Stormwater Management Report
Union Twist Dispensary

1158 Beacon Street
Newton, Massachusetts

PREPARED FOR:

Union Twist, INC.

1 International Place
Suite 3700
Boston, Massachusetts

August 25, 2020

PREPARED BY

FUSS & O'NEILL

108 Myrtle Street
Suite 502
Quincy, MA 02171

Project No. 20190241.A30

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1 Executive Summary

Union Twist Inc., proposes to construct a new marijuana dispensary in the Town of Newton, Massachusetts. The property is currently developed and occupied by a restaurant and a dry cleaners and related site development (parking, sidewalks, etc.). The site is bounded by Beacon Street to the north and commercial properties to the east and west, and residential properties to the south. The project location is depicted in *Figure 1*, Site Location Map.

The project proposes modifications to the existing site including conversion of the existing structure to a marijuana dispensary along with modifications to the existing site development including parking lots, driveways, sidewalks, stormwater infrastructure, utilities, and landscaping. The overall drainage pattern of the site will not change with this new project.

The proposed stormwater management system design is consistent with the guidelines of Massachusetts Stormwater Handbook, the Wetlands Protection Act Regulations 310 CMR 10.00. Stormwater best management practices (BMPs) will be implemented to provide the required water quality and recharge volume. Decreases in peak runoff rates will be achieved by a reduction in impervious area. The existing and proposed site conditions and proposed stormwater management system are described in detail in *Section 2* of this report.

The design drawings include controls to protect receiving stormwater systems and properties adjacent to the development from erosion and sedimentation impacts caused by construction site runoff. The plan incorporates both non-structural and structural controls, such as inspections, waste management, as well as good housekeeping and maintenance. The existing and proposed drainage systems will be protected with infiltration basin inlet protection devices, silt fencing, construction entrance and compost filter socks. Additional information related to erosion and sediment controls is included in *Section 4* of this report.

2 Project Description

2.1 Existing Conditions

The project is located south of Beacon Street on one parcel of land, with a total of approximately 20,000 square feet. Commercial properties are located to the east and west and residential properties are located to the south of the property. The parcel is developed and contains a dry cleaners, restaurant, and a parking area located north and south of the building. A site location map is in included in Figure 1.

There are no wetlands on the site. The site is not within a NHESP Priority Habitat of Rare Species, Estimated Habitat of Rare Wildlife, or Area of Critical Environmental Concern (ACEC). Available resource mapping data from MassGIS Oliver is shown in *Figure 2,* Resource Area GIS Map.

Data from the Federal Emergency Management Agency (FEMA) shows that the site lies in Zone X, in an area outside the 500-year floodplain. The FEMA Flood Insurance Rate Map (FIRM), Panel Number 25017C0554E (Effective Date: June 04, 2010), is included as *Figure 3.*

The site is characterized by Natural Resources Conservation Service (NRCS) as Haven silt loam (251B), 3 to 8 percent slopes, and Merrimac-Urban land complex (626B), 0 to 8 percent slopes. Both soils carry a HSG rating "A.", which is classified as soils having a high infiltration rate when thoroughly wet and a high rate of water transmission. This site also has soil classified as Udorthents, wet substratum (655). The NRCS soils report is included in *Appendix A*.

2.2 Proposed Conditions

The project proposes modifications to the existing site including conversion of the western portion of the existing building into a marijuana dispensary, along with modifications to the existing site development including parking lots, sidewalks, stormwater infrastructure, utilities, and landscaping. No land disturbances are proposed within 100 feet of any wetland resource areas.

Stormwater Management is achieved through two separate systems on the northern and southern portion of the site. One system is comprised of one sediment forebay and one infiltration basin while the other system is comprised of one deep sump catch basin. Through these BMPs, groundwater recharge and stormwater treatment are achieved. Reduction in stormwater peak discharge will be achieved by a reduction in impervious area.

The following stormwater BMPs are proposed for the project:

> Infiltration Basin 1PB - is located south of the building and will provide treatment and recharge for stormwater on the site. Runoff from the rear parking lot and other paved areas on the southern and western portion of the site will flow into Sediment Forebay 1PA which provides pre-treatment for Infiltration Basin 1PB.

The proposed BMPs have been sized to accommodate the 100-year Type III 24hr design storm without overtopping or exceeding system capacity and have been modeled using the Rawls' infiltration rate for loamy sand where applicable. Leak-offs and stone aprons will be used to dissipate flows to inlets to open surface BMPs.

3 Hydrologic Analysis

The hydrologic analyses for existing and proposed conditions were completed using a computer software package, HydroCAD version 10.00-21, to determine peak runoff flow rates and total runoff volumes for the watershed models. The model is based on the NRCS Technical Release 20 and Technical Release 55 (TR-55), and is subject to cumulative rainfall/volume dependent routing calculations. Hydrographs are prepared for each element of the watershed and routed through the dynamic-storage-indication method to produce various time-based results.

Two design points were developed for this project. These design points are summarized below:

- Link 1L – A manhole located in Beacon Street directly adjacent to the front of the site.
- Link 2L – Northeastern corner of the site.

The pre-development hydrologic analysis is included as Appendix B. The post-development hydrologic analysis is included as Appendix C.

3.1 Existing Watershed Summary

Stormwater runoff from the site is conveyed via sheet flow and shallow concentrated flow towards each of the design points as further discussed below. The property line has been used as the limit of analysis.

- Subwatershed 1S encompasses the vast majority of the property consisting of the parking lot and the building. Stormwater runoff from this subwatershed flows to the south towards a catch basin located on the existing parking lot. Runoff is then pumped to the public drainage system in Beacon Street, draining to design point 1L.

- Subwatershed 2S consists of a small portion of the site at the northern boundary that includes a portion the drive entrance and exit, the front grass area and sidewalk. Stormwater runoff from this subwatershed flows to the north onto Beacon Street ultimately draining to design point 2L.

The Pre-Development Watershed Map is included as *Figure 4.*

3.2 Proposed Watershed Summary

As a result of the proposed development, improvements to the stormwater management system have been made to eliminate the need for pumping. The boundary of the post-development analysis is the same as the pre-development conditions. The post-development subcatchments are described below.

- Subwatershed 1S consists of the portion of the property that includes the rear parking lot and western drive, the majority of the building, the majority of the sidewalk and grassed areas on the eastern side of the building, as well as the proposed sediment forebay and infiltration basin. Stormwater runoff from this subwatershed generally flows to the south and east towards Sediment Forebay 1PA. Stormwater from the areas adjacent the southeastern boundary is collected by a yard drain and redirected to the forebay. From the forebay, water flows into Infiltration basin 1PB, then to a yard drain within the basin and redirected to the public drainage system in Beacon Street at design point 1L.

- Subwatershed 1SA consists of the portion of the property that includes the front parking lot, the small portion of the north side of the building, as well as the majority of the northeastern portion of the site including sidewalk and grassed area. Stormwater runoff from this subwatershed flows generally east and south into a deep sump catch basin located at the southeastern corner of the front parking lot. Stormwater from the areas adjacent the northeastern boundary is collected by a yard drain and redirected to the catch basin. From the catch basin, water is directed to the public drainage system in Beacon Street at design point 1L.

- Subwatershed 2S consists of a small portion of the site at the northern boundary that includes portions of the drive entrance and exit, sidewalk, and front grassed areas. Stormwater runoff from this subwatershed flows to the north onto Beacon Street ultimately draining to design point 2L.

The Post-Development Watershed Map is included as *Figure 5.*

3.3 Hydrologic Analysis Results

The proposed BMPs allow for a greater volume of stormwater recharge as well as attenuate peak flows from the site, effectively reducing the site's runoff compared to the existing developed condition. The pre- and post-redevelopment peak flows for the two design points are included in the tables below.

2 Year Design Storm				
Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (Rate %)
(1L)	0.01	0.01	0.00	0%
(2L)	1.12	0.40	-0.72	-64%
Total	1.13	0.41	-0.72	-64%

10 Year Design Storm				
Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (Rate %)
(1L)	0.02	0.02	0.00	0%
(2L)	1.88	1.81	-0.07	-4%
Total	1.90	1.83	-0.07	-4%

25 Year Design Storm				
Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (Rate %)
(1L)	0.04	0.03	-0.01	-25%
(2L)	2.48	2.39	-0.09	-4%
Total	2.52	2.42	-0.10	-4%

100 Year Design Storm				
Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (Rate %)
(1L)	0.07	0.06	-0.01	-14%
(2L)	3.75	3.55	-0.20	-5%
Total	3.82	3.61	-0.21	-5%

2 Year Design Storm				
Design Point	Existing Flow (AF)	Proposed Flow (AF)	Net Change (AF)	Net Change (Vol %)
(1L)	0.001	0.000	-0.001	-100%
(2L)	0.075	0.025	-0.050	-67%
Total	0.076	0.025	-0.051	-67%

10 Year Design Storm				
Design Point	Existing Flow (AF)	Proposed Flow (AF)	Net Change (AF)	Net Change (Vol %)
(1L)	0.002	0.001	-0.001	-50%
(2L)	0.130	0.070	-0.060	-46%
Total	0.132	0.071	-0.061	-46%

25 Year Design Storm				
Design Point	Existing Flow (AF)	Proposed Flow (AF)	Net Change (AF)	Net Change (Vol %)
(1L)	0.003	0.002	-0.001	-33%
(2L)	0.174	0.107	-0.067	-39%
Total	0.177	0.109	-0.068	-38%

100 Year Design Storm				
Design Point	Existing Flow (AF)	Proposed Flow (AF)	Net Change (AF)	Net Change (Vol %)
(1L)	0.005	0.004	-0.001	-20%
(2L)	0.269	0.193	-0.076	-28%
Total	0.274	0.197	-0.077	-28%

The Results indicate that the proposed improvements will not result in increases in stormwater runoff from the site for the 2-, 10-, 25-, and 100-year, Type III, 24-hour storm events as compared to the pre-redevelopment peak runoff.

4 Soil Erosion and Sedimentation Control

Soil erosion and sedimentation control details and narratives for construction periods are provided on the site plans. Soil erosion and sedimentation control details and procedures are consistent with the "Massachusetts Erosion and Sediment Control Guideline for Urban and Suburban Areas."

Construction period erosion and sedimentation controls will include compost filter socks, stormwater inlet protection, and a silt fencing. Additional erosion and sediment controls will be utilized as required. Perimeter sediment controls will be placed down-gradient of disturbed areas. Water will be applied to exposed soils to provide dust control as needed.

Waste materials generated from construction activities will include excavated soil, trees, brush, stumps, pavement, building debris, and utilities. All excavation debris and other waste will be transported to an approved disposal facility. If required, materials may be temporarily stockpiled within designated staging areas. Details and procedures are provided in the construction site plans.

Construction materials, including site and building materials, will be present on-site during various stages of construction. All materials will be temporarily stored within designated staging or lay-down areas and will be transported to the site as needed.

5 Construction Sequence

A detailed construction sequence is included on the site plans. This construction sequence is subject to change based on construction methods, weather, or due to other unforeseen circumstances.

6 Massachusetts Stormwater Handbook Standards

The following is a description of how the proposed project conforms with the stormwater management standards (Standards) outlined in the Massachusetts Stormwater Handbook. The Stormwater Management Checklist is included in *Appendix D*.

Standard 1: No Untreated Discharge or Erosion to Wetlands
There are no wetlands near the site.

Standard 2: Peak Rate Attenuation
Post-redevelopment discharge rates from the 2-, 10-, 25-, and 100-year storm events will not increase as a result of the development compared to the pre-redevelopment condition. This will be achieved by the reduction of the impervious surface area.

Standard 3: Stormwater Recharge
The infiltration basin will allow infiltration and groundwater recharge. This BMP has been designed to provide storage in excess of the recharge volume required by this standard. Stormwater recharge calculations are included in *Appendix E.*

Standard 4: Water Quality
The BMPs will provide water quality treatment through filtration and infiltration. The basin provides storage in excess of the water quality volume required by this standard for the site. Water quality calculations are included in the BMP Sizing Calculations in *Appendix F*. Total Suspended Solid (TSS) removal calculations are included in *Appendix G*.

Standard 5: Land Uses with Higher Potential Pollutant Loads
The project does not contain any area of higher pollutant loads as defined by the Massachusetts Stormwater Handbook.

Standard 6: Critical Areas
The site is not located within Zone II or Interim Wellhead Protection Areas, or other Critical Areas, which include Shellfish Growing Areas, Bathing Beaches, Outstanding Resource Waters, Special Resource Waters, and Cold-Water Fisheries.

Standard 7: Redevelopment
The proposed project is considered a redevelopment project per the Massachusetts Stormwater Handbook.

Standard 8: Construction Pollution Prevention and Erosion and Sediment Controls
General erosion and sedimentation controls will be implemented and maintained in accordance with local, state, and federal requirements until construction is complete and disturbed areas have been stabilized.

Standard 9: Long-Term Operation and Maintenance Plan
A Long Term Operation and Maintenance Plan has been prepared and is included in *Appendix H.*

Standard 10: Illicit Discharges to Drainage System
This project does not contain illicit discharges to Stormwater Management Systems as defined in the Massachusetts Stormwater Handbook.

7 Summary

This Stormwater Management Report describes proposed work and stormwater management associated with the development of the Union Twist Dispensary at 1158 Beacon Street, Newton, Massachusetts. The stormwater management system includes one sediment forebay, one infiltration basin, and one deep sump catch basin. Peak runoff from the site will decrease when compared to pre-redevelopment conditions during the 2-, 10-, 25-, and 100-year storm events, due to the reduction of the impervious surface area on the site.

The proposed design addresses the applicable standards set forth in the MassDEP Stormwater Management Guidelines as described in *Section 6* of this report. Erosion control measures have been incorporated into the design. Based on the conditions summarized above, the proposed site improvements will have no adverse effect on abutters or the receiving drainage systems.

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Figure 1

Site Location Map

MAP REFERENCE:
THIS MAP WAS PREPARED FROM THE FOLLOWING QUADRANGES OF USGS HIGH RESOLUTION ORTHOIMAGERY, BOSTON/ PROVIDENCE, 2013:
19TCG165875 19TCG165890
19TCG180875 19TCG180890

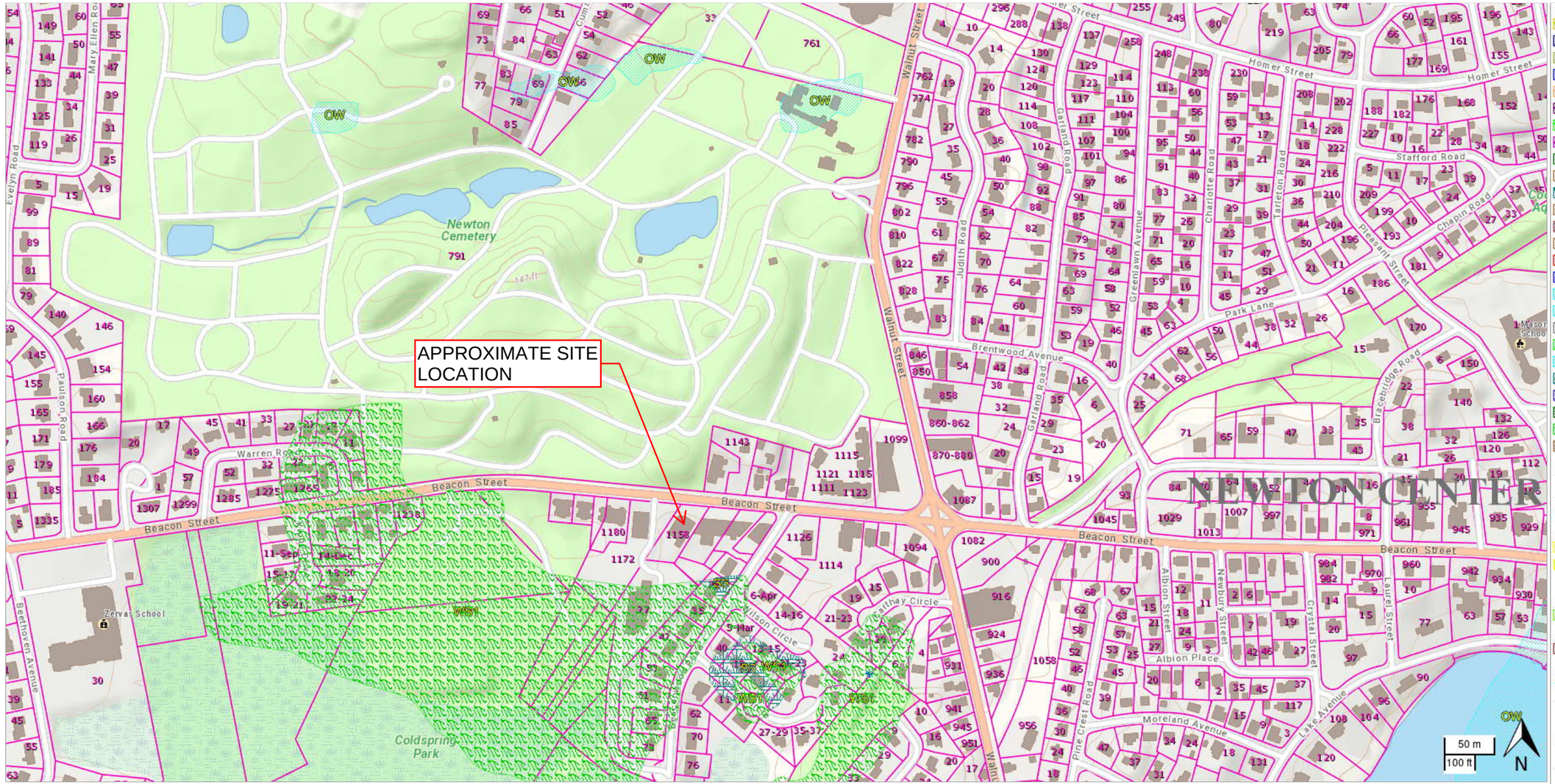
SCALE: HORZ.: 1"=150' VERT.: DATUM: HORZ.: VERT.: 0 75 150 GRAPHIC SCALE	FUSS&O'NEILL 108 MYRTLE STREET, SUITE 502 QUINCY, MA 02171 617.282.4675 www.fando.com	UNION TWIST INC. SITE LOCATION MAP 1158 BEACON STREET NEWTON MASSACHUSETTS	PROJ. No.: 20190241.A30 DATE: 5/6/2020 FIG. 1

FUSS & O'NEILL

Figure 2

Resource Area GIS Map

RESOURCE AREA MAP



DEP Wetlands Detailed With Outlines
- Barrier Beach System
- Barrier Beach-Deep Marsh
- Barrier Beach-Wooded Swamp Mixed Trees
- Barrier Beach-Coastal Beach
- Barrier Beach-Coastal Dune
- Barrier Beach-Marsh
- Barrier Beach-Salt Marsh
- Barrier Beach-Shrub Swamp
- Barrier Beach-Wooded Swamp Coniferous
- Barrier Beach-Wooded Swamp Deciduous
- Bog
- Coastal Bank Bluff or Sea Cliff
- Coastal Beach
- Coastal Dune
- Cranberry Bog
- Deep Marsh
- Barrier Beach-Open Water
- Open Water
- Rocky Intertidal Shore
- Salt Marsh
- Shallow Marsh Meadow or Fen
- Shrub Swamp
- Tidal Flat
- Wooded Swamp Coniferous
- Wooded Swamp Deciduous
- Wooded Swamp Mixed Trees

DEP Wetlands

Potential Vernal Pools

NHESP Priority Habitats of Rare Species

NHESP Estimated Habitats of Rare Wildlife

NHESP Ecoregions

NHESP Certified Vernal Pools

Tax Parcels for Query

Detailed Features

Tax Parcels for Display

Structures

MassGIS Statewide Basemap
MassGIS Topographic Features Basemap

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Figure 3

Flood Insurance Rate Map

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Massachusetts State Plane Mainland zone (FIPSZONE 2001), meters. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs. This information was derived from digital orthophotos produced at a scale of 1:5,000 from aerial photography dated April 2005.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- $^{4}76^{000}$N — 1000-meter Universal Transverse Mercator grid values, zone 19
- 600000 FT — 5000-foot grid values: Massachusetts State Plane coordinate system, Mainland zone (FIPSZONE 2001), Lambert Conformal Conic projection
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- ● M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
June 4, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0554E

FIRM

FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS
(ALL JURISDICTIONS)

PANEL 554 OF 656
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
NEWTON, CITY OF	250208	0554	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25017C0554E

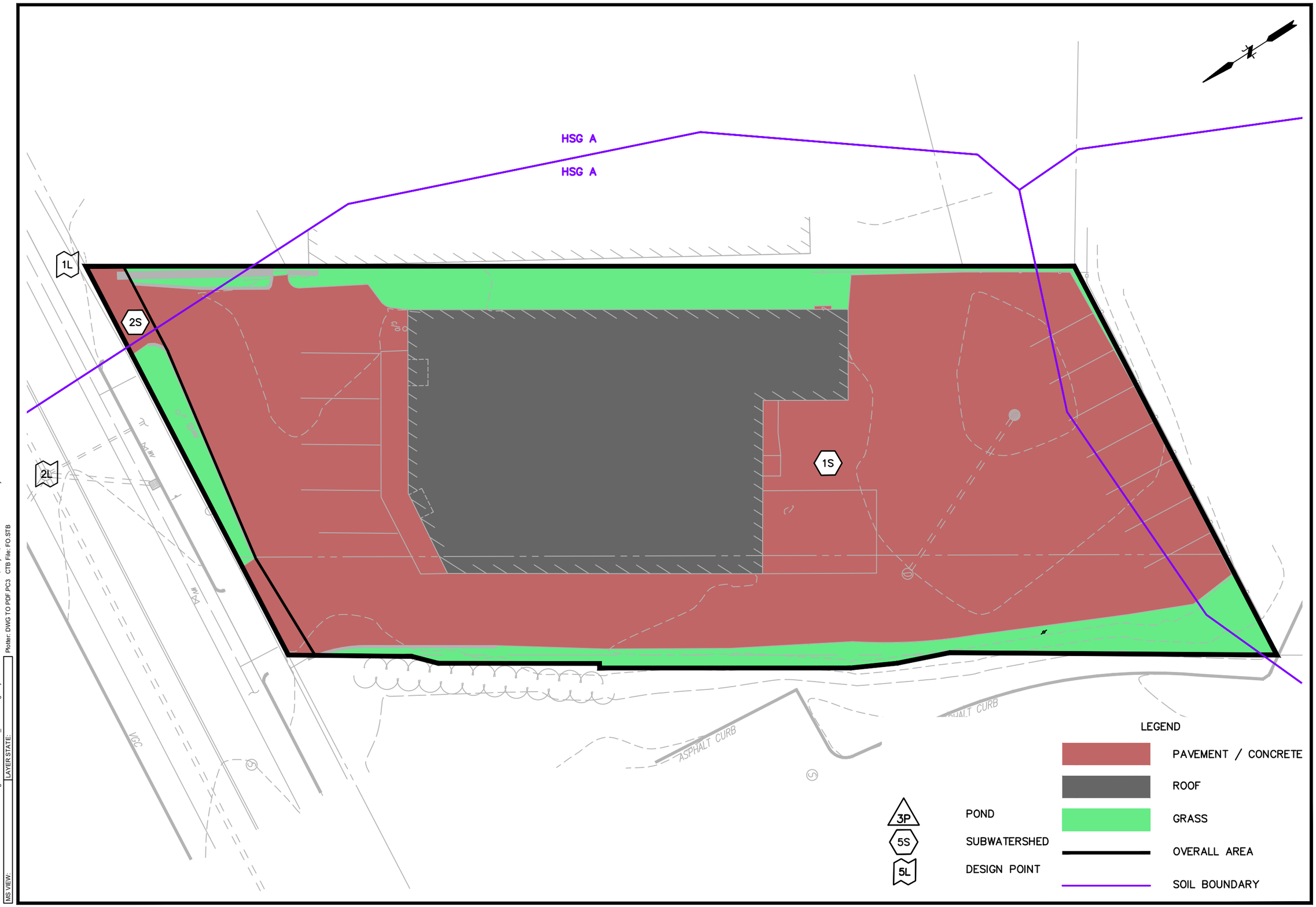
EFFECTIVE DATE
JUNE 4, 2010

Federal Emergency Management Agency

FUSS & O'NEILL

Figure 4

Pre-Development Watershed Map



SCALE:
HORZ.: 1" = 20'
VERT.:
DATUM:
HORZ.:
VERT.:
0 10 20
GRAPHIC SCALE

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UNION TWIST INC.
1158 BEACON STREET
NEWTON
MASSACHUSETTS

PRE-DEVELOPMENT WATERSHED MAP

PROJ. No.: 20190241.A30
DATE: 5/6/2020

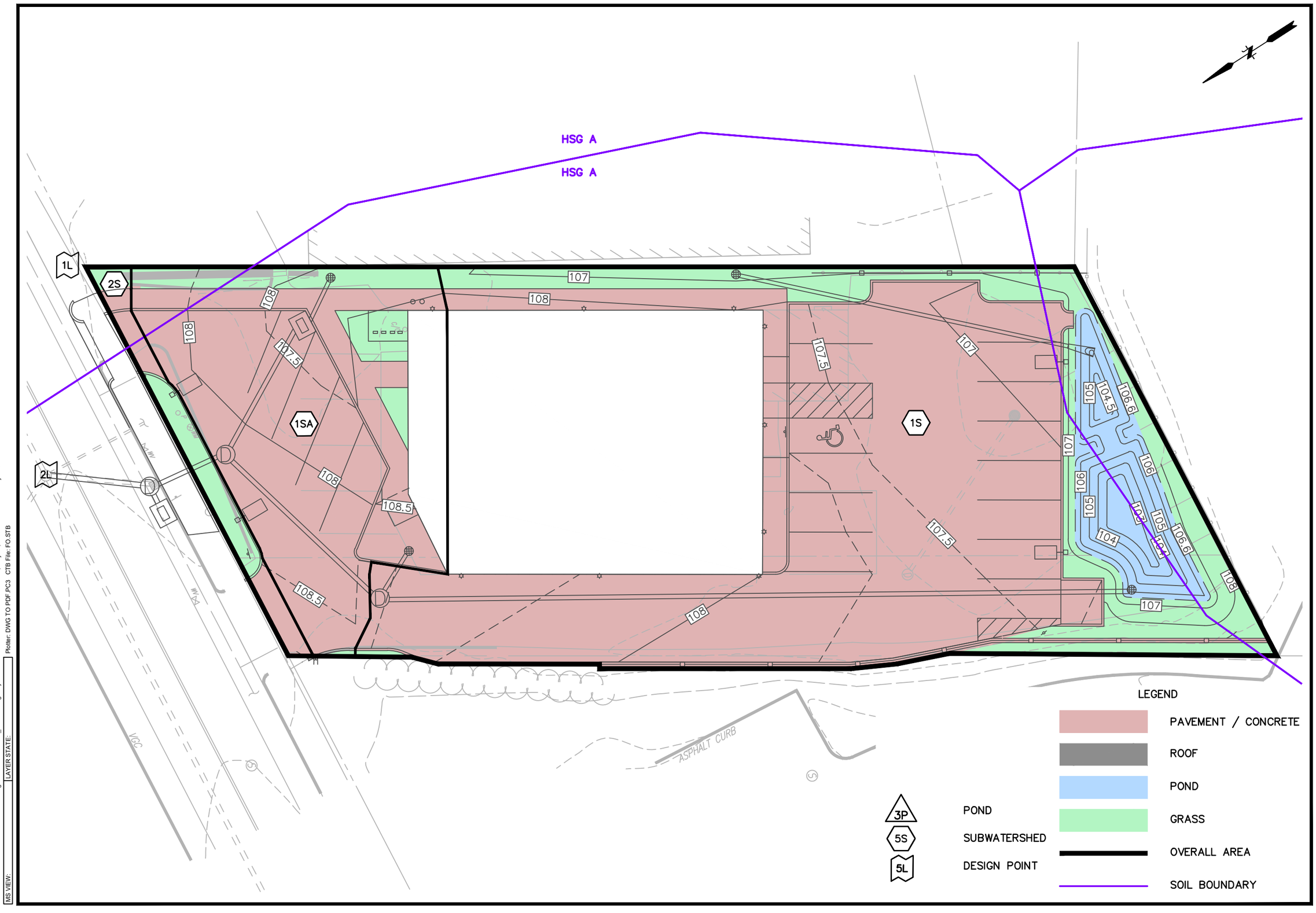
FIG.4

File Path: J:\DWG\P20190241\A30\Civil\Figures\20190241A30_DRN01.dwg Layout: PRE-DEVELOPMENT Plotted: Tue, May 12, 2020 - 9:30 AM User: jvaldez
Plotter: DWG TO PDF.PC3 CTB File: FO.STB
MS VIEW: LAYER STATE:

FUSS & O'NEILL

Figure 5

Post-Development Watershed Map



SCALE:
HORZ.: 1" = 20'
VERT.:
DATUM:
HORZ.:
VERT.:
0 10 20
GRAPHIC SCALE

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UNION TWIST INC.

POST-DEVELOPMENT WATERSHED MAP

1158 BEACON STREET

MASSACHUSETTS

NEWTON

PROJ. No.: 20190241.A30
DATE: 5/6/2020

FIG.5

File Path: J:\DWG\P20190241\A30\Civil\Figures\20190241A30_DRN01.dwg Layout: POST-DEVELOPMENT Plotted: Tue, May 12, 2020 - 9:31 AM User: jvaldez
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LAYER STATE:
MS VIEW:

Appendix A

NRCS Soil Report

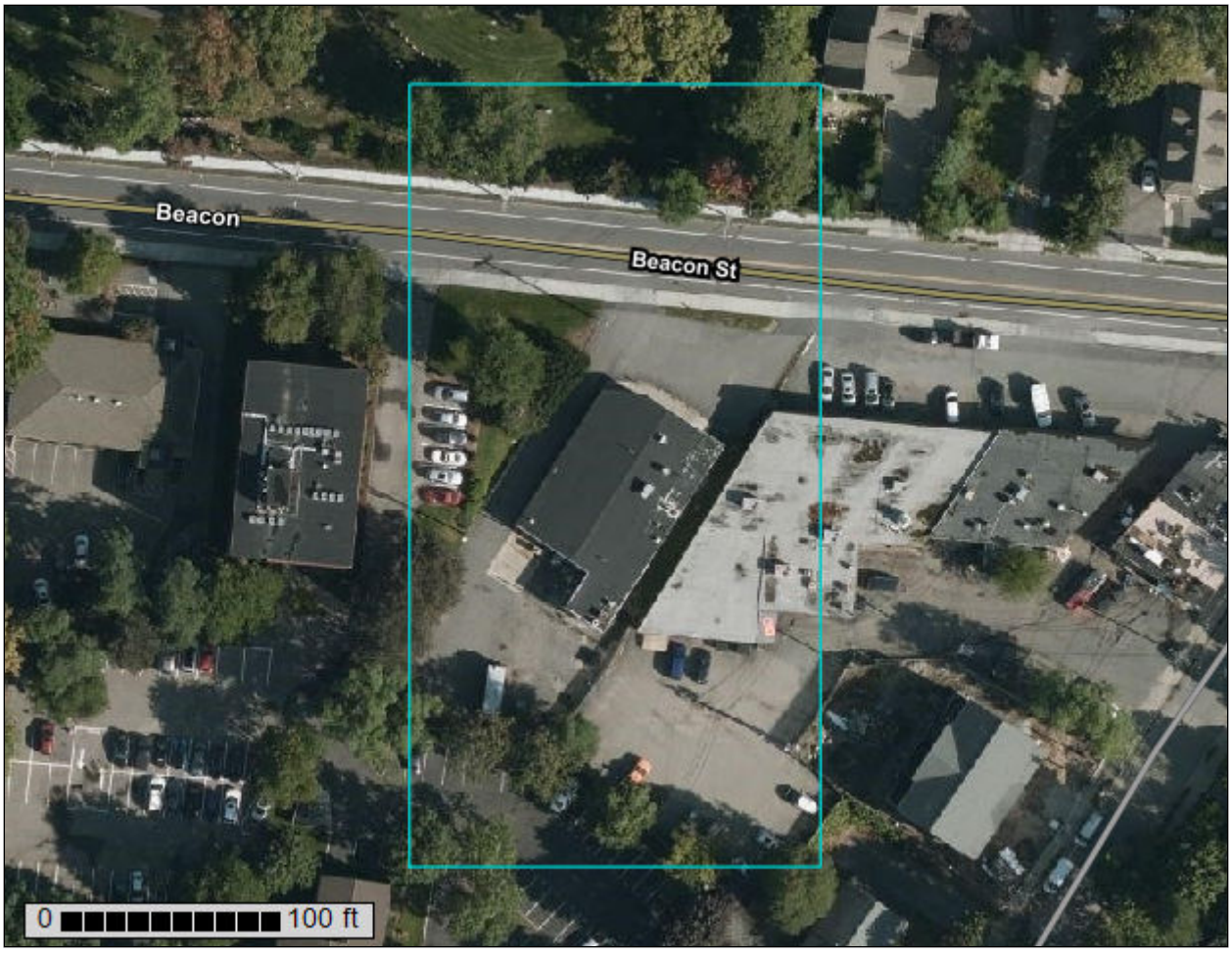
United States Department of Agriculture

NRCS

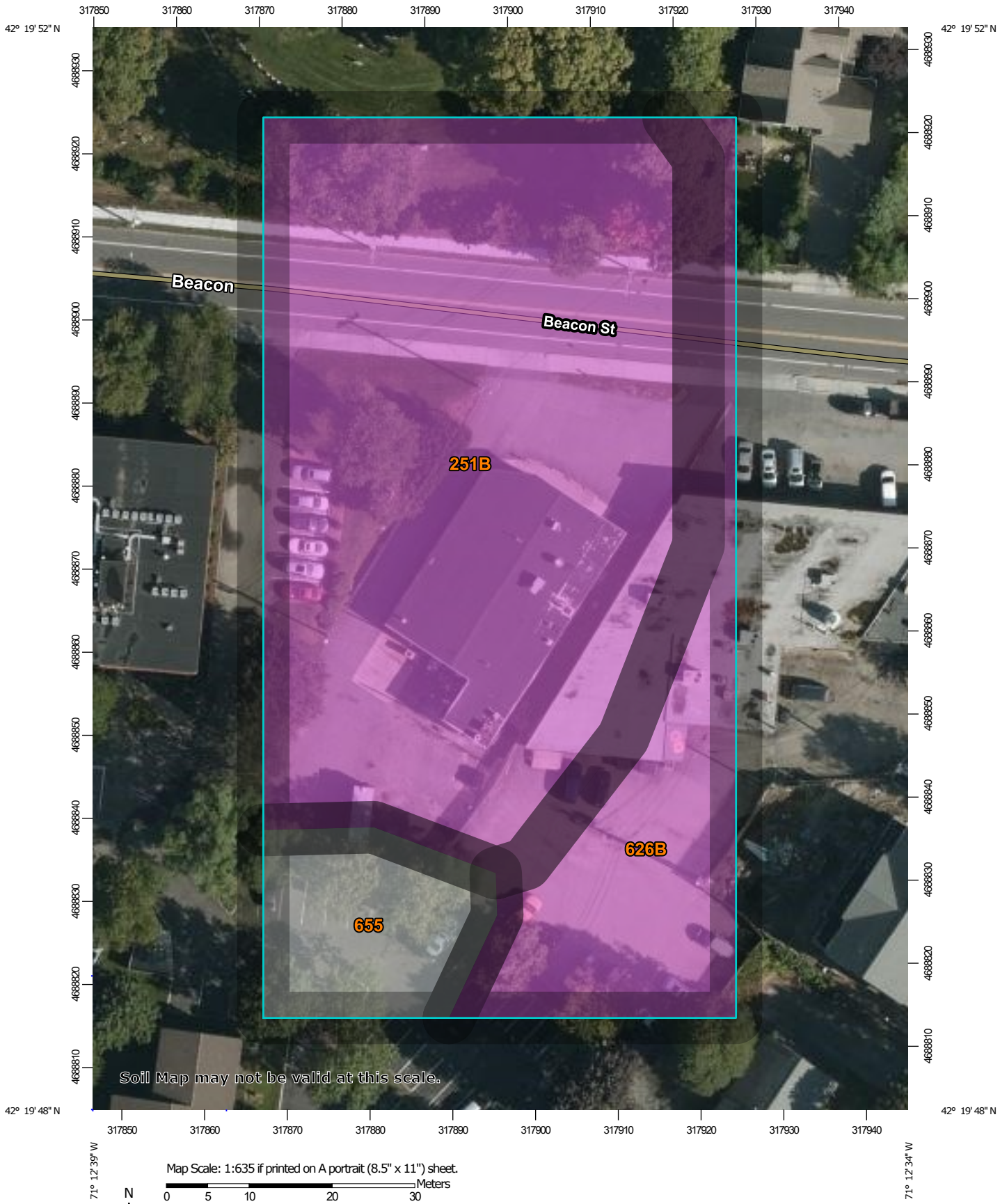
Natural Resources Conservation Service

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

Custom Soil Resource Report for Middlesex County, Massachusetts



January 27, 2020



Map Scale: 1:635 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 5 10 20 30

Feet
0 30 60 120 180

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 19, Sep 12, 2019

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

Date(s) aerial images were photographed: Sep 11, 2019—Oct 5, 2019

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
251B	Haven silt loam, 3 to 8 percent slopes	A	1.1	69.5%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	0.3	21.3%
655	Udorthents, wet substratum		0.1	9.2%
Totals for Area of Interest			**1.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

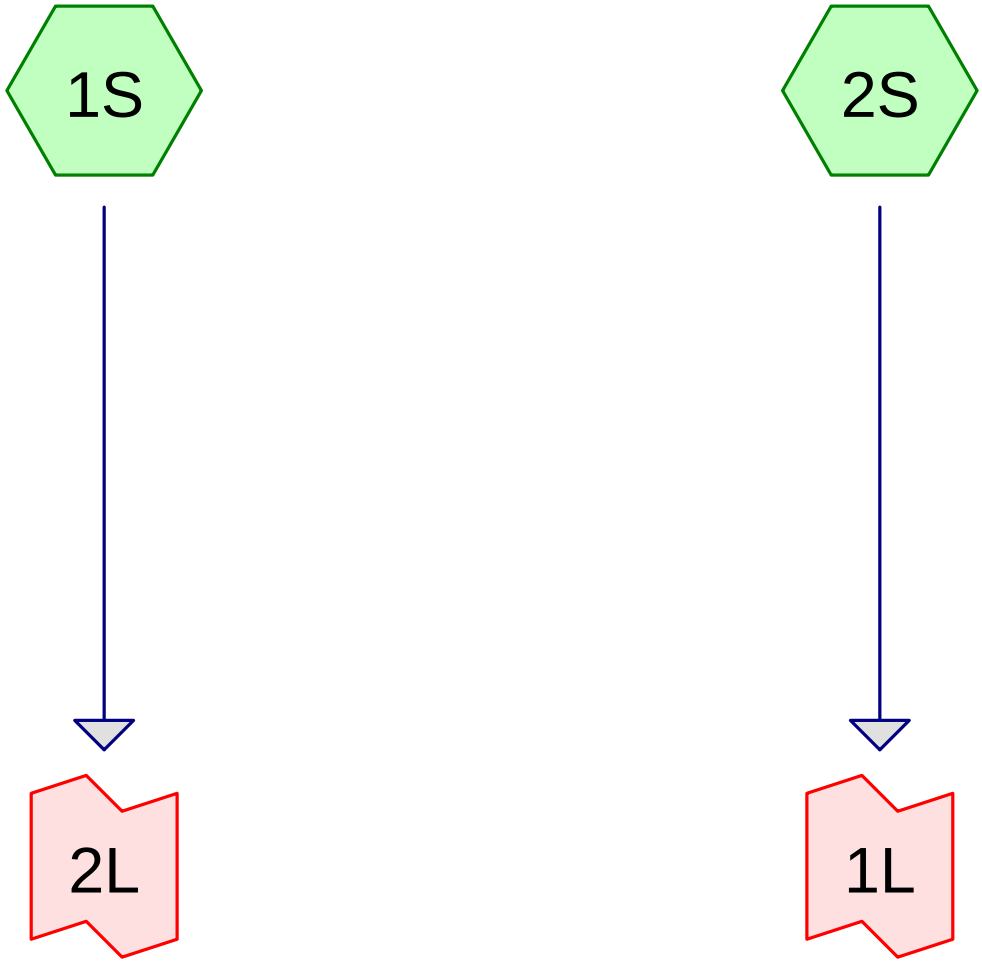
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix B

Pre-Development Watershed Analysis

EXISTING



Subcat Reach Pond Link

Routing Diagram for PRE VS POST
Prepared by {enter your company name here}, Printed 8/13/2020

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.16	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.77	2
3	25-Year	Type III 24-hr		Default	24.00	1	6.03	2
4	100-Year	Type III 24-hr		Default	24.00	1	8.78	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.068	39	>75% Grass cover, Good, HSG A (1S, 2S)
0.278	98	Paved parking, HSG A (1S, 2S)
0.119	98	Unconnected roofs, HSG A (1S)
0.465	**89**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.465	HSG A	1S, 2S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.465		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.068	0.000	0.000	0.000	0.000	0.068	>75% Grass cover, Good	1S, 2S
0.278	0.000	0.000	0.000	0.000	0.278	Paved parking	1S, 2S
0.119	0.000	0.000	0.000	0.000	0.119	Unconnected roofs	1S
0.465	**0.000**	**0.000**	**0.000**	**0.000**	**0.465**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=19,681 sf 86.45% Impervious Runoff Depth>2.00"
Tc=5.0 min CN=90 Runoff=1.12 cfs 0.075 af

Subcatchment 2S: Runoff Area=579 sf 46.29% Impervious Runoff Depth>0.56"
Tc=5.0 min CN=66 Runoff=0.01 cfs 0.001 af

Link 1L: Direct Runon to Beacon Street Inflow=0.01 cfs 0.001 af
Primary=0.01 cfs 0.001 af

Link 2L: Manhole Adjacent to Property Inflow=1.12 cfs 0.075 af
Primary=1.12 cfs 0.075 af

Total Runoff Area = 0.465 ac Runoff Volume = 0.076 af Average Runoff Depth = 1.96"
14.69% Pervious = 0.068 ac 85.31% Impervious = 0.397 ac

Summary for Subcatchment 1S:

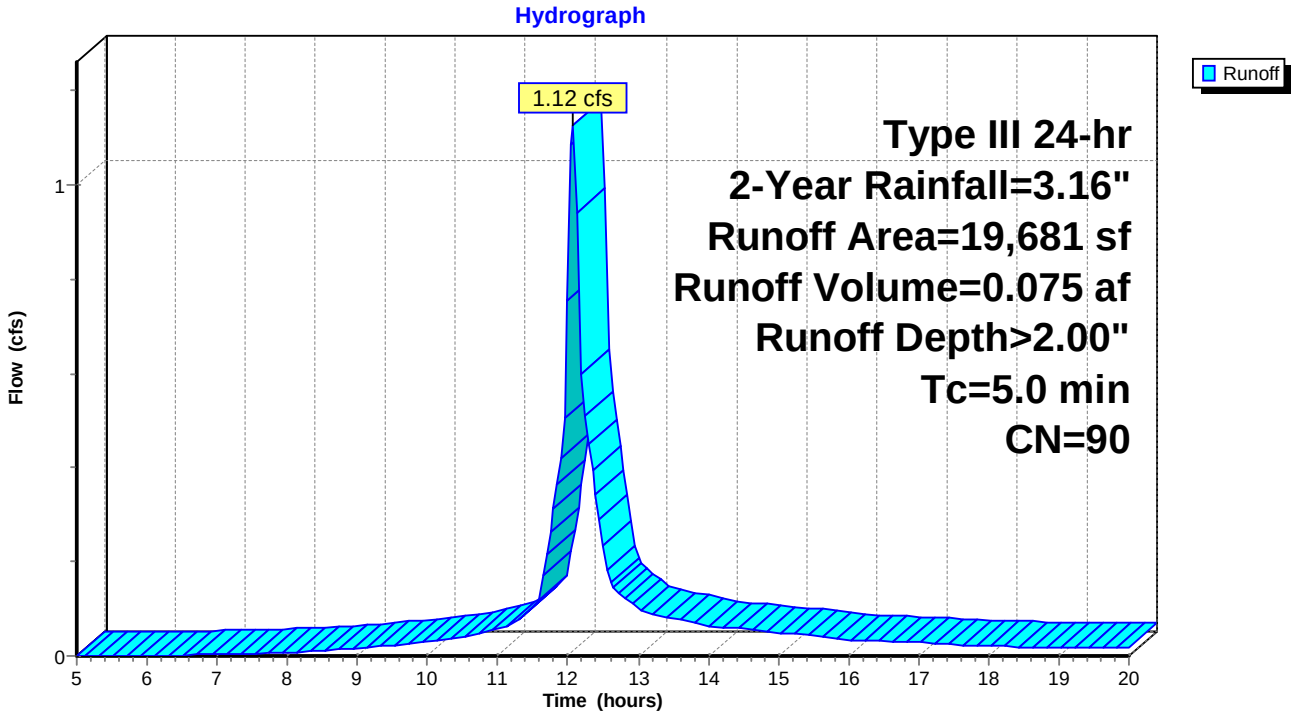
Runoff = 1.12 cfs @ 12.07 hrs, Volume= 0.075 af, Depth> 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
2,666	39	>75% Grass cover, Good, HSG A
5,195	98	Unconnected roofs, HSG A
11,820	98	Paved parking, HSG A
19,681	90	Weighted Average
2,666		13.55% Pervious Area
17,015		86.45% Impervious Area
5,195		30.53% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1S:



Summary for Subcatchment 2S:

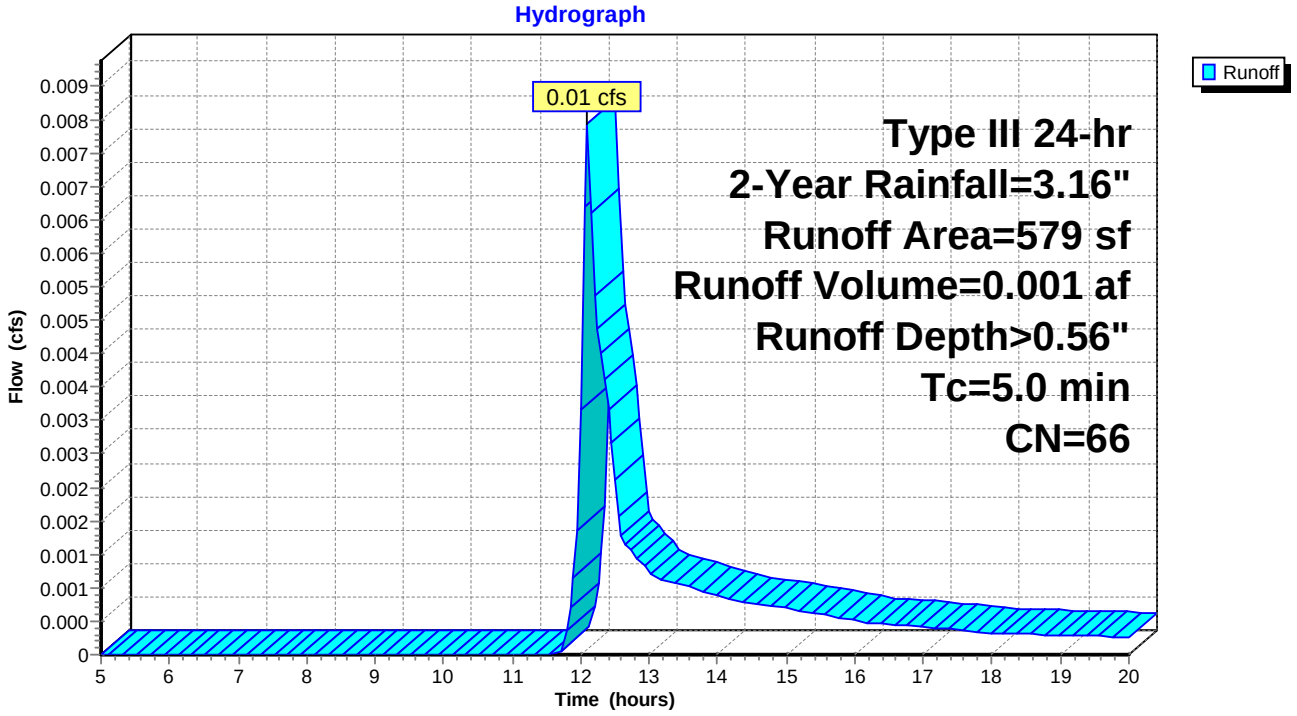
Runoff = 0.01 cfs @ 12.10 hrs, Volume= 0.001 af, Depth> 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
311	39	>75% Grass cover, Good, HSG A
0	98	Unconnected roofs, HSG A
268	98	Paved parking, HSG A
579	66	Weighted Average
311		53.71% Pervious Area
268		46.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 2S:

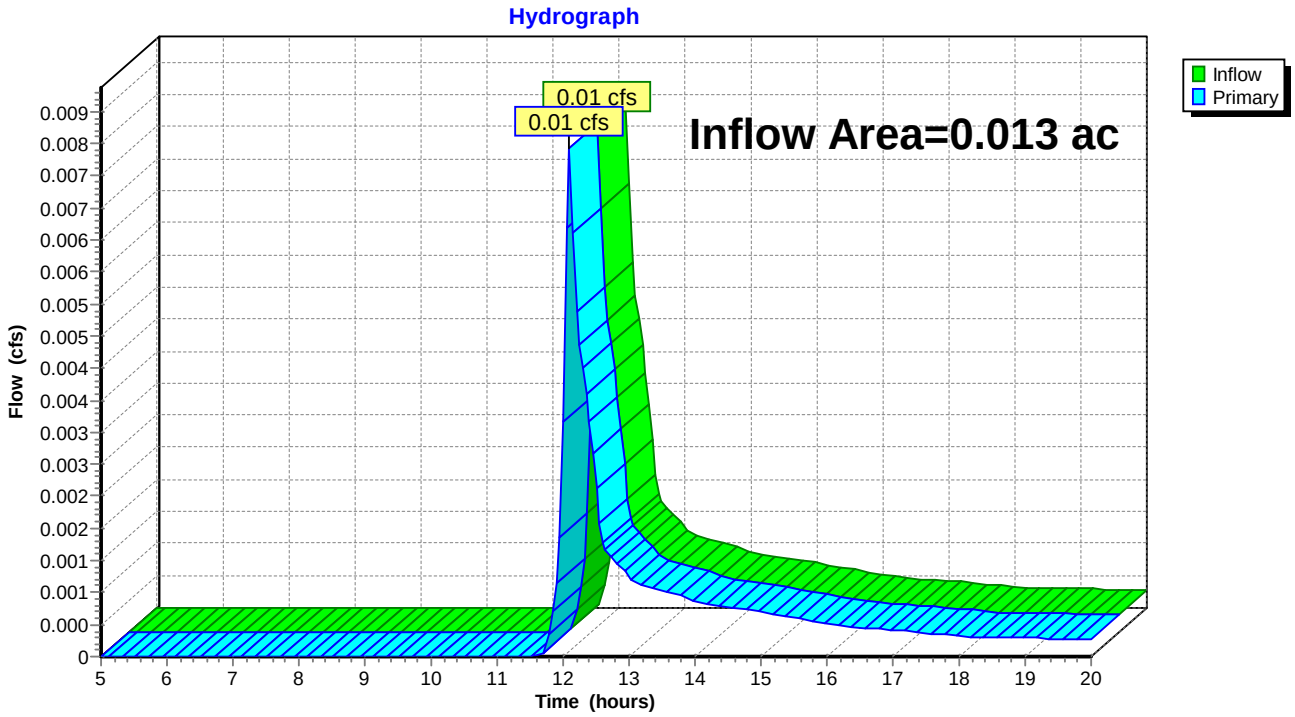


Summary for Link 1L: Direct Runon to Beacon Street

Inflow Area = 0.013 ac, 46.29% Impervious, Inflow Depth > 0.56" for 2-Year event
Inflow = 0.01 cfs @ 12.10 hrs, Volume= 0.001 af
Primary = 0.01 cfs @ 12.10 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: Direct Runon to Beacon Street

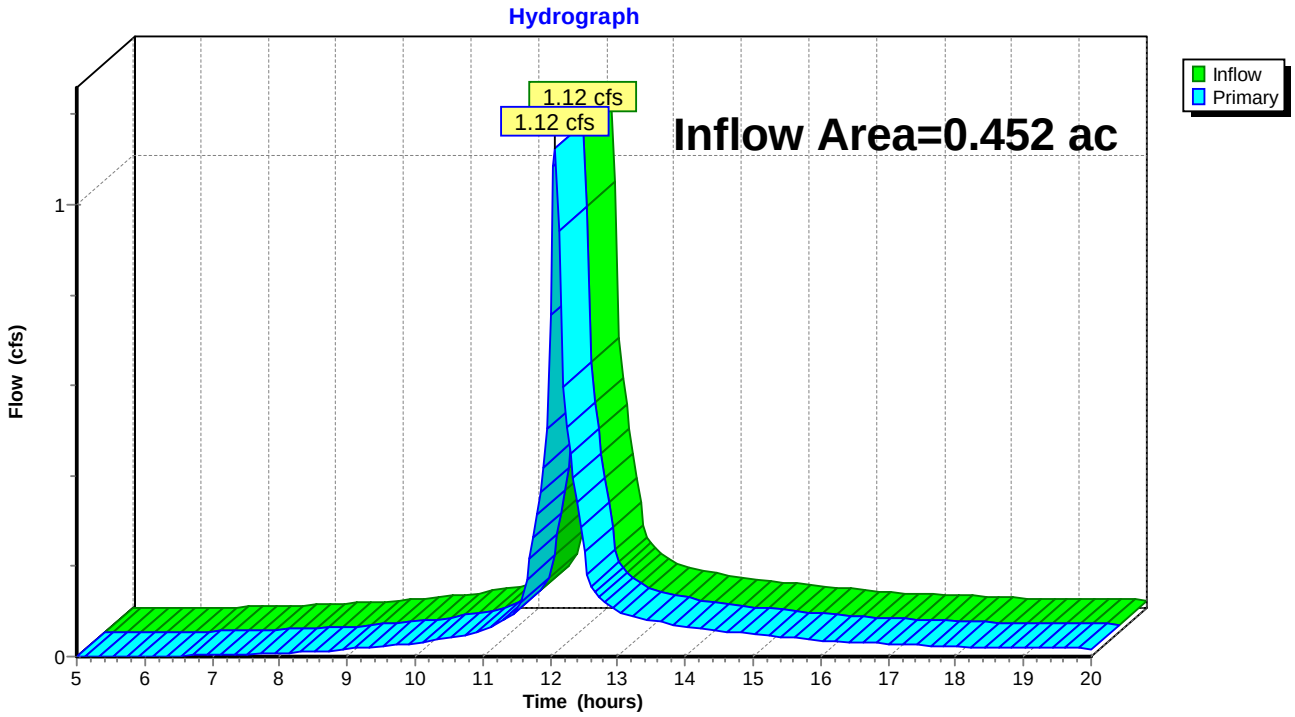


Summary for Link 2L: Manhole Adjacent to Property

Inflow Area = 0.452 ac, 86.45% Impervious, Inflow Depth > 2.00" for 2-Year event
Inflow = 1.12 cfs @ 12.07 hrs, Volume= 0.075 af
Primary = 1.12 cfs @ 12.07 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Manhole Adjacent to Property



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=19,681 sf 86.45% Impervious Runoff Depth>3.45"
Tc=5.0 min CN=90 Runoff=1.88 cfs 0.130 af

Subcatchment 2S: Runoff Area=579 sf 46.29% Impervious Runoff Depth>1.44"
Tc=5.0 min CN=66 Runoff=0.02 cfs 0.002 af

Link 1L: Direct Runon to Beacon Street Inflow=0.02 cfs 0.002 af
Primary=0.02 cfs 0.002 af

Link 2L: Manhole Adjacent to Property Inflow=1.88 cfs 0.130 af
Primary=1.88 cfs 0.130 af

Total Runoff Area = 0.465 ac Runoff Volume = 0.132 af Average Runoff Depth = 3.40"
14.69% Pervious = 0.068 ac 85.31% Impervious = 0.397 ac

Summary for Subcatchment 1S:

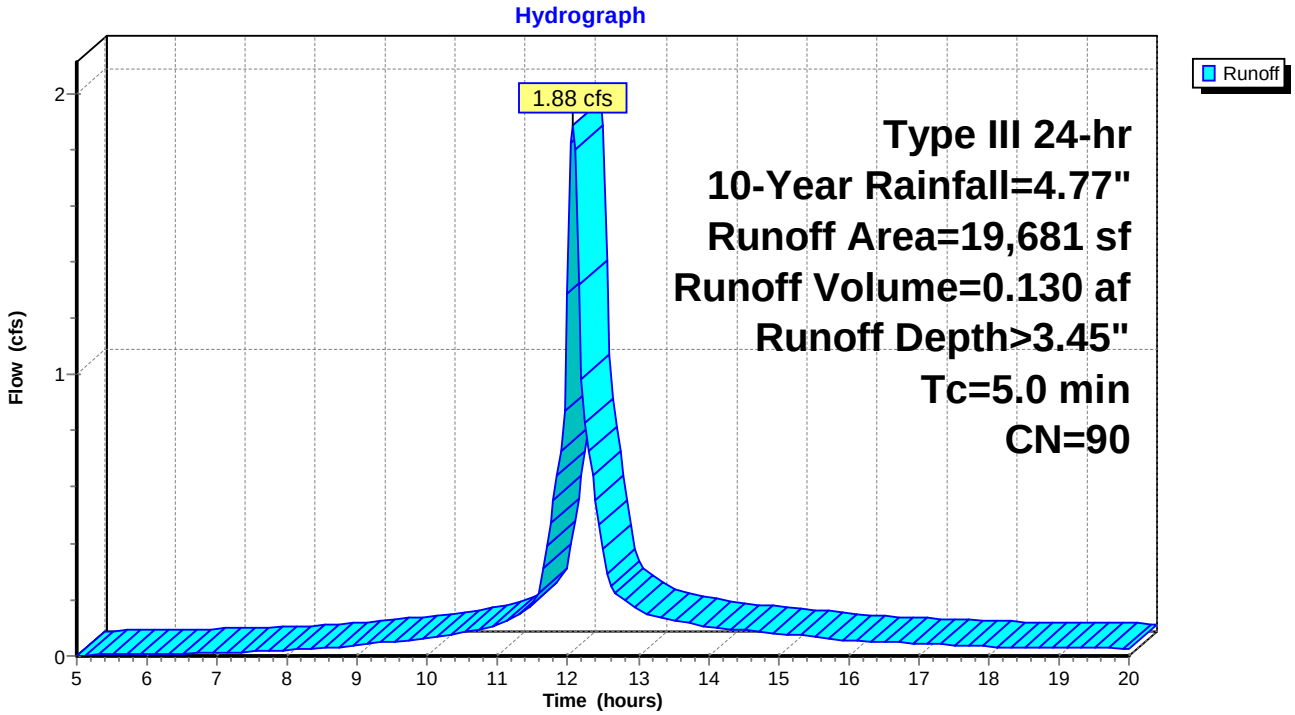
Runoff = 1.88 cfs @ 12.07 hrs, Volume= 0.130 af, Depth> 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
2,666	39	>75% Grass cover, Good, HSG A
5,195	98	Unconnected roofs, HSG A
11,820	98	Paved parking, HSG A
19,681	90	Weighted Average
2,666		13.55% Pervious Area
17,015		86.45% Impervious Area
5,195		30.53% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1S:



Summary for Subcatchment 2S:

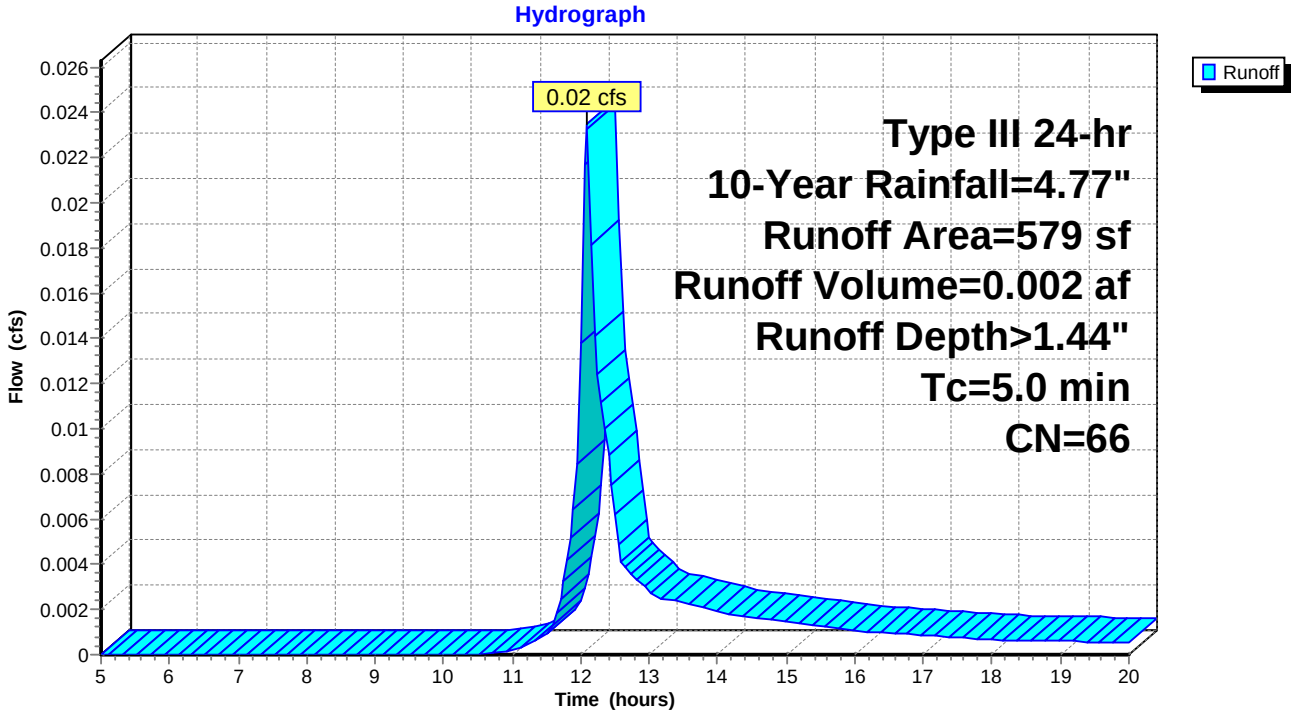
Runoff = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
311	39	>75% Grass cover, Good, HSG A
0	98	Unconnected roofs, HSG A
268	98	Paved parking, HSG A
579	66	Weighted Average
311		53.71% Pervious Area
268		46.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 2S:

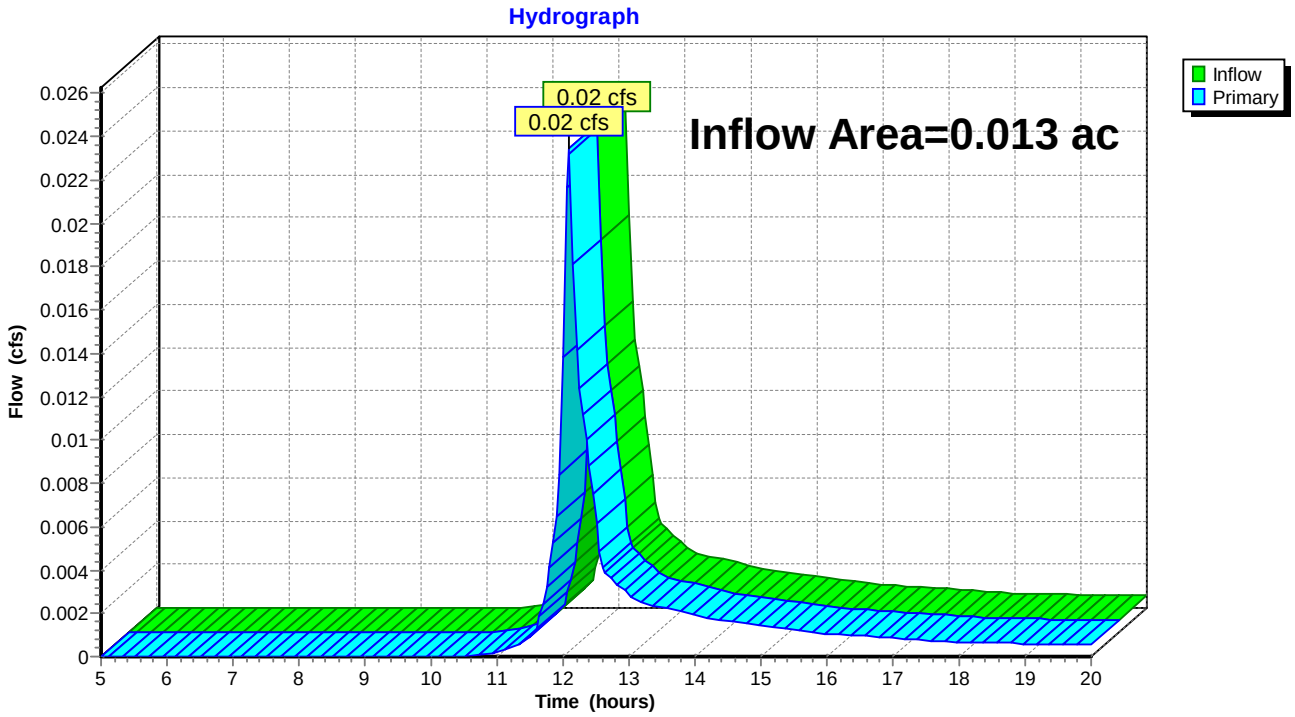


Summary for Link 1L: Direct Runon to Beacon Street

Inflow Area = 0.013 ac, 46.29% Impervious, Inflow Depth > 1.44" for 10-Year event
Inflow = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af
Primary = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: Direct Runon to Beacon Street

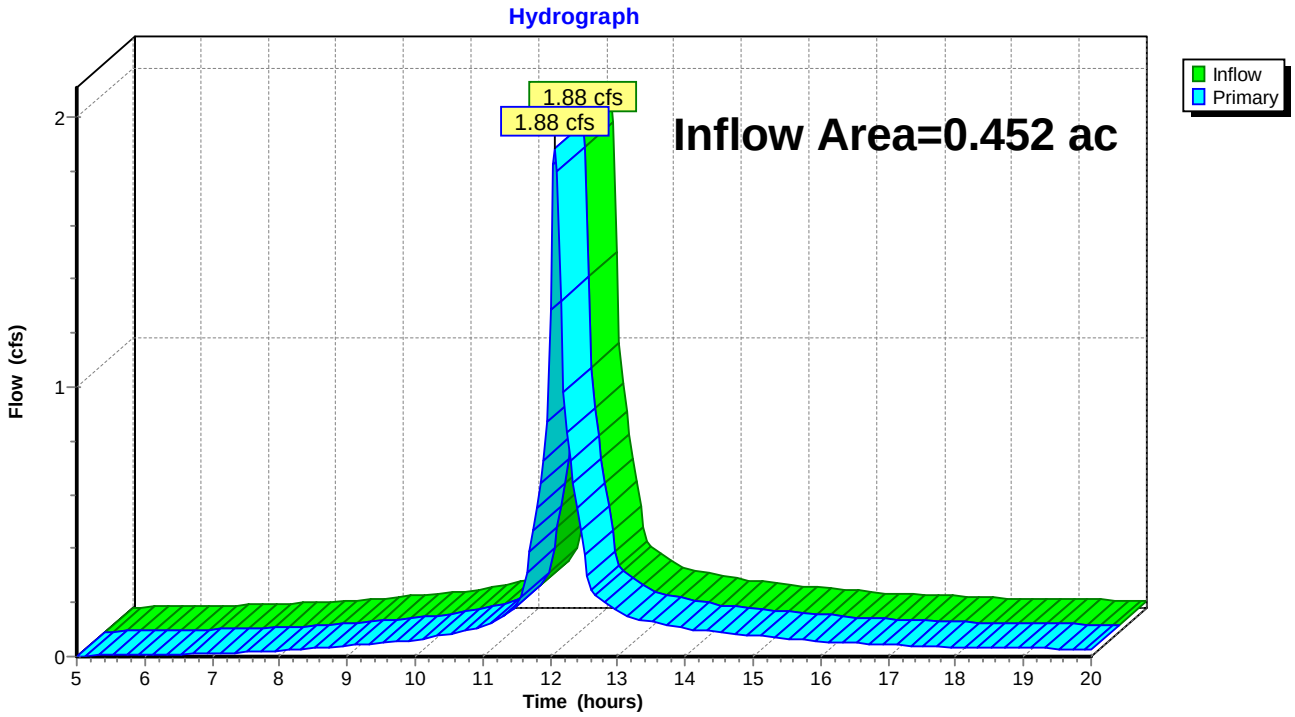


Summary for Link 2L: Manhole Adjacent to Property

Inflow Area = 0.452 ac, 86.45% Impervious, Inflow Depth > 3.45" for 10-Year event
Inflow = 1.88 cfs @ 12.07 hrs, Volume= 0.130 af
Primary = 1.88 cfs @ 12.07 hrs, Volume= 0.130 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Manhole Adjacent to Property



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=19,681 sf 86.45% Impervious Runoff Depth>4.61"
Tc=5.0 min CN=90 Runoff=2.48 cfs 0.174 af

Subcatchment 2S: Runoff Area=579 sf 46.29% Impervious Runoff Depth>2.27"
Tc=5.0 min CN=66 Runoff=0.04 cfs 0.003 af

Link 1L: Direct Runon to Beacon Street Inflow=0.04 cfs 0.003 af
Primary=0.04 cfs 0.003 af

Link 2L: Manhole Adjacent to Property Inflow=2.48 cfs 0.174 af
Primary=2.48 cfs 0.174 af

Total Runoff Area = 0.465 ac Runoff Volume = 0.176 af Average Runoff Depth = 4.54"
14.69% Pervious = 0.068 ac 85.31% Impervious = 0.397 ac

Summary for Subcatchment 1S:

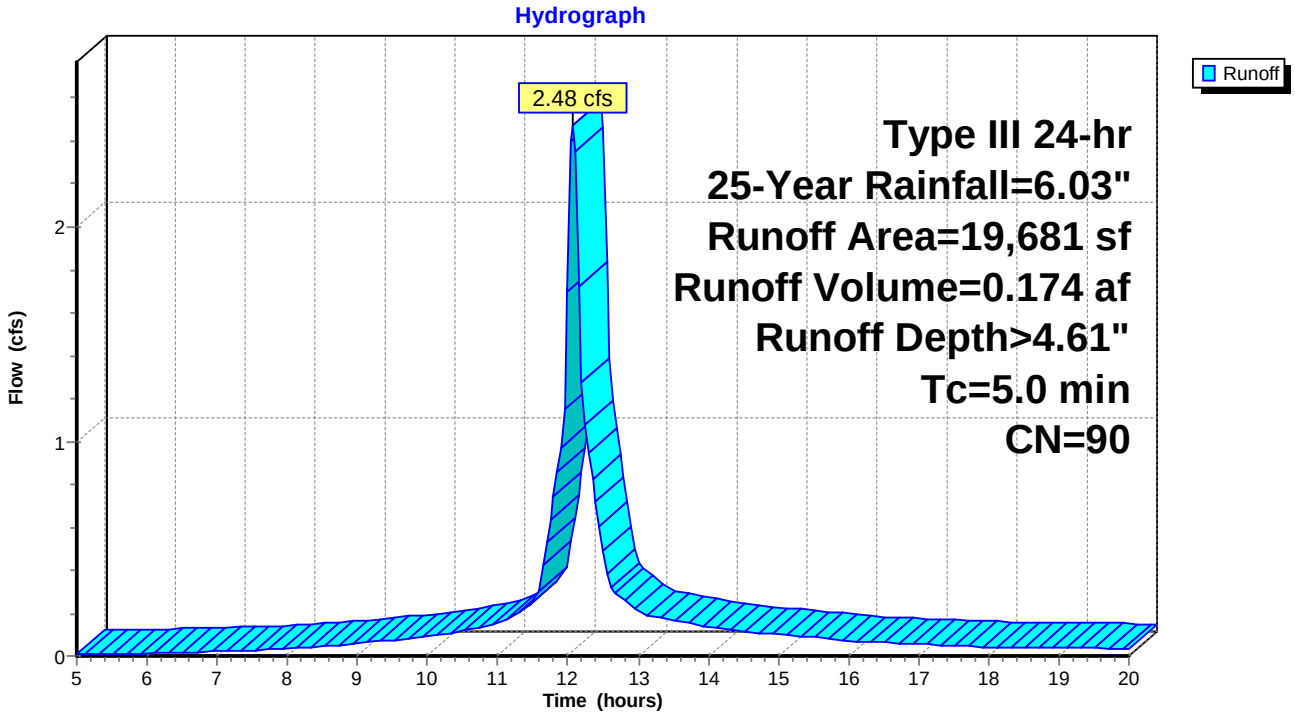
Runoff = 2.48 cfs @ 12.07 hrs, Volume= 0.174 af, Depth> 4.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
2,666	39	>75% Grass cover, Good, HSG A
5,195	98	Unconnected roofs, HSG A
11,820	98	Paved parking, HSG A
19,681	90	Weighted Average
2,666		13.55% Pervious Area
17,015		86.45% Impervious Area
5,195		30.53% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1S:



Summary for Subcatchment 2S:

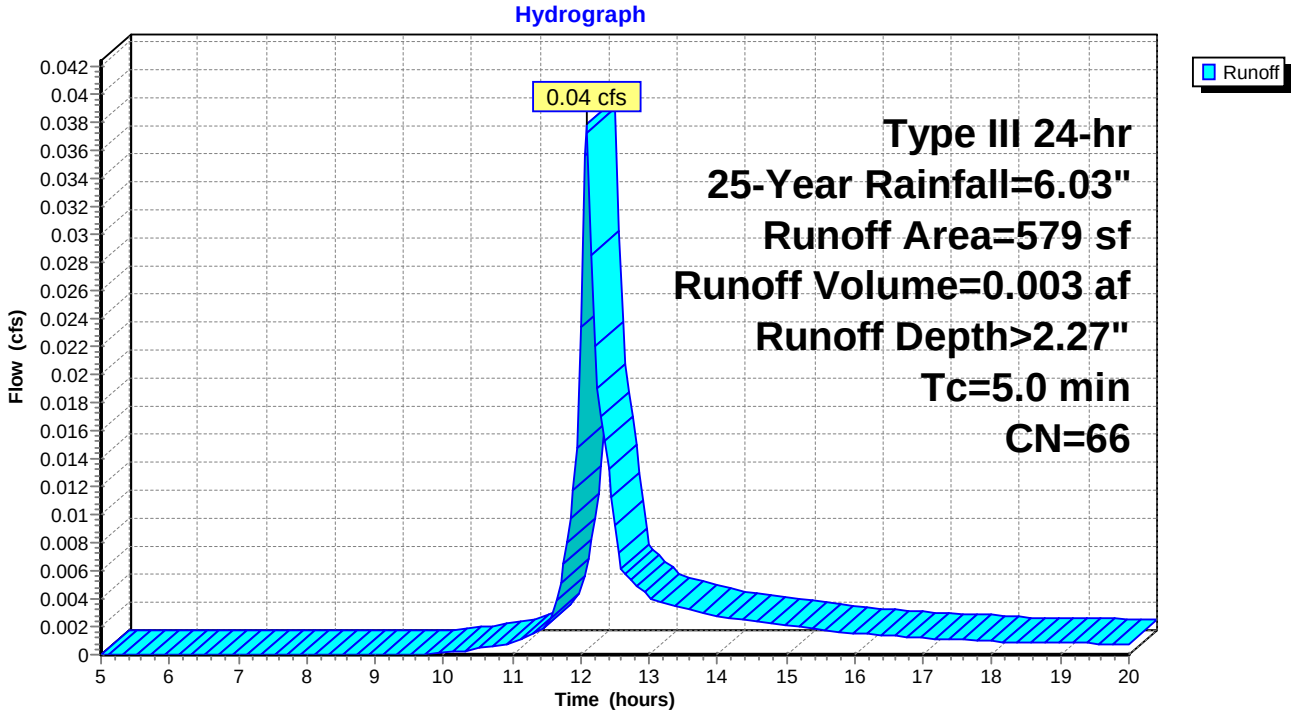
Runoff = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
311	39	>75% Grass cover, Good, HSG A
0	98	Unconnected roofs, HSG A
268	98	Paved parking, HSG A
579	66	Weighted Average
311		53.71% Pervious Area
268		46.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 2S:

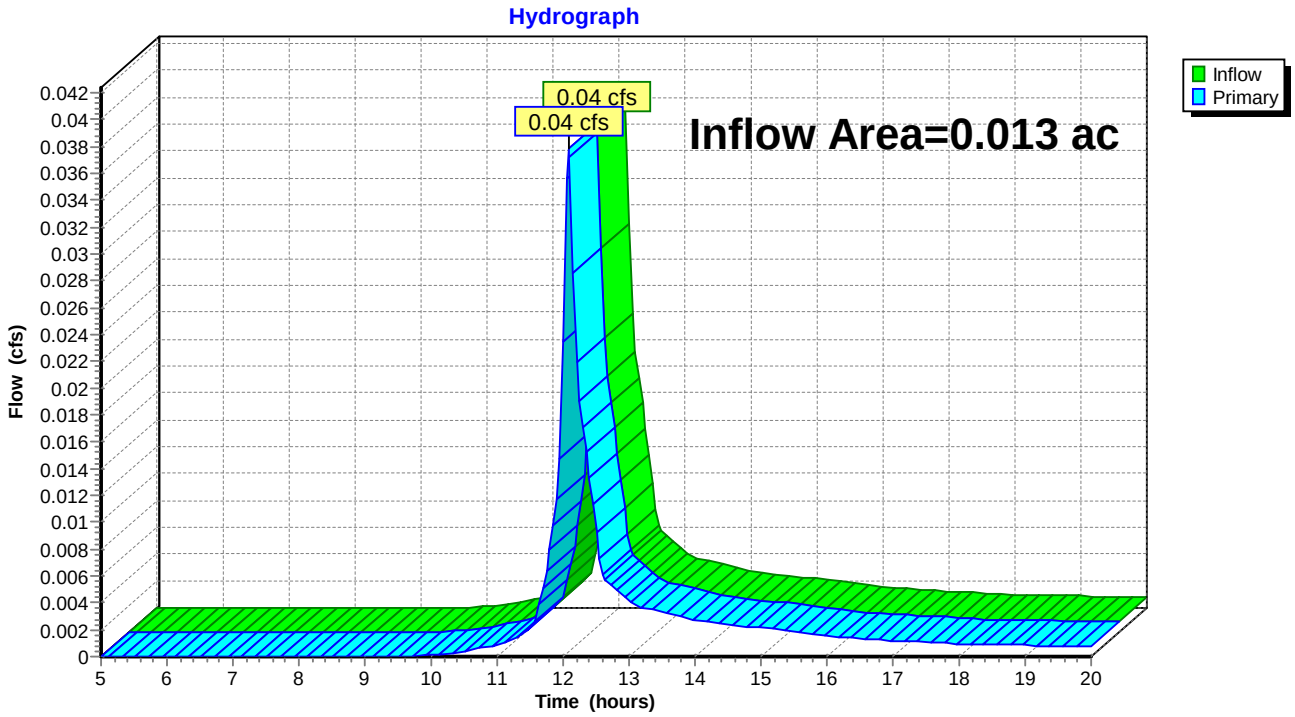


Summary for Link 1L: Direct Runon to Beacon Street

Inflow Area = 0.013 ac, 46.29% Impervious, Inflow Depth > 2.27" for 25-Year event
Inflow = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af
Primary = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: Direct Runon to Beacon Street

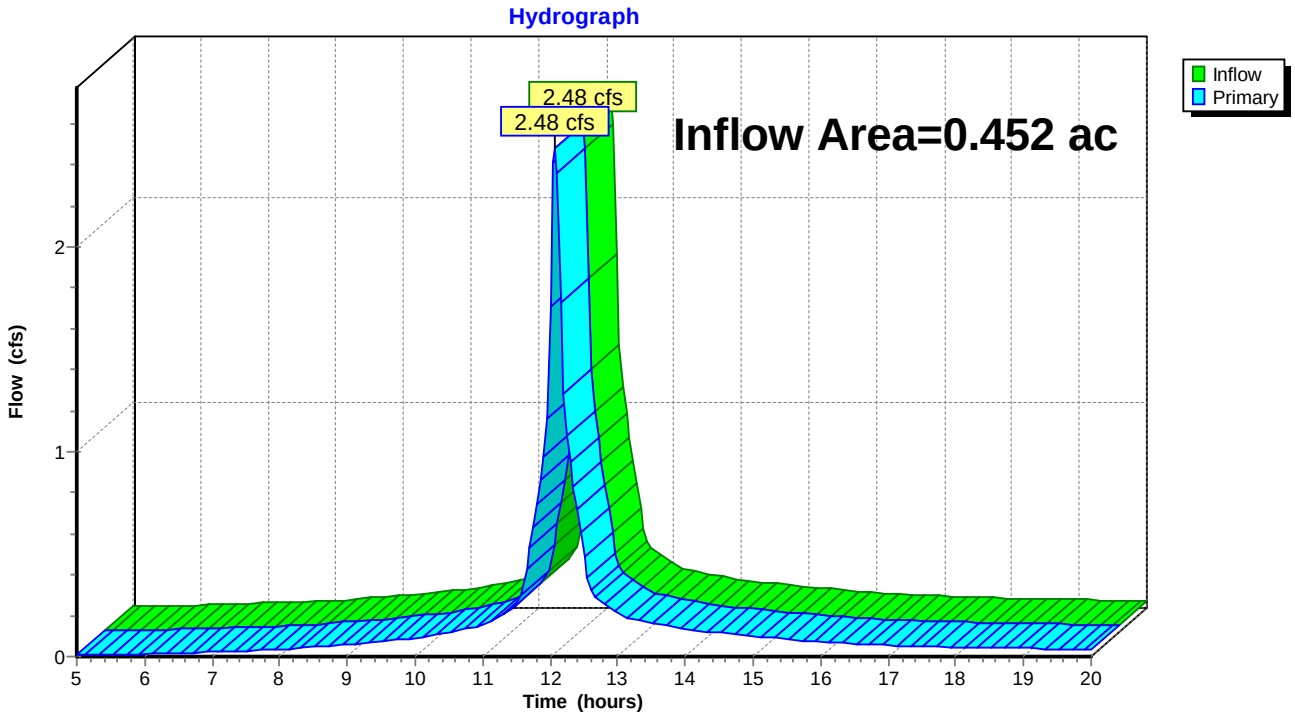


Summary for Link 2L: Manhole Adjacent to Property

Inflow Area = 0.452 ac, 86.45% Impervious, Inflow Depth > 4.61" for 25-Year event
Inflow = 2.48 cfs @ 12.07 hrs, Volume= 0.174 af
Primary = 2.48 cfs @ 12.07 hrs, Volume= 0.174 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Manhole Adjacent to Property



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=19,681 sf 86.45% Impervious Runoff Depth>7.15"
Tc=5.0 min CN=90 Runoff=3.75 cfs 0.269 af

Subcatchment 2S: Runoff Area=579 sf 46.29% Impervious Runoff Depth>4.33"
Tc=5.0 min CN=66 Runoff=0.07 cfs 0.005 af

Link 1L: Direct Runon to Beacon Street Inflow=0.07 cfs 0.005 af
Primary=0.07 cfs 0.005 af

Link 2L: Manhole Adjacent to Property Inflow=3.75 cfs 0.269 af
Primary=3.75 cfs 0.269 af

Total Runoff Area = 0.465 ac Runoff Volume = 0.274 af Average Runoff Depth = 7.07"
14.69% Pervious = 0.068 ac 85.31% Impervious = 0.397 ac

Summary for Subcatchment 1S:

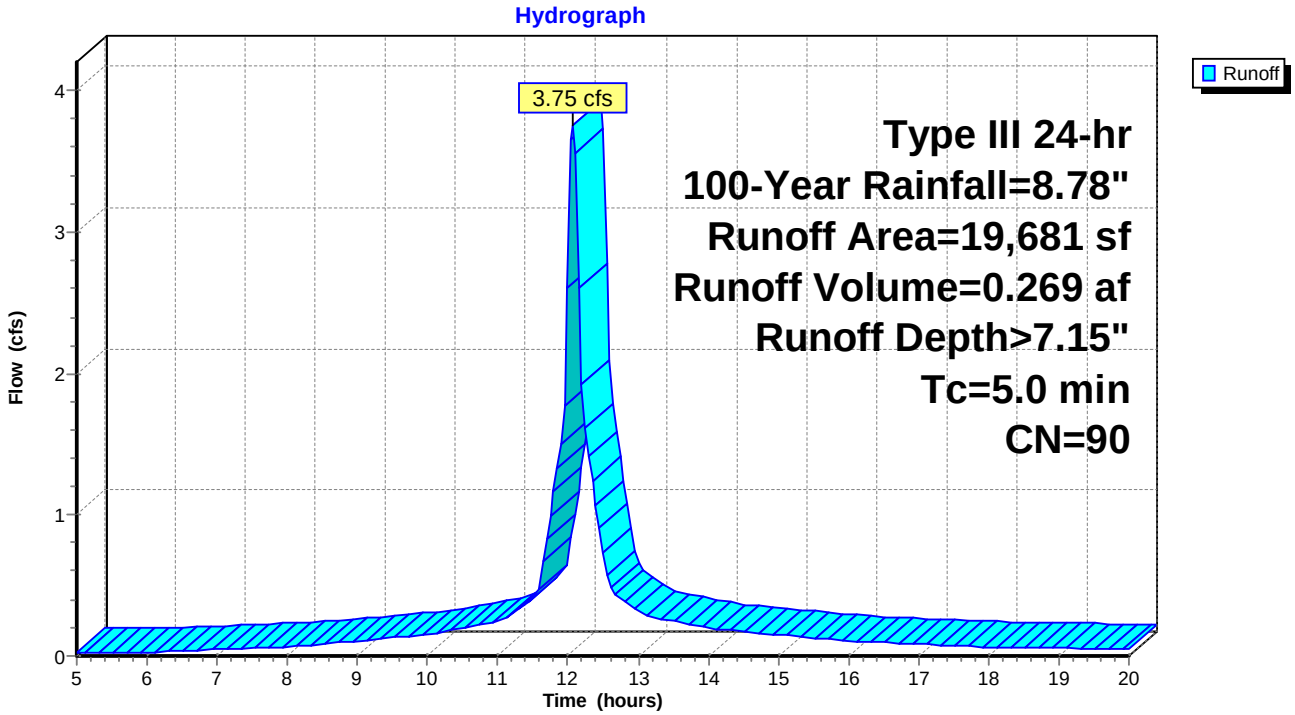
Runoff = 3.75 cfs @ 12.07 hrs, Volume= 0.269 af, Depth> 7.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
2,666	39	>75% Grass cover, Good, HSG A
5,195	98	Unconnected roofs, HSG A
11,820	98	Paved parking, HSG A
19,681	90	Weighted Average
2,666		13.55% Pervious Area
17,015		86.45% Impervious Area
5,195		30.53% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1S:



Summary for Subcatchment 2S:

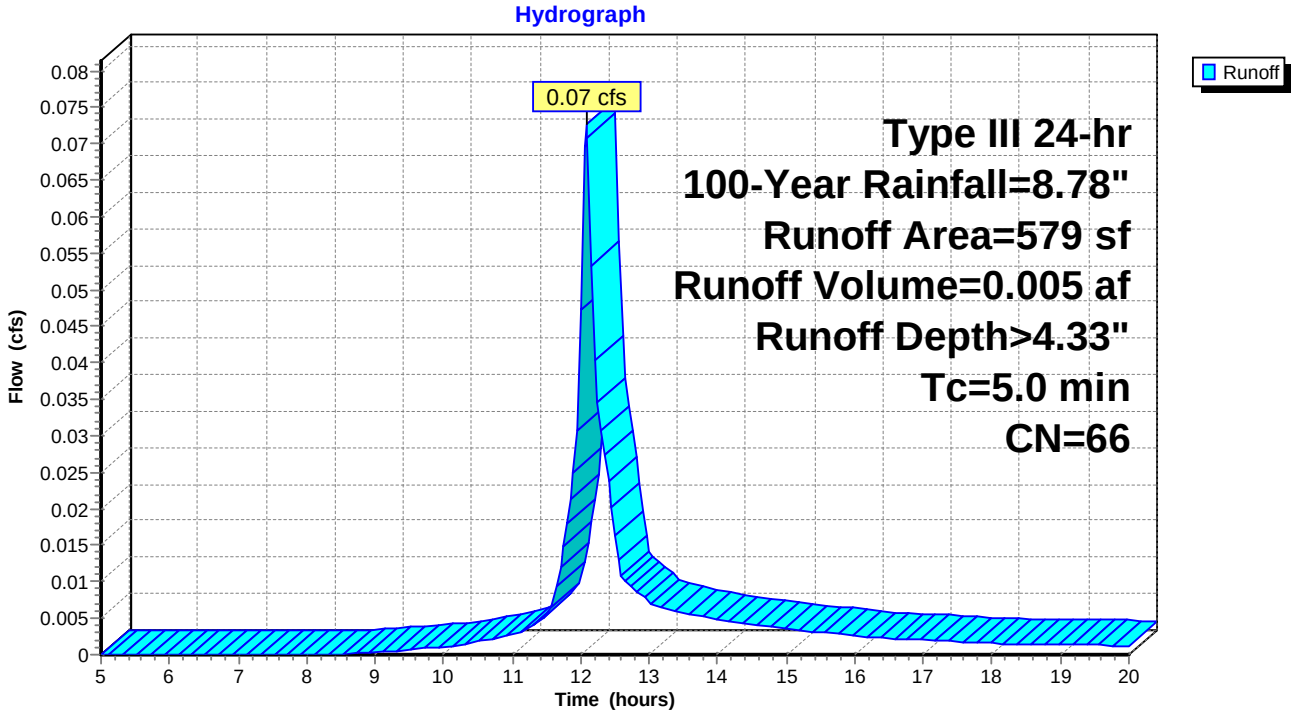
Runoff = 0.07 cfs @ 12.08 hrs, Volume= 0.005 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
311	39	>75% Grass cover, Good, HSG A
0	98	Unconnected roofs, HSG A
268	98	Paved parking, HSG A
579	66	Weighted Average
311		53.71% Pervious Area
268		46.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 2S:

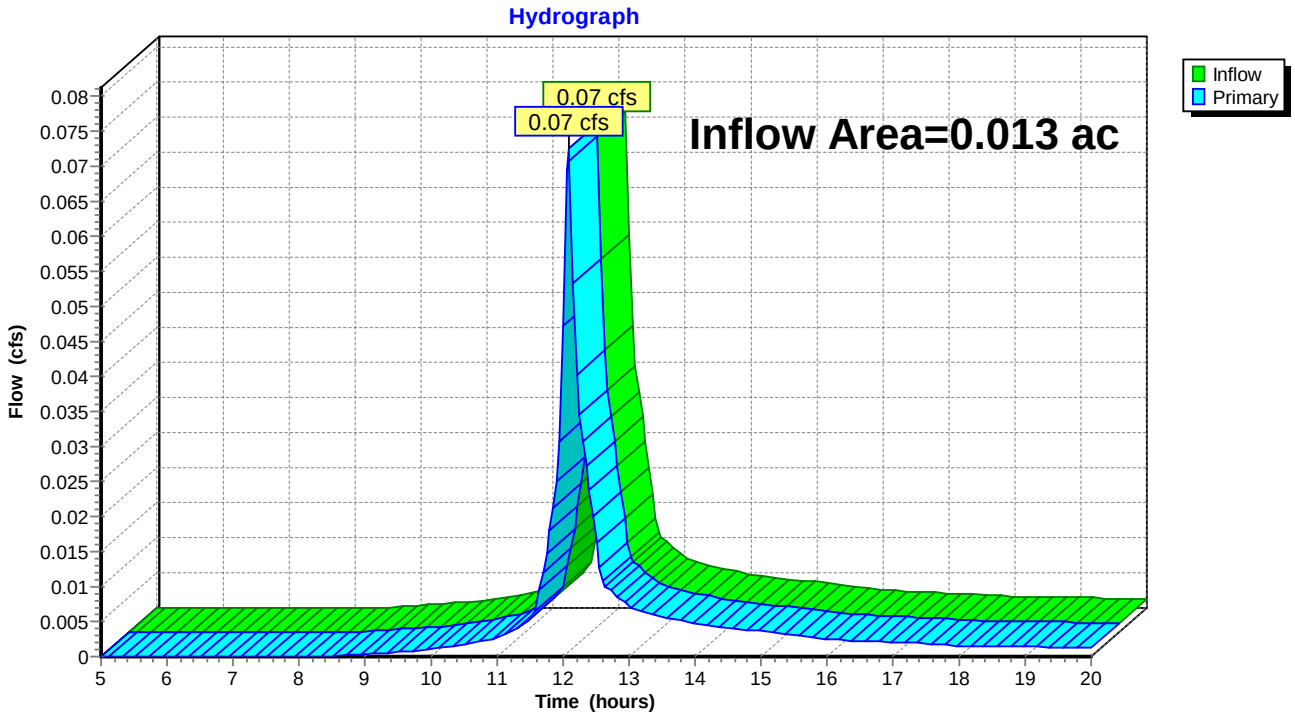


Summary for Link 1L: Direct Runon to Beacon Street

Inflow Area = 0.013 ac, 46.29% Impervious, Inflow Depth > 4.33" for 100-Year event
Inflow = 0.07 cfs @ 12.08 hrs, Volume= 0.005 af
Primary = 0.07 cfs @ 12.08 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: Direct Runon to Beacon Street

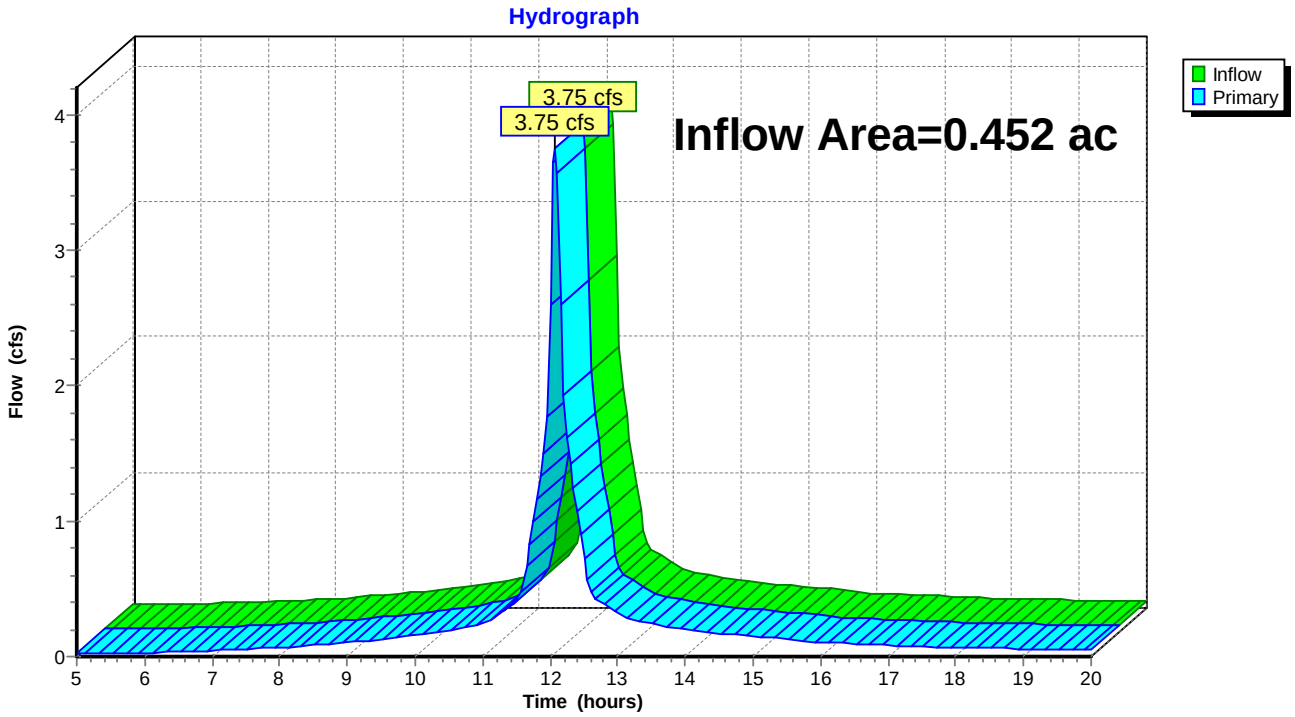


Summary for Link 2L: Manhole Adjacent to Property

Inflow Area = 0.452 ac, 86.45% Impervious, Inflow Depth > 7.15" for 100-Year event
Inflow = 3.75 cfs @ 12.07 hrs, Volume= 0.269 af
Primary = 3.75 cfs @ 12.07 hrs, Volume= 0.269 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Manhole Adjacent to Property



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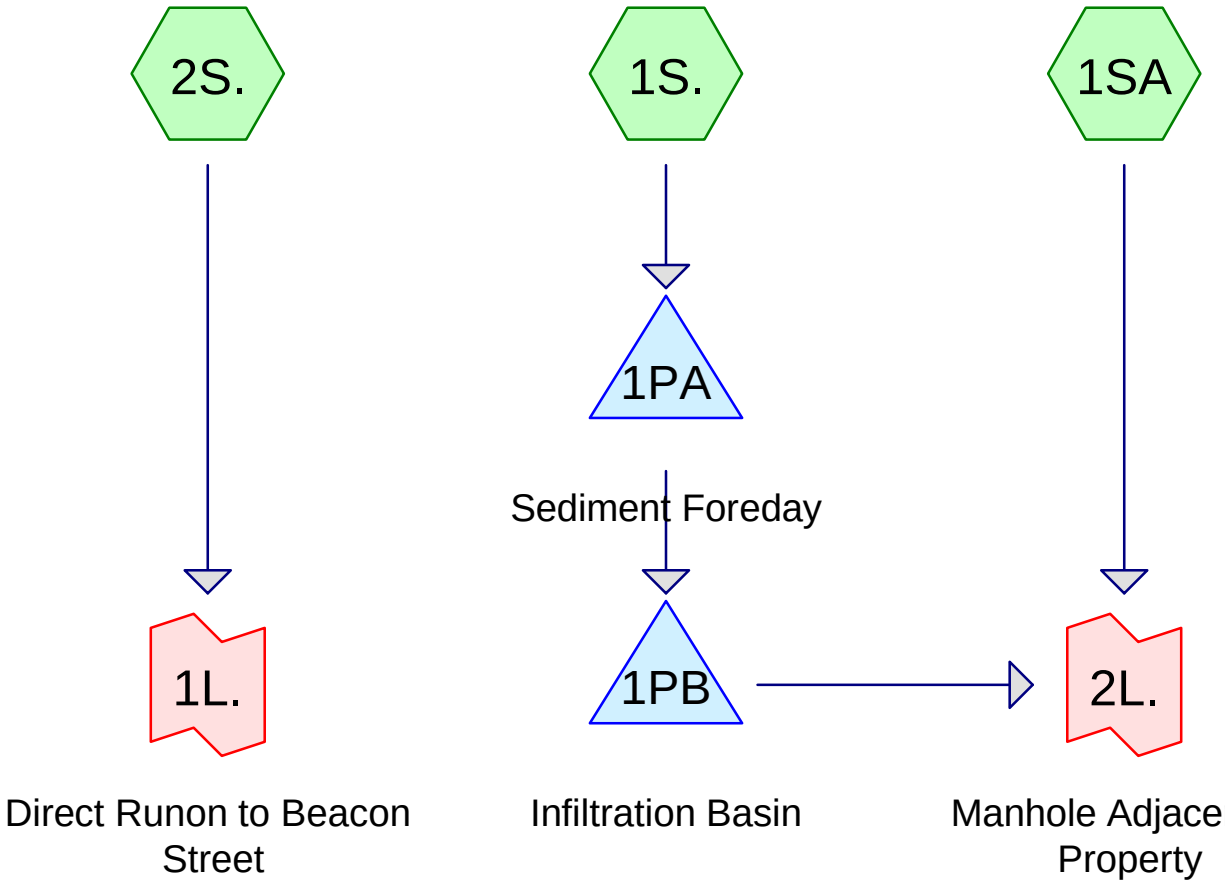
Appendix C

Post-Development Watershed Analysis

PROPOSED



Subcat Reach Pond Link

Routing Diagram for PRE VS POST
Prepared by {enter your company name here}, Printed 8/13/2020

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.16	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.77	2
3	25-Year	Type III 24-hr		Default	24.00	1	6.03	2
4	100-Year	Type III 24-hr		Default	24.00	1	8.78	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.065	39	>75% Grass cover, Good, HSG A (1S., 1SA, 2S.)
0.267	98	Paved parking, HSG A (1S., 1SA, 2S.)
0.110	98	Unconnected roofs, HSG A (1S., 1SA)
0.023	98	Water Surface, HSG A (1S.)
0.465	**90**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.465	HSG A	1S., 1SA, 2S.
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.465		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.065	0.000	0.000	0.000	0.000	0.065	>75% Grass cover, Good	1S., 1SA, 2S.
0.267	0.000	0.000	0.000	0.000	0.267	Paved parking	1S., 1SA, 2S.
0.110	0.000	0.000	0.000	0.000	0.110	Unconnected roofs	1S., 1SA
0.023	0.000	0.000	0.000	0.000	0.023	Water Surface	1S.
0.465	**0.000**	**0.000**	**0.000**	**0.000**	**0.465**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S.: Runoff Area=15,374 sf 87.36% Impervious Runoff Depth>2.09"
Tc=5.0 min CN=91 Runoff=0.91 cfs 0.062 af

Subcatchment 1SA: Runoff Area=4,349 sf 86.87% Impervious Runoff Depth>2.00"
Tc=5.0 min CN=90 Runoff=0.25 cfs 0.017 af

Subcatchment 2S.: Runoff Area=537 sf 40.60% Impervious Runoff Depth>0.44"
Tc=5.0 min CN=63 Runoff=0.01 cfs 0.000 af

Pond 1PA: Sediment Foreday Peak Elev=106.17' Storage=180 cf Inflow=0.91 cfs 0.062 af
Outflow=0.91 cfs 0.058 af

Pond 1PB: Infiltration Basin Peak Elev=106.32' Storage=1,143 cf Inflow=0.91 cfs 0.058 af
Discarded=0.06 cfs 0.037 af Primary=0.29 cfs 0.008 af Outflow=0.35 cfs 0.045 af

Link 1L.: Direct Runon to Beacon Street Inflow=0.01 cfs 0.000 af
Primary=0.01 cfs 0.000 af

Link 2L.: Manhole Adjacent to Property Inflow=0.40 cfs 0.025 af
Primary=0.40 cfs 0.025 af

Total Runoff Area = 0.465 ac Runoff Volume = 0.079 af Average Runoff Depth = 2.03"
13.99% Pervious = 0.065 ac 86.01% Impervious = 0.400 ac

Summary for Subcatchment 1S.:

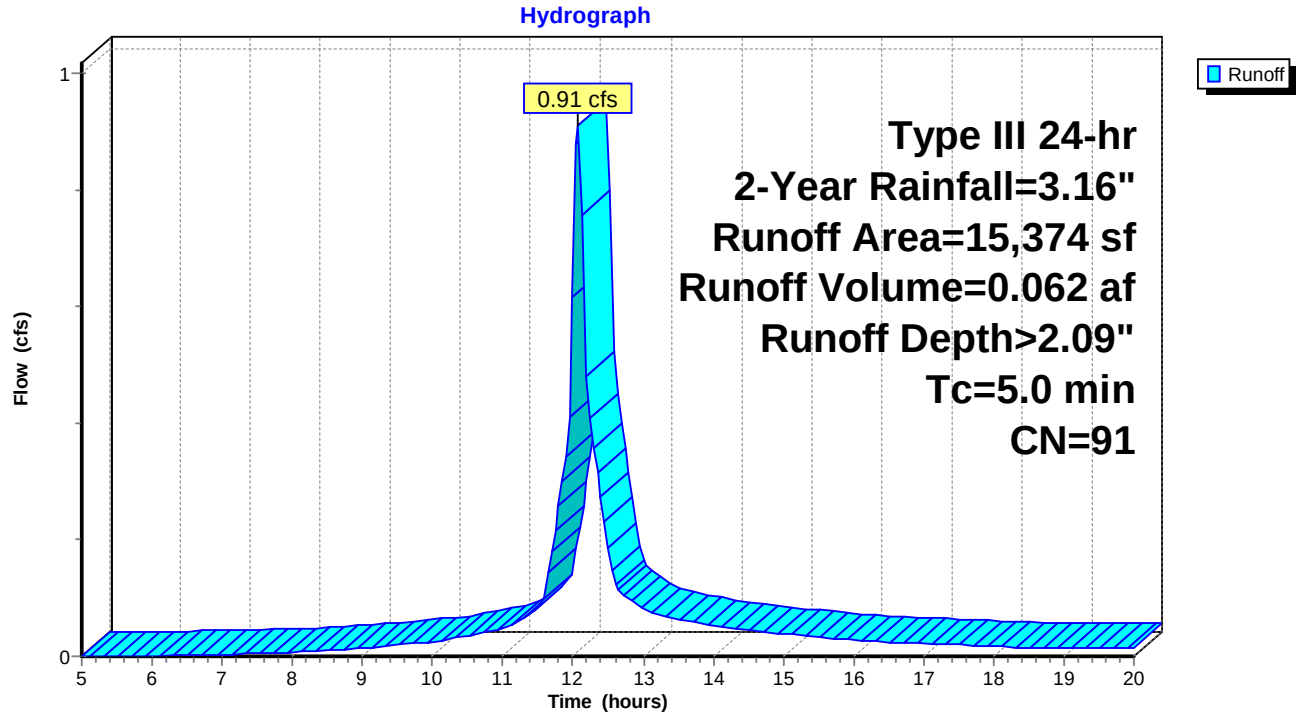
Runoff = 0.91 cfs @ 12.07 hrs, Volume= 0.062 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
1,944	39	>75% Grass cover, Good, HSG A
4,331	98	Unconnected roofs, HSG A
8,079	98	Paved parking, HSG A
1,020	98	Water Surface, HSG A
15,374	91	Weighted Average
1,944		12.64% Pervious Area
13,430		87.36% Impervious Area
4,331		32.25% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1S.:



Summary for Subcatchment 1SA:

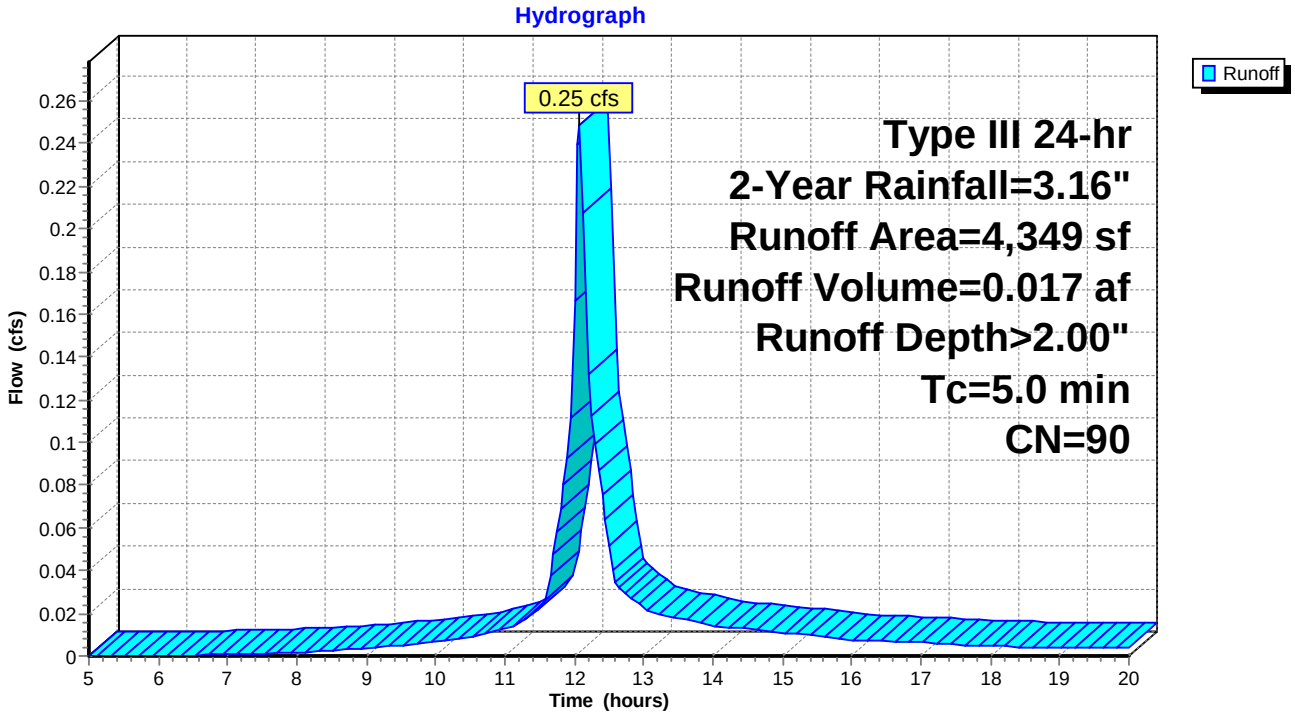
Runoff = 0.25 cfs @ 12.07 hrs, Volume= 0.017 af, Depth> 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
571	39	>75% Grass cover, Good, HSG A
457	98	Unconnected roofs, HSG A
3,321	98	Paved parking, HSG A
4,349	90	Weighted Average
571		13.13% Pervious Area
3,778		86.87% Impervious Area
457		12.10% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1SA:



Summary for Subcatchment 2S.:

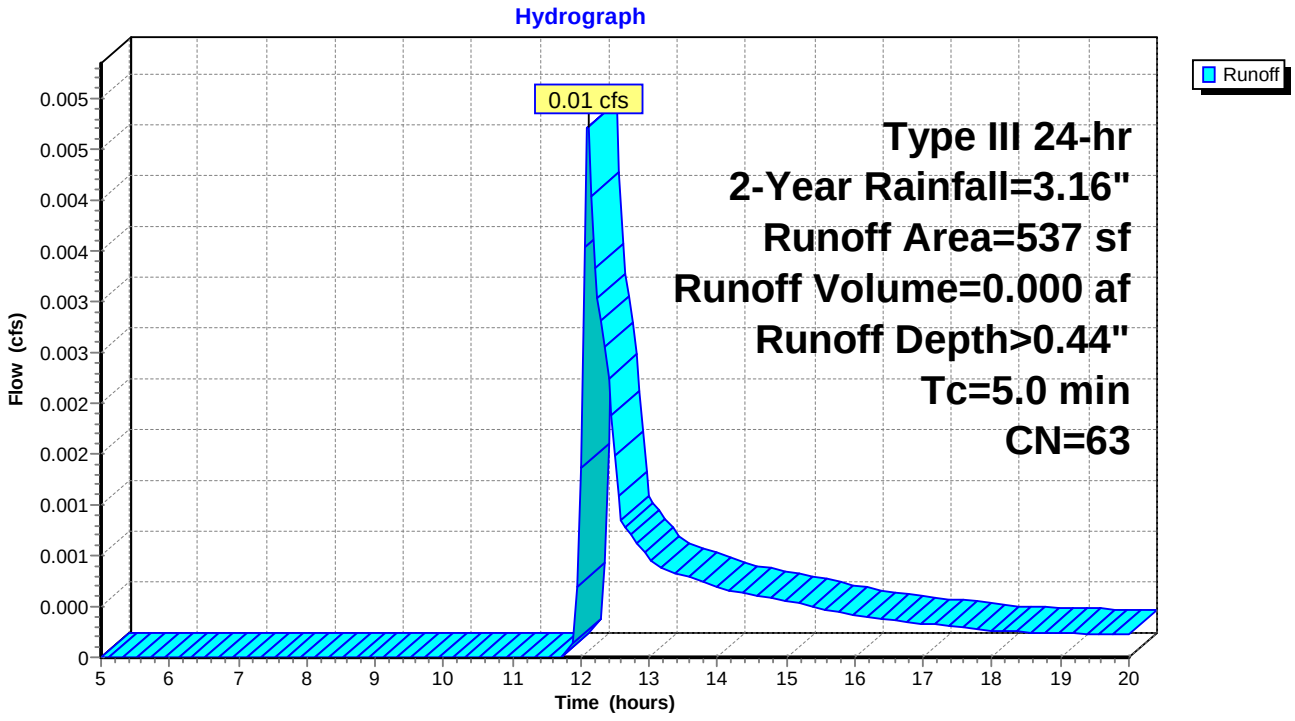
Runoff = 0.01 cfs @ 12.11 hrs, Volume= 0.000 af, Depth> 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
319	39	>75% Grass cover, Good, HSG A
218	98	Paved parking, HSG A
537	63	Weighted Average
319		59.40% Pervious Area
218		40.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 2S.:



Summary for Pond 1PA: Sediment Foreday

Inflow Area = 0.353 ac, 87.36% Impervious, Inflow Depth > 2.09" for 2-Year event
Inflow = 0.91 cfs @ 12.07 hrs, Volume= 0.062 af
Outflow = 0.91 cfs @ 12.09 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.7 min
Primary = 0.91 cfs @ 12.09 hrs, Volume= 0.058 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 106.17' @ 12.09 hrs Surf.Area= 212 sf Storage= 180 cf

Plug-Flow detention time= 34.1 min calculated for 0.058 af (94% of inflow)
Center-of-Mass det. time= 14.5 min (784.9 - 770.4)

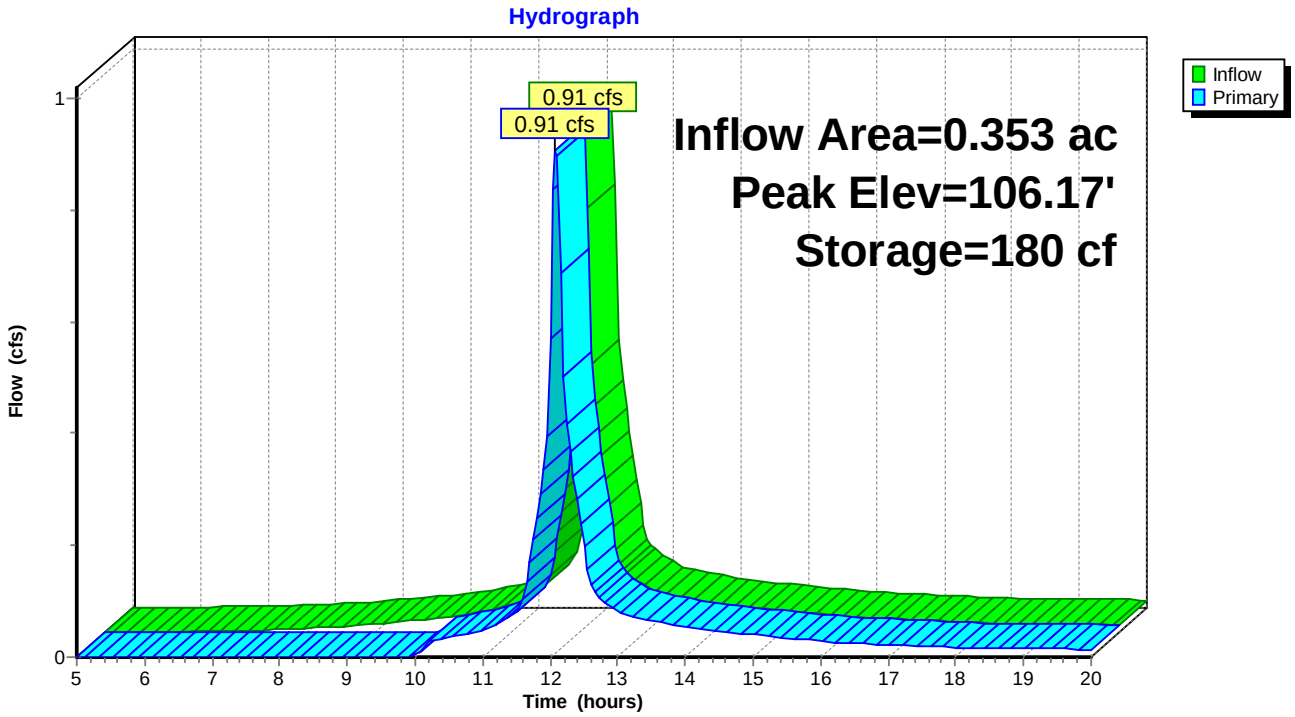
Volume	Invert	Avail.Storage	Storage Description
#1	104.50'	283 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
104.50	28	30.0	0	0	28
105.00	66	46.0	23	23	127
106.00	189	68.0	122	145	334
106.60	274	75.0	138	283	425

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.88 cfs @ 12.09 hrs HW=106.17' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.88 cfs @ 1.04 fps)

Pond 1PA: Sediment Foreday



Summary for Pond 1PB: Infiltration Basin

Inflow Area = 0.353 ac, 87.36% Impervious, Inflow Depth > 1.98" for 2-Year event
Inflow = 0.91 cfs @ 12.09 hrs, Volume= 0.058 af
Outflow = 0.35 cfs @ 12.33 hrs, Volume= 0.045 af, Atten= 62%, Lag= 14.8 min
Discarded = 0.06 cfs @ 12.33 hrs, Volume= 0.037 af
Primary = 0.29 cfs @ 12.33 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 106.32' @ 12.33 hrs Surf.Area= 651 sf Storage= 1,143 cf

Plug-Flow detention time= 165.7 min calculated for 0.045 af (77% of inflow)
Center-of-Mass det. time= 110.4 min (895.3 - 784.9)

Volume	Invert	Avail.Storage	Storage Description
#1	103.00'	1,335 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

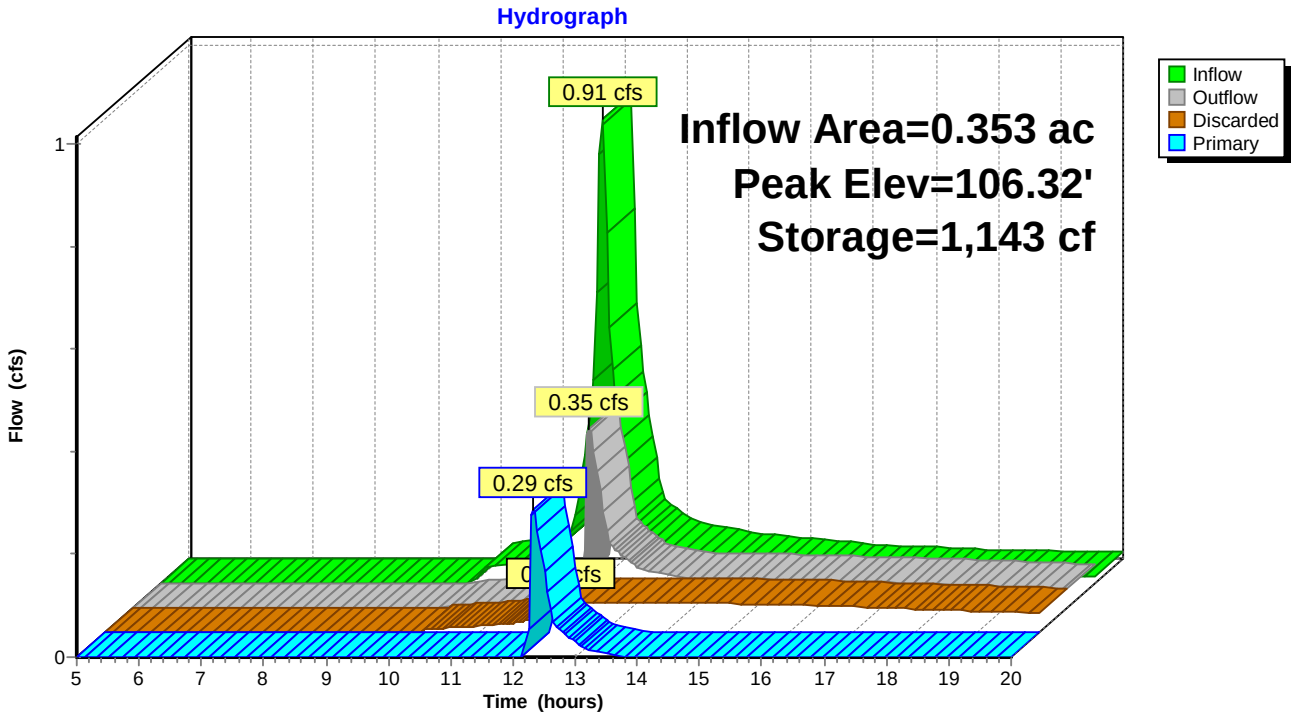
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
103.00	103	54.0	0	0	103
104.00	227	71.0	161	161	283
105.00	387	89.0	303	464	526
106.00	583	105.0	482	946	791
106.60	714	113.0	388	1,335	945

Device	Routing	Invert	Outlet Devices
#1	Device 2	106.25'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	105.05'	**12.0" Round Culvert** L= 169.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 105.05' / 104.20' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	103.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 101.00'

Discarded OutFlow Max=0.06 cfs @ 12.33 hrs HW=106.32' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=0.28 cfs @ 12.33 hrs HW=106.32' (Free Discharge)
↑—**2=Culvert** (Passes 0.28 cfs of 2.62 cfs potential flow)
↑—**1=Orifice/Grate** (Weir Controls 0.28 cfs @ 0.86 fps)

Pond 1PB: Infiltration Basin

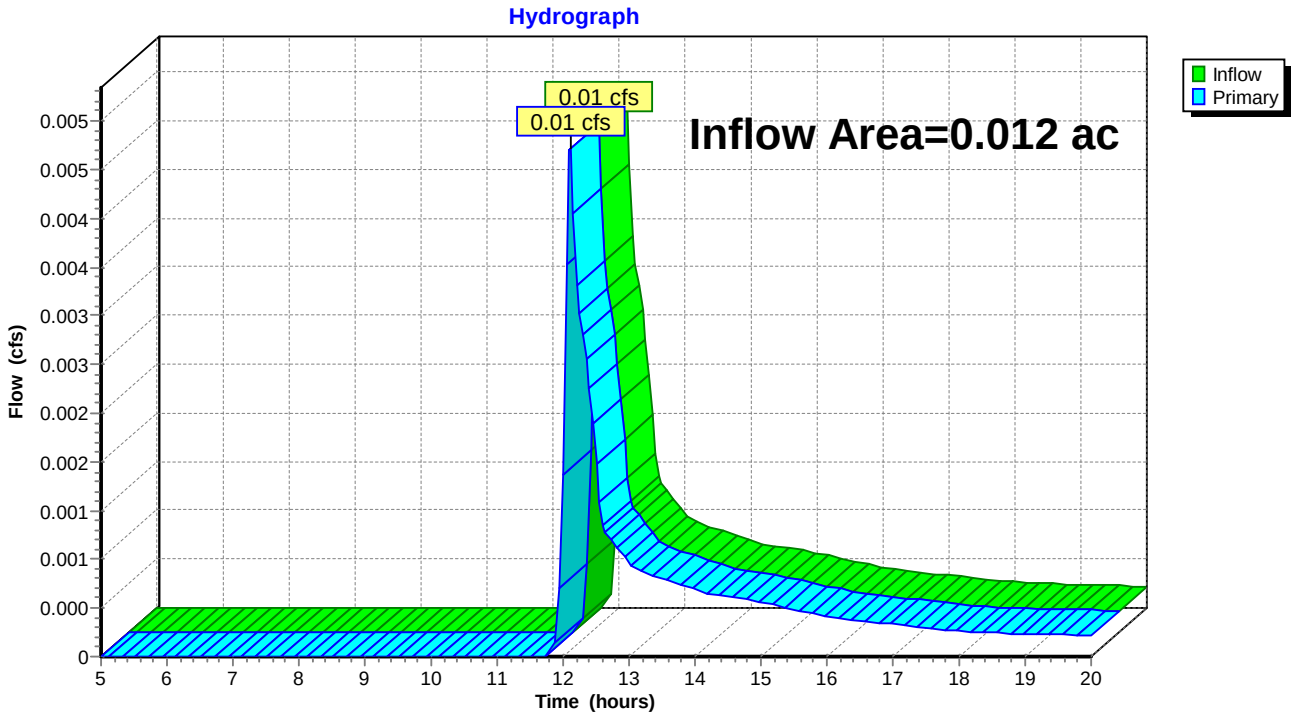


Summary for Link 1L.: Direct Runon to Beacon Street

Inflow Area = 0.012 ac, 40.60% Impervious, Inflow Depth > 0.44" for 2-Year event
Inflow = 0.01 cfs @ 12.11 hrs, Volume= 0.000 af
Primary = 0.01 cfs @ 12.11 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L.: Direct Runon to Beacon Street

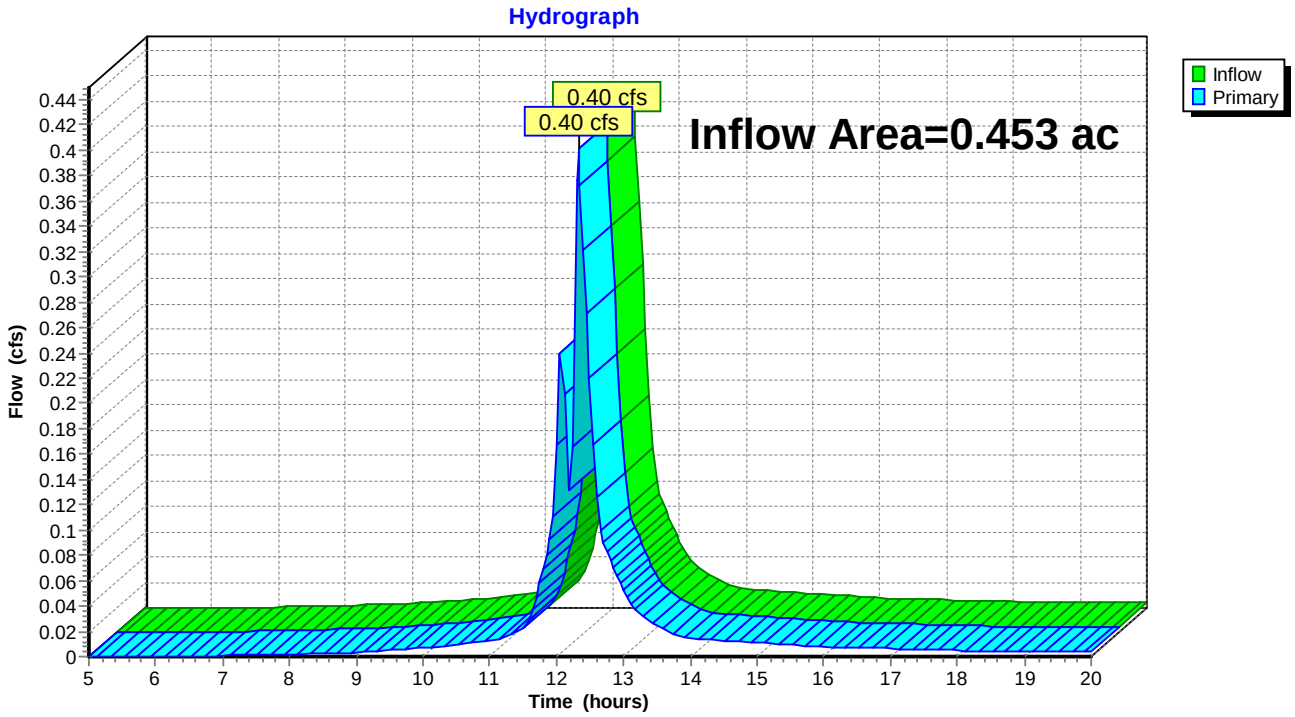


Summary for Link 2L.: Manhole Adjacent to Property

Inflow Area = 0.453 ac, 87.25% Impervious, Inflow Depth > 0.66" for 2-Year event
Inflow = 0.40 cfs @ 12.32 hrs, Volume= 0.025 af
Primary = 0.40 cfs @ 12.32 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L.: Manhole Adjacent to Property



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S.: Runoff Area=15,374 sf 87.36% Impervious Runoff Depth>3.55"
Tc=5.0 min CN=91 Runoff=1.50 cfs 0.105 af

Subcatchment 1SA: Runoff Area=4,349 sf 86.87% Impervious Runoff Depth>3.45"
Tc=5.0 min CN=90 Runoff=0.42 cfs 0.029 af

Subcatchment 2S.: Runoff Area=537 sf 40.60% Impervious Runoff Depth>1.24"
Tc=5.0 min CN=63 Runoff=0.02 cfs 0.001 af

Pond 1PA: Sediment Foreday Peak Elev=106.24' Storage=194 cf Inflow=1.50 cfs 0.105 af
Outflow=1.50 cfs 0.101 af

Pond 1PB: Infiltration Basin Peak Elev=106.45' Storage=1,232 cf Inflow=1.50 cfs 0.101 af
Discarded=0.06 cfs 0.043 af Primary=1.41 cfs 0.041 af Outflow=1.48 cfs 0.084 af

Link 1L.: Direct Runon to Beacon Street Inflow=0.02 cfs 0.001 af
Primary=0.02 cfs 0.001 af

Link 2L.: Manhole Adjacent to Property Inflow=1.81 cfs 0.070 af
Primary=1.81 cfs 0.070 af

Total Runoff Area = 0.465 ac Runoff Volume = 0.135 af Average Runoff Depth = 3.47"
13.99% Pervious = 0.065 ac 86.01% Impervious = 0.400 ac

Summary for Subcatchment 1S.:

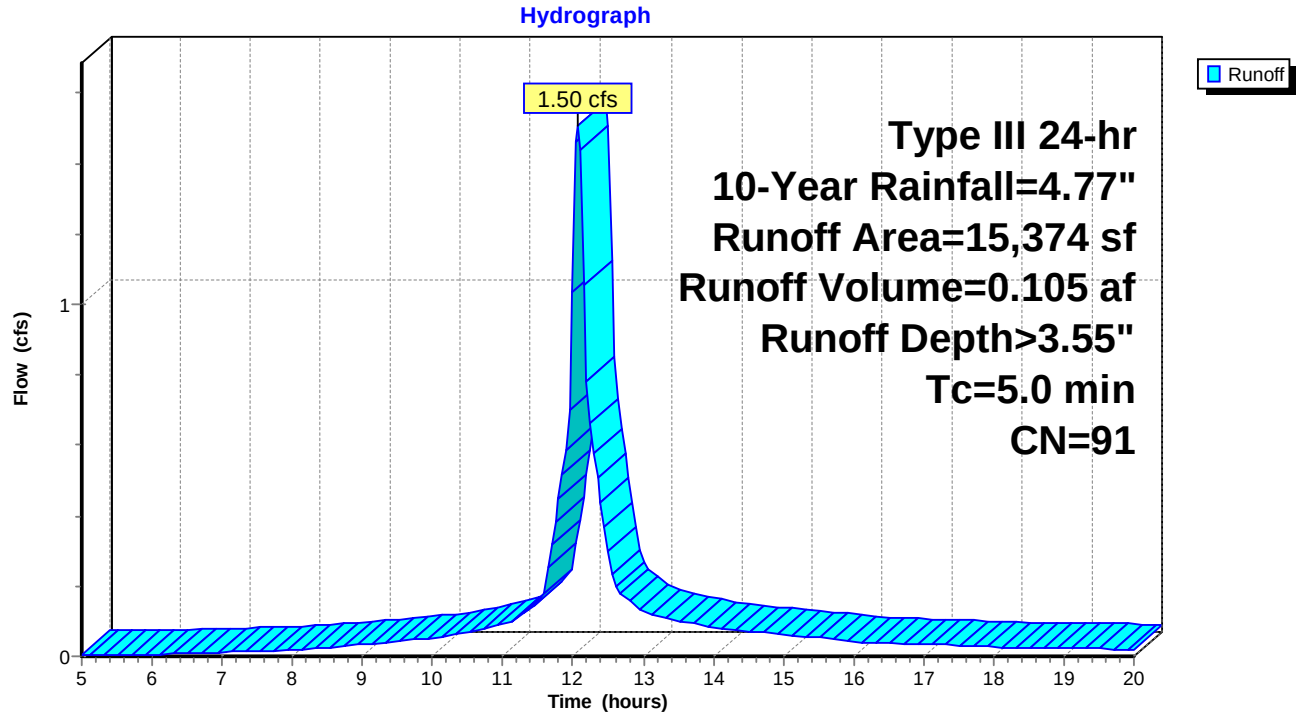
Runoff = 1.50 cfs @ 12.07 hrs, Volume= 0.105 af, Depth> 3.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
1,944	39	>75% Grass cover, Good, HSG A
4,331	98	Unconnected roofs, HSG A
8,079	98	Paved parking, HSG A
1,020	98	Water Surface, HSG A
15,374	91	Weighted Average
1,944		12.64% Pervious Area
13,430		87.36% Impervious Area
4,331		32.25% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1S.:



Summary for Subcatchment 1SA:

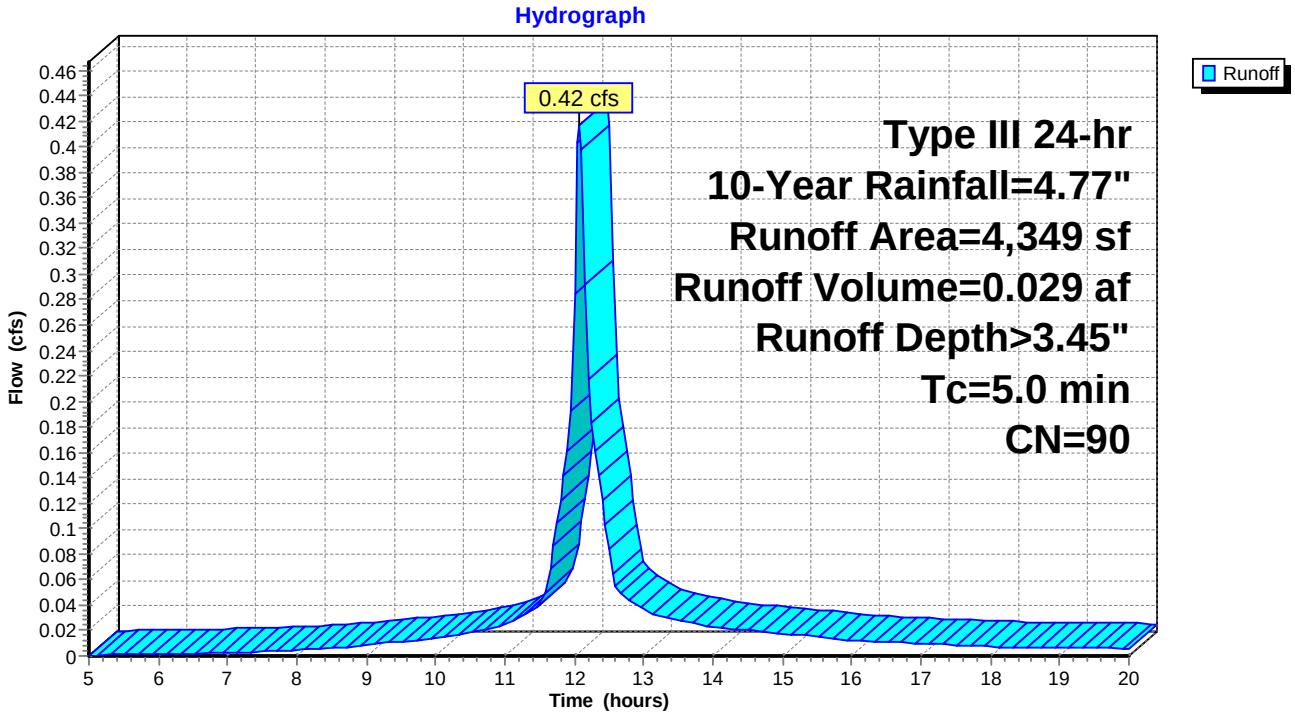
Runoff = 0.42 cfs @ 12.07 hrs, Volume= 0.029 af, Depth> 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
571	39	>75% Grass cover, Good, HSG A
457	98	Unconnected roofs, HSG A
3,321	98	Paved parking, HSG A
4,349	90	Weighted Average
571		13.13% Pervious Area
3,778		86.87% Impervious Area
457		12.10% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1SA:



Summary for Subcatchment 2S.:

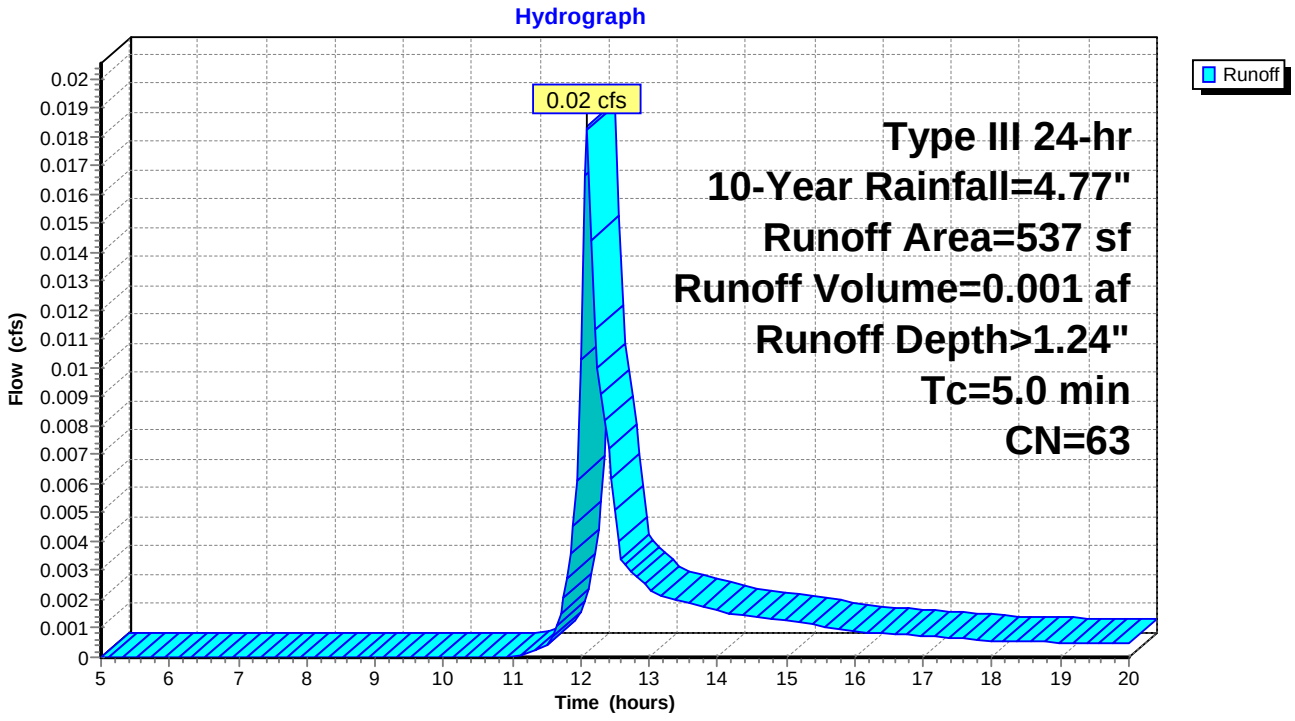
Runoff = 0.02 cfs @ 12.09 hrs, Volume= 0.001 af, Depth> 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
319	39	>75% Grass cover, Good, HSG A
218	98	Paved parking, HSG A
537	63	Weighted Average
319		59.40% Pervious Area
218		40.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 2S.:



Summary for Pond 1PA: Sediment Foreday

Inflow Area = 0.353 ac, 87.36% Impervious, Inflow Depth > 3.55" for 10-Year event
Inflow = 1.50 cfs @ 12.07 hrs, Volume= 0.105 af
Outflow = 1.50 cfs @ 12.08 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.6 min
Primary = 1.50 cfs @ 12.08 hrs, Volume= 0.101 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 106.24' @ 12.08 hrs Surf.Area= 221 sf Storage= 194 cf

Plug-Flow detention time= 24.2 min calculated for 0.101 af (96% of inflow)
Center-of-Mass det. time= 11.3 min (769.5 - 758.2)

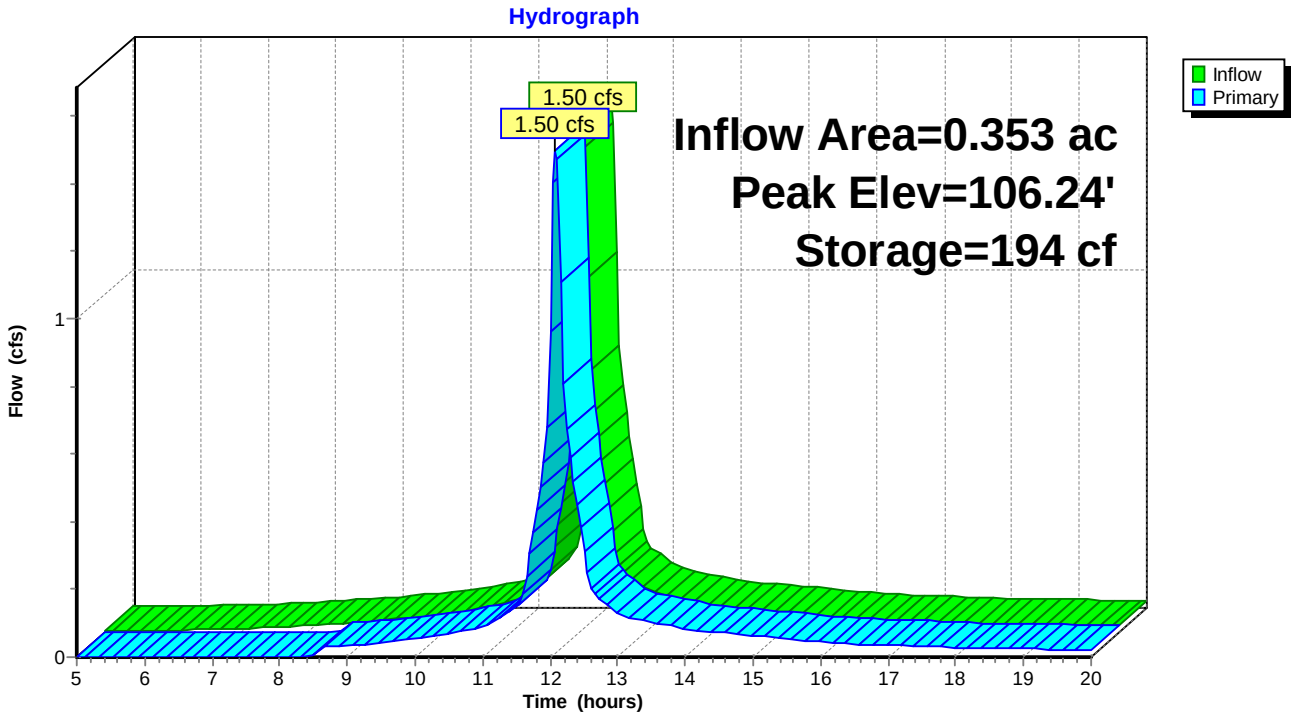
Volume	Invert	Avail.Storage	Storage Description
#1	104.50'	283 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
104.50	28	30.0	0	0	28
105.00	66	46.0	23	23	127
106.00	189	68.0	122	145	334
106.60	274	75.0	138	283	425

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=1.45 cfs @ 12.08 hrs HW=106.23' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.45 cfs @ 1.23 fps)

Pond 1PA: Sediment Foreday



Summary for Pond 1PB: Infiltration Basin

Inflow Area = 0.353 ac, 87.36% Impervious, Inflow Depth > 3.44" for 10-Year event
Inflow = 1.50 cfs @ 12.08 hrs, Volume= 0.101 af
Outflow = 1.48 cfs @ 12.10 hrs, Volume= 0.084 af, Atten= 1%, Lag= 1.3 min
Discarded = 0.06 cfs @ 12.10 hrs, Volume= 0.043 af
Primary = 1.41 cfs @ 12.10 hrs, Volume= 0.041 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 106.45' @ 12.10 hrs Surf.Area= 681 sf Storage= 1,232 cf

Plug-Flow detention time= 106.3 min calculated for 0.084 af (83% of inflow)
Center-of-Mass det. time= 59.9 min (829.4 - 769.5)

Volume	Invert	Avail.Storage	Storage Description
#1	103.00'	1,335 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

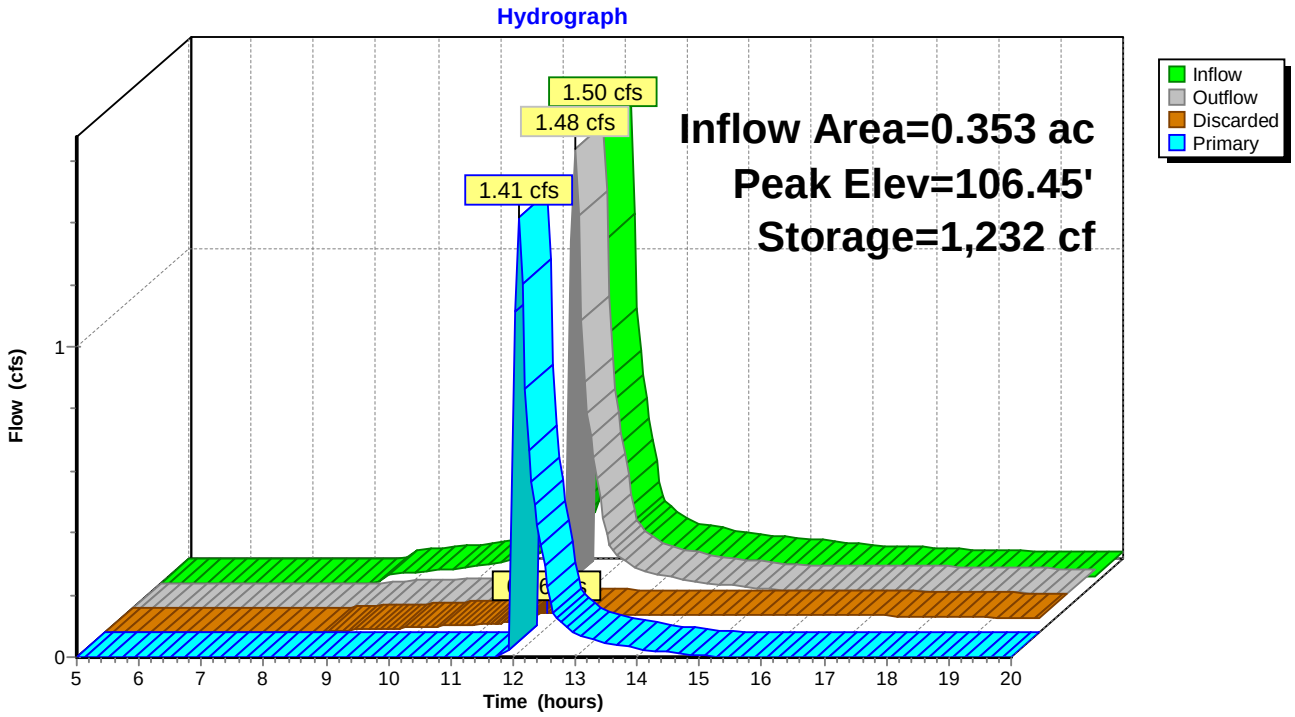
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
103.00	103	54.0	0	0	103
104.00	227	71.0	161	161	283
105.00	387	89.0	303	464	526
106.00	583	105.0	482	946	791
106.60	714	113.0	388	1,335	945

Device	Routing	Invert	Outlet Devices
#1	Device 2	106.25'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	105.05'	**12.0" Round Culvert** L= 169.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 105.05' / 104.20' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	103.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 101.00'

Discarded OutFlow Max=0.06 cfs @ 12.10 hrs HW=106.45' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=1.39 cfs @ 12.10 hrs HW=106.45' (Free Discharge)
↑—**2=Culvert** (Passes 1.39 cfs of 2.63 cfs potential flow)
↑—**1=Orifice/Grate** (Weir Controls 1.39 cfs @ 1.47 fps)

Pond 1PB: Infiltration Basin

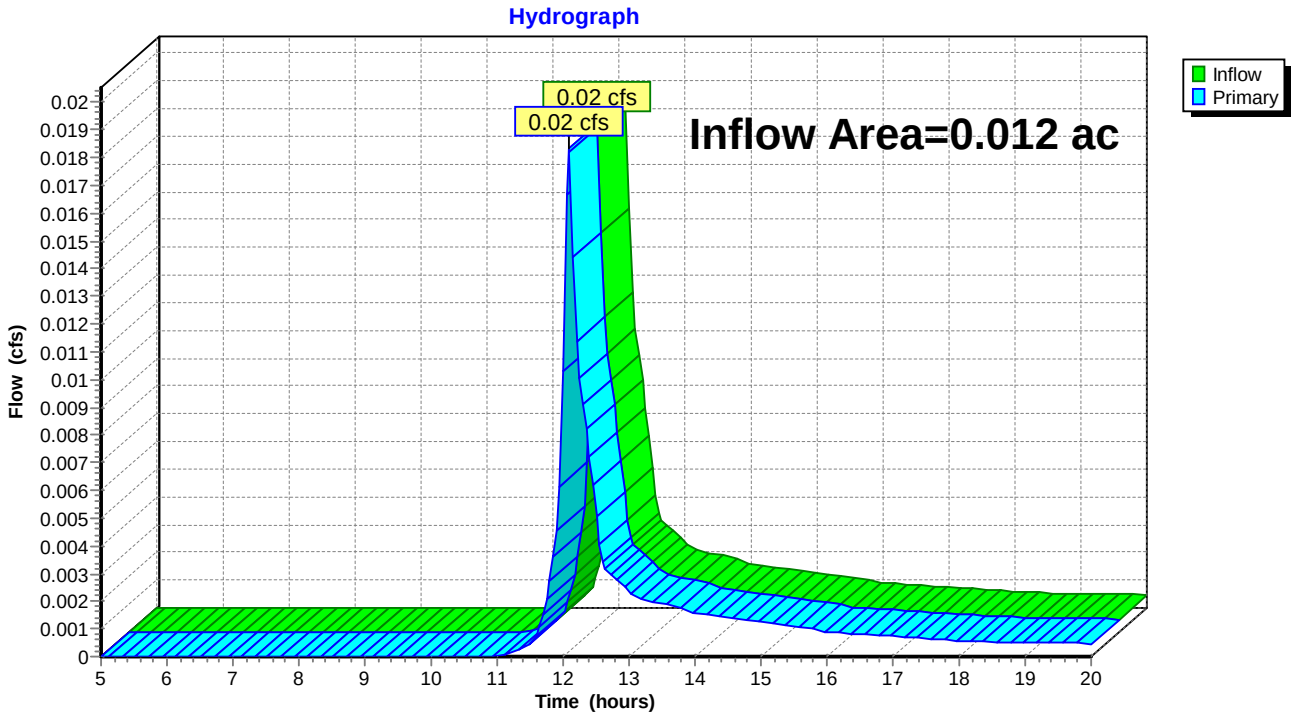


Summary for Link 1L.: Direct Runon to Beacon Street

Inflow Area = 0.012 ac, 40.60% Impervious, Inflow Depth > 1.24" for 10-Year event
Inflow = 0.02 cfs @ 12.09 hrs, Volume= 0.001 af
Primary = 0.02 cfs @ 12.09 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L.: Direct Runon to Beacon Street

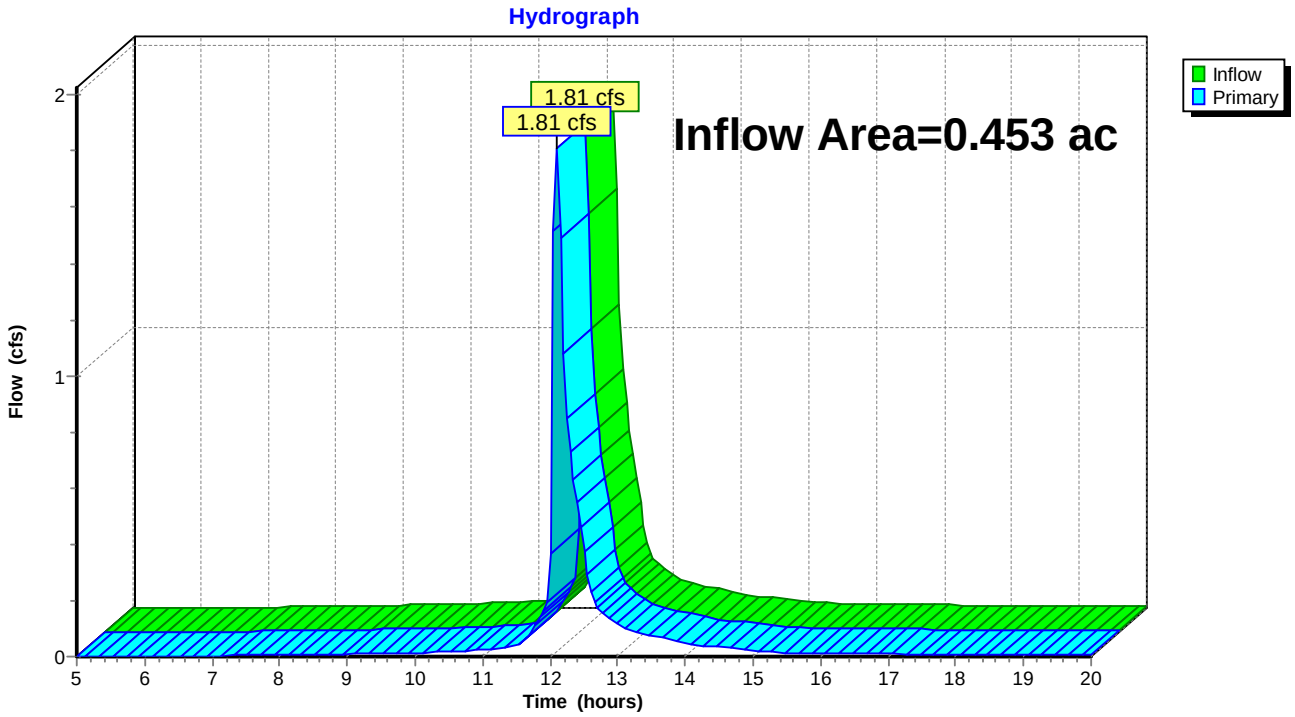


Summary for Link 2L.: Manhole Adjacent to Property

Inflow Area = 0.453 ac, 87.25% Impervious, Inflow Depth > 1.85" for 10-Year event
Inflow = 1.81 cfs @ 12.10 hrs, Volume= 0.070 af
Primary = 1.81 cfs @ 12.10 hrs, Volume= 0.070 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L.: Manhole Adjacent to Property



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S.: Runoff Area=15,374 sf 87.36% Impervious Runoff Depth>4.71"
Tc=5.0 min CN=91 Runoff=1.96 cfs 0.139 af

Subcatchment 1SA: Runoff Area=4,349 sf 86.87% Impervious Runoff Depth>4.61"
Tc=5.0 min CN=90 Runoff=0.55 cfs 0.038 af

Subcatchment 2S.: Runoff Area=537 sf 40.60% Impervious Runoff Depth>2.01"
Tc=5.0 min CN=63 Runoff=0.03 cfs 0.002 af

Pond 1PA: Sediment Foreday Peak Elev=106.28' Storage=204 cf Inflow=1.96 cfs 0.139 af
Outflow=1.95 cfs 0.135 af

Pond 1PB: Infiltration Basin Peak Elev=106.49' Storage=1,260 cf Inflow=1.95 cfs 0.135 af
Discarded=0.06 cfs 0.047 af Primary=1.86 cfs 0.069 af Outflow=1.92 cfs 0.116 af

Link 1L.: Direct Runon to Beacon Street Inflow=0.03 cfs 0.002 af
Primary=0.03 cfs 0.002 af

Link 2L.: Manhole Adjacent to Property Inflow=2.39 cfs 0.107 af
Primary=2.39 cfs 0.107 af

Total Runoff Area = 0.465 ac Runoff Volume = 0.179 af Average Runoff Depth = 4.62"
13.99% Pervious = 0.065 ac 86.01% Impervious = 0.400 ac

Summary for Subcatchment 1S.:

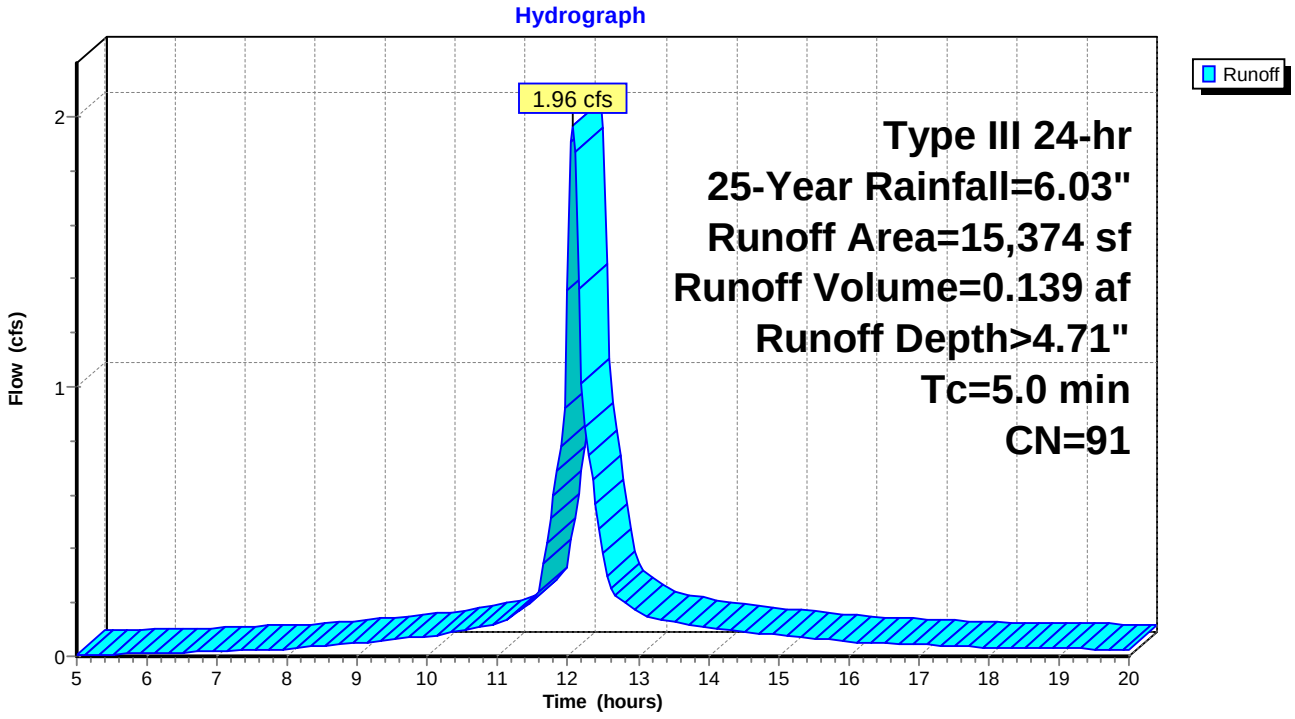
Runoff = 1.96 cfs @ 12.07 hrs, Volume= 0.139 af, Depth> 4.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
1,944	39	>75% Grass cover, Good, HSG A
4,331	98	Unconnected roofs, HSG A
8,079	98	Paved parking, HSG A
1,020	98	Water Surface, HSG A
15,374	91	Weighted Average
1,944		12.64% Pervious Area
13,430		87.36% Impervious Area
4,331		32.25% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1S.:



Summary for Subcatchment 1SA:

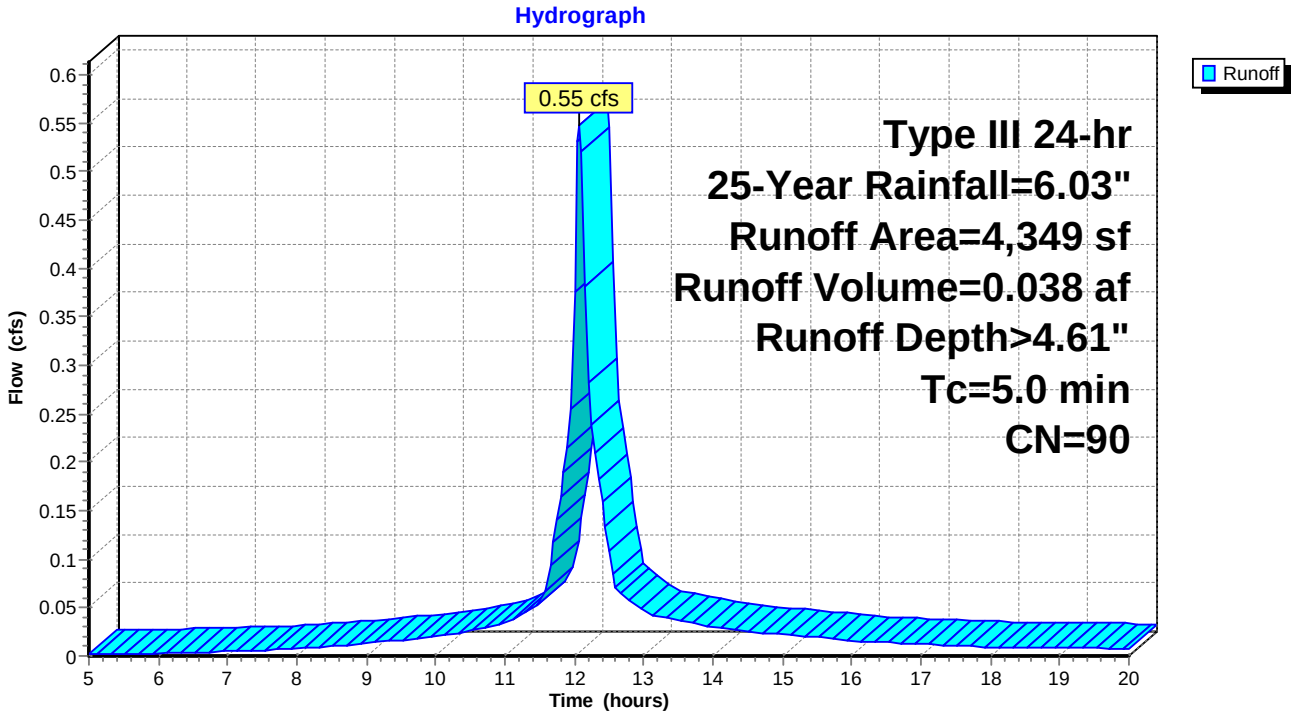
Runoff = 0.55 cfs @ 12.07 hrs, Volume= 0.038 af, Depth> 4.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
571	39	>75% Grass cover, Good, HSG A
457	98	Unconnected roofs, HSG A
3,321	98	Paved parking, HSG A
4,349	90	Weighted Average
571		13.13% Pervious Area
3,778		86.87% Impervious Area
457		12.10% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1SA:



Summary for Subcatchment 2S.:

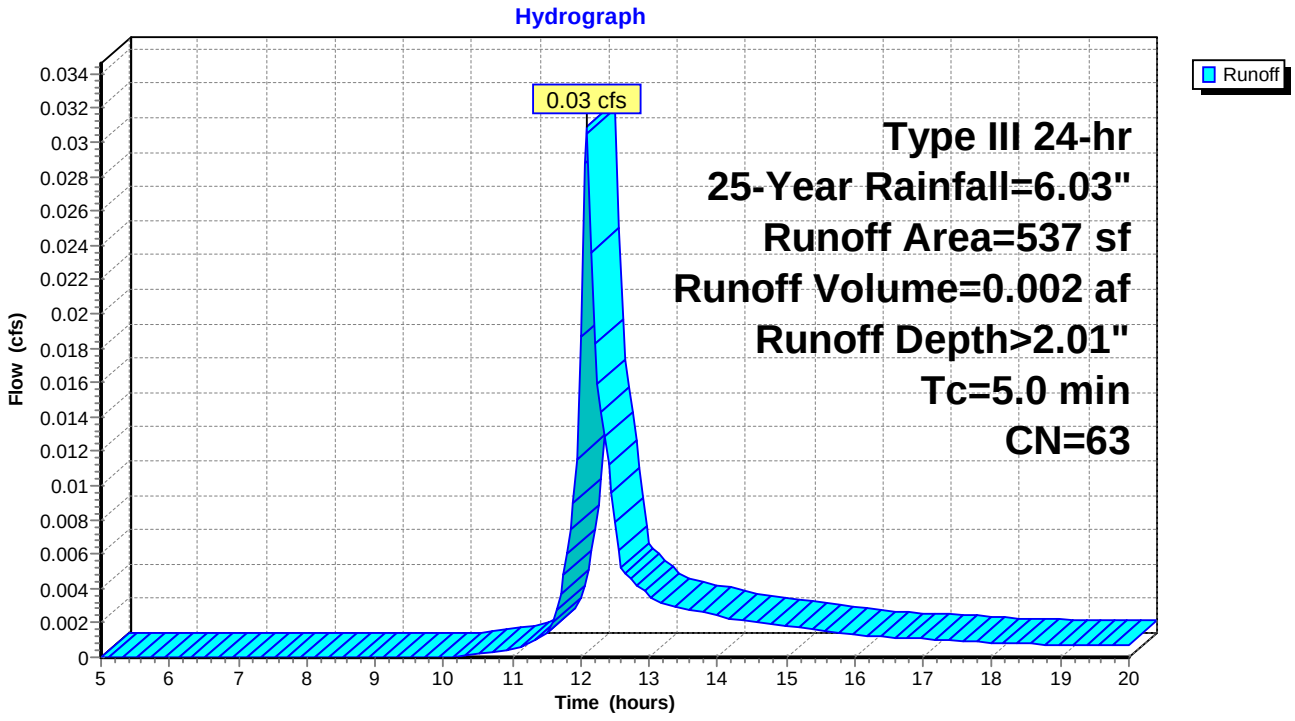
Runoff = 0.03 cfs @ 12.08 hrs, Volume= 0.002 af, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
319	39	>75% Grass cover, Good, HSG A
218	98	Paved parking, HSG A
537	63	Weighted Average
319		59.40% Pervious Area
218		40.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 2S.:



Summary for Pond 1PA: Sediment Foreday

Inflow Area = 0.353 ac, 87.36% Impervious, Inflow Depth > 4.71" for 25-Year event
Inflow = 1.96 cfs @ 12.07 hrs, Volume= 0.139 af
Outflow = 1.95 cfs @ 12.08 hrs, Volume= 0.135 af, Atten= 1%, Lag= 0.6 min
Primary = 1.95 cfs @ 12.08 hrs, Volume= 0.135 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 106.28' @ 12.08 hrs Surf.Area= 227 sf Storage= 204 cf

Plug-Flow detention time= 19.6 min calculated for 0.135 af (97% of inflow)
Center-of-Mass det. time= 9.5 min (762.0 - 752.5)

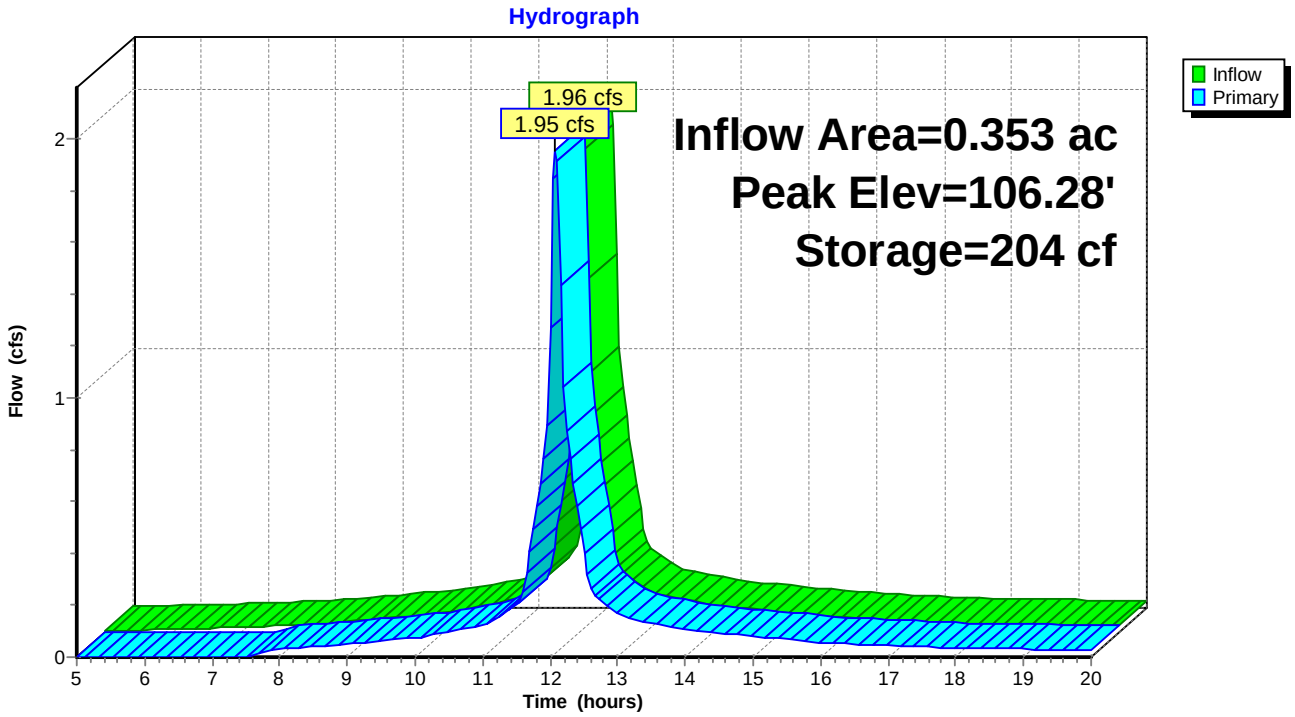
Volume	Invert	Avail.Storage	Storage Description
#1	104.50'	283 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
104.50	28	30.0	0	0	28
105.00	66	46.0	23	23	127
106.00	189	68.0	122	145	334
106.60	274	75.0	138	283	425

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=1.89 cfs @ 12.08 hrs HW=106.28' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.89 cfs @ 1.35 fps)

Pond 1PA: Sediment Foreday



Summary for Pond 1PB: Infiltration Basin

Inflow Area = 0.353 ac, 87.36% Impervious, Inflow Depth > 4.60" for 25-Year event
Inflow = 1.95 cfs @ 12.08 hrs, Volume= 0.135 af
Outflow = 1.92 cfs @ 12.10 hrs, Volume= 0.116 af, Atten= 1%, Lag= 1.1 min
Discarded = 0.06 cfs @ 12.10 hrs, Volume= 0.047 af
Primary = 1.86 cfs @ 12.10 hrs, Volume= 0.069 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 106.49' @ 12.10 hrs Surf.Area= 690 sf Storage= 1,260 cf

Plug-Flow detention time= 86.4 min calculated for 0.115 af (85% of inflow)
Center-of-Mass det. time= 44.5 min (806.5 - 762.0)

Volume	Invert	Avail.Storage	Storage Description
#1	103.00'	1,335 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

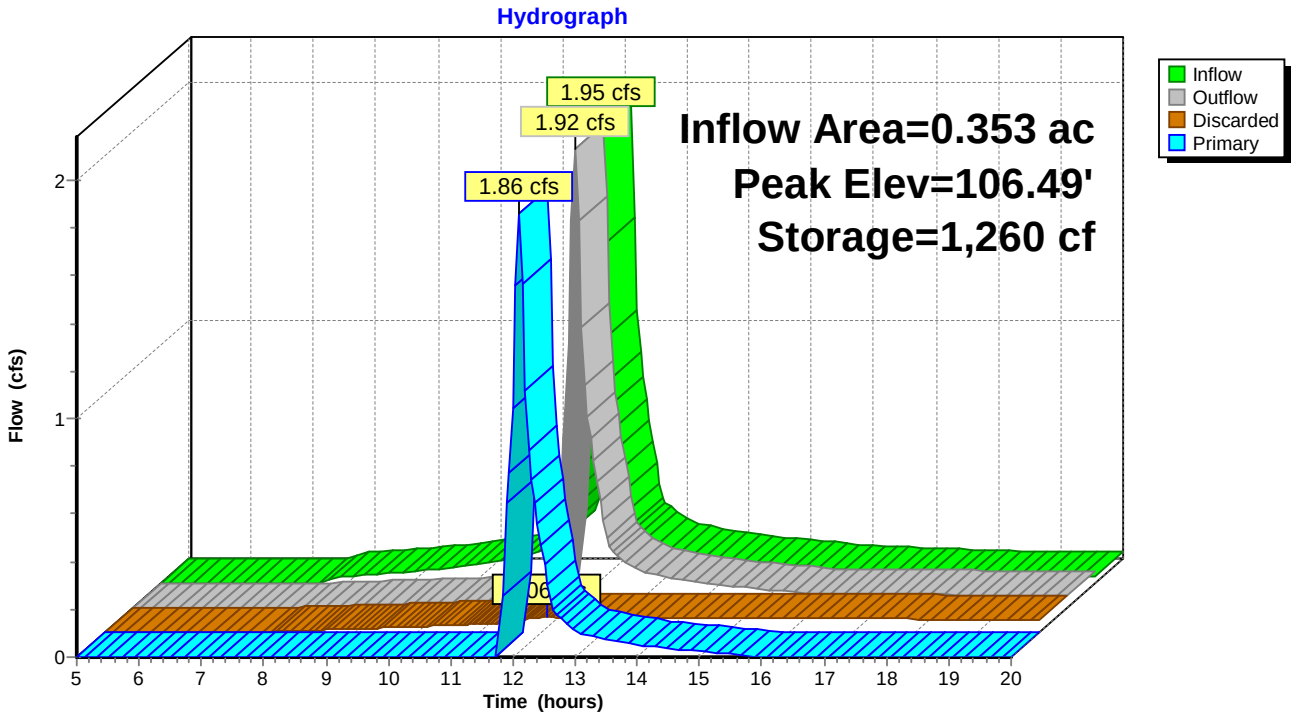
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
103.00	103	54.0	0	0	103
104.00	227	71.0	161	161	283
105.00	387	89.0	303	464	526
106.00	583	105.0	482	946	791
106.60	714	113.0	388	1,335	945

Device	Routing	Invert	Outlet Devices
#1	Device 2	106.25'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	105.05'	**12.0" Round Culvert** L= 169.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 105.05' / 104.20' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	103.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 101.00'

Discarded OutFlow Max=0.06 cfs @ 12.10 hrs HW=106.49' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=1.86 cfs @ 12.10 hrs HW=106.49' (Free Discharge)
↑—**2=Culvert** (Passes 1.86 cfs of 2.67 cfs potential flow)
↑—**1=Orifice/Grate** (Weir Controls 1.86 cfs @ 1.62 fps)

Pond 1PB: Infiltration Basin

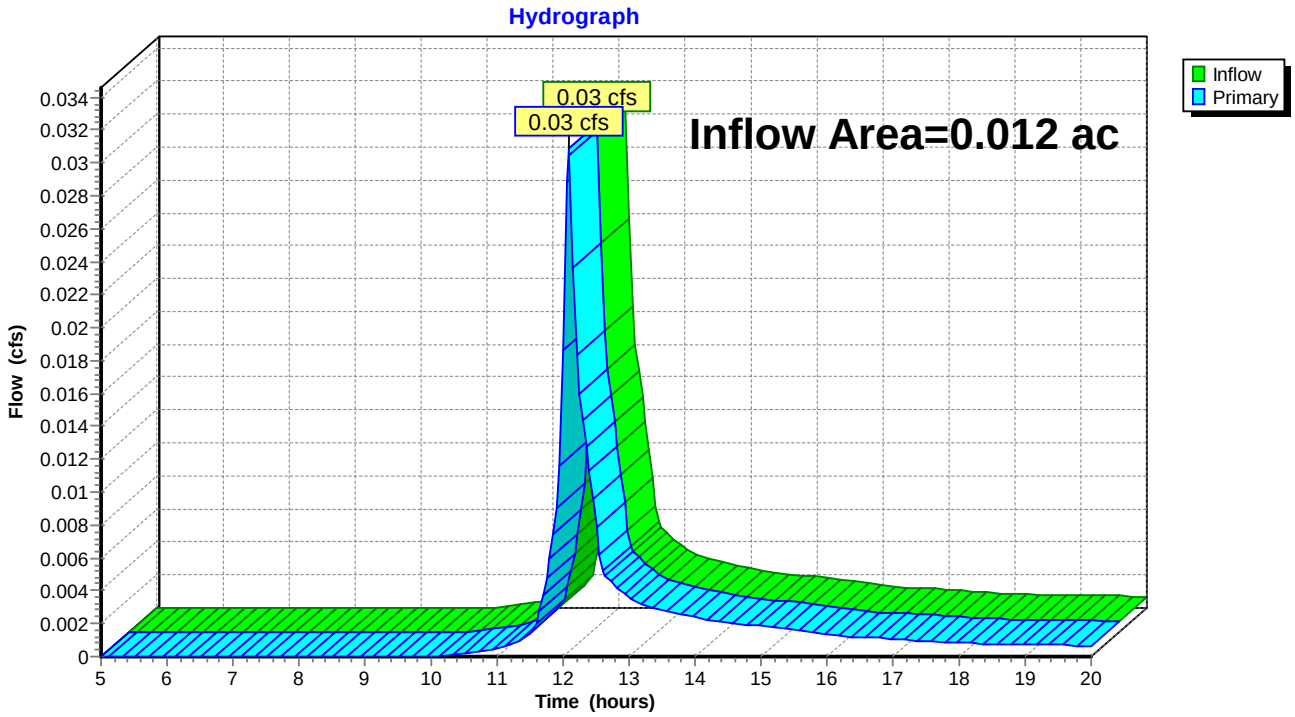


Summary for Link 1L.: Direct Runon to Beacon Street

Inflow Area = 0.012 ac, 40.60% Impervious, Inflow Depth > 2.01" for 25-Year event
Inflow = 0.03 cfs @ 12.08 hrs, Volume= 0.002 af
Primary = 0.03 cfs @ 12.08 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L.: Direct Runon to Beacon Street

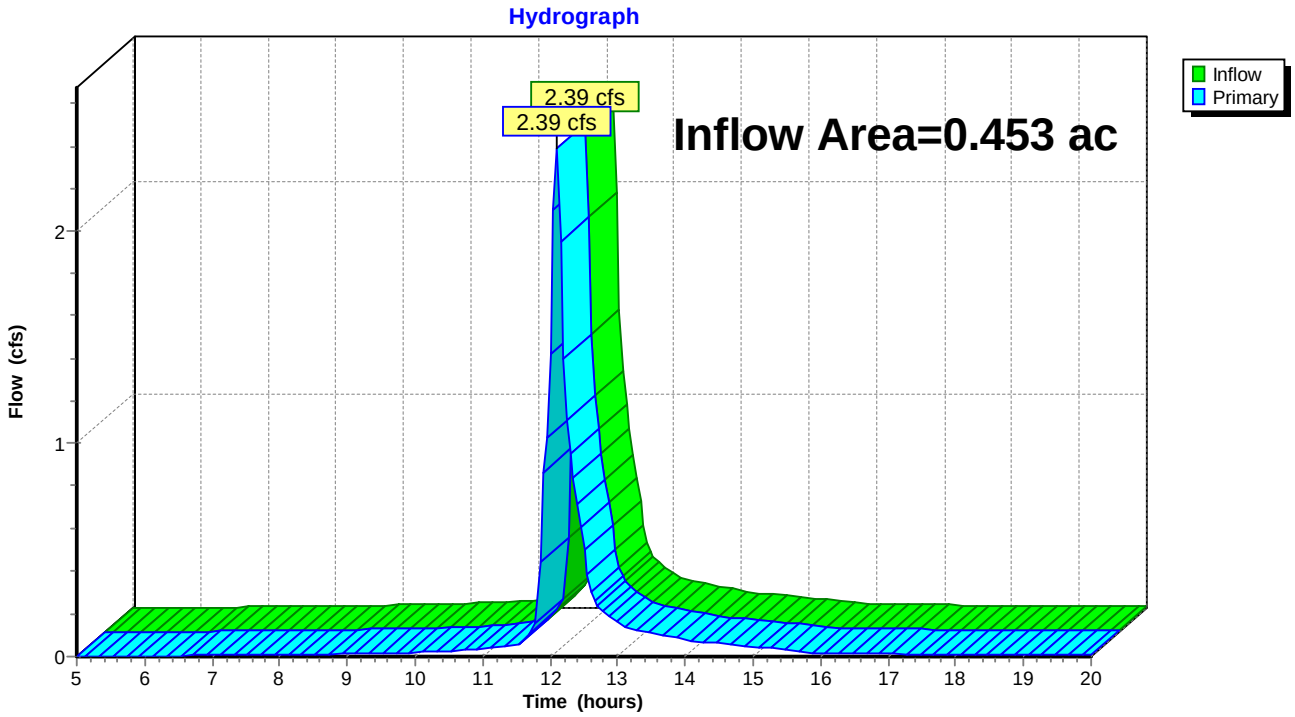


Summary for Link 2L.: Manhole Adjacent to Property

Inflow Area = 0.453 ac, 87.25% Impervious, Inflow Depth > 2.84" for 25-Year event
Inflow = 2.39 cfs @ 12.09 hrs, Volume= 0.107 af
Primary = 2.39 cfs @ 12.09 hrs, Volume= 0.107 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L.: Manhole Adjacent to Property



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S.: Runoff Area=15,374 sf 87.36% Impervious Runoff Depth>7.25"
Tc=5.0 min CN=91 Runoff=2.95 cfs 0.213 af

Subcatchment 1SA: Runoff Area=4,349 sf 86.87% Impervious Runoff Depth>7.15"
Tc=5.0 min CN=90 Runoff=0.83 cfs 0.059 af

Subcatchment 2S.: Runoff Area=537 sf 40.60% Impervious Runoff Depth>3.98"
Tc=5.0 min CN=63 Runoff=0.06 cfs 0.004 af

Pond 1PA: Sediment Foreday Peak Elev=106.37' Storage=224 cf Inflow=2.95 cfs 0.213 af
Outflow=2.94 cfs 0.210 af

Pond 1PB: Infiltration Basin Peak Elev=106.59' Storage=1,324 cf Inflow=2.94 cfs 0.210 af
Discarded=0.07 cfs 0.053 af Primary=2.75 cfs 0.133 af Outflow=2.82 cfs 0.187 af

Link 1L.: Direct Runon to Beacon Street Inflow=0.06 cfs 0.004 af
Primary=0.06 cfs 0.004 af

Link 2L.: Manhole Adjacent to Property Inflow=3.55 cfs 0.193 af
Primary=3.55 cfs 0.193 af

Total Runoff Area = 0.465 ac Runoff Volume = 0.277 af Average Runoff Depth = 7.14"
13.99% Pervious = 0.065 ac 86.01% Impervious = 0.400 ac

Summary for Subcatchment 1S.:

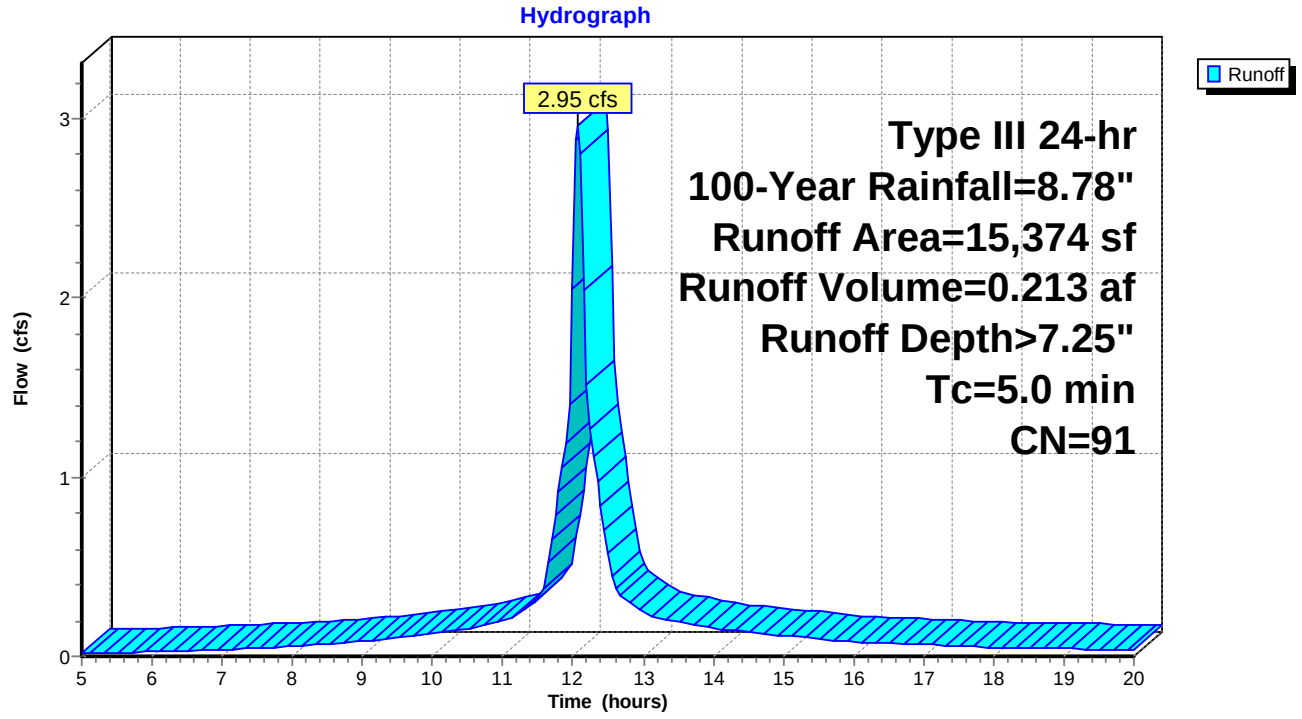
Runoff = 2.95 cfs @ 12.07 hrs, Volume= 0.213 af, Depth> 7.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
1,944	39	>75% Grass cover, Good, HSG A
4,331	98	Unconnected roofs, HSG A
8,079	98	Paved parking, HSG A
1,020	98	Water Surface, HSG A
15,374	91	Weighted Average
1,944		12.64% Pervious Area
13,430		87.36% Impervious Area
4,331		32.25% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1S.:



Summary for Subcatchment 1SA:

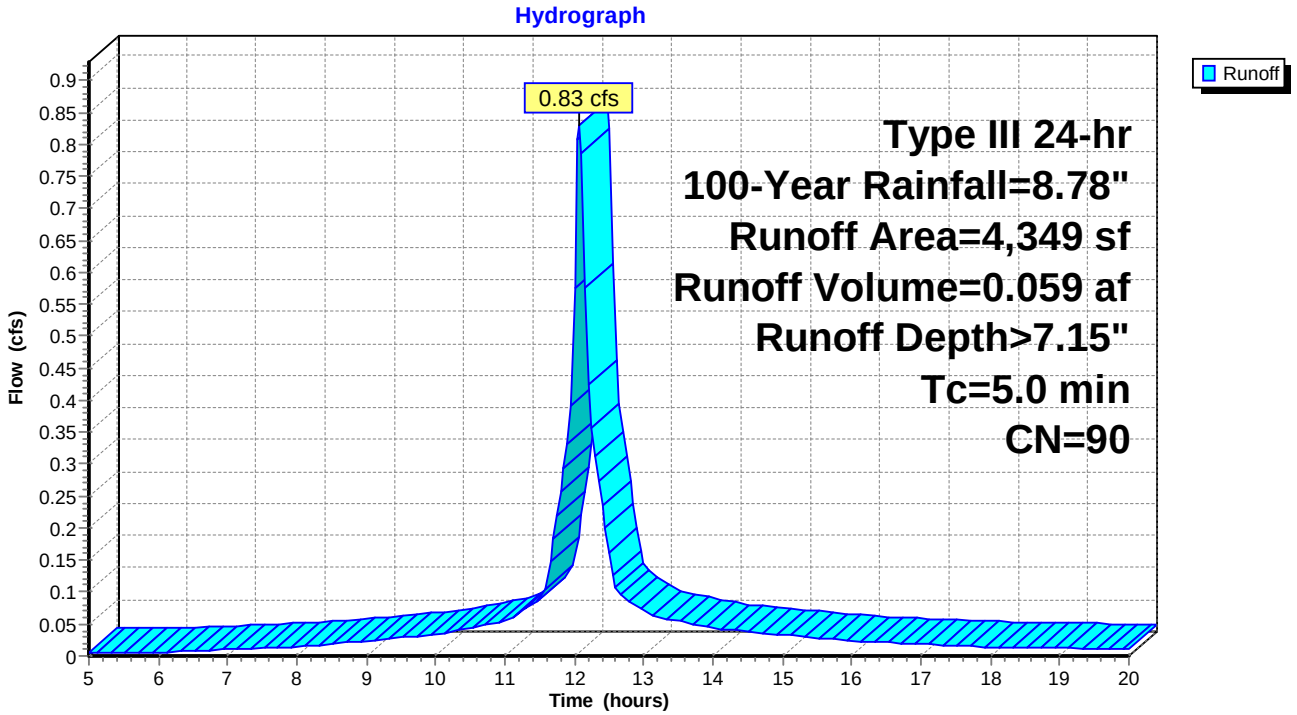
Runoff = 0.83 cfs @ 12.07 hrs, Volume= 0.059 af, Depth> 7.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
571	39	>75% Grass cover, Good, HSG A
457	98	Unconnected roofs, HSG A
3,321	98	Paved parking, HSG A
4,349	90	Weighted Average
571		13.13% Pervious Area
3,778		86.87% Impervious Area
457		12.10% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 1SA:



Summary for Subcatchment 2S.:

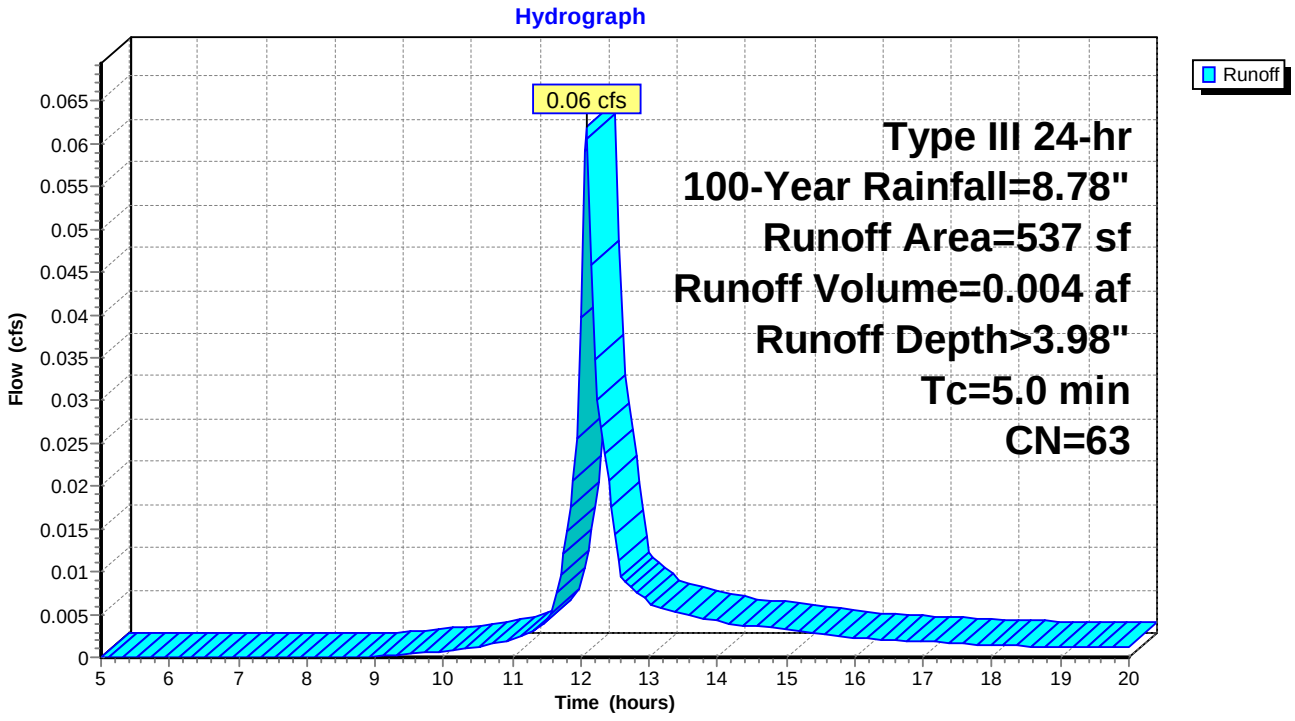
Runoff = 0.06 cfs @ 12.08 hrs, Volume= 0.004 af, Depth> 3.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
319	39	>75% Grass cover, Good, HSG A
218	98	Paved parking, HSG A
537	63	Weighted Average
319		59.40% Pervious Area
218		40.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, MINIMIM FOR SHORT TRAVEL TIMES**

Subcatchment 2S.:



Summary for Pond 1PA: Sediment Foreday

Inflow Area = 0.353 ac, 87.36% Impervious, Inflow Depth > 7.25" for 100-Year event
Inflow = 2.95 cfs @ 12.07 hrs, Volume= 0.213 af
Outflow = 2.94 cfs @ 12.08 hrs, Volume= 0.210 af, Atten= 1%, Lag= 0.5 min
Primary = 2.94 cfs @ 12.08 hrs, Volume= 0.210 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 106.37' @ 12.08 hrs Surf.Area= 240 sf Storage= 224 cf

Plug-Flow detention time= 13.9 min calculated for 0.209 af (98% of inflow)
Center-of-Mass det. time= 6.9 min (752.2 - 745.2)

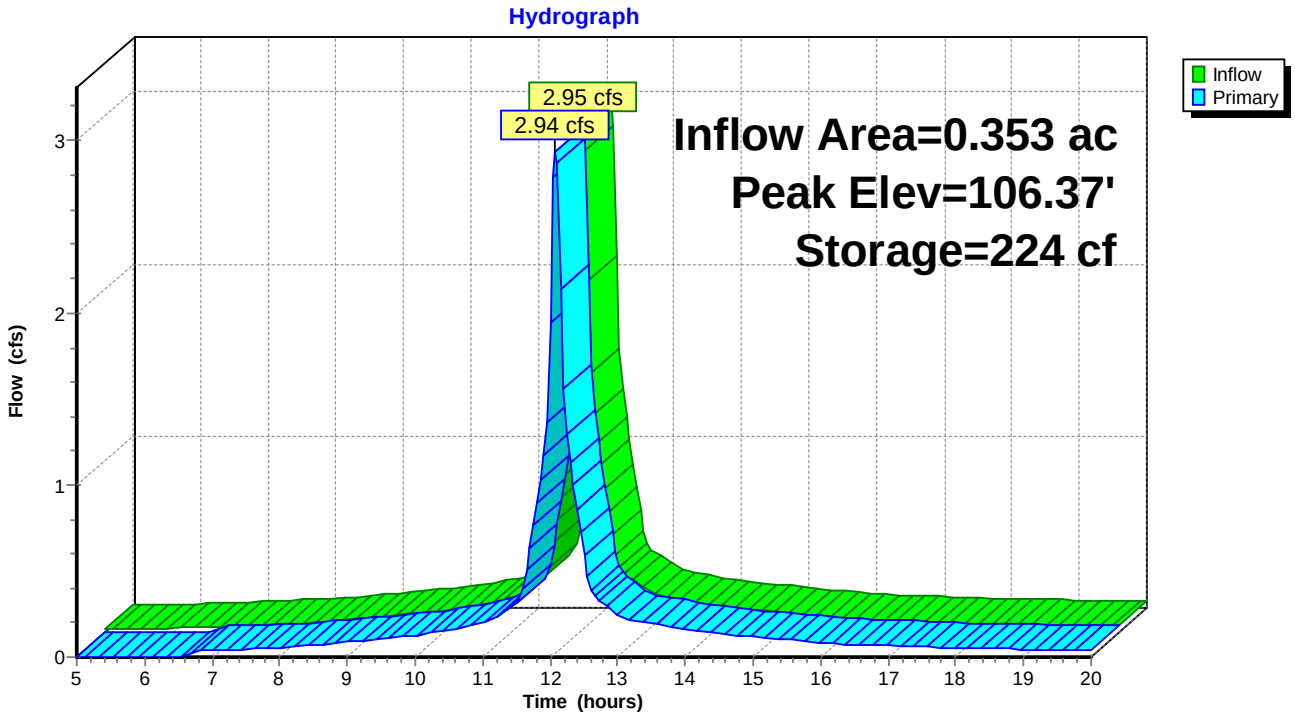
Volume	Invert	Avail.Storage	Storage Description
#1	104.50'	283 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
104.50	28	30.0	0	0	28
105.00	66	46.0	23	23	127
106.00	189	68.0	122	145	334
106.60	274	75.0	138	283	425

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=2.84 cfs @ 12.08 hrs HW=106.36' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 2.84 cfs @ 1.56 fps)

Pond 1PA: Sediment Foreday



Summary for Pond 1PB: Infiltration Basin

Inflow Area = 0.353 ac, 87.36% Impervious, Inflow Depth > 7.14" for 100-Year event
Inflow = 2.94 cfs @ 12.08 hrs, Volume= 0.210 af
Outflow = 2.82 cfs @ 12.10 hrs, Volume= 0.187 af, Atten= 4%, Lag= 1.3 min
Discarded = 0.07 cfs @ 12.10 hrs, Volume= 0.053 af
Primary = 2.75 cfs @ 12.10 hrs, Volume= 0.133 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 106.59' @ 12.10 hrs Surf.Area= 711 sf Storage= 1,324 cf

Plug-Flow detention time= 65.0 min calculated for 0.186 af (89% of inflow)
Center-of-Mass det. time= 30.0 min (782.1 - 752.2)

Volume	Invert	Avail.Storage	Storage Description
#1	103.00'	1,335 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

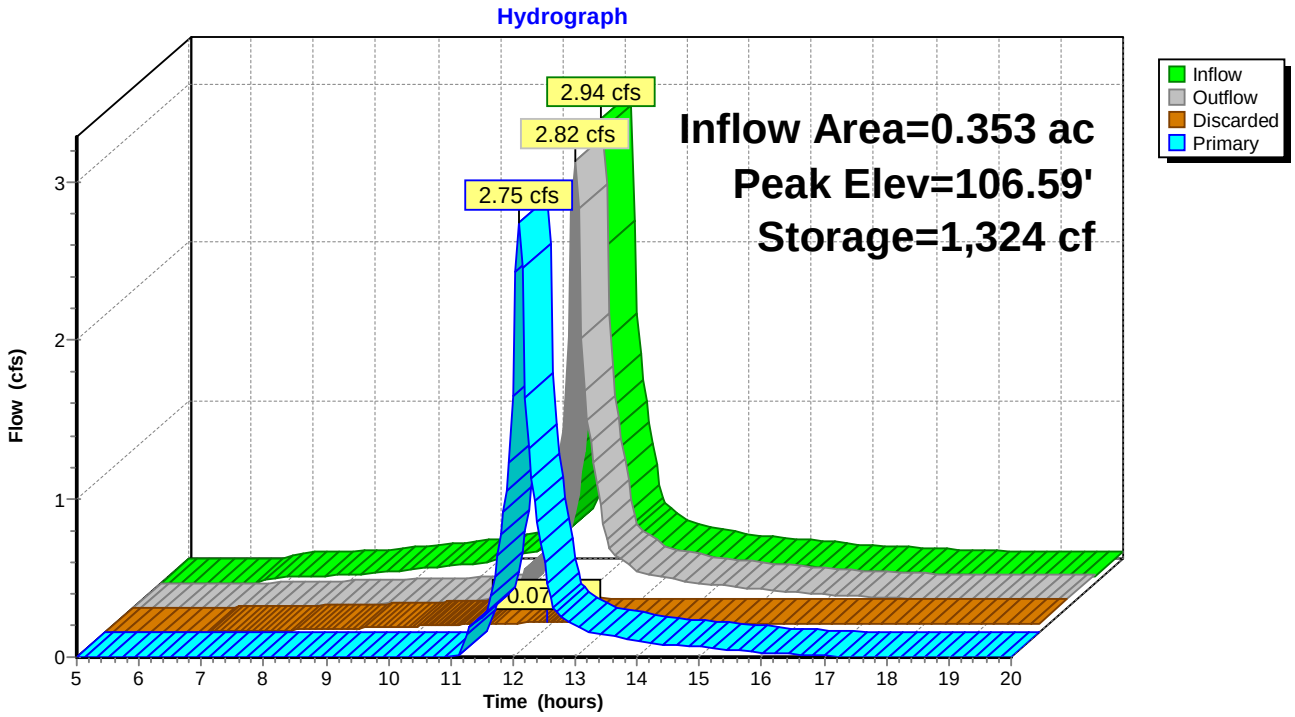
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
103.00	103	54.0	0	0	103
104.00	227	71.0	161	161	283
105.00	387	89.0	303	464	526
106.00	583	105.0	482	946	791
106.60	714	113.0	388	1,335	945

Device	Routing	Invert	Outlet Devices
#1	Device 2	106.25'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	105.05'	**12.0" Round Culvert** L= 169.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 105.05' / 104.20' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	103.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 101.00'

Discarded OutFlow Max=0.07 cfs @ 12.10 hrs HW=106.59' (Free Discharge)
↑**3=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=2.76 cfs @ 12.10 hrs HW=106.59' (Free Discharge)
↑**2=Culvert** (Barrel Controls 2.76 cfs @ 3.52 fps)
↑**1=Orifice/Grate** (Passes 2.76 cfs of 2.99 cfs potential flow)

Pond 1PB: Infiltration Basin

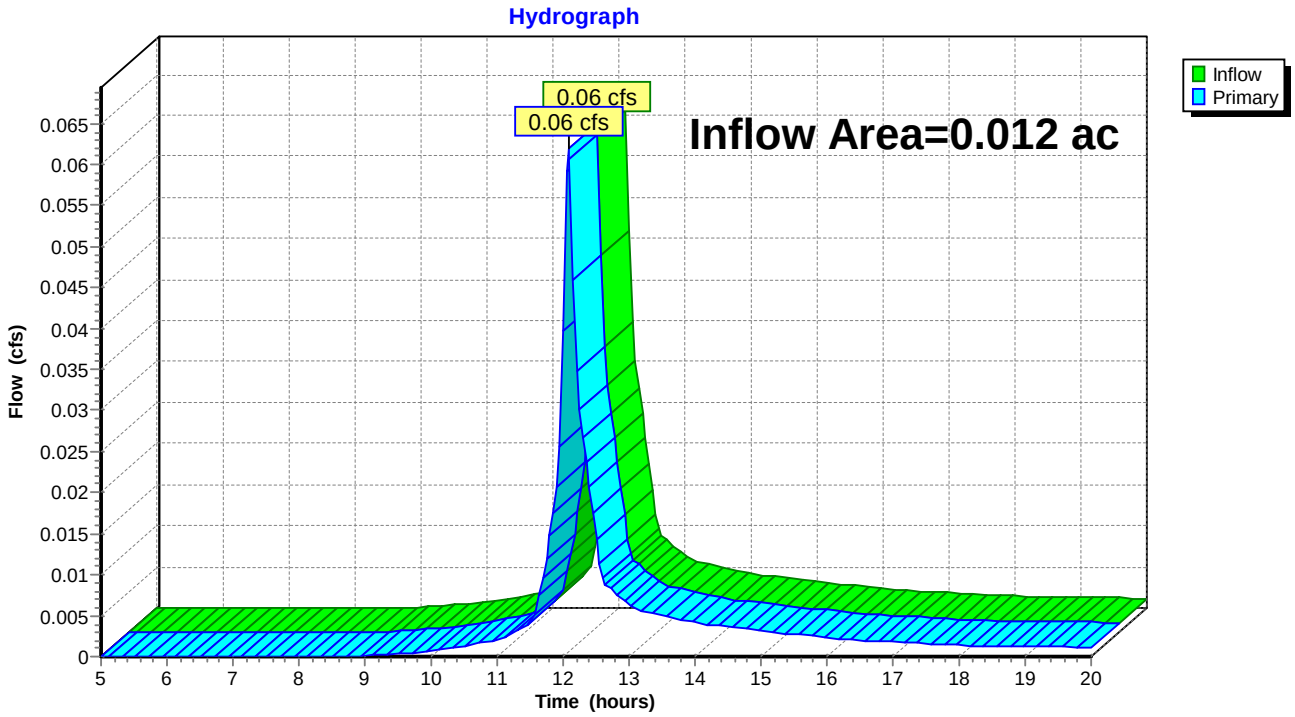


Summary for Link 1L.: Direct Runon to Beacon Street

Inflow Area = 0.012 ac, 40.60% Impervious, Inflow Depth > 3.98" for 100-Year event
Inflow = 0.06 cfs @ 12.08 hrs, Volume= 0.004 af
Primary = 0.06 cfs @ 12.08 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L.: Direct Runon to Beacon Street

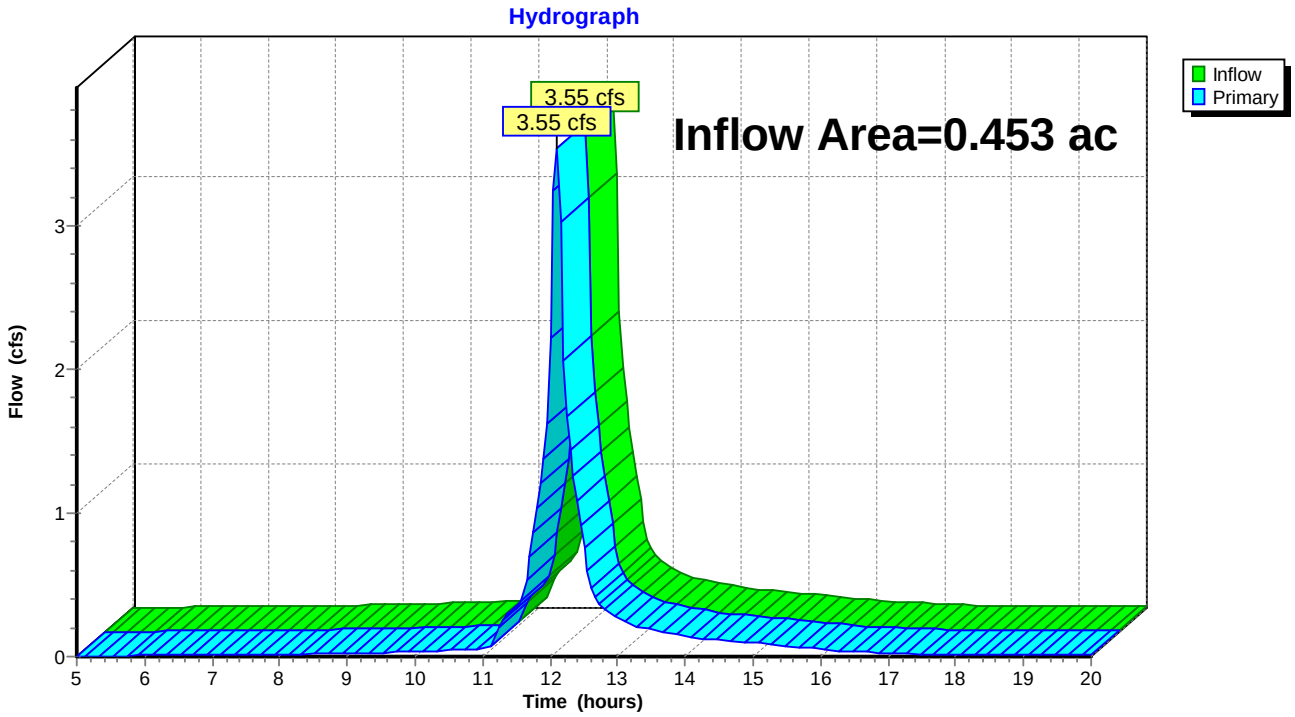


Summary for Link 2L.: Manhole Adjacent to Property

Inflow Area = 0.453 ac, 87.25% Impervious, Inflow Depth > 5.11" for 100-Year event
Inflow = 3.55 cfs @ 12.09 hrs, Volume= 0.193 af
Primary = 3.55 cfs @ 12.09 hrs, Volume= 0.193 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L.: Manhole Adjacent to Property



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Appendix D

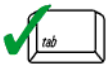
Stormwater Management Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

[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

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:

- [X] No disturbance to any Wetland Resource Areas
- [ ] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [X] 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
- [X] Other (describe): Infiltration Basin

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

Appendix F

BMP Sizing Calculations

Inifltration Basin and Sdiment Forebay

Objective: Size Best Management Practice (BMP) in accordance with Standards 3 and 4 of the MA Stormwater Handbook. BMP shall be sized to infiltrate the required recharge volume (Standard 3) and provide treatment for the required water quality volume (Standard 4).

1) Calculate Required Recharge Volume (Standard 3)

$Rv = (F/12)*(A_{IMP})$ 809 cf

F (target depth factor)	0.6	in (soil group A, Table 2.3.2 of MA Stormwater Handbook)
A_{IMP} (impervious area)	16,188	sf

2) Calculate Drawdown Time (Standard 3)

T_d=Storage Volume / (K*(1'/12")*Bottom Area)= 50 hours

Storage Volume	1,036	cf at lowest orifice elevation (from HydroCad)
K (sat. hydraulic conductivity)	2.41	in/hr (Rawls Rate for sandy loam, Table 2.3.3 of MA Stormwater Handbook)
Bottom Area	103	sf (from HydroCAD)

50 < 72 hrs

3) Calculate Water Quality Volume (WQv) (Standard 4)

$V_{WQ} =(D_{WQ}/ 12)*(A_{IMP})$= 675 cf

D_{WQ} (water quality depth)	0.5	in (1" for LUHPPL, Zone II, or critical area, 0.5" other)
A_{IMP} (impervious area)	16,188	sf (double contributing area, equivalent of 1" of water quality depth)

4) Size BMP to store greater of V_{WQ} and R_V

V_{WQ}=	675	cf	
R_V=	809	cf	
Actual Storage=	1,036	cf	(from HydroCAD)

1,036 > 809

Elevation	Surface Area (SF)	Cumulative Storage (CF)	
103.00	103	0	
104.00	227	161	
105.00	387	464	
106.00	583	946	
106.15	615	1,036	Lowest orifice elevation (from HydroCad)
106.60	714	1,335	

5) Pretreatment BMP - Sediment Forebay

A_{IMP} (impervious area)	16,188	sf (impervious area flowing to forebay)
Req. Storage Volume=(0.1)*(1'/12")*(A_{IMP})=	135	cf
Actual Storage=	145	cf

145 > 135

Elevation	Surface Area (SF)	Cumulative Storage (CF)	
104.50	28	0	
105.00	66	23	
105.50	120	69	
106.00	189	145	Lowest orifice elevation (from HydroCad)
106.60	274	283	

Stage-Area-Storage for Pond 1PA: Sediment Forebay

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
104.50	28	0
104.52	29	1
104.54	30	1
104.56	32	2
104.58	33	2
104.60	34	3
104.62	36	4
104.64	37	5
104.66	38	5
104.68	40	6
104.70	41	7
104.72	43	8
104.74	44	9
104.76	46	9
104.78	47	10
104.80	49	11
104.82	50	12
104.84	52	13
104.86	54	14
104.88	55	16
104.90	57	17
104.92	59	18
104.94	61	19
104.96	62	20
104.98	64	22
105.00	66	23
105.02	68	24
105.04	70	26
105.06	72	27
105.08	74	28
105.10	75	30
105.12	77	31
105.14	79	33
105.16	81	35
105.18	83	36
105.20	86	38
105.22	88	40
105.24	90	41
105.26	92	43
105.28	94	45
105.30	96	47
105.32	98	49
105.34	101	51
105.36	103	53
105.38	105	55
105.40	108	57
105.42	110	59
105.44	112	62
105.46	115	64
105.48	117	66
105.50	120	69
105.52	122	71
105.54	125	73
105.56	127	76
105.58	130	79
105.60	132	81
105.62	135	84
105.64	137	87
105.66	140	89
105.68	143	92
105.70	145	95
105.72	148	98
105.74	151	101
105.76	154	104
105.78	157	107
105.80	159	110
105.82	162	113
105.84	165	117
105.86	168	120
105.88	171	123
105.90	174	127
105.92	177	130
105.94	180	134
105.96	183	138
105.98	186	141
106.00	189	145
106.02	192	149
106.04	194	153
106.06	197	157
106.08	199	161
106.10	202	165
106.12	205	169
106.14	207	173
106.16	210	177
106.18	213	181
106.20	216	185
106.22	218	190
106.24	221	194
106.26	224	199
106.28	227	203
106.30	230	208
106.32	232	212
106.34	235	217
106.36	238	222
106.38	241	227
106.40	244	231
106.42	247	236
106.44	250	241
106.46	253	246
106.48	256	251
106.50	259	257
106.52	262	262
106.54	265	267
106.56	268	272
106.58	271	278
106.60	**274**	**283**

Stage-Area-Storage for Pond 1PB: Infiltration Basin (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
105.16	416	529	105.70	520	781
105.17	417	533	105.71	522	786
105.18	419	537	105.72	524	791
105.19	421	541	105.73	526	796
105.20	423	545	105.74	528	802
105.21	425	550	105.75	530	807
105.22	427	554	105.76	532	812
105.23	429	558	105.77	534	818
105.24	430	562	105.78	536	823
105.25	432	567	105.79	539	828
105.26	434	571	105.80	541	834
105.27	436	575	105.81	543	839
105.28	438	580	105.82	545	845
105.29	440	584	105.83	547	850
105.30	442	589	105.84	549	856
105.31	443	593	105.85	551	861
105.32	445	598	105.86	553	867
105.33	447	602	105.87	555	872
105.34	449	606	105.88	557	878
105.35	451	611	105.89	559	883
105.36	453	615	105.90	562	889
105.37	455	620	105.91	564	894
105.38	457	625	105.92	566	900
105.39	459	629	105.93	568	906
105.40	461	634	105.94	570	912
105.41	463	638	105.95	572	917
105.42	464	643	105.96	574	923
105.43	466	648	105.97	577	929
105.44	468	652	105.98	579	934
105.45	470	657	105.99	581	940
105.46	472	662	106.00	583	946
105.47	474	666	106.01	585	952
105.48	476	671	106.02	587	958
105.49	478	676	106.03	589	964
105.50	480	681	106.04	591	970
105.51	482	686	106.05	593	976
105.52	484	690	106.06	596	981
105.53	486	695	106.07	598	987
105.54	488	700	106.08	600	993
105.55	490	705	106.09	602	999
105.56	492	710	106.10	604	1,005
105.57	494	715	106.11	606	1,011
105.58	496	720	106.12	608	1,018
105.59	498	725	106.13	610	1,024
105.60	500	730	106.14	612	1,030
105.61	502	735	106.15	615	1,036
105.62	504	740	106.16	617	1,042
105.63	506	745	106.17	619	1,048
105.64	508	750	106.18	621	1,054
105.65	510	755	106.19	623	1,061
105.66	512	760	106.20	625	1,067
105.67	514	765	106.21	627	1,073
105.68	516	770	106.22	629	1,079
105.69	518	776	106.23	632	1,086

Appendix G

TSS Removal Calculations

TSS Removal Calculation Sheet Instructions

Either a completed automated form or non-automated form must be submitted as part of the Stormwater Report accompanying the Wetlands NOI

Automated Version Instructions

The automated version may be used EXCEPT when a Proprietary BMP is proposed. This is because Proprietary BMPs have variable removal rates.
The only exceptions are for Proprietary BMPs reviewed through the TARP Tier II Field Protocol for which MassDEP has granted written reciprocity.
BMPs must be designed in accordance with the Design Specifications contained in Mass. Stormwater Handbook Volume II to receive the TSS Removal Rating.
Separate Excel spreadsheets must be completed for each stormwater outlet or BMP train.
E.g. if there are two separate BMP trains discharging to two separate stormwater outlets, two separate sheets must be submitted.
Separate sheets must be submitted for Pretreatment (e.g. for 44% TSS removal prior to recharge) and Treatment (e.g. 80% TSS removal for new development).
To use automated sheet:
Click on Worksheet Tab labeled Automated Sheet
Click on Cell B11 (Shaded Blue)
Carrot Appears in lower right side of Cell B11
Click on Carrot
Drop Down Menu of BMPs will open. The BMPs are those listed in Volume I. No proprietary BMPs are listed in Drop Down Menu.
BMPs are listed alphabetically
Select One BMP per block. Start with most upgradient practices.
After BMP is selected in Cell B11, Cell C11 will automatically be populated with the DEP assigned TSS Removal Rate.
If there are multiple BMPs, go to Cell B12, select BMP, and so on (i.e. select BMPs in Cell B13, B14, and B15).
Final result is returned in Cell E16
All cells are locked except for Column B (to select BMPs) and Location, Project, Prepared By, and Date blocks.
Complete Location, Project, Prepared by, and Date Blocks.

Non-automated Sheet

The non-automated version must be completed if any Proprietary BMPs or traditional non-listed BMPs are proposed.
The non-automated version is locked to prevent it from being manipulated.
The non-automated version must be printed and completed by hand or typewriter.
Write name of BMP in Column B.
Write annual TSS removal rate in Column C (written documentation must be submitted to issuing authority substantiating TSS removal claim)
Multiply Column C by Starting Load in Column D and enter Result in Column E (e.g. Deep Sump CB 0.25 x 1 = 0.25, Enter 0.25 in Column E).
Subtract Column E from D, Enter Result in Column F (e.g. 1.00 - 0.25 = 0.75, Enter 0.75 in Column F).
Enter new BMP in Column B, next row down. Enter TSS Removal Rate in that same row.
In Column D, enter Starting Load from prior Row (e.g. 0.75).
Multiply Column C TSS Removal Rate by new starting load, and enter result into Column E, and so on.
Add up all the values listed in Column E.
Enter final result in Cell E16, block that is labeled Total TSS Removal.
Complete Location, Project, Prepared by, and Date Blocks.

Documentation

VERSION 1, March 4, 2008
Automated Sheet
Drop Down Menu in Column B created using "Data Validation"
Column C populated using data array from hidden table using "Vertical Lookup"
Column D values from Column F
Column E values producrs of Column C x Column D values
Column F values Column D - Column E

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Pretreatment for discharge to public storm system

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
	0.00	**0.75**	**0.00**	**0.75**
	0.00	**0.75**	**0.00**	**0.75**
	0.00	**0.75**	**0.00**	**0.75**
	0.00	**0.75**	**0.00**	**0.75**

Total TSS Removal = **25%**

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

Project: **1158 Beacon Street Newton, MA**

Prepared By: **Fuss & O'Neill**

Date: **5/6/2020**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Pretreatment for Infiltration Basin

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Sediment Forebay	**0.25**	**1.00**	**0.25**	**0.75**
	0.00	**0.75**	**0.00**	**0.75**
	0.00	**0.75**	**0.00**	**0.75**
	0.00	**0.75**	**0.00**	**0.75**
	0.00	**0.75**	**0.00**	**0.75**

Total TSS Removal = **25%**

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

Project: **1158 Beacon Street Newton, MA**

Prepared By: **Fuss & O'Neill**

Date: **5/6/2020**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Infiltration Basin

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Infiltration Basin	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

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

Project: **1158 Beacon Street Newton, MA**

Prepared By: **Fuss & O'Neill**

Date: **5/6/2020**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

From MassDEP Stormwater Handbook Vol. 1

TSS Removal Efficiencies for Best Management Practices	
Best Management Practice (BMP)	**TSS Removal Efficiency**
Non-Structural Pretreatment BMPs	
Street Sweeping	0-10%, See Volume 2, Chapter 1.
Structural Pretreatment BMPs	
Deep Sump Catch Basins	25% only if used for pretreatment and only if off-line
Oil Grit Separator	25% only if used for pretreatment and only if off-line
Proprietary Separators	Varies – see Volume 2, Chapter 4.
Sediment Forebays	25% if used for pretreatment
Vegetated filter strips	10% if at least 25 feet wide, 45% if at least 50 feet wide
Treatment BMPs	
Bioretention Areas including rain gardens	90% provided it is combined with adequate pretreatment
Constructed Stormwater Wetlands	80% provided it is combined with a sediment forebay
Extended Dry Detention Basins	50% provided it is combined with a sediment forebay
Gravel Wetlands	80% provided it is combined with a sediment forebay
Proprietary Media Filters	Varies – see Volume 2, Chapter 4
Sand/Organic Filters	80% provided it is combined with sediment forebay
Treebox filter	80% provided it is combined with adequate pretreatment
Wet Basins	80% provided it is combined with sediment forebay
Conveyance	
Drainage Channels	For conveyance only. No TSS Removal credit.
Grass Channels (formerly biofilter swales)	50% if combined with sediment forebay or equivalent
Water Quality Swale – wet & dry	70% provided it is combined with sediment forebay or equivalent
Infiltration BMPs	
Dry Wells	80% for runoff from non-metal roofs; may also be used for runoff from metal roofs but only if metal roof is not located within a Zone II, or IWPA or at an industrial site
Infiltration Basins & Infiltration Trenches	80% provided it is combined with adequate pretreatment (sediment forebay or vegetated filter strip, grass channel, water quality swale) prior to infiltration
Leaching Catch Basins	80% provided a deep sump catch basin is used for pretreatment
Subsurface Structure	80% provided they are combined with one or more pretreatment BMPs prior to infiltration.
Other BMPs	
Dry Detention Basins	For peak rate attenuation only. No TSS Removal credit.
Green Roofs	See Volume 2. Chapter 2. May reduce required water quality volume. No TSS Removal Credit.
Porous Pavement	80% if designed to prevent runon and with adequate storage capacity. Limited to uses identified in Volume 2, Chapter 2.
Rain Barrels and Cisterns	May reduce required water quality volume. No TSS Removal Credit.

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Appendix H

Long Term O&M Plan

Long-Term Operation and Maintenance Plan
Union Twist Dispensary

1158 Beacon Street
Newton, Massachusetts

PREPARED FOR:

Union Twist, INC.

1 International Place
Suite 3700
Boston, Massachusetts

August 13, 2020

FUSS & O'NEILL

108 Myrtle Street
Suite 502
Quincy, Massachusetts 02171

Project No. 20190241.A30

FUSS & O'NEILL

Table of Contents

Long-Term Operation and Maintenance Plan
Union Twist Dispensary

1 Introduction

The purpose of this Long-Term Operation and Maintenance Plan (O&M Plan) is to outline the requirements for source control and pollution prevention for the proposed marijuana dispensary located at 1158 Beacon St, Newton, Massachusetts. The property is currently developed and occupied by a restaurant and a dry cleaners and related site development (parking, sidewalks, etc.). The site is bounded by Beacon Street to the north and commercial properties to the east and west, and residential properties to the south. The project location is depicted in Figure 1, Site Location Map.

The project proposes modifications to the existing site including conversion of the existing structure to a marijuana dispensary along with modifications to the existing site development including parking lots, driveways, sidewalks, stormwater infrastructure, utilities, and landscaping. The overall drainage pattern of the site will not change with this new project.

Stormwater Management is achieved through two separate systems on the northern and southern portion of the site. One system is comprised of one sediment forebay and one infiltration basin while the other system is comprised of one deep sump catch basin. Through these best management practices (BMPs), groundwater recharge, and stormwater treatment are achieved. The redevelopment results in a decrease in net impervious area, providing stormwater peak discharge reduction. A map depicting the location of the BMPs is provided in *Figure 2*.

The long-term requirements include following proper site operation procedures and implementing an inspection and maintenance program to ensure the success and minimize the deterioration of the stormwater system over time. The Contractor is responsible for implementing this O&M Plan during construction. The Owner is responsible thereafter. Maintenance operations shall be funded by the Owner. In the event the facility becomes owned by different entities, this Long-Term Operation and Maintenance Plan shall be transferred to the future owners/operators. Checklists to assist with the inspection and maintenance activities are provided in *Appendix A*.

This plan has been prepared in accordance with the requirements set forth in Standard 4 and Standard 9 of the Massachusetts Stormwater Handbook.

2 Pollution Prevention

The following pollution prevention activities shall be conducted to minimize potential impacts on stormwater runoff quality. The Contractor is responsible for all activities during construction. The Owner is responsible thereafter.

2.1 Good Housekeeping

Good housekeeping shall be implemented to minimize the impacts to protected areas by pollutants, soil, and fugitive sediment. The site shall be kept in good working order. Trash shall be kept in covered containers (i.e., dumpsters) to prevent waste from escaping. Fugitive litter that is deposited on the site shall be removed and placed in a proper enclosed container.

2.1.1 Parking Lot Sweeping

Parking lots and paved roadway areas on the site shall be swept at a minimum of once every other month, or 6 times per year, with sweeping scheduled primarily in the spring and fall time. Sweeping shall be accomplished with a rotary broom type sweeper or equivalent. Sweeping activities shall take place during off-peak hours for the proposed marijuana dispensary, to ensure accessibility for the sweeper to get as close to curbs as possible.

2.2 Chemical and Petroleum Products

All chemical and petroleum product containers stored on the site (excluding those contained within vehicles and equipment) shall be provided with impermeable containment which will hold at least 110% of the volume of the largest container, or 10% of the total volume of all containers in the area, whichever is larger, without overflow from the containment area. All chemicals and their containers shall be stored under a roofed area. Containers of 100 gallon capacity or more may be stored without a roof only if stored in a double-walled tank. On-site vehicles shall be monitored for leaks and receive maintenance as needed.

2.2.1 Spill Control Practices

Any discharge of waste oil or other pollutant to the stormwater system will be reported immediately to the Massachusetts Department of Environmental Protection (MA DEP). The Owner will be responsible for any incident of groundwater contamination resulting from the improper discharge of pollutants to the stormwater system, and may be required by MA DEP to remediate incidents that may impact groundwater quality. Should property ownership be transferred, the subsequent owner/operator will be informed of the legal responsibilities associated with operation of the stormwater system, as indicated above.

The following practices shall be implemented to mitigate spills of material and prevent their release to the waters of the Commonwealth:

- Manufacturers' recommended methods for spill cleanup shall be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.

- Materials and equipment necessary for spill cleanup will be kept in material storage areas. Equipment and materials will include but not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.

- Spills will be cleaned up immediately after discovery.

- Spills of toxic or hazardous material will be reported to the appropriate State and local government agency, regardless of size.

2.3 Landscaped Areas

Lawn areas will be mowed during the growing seasons as required to maintain a health stand of vegetation. This is typically once a week but can vary depending on weather conditions. If bagged, grass clippings are to be removed from the site and legally disposed of at an off-site location.

Fertilizers, if required for the maintenance of lawn areas, will be applied only in the amounts recommended by the manufacturer. If kept on site, fertilizers will be stored in a covered area. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.

2.4 Pet Waste Management

There are no provisions for accommodating pets as part of the marijuana dispensary operation. If pets or service animals are required by facility staff, the O&M Plan shall be amended to include pet waste management practices.

2.5 Snow Management

Stormwater runoff caused by snow melt must be properly managed to prevent erosion and pollution. Therefore, a snow management plan has been developed to identify storage areas throughout the site.

Snow management operations can vary depending on current weather patterns, available equipment, and previous storm events. Below is a general description of how snow will be managed on the site.

- Keep pedestrian and emergency routes cleared. Ensure stockpiles do not obstruct sight lines at driveway or road intersections.

- Snow removed from the drive aisle and parking spaces will be stored in the marked areas of the parking lot.

- Snow removed from the sidewalks along the front of the building will be stored in the adjacent lawn areas.

- Snow will be stockpiled onsite until the available capacity is exceed at which point it will be loaded into trucks and properly disposed of at an off-site location.

A Snow Storage Plan is provided as *Figure 3.*

3 Inspection and Maintenance Requirements for Permanent Stormwater Controls

The following inspection and maintenance activities shall be conducted to ensure the success and minimize the deterioration of the stormwater system over time. A map depicting the location of the components of the stormwater management system is provided in *Figure 2*. Checklists to assist with the inspection and maintenance activities are provided in *Appendix A*.

3.1 Infiltration Basins

3.1.1 Post-Construction Inspections

Following construction, the infiltration basin shall be inspected after every storm event larger than one-inch in the first six months. If after these storm there is standing water in the basin 48 to 72 hours after may indicate that there is clogging. Clogging can be the result of upland sediment erosion, excessive compaction of soil, or low spots and should be addressed immediately.

Vegetation shall be watered once every two to three days for first two months, then sporadically after establishment during the first year after installation. If droughty, watering after the initial year may be required.

If at least 25 percent vegetation coverage is not established after the first growing season, reinforcement planting should be installed. If the surface of the basins becomes clogged to the point that standing water is observed on the surface 36 hours after precipitation events, remove accumulated sediment or till the surface to breakup any hard-packed soil and then vegetate.

3.1.2 Monthly Periodic Inspections

The infiltration basin shall be inspected monthly for evidence for vegetation health and the presence of trash (e.g., litter, debris, etc.). Trash deposited on the surface of the basins shall be removed manually and shall be disposed of in accordance with applicable local, state, and federal guidelines and regulations. Mowing shall occur when vegetation reaches a height at which it cannot support its own weight (typically two (2) to twelve (12) times per year), remove grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. Remove trash and debris at the same time. Inspect and clean pretreatment devices associated with basins at least twice a year, and ideally every other month.

3.1.3 Semiannual Inspection

Inspections should occur twice per year. During these inspections the infiltration basin should be checked for signs of differential settlement, cracking, erosion, leakage, conditions of riprap, sediment accumulation, and the health of the turf.

Sediment shall be removed from the basins when the accumulation exceeds one inch or when there is evidence that the infiltration capacity has been significantly reduced. Sediment and debris must be removed manually with rakes rather than heavy equipment to avoid compacting. Removed sediments shall be dewatered (if necessary) and disposed of in an acceptable manner.

Use deep tilling to break up clogged surfaces, and revegetate immediately. Remove sediment from the basin as necessary, but wait until the floor of the basin is thoroughly dry. Use light equipment to remove the top layer so as to not compact the underlying soil. Deeply till the remaining soil, and revegetate as soon as possible.

Any areas within the extents of the basins that are subject to erosion or gullying shall be replenished with the original design material and re-vegetated according to design drawings. Prune vegetated areas and remove any dead materials. Separation of herbaceous vegetation rootstock should occur when over-crowding is observed, or approximately once every three years. If required, apply fertilizer to areas where vegetation is not fully established.

3.2 Sediment Forebays

3.2.1 Post-Construction Inspections

Following construction, the sediment forebays shall be inspected after every storm event larger than one-inch in the first six months following construction.

Vegetation shall be watered once every two to three days for first two months, then sporadically after establishment during the first year after installation. If droughty, watering after the initial year may be required.

If at least 25 percent vegetation coverage is not established after the first growing season, reinforcement planting should be installed. If the surface of the basins becomes clogged to the point that standing water is observed on the surface 36 hours after precipitation events, remove accumulated sediment or till the surface to breakup any hard-packed soil and then vegetate.

3.2.2 Monthly Periodic Inspections

The sediment forebay shall be inspected monthly for evidence for vegetation health, the presence of trash (e.g., litter, debris, etc.), and sediment accumulation. Trash deposited on the surface of the basins should be removed manually and shall be disposed of in accordance with applicable local, state, and federal guidelines and regulations. The forebay shall be mowed as required to maintain a healthy stand of grass between three (3) and six (6) inches tall.

If sediment has accumulated to half the depth of the forebay, remove the sediment. Otherwise, note the depth on the inspection checklist.

3.2.3 Quarterly Inspections

Remove accumulated sediment on a quarterly basis, regardless of the depth. Sediment and debris must be removed manually with rakes rather than heavy equipment to avoid compacting. Removed sediments shall be dewatered (if necessary) and disposed of in an acceptable manner. Any areas that are subject to erosion or gullying shall be replenished with topsoil and re-vegetated according to design drawings. Erosion control blankets shall be used as needed to ensure stabilization of the floor and side slopes of the forebays during revegetation.

The quarterly inspection of the basin should include checking for standing water or other evidence of clogging by accumulated sediments, checking inlets and outlets for signs of erosion and damage, checking the overflow structures for blockage and structural integrity, and checking the slopes of the basins for erosion or gullying. Inspect stone to determine if high flows have caused scour beneath the channels or dislodged any of the stone. If repairs are needed, they should be performed immediately.

3.3 Drainage Structures

3.3.1 Post-Construction Inspections

Immediately prior to the end of construction and acceptance by the Owner, the Contractor shall clean all drainage structures (i.e. catch basin and yard drains).

3.3.2 Quarterly Inspections

Drainage structures shall be inspected at minimum of four times per year, at minimum. Sediment shall be removed at least twice per year, or when the depth reaches half the height between the bottom of the structure and the lowest pipe invert elevation. Inspections shall include checking for debris, sediment, and hydrocarbons, and structural integrity or damage. Deficiencies must be corrected immediately. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations. Grates shall not be welded to the frame so the structures can be easily inspected and maintained.

3.4 Anticipated Costs

The annual cost for the inspections and maintenance for the property is estimated to be from $9,500 to $14,500 per year, if performed by an independent third party. A budgetary opinion of cost for the maintenance is included in Appendix B.

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Figure 1

USGS Site Location Map

MAP REFERENCE:
THIS MAP WAS PREPARED FROM THE FOLLOWING QUADRANGES OF USGS HIGH RESOLUTION ORTHOIMAGERY, BOSTON/ PROVIDENCE, 2013:
19TCG165875 19TCG165890
19TCG180875 19TCG180890

SCALE: HORZ.: 1"=150' VERT.: DATUM: HORZ.: VERT.: 0 75 150 GRAPHIC SCALE	FUSS&O'NEILL 108 MYRTLE STREET, SUITE 502 QUINCY, MA 02171 617.282.4675 www.fando.com	UNION TWIST INC. SITE LOCATION MAP 1158 BEACON STREET NEWTON MASSACHUSETTS	PROJ. No.: 20190241.A30 DATE: 5/6/2020 FIG. 1

FUSS & O'NEILL

Figure 2

BMP Location Map

File Path: J:\DWG\P2019\0241\A30\Civil\Figures\20190241A30_BMP.dwg Layout: BMP Plotted: Thu, August 13, 2020 - 12:53 PM User: sfranjeskos
MS VIEW: | LAYER STATE: | Plotter: DWG TO PDF.PC3 CTB File: FO.STB

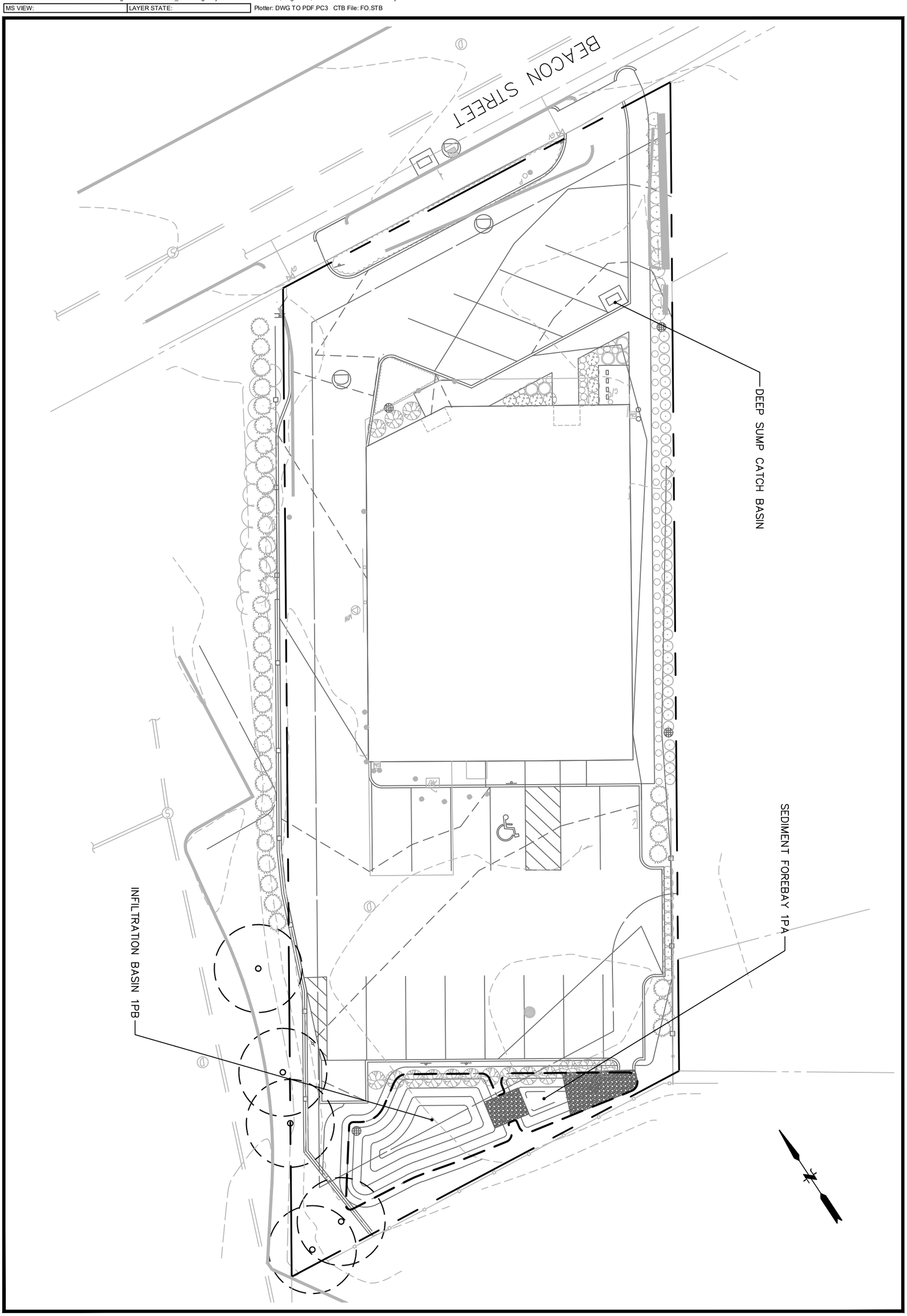

FIG.2

PROJ. No.: 20190241.A30
DATE: 8/13/2020

UNION TWIST INC.

BMP LOCATION MAP

1158 BEACON STREET

NEWTON MASSACHUSETTS

FUSS & O'NEILL
108 MYRTLE STREET, SUITE 502
QUINCY, MA 02171
617.282.4675
www.fando.com

SCALE:
HORZ.: 1"=30'
VERT.:
DATUM:
HORZ.:
VERT.:
0 10 20
GRAPHIC SCALE

FUSS & O'NEILL

Figure 3

Snow Storage Map

File Path: J:\DWG\P2019\0241\A30\Civil\Figures\20190241A30_BMP.dwg Layout: SNOW Plotted: Thu, August 13, 2020 - 12:53 PM User: sfranjeskos
MS VIEW: | LAYER STATE: | Plotter: DWG TO PDF.PC3 CTB File: FO.STB

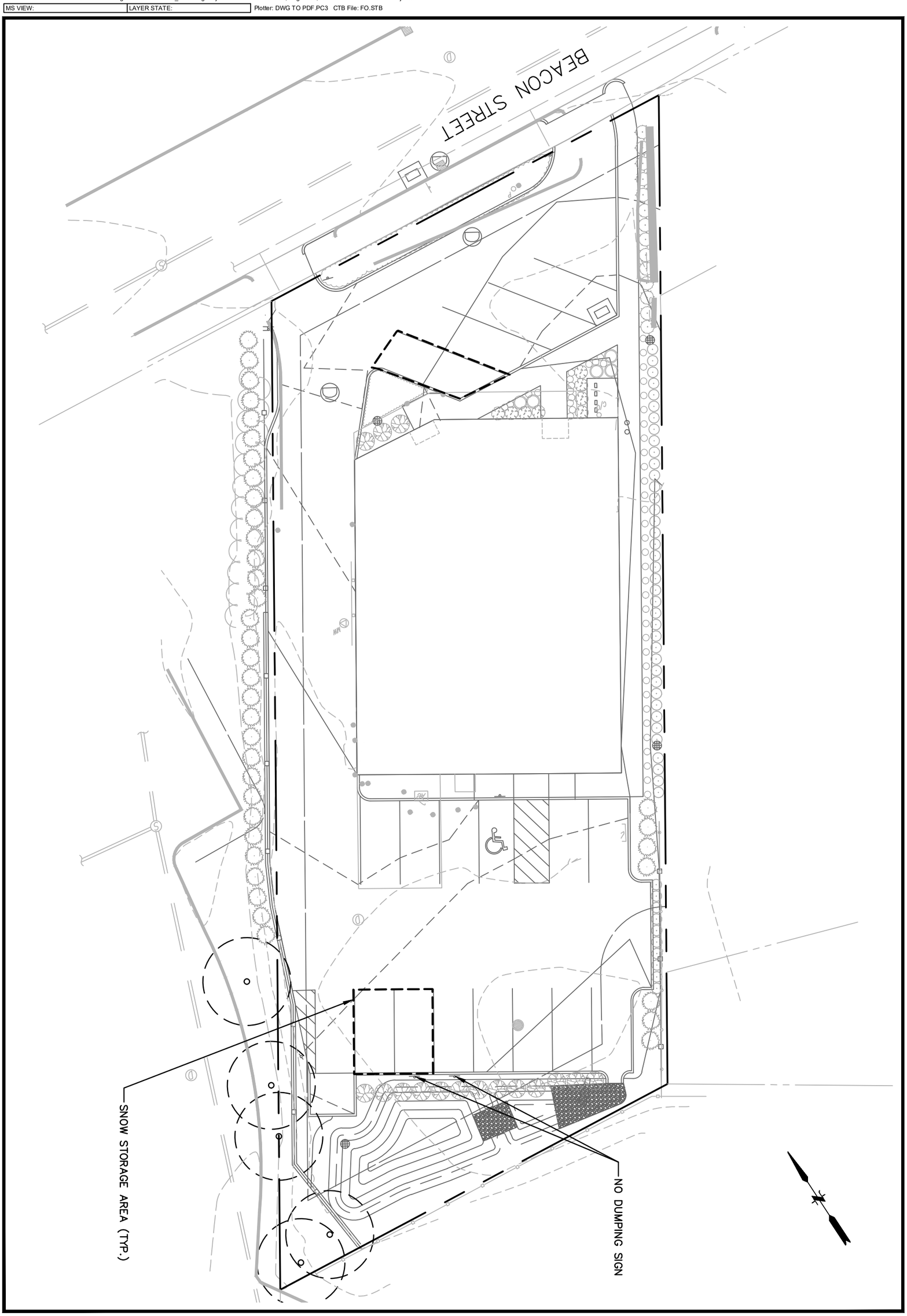

FIG. 3

PROJ. No.: 20190241.A30
DATE: 8/13/2020

UNION TWIST INC.

SNOW STORAGE MAP

1158 BEACON STREET

NEWTON MASSACHUSETTS

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QUINCY, MA 02171
617.282.4675
www.fando.com

SCALE:
HORZ.: 1"=30'
VERT.:
DATUM:
HORZ.:
VERT.:
0 10 20
GRAPHIC SCALE

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Appendix A

Operation, Maintenance, and Management Inspection Checklists

Operation, Maintenance, and Management Inspection Checklists
Master Checklist
1158 Beacon Street

Inspection Year: _____

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Infiltration Basin												
Inspect for and Remove Trash (monthly)												
Mow (as required)												
Semi-Annual inspection												
Sediment Forebay												
Inspect for and Remove Trash (monthly)												
Mow (as required)												
Quarterly Inspection												
Drainage Structures												
Quarterly Inspection												

Operation, Maintenance, and Management Inspection Checklists
Infiltration Basin
1158 Beacon Street

Inspector Name: _____

Inspection Date: _____

Reviewed By: _____

Review Date: _____

Type of Inspection (Circle One):

Monthly Annual

BMP Name:

_____

No.	Monthly	Annual	Item	Criteria	Satisfactory	Unsatisfactory	Notes
1			Trash/Debris	Basin is free of debris, litter, and waste.			
2			Turf	Grass has not reached a height at which it cannot support its own weight			
3			Sediment	Depth of Sediment is less than one inch.			

4			Clogging	Basins appears to be draining freely and not clogged.			
5			Overflow Structures	Overflow structures are free of blockage and are structurally sound			
6			Erosion	There are no signs of erosion and scouring.			
7			Vegetation	Vegetation is satisfactorily pruned to remove any dead material. Rootstocks are not overcrowded.			

Operation, Maintenance, and Management Inspection Checklists
Sediment Forebay
1158 Beacon Street

Inspector Name: _____

Inspection Date: _____

Reviewed By: _____

Review Date: _____

Type of Inspection (Circle One):

Monthly Quarterly

BMP Name:

_____

No.	Monthly	Quarterly	Item	Criteria	Satisfactory	Unsatisfactory	Notes
1			Trash/Debris	Forebay is free of debris, litter, and waste.			
2			Turf	Grass height is between 3 and 6 inches.			
3			Sediment	Depth of Sediment is less than half the depth of the basin.			

4			Sediment Removal	Accumulated sediment has been removed.			
5			Inlet Stabilization	River stone inlets do not show scouring.			
6			Overflow Structures	Overflow structures are free of blockage and are structurally sound			
7			Erosion	There are no signs of erosion and scouring.			

Operation, Maintenance, and Management Inspection Checklists
Drainage Structures
1158 Beacon Street

Inspector Name: _____

Inspection Date: _____

Reviewed By: _____

Review Date: _____

Type of Inspection (Circle One):

Quarterly

Structure Name:

_____

No.	Quarterly	Item	Criteria	Satisfactory	Unsatisfactory	Notes
1		Trash/Debris	Structure is free of debris, litter, and waste.			
2		Sediment	Depth of sediment is less than half the height between the bottom of the structure and the lowest pipe invert elevation and has been removed within the last six months.			
3		Concrete Surfaces	Concrete surfaces are structurally sound and have negligible spalling and cracking.			

Appendix B

Annual O&M Budgetary Opinion of Cost

FUSS & O'NEILL

FUSS & O'NEILL, INC.

108 Myrtle Street, Suite 502
Quincy, MA 02171

BUDGETARY OPINION OF COST	DATE PREPARED 08/13/20	SHEET 1 OF 1
PROJECT : Union Twist Dispensary	BASIS :	
LOCATION : 1158 Beacon Street, Newton, MA		
DESCRIPTION Long Term Stormwater O&M Costs	ESTIMATOR : JEV	CHECKED BY : SM

Since Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

ITEM NO.	ITEM DESCRIPTION	UNIT MEAS.	NO. UNITS	PER UNIT	TOTAL COST
1	Site Inspections[2]	EA	12	$ 250.00	$ 3,000.00
2	Monthly Removal of Trash[3]	EA	12	$ 125.00	$ 1,500.00
3	Mowing of Infiltration Basins[4]	EA	6	$ 300.00	$ 1,800.00
4	Mowing of Sediment Forebays[5]	EA	12	$ -	$ -
5	Sediment Removal[6]	EA	4	$ 500.00	$ 2,000.00
6	Vacuum Truck - Drainage Structures & Infiltration Systems[7]	DAY	2	$ 1,400.00	$ 2,800.00
7	Parking Lot Sweeping[8]	DAY	6	$ 100.00	$ 600.00
		SUBTOTAL OPINION OF CONSTRUCTION COST			**$ 11,700.00**

TOTAL COST (-15% TO +30% ROUNDED) $10,000 TO $15,000

Notes

1. The following equipment and labor rates were used for this estimate: Site Inspector - $1,000/day; Laborer - $500/day; Skidsteer & Operator - $1,000/day; Dump Truck - $500/day; Vacum Truck - $1800/day
2. Assume a Site Inspector is required for 1/4 day per inspection.
3. Assumes 1 Laborer for a 1/4 day.
4. Assumes 1 Laborer for a 1/2 day and an additional $50 for a weedwacker.
5. Assumes mowing is done as part of normal landscaping maintenance.
6. Assumes 1 Laborer, 1 Skidsteer & Operator, and 1 Dump Truck for 1/2 day.
7. Assumes 2 Laborers and 1 Vaccum Truck for 1/2 Day.
8. Assumes $100 per sweep performed on average every other month.