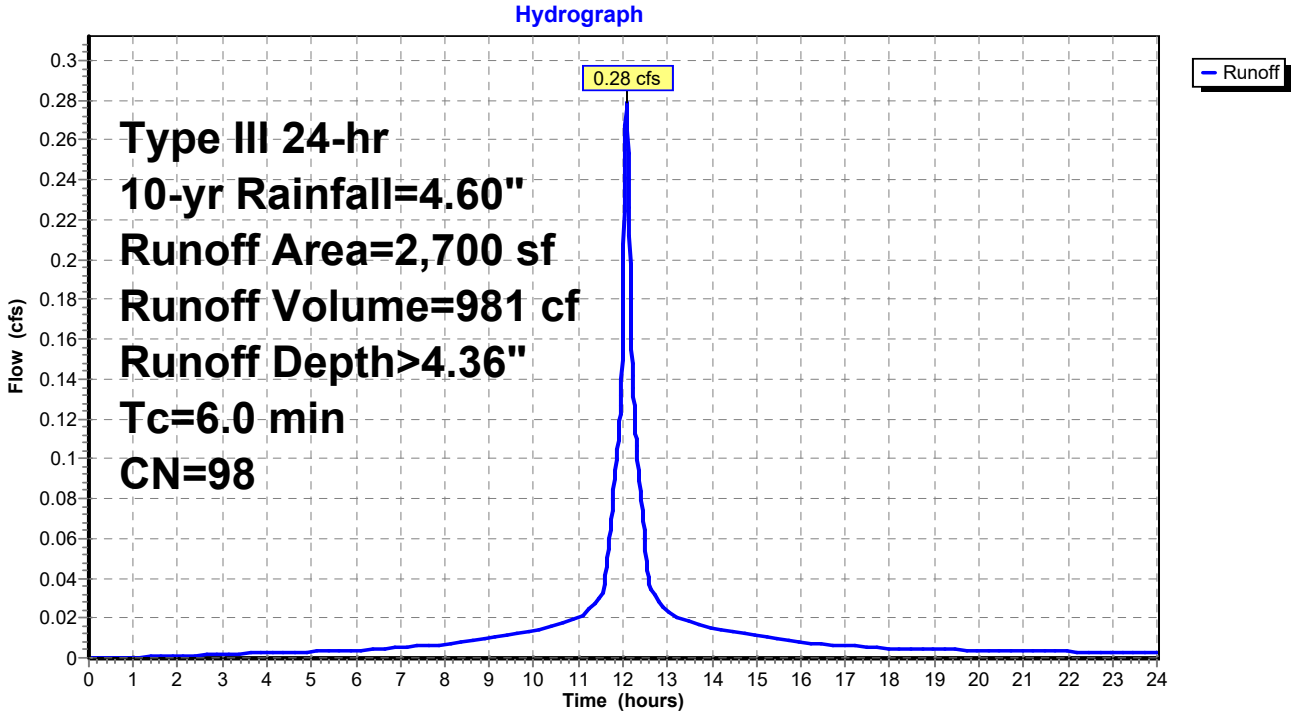
Runoff = 0.28 cfs @ 12.08 hrs, Volume= 981 cf, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.60"

	Area (sf)	CN	Description
*	2,700	98	Pavers
	2,700		100.00% Impervious Area

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

Subcatchment PAVERS: PERM. PAVERS



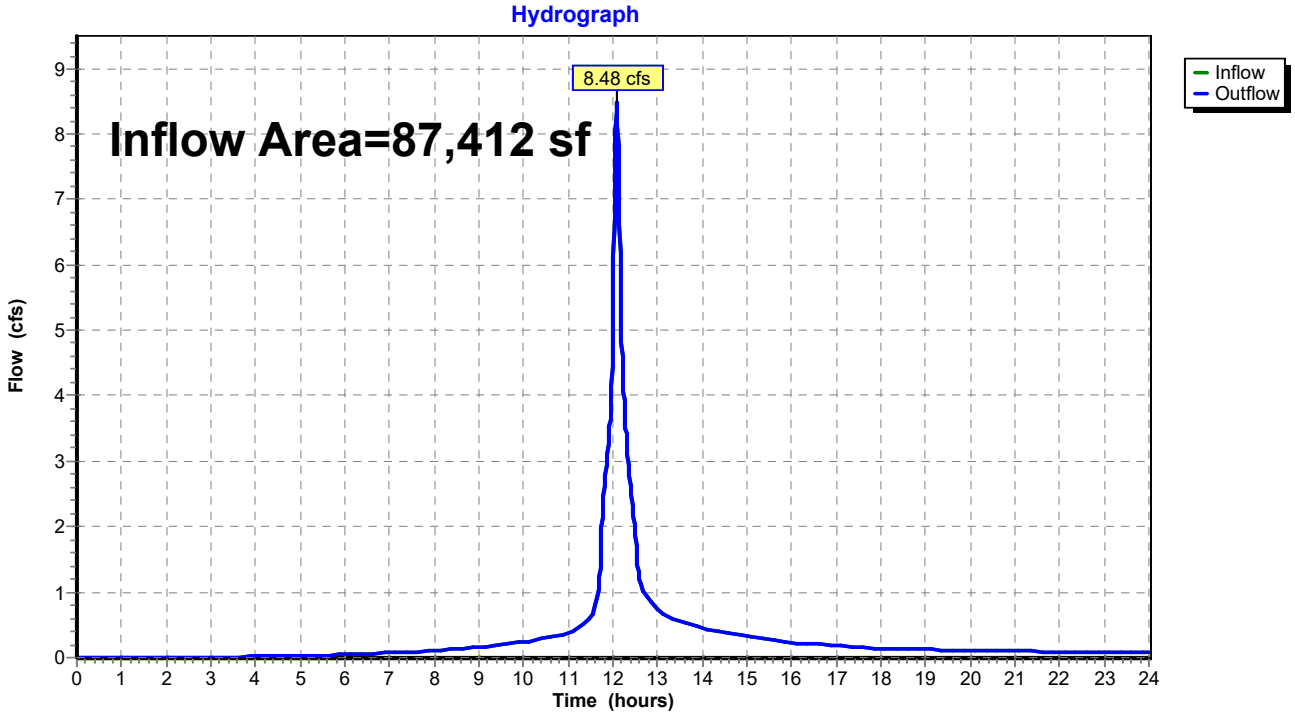
Summary for Reach 12R: Proposed Total to Harbor

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,412 sf, 87.67% Impervious, Inflow Depth > 3.55" for 10-yr event
Inflow = 8.48 cfs @ 12.09 hrs, Volume= 25,876 cf
Outflow = 8.48 cfs @ 12.09 hrs, Volume= 25,876 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 12R: Proposed Total to Harbor



Summary for Pond PP: STONE RESERVOIR

Inflow Area = 2,700 sf,100.00% Impervious, Inflow Depth > 4.36" for 10-yr event
Inflow = 0.28 cfs @ 12.08 hrs, Volume= 981 cf
Outflow = 0.04 cfs @ 12.57 hrs, Volume= 837 cf, Atten= 85%, Lag= 29.1 min
Discarded = 0.01 cfs @ 12.57 hrs, Volume= 688 cf
Primary = 0.03 cfs @ 12.57 hrs, Volume= 148 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 15.80' @ 12.57 hrs Surf.Area= 2,700 sf Storage= 406 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 134.0 min (882.9 - 748.9)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	810 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 2,700 cf Overall x 30.0% Voids

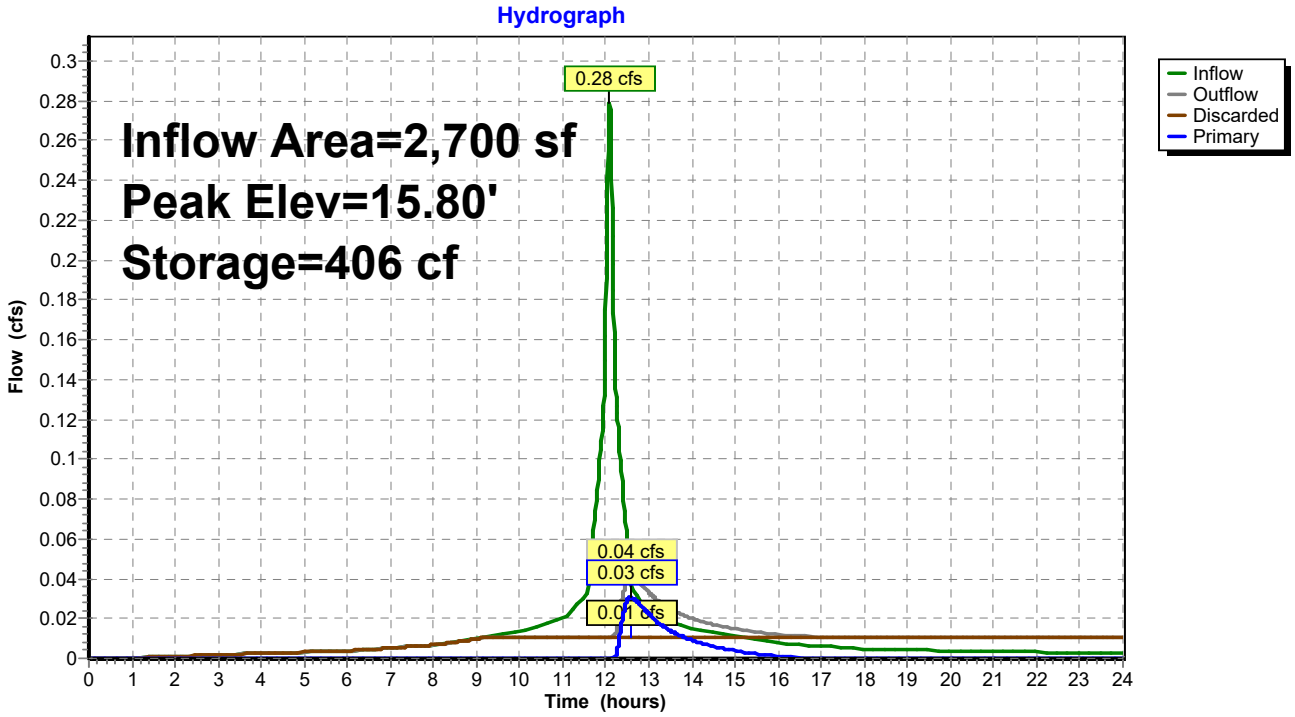
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.30	2,700	0	0
16.30	2,700	2,700	2,700

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	15.70'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 15.70' / 15.20' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 12.57 hrs HW=15.80' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.03 cfs @ 12.57 hrs HW=15.80' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 0.03 cfs @ 1.08 fps)

Pond PP: STONE RESERVOIR



Stage-Area-Storage for Pond PP: STONE RESERVOIR

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
15.30	**2,700**	0
15.31	2,700	8
15.32	2,700	16
15.33	2,700	24
15.34	2,700	32
15.35	2,700	41
15.36	2,700	49
15.37	2,700	57
15.38	2,700	65
15.39	2,700	73
15.40	2,700	81
15.41	2,700	89
15.42	2,700	97
15.43	2,700	105
15.44	2,700	113
15.45	2,700	122
15.46	2,700	130
15.47	2,700	138
15.48	2,700	146
15.49	2,700	154
15.50	2,700	162
15.51	2,700	170
15.52	2,700	178
15.53	2,700	186
15.54	2,700	194
15.55	2,700	203
15.56	2,700	211
15.57	2,700	219
15.58	2,700	227
15.59	2,700	235
15.60	2,700	243
15.61	2,700	251
15.62	2,700	259
15.63	2,700	267
15.64	2,700	275
15.65	2,700	283
15.66	2,700	292
15.67	2,700	300
15.68	2,700	308
15.69	2,700	316
15.70	2,700	324
15.71	2,700	332
15.72	2,700	340
15.73	2,700	348
15.74	2,700	356
15.75	2,700	364
15.76	2,700	373
15.77	2,700	381
15.78	2,700	389
15.79	2,700	397
15.80	2,700	405
15.81	2,700	413
15.82	2,700	421
15.83	2,700	429
15.84	2,700	437
15.85	2,700	446
15.86	2,700	454
15.87	2,700	462
15.88	2,700	470
15.89	2,700	478
15.90	2,700	486
15.91	2,700	494
15.92	2,700	502
15.93	2,700	510
15.94	2,700	518
15.95	2,700	527
15.96	2,700	535
15.97	2,700	543
15.98	2,700	551
15.99	2,700	559
16.00	2,700	567
16.01	2,700	575
16.02	2,700	583
16.03	2,700	591
16.04	2,700	599
16.05	2,700	608
16.06	2,700	616
16.07	2,700	624
16.08	2,700	632
16.09	2,700	640
16.10	2,700	648
16.11	2,700	656
16.12	2,700	664
16.13	2,700	672
16.14	2,700	680
16.15	2,700	689
16.16	2,700	697
16.17	2,700	705
16.18	2,700	713
16.19	2,700	721
16.20	2,700	729
16.21	2,700	737
16.22	2,700	745
16.23	2,700	753
16.24	2,700	761
16.25	2,700	769
16.26	2,700	778
16.27	2,700	786
16.28	2,700	794
16.29	2,700	802
16.30	2,700	**810**

Summary for Subcatchment 5S: Site Area

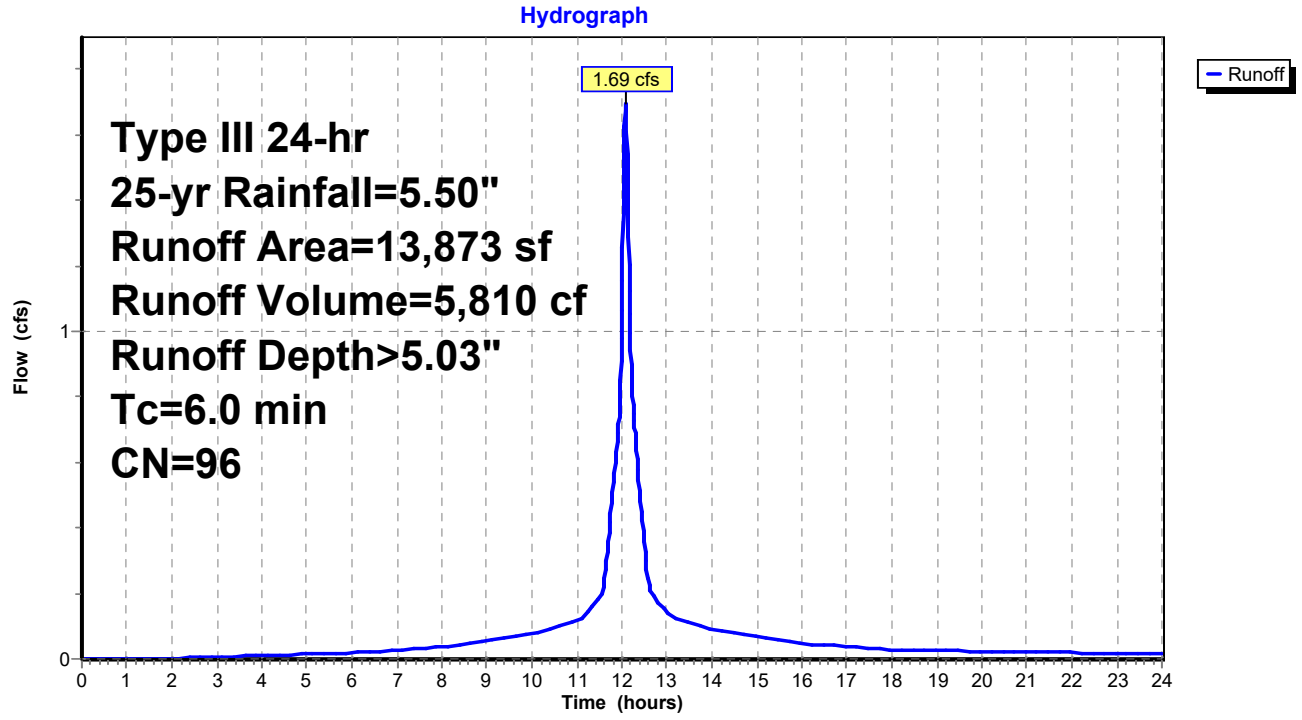
Runoff = 1.69 cfs @ 12.08 hrs, Volume= 5,810 cf, Depth> 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.50"

	Area (sf)	CN	Description
	1,331	80	>75% Grass cover, Good, HSG D
	12,042	98	Paved parking, HSG D
*	500	80	Peastone
	13,873	96	Weighted Average
	1,831		13.20% Pervious Area
	12,042		86.80% Impervious Area

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

Subcatchment 5S: Site Area



Summary for Subcatchment 6S: Existing Roof, Site Area, & Garage

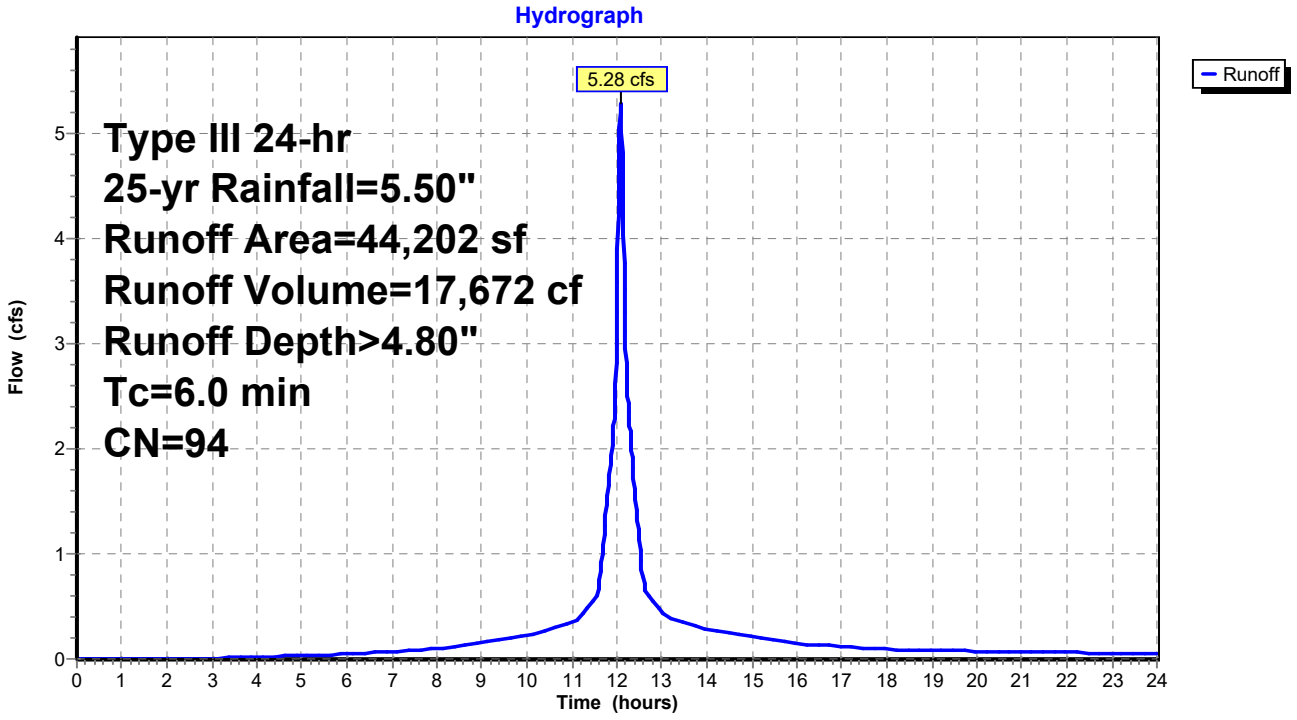
Runoff = 5.28 cfs @ 12.08 hrs, Volume= 17,672 cf, Depth> 4.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.50"

Area (sf)	CN	Description
25,257	98	Roofs, HSG D
9,995	98	Paved parking, HSG D
8,950	80	>75% Grass cover, Good, HSG D
44,202	94	Weighted Average
8,950		20.25% Pervious Area
35,252		79.75% Impervious Area

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

Subcatchment 6S: Existing Roof, Site Area, & Garage



Summary for Subcatchment PAVERS: PERM. PAVERS

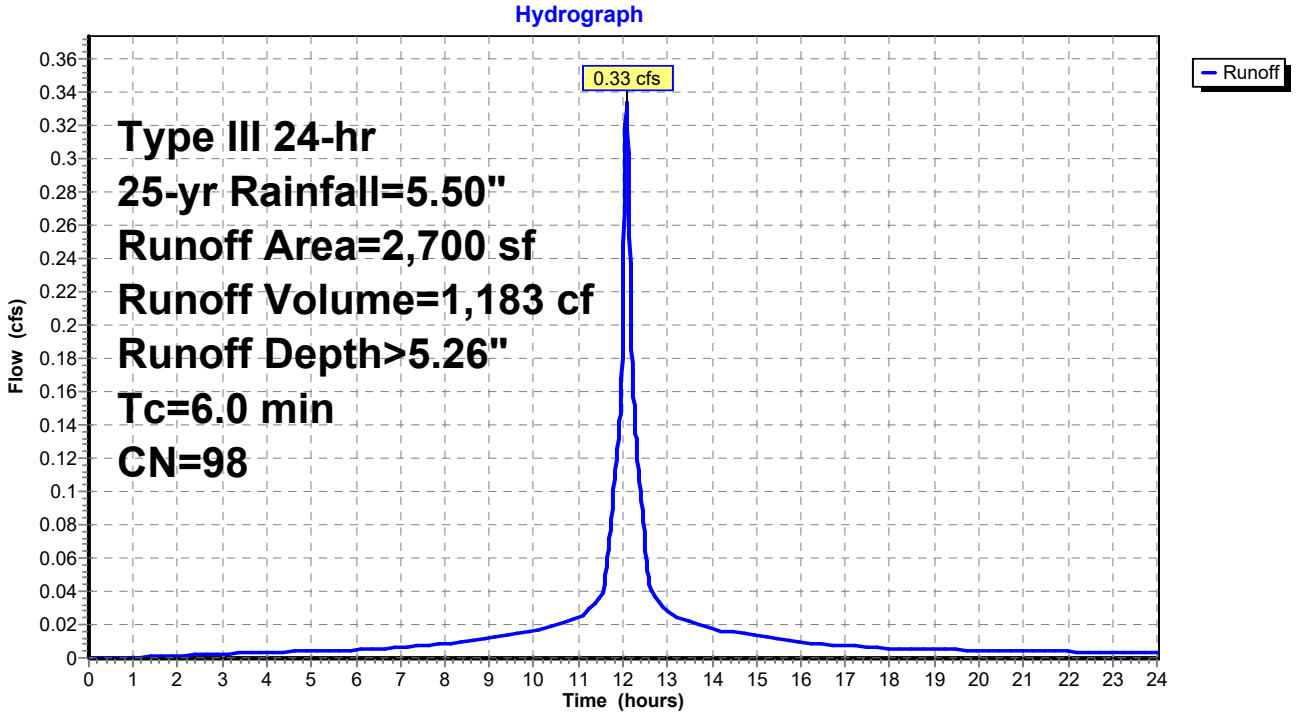
Runoff = 0.33 cfs @ 12.08 hrs, Volume= 1,183 cf, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.50"

	Area (sf)	CN	Description
*	2,700	98	Pavers
	2,700		100.00% Impervious Area

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

Subcatchment PAVERS: PERM. PAVERS



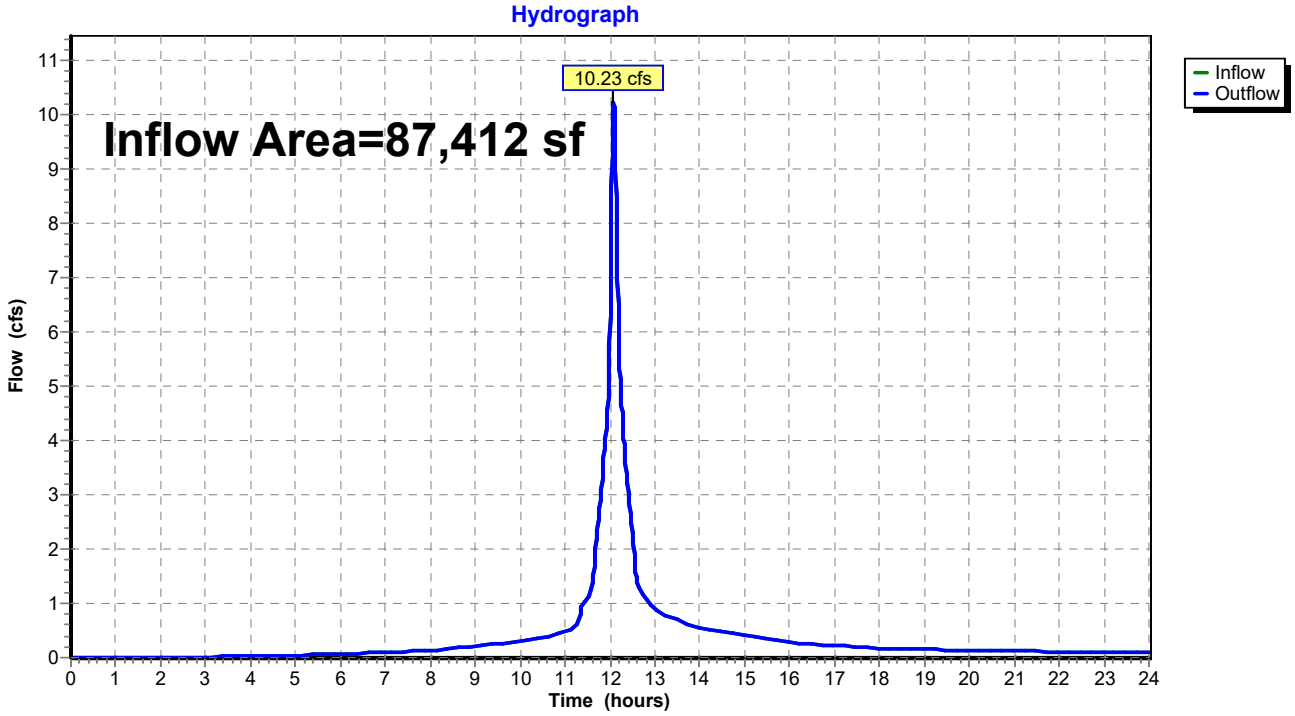
Summary for Reach 12R: Proposed Total to Harbor

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,412 sf, 87.67% Impervious, Inflow Depth > 4.44" for 25-yr event
Inflow = 10.23 cfs @ 12.09 hrs, Volume= 32,308 cf
Outflow = 10.23 cfs @ 12.09 hrs, Volume= 32,308 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 12R: Proposed Total to Harbor



Summary for Pond PP: STONE RESERVOIR

Inflow Area = 2,700 sf,100.00% Impervious, Inflow Depth > 5.26" for 25-yr event
Inflow = 0.33 cfs @ 12.08 hrs, Volume= 1,183 cf
Outflow = 0.09 cfs @ 12.44 hrs, Volume= 1,011 cf, Atten= 74%, Lag= 21.2 min
Discarded = 0.01 cfs @ 12.44 hrs, Volume= 716 cf
Primary = 0.08 cfs @ 12.44 hrs, Volume= 296 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 15.86' @ 12.44 hrs Surf.Area= 2,700 sf Storage= 457 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 107.9 min (853.9 - 745.9)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	810 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 2,700 cf Overall x 30.0% Voids

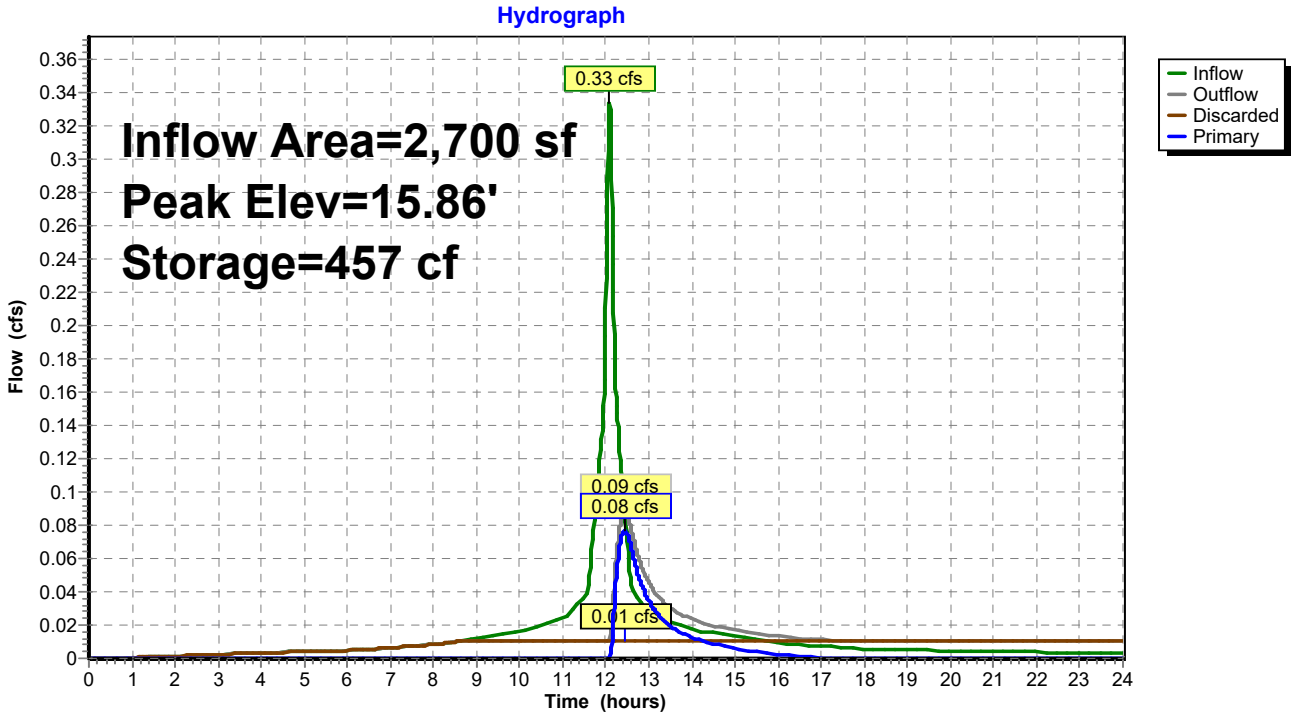
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.30	2,700	0	0
16.30	2,700	2,700	2,700

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	15.70'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 15.70' / 15.20' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 12.44 hrs HW=15.86' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.08 cfs @ 12.44 hrs HW=15.86' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 0.08 cfs @ 1.38 fps)

Pond PP: STONE RESERVOIR



Stage-Area-Storage for Pond PP: STONE RESERVOIR

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
15.30	**2,700**	0
15.31	2,700	8
15.32	2,700	16
15.33	2,700	24
15.34	2,700	32
15.35	2,700	41
15.36	2,700	49
15.37	2,700	57
15.38	2,700	65
15.39	2,700	73
15.40	2,700	81
15.41	2,700	89
15.42	2,700	97
15.43	2,700	105
15.44	2,700	113
15.45	2,700	122
15.46	2,700	130
15.47	2,700	138
15.48	2,700	146
15.49	2,700	154
15.50	2,700	162
15.51	2,700	170
15.52	2,700	178
15.53	2,700	186
15.54	2,700	194
15.55	2,700	203
15.56	2,700	211
15.57	2,700	219
15.58	2,700	227
15.59	2,700	235
15.60	2,700	243
15.61	2,700	251
15.62	2,700	259
15.63	2,700	267
15.64	2,700	275
15.65	2,700	283
15.66	2,700	292
15.67	2,700	300
15.68	2,700	308
15.69	2,700	316
15.70	2,700	324
15.71	2,700	332
15.72	2,700	340
15.73	2,700	348
15.74	2,700	356
15.75	2,700	364
15.76	2,700	373
15.77	2,700	381
15.78	2,700	389
15.79	2,700	397
15.80	2,700	405
15.81	2,700	413
15.82	2,700	421
15.83	2,700	429
15.84	2,700	437
15.85	2,700	446
15.86	2,700	454
15.87	2,700	462
15.88	2,700	470
15.89	2,700	478
15.90	2,700	486
15.91	2,700	494
15.92	2,700	502
15.93	2,700	510
15.94	2,700	518
15.95	2,700	527
15.96	2,700	535
15.97	2,700	543
15.98	2,700	551
15.99	2,700	559
16.00	2,700	567
16.01	2,700	575
16.02	2,700	583
16.03	2,700	591
16.04	2,700	599
16.05	2,700	608
16.06	2,700	616
16.07	2,700	624
16.08	2,700	632
16.09	2,700	640
16.10	2,700	648
16.11	2,700	656
16.12	2,700	664
16.13	2,700	672
16.14	2,700	680
16.15	2,700	689
16.16	2,700	697
16.17	2,700	705
16.18	2,700	713
16.19	2,700	721
16.20	2,700	729
16.21	2,700	737
16.22	2,700	745
16.23	2,700	753
16.24	2,700	761
16.25	2,700	769
16.26	2,700	778
16.27	2,700	786
16.28	2,700	794
16.29	2,700	802
16.30	2,700	**810**

Summary for Subcatchment 5S: Site Area

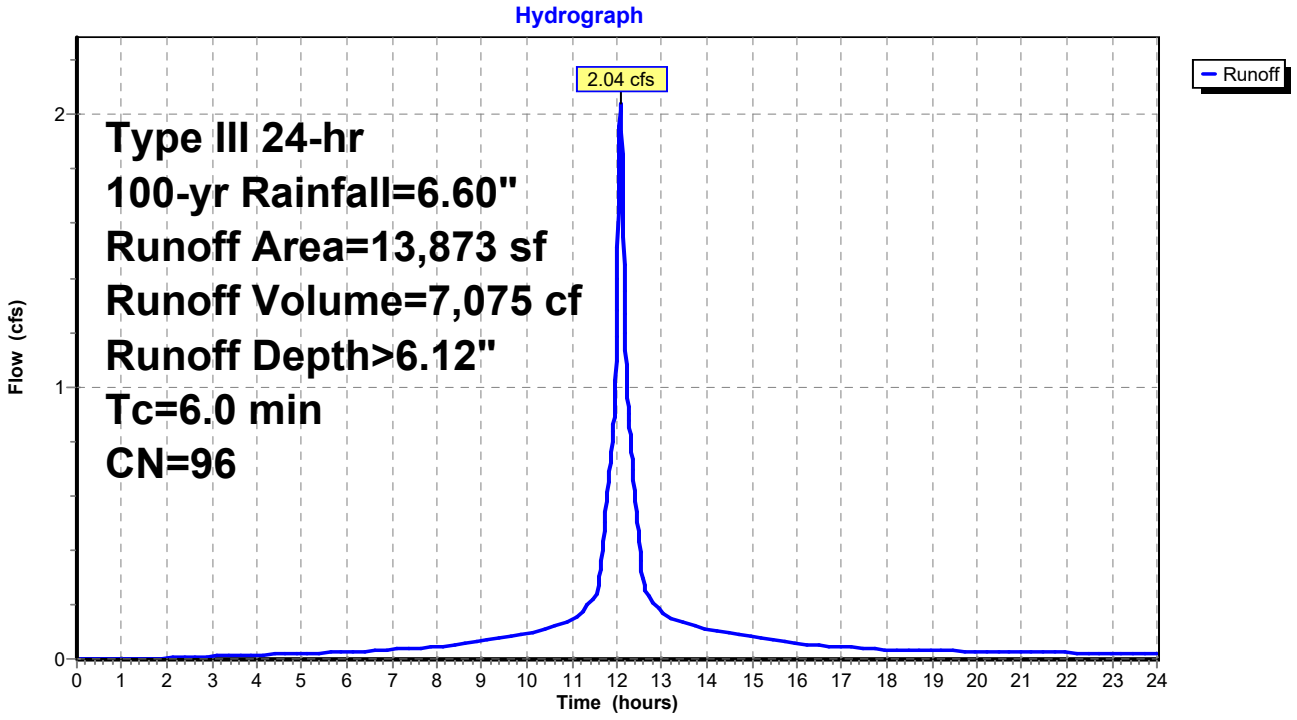
Runoff = 2.04 cfs @ 12.08 hrs, Volume= 7,075 cf, Depth> 6.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

	Area (sf)	CN	Description
	1,331	80	>75% Grass cover, Good, HSG D
	12,042	98	Paved parking, HSG D
*	500	80	Peastone
	13,873	96	Weighted Average
	1,831		13.20% Pervious Area
	12,042		86.80% Impervious Area

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

Subcatchment 5S: Site Area



Summary for Subcatchment 6S: Existing Roof, Site Area, & Garage

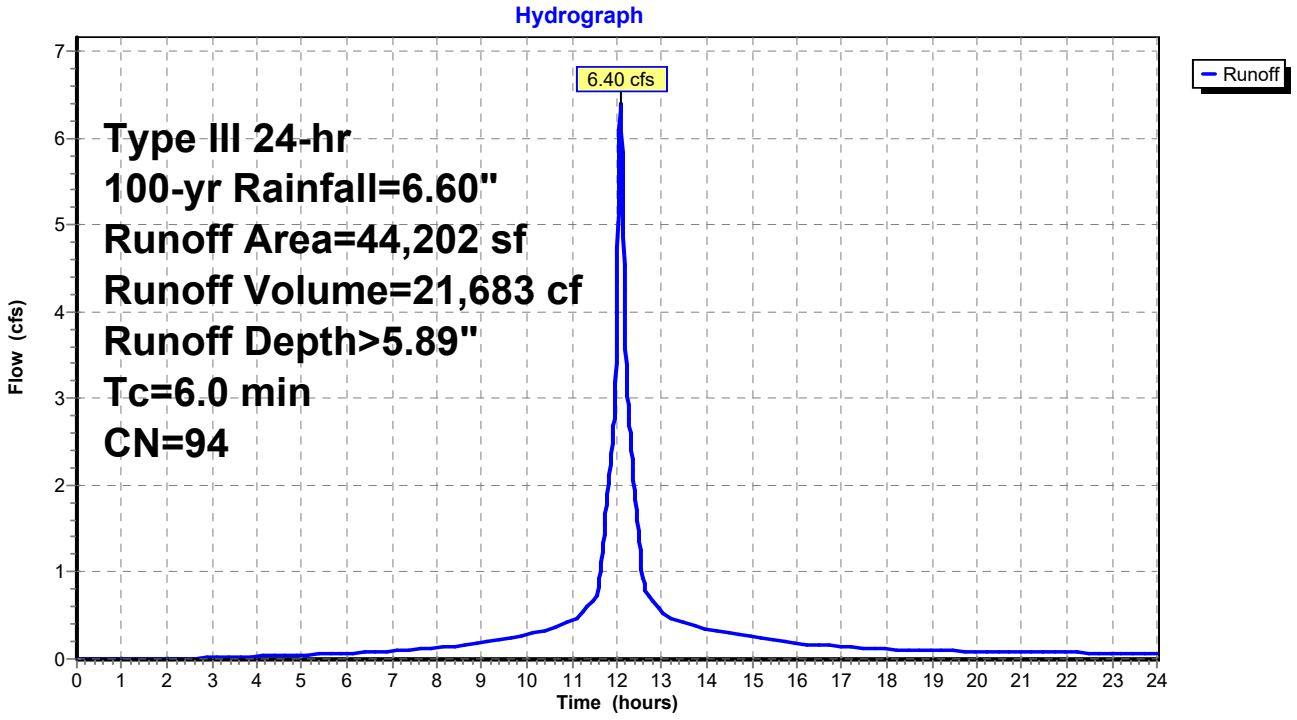
Runoff = 6.40 cfs @ 12.08 hrs, Volume= 21,683 cf, Depth> 5.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

Area (sf)	CN	Description
25,257	98	Roofs, HSG D
9,995	98	Paved parking, HSG D
8,950	80	>75% Grass cover, Good, HSG D
44,202	94	Weighted Average
8,950		20.25% Pervious Area
35,252		79.75% Impervious Area

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

Subcatchment 6S: Existing Roof, Site Area, & Garage



Summary for Subcatchment PAVERS: PERM. PAVERS

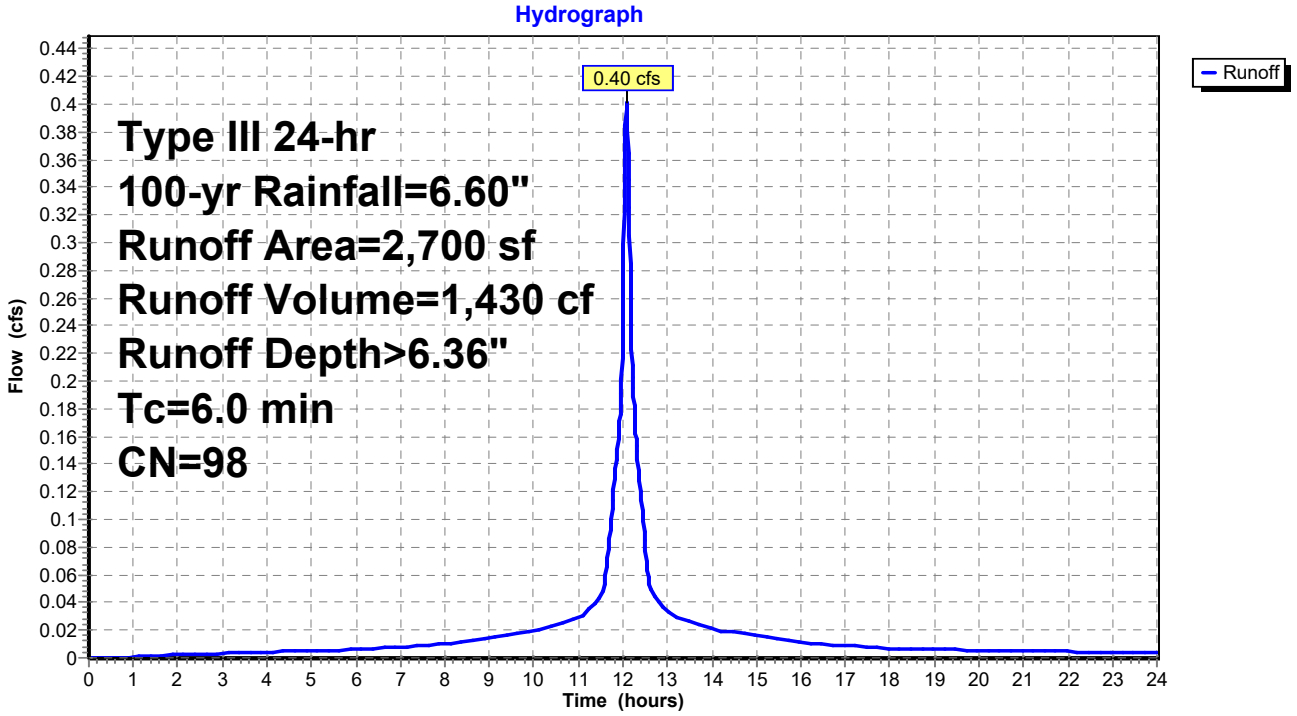
Runoff = 0.40 cfs @ 12.08 hrs, Volume= 1,430 cf, Depth> 6.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.60"

	Area (sf)	CN	Description
*	2,700	98	Pavers
	2,700		100.00% Impervious Area

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

Subcatchment PAVERS: PERM. PAVERS



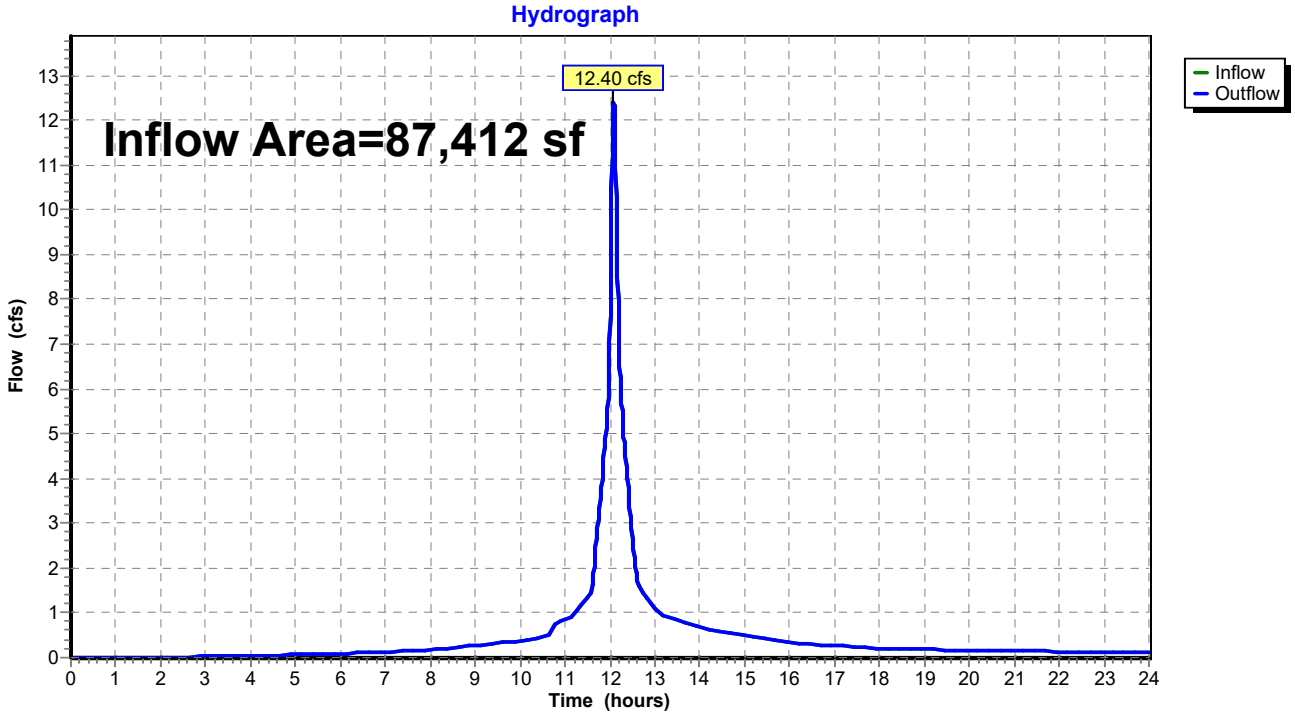
Summary for Reach 12R: Proposed Total to Harbor

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,412 sf, 87.67% Impervious, Inflow Depth > 5.52" for 100-yr event
Inflow = 12.40 cfs @ 12.09 hrs, Volume= 40,199 cf
Outflow = 12.40 cfs @ 12.09 hrs, Volume= 40,199 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 12R: Proposed Total to Harbor



Summary for Pond PP: STONE RESERVOIR

Inflow Area = 2,700 sf,100.00% Impervious, Inflow Depth > 6.36" for 100-yr event
Inflow = 0.40 cfs @ 12.08 hrs, Volume= 1,430 cf
Outflow = 0.15 cfs @ 12.31 hrs, Volume= 1,230 cf, Atten= 62%, Lag= 13.6 min
Discarded = 0.01 cfs @ 12.31 hrs, Volume= 746 cf
Primary = 0.14 cfs @ 12.31 hrs, Volume= 484 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 15.93' @ 12.31 hrs Surf.Area= 2,700 sf Storage= 509 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 86.2 min (829.4 - 743.2)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	810 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 2,700 cf Overall x 30.0% Voids

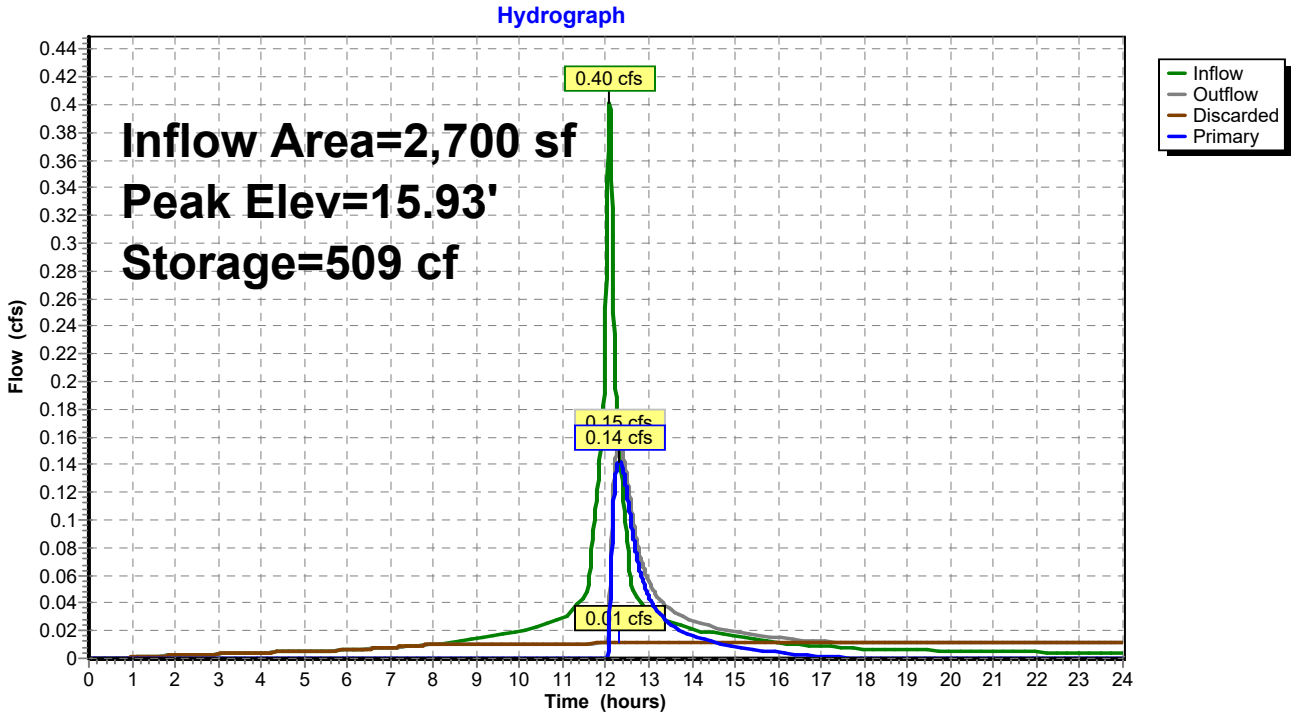
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.30	2,700	0	0
16.30	2,700	2,700	2,700

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	15.70'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 15.70' / 15.20' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 12.31 hrs HW=15.93' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.14 cfs @ 12.31 hrs HW=15.93' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 0.14 cfs @ 1.63 fps)

Pond PP: STONE RESERVOIR



Stage-Area-Storage for Pond PP: STONE RESERVOIR

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
15.30	**2,700**	0
15.31	2,700	8
15.32	2,700	16
15.33	2,700	24
15.34	2,700	32
15.35	2,700	41
15.36	2,700	49
15.37	2,700	57
15.38	2,700	65
15.39	2,700	73
15.40	2,700	81
15.41	2,700	89
15.42	2,700	97
15.43	2,700	105
15.44	2,700	113
15.45	2,700	122
15.46	2,700	130
15.47	2,700	138
15.48	2,700	146
15.49	2,700	154
15.50	2,700	162
15.51	2,700	170
15.52	2,700	178
15.53	2,700	186
15.54	2,700	194
15.55	2,700	203
15.56	2,700	211
15.57	2,700	219
15.58	2,700	227
15.59	2,700	235
15.60	2,700	243
15.61	2,700	251
15.62	2,700	259
15.63	2,700	267
15.64	2,700	275
15.65	2,700	283
15.66	2,700	292
15.67	2,700	300
15.68	2,700	308
15.69	2,700	316
15.70	2,700	324
15.71	2,700	332
15.72	2,700	340
15.73	2,700	348
15.74	2,700	356
15.75	2,700	364
15.76	2,700	373
15.77	2,700	381
15.78	2,700	389
15.79	2,700	397
15.80	2,700	405
15.81	2,700	413
15.82	2,700	421
15.83	2,700	429
15.84	2,700	437
15.85	2,700	446
15.86	2,700	454
15.87	2,700	462
15.88	2,700	470
15.89	2,700	478
15.90	2,700	486
15.91	2,700	494
15.92	2,700	502
15.93	2,700	510
15.94	2,700	518
15.95	2,700	527
15.96	2,700	535
15.97	2,700	543
15.98	2,700	551
15.99	2,700	559
16.00	2,700	567
16.01	2,700	575
16.02	2,700	583
16.03	2,700	591
16.04	2,700	599
16.05	2,700	608
16.06	2,700	616
16.07	2,700	624
16.08	2,700	632
16.09	2,700	640
16.10	2,700	648
16.11	2,700	656
16.12	2,700	664
16.13	2,700	672
16.14	2,700	680
16.15	2,700	689
16.16	2,700	697
16.17	2,700	705
16.18	2,700	713
16.19	2,700	721
16.20	2,700	729
16.21	2,700	737
16.22	2,700	745
16.23	2,700	753
16.24	2,700	761
16.25	2,700	769
16.26	2,700	778
16.27	2,700	786
16.28	2,700	794
16.29	2,700	802
16.30	2,700	**810**

Mission Statement

At Nitsch Engineering, we embrace our tagline, "Building better communities with you." These "communities" include the A/E/C industry, our local municipalities, and our employees. Both internally and externally, we strive to embody a high level of corporate citizenship through sustainable business practices, community involvement, and charitable contributions.

We define ourselves by *why* we do what we do – to positively impact our clients, employees, and communities by focusing on our core values and conducting ourselves with integrity, close personal attention to the needs and goals of our clients and employees, a commitment to professional standards, and, at all times, a caring attitude.

Nitsch Engineering
Boston MA | Lawrence MA | Worcester MA | Washington DC
617-338-0063 www.nitscheng.com info@nitscheng.com

Nitsch Engineering

March 24, 2015
Revised March 27, 2019

STORMWATER OPERATIONS AND MAINTENANCE PLAN

For

NEW STREET LANDSCAPE IMPROVEMENTS
Boston, Massachusetts

Prepared for:

New Street Development, LLC
1477 NW Everett Street
Portland, OR 97209

Prepared by:

NITSCH ENGINEERING, INC.
2 Center Plaza, Suite 430
Boston, MA 02108

Nitsch Project #6729

Stormwater System Operations and Maintenance Plan

Project: New Street Development
Location: Boston MA

Owner: New Street Development, LLC

Date: March 24, 2015

Prepared by: Nitsch Engineering, Inc.
2 Center Plaza, Suite 430
Boston, MA 02108
(617) 338-0063

Prepared for: New Street Development, LLC ***Nitsch Project #6729***

I. Stormwater management system owner: New Street Development, LLC

II. Parties responsible for O&M during construction: Contractor

III. Parties responsible for O&M post-construction: New Street Development, LLC

IV. A schedule for O&M: See below

V. Routine and non-routine maintenance tasks to be undertaken during and after construction: See below

VI. The entire stormwater management system will be inspected and cleaned by the Contractor prior to the completion of construction. A report of the inspection/cleaning will be forwarded to the owner and the design engineer.

VII. The stormwater management system shall be inspected the first year of operation after large rainfall events (all storms greater than 0.5-inch in 24-hour period) to verify functionality.

VIII. The driveways and parking areas shall be swept six times per year.

IX. All material removed during the cleaning operations shall be disposed of in accordance with applicable guidelines and regulations.

X. All post construction maintenance activities will be documented and kept on file and made available upon request.

XI. The drainage system shall be maintained. The repair of any component of the system shall be made as soon as possible to prevent any potential pollutants (including silt) from entering the resource areas or the existing closed drainage system.

Part I: Construction of the System

Sediment and erosion control during construction will prevent possible damage to the drainage systems. The following guidelines shall be adhered to during construction.

1. Keep land disturbance to a minimum. Plan the phases of development so that only the areas actively being developed are exposed. All other areas should have natural vegetation preserved, have good temporary cover, or permanent vegetation established.

2. Stabilize disturbed areas. Permanent structures, temporary or permanent vegetation, and mulch should be employed as quickly as possible after land is disturbed.

3. Protect disturbed areas from stormwater runoff. Install erosion control or stormwater management measures to prevent water from entering and running over disturbed areas, and to prevent erosion damage to downstream facilities.

4. Install perimeter control practices. Use practices that isolate the development site from surrounding areas. Siltation fence, haybales, and temporary settlement basin shall be utilized.

5. The swales, area drains and underground infiltration systems shall not be used as temporary sediment traps for construction. Sediment and erosion controls should be used to keep runoff and sediment away from these systems/structures. During and after excavation, all excavated materials should be placed downstream, away from these stormwater management systems, to prevent the redeposit of these materials during runoff events. These materials should be properly handled and disposed of during and after construction. Light earth-moving equipment shall be used to excavate the infiltration systems to minimize the compaction of the soils beneath the trench floor.

6. If necessary, temporary dewatering and groundwater control systems shall be designed to keep excavations free of water and to avoid disturbance of the sub-grade. The flows of all water resulting from pumping shall be managed so as not to cause erosion, siltation of drainage systems, or damage to adjacent properties or resource areas associated with the project site.

7. Contractor shall clean/flush entire stormwater system prior to final acceptance by the owner. The Contractor shall clean the interior of all drainage piping and structures of dirt and other superfluous material as work progresses. Care shall be taken to prevent earth, water and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and manholes being careful to prevent soil, water and debris from entering the proposed infiltration systems, any storm drains, the isolated wetland area, and adjacent properties. The Contractor shall place plugs in the ends of uncompleted pipe at the end of the work day or whenever work stops. Flush lines between manholes if required to remove collected debris. Remove and dispose all debris, mortar, and soil from the bottom of all structures. The Contractor shall remove and dispose of sediment and debris from the catch basins and water quality structures.

Part II: Maintenance of the System

Maintenance Schedule during Construction

Sediment Control	***Inspection***	***Maintenance Thresholds***	***Maintenance Action***
Street Sweeping	Sweep six (6) times per year	Per Schedule	Sweep access roads and all parking lots
Erosion control silt fences, haybales	Weekly and after large storm events (more than 0.25-inch of rainfall in 24-hour period)	If integrity of the system is compromised	Restore the integrity of the system and/or clean sediment out
Catch Basins/ Drain Manholes w/deep sumps	Weekly and after large storm events (more than 0.25-inches of rainfall in 24-hour period)	If the sump is 1/3 full with sediment	Clean sediment out
Water Quality Structures (Stormceptor Units®)	Weekly and after large storm events (more than 0.25-inches of rainfall in 24-hour period)	If the sediment depth is 15% of the interceptor's sediment storage (approximately 0.67 feet for Model 450i and 0.75 feet for Model #1200)	Clean sediment out with a vacuum truck
Adjacent Roadways	Weekly and after large storm events (more than 0.25-inches of rainfall in 24-hour period)	If sediment is greater than 1/2 inch in any area of the paved surfaces	Sweep/clean sediment from street
Stormwater Retention Systems	Weekly and after large storm events (more than 0.25-inches of rainfall in 24-hour period)	When sediment is observed in infiltration basin	Remove sediment by jetting system in accordance with Manufacturer's recommendations. Replace system if infiltration component is compromised.
Porous Pavers W/ Underdrain	Weekly and after large storm events (more than 0.25-inches of rainfall in 24-hour period)	When sediment is observed at surface	Blowing to Remove surface Debris and litter/Vacuum as needed

After all slopes have been fully stabilized all erosion control measures shall be cleaned out. All temporary erosion control measures shall be removed.

Post-Construction Maintenance Schedule

Maintenance Schedule Post-Construction

Sediment Control	***Inspection***	***Maintenance Thresholds***	***Maintenance Action***
Street Sweeping	Sweep six (6) times per year	Per Schedule	Sweep access roads and all parking lots
Catch Basins/ Drain Manholes w/deep sumps	Semi-annually and after large storm events (more than 3.2-inches of rainfall in 24-hour period)	If the sump is 1/3 full with sediment	Clean sediment out
Water Quality Structures (Stormceptor Units®)	Semi-annually and after large storm events (more than 3.2-inches of rainfall in 24-hour period)	If the sediment depth is 15% of the interceptor's sediment storage (approximately 0.67 feet for Model 450i)	Clean sediment out with a vacuum truck
Stormwater Retention Systems	Semi-annually and after large storm events (more than 3.2-inches of rainfall in 24-hour period)	When sediment is observed in the access manholes	Remove sediment by jetting system in accordance with Manufacturer's recommendations
Porous Pavers W/ Underdrain	Semi-annually and after large storm events (more than 3.2-inches of rainfall in 24-hour period)	Debris/litter observed	Blowing to Remove surface debris and litter. Do **not** powerwash.
	Semi-annually and after large storm events (more than 3.2-inches of rainfall in 24-hour period)	Sediment buildup observed	Vacuum clean (See enclosed maintenance document) Do **not** power wash.

New Street Development should prepare and maintain a report for each semi-annual inspection of the Stormwater Management System.

Part III: Repair of the System

The drainage system shall be maintained. The repair of any component of the system shall be made as soon as possible to prevent any potential pollutants including silt from discharging offsite or to the resource areas located on the property.

Part IV: Snow Management

Snow will be managed by the owner's snow removal crews. Snow will be placed on the sides and edges of the driveways. Snow should not be stockpiled along the waterfront or within the limits of the 100-ft buffer zone.

Part V: Reporting

Construction Maintenance Reporting

The Contractor shall maintain a record of erosion control measures and drainage system inspections and maintenance during construction. Attached is a prototype of the Erosion and Sedimentation Controls Inspection and Maintenance Report and the Stormwater Management System Report to be used.

Post-Construction Maintenance Reporting

The owner shall maintain a record of drainage system inspections and maintenance. Attached is a prototype of the Stormwater Management System Report to be used.

EROSION AND SEDIMENTATION CONTROLS INSPECTION AND MAINTENANCE REPORT

INSPECTOR: _____ DATE: _____ NUMBER: _____

DAYS SINCE LAST RAINFALL: _____ AMOUNT LAST RAINFALL: _____ INCHES

TEMPORARY STABILIZATION

CATCH BASIN SILT SACKS? (YES/NO)	PAVED AREAS? (YES/NO)	LANDSCAPED AREAS? (YES/NO)

COMMENTS/ACTION:

TO BE PERFORMED BY: _____ ON OR BEFORE: _____

STABILIZED CONSTRUCTION ENTRANCES

IS SEDIMENT TRACKED ONTO ROAD? (YES/NO)	IS THE GRAVEL CLEAN? (YES/NO)	DOES ALL TRAFFIC USE THE STABILIZED ENTRANCE TO LEAVE THE SITE? (YES/NO)

COMMENTS/ACTION:

TO BE PERFORMED BY: _____ ON OR BEFORE: _____

SILT FENCES AND HAYBALES

	DEPTH OF SEDIMENT	CONDITION OF EFFLUENT?	CONDITION OF SILT FENCE	ANY EVIDENCE OF SEDIMENT BYPASSING THE FENCE
SILT FENCE				

COMMENTS/ACTION:

TO BE PERFORMED BY: _____ ON OR BEFORE: _____

CHANGES REQUIRED TO THE POLLUTION PREVENTION PLAN/REASONS FOR CHANGES:

INSPECTED BY _____ SIGNATURE _____ DATE _____

STORMWATER MANAGEMENT SYSTEM REPORT

New Street Development Boston, MA		Inspected by:_____ Date:_____
Component	Status	Action Taken

700 Tuscarawas Street West
Canton, OH 44701
(330) 456-0031

15718 Clear Spring Road
Williamsport, MD 21795
(301)223-7700

MAINTENANCE OF PERMEABLE PAVEMENTS

PREVENTATIVE MAINTENANCE

One of the most effective methods to reduce clogging is to watch out for potential sources of unwanted sediment. Sediment that can clog a pavement's pores can come from construction sand, muddy construction traffic, eroded soil, grit applied to pavements for winter traction and overhanging trees. Sources such as nearby or adjacent beds containing loose mulch or soil can contribute to slowing infiltration. Care should be taken to avoid runoff through these areas or to retain the sediment through additional vegetation. Permeable pavements should be inspected after major storms for heavy sediment that may have been tracked to the surface and that sediment should be removed. Permeable pavements should be observed periodically during rain events for proper water infiltration into the system and observation pipes (if present) should be inspected at least once per year to verify water flow & exfiltration. Nevertheless, with proper maintenance, a properly designed and installed permeable clay brick paving system should remain permeable indefinitely.

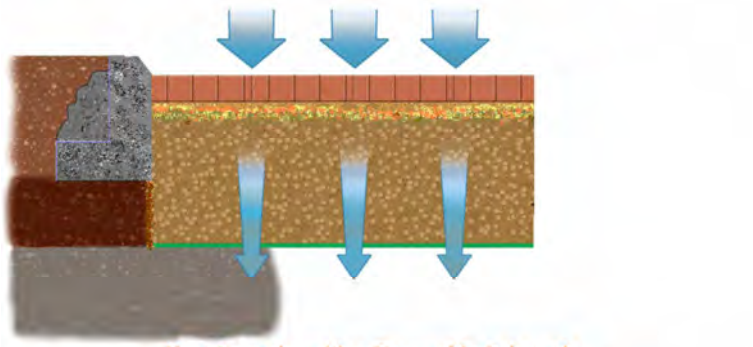
JOINT & VOID CLEANING

Studies (James, Hunt) show removing sediment and debris from the joint/void opening will greatly increase surface infiltration. It is common that a debris "chip" will form in the top part of the joint and this chip is best removed through light vacuuming on an annual or semiannual basis. At a Maintenance Seminar held at the Morton Arboretum where a large permeable pavement system has been installed and in place for many years, removal of existing permeable pavers in high impact areas (snow pile collection areas, bus parking area, and dumpster area) indicated that most debris is retained in the top 1 ½" of the joint where it is accessible by vacuum suction. Vacuuming lifts sediment out and restores the pores to their original open condition.

Vacuum equipment is either truck-mounted or walk-behind. Most urban municipalities and most large property management companies already own the required type of equipment. The surface should be dry when cleaning; vacuuming should not be accompanied by washing. As infiltration declines (approx. 20-30 years) or as observation of slow infiltration occurs, the debris (possibly jointing material as well, typically #89 stone) in the top 1 ½" should be removed and new replacement jointing

material (#89 stone) should be swept into the joints until full. Pressure washers are not recommended on permeable pavements and should not be used. Debris will most likely be driven deeper into the system only adding to the clogging potential.

It is easy to monitor a pavement's relative permeability and need for vacuuming over time. The simplest method is a visual inspection. When a properly constructed permeable pavement is clean and unclogged, the space between open-graded aggregate particles in joints and openings is clearly visible; if the open space within the aggregate is not visible, then sediment is clogging the pavement. A simple confirming test is to pour water from a bottle gently onto the middle of a paver. If the water disappears rapidly and completely into the first joint or opening it finds, then the pavement has relatively high permeability and requires no maintenance. However, if the water flows over a number of joints and openings before completely infiltrating, then the aggregate is clogged and it is time for vacuuming.



How it works with a Permeable Subgrade

Rain water trickle feeds through the system and is filtered and cleansed by the various layers before dispersing into the ground.

SEASONAL

A permeable pavement that is free from eroding soil and winter sanding may not need vacuuming for many years. Instead, vacuuming may be needed only in isolated instances such as construction vehicles tracking mud onto the surface. In this case, the vacuuming should be limited to the pavement area actually affected by sediment. Local clogging of one area of a pavement does not reduce the permeability of other parts of the system. Seasonal blowing to remove surface debris such as tree litter, mulch and

loose dry soil is also beneficial and reduces the need for, or the required frequency of, vacuuming. Do not power wash.

WINTERTIME

Grit or sand should not be applied to the pavement for winter traction. Instead, rely only on snow removal and deicing agents. In a municipality where grit or sand is spread on public streets, vehicles can track it onto parking lots and driveways. The material tends to concentrate where piles of snow are pushed during the winter. Vacuuming will be necessary at least once per year: in the spring, following snowmelt. Where appropriate, No. 8 or No. 9 aggregate can be used for traction control. Deicing salt does not clog permeable clay brick pavements, nor cause any deterioration to the pavers. Deicing agents dissolve readily and then flush through with meltwater, without accumulating in the pavement. Research at the University of New Hampshire suggests that permeable pavements require less salting than impervious pavements or none at all, because meltwater drains away so readily through the pores.

SNOW REMOVAL & DEICING

Clearing snow from clay pavements can be undertaken using plows, snow blowers, shovels and brushes as used for other pavements. Care must be taken to ensure that the blades of the equipment do not scrape the pavement surface in a manner that might

cause chipping. Rubber or urethane blade edges can be used, and set at 1/4" above the pavement. This can be accomplished by using guide wheels. Any residual snow can be cleared with brushes. Some snow-clearing procedures use heavy equipment to stockpile and subsequently remove the snow from the property. If such equipment is used, the load capacity of the pavement should be adequately designed.

Several proprietary chemical products are available for preventing and removing ice from paved surfaces that perform well and reduce potential staining of pavers. Deicing of pavements has been undertaken for many years using rock salt. This material contains calcium chloride and can cause efflorescence for a period of time. Among these are calcium magnesium acetate and urea. The former is preferred because it is more effective at lower temperatures. Pure magnesium chloride is a premium deicer shown to not effloresce in lab testing as well. One must also remember, plowed permeable paver systems tend to stay drier with minimal ice due to the natural draining of the pavement and to the transfer of warmer air from the open graded aggregate base and sub-base. (Depends on base thickness).

EFFLORESCENCE

Efflorescence is a white, powdery substance that may occasionally appear on the surface of pavers. It is the product of soluble compounds normally found in other pavement components or underlying soils, which are deposited on the surface of the paver as absorbed water evaporates from the pavement surface. Soluble compounds absorbed by the pavement from deicing chemicals also may cause efflorescence. Efflorescence often can be vacuumed or brushed off the surface and removed from dry pavers. Washing downhill with water may temporarily dissipate soluble compounds by dissolving them. However, care must be taken to ensure that the contaminated water drains away from and does not re-enter the paving system. In many cases, efflorescence will be minimal and will wear away naturally with traffic and weathering during the early life of the pavement. If the salts are more persistent, proprietary cleaners are available to assist in their removal.

WHAT CAUSES EFFLORESCENCE?

Salt carrying aggregates like limestone. ***Limestone aggregates and manufactured sands should not be used if efflorescence is a concern.***
COMMON SALT SOURCES
Base Aggregates like limestone
Bedding Sands like stone screenings
Snow Melt Products like rock salt
Cement Products like concrete & mortar
Treated Water
Fertilizers
Pre-emergent
Weed Killers
Educate the customer in advance of any potential problems that may arise.

Attachment E

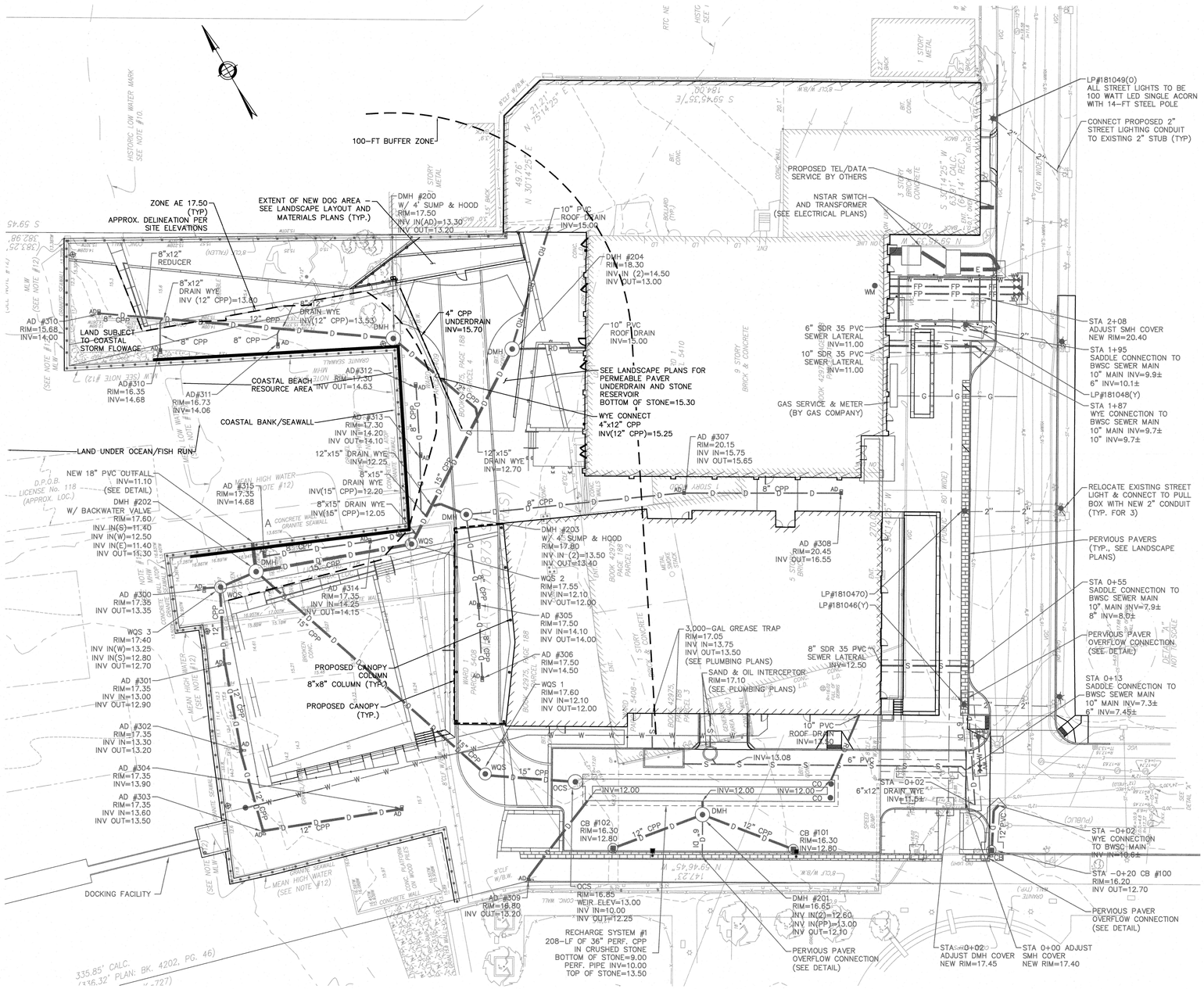
PROJECT PLANS

LEGEND & ABBREVIATIONS

——D——	STORM DRAIN PIPE
▨	INLET PROTECTION
◉	DRAIN MANHOLE
Ⓠ	WATER QUALITY STRUCTURE
▣	CATCH BASIN
AD	AREA DRAIN
CB	CATCH BASIN
CPP	CORRUGATED POLYETHYLENE PIPE
DMH	DRAIN MANHOLE
INV	INVERT ELEVATION
OCS	OUTLET CONTROL STRUCTURE
RIM	RIM ELEVATION
TYP	TYPICAL
WQS	WATER QUALITY STRUCTURE

GENERAL NOTES:

1. TOPOGRAPHIC DATA, PROPERTY LINE INFORMATION, AND EXISTING SITE FEATURES WERE OBTAINED FROM A PLAN ENTITLED "EXISTING CONDITIONS PLAN", PREPARED BY HARRY R. FELDMAN, INC., DATED AUGUST 11, 2008.
2. THE LOCATIONS AND ELEVATIONS OF ALL EXISTING UTILITIES SHALL BE CONSIDERED APPROXIMATE AND MUST BE VERIFIED BY THE CONTRACTOR PRIOR TO ANY UTILITY CONNECTIONS OR CROSSINGS OF PROPOSED UTILITIES AND EXISTING UTILITIES. THE CONTRACTOR SHALL CONTACT THE RESPECTIVE UTILITY COMPANIES RELATIVE TO THE LOCATIONS AND ELEVATIONS OF THEIR LINES. THE CONTRACTOR SHALL KEEP A RECORD OF ANY DISCREPANCIES OR CHANGES IN THE LOCATIONS OF ANY UTILITIES SHOWN OR ENCOUNTERED DURING CONSTRUCTION. ANY DISCREPANCIES SHALL BE REPORTED TO NITSCH ENGINEERING.
3. THE CONTRACTOR SHALL COMPLY WITH MASSACHUSETTS GENERAL LAWS CHAPTER 82, SECTION 40, AS AMENDED, WHICH STATES THAT NO ONE MAY EXCAVATE IN THE COMMONWEALTH OF MASSACHUSETTS EXCEPT IN AN EMERGENCY WITHOUT 72 HOURS NOTICE, EXCLUSIVE OF SATURDAYS, SUNDAYS, AND LEGAL HOLIDAYS, TO NATURAL GAS PIPELINE COMPANIES, AND MUNICIPAL UTILITY DEPARTMENTS THAT SUPPLY GAS, ELECTRICITY, TELEPHONE, OR CABLE TELEVISION SERVICE IN OR TO THE CITY OR TOWN WHERE THE EXCAVATION IS TO BE MADE. THE CONTRACTOR SHALL CALL "DIG SAFE" AT 1-888-DIG-SAFE.
4. THE CONTRACTOR SHALL COMPLY WITH MASSACHUSETTS GENERAL LAWS CHAPTER 82A, ALSO REFERRED TO AS JACKIE'S LAW, AS DETAILED IN SECTION 520 CMR 14.00 OF THE CODE OF MASSACHUSETTS REGULATIONS.
5. ALL UTILITY CONNECTIONS ARE SUBJECT TO THE APPROVAL OF, AND GRANTING OF PERMITS BY, THE BOSTON WATER AND SEWER. IT SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO SEE THAT ALL PERMITS AND APPROVALS ARE OBTAINED BEFORE STARTING CONSTRUCTION. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR MAKING ALL NECESSARY ARRANGEMENTS FOR AND FOR PERFORMING ANY NECESSARY WORK INVOLVED IN CONNECTION WITH THE DISCONTINUANCE OF ANY UTILITIES OR WITHIN THE JURISDICTION OF ANY UTILITY COMPANIES, SUCH AS ELECTRICITY, TELEPHONE, WATER, GAS, AND ANY SYSTEM OR SYSTEMS WHICH WILL BE AFFECTED BY THE WORK TO BE PERFORMED UNDER THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY ALL APPROPRIATE AGENCIES, DEPARTMENTS, AND UTILITY COMPANIES, IN WRITING, AT LEAST 48 HOURS AND NOT MORE THAN 30 DAYS PRIOR TO ANY CONSTRUCTION. CONSTRUCTION SHALL NOT INTERFERE WITH OR INTERRUPT UTILITIES WHICH ARE TO REMAIN IN OPERATION.
6. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL LAWS, RULES, REGULATIONS AND SAFETY CODES IN THE CONSTRUCTION OF ALL IMPROVEMENTS.
7. THE CONTRACTOR SHALL TAKE ADEQUATE PRECAUTIONS TO PROTECT ALL WALKS, GRADING, SIDEWALKS AND SITE DETAILS OUTSIDE OF THE LIMITS OF REGRADING AND WORK AS SHOWN ON THE DRAWINGS AND SHALL REPAIR AND REPLACE OR OTHERWISE MAKE GOOD AS DIRECTED BY THE ENGINEER OR OWNER'S DESIGNATED REPRESENTATIVE ANY SUCH OR OTHER DAMAGE SO CAUSED.
8. THE CONTRACTOR SHALL REMOVE FROM THE SITE ALL RUBBISH AND DEBRIS FOUND THEREON. STORAGE OF SUCH MATERIALS ON THE PROJECT SITE WILL NOT BE PERMITTED. THE CONTRACTOR SHALL LEAVE THE SITE IN SAFE, CLEAN, AND LEVEL CONDITION UPON COMPLETION OF THE SITE CLEARANCE WORK.
9. THE CONTRACTOR SHALL REMOVE FROM THE AREA OF CONSTRUCTION PAVEMENT, CONCRETE, GRANITE CURBING, CEMENT CURBING, POLES AND FOUNDATIONS, ISLANDS, TREE BERMS AND OTHER FEATURES WITHIN THE LIMITS OF CONSTRUCTION AS REQUIRED TO ACCOMMODATE NEW CONSTRUCTION WHETHER SPECIFIED ON THE DRAWINGS OR NOT.
10. FOR SITE LAYOUT, MATERIALS, PLANTINGS, GROUND COVER, AND DETAILS SEE LANDSCAPE ARCHITECT'S DRAWINGS.
11. ALL WATER, SEWER, AND DRAIN WORK SHALL BE PERFORMED ACCORDING TO THE REQUIREMENTS AND STANDARD SPECIFICATIONS OF THE BOSTON WATER AND SEWER COMMISSION.
12. ELEVATIONS REFER TO BOSTON CITY BASE.
13. UTILITY STRUCTURES TO BE ABANDONED SHALL BE REMOVED TO A DEPTH OF NO LESS THAN 3 FEET BELOW FINISHED GRADE. THE BOTTOMS OF THE STRUCTURES SHALL BE BROKEN AND THE STRUCTURES SHALL BE BACKFILLED WITH GRAVEL BORROW AND COMPACTED.
14. CONTRACTOR SHALL MAINTAIN ALL EXISTING UTILITIES EXCEPT THOSE NOTED TO BE ABANDONED OR REMOVED & DISPOSED.
15. ALL GRATES IN WALKWAYS SHALL BE ADA COMPLIANT.



SCALE: 1" = 20'

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10 NEW STREET
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Nitsch Engineering
www.nitscheng.com
2 Center Plaza, Suite 430
Boston, MA 02108
T: (617) 338-0063
F: (617) 338-6472

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JOHN M. SCHMID Civil No. 30155
4/12/19

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311 SUMMER STREET BOSTON, MA 0 617.234.3100

ISSUANCES

No.	Description	Date
	RDA	10.24.18
	RDA	2.2.19
	NOI	03.29.19
	NOI	04.05.19
	NOI	04.12.19

Checked By: JMS

SITE UTILITY PLAN

Drawing Scale: 1"=20'

Job No. 14011.00

NOI-1

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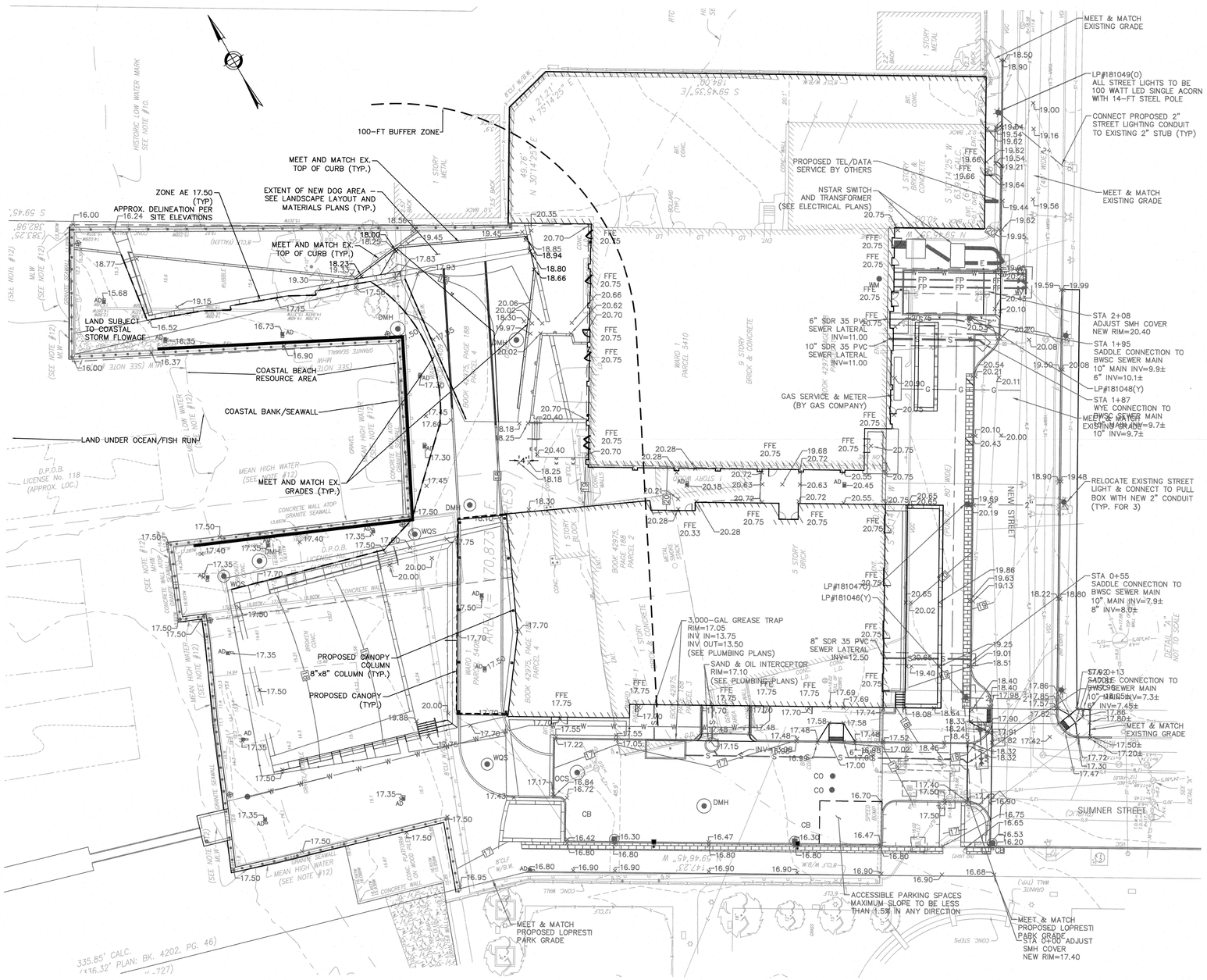
GRADING NOTES

1. REFER TO SHEET C000 FOR GENERAL NOTES, ABBREVIATIONS, AND LEGEND.
2. PITCH EVENLY BETWEEN SPOT GRADES.
3. ALL PAVED AREAS MUST PITCH TO DRAIN AT A MINIMUM OF 1% (OR ONE-EIGHTH INCH (1/8") PER FOOT) UNLESS OTHERWISE NOTED.
4. WHERE NEW PAVING MEETS EXISTING PAVING, MEET LINE AND GRADE OF EXISTING PAVING.
5. CROSS SLOPES OF PEDESTRIAN WALKS SHALL NOT EXCEED 1.5%.
6. SLOPES OF PEDESTRIAN WALKS SHALL NOT EXCEED 4.5% UNLESS OTHERWISE NOTED.
7. PROVIDE POSITIVE DRAINAGE AWAY FROM FACE OF BUILDINGS AT ALL LOCATIONS.
8. THE GENERAL CONTRACTOR SHALL BLEND NEW GRADING SMOOTHLY INTO EXISTING GRADING AT LIMITS OF GRADING.
9. THE CONTRACTOR SHALL VERIFY EXISTING GRADES IN THE FIELD AND REPORT ANY DISCREPANCIES IMMEDIATELY TO THE ARCHITECT OR OWNER'S REPRESENTATIVE PRIOR TO STARTING WORK.
10. REFER TO THE EARTHWORK SECTION OF SPECIFICATIONS FOR SPECIFIC EXCAVATION, BACKFILLING, AND GRADING PROCEDURES.
11. SURPLUS MATERIALS SHALL NOT BE REMOVED FROM THE SITE UNLESS DIRECTED BY THE OWNER OR OWNER'S REPRESENTATIVE. REFER TO EARTHWORK SPECIFICATIONS FOR DETAILS.
12. ANY AREA(S) OUTSIDE OF THE LIMIT-OF-WORK THAT IS DISTURBED SHALL BE RESTORED TO ITS ORIGINAL CONDITION/GRADE AT NO COST TO THE OWNER.



SCALE:
1" = 20'
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JOHN M. SCHMID
No. 41251
4/12/19

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311 SUMMER STREET BOSTON, MA 0 617.234.3100

ISSUANCES

No.	Description	Date
	RDA	10.24.18
	NOI	03.29.19
	NOI	04.05.19
	NOI	04.12.19

Checked By: JMS

GRADING PLAN

Drawing Scale: 1"=20'

Job No. 14011.00

NOI-2

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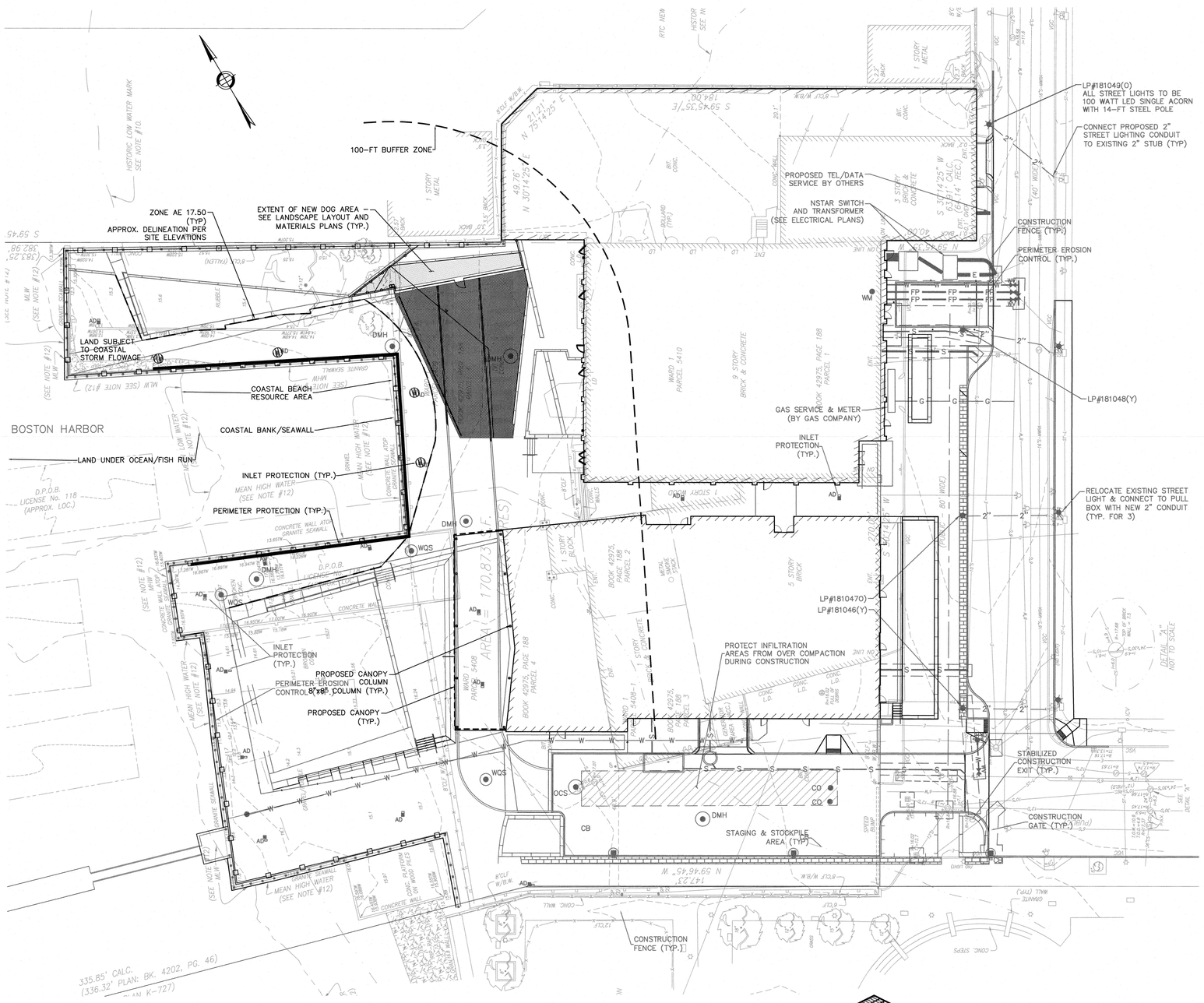
EROSION CONTROL NOTES:

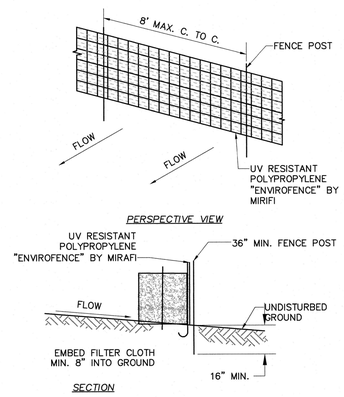
1. ALL EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH PUBLISHED EROSION CONTROL AND SEDIMENT GUIDELINES FOR MASSACHUSETTS (SEE REFERENCE BELOW, NOTE #6).
2. SEDIMENT CONTROL MEASURES SHALL BE ADJUSTED TO MEET FIELD CONDITIONS AT THE TIME OF AND DURING ALL PHASES OF CONSTRUCTION AND BE CONSTRUCTED PRIOR TO AND IMMEDIATELY AFTER ANY GRADING OR DISTURBANCE OF EXISTING SURFACE MATERIAL ON THE SITE.
3. PERIODIC INSPECTION AND MAINTENANCE OF ALL SEDIMENT CONTROL STRUCTURES SHALL BE PROVIDED TO INSURE THAT THE INTENDED PURPOSE IS ACCOMPLISHED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SEDIMENT LEAVING THE LIMIT OF WORK. SEDIMENT CONTROL MEASURES SHALL BE IN WORKING CONDITION AT THE END OF EACH WORKING DAY.
4. ALL POINTS OF CONSTRUCTION INGRESS OR EGRESS WILL BE PROTECTED TO PREVENT TRACKING OF MUD ONTO PUBLIC WAYS.
5. ALL SEDIMENT WILL BE PREVENTED FROM ENTERING ANY STORM DRAINAGE SYSTEM (I.E. THROUGH THE USE OF HAY BALES, CATCH BASIN SEDIMENT TRAPS, GRAVEL, BOARDS OR OTHER APPLICABLE METHODS).
6. THE CONTRACTOR INSTALLING THE ABOVE SHALL OBTAIN AND FOLLOW THE "MASSACHUSETTS EROSION AND SEDIMENT CONTROL GUIDELINES FOR URBAN AND SUBURBAN AREAS" PREPARED BY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF RESOURCE PROTECTION, DATED MAY 1997, REPRINTED MAY 2003 (OR LATEST EDITION), AND THE 2008 NPDES GENERAL PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES, OR LATEST EDITION.
7. ALL DRAINAGE SWALES AND GROUND SURFACES WITHIN THE LIMIT OF WORK SHALL BE PROTECTED.
8. AFTER ANY SIGNIFICANT RAINFALL, SEDIMENT CONTROL STRUCTURES SHALL BE INSPECTED FOR INTEGRITY. ANY DAMAGED DEVICES SHALL BE CORRECTED IMMEDIATELY.
9. ALL STOCK PILES SHALL BE PROTECTED AND LOCATED AWAY FROM EXISTING WATER BODIES & WITHIN THE LIMIT OF WORK.
10. ANY SEDIMENT TRACKED ONTO PAVED AREAS SHALL BE SWEPT AT THE END OF EACH WORKING DAY.
11. ALL DEBRIS GENERATED DURING SITE PREPARATION ACTIVITIES SHALL BE LEGALLY DISPOSED OF OFF-SITE.
12. ALL TOPSOIL ENCOUNTERED WITHIN THE WORK AREA SHALL BE STRIPPED TO ITS FULL DEPTH AND STOCKPILED FOR REUSE. EXCESS TOPSOIL SHALL BECOME THE PROPERTY OF THE OWNER AND SHALL BE STOCKPILED AS DIRECTED BY THE OWNER. TOPSOIL PILES SHALL REMAIN SEGREGATED FROM EXCAVATED SUBSURFACE SOIL MATERIALS.
13. TEMPORARY DIVERSION DITCHES, PERMANENT DITCHES, CHANNELS, EMBANKMENTS AND ANY DENUDED SURFACE WHICH WILL BE EXPOSED FOR A PERIOD OF 14 CALENDAR DAYS OR MORE SHALL BE CONSIDERED CRITICAL VEGETATION AREAS. THESE AREAS SHALL BE MULCHED WITH STRAW. MULCH SHALL BE SPREAD UNIFORMLY IN A CONTINUOUS BLANKET OF SUFFICIENT THICKNESS TO COMPLETELY HIDE THE SOIL FROM VIEW.
14. AN EROSION CONTROL BARRIER SHALL BE INSTALLED ALONG THE EDGE OF PROPOSED DEVELOPMENT AS INDICATED IN THE PLAN PRIOR TO COMMENCEMENT OF DEMOLITION OR CONSTRUCTION OPERATIONS.
15. THE CONTRACTOR IS RESPONSIBLE FOR REMOVAL OF ALL EROSION AND SEDIMENT CONTROLS AT THE COMPLETION OF SITE CONSTRUCTION.
16. MEANS OF EROSION AND SEDIMENT PROTECTION AS NOTED ON THE DRAWINGS INDICATE THE MINIMUM PROVISIONS NECESSARY. ADDITIONAL MEANS OF PROTECTION SHALL BE PROVIDED BY THE CONTRACTOR AS REQUIRED FOR CONTINUED OR UNFORESEEN EROSION PROBLEMS, AT NO ADDITIONAL EXPENSE TO THE OWNER.
17. THE CONTRACTOR SHALL USE TEMPORARY SEEDING, MULCHING OR OTHER APPROVED STABILIZATION MEASURES TO PROTECT EXPOSED AREAS DURING PROLONGED CONSTRUCTION OR OTHER LAND DISTURBANCE. STOCKPILES THAT WILL BE EXPOSED FOR LONGER THAN 15 DAYS SHALL BE SEEDED WITH AN ANNUAL RYE.
18. ALL STOCKPILED MATERIALS SHALL BE LOCATED AT LEAST 100-FEET FROM THE WETLANDS. EXCESS EXCAVATED MATERIALS SHALL BE REMOVED FROM THE SITE AND PROPERLY DISPOSED OF WITHIN 20 DAYS AFTER EXCAVATION.

OPERATION AND MAINTENANCE:

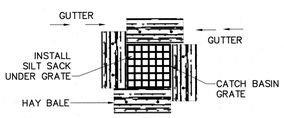
PART I: DURING CONSTRUCTION: THE CONTRACTOR SHALL PROTECT THE COASTAL BANK AND BOSTON HARBOR DURING CONSTRUCTION FROM EROSION AND PREVENT SEDIMENT FROM ENTERING THE HARBOR. THE FOLLOWING MINIMUM GUIDELINES SHALL BE ADHERED TO DURING CONSTRUCTION:

1. KEEP LAND DISTURBANCE TO A MINIMUM. PLAN THE PHASES OF DEVELOPMENT SO THAT ONLY THE AREAS ACTIVELY BEING DEVELOPED ARE EXPOSED. ALL OTHER AREAS SHOULD HAVE NATURAL VEGETATION PRESERVED, HAVE GOOD TEMPORARY COVER, OR PERMANENT VEGETATION ESTABLISHED.
2. STABILIZE DISTURBED AREAS. TEMPORARY OR PERMANENT VEGETATION AND MULCH SHOULD BE EMPLOYED AS QUICKLY AS POSSIBLE AFTER LAND IS DISTURBED.
3. PROTECT DISTURBED AREAS FROM STORMWATER RUNOFF. INSTALL EROSION CONTROL OR STORMWATER MANAGEMENT MEASURES TO PREVENT WATER FROM ENTERING AND RUNNING OVER DISTURBED AREAS, AND TO PREVENT EROSION DAMAGE TO DOWNSTREAM FACILITIES.
4. INSTALL PERIMETER CONTROL PRACTICES. USE PRACTICES THAT ISOLATE THE DEVELOPMENT SITE FROM SURROUNDING AREAS. SILTATION FENCE, HAYBALES, AND OTHER TEMPORARY EROSION CONTROL DEVICES.

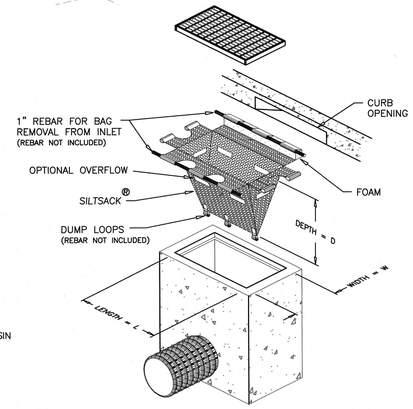




SILT FENCE DETAIL WITH HAY BALE
NOT TO SCALE



PLAN
CATCH BASIN INLET EROSION CONTROL
NOT TO SCALE



SILT SACK DETAIL
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SCALE:
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www.nitscheng.com
2 Center Plaza, Suite 430
Boston, MA 02108
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F: (617) 338-6472

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COMMONWEALTH OF MASSACHUSETTS
JOHN M. SIMMEL
No. 31155
REGISTERED PROFESSIONAL ENGINEER
4/12/19

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311 SUMMER STREET BOSTON, MA 0 617.234.3100

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No.	Description	Date
	RDA	10.24.18
	NOI	03.29.19
	NOI	04.05.19
	NOI	04.12.19

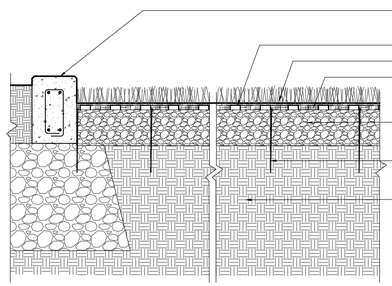
Checked By: JMS

STORMWATER POLLUTION PREVENTION PLAN

Drawing Scale: 1"=20'

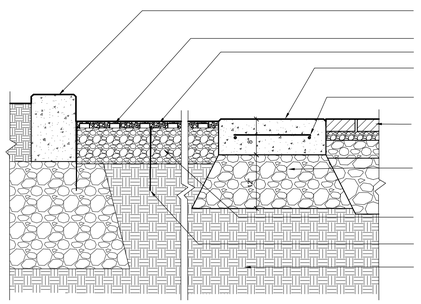
Job No. 14011.00

NOI-3



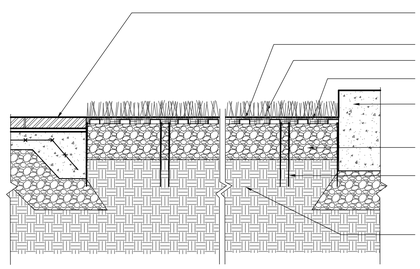
1 EXISTING CONDITION - REINFORCED GRASS

SCALE: 3/4"=1'-0"



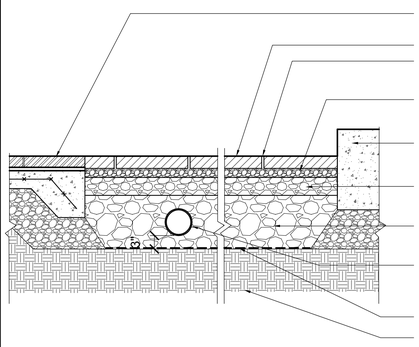
1 PROPOSED CONDITION - PEASTONE SURFACING

SCALE: 3/4"=1'-0"



2 EXISTING CONDITION - REINFORCED GRASS

SCALE: 3/4"=1'-0"



2 PROPOSED CONDITION - PERMEABLE PAVER

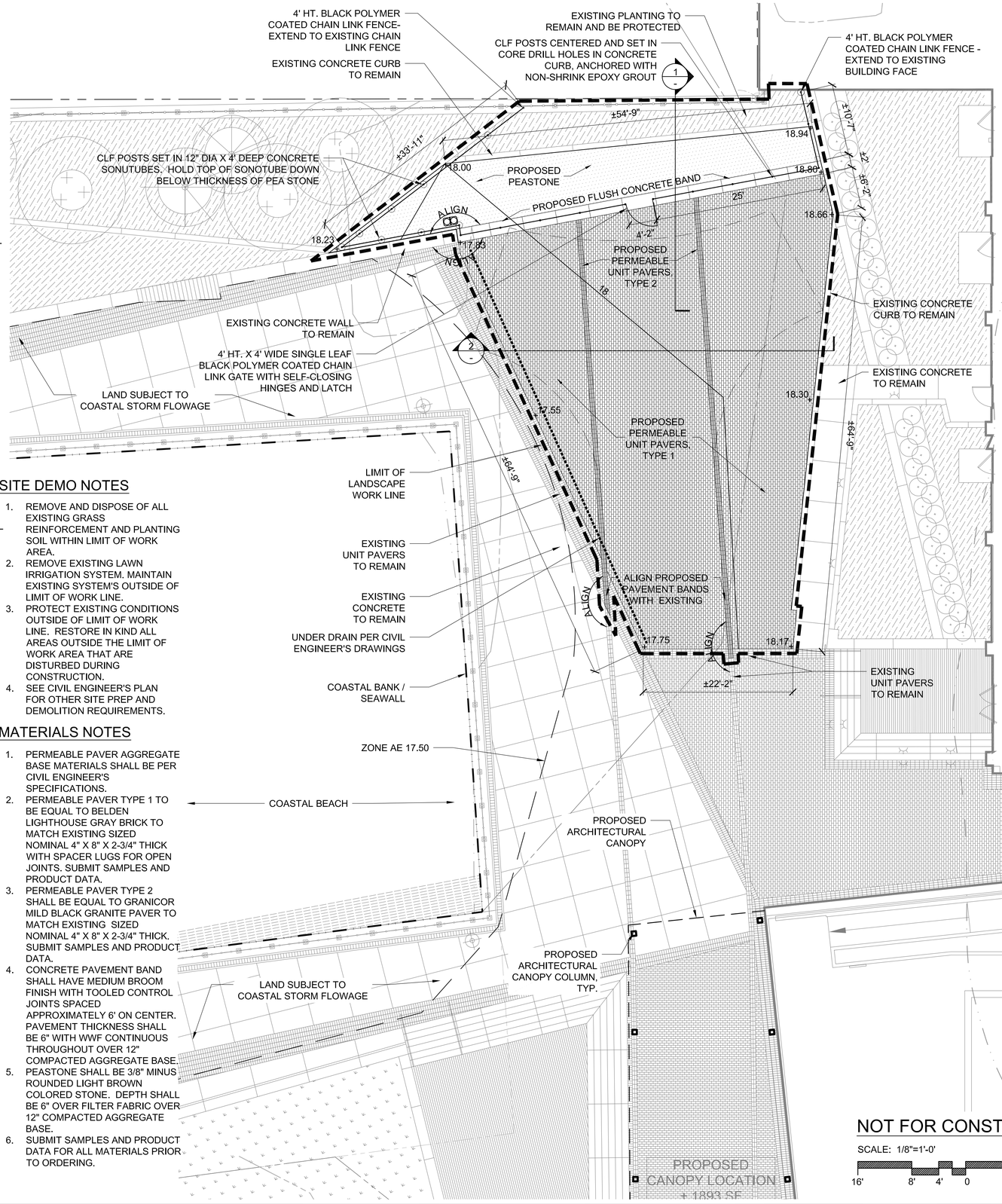
SCALE: 3/4"=1'-0"

SITE DEMO NOTES

1. REMOVE AND DISPOSE OF ALL EXISTING GRASS REINFORCEMENT AND PLANTING SOIL WITHIN LIMIT OF WORK AREA.
2. REMOVE EXISTING LAWN IRRIGATION SYSTEM. MAINTAIN EXISTING SYSTEM'S OUTSIDE OF LIMIT OF WORK LINE.
3. PROTECT EXISTING CONDITIONS OUTSIDE OF LIMIT OF WORK LINE. RESTORE IN KIND ALL AREAS OUTSIDE THE LIMIT OF WORK AREA THAT ARE DISTURBED DURING CONSTRUCTION.
4. SEE CIVIL ENGINEER'S PLAN FOR OTHER SITE PREP AND DEMOLITION REQUIREMENTS.

MATERIALS NOTES

1. PERMEABLE PAVER AGGREGATE BASE MATERIALS SHALL BE PER CIVIL ENGINEER'S SPECIFICATIONS.
2. PERMEABLE PAVER TYPE 1 TO BE EQUAL TO BELDEN LIGHTHOUSE GRAY BRICK TO MATCH EXISTING SIZED NOMINAL 4" X 8" X 2-3/4" THICK WITH SPACER LUGS FOR OPEN JOINTS. SUBMIT SAMPLES AND PRODUCT DATA.
3. PERMEABLE PAVER TYPE 2 SHALL BE EQUAL TO GRANICOR MILD BLACK GRANITE PAVER TO MATCH EXISTING SIZED NOMINAL 4" X 8" X 2-3/4" THICK. SUBMIT SAMPLES AND PRODUCT DATA.
4. CONCRETE PAVEMENT BAND SHALL HAVE MEDIUM BROOM FINISH WITH TOOLED CONTROL JOINTS SPACED APPROXIMATELY 6' ON CENTER. PAVEMENT THICKNESS SHALL BE 6" WITH WWF CONTINUOUS THROUGHOUT OVER 12" COMPACTED AGGREGATE BASE.
5. PEASTONE SHALL BE 3/8" MINUS ROUNDED LIGHT BROWN COLORED STONE. DEPTH SHALL BE 6" OVER FILTER FABRIC OVER 12" COMPACTED AGGREGATE BASE.
6. SUBMIT SAMPLES AND PRODUCT DATA FOR ALL MATERIALS PRIOR TO ORDERING.



NOT FOR CONSTRUCTION

SCALE: 1/8"=1'-0'

16' 8' 4' 0 8' 16'

PREPARED BY:

PROJECT NAME / CLIENT:

THE EDDY

6-26 NEW STREET, EAST BOSTON MA 02128

CWDG PROJECT NUMBER: XXXX

ISSUANCES:

REV #	DATE	DESCRIPTION

STAMP:

MASSACHUSETTS JOHN HENRY COPLEY, JR. No. 715 REGISTERED LANDSCAPE ARCHITECT

DRAWING TITLE:

LANDSCAPE LAYOUT AND MATERIALS PLAN

DRAWN BY:	IR
CHECKED BY:	JC
SCALE:	1/8" = 1'-0"
DATE:	3.6.19
SHEET	1 OF 1

DRAWING NUMBER:

L-1

4/5/2019 9:01:03 AM - T:\1849 NEW STREET DOG AREA WITH GERDING EDLEN\CONSTRUCTION DRAWINGS\CURRENT CWDG DRAWINGS\XREFS\180906_MASTER_0_DOG AREA.DWG - IAN RAMEY